Report of the 48th Meeting of



The Coordination Group For Meteorological Satellites



REPORT OF THE 48TH PLENARY SESSION OF THE COORDINATION GROUP FOR METEOROLOGICAL SATELLITES

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PLENARY SESSION

1. OPENING SESSION

1.1 Welcome addresses by the co-chairs: Dr. Peng ZHANG, CMA, and Head of CGMS Secretariat, Mr. Alain Ratier, EUMETSAT Director-General

On behalf of CMA, Dr. Peng ZHANG, Deputy Director of CMA NSMC, welcomed all participants to the 48th and virtual plenary session of CGMS. Due to the COVID-19 pandemic, CGMS has had to shift to online meetings.

The CGMS framework is an excellent place to share information, and to coordinate meteorological satellites and beyond. Dr. Zhang hoped that CMA will be in a position to host a face-to-face CGMS-49 plenary session in Xian, China, in 2021.

Mr. Alain Ratier welcomed all participants to the virtual meeting regretting not to be able to meet in person. He drew the participants' attention to the fact that there were two CGMS relevant anniversaries this year, the 50 years of China's and CMA's FengYun programme and likewise the creation of US's NOAA/NESDIS. Mr. Ratier thanked all contributors to the meeting, highlighted the upcoming and important interventions in WMO on the data policy among other, and concluded by hoping that CGMS-49 would be executed face-to-face in 2021.

1.2 Verbal interventions to introduce key issues relevant to CGMS since last plenary

CNES, Pierre Tabary:

CNES, in partnership with EUMETSAT, has developed the IASI and IASI-NG instruments, the data are operationally assimilated supporting NWP, atmospheric composition and climate applications. This includes CO measurements and the recent impact of COVID.

EUMETSAT, Alain Ratier:

EUMETSAT recalled that it is the operator of Sentinel-3, soon to be complemented by the Sentinel-CS/Michael Freilich planned for launch on 10 November. EUMETSAT currently prepares for its next generation mandatory programmes MTG and EPS-NG, as well as the handling of big data services. EUMETSAT Member States are also considering micro satellites for microwave sounding purposes.

IMD, Mrutyunjay Mohapatra, DGM/PR to WMO:

"I want to extend special thanks to EUMETSAT particularly to Dr. Alain Ratier for supporting IMD with the provision of Meteosat-8 services over the Indian Ocean (IODC) and the agreement to grant the license of EUMETCast data through terrestrial link. India is committed to sustain the INSAT services over IODC with the launch of INSAT-3DS in 2021/2022. India is also bringing GISAT-1 at 85.5°E with three hyperspectral reflective types of payload to support the agro-meteorological requirement of the region. IMD, in coordination with ISRO, supported the space observations without any failure during COVID-19 period as

requested by WMO through the RAPID online visualisation tool. IMD has set up a new ground receiving and processing system, Multi-Mission Meteorological Data Reception and Processing System (MMDRPS) using the latest state of the art technology, cutting down the processing time substantially along with generation of new sets of products from INSAT. Shortly, we are going to launch the web based online data supply portal. IMD, in coordination with ISRO, is disseminating the SCATSAT wind data through GTS to meet the international requirements. The CGMS platform is the best way to resolve all the issues related to satellite meteorology and introducing new advancements and research in the field by which all members can plan their activity well in advance and use this forum for betterment of the society."

ISRO, Raj Kumar:

"We are grateful to EUMETSAT for planning and organising the Plenary quite well keeping the important points in the Agenda. We are also thankful to EUMETSAT for coming up with an idea of planning a special session to have discussions on the important topic of Scatterometry. Special thanks to Dr Alain Ratier and EUMETSAT team for wonderful cooperation with ISRO. We will continue to have active discussions for the data exchange by both the organisations and scientific cooperation."

JAXA, Takeshi HIRABAYASHI:

"I would like to thank you for the opportunity to speak. Let me introduce myself. I am Takeshi HIRABAYASHI, and I was appointed as Senior Chief Officer of Satellite Applications of JAXA in May of this year, taking over from my predecessor Mr. Kazuo TACHI.

From this meeting, I am now serving as the JAXA representative for CGMS. JAXA would like to contribute to meteorological services and climate change monitoring through CGMS in cooperation with other members. As part of our efforts, JAXA has been developing and operating the Advanced Microwave Scanning Radiometer: AMSR series. The data from GCOM-W/AMSR2 launched in 2012 has been utilised by many members of CGMS, including EUMETSAT, NOAA, and JMA. As for the AMSR3, a successor sensor, we have launched a project for GOSAT-GW, which will carry the TANSO-3 greenhouse gas observation sensor together with AMSR3. The development has started for a launch in JFY2023.

I would like to express my sincere gratitude to CGMS and related organisations for the generous support at the time of the launch of AMSR3 project.

Meanwhile, we contribute to the field of precipitation radar as well. GPM/DPR launched in 2014, has made significant contributions to scientific research by measuring the three-dimensional structure of rainfall. In order to continuously produce these results, JAXA is considering the development of next-generation precipitation radar. We would like to promote cooperation with CGMS in this field as well. I look forward to your support for the launch of this project. The DPR also plays a role as the reference, important for generating composite maps such as Global Precipitation Map (GSMaP) used in a wide range of fields. I hope for your cooperation to continue the long-term observation of precipitation radar data that has begun from TRMM in 1997."

JMA, Hironobu YOKOTA:

"Good evening, everyone. I am Hironobu YOKOTA, director of Satellite Program Division of Japan Meteorological Agency.

Among geostationary satellites, the Himawari-series are operated by JMA over the last 40 years or so, and play a great role in preventing natural disasters in East Asia and West Pacific countries. I would like to take this opportunity to thank our international partners, particularly GOES-9 back-up operation by NOAA/NESDIS about 15 years ago, and cooperative works to develop Himawari 8/9's related utilisation techniques with JAXA, EUMETSAT, NOAA and various other partners.

JMA launched the Himawari request service, which provides 2.5-minute target area observations to NMHSs in Asia-Pacific region in 2018. It has contributed to precise monitoring of cyclones and severe weather in those countries and bushfires in Australia from late last year to early this year.

Recently, strong typhoons and extreme severe weather events often cause big damages in Japan, so the risk management is strongly requested. In 2018, JMA established a 10-year strategy toward 2030 for services supporting public safety. To address challenges relating disaster risk reduction, JMA plans to set-up efforts in the development of observation and forecast techniques and the Himawari follow on satellite is expected to provide more and more precise observations to improve severe weather prediction. The hyper-spectral infrared sounder will be a strong candidate for the new sensor to be loaded to Himawari follow-on satellite.

The government of Japan revised the basic plan on space policy and related implementation plan this year. In the Japanese government's strategic plan, the manufacturing of the Himawari follow-on satellite will start by FY2023 with an aim to start operations approximately in FY2029. The high-resolution observations are expected to support disaster prevention.

So, I and my colleagues will make every effort to steady progress to the follow-on satellite programme to contribute to natural disaster prevention at an international level.

Finally, we would like to thank the CGMS Secretariat for preparing this meeting despite the difficult situation worldwide. We hope it will be a fruitful meeting.

Thank you for your attention."

NASA, Jack Kaye:

"Thank you to the organizers for all their efforts to provide the opportunity to safely come together to share and coordinate our efforts related to Earth observing satellites. We at NASA benefit enormously from these discussions, and we sincerely believe that the decisions that result from our collective work and at this forum will hold great significance in the years ahead. We are therefore committed to making this conference productive and fruitful."

NOAA, Stephen Volz:

The GOES-East and GOES-West constellation works well. JPSS follow-on #2 GOES-19 is in production with a launch expected in 2021/2022. The dedicated operational space weather mission, Space Weather Follow-On (SWFO), is planned for launch in the 2024 timeframe. Preparations are also underway for a microwave infrared sounding mission for launch around 2025. Following the outcome of the Commercial Weather Data Pilot project, NOAA expects to commercially acquire near-real-time radio occultation data in the relatively near future. Finally, work is ongoing on cloud data storage, data processing and data dissemination.

ROSHYDROMET, Konstantin Litovchenko:

"Roshydromet wishes everybody good health in these challenging times."

Roshydromet continues to prepare the launched Meteor-M N2-2 and Electro L-3 for operations to start in December 2020. Electro-L2 is being moved to 14.5 °W and Electro-L3 will be positioned at 76 °E.

Since last CGMS plenary in Sochi, the Russian meteorological satellite constellation, as well as the State geographically distributed system of space environmental monitoring, continued to develop.

In July 2019 the polar orbiting satellite Meteor-M #2-2 was successfully launched. The satellite operates at sun-synchronous afternoon orbit and provides multispectral imagery, microwave and infrared sounding data, heliogeophysical measurements, data collection and transmission from ground platforms, dissemination of HRPT and LRPT data.

Meteor-M #2-2 is operated with substantial limitations due to impact of space debris on the spacecraft.

The geostationary satellite Electro-L #3 was successfully launched in December 2019 and is now in the commissioning phase, planned to terminate in November 2020.

As a result, the operational geostationary constellation of Electro-L #2 at 14.5 °West and Electro-L #3 at 76 °East will provide multispectral imagery, heliogeophysical measurements, data collection and transmission from ground platforms, dissemination of HRPT and LRPT data.

The Roshydromet operated ground-based system of space environmental monitoring composed of European, Siberian and Far East centres of SRC Planeta provides receiving, processing and dissemination of meteorological satellite data for more than 500 users in Russia. Via the EUMETSAT EARS service for data collection and dissemination, Roshydromet provides operational satellite data for all users worldwide.

With great pleasure, I wish for all a successful work at this CGMS session.

Thank you."

WMO, Lars Peter Riishojgaard:

COVID-19 has taken its toll on WMO and there is a clear impact on the monitoring observing system, in particular on the in-situ measurements, which have dropped significantly in the period. WMO will address this further under the related agenda items.

CMA, Peng ZHANG:

CMA is preparing for the FY-3E early morning satellite launch in 2021, and FY-4B which is planned in 2021.

CMA also provided a short announcement on the 50th anniversary of the Chiense FengYun meteorological satellite programme whose mission is to develop and operate the FengYun meteorological satellite system in order to enhance the ability of meteorological satellite application in monitoring weather, climate, environment and natural disasters for the protection of lives and property of people, and the benefits of societal-economical development. CMA noted the importance of international cooperation in the framework of WMO, CGMS, CEOS, GEO, partner satellite agencies and user communities.

2. APPROVAL OF THE AGENDA

The CGMS-48 plenary adopted the proposed agenda.

3. WMO MATTERS FOR COORDINATION WITH CGMS SPACE AGENCIES

SESSION OBJECTIVES: Plenary to note the status of reforms and calendar of events. CGMS space agencies to support WMO and the WMO space programme and contribute to space programme trust funds to support OSCAR and other activities

CGMS-48-WMO-WP-13: WMO constituent reform and impact on coordination with CGMS including implementation of the WIGOS

WMO informed CGMS on the status of its reforms, the impacts of COVID-19 on the work of WMO and major ongoing WMO initiatives.

The WMO Constituent Reform, launched by the 18th World Meteorological Congress in 2019, has progressed with the establishment of two new commissions, an Infrastructure Commission (INFCOM) and a Services Commission (SERCOM), replacing the previous eight WMO commissions under the overarching framework of the Earth System Approach. WMO has created several standing committees and study groups under the Infrastructure Commission (for details see WMO-No. 1251)¹.

As subsidiary bodies to the standing committees, space-related expert teams are being established, including the Expert Teams on Space Systems and Utilization (ET-SSU), the Joint Expert Team On Earth Observing Systems Design And Evolution (JET-EOSDE), the Expert Team on Radio Frequency Coordination (ET-RFC) and a proposed Expert Team on Space Weather (ET-SW, naming tbc).

¹ See https://meetings.wmo.int/JM-TC/SitePages/Session%20Information.aspx

In light of the COVID-19 pandemic, the importance of monitoring the status of observation systems and access to the data, including through the WIGOS Data Quality Management System (WDQMS, https://wdqms.wmo.int), has been demonstrated. While the space-based observing system has proven to be resilient, there has been an impact on surface and in-situ observing networks and, consequently, on quality and availability of observations.

To support the implementation of the Vision for WIGOS in 2040, approved by the 18th World Meteorological Congress in 2019², WMO will sub-contract the development of a related high-level plan.

Other major ongoing initiatives include the WMO Data Conference to inform the development of a revised WMO Data Policy³, the WMO Global Basic Observing Network (GBON), and the Systematic Observations Funding Facility (SOFF). The presentation also highlighted the WMO-IATA Collaborative AMDAR Programme (WICAP).

WMO continuously develops the space-based component of the Observing Systems Capability Analysis and Review Tool (OSCAR/Space) and updates it with the help of the OSCAR/Space Support Team (O-SST). The WMO Space Programme conducted user surveys in cooperation with the WMO Regional Coordination Groups on Satellite Data Requirements and organised many worldwide capacity development and training events in the framework of the WMO/CGMS Virtual Laboratory for Training and Education in Satellite Meteorology (VLab).

The presentation concluded with listing several important upcoming events of interest to CGMS:

- 28 Sep 2 Oct 2020 WMO Executive Council 72nd Session
- 23 Oct 2020 Stakeholder consultation on satellite data and WMO Data Policy
- 9-13 November 2020 Joint session of Infrastructure and Services Commission and Research Board
- 16-19 November WMO Data Conference
- April 2021 Extraordinary Executive Council
- Mid 2021 Extraordinary Congress

WMO invited CGMS to:

- contribute experts to relevant expert teams
- provide support to the VLab Trust Fund
- provide support to the WMO Space Programme Trust Fund
- help ensure continued IODC coverage
- participate in and provide support for upcoming events

EUMETSAT informed plenary that in February 2022, Meteosat-9 would be moved to the IODC position (37.5° E or 44.5° E, to be decided by the EUMETSAT Council end of 2020) in order to replace Meteosat-8 once it has reached the end of its lifetime.

² See https://community.wmo.int/vision2040.

³ See https://meetings.wmo.int/WMO-Data-Conference/SitePages/Conference%20Scheme.aspx.

Plenary deferred the following CGMS-47 actions to CGMS-49:

| CGMS-47 | CGMS-47 actions – Plenary Session | | | | | | | | |
|----------------|-----------------------------------|---------|--|--------------------------|--------|--|--|--|--|
| Actionee | AGN item | Action# | Description | Deadline | Status | | | | |
| WMO | Н | A46.11 | On ocean variables: In view of the anticipated reform of JCOMM, WMO to provide a report with proposals on future coordination/ cooperation between JCOMM and CGMS. See also (CGMS-48-WMO-WP-15). | CGMS-49 (CGMS- 47) | OPEN | | | | |
| IOC- UNESCO | 3.3 | A47.05 | On operational oceanography: IOC-UNESCO to provide to GCMS-48 guidance on satellite data requirement for improved coastal ocean prediction and services 2020 Aug: Deferred to CGMS-49 in view of virtual plenary | CGMS-49 (CGMS- 48) | OPEN | | | | |

CGMS-48-WMO-WP-15: Report on the status of the update of the WMO data policy

WMO informed plenary about further developments in WMO related to the data policy renewal and several interlinked initiatives.

WMO has established a study group on data issues and policies to develop an overarching WMO Data Policy, consolidating the existing WMO data policy-related resolutions 40, 60, and 25, and expanding these to cover Earth system monitoring and prediction.

Given that satellites play a vital role in meteorology and related WMO activities, both by volume and by impact, the position of CGMS agencies on WMO data policy data exchange is highly important.

WMO is presently drafting a new overarching data policy resolution, supported by a series of planned stakeholder consultations that will also include CGMS members.

Closely linked to this activity, is the work of the Study Group on the Global Basic Observing Network (GBON). GBON develops regulatory material and an implementation plan aimed at clearly restating WMO observational obligations for WMO members for ground-based and in-situ measurements. The recent Systematic Observations Funding Facility (SOFF) initiative supports WMO members in meeting their GBON obligations, with the support of funding partners, including the World Bank.

In response to Action A47.02⁴, WMO proposes to revise the Critical Satellite Data paper with the aim for CGMS WG III to integrate relevant text from the approved version of this paper into a revised version of the CGMS Baseline at its workshop in February 2021. The WMO Secretariat would then integrate the revised CGMS Baseline into the draft Manual on WIGOS in March 2021; and following the approval of the new version of the CGMS Baseline by CGMS-49 plenary in May 2021, the draft Manual on WIGOS,

⁴ Action A47.02: "WMO to provide a report at next CGMS on baseline requirements for satellite products for global NWP, to trigger a CGMS discussion on status of delivery of such observations and possible improvements in the future and inclusion in the CGMS baseline document"

reflecting the revised CGMS Baseline, will be presented for endorsement by the WMO Extraordinary Congress in June 2021.

The presentation concluded with information on the timeline of the planned WMO Data Conference⁵ and its preparatory workshops.

WMO invited CGMS plenary to:

- Take note of the plans for the development of a new WMO resolution on data policy;
- Take note of the calendar of events leading up to the WMO Data Conference in November; and
- Comment on the proposed approach to responding to CGMS plenary action A47.02.

WMO invited CGMS members to engage in the WMO data policy discussions, both in the preparatory stakeholder consultation on satellite data and WMO Data Policy (on October 23 and during the Data Conference itself).

EUMETSAT noted that GBON is a very good example, but it is important to assure that data critical for Numerical Weather Prediction (NWP) will be available for all NWP centres to secure the highest possible NWP quality and enabling scientific competition between centres, because the NWP centres serve all WMO members. EUMETSAT also commented that the link between GBON and SOFF was not as explicit as it could be and requested a confirmation from WMO that SOFF would not be addressing any commercial satellite data. Recalling the CGMS-47 plenary discussions concerning the list of basic data to be made available to all NWP centres, EUMETSAT asked WMO to ensure that the focus will be on critical NWP data and not on satellite data for a wide range of general application areas.

WMO confirmed that the role of SOFF is solely to finance GBON observing network activities and not used as a mechanism for the purchase of satellite data.

As for the list of basic data for NWP centres, WMO noted that a clear statement from CGMS on what it would like to include in the CGMS baseline would be helpful.

NOAA noted that the data policy discussions might take years to resolve and that it may be overly optimistic to define a definitive list of NWP basic data that will stand the test of time. WMO acknowledged the complexity of the issue(s) and supported EUMETSAT's intervention to begin with something simple and basic. WMO further clarified that the list of basic satellite products for NWP would form part of the WIGOS regulatory material and would not be part of a data policy resolution.

In view of the circumstances, plenary deferred the following CGMS-47 actions to CGMS-49:

| CGMS-47 actions – Plenary Session | | | | | | | | |
|-----------------------------------|-------|----------|--|-----------|--------|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | |
| | item | | | | | | | |
| WMO | 3.2.5 | A47.02 | On global NWP: | CGMS-49 | OPEN | | | |
| | | | WMO to provide a report at next CGMS on baseline | (CGMS-48) | | | | |

⁵ See https://meetings.wmo.int/WMO-Data-Conference/SitePages/Conference%20Scheme.aspx.

| CGMS-47 a | CGMS-47 actions – Plenary Session | | | | | | | |
|--------------|-----------------------------------|---------|---|----------------------|--------|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | |
| | item | | | | | | | |
| | | | requirements for satellite products for global NWP, to trigger a CGMS discussion on status of delivery of such observations and possible improvements in the future and inclusion in the CGMS baseline document. 2020 Aug: See related CGMS-48-WMO-WP-13, CGMS-48- | | | | | |
| | | | WMO-WP-15. Action carried over to CGMS-49 | | | | | |
| NOAA, WMO | 3.2 | A47.03 | On PP sector engagement: WMO and NOAA to report on the status of affairs and related issues on public private sector engagement to CGMS-48 2020 Aug: Due to the plenary being virtual, the agenda has been reduced. WMO will also address this point at the WMO Data Conference in November 2020. Action carried over to CGMS-49. | CGMS-49 (CGMS-48) | OPEN | | | |

4. THEMATIC SESSION: HYPERSPECTRAL INFRARED SOUNDING (HSIR) OBSERVATIONS

SESSION OBJECTIVES: To review how CGMS space agencies plan to respond to the requirements of the WIGOS Vision 2040 with regard to hyperspectral infrared sounding observations. To review recent results from hyperspectral infrared sounding applications. Relevant CGMS members to consider optimising the orbital planes for their future LEO missions in contribution to WIGOS Vision 2040.

CGMS-48-EUMETSAT-WP-08: Setting the scene - Scope of HSIR for CGMS incl. WIGOS 2040

Hyperspectral infrared sounding instruments have become a crucial part of the global observing system over the last decade and a half. Numerous meteorological satellite organisations operate instruments and will in the future continue to operate such instruments, in both the polar orbit (CMA, EUMETSAT, NOAA, Roshydromet) and in the geostationary orbit (CMA, EUMETSAT). Even though the key driver for hyperspectral infrared sounding data is in support of global NWP, their importance for nowcasting, atmospheric chemistry, air quality (including emission detection), greenhouse gases, and 3D wind fields have also been demonstrated.

4.1 Users' perspective: Hyperspectral infrared sounding - Needs and requirements

CGMS-48-GUEST-WP-06: Impact of High Spectral Resolution Sounders (HSIR) on NWP

ECMWF provided a presentation on the impact of hyperspectral infrared sounding on numerical weather prediction. Radiation measurements from High Spectral Resolution Sounders (HSIR) provide highly detailed information on atmospheric temperature, composition and dynamics. Studies at ECMWF have shown that for Numerical Weather Prediction (NWP), instruments such as IASI and CrIS are the single most influential sensors on-board current operational LEO platforms. However, in terms of overall forecast impact, HSIR sensors lag behind the combined impact of all microwave sensors.

This is due in part to far fewer HSIR sensors currently in space (compared to microwave sensors), but also due to the fact that the available HSIR sensors are clustered around the morning (~09:30) and afternoon (~13:30) orbital planes.

With the prospect of Russia and China launching future satellites in alternative complementary orbits, ECMWF has invested significant effort preparing its data assimilation system to use observations from these new sensors (IKFS and HIRAS respectively). The ECMWF 4D-Var assimilation system is able to extract wind information from high temporal frequency humidity sensitive radiances and observations from the future MTG-IRS (and other GEO HSIR sensors). One expects these observations to have a significant impact on NWP. In preparation for this, ECMWF currently works with observations from the experimental GIIRS instrument on FY-4A, showing some promising early impacts.

Finally, the complexity and sophistication of HSIR sensors - that allows them to deliver such detailed atmospheric information - also makes these instruments very challenging to exploit to their full potential. In particular, handling interfering signals due to cloud, aerosol and trace gas contamination and characterising inter-channel error correlation matrices is significantly more difficult for HSIR than microwave sensors.

As such, to realise the full impact of HSIR instruments now and in the future, we must be prepared to invest proportionally more in development of the required data processing and assimilation science.

Plenary noted that observation frequency is key to achieving an impact on NWP from HSIR sensor data. GEO observations represent a powerful tool in this regard, however significant impact can also be achieved with LEO constellations. There is no unique impact of specific orbits.

Plenary further noted that improved spatial resolution is key for NWP, whereas improved spectral resolution is important for atmospheric composition applications.

CGMS-48-NOAA-WP-26: Impact of HSIR on regional modelling

NOAA/NESDIS and NOAA/OAR have collaborated on demonstration of use of direct broadcast sounder data in the NOAA regional hourly updating forecast models. The reduced latency for the direct broadcast is critical for the hourly updating models.

For hourly updating models like the "Rapid Refresh", direct broadcast data feeds substantially increase the number of assimilated observations, leading to significant forecast error reduction. The use of the direct broadcast data has been operational since 2018.

The Rapid Refresh Prediction (RAP) data assimilation system incorporates IASI, AIRS and CrIS hyperspectral IR data. CrIS data are also used for model forecast verification. Verification of model forecasts against CrIS brightness temperature reveals even larger data impacts from assimilation of satellite data and direct broadcast data.

For the coming Rapid Refresh Prediction version 5 updates, adding CrIS-FSR data from N20 (72 channels) leads to further RAP forecast error reductions, especially for relative humidity.

Low latency is essential for achieving HSIR impacts on regional modelling, but it should be noted that the low latency can be achieved either through direct broadcast or through other means.

CGMS-48-JMA-WP-08: Impacts of potential usage of HSIR for Himawari-8/9 follow-on program

In the study reported by JMA, the impacts of hyperspectral sounder installation on a geostationary satellite (GeoHSS) were assessed via observing system simulation experiments (OSSEs) to help evaluate the Himawari follow-on programme.

The study simulated hypothetical GeoHSS observations using an accurate reanalysis dataset for 2018 heavy rainfall and typhoon events in western Japan. The global data assimilation experiment demonstrated that the assimilated GeoHSS clear-sky radiances improved representative meteorological field forecasts and significantly reduced typhoon positional errors. A regional data assimilation experiment showed that assimilated temperature and relative humidity profiles derived from GeoHSS data improved information on heavy rainfall associated with enhanced south-westerly moisture flow off the north-western coast of Kyushu Island.

These results indicate that the GeoHSS provides valuable information on frequently provided data regarding vertically resolved temperature and humidity, thereby helping to improve forecasting of extreme meteorological events.

JMA invited CGMS agencies to:

- publish and discuss their HSIR OSSE/OSE assessment results for weather/environment applications;
- share the information on HSIR such as instrument developments, observation performance, data processing, operation, and applications; and
- promote the public awareness of the socio-economic benefits of the HSIR.

Plenary noted the importance of broadly communicating the results from OSSEs as well as OSEs, as they do contribute to the assessment of the WIGOS Vision 2040 implementation priorities.

4.2 CGMS space agency response (status, plans, campaigns, applications)

CGMS-48-CMA-WP-02: Progress of CMA in Hyperspectral sounders

CMA described the performance progress of hyper-spectral soundings onboard both its GEO and LEO platforms. As the first GEO hyper-spectral sounder (GIIRS, on FY-4A), its L1 radiance has been improved significantly in 2019 and is generally accepted by NWP and T/H profile retrieval applications, where its spectral shifts (less than 5ppm for LW band and less than 10ppm for MW band) and radiometric accuracy (less than 1K for most channels) behave reasonable well.

The main enhanced specifications of FY-4B/-4C GIIRS are in particular to meet the increasing requirements for NWP and retrieval uses, including the more symmetric layout of sensor array and the higher spatial resolution. CMA operationally assimilates the GIIRS L1 radiance data in the GRAPES model.

HIRAS, on-board the FY-3D satellite, completed its second decontamination in 2019, where MW and SW bands FOV3 solar contamination was eliminated by adjustment of cold space viewing angle. Its calibration accuracies are in general less than 0.3, 0.7 and 1.0 K in the LWIR, MWIR and SWIR bands, respectively. Mean and standard deviation of its spectral bias relative to the line-by-line simulated spectra are within 5 ppm.

HIRAS data has been in operational retrievals of atmospheric T and WV profiles and OLR products, and in NWP test applications, atmospheric composition retrieval, and global stratospheric gravity wave research.

GIIRS data represent a very important tool for preparation of future HSIR GEO missions and CGMS appreciated the efforts of CMA to enable the CGMS community benefit from the FY-4A experience, in particular through the cooperation with SSEC/UW, ECMWF and EUMETSAT.

JMA noted they have faced difficulties in evaluating the FY-4A GIIRS data and CMA committed to supporting JMA in this regard.

Plenary noted with appreciation CMA's efforts in positioning FY-3E in the early morning orbit and welcomed the proposal from CMA in its previous presentation to open the registration for the Fengyun Satellite Application Project, opening in September 2020, including early access to FY-3E data. Plenary stressed the importance of FY-3E, which will conclude the implementation of the three orbital planes of HSIR as per the CGMS baseline.

CGMS-48-CNES-WP-02: IASI/IASI NG experience and development of science and scientific applications for NWP, climate and air quality

The paper provided an overview of the on HSIR instrument activities at CNES. EUMETSAT and CNES cooperates on IASI activities. The CNES led development of IASI-NG (next generation) is underway. IASI-NG will provide improved spectral resolution and SNR with a factor of 2 over IASI. CNES noted that the main benefits of HSIR fall into three categories: NWP, atmospheric composition and climate. The CNES science activities are focusing on atmospheric composition supported by a large network of research institutes across Europe including ten French institutes. The activities have a strong link to downstream services like the Copernicus Atmospheric Monitoring Services (CAMS) and the Volcanic Ash Advisory Centres (VAACs) and are also linked to the EUMETSAT SAF on Atmospheric Composition. Plenary also noted the strong relevance to climate and many of the GCOS ECVs.

The presentation also highlighted the impact of the COVID-19 pandemic with examples over Europe and China.

In the discussion, Plenary highlighted that spectral resolution is critical for atmospheric composition and chemistry as well as for climate, although the data have a large potential for other applications too. Whilst spatial resolution is important, the criticality lies in the performance balance between spatial and spectral resolution and the Signal-to-Noise Ratio (SNR).

CGMS-48-EUMETSAT-WP-01: EUMETSAT plans and applications

The paper provided an overview of the EUMETSAT contribution to the Vision 2040 of WIGOS in both GEO and LEO orbits, two complementary future programmes:

- Hyperspectral infrared instruments with very high spectral resolution/sampling and high radiometric accuracy in LEO, called IASI-NG
- Hyperspectral infrared instruments with high spatial resolution and high temporal repetition in GEO, called MTG-IRS.

EUMETSAT recalled that it operates the IASI instruments since 2006 (with currently three in-orbit, on-board MetOp) and showed that IASI has brought an increased contribution to operational weather forecasting and has become a well-established data source for AC/AQ applications, and further contributions are expected with IASI-NG.

Thanks to its large spectral coverage, its fine spectral resolution and its stability and consistency within the three instruments, IASI provides a worldwide GSICS reference for all infrared sounders and imagers.

Complementing CNES's presentation related to the IASI-NG contribution to the atmospheric composition community, EUMETSAT added that MTG-IRS would also contribute to this community to some extent. It will bring an important contribution to NWP applications with its high spatial resolution and high temporal repetition. Moreover, it was shown that IRS will bring additional applications using hyperspectral IR sounders, like nowcasting and 3D winds (also expected with IASI-NG).

CGMS Recommendations:

- To complete the GEO hyperspectral infrared instruments belt;
- To complete the LEO orbits: early morning (CGMS baseline); and
- Optimisation of additional orbits (late morning and afternoon).

CGMS-48-NOAA-WP-16: OSSEs for assessment of hyperspectral infrared measurements from geostationary orbit in support of potential manifest of a hyperspectral radiometric spectrometer on GEO-XO

The presentation gave and overview of the NOAA activities for the assessment of HSIR for GEO within the context of GEO-XO (GEO and extended). The main objectives are to help formulate the information needed to include in industry studies of the future constellation performance baseline and to review the current "state-of-the-science" and provide an assessment of the potential value to the National Weather Service application. Three research groups are developing independent OSSE/OSEs, including data simulations, related to assessment of hyperspectral infrared measurements:

- NOAA/NESDIS STAR and OAR/AOML:
 - Build on previous studies investigating impacts from GEO sounders; and
 - Assess impact on NOAA global system (FV3GFS) 4DEnVar, high resolution regional (RAP/HRRR FV3-SAR, WoF) and HWRF.

NASA GSFC GMAO:

- The proposed work aimed to simulate and assimilate hyperspectral infrared radiance observations measured from a geostationary orbit in the context of a future GOES sounder; and
- The GMAO Meteorological OSSE framework.

- CIMSS:

 Real case demonstration of relative impact and added value from a GEO-hyperspectral IR sounder for local severe storm (LSS) forecast (heavy precipitation etc.).

The studies are looking at the pros and cons of shortwave versus longwave HSIR. In the future and with new findings, the assessment teams will incorporate these as well as extending the benefit analysis to include detailed societal benefit analytics. The current objective is to complete value assessment in the Q3 2020 and to prepare reports and out-briefs for inclusion in the GEO-XO Milestone-1 Review.

In the discussion, ECMWF noted and NOAA acknowledged that even though assimilation of short-wave measurements could bring significant benefits, the scientific and technical difficulties in achieving these benefits have so far meant that operational assimilation has been restricted to long-wave measurements.

CGMS-48-joint-ROSCOSMOS-ROSHYDROMET-WP-01: Russian FTIR spectrometer (IKFS-2) for meteorological satellites: flight experience and further development

The first Russian hyperspectral infrared (IR) atmospheric sounder IKFS-2 was launched in July 2014 on the "Meteor-M" No. 2. IKFS-2 is a Fourier transform spectrometer with a spectral range of 5-15 μ m and spectral resolution of 0.4-0.7 cm-1 (apodised spectra). During the commissioning phase, the IKFS-2 instrument status and data quality underwent a comprehensive investigation. The instrument performance has remained stable since launch, and the actual IKFS-2 characteristics meet the planned requirements (threshold value of NESR, uncertainty of on-board radiometric and spectral calibrations, spectral resolution).

The intercomparisons of IKFS-2 data with collocated IASI and CrIS spectra show that the discrepancies in the average spectra and their variability do not exceed measurement noise.

The operational IKFS-2 L2 processor has been developed and tested to carry out the retrieval of atmospheric temperature and humidity profiles, surface temperature as well as ozone, carbon dioxide, methane, and nitrous oxide total content (in clear sky conditions). The examples given confirm the proper quality and stability of IKFS-2 based L2 products.

In 2018, numerical experiments began on the IKSF-2 data assimilation (using the global data assimilation system of the Hydrometcenter of Russia). The trials being performed demonstrate that for NWP purposes the assimilation of the IKSF-2 data from subsets of the most informative "temperature" channels (in 660-750 cm-1 spectral region) provides a significant increase in accuracy of the 3-day weather forecast in the southern hemisphere (in terms of temperature and geopotential height fields).

In accordance with the existing Russian Federal Space Program, the next IKSF-2 instrument is planned for launch in August 2021 on board the Meteor-M satellite No. 2-3. The IKFS-2 series will continue with the launch of Meteor-M satellite No. 2-6 in the 2025 timeframe. By the end of the decade (2029), Russia expects to launch a new meteorological Meteor-MP satellite with an advanced IKFS-3 FTIR spectrometer on-board. The development of an IKFS-GS Fourier spectrometer for instalment on the new Russian geostationary satellites of Electro-M series is also underway. (The paper includes the specifications for these instruments).

Roshydromet noted that IKFS measurements will not be available on direct broadcast, but that they would strive to provide improved latency measurements through other means.

In the discussion, plenary noted that a 3 pm Russian HSIR can have a major impact as it would fill a data void gap, in terms of ECT, as noted in the ECMWF presentation. Plenary further noted that timeliness remains an issue and there is currently no direct broadcast capability foreseen for the future satellites. Roshydromet noted that they do have three centres - Moscow, Novosibirsk and Khabarovsk - that can receive data and transfer these to the public, and in this context confirmed they are prepared to work on an improved timeliness.

CGMS-48-NASA-WP-06: High resolution infrared spectroscopy-48

The NASA presentation on high resolution infrared spectroscopy provided an overview of hyperspectral infrared systems used by NASA currently or in the recent past, including spaceborne, airborne, and advancements in small satellite technology. The presentation highlighted milestones and/or results from these. Looking ahead, the presentation described how the 2017 Decadal Survey report "Thriving on our Changing Planet", guides NASA's Earth Science Division's balanced and robust programme of space observations, technology development, research, and application. One highlight from the Decadal Survey Incubation Program is the Planetary Boundary Layer targeted observable, in which a hyperspectral infrared sounder is included as one candidate measurement approach under consideration.

In the discussion, plenary noted that small sat capabilities are important as a way to deploy constellations and to improved temporal coverage.

4.3 Wrap-up, conclusions, actions/recommendations, HLPP impact

In concluding the session discussions, plenary agreed on the following HLPP amendments:

In HLPP section 1.2 (expansion of response to WIGOS):

Work towards ensuring optimised High Spectral resolution IR measurements from LEO and GEO orbits to improve time sampling, spatial and spectral resolution and timeliness of observations, including in particular the deployment of HSIR instruments across the full GEO ring as per WIGOS vision 2040.

In section 3 (User Interface):

3.12 Improve the exchange of characterisation data for geostationary and low Earth orbit hyperspectral infrared instruments and make available results of NWP impact assessment studies and OSSEs to the user communities;

In Section 4 (Intercalibration):

To maintain within GSICS a framework for inter-calibration of hyper-spectral infrared sounders

It should be noted that several targets relevant to HSIR instruments already exist in the proposed HLPP revision for the period 2020-2024 and are considered work-in-progress. These are quoted here for completeness:

- 3.12 Develop efficient standardised data handling for high-resolution imaging and hyperspectral instruments, employing novel methods like dissemination of hyperspectral infrared data based on Principal Component Analysis;
- 3.13 Explore options for optimal data exchange of advanced data from new generation GEOs, in consultation with the global NWP centres through GODEX-NWP.
- 4.1.2 Establish within GSICS a consistent inter-calibration for thermal IR channels using hyper-spectral sounders as reference. The implementation will be done successively by the individual satellite operators.
- 4.2.7 To establish together with the user community a commonly agreed approach for retrieval of Principal Component scores and associated parameters from hyperspectral infrared data, minimising information loss including the mutually acceptable update strategy for the principal component basis and to implement such an approach in a coordinated manner.
- 4.3.3 Conduct an intercomparison study between the different methods to derive level 2 data from infrared hyperspectral sounders, recognising that there are several software packages available that utilise AIRS/IASI/CrIS data."

| CGMS-48 a | CGMS-48 actions – Plenary Session | | | | | | | | |
|---------------------------------------|-----------------------------------|---------|--|----------|--------|--|--|--|--|
| Actionee | AGN item | Action# | Description | Deadline | Status | | | | |
| СМА | 4.3 | A48.01 | CMA to consider sharing a state-of-the-art reference FY-4A GIIRS dataset | CGMS-49 | OPEN | | | | |
| CMA, EUM, NOAA, ROSH, JMA | 4.3 | A48.02 | CGMS operators to publish and discuss HSIR OSSE/OSE assessment results for weather/environment applications. | CGMS-49 | OPEN | | | | |

| Actionee | AGN item | Rec# | Description | Status |
|-------------------------------|-------------|--------|--|--------------------------|
| CMA, EUM, NOAA, ROSH | 4.3 | R48.01 | CGMS operators to provide HSIR data with sufficient latency meeting NWP requirements, in particular regional NWP, through direct broadcast or other means. | Review at CGMS- 49 |
| CMA, EUM, NOAA, ROSH | 4.3 | R48.02 | CGMS operators to implement and distribute reduced volume HSIR datasets in NRT for NWP, using a subset of channels. | Review at CGMS- 49 |
| CMA, EUM, NOAA, ROSH | 4.3 | R48.03 | CGMS Operators are encouraged to continue supporting research activities facilitating the use of hyperspectral infrared data. | Review at CGMS- 49 |
| ROSC ROSH | 4.3 | R48.04 | Roshydromet/Roscosmos to consider deploying future IKFS instruments in orbits complementary to operational HSIR instruments. | Review at CGMS- 49 |
| ROSH | 4.3 | R48.05 | Roshydromet to work towards improved timelines. | Review at CGMS- 49 |
| CMA, EUM, NOAA, ROSH | 4.3 | R48.06 | CGMS operators to improve spatial resolution of HSIR instruments to meet NWP requirements for cloud clearing, noting that spectral resolution remains important for atmospheric composition. | Review at CGMS- 49 |
| CMA, EUM, NOAA, ROSH | 4.3 | R48.07 | CGMS operators to share the information on HSIR such as instrument developments, observation performance, data processing, operation, and applications. | Review at CGMS- 49 |
| SETT | 4.3 | R48.08 | CGMS to promote the public awareness of the socioeconomic benefits of HSIR observations. SETT to explore how this might be undertaken. | Review at CGMS- 49 |

5. WORKING GROUP REPORTS

5.1 Satellite systems and operations – report WGI

CGMS-48-CGMS-WP-18: Report on the key outcomes of WGI discussions

WGI addressed the status of discussion on frequency matters and decisions from WRC-19 including the initial preparations for the WRC-23. SFCG and WMO are on a yearly basis defining and refining their positions for WRC-23 and provide CGMS with the latest status. WGI has reviewed and provided feedback on issues of mutual interest and concern and will include relevant WRC-23 issues in the HLPP.

In the period, WGI reviewed a number of best practices presented for endorsement by CGMS-48 plenary. These include Direct Broadcast (DB) detailing transmission signal monitoring and customer notifications (BP 10), CGMS agency best practices in support to local and regional processing of LEO direct broadcast data (BP 4), Satellite direct broadcast and reception station performance requirements (BP 9). CGMS-48

plenary then endorsed the proposed revision of these CGMS agency best practices in support to local and regional processing of LEO direct broadcast data. Further, WGI discussed how to address the direct broadcast high data rates from future satellites in the HLPP.

The Working Group published the first best practice on DCS data access. The DCS subgroup had prepared and published the DCS handbook on 1 March 2020. Work on the new enhanced DCP standard is progressing.

WGI received an in-depth analysis by EUMETSAT on possible benefits of orbit coordination to maximise the number of satellites that individual ground stations can support. Plenary requested members to nominate mission analysis experts to form a Task Group, for reviewing simulations of coordination of LEO orbits. This Task Group should also ascertain the applicability to operational and planned missions, and determine further work required on the prototype simulation tool.

In view of the now long-term vacant WGI Co-chair position, the CGMS Secretariat invited CGMS members to come forward with nominations, and to secure this by CGMS-49.

| CGMS-47 actions – Plenary Session | | | | | | | | |
|-----------------------------------|------|----------|--|----------|--------|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | |
| | item | | | | | | | |
| CGMS | 5.1 | A47.06 | WGI co-chair: | Jan 2021 | OPEN | | | |
| members | | | CGMS members to propose candidates for the WGI co- | (Dec | | | | |
| | | | chair | 2019) | | | | |

5.2 Data access and end user support - report WGIV

CGMS-48-CGMS-WP-19: Report on the key outcomes of WGIV discussions

The WGIV session focussed on four main topics: Big data and cloud services, cyber security, coordination of metadata implementation, and user readiness.

A joint session between WGI and WGIV, addressed EUMETSAT new big data services and the NOAA experience with implementation of new architecture as well as the global coordination on handling future large data volumes and associated data circulation, global or inter-regional data circulation and access, and cloud services interoperability. An expert group headed by WGIV will further develop and address this topic.

WMO has started an activity of metadata scoring with the purpose to provide indication on the metadata quality and provide corrective actions to improve it. WMO will provide this information to the satellite operators publishing data in the WIS. Creating and bringing metadata records up to date is important, in particular for new space weather data.

WGIV has formed an expert group on cyber security towards end users. So far, EUMETSAT, ISRO, JMA, NOAA and ROSHYDROMET participate with other CGMS members invited to join.

On training and education on the use of satellite data, the VLab Co-chair presented a progress report, demonstrating that the work of the VLab is considered very important for training users of existing satellite data and even more so for the data from the new generation of GEO and LEO satellites.

WGIV fully supports the continuation of the VLab and the necessity for the corresponding budget provision. WGIV recalled to CGMS members the need for securing the continuity of this activity through contributions to the WMO VLab trust fund. The 10th VLab Management Group Meeting (VLMG-10) will be held at EUMETSAT on 13-17 September 2021 and CGMS members are invited to participate.

WGIV also recalled that CGMS members active in VLab, to provide nominations for the next Co-chair to represent CGMS satellite operators in the VLab (starting October 2020):

| CGMS-47 a | CGMS-47 actions – Plenary Session | | | | | | | |
|-----------------|-----------------------------------|---------|---|---------------------------|----------|--|--|--|
| Actionee | AGN item | Action# | Description | Deadline | Status | | | |
| CGMS members | 9.1 | A47.17 | On training and education: CGMS members active in VLab to propose the next Co- Chair to represent CGMS satellite operators in the VLab (starting October 2020). Nominations to be presented to VLab by December 2019. 2020 May CGMS-48 WG discussions: Vlab matters have been transferred to WGIV on user preparedness. | Oct 2020 (Dec 2019) | Critical | | | |

| CGMS-47 recommendation – Plenary Session | | | | | | | |
|--|------|--------|---|----------|--|--|--|
| Actionee | AGN | Rec# | Description | Status | | | |
| | item | | | | | | |
| CGMS | 9.1 | R47.10 | On training and education: | Critical | | | |
| members | | | CGMS members to provide contributions into the WMO VLab Trust | | | | |
| | | | Fund to ensure the continuation of technical support to the VLab. | | | | |
| | | | CGMS members considering to provide additional support should | | | | |
| | | | contact the WMO Space Programme Secretariat | | | | |
| | | | (recommendation transferred to WGIV in 2020) | | | | |

5.3 Satellite data and products - report WGII

CGMS-48-CGMS-WP-21: Report on the key outcomes of WGII discussions incl. CGMS International Science Working Groups, GSICS, SCOPE-CM and other international initiatives. Revised WGII ToRs for endorsement by plenary.

WGII provided an overview of all activities undertaken since CGMS-47 and in particular the outcome of discussions of the CGMS-48 WGII discussions. In particular related to the update of the WGII Terms of Reference and for endorsement by plenary, the impact of COVID-19 and the CGMS ISWGs and their respective priority discussions, the WGClimate, SCOPE-CM routine phase and next steps, the GSICS 2020 priorities, agricultural applications, and the flood mapping pilot initiative.

CGMS-48-CGMS-WP-30: Revised WGII Terms of Reference

The CGMS-46 plenary decided to review and update the Terms of Reference for the CGMS working groups every five years. Accordingly, WGII reviewed its Terms of Reference during the CGMS-48 Working Group meeting and presented these to plenary, who endorsed the updates.

Furthermore, as per the Terms of Reference, a new co-chair needs to be nominated, and following the departure of Kenneth Holmlund, EUMETSAT and WGII co-rapporteur, a new rapporteur needs to be appointed.

| CGMS-48 a | CGMS-48 actions – Plenary Session | | | | | | | | |
|------------------------------------|-----------------------------------|----------|--|----------|--------|--|--|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | | | |
| CGMS space agency members | 5.3 | A48.03 | CGMS space agency members to nominate a new co- chair for WGII (the action will be allocated to WGII) | Dec 2020 | OPEN | | | | |
| EUM | 5.3 | A48.04 | EUMETSAT to nominate a new rapporteur for WGII (the action will be allocated to WGII) | Dec 2020 | OPEN | | | | |

CGMS-48-SCOPE-CM-WP-01: Implementation Plan for the Routine Phase of the Sustained Coordinated Processing for Environmental Satellite Data for Climate Monitoring (SCOPE-CM) Initiative for endorsement by plenary

The Sustained Coordinated Processing for Environmental Satellite Data for Climate Monitoring initiative (SCOPE-CM) has pursued its objectives through sequential phases. At the 14th SCOPE-CM Executive Panel (EP) held in February 2019, the EP agreed to close-out the SCOPE-CM phase 2 activities.

At CGMS-47, SCOPE-CM presented a "Proposal for Revised SCOPE-CM Strategy for Sustained Climate Data Records" which describes the phase 2 achievements, lessons learned, options for SCOPE-CM's future and a recommended way forward. The CGMS-47 Plenary endorsed the new SCOPE-CM strategy, the proposed way forward, and issued an action for SCOPE-CM to develop an implementation plan for submission to CGMS-48 Plenary.

The working paper provides details of the next phase, the routine phase, of SCOPE-CM. It describes the changes in priorities and activities as well as the governance and relationships with key stakeholders. In particular, it clarifies the roles and responsibilities with respect to the Joint CEOS/CGMS Working Group on Climate. The paper provides an outline of the next steps and invited CGMS-48 plenary to endorse these.

The preparation of a more detailed Implementation Plan relies on the forthcoming gap analysis of the ECV Inventory (v3.0, released on 31 July 2020). While significant details remain to be elaborated, the proposed next steps for SCOPE-CM include:

1. CGMS agencies are requested to express their interest in SCOPE-CM and to nominate a point of contact;

- 2. SCOPE-CM to identify CEOS/CGMS agency planned CDRs from the WGClimate ECV Inventory, potentially requiring international collaboration for continuation;
- 3. SCOPE-CM to analyse agency-contributed CDRs with a potential for improved quality through SCOPE-CM led collaborative projects, e.g. through process and product harmonisation, algorithm intercomparison and exchange; and
- 4. SCOPE-CM to analyse CEOS/CGMS contributions against GCOS ECV gaps and to develop an initial sustainment agenda for proposal to CGMS-49.

Concluding the discussions, CGMS-48 plenary endorsed the SCOPE-CM Implementation Plan for the routine phase of the SCOPE-CM initiative (CGMS-48-SCOPE-CM-WP-01).

5.4 Operational continuity and contingency planning - report WGIII

CGMS-48-CGMS-WP-20: Report on key outcomes of WGIII discussions

WGIII reported on the main outcomes of the second risk assessment workshop in February 2020 and the WGIII session in May 2020. WGIII presented the revision of the CGMS baseline to plenary for endorsement, and the risk assessment for information.

CGMS-48-CGMS-WP-02: Revised CGMS baseline - for endorsement by plenary

At CGMS-46 in Bengaluru, plenary endorsed the first CGMS baseline, the commitment of observational missions synchronised with the development of the WMO Vision for WIGOS 2040 (ref. CGMS-46 CGMS-WP-04, and -27).

The second CGMS WGIII risk assessment workshop took place in EUMETSAT on 19-21 February 2020 on whose occasion WGIII conducted the CGMS baseline review and related risk assessment. The working group proposed a number of revisions to both documents, which the CGMS-48 working groups reviewed on 25-29 May 2020.

The main changes to the baseline from the 2018 version are:

- Renaming the document from "CGMS Baseline Sustained contributions to the Global Observing System" to "CGMS Baseline – Sustained contributions to the observing of the Earth system, space environment and the Sun";
- Rearranging sensors into logical groupings;
- Updating the types of observations derived from hyperspectral infrared sounders; included atmospheric composition and winds (in addition to atmospheric temperature and humidity)
- Defining CGMS's commitment to the number of radio occultations: 6000 occultations from low inclination orbits distributed geographically and temporally; 1000 occultations from drifting high inclination orbits; and 7600 occultations from sun-synchronous orbits. Electron density profiles were also added;
- Adding SWIR spectrometer in LEO to capture CO2 and methane observations; and
- Renaming Ion/Electron/Proton Spectrometer to Energetic Particle Sensor.

(The working paper contains the full draft text of the second revision of the CGMS baseline, shown in track changes in the approved 2018 version).

EUMETSAT noted that the title change might require further discussions, in that it possibly now goes beyond the WMO Vision 2040.

CGMS-48 plenary endorsed the second revision of the CGMS baseline and requested WMO to consider the revised baseline in forthcoming updates of the Manual on the Global Observing System (and related materials).

CGMS-48-CGMS-WP-27: Outcome of the second CGMS risk assessment

Linked to the CGMS baseline approved at CGMS-46, CGMS WGIII undertook the first risk assessment in spring 2019 and presented the outcome to CGMS-47 (ref. CGMS-47 CGMS-WP-07a, and -07b). The second CGMS WGIII risk assessment workshop took place in EUMETSAT on 19-21 February 2020. The working group reviewed the status of affairs and made a number of updates to the risk assessment since last year, which in turn the WGIII reviewed at CGMS-48 session on 28-29 May 2020.

WGIII recalled that CGMS conducts the annual risk assessment against the CGMS baseline to track how CGMS is meeting its commitments and to form the basis for CGMS actions to ensure continuity.

The top-level risk assessment focus areas identified are:

- Long term continuity risk for critical sensors (e.g. microwave and hyperspectral sounders, and multipurpose imagers) in the early morning orbit towards the end of the decade:
 - CMA planning underway for a follow-on to FY-3E in the early morning orbit
 - After the launch of FY-3E, a WMO Tiger Team will assess the benefit of the early morning orbit to inform CMA's plans;
- Continuity risk for the number and geographic distribution of radio occultations; especially in the low to mid-latitudes:
 - Recommendation to CGMS members to fly RO sensor providing coverage in the low- to midlatitudes;
- Long term plans for Atmospheric Chemistry observations need to be confirmed;
- Long term continuity risk for Microwave Imager in the early morning orbit; ~6GHz capability for all-weather sea surface temperatures is critical:
 - NOAA to confirm U.S. plans for early morning coverage;
- No long term plans for a Precipitation Radar sensor:
 - GPM Core nominal operation 3 years from 2014 to 2017. Currently it is on post-nominal operation and is in year by year extension. Next Generation PR is not yet approved.
 - CMA should promote the programme approval beyond FY-3G (rainfall mission);
- No long term plans for a Scatterometer senor in the afternoon orbit:
 - ISRO should confirm plans beyond Oceansat-3;

- Risk of a gap in Coronagraph and Plasma Analyser sensors in the near term
 - ISRO should confirm launch plans and capabilities of Aditya-L1 mission
 - Members should develop contingency plans for potential gaps in solar imagery from the Earth-Sun line, and solar wind observations at L1.

This resulted in the following recommended actions:

- CGMS plenary to take note of the outcome of the 2nd CGMS risk assessment;
- Relevant CGMS members to consider the actions raised in the 2nd risk assessment review and inform the CGMS Secretariat and WGIII accordingly;
- CGMS members to investigate the use of commercial RO data (ensuring compliance with national and international mandates and policies) to supplement data in the polar orbit and to mitigate against the loss of data in the equatorial region;
- CGMS members to fly RO sensors on future LEO missions;
- CMA to promote the programme approval beyond FY-3G (rainfall mission);
- JAXA to confirm plans to fly a precipitation radar beyond GPM;
- ESA to provide details on future Sentinel mission to monitor CO2;
- EUMETSAT to encourage NSOAS (MNR) to make HY-2 backscatter data globally available;
- CGMS members to propose alternative data sources for consideration as gap mitigation in event of
 loss or degradation of current L1 capabilities prior to SWFO-L1 data availability and WGIV to develop
 plans to ensure near real-time access to those data;
- ISRO to confirm launch date and data latency for the Aditya-L1 mission;
- ISRO to confirm plans beyond Oceansat-3;
- CGMS to update the HLPP to address long-term CO2 monitoring;
- IPWG to review operational utilisations of Spaceborne Precipitation Radar in collaboration with the Precipitation Virtual Constellation of the Committee on Earth Observation Satellites (CEOS/P-VC), which can be a key factor to continue long-term spaceborne precipitation radar observations; and
- CGMS to consider mitigating the risk of gap on 6GHz imaging continuity after GOSAT-GW.

CGMS-48 plenary took note of the outcome of the second CGMS risk assessment review.

CGMS members are requested to take into account the actions raised in the second risk assessment review and provide feedback to the CGMS Secretariat and WGIII accordingly (these actions will be recorded in the WGIII list of actions).

CGMS-48-WMO-WP-21: Risk assessment based on WMO OSCAR/Space gap analysis

In the working paper, WMO presented the WMO gap analysis for the 28 instrument types or technologies based on the information recorded in the OSCAR/Space database. It is a follow on of the document CGMS-47-WMO-WP-17a (Risk assessment from the WMO OSCAR/Space gap analysis) constituting two sections:

- WMO gap analysis for each of the 188 variables processed in the OSCAR/Space database (124 for Earth observation, 64 for Space weather); and
- WMO gap analysis for 28 instrument types or technologies (22 for Earth observation, 6 for Space weather).

The following general conclusions for the gap analysis are drawn:

For Earth observation missions:

- At large, the CGMS baseline is reasonably fulfilled;
- There are certain gaps in geographic coverage and service continuity through the full decade; and
- Certain variables advocated by WIGOS are observed with either poor quality or not existing, requiring operational follow on of demonstration missions, or technological developments.

For space weather missions:

- Solar monitoring is now well covered and there is great focus on maintaining satellites at L1, as well as planning to exploit L5. A backbone of observations is sustained by operational meteorological satellites in GEO and LEO; and
- Missions flying through the magnetosphere, especially in clusters to reconstruct gradients, are close to end of life, and plans for new such missions are unknown.

Suggested mitigation actions include indication of necessary operational follow on of successful demonstration missions, or new developments not yet committed in the CGMS baseline but considered in the framework of the Vision for WIGOS in 2040.

CGMS-48 plenary took note of the status of the WMO gap analysis for the instrument types or technologies based on the information recorded in the OSCAR/Space database.

5.5 Space Weather Coordination Group - report SWCG

CGMS-48-CGMS-WP-22: Report on the key outcomes of SWCG discussions

The SWCG informed plenary of the main activities undertaken since CGMS-47 including:

- updates of the status of future space weather missions;
- progress on the establishment of a framework for inter-calibration of energetic particle sensors in GEO following GSICS principles;
- ICAO is incorporating Russian and Chinese forecast centres as a joint and fourth global space weather service centre;
- ongoing progress in ensuring the correct structuring of space weather data within the WMO OSCAR/Space database; and
- good progress made on the survey of the ISES community of operational space weather prediction centres to help establish areas for improvement in data provision.

The SWCG also held a joint session with WGs I and IV where they reviewed the status of user and operator surveys being conducted by the SWCG. They highlighted the need for continued commitment by CGMS member satellite operators to provide regular inputs on satellite anomalies to ensure resources can be found to process and utilise the data. The WGs established the Satellite Anomaly Database Task Group, and it will provide a dedicated anomaly template form to members prior to CGMS-49 to facilitate the compilation process. Further, the WGs noted the need to reach out to the commercial sector to encourage their participation in operational anomaly collection. Another important point is to perform energetic particle sensor intercalibrations both retrospectively on existing instruments and to include such activity for future instruments. Finally, the WGs reviewed the status of the White Paper on space weather instrument intercalibration approach to be finalised by GSICS.

6. SUPPORT TO OPERATIONAL CLIMATE AND GREENHOUSE GAS MONITORING

SESSION OBJECTIVE: GCOS requirements and CGMS agency expectations; WGClimate: endorsement of new leadership proposal; CGMS agency contributions to WGClimate; engagement of CGMS space agencies in GHG TT and roadmap activities towards the operationalisation of the GHG monitoring system and how to reflect this within the CGMS WGs; engagement of CGMS members to produce GEO ring radiance input for the provision of cloud climatology data records.

6.1 GCOS

CGMS-48-WMO-WP-09: GCOS status and future plans

WMO reaffirmed its commitment to host GCOS and provided an update of the GCOS implementation plan and requirements. WMO also informed plenary that the 2nd Climate Observation Conference will be held on 12-14 October 2021.

CGMS plenary took note of the status and was pleased to see that the GCOS initiative is now secured and embedded within the new WMO structure following the reform.

6.2 CEOS/CGMS Joint Working Group on Climate (WGClimate)

The Chair of the CEOS/CGMS joint working group on climate provided three related reports:

CGMS-48-JWGCLIM-WP-02: WGClimate status report

The presentation addressed the progress in the implementation of the Joint CEOS/CGMS Working Group on Climate (WGClimate) objectives since CGMS-47. Namely:

WGClimate published the **ECV** Inventory v3 online 30 July 2020: on https://climatemonitoring.info/ecv_inventory. 35 of the 37 ECVs of the GCOS IP space-observables are covered with some contribution in the Inventory V3. The ECVs for lightning, permafrost, and aboveground biomass are represented for the first time. From current ECVs, only ocean surface currents and anthropogenic GHG fluxes appear as gaps. Due to the COVID-19 pandemic, the delivery of the full Cycle 3 Gap Analysis and Coordinated Action Plan is postponed to the autumn 2020 and is expected to be ready for approval by the end of 2020. Intensified exchanges with CMA and JAXA on providing inputs to the inventory have taken place, raising hopes to have more completeness in the Inventory V4. The gap analysis process will be further rationalised to ensure affordability, including an annual workshop. WGClimate requests CGMS member agencies to send experts on ECVs to this workshop.

CGMS-48-JWGCLIM-WP-03: Roadmap for implementation of a constellation architecture for monitoring carbon dioxide and methane from space

The purpose of the greenhouse gas (GHG) Roadmap is to coordinate ongoing and planned greenhouse gas measurement and analysis activities across space agencies and foster the development of interfaces with stakeholders and users. The GHG Roadmap (v2.4) describes an approach for implementing the GHG Strategy and specifies resource needs. It is a "living" document, maintained by the WGClimate GHG Task Team. The work plan is provided in Annex C of the document, and updated as necessary. WGClimate asked CGMS plenary to endorse the document and the provision of the resources identified for the specific activities and entities (i.e. CGMS WGs and the GHG Task Team).

In addition, the activity targets the engagement of the CGMS Working Groups to address the transition of the current GHG monitoring system into an operational system. In order to provide an interface between CGMS and the GHG Task Team, representatives from CGMS working groups I-IV will be represented. This includes ensuring a direct reporting line to the specific area of CGMS competence.

Concluding the discussions on this item, CGMS-48 plenary endorsed the WGClimate Greenhouse Gas Task Team roadmap v2.4 for the implementation of a constellation architecture for monitoring carbon dioxide and methane from space (CGMS-48-JWGCLIM-WP-03).

WGClimate has published a call for use cases for climate data records https://climatemonitoring.info/use-cases, a new routine activity. CGMS agencies are requested to organise submission of use cases for climate data records within their respective areas via https://climatemonitoring.info/use-cases.

| CGMS-47 a | CGMS-47 actions – Plenary Session | | | | | | | | |
|-----------|-----------------------------------|----------|---|-----------|--------|--|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | | |
| | item | | | | | | | | |
| CGMS | 8.2 | A47.14 | CGMS members (space agencies) to submit use cases | CGMS-49 | OPEN | | | | |
| members | | | for climate data records within their respective areas | (CGMS-48) | | | | | |
| | | | via https://climatemonitoring.info/use-cases | | | | | | |

WGClimate has conducted a workshop with the WCRP core project GEWEX on the development of improved cloud property climate data records. This requires cross-calibrated radiometric data for all involved geostationary instruments in a first step. Today there is no polar satellite component specified, however it is likely it will have an equal role to that of the GEO component. CGMS agencies, in particular those operating geostationary satellites, are encouraged to make commitments within GSICS and SCOPE-CM (IOGEO project) that enable the creation and maintenance of the cross-calibrated 'geo-ring' radiance climate data records.

| CGMS-48 a | CGMS-48 actions – Plenary Session | | | | | | | | |
|-----------|-----------------------------------|--------|--|----------|--------|--|--|--|--|
| Actionee | AGN | Action | Description | Deadline | Status | | | | |
| | item | # | | | | | | | |
| CGMS | 6.2 | A48.05 | CGMS agencies, in particular those operating | CGMS-49 | OPEN | | | | |
| space | | | geostationary satellites, are encouraged to make | | | | | | |
| agencies | | | commitments within GSICS and SCOPE-CM that enable | | | | | | |
| | | | the creation and maintenance of the cross-calibrated | | | | | | |
| | | | 'geo-ring' radiance climate data record and in second | | | | | | |
| | | | step to a project for the cloud property data records. | | | | | | |

GCOS and WGClimate agreed on direct interaction on the relevant part of the GCOS Status Report, with WGClimate delivering inputs until the end of August 2020. The GCOS Secretariat presented the update of the GCOS requirements and the plans for the development of the next GCOS IP to WGClimate#12 in May 2020. These do not accommodate application- or scale-specific requirements. For example, for total column atmospheric CO2 numbers are for global trend estimates with suggestions if useful for adaptation and extremes. However, there is a shift of focus from monitoring and studying the natural carbon cycle to monitoring anthropogenic emissions - a very significant step up in requirements. The concern of WGClimate is that this will not be reflected in the next GCOS IP resulting in GCOS losing its relevance as a reference framework for space agencies. WGClimate sees an improved approach for compiling GCOS ECV requirements as essential for GCOS. The pathway to a new approach might be discussed in the WMO GCOS Study Group to be taken into account for the next GCOS Implementation Plan.

Engagement with UNFCCC/SBSTA has evolved very positively. WGClimate provided full reporting including a CEOS/CGMS statement to SBSTA-50 in Bonn, Germany, in June 2019, and to SBSTA-51 in Madrid, Spain, in December 2019. WGClimate also participated in the Earth Information Day and received good recognition for the space agency contributions, as is evident from the event report:

https://unfccc.int/sites/default/files/resource/EarthInformationDay2019.SummaryReport.pdf.

The SBSTA-52/COP-26 is postponed to 2021 due to the COVID-19 pandemic and no formal statements will be made in 2020. WGClimate will further provide support to the UNFCCC Secretariat and the parties in the synthesis and assessment phase of the first global stocktake process and will actively engage in the newly established ad-hoc group on Systematic Observations on support of the first global stocktake.

CGMS-48-JWGCLIM-WP-04: WGClimate leadership proposal - nomination

The 12th session of WGClimate in May 2020 unanimously recommended Jeffrey Privette (NOAA) as the next WGClimate vice chair and WGClimate asked CGMS-48 Plenary to endorse this recommendation. Dr. Privette's term would begin after the October 2020 CEOS Plenary for a two-year term, followed by another two-year term as Chair of the WGClimate corresponding to a total commitment of four years.

In response, NOAA confirmed its full support for this proposal and CGMS-48 Plenary endorsed the recommendation.

CGMS-48-GUEST-WP-05: CGMS and WCRP cooperation on Obs4MIPs (Observations for Model Intercomparisons Project) and global reanalysis activities-announcement

The World Climate Research Programme (WCRP) has the mission to coordinate and facilitate international climate research to develop, share and apply the climate knowledge that contributes to societal well-being.

WCRP acknowledges the very strong contribution of space agencies to this mission and the many associated research activities taking place throughout its core activities. As part of its work, WCRP (partly through its Data Advisory Council, WDAC), has been spearheading important initiatives around observations for model intercomparisons, the success of which very much depend on availability, length and quality of Earth observations and climate data records. Among them are Obs4MIPs and reanalyses.

In order to meet the growing need to advance research, and for serving policy and service expectations, there is an opportunity now for even closer coordination between WCRP and space agencies on climate observations and analyses as the programme is putting a stronger emphasis on synergies between science and society, which fundamentally depend on sustained Earth observations.

CGMS members are invited to note the new strategic objectives and new implementation elements of WCRP, including new proposed Lighthouse activities, for which Earth Observations will play a key role. WCRP also encouraged CGMS members to continue supporting WCRPs climate research with the contribution of new and updated datasets targeting the improvement of climate models, and the support of climate information for stakeholder communities.

6.3 Wrap-up, conclusions, actions/recommendations, HLPP impact

Plenary congratulated WGClimate on its achievements and thanked Joerg Schulz for his leadership as Chair, welcomed and endorsed the proposal for Jeff Privette becoming the new vice Chair, and noted that the current vice Chair, A. von Bargen, would serve as the new Chair. Plenary further recognised that resources are, and will remain, an issue that must be addressed and the CGMS agencies are encouraged to look at their commitments towards the work performed by the WGClimate.

With respect to the GHG Task Team and CGMS involvement, the European Commission emphasised the similarities between the aim of GHG monitoring and CGMS activities, like managing constellations of operational satellites. Therefore, CGMS can play a very strong role in the implementation. It was noted that the first global stocktake in 2023 will use what is available, however it was important to take action now in order to be ready with an operational/pre-operational system for the second stocktake in 2028. Therefore, a strong commitment from the CGMS agencies and CGMS itself is essential.

Regarding observations, plenary noted that the potential contributions to GHG monitoring, had also been discussed during the HSIR session. There is a desire to support the carbon monitoring constellation with a GEO ring contribution. Once GEOCarb data are available, it will be very important to undertake lessons learned. In parallel, CGMS agencies are encouraged to plan similar missions.

Plenary welcomed the proposal to have dedicated points of contacts from each of the four CGMS Working Groups (I - IV) for the WGClimate GHG Task Team and placed the following actions:

| CGMS-48 a | ctions - | - Plenary S | ession | | | |
|-----------|----------|-------------|--|----------|--------|--|
| Actionee | AGN | Action | Description | Deadline | Status | |
| | item | # | | | | |
| Co-chairs | 6.2 | A48.06 | CGMS WGI - WGIV co-chairs to identify a point of contact | Oct 2020 | OPEN | |
| of WGI, | | | from CGMS WGI, WGII, WGIII and WGIV to become a | | | |
| WGII, | | | member of the WGClimate GHG Task Team, therefore | | | |
| WGIII, | | | providing the interface as well as a direct reporting line | | | |
| WGIV | | | back to that specific area of CGMS competence (deadline | | | |
| | | | end of October 2020) | | | |
| Chairs of | 6.2 | A48.07 | WGClimate/GHG TT Chair to define priorities for CGMS | Nov 2020 | OPEN | |
| WGClima | | | WGI-IV contributions. | | | |
| te/GHG | | | | | | |
| TT | | | | | | |
| Co-chairs | 6.2 | A48.08 | CGMS WGs I-IV to reflect the operationalisation of the | CGMS-49 | OPEN | |
| of WGI, | | | GHG monitoring system and to discuss with the | | | |
| WGII, | | | WGClimate GHG Task Team the roles of each WG for the | | | |
| WGIII, | | | implementation that becomes part of the | | | |
| WGIV | | | roadmap's work plan (deadline CGMS-49 Plenary to serve | | | |
| | | | as input for next WGClimate presentation) | | | |

Plenary then discussed the adequacy of the GCOS requirements. Plenary noted that for the GHG activities it is crucial to be able to base these activities on the GCOS requirements. Today the requirements (expressed as threshold, breakthrough and goal) are not suitable to support the CGMS agencies in assessing the performance of their systems. Albeit a complex matter, it would be critical to ensure that the requirements evolve in the future. In order to adequately support the GHG monitoring activities, it would e.g. be important to look at requirements at different temporal and spatial scales. Plenary therefore placed the following recommendation on WMO:

| CGMS-48 RECOMMENDATIONS – Plenary Session | | | | | | | |
|---|------|--------|---|-------------------|--|--|--|
| Actionee | AGN | Rec# | Description | Status | | | |
| | item | | | | | | |
| WMO | 6.3 | R48.09 | WMO to ensure that the GCOS requirements as well as | Review at CGMS-49 | | | |
| | | | the process to define them are designed in such a way | | | | |
| | | | that requirements, stemming from the CGMS agencies' | | | | |
| | | | need to assess performances, can be captured. | | | | |

7. THEMATIC SESSION: SCATTEROMETRY

SESSION OBJECTIVE: Coordination of global scatterometer constellation including coverage optimisation and data sharing in response to WIGOS 2040

7.1 Key note: Scatterometer observations and applications

CGMS-48-GUEST-WP-07: Scatterometry, main applications, benefits, planned developments

The paper provided the CEOS OSVW-VC report on scatterometry. It introduced the current scatterometer OSVW (Ocean Surface Vector Wind) constellation, for which EUMETSAT and ISRO are the anchors of the constellation operating the ASCAT's and OSCAT instruments respectively. China is also flying scatterometers on the research mission CFOSAT (a joint mission with CNES) and on the operational HY-2B with plans for additional operational scatterometers in the HY-series (NSOAS) and FY-3E (CMA).

In view of the planning, a number of scatterometer OSVW missions will be available. However, near real-time access to data for all users needs confirming. Furthermore, there is a cluster of missions around the 6 am and 9 am ECTs, whereas OceanSat3 will provide coverage around noon. An additional mission around 3 am would provide better temporal sampling to support operational weather and climate needs.

One can note that scatterometers are a mature and proven technology for the retrieval of ocean surface wind vectors. It is the "gold standard" for satellite OSVWs and the data are trusted by the marine weather community. Scatterometers also provide daily ice extent measurements and soil moisture measurements. The satellite OSVWs are important:

- For situational awareness of actual conditions at the ocean surface; and
- Since wind drives the ocean and the ocean modulates the atmosphere (coupled system).

Applications of satellite OSVW ranges from the:

- (1) short term (operational weather forecasting to direct use by human forecasters as observations to support decision making (i.e. initiate and terminate warnings) and verify NWP model guidance and assimilation to NWP models for initialisation); to
- (2) longer term (monitoring seasonal to inter-annual changes in our climate).

It is important to understand that the system capability must match the measurement objective in terms of spatial and temporal sampling. Observation requirements vary greatly depending on the spatial and temporal scales of phenomena that need capturing. Sampling requirements in space and time are driven by the need to capture the variability.

The paper also gave some examples on how satellite OSVWs are utilised and demonstrated the impact of satellite OSVW in NWP models.

Plenary noted that in the OSVW recommendation the vision from WMO WIGOS 2040 and the IOVWST scatterometers are part of the "Backbone system with specified orbital configuration and measurement approaches".

This is also consistent with the CGMS baseline which is based on a Sun-synchronous core satellite constellation in three orbital planes (morning, afternoon, early morning). The International Ocean Vector Wind Science Team (IOVWST) recommends:

- At least three scatterometers in orbits designed roughly meeting the WMO requirements (i.e. observations every 6 hours as required for global NWP or better).
- One instrument in a non-sun-synchronous orbit for sampling the diurnal cycle, better mid-latitude sampling, and to provide inter-calibration.

In conclusion, the paper recommends:

- Optimisation of orbits to improve temporal sampling (at a minimum to achieve the 6-hour WMO minimum observation cycle requirement);
- Sharing of information (sensor and measurements) sufficient for independent validation and verification;
- Open and near real-time data access to support the marine weather mission;
- Systematic and sustained high quality and consistent observations of the ocean surface vector wind field at sufficient temporal and spatial resolutions to support the application; and
- Support end user training and outreach activities.

7.2 CGMS space agency response (status, plans, applications)

CGMS-48-ISRO-WP-01: ISRO report on the status and plans of its scatterometer programme

The paper noted that due to on-board failure, ISRO switched on the redundant chain on SCATSAT-1 on June 6 2019. This has required some recalibration of the sigma0 (radar cross section of a surface). Data has been freely available to the global community since October 2016. The paper also provided an overview of applications and noted the following gap areas:

- More frequent observations are needed for extreme events; and
- High wind (> 20 m/s) accuracy is not very good and need improvements.

In the future, it would be important to establish a working team to document validation sources and metrics, intercalibration and to generate climate quality products. There is a need to develop unified geophysical model functions (GMFs) and retrieval models for all scatterometers and algorithms for extreme wind cases. Further, the global scatterometer constellation to monitor extreme events, diurnal variation and impact on NWP and climate need defining.

CGMS-48-CMA-WP-03: CMA Report on the Preparation of Scatterometer on FY-3E

The paper provides the status on the development of the dual-frequency scatterometer WindRAD on the Chinese FengYun-3E (FY-3E) meteorological satellite. The paper reviews the system application objective and the developing progress for the WindRAD and introduces the design research of the WindRAD system characteristics undertaken by NSMC/CMA. WindRAD adopts some innovative technologies, such as dual frequency radar and rotating fan-beam antennae. Therefore, relatively high accuracy of OSWF can still be achieved even though the return echoes are much less, than the system noises of the radar under low wind speed condition.

Test results of the WindRAD flight model of the WindRAD show its system parameters meet the user requirement. This year, CMA/NSMC focuses on refining the data processing algorithm and product format and on preparing the proxy WindRAD data for OSWF applications.

CGMS-48-CNSA-WP-01: NSOAS report on the status and plans of its scatterometer programme

The paper recalled the objective of the HY-2 mission to monitor ocean dynamic parameters in the microwave region and providing parameters like surface wind, SSH, SWH and SST. The paper further gave a brief overview of the instrumentation and some examples of products.

The paper introduced CFOSAT, declared operational in February 2020, and addressed data access and availability including data timeliness. Finally, the paper provides an outline of future missions with two satellites HY-2C and -2D in inclined orbits forming a three-satellite constellation together with HY-2B.

The future generation HY-2 satellites (HY-2E and onwards) are planned with a more powerful ability to measure ocean dynamics with the main payloads being interferometric radar imaging altimeter, dual-frequency Qual-Pol scatterometer and multichannel Qual-Pol radiometer, with the initial launch planned in 2023.

CGMS-48-EUMETSAT-WP-09: EUMETSAT report on the status and plans of its scatterometer programme

EUMETSAT currently operates three ASCAT scatterometers on the EPS/MetOp satellite series. In parallel, three new and improved scatterometer instruments are designed and built as part of the EPS-SG/Metop-SG programme. In summary, those instruments will provide operational ocean surface wind, sea ice and soil moisture data for a range of several decades.

Whilst the main focus of EUMETSAT is on the calibration/validation of the Level-1 backscatter data, and on the evolution of the Level-1 products, higher level products are provided by the EUMETSAT's satellite application facilities (SAFs): OSI SAF (winds and sea ice parameters) and H SAF (soil moisture).

EUMETSAT provides NRT data in support of NWP as well as reprocessed time series for climate applications, taking into account user priorities as necessary. Of main importance in this context are: 1) temporal coverage and timeliness; 2) coastal winds, where most activities take place; 3) extreme wind events (e.g. tropical cyclones/hurricanes), to prevent damage/casualties, and 4) intercalibration and standards for ease of access/efficiency.

7.3 Wrap-up, conclusions, actions/recommendations, HLPP impact

The WMO gap analysis and the CGMS risk analysis of the CGMS baseline capture the current status of CGMS scatterometer contributions towards the WIGOS Vision 2040. There are options to coordinate and optimise these missions, which could be addressed by a task team. Important is also to make the best use of the existing constellation, including e.g. cross-calibration, this could equally be addressed by the same task team. The proposal would be to involve the CGMS International Winds Working Group (IWWG), establish Terms of Reference, and to develop a roadmap for the work, for CGMS-49 endorsement.

ISRO pointed out the need to optimise and plan for a constellation that meets the objective of a 6-hourly coverage. As for intercalibration, it was noted that CEOS WGCV also addresses this aspect.

NOAA noted that all CGMS members are CEOS members and therefore questioned the need for another coordination/task group. However, a number of these aspects are not covered by CEOS, and CGMSSEC added that the task team would need to report to both CEOS and CGMS. There is a need for stronger user agency views since CEOS is more research driven and operational matters, like data formats and delivery, fits better with CGMS. The task team shall be composed of both CEOS and CGMS representatives and shall focus on the user aspects and any reports shall also be made available to the virtual constellation.

EUMETSAT proposed, and CGMS-49 plenary concurred, that Ad Stoffelen from KNMI, The Netherlands, (and strongly involved in the EUMETSAT OSI SAF) will lead this activity.

| CGMS-48 a | CGMS-48 actions – Plenary Session | | | | | | | | |
|-----------|-----------------------------------|----------|--|----------|--------|--|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | | |
| | item | | | | | | | | |
| CGMS | 7.3 | A48.09 | CGMS members to provide point(s) of contact to be part | 20 Dec | OPEN | | | | |
| members | | | of the SCAT task team (together with Ad Stoffelen, | 2020 | | | | | |
| | | | OSVW-VC (Co-chairs Paul Chang/NOAA, Raj Kumar/ISRO, | | | | | | |
| | | | Stefanie Linow/EUM), and IWWG (Co-chairs Regis | | | | | | |
| | | | Bordes/Steve Wanzong), | | | | | | |
| SCAT | 7.3 | A48.10 | SCAT task team to present the Terms of Reference, and | CGMS-49 | OPEN | | | | |
| task | | | roadmap for the work to CGMS-49 plenary for | | | | | | |
| team | | | endorsement | | | | | | |

As for the HLPP the following targets were introduced:

- Under 1.2: Work towards optimising the distribution of planned scatterometer missions across different polar and inclined non synchronous orbits to achieve the 6 hour sampling requirement of the WIGOS and resolve diurnal variations measurements meeting the WIGOS requirements, resolving the better the diurnal cycle and with coordinated calibration and processing;
- 3.12: Improve acquisition, access to and exchange of near-real-time scatterometer data, share access to calibration and validation information across CGMS agencies, and make available results of NWP impact assessment studies; and
- 4.1.6: Establish mechanisms for the cross-calibrating scatterometers across the vector products across the constellation scatterometer.

8. HLPP - ENDORSEMENT OF THE CGMS HIGH LEVEL PRIORITY PLAN (HLPP) 2020-2024

CGMS-48-CGMS-WP-15: Revised HLPP 2020-2024 - for plenary endorsement

As part of the agreed revision cycle for the CGMS High Level Priority Plan, this document presents a proposed HLPP covering the period 2020-2024. The plan is based on the following intersessional activities:

- Recommendations from of WG-I, -II, -III and -IV as well as SWCG;
- Meetings of the International Science Working Groups;

together with any considerations resulting from plenary discussions. WG-I, -II,-III and -IV, as well as SWCG considered the draft revision at the WG meetings on 25-29 May 2020 and proposed a number of amendments, all highlighted in the revised HLPP. The structure of the document has been amended to better reflect the integration into CGMS of activities related to monitoring of climate including greenhouse gases and of space weather.

The proposed revision had been distributed to CGMS members prior to CGMS-48 plenary enabling them to provide any final comments to CGMSSEC by 12 August 2020.

CGMS-48 plenary endorsed the revised HLPP covering the period 2020-2024 and the CGMS Secretariat will published the new version on the CGMS website following the meeting.

9. AOB AND CLOSING SESSION

9.1 Any other business

Being the last plenary session of Mr. Alain Ratier, EUMETSAT Director-General and Head of the CGMS Secretariat, CMA (including a video message from Dr. Jun YANG, Director-General of CMA/NSMC), CNES, JMA, NOAA, ROSHYDROMET, and WMO sincerely thanked Mr. Ratier for his significant contributions to CGMS over the years both on a bilateral and multilateral basis. Moreover, the fact that he has always emphasised the importance of the satellite community for the benefit of the global users.

9.2 CGMS-49 in 2021

CMA confirmed it will host CGMS-49 in 2021.

9.3 Closing remarks

The co-chairs thanked everyone for their contributions and looked forward to – as far as is possible – a CGMS-49 plenary face-to-face meeting. Until then, the CGMS flag will remain in China.



WG I AND JOINT WGI-WGIV REPORTS

Chair: Vanessa Griffin (NOAA)

Rapporteur: Sean Burns (EUMETSAT)

1. Welcome and review of agenda with objectives of the meeting

WGI reviewed and adopted the draft agenda proposed by the CGMS Secretariat prior to the meeting, which is in line with the Terms of Reference for WGI.

WGI included representatives of the satellite operators from CMA, EUMETSAT, IMD, ISRO, JMA, KARI, KMA, NASA, NICT, NOAA, ROSHYDROMET and WMO (see CGMS report for full list of participants).

The WGI meeting was extraordinarily conducted by WebEx.

In view of the common items of interest in relation to Space Weather, the representatives of WGI, WGIV and the Space Weather Coordination Group participated in the joint WGI-WGIV-SWCG meeting.

Additionally a joint WGI and WGIV meeting took place covering Global coordination on handling future large data volumes and associated data circulation, Global or inter-regional data circulation and access, and Cloud Services interoperability.

1.1 Election of WGI Co-chair

There remains a vacant position for Co-Chair of WGI. CGMS Members are requested to provide nominations to the CGMS Secretariat.

| CGMS-47 actions – WGI | | | | | | | | |
|-----------------------|------|---------|---|----------|--------|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | |
| | item | | | | | | | |
| CGMS | 1.1 | | CGMS Members are requested to provide nominations | August | OPEN | | | |
| Member | | | to the CGMS Secretariat for the position of Co-Chair of | 2020 | | | | |
| | | | CGMS Working Group I | | | | | |

2. Review of actions and recommendations from previous meetings and status update

WGI discussed the actions and recommendations from previous CGMS plenary sessions (CGMS-47 and earlier) and the final status is provided in Annex II of this report.

3. Frequency Management matters (incl. space weather matters)

3.1 Frequency management topics and WRC-19 preparation status

CGMS-48-CGMS-WP-04: Report from the CGMS/SFCG Liaison Officer

This document provides a report from the CGMS/SFCG Liaison Officer on the discussions and outcome of SFCG-39 (1 – 8 July 2019, Berlin, Germany) on frequency matters of mutual interest/concern, namely:

- WRC-19 issues of mutual interest/concern to SFCG and CGMS;
- Databases SFCG Remote Sensing Disaster Database (RSDD) and IEEE GRSS Database;
- Space weather observations using radio frequencies;
- RFI to EESS(passive) sensors and interference reporting;
- Optimisation of the use of the S-band (2025-2110 MHz and 2200-2290 MHz;
- SFCG-Recommendations related to the new EESS uplink allocation in 7190-7250 MHz.

Furthermore, information was also provided on consequential/resulting activities in WMO Steering Group for Radio Frequency Coordination (SG-RFC), on issues of relevance to CGMS.

CGMS was invited to note this report and to provide feedback and information on its activities to SFCG-40 (deferred from September 2020 to September/October 2021 due to the COVID-19 pandemic) on any frequency related matter as appropriate.

CGMS-48-CGMS-WP-05: Outcome of WRC-19 and outlook to WRC-23

The World Radiocommunication Conference 2019 (WRC-19) took place in Sharm el-Sheikh, Egypt, from 28 October to 22 November 2019 with the participation of more than 3400 delegates. The conference discussed and concluded upon quite a large number of agenda items of interest to CGMS members.

Almost all of them were positively concluded with regard to the current and future use of meteorological and Earth-exploration satellite systems. In particular, WRC-19 outcomes ensure continued adequate protection of measurements by scatterometers and altimeters operating in the 5 GHz range (agenda item 1.16), and adequate operational conditions for Data Collection Systems (DCS) from polar and geostationary orbits (agendas item 1.2).

The outcomes of WRC-19 ensure continued or improved protection of passive microwave measurements from in bands from 31.3 to 92 GHz and even up to 450 GHz that are adjacent to or overlapping with bands used or considered for use by fixed, mobile and fixed satellite services (agenda items 1.6, 1.13, 1.14, 1.15 and 9.1.9).

The outcome of WRC-19 was less satisfactory as regards the limits set to unwanted emissions from IMT-2020/5G systems operating in the 25.5-27 GHz band into the adjacent 23.6-24 GHz band used by passive microwave measurements (agenda item 1.13). Here especially the interim limits, applicable until 1 September 2027 are considered too relaxed for adequate protection of passive sensors and the period is too long, as mass-market deployment of IMT-2020/5G is expected for 2024/2025. In the light of this

outcome of WRC-19, the actual IMT-2020/5G deployment in the 26 GHz band and its impacts on passive microwave measurements needs to be monitored.

Furthermore, WRC-19 and did not agree on global regulations to protect Earth stations that receive meteorological and Earth-exploration data in the band 25.5-27 GHz (agenda item 1.13). Such measures were considered a national issue and decisions on how to deal with the protection of Earth stations was left to the individual countries.

The agenda for WRC-23 contains again a number of items of interest to CGMS but without similar severe threats as at WRC-19, at this point in time. However, the preparatory works at regional and ITU-R level needs to be carefully followed with the same level of involvement of CGMS member agencies as for WRC-19.

CGMS-48-WMO-WP-03: Review and updating of information on frequency plan of meteorological satellites in OSCAR/Space

In 2012, WMO was requested by CGMS to act as repository of information on the frequency plan of meteorological satellites. A comprehensive template for submitting information was agreed in cooperation with experts in charge of frequency management. The information is maintained in OSCAR/Space (see https://www.wmo-sat.info/oscar/spacecapabilities). This working paper informed CGMS about the status of information on the frequency plan of meteorological satellites in OSCAR/Space and the need to update this information.

In the first few years, despite some difficulties due to the complexity of the template, the flow of information was sufficiently satisfactory. However, with elapsing time, the information flow has become more irregular and inaccurate and much of the frequency information is therefore outdated.

For WMO to maintain the frequency information in OSCAR/Space it is necessary to receive the appropriate information accurately, complete and timely.

This document therefore aimed at re-establishing the quality level of the frequency information recorded in OSCAR/Space, with an associated action.

It was discussed whether or not to continue to make publically available in OSCAR/Space, frequency information on frequency bands for exchanging data between the satellite and the ground (or between satellites), i.e. TLC links, as these are not required for Microwave instrument and measurement gap analysis for ensuring global long-term continuity/contingency.

CGMS uses the information on TLC frequency use in OSCAR/Space to be informed about the satellite status of current, future and R&D satellites, hyperlinked from the corresponding CGMS website area "satellite status". Thus, this information serves CGMS as an important repository for long term planning and coordination of the frequency band use for TLC purposes. To avoid potential misuse/misinterpretation of information outside of the meteorological community (for example for judging about the density of use of the bands as an argument to get access to the band) further discussion will have to take place on how to keep this valuable information available to CGMS members without the

possible threat of misuse/misinterpretation. Noting that SFCG also maintains a non-public database of such frequencies for coordination among SFCG-members only, the issue on how to treat and maintain such information in future requires further discussions in the coming meetings of CGMS and SFCG in close exchange with WMO. For the time being, the status quo is maintained.

CGMS-48-WMO-WP-01: Status of MW frequency recording in OSCAR/Space

The OSCAR/Space database provides, inter alia, information on the frequencies utilised by MW instruments for Earth observation. Detailed information is reported since the early stage of the database within the Instrument descriptive pages. In addition, since a few years, compact information related to frequency protection issues is being added to the satellite descriptive pages. This document provided information about MW frequencies recording in OSCAR/Space. The latest table of MW frequencies used by Earth observation sensors is provided in support of considerations for RF protection.

CGMS-48-WMO-WP-02: Preliminary WMO Position Paper on WRC-23

Attached to this document is the preliminary WMO position on agenda items of the World Radiocommunication Conference 2023 (WRC-23), as prepared by the WMO Steering Group for Radio Frequency Coordination (SG-RFC) at its 2020 meeting, held from 11 to 13 February 2020 (see https://wiswiki.wmo.int/tiki-index.php?page=SG-RFC-2020). Among WRC-23 agenda items, seventeen items are related to frequency bands or issues of prime interest or concern for meteorology and the related fields.

- Agenda item 1.2: International Mobile Telecommunications (IMT)
- Agenda item 1.3: 3 600-3 800 MHz band for mobile service within Region 1
- Agenda item 1.4: High-altitude platform stations as IMT base stations (HIBS)
- Agenda item 1.6: Sub-orbital vehicles
- Agenda Item 1.10: Possible new allocations for the aeronautical mobile service
- Agenda item 1.12: Earth exploration-satellite service (active) around 45 MHz
- Agenda item 1.13: Space research service allocation 14.8-15.35 GHz
- Agenda item 1.14: EESS (passive) in 231.5-252 GHz
- Agenda item 1.16: Earth Stations in Motion (ESIMs)
- Agenda item 1.17: Intersatellite links in specific frequency bands
- Agenda Item 1.18: Potential new allocations to the MSS
- Agenda item 7: Satellite regulatory procedures
- Agenda item 9.1a): Space weather sensors
- Agenda item 9.1b): Amateur service and amateur-satellite service allocations
- Agenda item 9.1c): Study use of IMT for fixed wireless access
- Agenda item 9.1d): Protection of EESS (passive)
- Agenda item 10: Preliminary agenda for WRC-27

This document reflects the WMO position as of 6 April 2020 and is expected to be further refined prior to the 72nd session of the WMO Executive Council, which is set to be rescheduled later in 2020.

| CGMS-48 ACTIONS - WGI | | | | | | | | |
|-----------------------|------|---------|--|----------|--------|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | |
| | item | | | | | | | |
| CGMS | WGI/ | WGI/A | WG I to review the status of information on the | CGMS-49 | OPEN | | | |
| Members | 3.1 | 48.1 | frequency plan of meteorological satellites recorded | | | | | |
| | | | in OSCAR/Space and to provide guidance and a plan | | | | | |
| | | | for updating the missing and outdated information as | | | | | |
| | | | identified in CGMS-48-WMO-WP-03 | | | | | |
| CGMS | WGI/ | WGI/A | CGMS is invited to review the preliminary WMO | CGMS-49 | OPEN | | | |
| Members | 3.1 | 48.2 | position paper and to assist in making this | | | | | |
| | | | information known to its members' national and | | | | | |
| | | | international preparation processes for WRC-23 | | | | | |

| CGMS-48 RECOMMENDATIONS - WGI | | | | | | | |
|-------------------------------|------|---------|---|-------------------|--|--|--|
| Actionee | AGN | Action# | Description | Status | | | |
| | item | | | | | | |
| CGMS | WGI | WGI/R | CGMS member agencies to monitor the actual IMT- | Review at CGMS-49 | | | |
| Members | /3.1 | 48. | 2020/5G deployment in the 26 GHz band and its | | | | |
| | | | impacts on passive microwave measurements and | | | | |
| | | | inform WGI as appropriate. | | | | |

3.2 Frequency-related topics in support to space weather

No specific papers were presented under this item, however this was addressed in the previous section.

- 4. Meteorological satellites space to ground interface (Direct Readout) and LHRIT global specification (CCSDS based) and best practices for direct readout processing
- 4.1 CGMS agency best practices in support to local and regional processing of LEO direct broadcast data

CGMS-48-CGMS-WP-06: Update of CGMS agency best practices in support to local and regional processing of LEO direct broadcast data

The endorsed CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data is now available as a CGMS document. It is located on the CGMS home page under Publications -> Best Practices.

This paper presents ongoing work and potential evolutions of the CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data.

Manufacturers and operators of Direct Broadcast reception stations for the polar orbiting satellites critically depend on support from the satellite operating CGMS agencies. This includes the provision of technical specification of the Direct Broadcast, TLE orbit information, software packages for product processing, auxiliary operational data for instrument processing as well as operational coordination.

The paper has been written in coordination with all CGMS members via dedicated Inter-sessional meetings held after CGMS 47.

Two updates to existing best practices were proposed for endorsement by Plenary:

- BP.04 Provision and maintenance of Product Processing software packages aiming at minimising the impact of direct broadcast downlink or reception degradation:
 - Each LEO satellite operator should therefore ensure that the product processing software is robust against sporadically missing data packets from the instrument or satellite in the sense that the software limits the extent of degraded or lost observations in the generated product(s) to the minimum possible.
- BP.09 Satellite Direct Broadcast and Reception Station Performance Requirements. The required G/T value updated with the value planned for the JPSS and EPS-SG direct broadcast, namely 22.7 dB/K. Change the allocation for reception station losses, rain and atmospheric losses, and link budget margin from 7.05 dB to 8.55 dB.

A new Best Practice was proposed for endorsement by Plenary:

- BP.10 Monitoring of the Direct Broadcast Downlink, with the following content summary:
 - Operators of satellites with DB should routinely monitor the quality of the DB downlink and address any anomalies in accordance with each organisation's established procedures, and notify users of degraded performance.
 - Monitored signal quality parameters should include receive signal strength, signal to noise ratio, spectral power distribution, and carrier, bit and frame lock statistics.
 - Monitored data quality parameters should include discarded frames and packets, missing frames and packets, and frames and packets with bad length or sequence errors.

The following papers presented the status of implementation of the CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data:

https://www.cgms-info.org/index .php/cgms/page?cat=PUBLICATIONS&page=CGMS+best+practices

CGMS-48-CMA-WP-04: Implementation of CGMS best practices for LEO direct broadcast data at CMA

This paper presents status of implementation at CMA for each of the FY-3D and FY-3E LEO satellite missions.

CGMS-48-EUMETSAT-WP-03: Implementation of CGMS best practices for LEO direct broadcast data at EUMETSAT

This paper presents status of implementation at EUMETSAT for each of the Metop and Metop-SG LEO satellite missions.

CGMS-48-NOAA-WP-03: Implementation of CGMS best practices for LEO direct broadcast data at NOAA

This paper presents status of implementation at NOAA for the NOAA-15, NOAA-18, NOAA-19, S-NPP, and NOAA-20 missions.

CGMS-48-EUMETSAT-WP-15: Future direct broadcast data rates from polar orbiting satellites

In response to the continuous increase in instrument data rates, a migration from L-band (1.8 GHz) to X-band (7.8 GHz) based direct broadcast is currently ongoing. However, even while this migration is still ongoing, indications are that the latest generation of satellites is gradually reaching the limits of the current conventional design of the direct broadcast downlink in X-band.

With the potential of even higher data rates from future polar orbiting satellites, this working paper outlined a number of elements that could be considered in addressing and preparing for higher direct broadcast data rates. As the feasibility and implications of these elements have not been established, they do not form recommendations, but are presented for further study and evaluation by the agencies.

- Simultaneous use of RHCP and LHCP
 - One potential way to increase the capacity of the direct broadcast is to make simultaneous use of RHCP and LHCP, where current practice is to make use of only one of the two.
- Use of band 8025-8400 MHz (width 375 MHz) in addition to the 7750-7900 MHz band (width 150 MHz)
 - It is to be noted that the band 8025-8400 MHz is already heavily used by more than 100 satellite systems, with a trend of each satellite using a large bandwidth. The initial impression is that it would appear more attractive to focus on the best possible use of 7750-7900 MHz band, which is allocated to the meteorological satellites in the downlink direction by ITU Radio Regulations.
- Coding and Modulation
 - The choice of the coding and modulation scheme for the direct broadcast has typically been conservative, mainly to keep the reception equipment simple and affordable. It would, nevertheless, be worth reviewing the situation as several new schemes have been added to the standards. This could include variable and adaptive coding and modulation.
- Multi-beam design
 - An element in the continued increase in data rate capacity of the general purpose
 telecommunication satellites has been a move away from large footprint antennae to multibeam designs, where the individual beams cover a smaller geographic area. It permits
 focusing power and data rate over areas where actually needed, rather than across a wide
 footprint. Technically, it would require knowledge of the positions of acquiring reception
 stations.
- Improvements to the Direct Broadcast Reception Stations
 - Potential improvements to the direct broadcast reception stations design that would improve the overall link budget could be considered.

Additionally a number of options that could studied and considered in more detail to limit the increase in payload data to be accommodated in the X-band direct broadcast.

Multi-satellite constellation

- Although outside the scope of the present work and mainly driven by other design considerations, the distribution of the instruments on multiple satellites does contribute to reducing the data rate in the X-band direct broadcast, as each satellite has its direct broadcast downlink.
- The EUMETSAT Metop-SG satellite under preparation is an example of a two-satellite constellation with Metop-SG A and Metop-SG B having different instruments and each satellite having an 80 Mbps X-band downlink.

- Selection of Instruments

• Inclusion of in X-band direct broadcast only of instruments of prime interest to local and regional users and for which a supported product processing package is foreseen.

- Subset of an instrument data

- When an instrument is of interest to local users, but the full instrument data rate cannot be accommodated of the X-band direct broadcast downlink, a subset of instrument channels or pixel resolutions could be selected.
- Lossless compression of instrument data
 - Lossless compression of high spatial resolution image data might be a preferable alternative to providing subset of the image instrument data.
- Lossy compression of hyperspectral sounder data
 - Well established methods based on Principal Component scores exists for compressing hyperspectral sounder data. Provides a high compression ratio and small losses. Compression could be at the level of interferograms or at the level of the spectral channels.

It is proposed to continue the discussion of the elements that could be considered in addressing and preparing for higher direct broadcast data rates.

It is furthermore proposed to detail a set of studies to be performed by the agencies on the mechanisms that could be used to address higher data rates from polar orbiting meteorological satellites. The CGMS agencies were invited to contribute to these studies, either as a lead entity or in support.

| CGMS-48 ACTIONS - WGII | | | | | | | | |
|------------------------|-------------|---------|---|----------|--------|--|--|--|
| Actionee | AGN item | Action# | Description | Deadline | Status | | | |
| CGMS | WGI/ | WGI/A | CGMS Direct Broadcast operators to consider if the | CGMS-49 | OPEN | | | |
| Members | 4.1 | 48.3 | installation of processing S/W packages can be made | | | | | |
| | | | more user friendly and if there is a potential for | | | | | |
| | | | standardising the approach, considering the available | | | | | |
| | | | methods and tools and report to WGI | | | | | |
| DB Sub- | WGI/ | WGI/A | DB Working Group to agree a set of studies to be | CGMS-49 | OPEN | | | |
| Group | 4.1 | 48.4 | performed by the CGMS agencies on the mechanisms | | | | | |
| | | | that could be used to address higher data rates from | | | | | |

| CGMS-48 | CGMS-48 ACTIONS - WGII | | | | | | | | |
|----------|------------------------|----------|--|----------|--------|--|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | | |
| | item | | | | | | | | |
| | | | polar orbiting meteorological satellites. The CGMS | | | | | | |
| | | | agencies are invited to contribute to these studies, | | | | | | |
| | | | either as a lead entity or in support. | | | | | | |

4.2 Development of efficient standardised data handling for high-resolution imaging and hyperspectral instruments

CGMS-48-CGMS-WP-08: Review of status and Terms of Reference of Task Force on Satellite Data and Codes

The CGMS Task Force on Satellite Data and Codes was established by CGMS in 2007 in response to the need for an expert body to coordinate activities on data formats between agencies and to support the work of WMO's expert teams working on format topics.

The Task Force had its first meeting in 2008 during which the Terms of Reference were refined.

In the meantime, the Task Force has continued to operate on a correspondence basis. The WMO expert teams routinely seek the confirmation of the Task Force that proposed data format changes are appropriate from the satellite community's perspective.

This paper recalls the current Terms of Reference and Membership of the Task Force and asks Members to update their nomination of participating experts.

| CGMS-48 ACTIONS - WGII | | | | | | | | |
|------------------------|------|----------|--|----------|--------|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | |
| | item | | | | | | | |
| CGMS | WGI/ | WGI/A | CGMS Members are asked to update their nomination of | August | OPEN | | | |
| Members | 4.2 | 48.5 | experts to participate in the Task Force on Satellite Data | 2020 | | | | |
| | | | and Codes in coordination with WGIV | | | | | |

CGMS-48-CGMS-WP-07: Report on activities in Climate and Forecast (CF) conventions regarding space data products

A WG-I liaison between CGMS and the governing bodies of the netCDF Climate and Forecast (CF) Conventions actively represents the interests of CGMS members within the CF community. The key developments that have taken place in this regard over the past year were:

- Support for the use of hierarchical groups in netCDF-4 data products;
- Clarification of the use of geostationary projections;
- Stronger collaboration between CF and WMO;
- Enhancement of the capabilities of implementing changes to the CF Conventions in a timely fashion.

In addition to presenting the details of these steps, areas to focus on until CGMS-49 were proposed, which should be coordinated in the interim with the participants of the intersessional meetings on data formats and formatting standards. These are:

- Collaboration between WMO and CF. Previous to CGMS-48, a meeting took place between represents of the WMO and CF Communities. At this meeting a mailing list was established to facilitate collaborative discussions between WMO, the CF Governance Panel, and interested parties. Outputs of these discussions has fed into discussions at WMO and proposed Terms of Reference for an Expert Team that should between WMO and the CF Community. This activity should continue to receive support from CGMS, as ensuring the beneficial evolution of both bodies of standards will provide value to CGMS members.
- Standardisation of subsampled coordinates. Several approaches are used by CGMS members to reduce the volume of data products by providing a subset of the full set of coordinates needed to geolocate all observations within a data product. Work has been initiated to standardise these approaches within CF, and CGMS should participate in this process in order to ensure an outcome that is beneficial to both producers and users of such products.
- New data types. Further progress is needed on data types that are available as part of the netCDF-4 specification, such as strings and enumerated values.

WGI welcomed the work that had been performed in this area.

5. Data collection systems

5.1 DCS sub-group reports

CGMS-48-CGMS-WP-09: Report from CGMS DCS sub-group

At CGMS-46, WGI endorsed the proposal for the creation of a Data Collection Service (DCS) sub-group dedicated to DCS activities. The main purpose of the group was to make more effective progress with DCS activities and issues in the context of CGMS. The first task of the group has been to address the need for and make proposals for a new IDCS DCP standard, the development of DCS best practices for DCS data access and for DCP certification, as well as the inclusion of CGMS DCS webpage.

The DCS sub-group, consisting of DCS Managers from each of the satellite operators, have met virtually as part of the WGI Intersessional meetings, but also face-to-face in the context of other already scheduled DCS-related meetings. The last face-to-face took place in Boston as part of the AMS on 30 September and 1 October 2019.

This paper presents the status of the DCS sub-group activities and progress since CGMS-47. This has included the publication of a DCS Handbook:

(https://www.cgms-info.org/documents/DCS Handbook 1Mar2020.pdf).

The CGMS Best Practice for DCS data access has been rewritten taking into account the comments during CGMS-47 and was proposed for endorsement at CGMS-48.

The discussions of the Enhanced DCP (E-DCP) standard have continued and is a major topic for the subgroup. The draft Enhanced DCP (E-DCP) document has now been created describing possible application areas, user requirements and technical specification, initially based on ESA study. This document will be the basis for finalising the new standard, which could then by endorsed by CGMS. This 'true' international DCP that could be used on either EUMETSAT, NOAA or JMA satellites, and possibly other agencies operating DCS. Several questions still need to be addressed, including how the development of this standard will be funded, and which bandwidth could be used and selection of the target use. There is a lot of interest in the development of this new standard and a group of the interested parties were identified that could contribute to the formulation of a new standard. The DCS sub-group will, in collaboration with interested parties, elaborate the user requirements, the technical specifications, potential applications also taking into account the Small Sat experiments, which are being coordinated by NOAA. The group also considered the use of a standard format, this will be further analysed and added to the new DCP standard.

It is expected that the DCS-sub group will have a face-to-face meeting during the Satcom Forum 2021 at the Meteorological Technology World Expo 2021.

WGI welcomed the work that had been performed by the DCS Sub Group.

| CGMS-48 ACTIONS - WGII | | | | | | | | |
|------------------------|------|---------|---|----------|--------|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | |
| | item | | | | | | | |
| DCS Sub- | WGI/ | WGI/A | To coordinate the elaboration of the user | CGMS-49 | OPEN | | | |
| Group | 5.1 | 48.6 | requirements, the technical specifications, and | | | | | |
| | | | potential applications for a new DCP Standard and | | | | | |
| | | | make a proposal to WGI also to include a section on | | | | | |
| | | | DCP formats into the E-DCP Specification | | | | | |

CGMS-48-NOAA-WP-02: Report and status of the small satellite DCS use concept validation project

The basic concept of the Satellite DCS Use Concept Validation project, is to enable satellites, typically LEO smallsats, to interface with DCS Receivers and thus provide a low rate data (300 or greater bps) service to satellite users; primarily to assist in launch, early orbit, and anomaly (LEO&A) operations. Satellite DCS users are good candidates for using the relatively underutilised international DCS channels (iDCS). The IDCS is designed to allow use between the various DCS receivers (i.e. GOES, METSAT, HIMAWARI), so it's well suited for using with satellites and current regional DCS users won't be crowded. It is expected that using DCS may assist in minimising the risk of interference but will not eliminate it. Additional regulatory controls and protections will continue to be needed as well.

The project is designed to be carried on two hosted satellites. The first hosted payload will be focused on demonstrating that the concept of satellites using the DCS is valid. The second hosted payload will focus

on operational considerations, primarily can a satellite use the DCS at any time and access any subscribed DCS (i.e. EUMETSAT, NOAA, JMA).

While risk reduction was the original driver in identifying the opportunity, additional benefits have also been identified.

- 1. Increased use of the International channels, which are currently underutilised.
- 2. Low cost enablement of scientific, educational, and development satellite low data rate communications to respective mission centers.
- 3. Ability to enable LEO&A during clustered deployments.
- 4. Projected demand for enabling the two-way communications capabilities of the DCS.
- 5. Demonstrated continued efforts by NOAA/NESDIS to facilitate good spectrum stewardship and efforts towards responsible sharing of spectrum resources.

WGI noted the progress of the Project and looked forward to seeing the outcome of the experiment.

CGMS-48-CGMS-WP-11: Proposed Best Practices for DCP data access

A set of proposed Best Practices on DCS data access was presented and reviewed by WGI at CGMS-47 (CGMS-47-CGMS-WP-17). This paper presents an updated version of the full set of Best Practices on DCS data access, which has taken into account the feedback from CGMS-47.

Most Satellite Operators provide several mechanisms for DCP Operators to access their own DCP data, including:

- the WMO GTS;
- satellite dissemination either via the operator's own Meteorological Satellite, and/or via a commercial satellite telecom provider;
- the Internet.

This first version of the Best Practice focuses on the provision of DCS data via the Internet. The access to DCS data via the Internet crucially depends on support from the CGMS agencies operating DCS. This includes the provision of the technical specification of DCP standards, the division of the DCP bandwidth and the recognised and agreed usage by the operational agencies, as well as operational coordination.

There is currently no standard global specification for the access to DCS data via the Internet. This has caused issues for the users when operating systems from different agencies and manufacturers when delivering solutions to the users. Rather than provide a specification, a more pragmatic way forward is to develop Best Practices, which would form a basis for the Satellite Operators to offer DCS solutions that allow the DCS Data Users, DCP Operators and the DCP Transmitter Manufacturers to make the most effective use of the system.

The proposed Best Practices on DCP data access can be found in Annex A of the working paper.

5.2 Operational DCS systems – agency reports

CGMS-48-CMA-WP-05: CMA DCS status report

The paper is an update on the Chinese Data Collection System of meteorological satellites along with DCP technical descriptions. Currently the FY-4A at 104.7°E is used operationally for DCS. It has 433 channels composed of 400 HDCP channels (750 Hz spacing/600 bps) and 33 international channels (3 KHz/100 bps). The Chinese DCS is based on an approach of FD (Frequency Division) with the combination of TD (Time Division). The FY-4A DCS is operated by NSMC (National Satellite Meteorological Center) which is one of the operational units of China Meteorological Administration.

Currently there are 52 HDCPs deployed within China territory.

CGMS-48-EUMETSAT-WP-02: EUMETSAT DCS status report

This paper presents the status of the EUMETSAT Data Collection Services (DCS) currently supported by Meteosat-11 at 0° and Meteosat-8 at 41.5°E IODC (Indian Ocean Data Coverage). Included are details of channel utilisation, DCP allocation, geographical distribution and DCP data dissemination mechanisms.

The DCS is one of the core services operated by EUMETSAT in support of meteorology and weather prediction. It serves an important role in enabling data collection platform (DCP) operators to use the Meteosat system to receive environmental data collected from DCP platforms.

EUMETSAT DCS, initially established with the first generation of Meteosat satellites (MFG) in 1977, has continued and expanded with Meteosat Second Generation (MSG), and will also be embarked on the future Meteosat Third Generation (MTG).

The EUMETSAT DCS currently supports both standard-rate (100bps) and highrate (1200bps) DCPs. The high-rate (HRDCP) has improved capabilities and can be used for application such as warnings of potentially devastating natural phenomena such as tsunamis. The prime IODC application is for the Indian Ocean Tsunami Warning Network (IOTWS). As of 31 March 2020, there are 137 DCP operators located in 76 countries (Europe, Africa, Asia). There are a total of 1517 DCPs allocated, with 410 actively transmitting. Out of these 144 are HRDCPs (119 supported by Meteosat-11 at 0° and 25 by Meteosat-8 at 41.5°E). The remaining 1373 are standard rate DCPs (1225 supported by Meteosat-11 at 0° and 148 by Meteosat-8 at 41.5°E). Since March 2019, 27 new DCPs have been assigned (3 of them HRDCP). The EUMETSAT DCS has a typical reliability greater than 99%.

CGMS-48-ISRO-WP-02: ISRO DCS status report

Data Relay Transponder (DRT) payload is currently available on 3 Indian satellites – INSAT-3D, INSAT-3DR and GSAT-17, which provides uplink facility at 402 MHz with global coverage and downlink at 4503 MHz with coverage over India. DRT are supporting 125 PRBS, 560 AWS and 1350 ARGs of Indian Meteorological Departments, 592 terminals of Central Water Commission, 95 terminals of Snow and Avalanche Study Establishment, 83 terminals of the state of Andhra Pradesh, 10 ARGS of TIFC, and ~1187 AWS of ISRO.

ISRO AWS provide half-hourly measurements of surface temperature, pressure, humidity, wind speed and direction, precipitation and sunshine. ISRO's present AWS are uplinked to DRT, but additional capability of transmitting data through GSM/GPRS is under consideration. At present 30 of these AWS are taken up for GSM/GPRS compatibility for data transfer. IMD is planning to add 550 AWSs and 2000 ARGs, and CWC is planning to add about 2000 terminals of water resource monitoring.

CGMS-48-JMA-WP-02: Himawari-DCS's international contributions to disaster risk reduction

The Japan Meteorological Agency (JMA) has operated the Data Collection System (DCS) since its first Geostationary Meteorological Satellite (GMS) went into operation in 1978. The system plays an important role in collecting meteorological information as well as seismic intensity and tidal/tsunami data collaborating with the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS). In Japan, more than 400 DCPs collect seismic intensity data. The Himawari-8 DCS has been operational since July 2015, and it is planned that Himawari-9 will take over the DCS service in 2022 and continue in this role until 2029. JMA has no plans to change the specifications of the Himawari-8/9 DCS. The Agency is considering the Himawari-8/9 follow-on program that will replace Himawari-8/9, including the DCS.

CGMS-48-NOAA-WP-05: NOAA DCS status report

The GOES DCS Environmental Data Relay system supports over 659 user agencies, 2,134 individual users operating approximately 40,000 Data Collection Platforms (DCPs). Over 30,000 of these DCP platforms are utilised to collect and transmit data through either a DCS transponder hosted on either the GOES East or West satellite. The DCS Administrative and Data Distribution System is used to manage user channel access for distributing over 8 million observations made through the DCPs.

Key projects and events include the 100 BPS discontinuation, ongoing spectrum challenges, DAMS-NT enhancement project, CS1 to CS2 transition and the DCS two-way communication project.

WGI noted that NOAA is no longer supporting 100 Bit Per Second messages. This change effects data distributed on DADDS, LRGS, HRIT and NWSTG enabled platforms. NOAA are encouraging our users to switch to 300 or 1200 BPS transmitters. The discontinuation of 100 bps message traffic is in accordance with the GOES DCS High Data Rate (HDR) Transition Plan as approved by the 2004 meeting of the Satellite Telemetry Interagency Working Group (STIWG).

CGMS-48-ROSHYDROMET-WP-01: Status of Russian data collection system

This paper presents the current status and technical specifications of the Russian data collection system and related future plans. The DCS is established to provide collection and distribution of meteorological data from the remote areas and to support natural hazards warning system. Roshydromet has developed and deployed the national DCS based on Electro-L series geostationary satellites with a backup option via Luch series communication satellite.

The number of DCPs is now 679 DCPs allocated. DCPs are distributed all over the Russian territory, including 138 DCPs in hard-to-reach areas. The orbital positions of Electro-L N2 & N3 are planned to be changed. Electro-L N3 will be moved to the position of 76°E, and Electro-L N2 will take the position of 14.5°W.

6. System and operations aspects

6.1 Space debris and collision avoidance. Coordination with the IADC

During CGMS-47, it was proposed to form a Task Group on Space Debris and Collision Avoidance to produce a Best Practice on Collision Avoidance, based on papers presented at CGMS-47: CGMS-47-EUMETSAT-WP-15 and CGMS-47-NOAA-WP-10.

WGI considered that the action is still valid and solicited nomination for members from interested Agencies.

| CGMS-48 ACTIONS - WGII | | | | | | | | |
|------------------------|------|----------|---|----------|--------|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | |
| | item | | | | | | | |
| NOAA | WGI/ | WGI/A4 | Form a Task Group on Space Debris and Collision | August | OPEN | | | |
| | 6.2 | 7.09 | Avoidance to produce a Best Practice on Collision | 2020 | | | | |
| | | | Avoidance | | | | | |

7. Implementation of WGI aspects of the global contingency plan (as proposed by WGIII)

The objective of the Risk Assessment Workshop is to:

- Update CGMS Baseline based on member inputs;
- Prepare a consolidated Risk Assessment against the CGMS Baseline;
- Identify contingency actions to be taken, or actions to identify in the High Level Priority Plan;
- Identify ways to integrate satellite data into the CGMS Baseline and characterise CGMS' contribution (e.g., space weather contribution was updated).

The Working Group III held a workshop 19-21 February 2020, hosted by EUMETSAT and attended by Representatives of WGII and Space Weather Coordination Group.

WGI reviewed the draft update of the CGMS Risk Assessment.

CGMS-48-CGMS-WP-12WGI: Draft update of the CGMS Baseline

CGMS endorsed the first CGMS baseline, commitment of observational missions synchronised with the development of the WMO Vision for WIGOS 2040, at CGMS-46 in Bengaluru (ref. CGMS-46 CGMS-WP-04, and -27).

The 2nd CGMS WGIII risk assessment workshop was held in EUMETSAT on 19-21 February 2020 on whose occasion the CGMS baseline and related risk assessment was conducted. The working group reviewed the

CGMS baseline and proposed revisions. The draft text of the second revision of the CGMS baseline is included in this paper.

The text was reviewed by WGI and other WGs during CGMS-48 on 25-29 May 2020, in order to conclude on a final text for endorsement by CGMS-48 plenary on 25-26 August 2020.

Following the CGMS-48 working group discussions, CGMS members are requested to recommend the 2nd revision of the CGMS baseline to CGMS-48 plenary for endorsement (and, at that stage, for WMO to take into account the new baseline in forthcoming updates of the Manual on the Global Observing System and related materials).

CGMS-48-EUMETSAT-WP-04: Coordination of LEO orbits - Outcome of simulations

To maximise the amount of instrument observation collected with the most efficient use of ground station resources, it is beneficial to reduce pass scheduling conflicts through the coordination of the orbital phasing of satellites within and between satellite operating agencies.

A preliminary analysis was provided in paper CGMS-47-EUM-WP-09 which demonstrated the potential benefits of in-orbit coordination, identifying the main drivers and constraints in achieving that goal.

This paper is in response to a WGI action to perform a more detailed analysis consisting of:

- developing a simulation algorithm considering all identified variables impacting the LEO orbit coordination;
- developing plots and other simulation outputs as tools for illustrating the potential coordination;
- possibilities and improvements in both global and direct broadcast mission return.

The goal of the output of this action is to form the basis of a Best Practice on coordination of LEO orbits.

This paper reports on a prototype simulation algorithm, which has been built for assessing in-orbit coordination possibilities and benefits. This can be applied both for future, to be defined missions and for specific, currently defined or operational missions.

The paper recommends that further work should also be performed on the prototype algorithm to provide analysis results for optimising orbital configurations to avoid radio frequency interferences between satellite system operating on multiple orbital planes, where more than one antenna is available at a specific ground station site.

The simulation outputs are also currently rudimentary and should be developed further once the full functional scope of the tool has been defined.

It is therefore recommended that this work be performed prior to the formulation of the foreseen Best Practice. CGMS Members are requested to nominate mission analysis experts to a Task Group, who are then invited to review the Simulation algorithm and outputs for the coordination of LEO orbits at a dedicated Intersessional Meeting to demonstrate the tool. The Task Group would:

- ascertain the applicability to operational and planned missions;
- determine further work required on the prototype simulation tool;
- assess its role in the formulation of a Best Practice on coordination of LEO orbits.

| CGMS-48 A | CGMS-48 ACTIONS - WGII | | | | | | | | |
|-----------------|------------------------|---------------|---|----------------|--------|--|--|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | | | |
| CGMS members | WGI/ 7.1 | WGI/A4 8.7 | CGMS Members are requested to nominate mission analysis experts to a Task Group, who are then invited to review the Simulation algorithm and outputs for the coordination of LEO orbits. The Task Group would: • ascertain the applicability to operational and planned missions • assess its role in the formulation of a Best Practice on coordination of LEO orbits • determine further work required on the prototype simulation tool | August 2020 | OPEN | | | | |

8. Global coordination on handling future large data volumes and associated data circulation

The following papers were presented as part of a joint session between WGI and WGIV, along with papers covering Global coordination on handling future large data volumes and associated data circulation, Global or inter-regional data circulation and access, and Cloud Services interoperability.

CGMS-48-EUMETSAT-WP-05: EUMETSAT new big data services status report

The paper reports on EUMETSAT's progress made towards operational readiness for the Big Data Services via a preceding pilot phase. The status of the related procurements is also presented.

As part of the final phase of implementing the Data Services Roadmap for the new EUMETSAT Big Data Services, in 2020 new operational data access capabilities will be released. During the preceding pilot phase, users are encouraged to explore these new services and provide feedback, which will help shape the service in future. It is envisage that these services become part of the operational data access portfolio between Q4 2020 and Q1 2021. These new Data Services include:

- The Data Store allows the download of EUMETSAT products and data from a central online data repository.
- EUMETView is a visualisation service that allows users to view EUMETSAT imagery in a more interactive and web service based way i.e. Web Map Services.
- The Data Tailor makes it possible for users to subset and aggregate EUMETSAT data products in space and time, filter layers, generate quicklooks, project onto new coordinate reference systems, and reformat into common GIS formats (netCDF, GeoTIFF, etc.). It offers a uniform way to transform both historical and near real-time satellite data provided by EUMETSAT.

- EUMETCast-Terrestrial is the ground-based dissemination mechanism complementing
 EUMETSAT-Satellite utilising both academic and commercial communication links.
- EUMETSAT will also offer the execution of algorithms directly on EUMETSATs data, in order to implement the "users to the data" paradigm, via the provisioning of virtual computational environments that seamless integrate with above mentioned services. This service will be initially restricted to its EUMETSAT NHMSs official duty use.

The paper also addresses the pilot phase of the European Weather Cloud initiative, introducing the overall concepts and arrangements and status of technical activities.

The pilot phase of the European Weather Cloud will validate these arrangements, which will be updated with the received feedback and the gained experience. A notional timeline leading to a potential entry into operations is presented, highlighting the likely need for an extension of the pilot phase, which will be formalised in due course.

CGMS-48-NOAA-WP-04: NOAA experience with implementation of new architecture

In anticipation of developing new Earth observation capabilities in its next-generation architecture, NOAA is relying on its NSOSA study to inform decisions on new platforms, emerging technologies and ideal orbits. NOAA is maintaining our current space capabilities while capitalising on opportunities to augment observations over the next decade in low Earth orbit and replenish observations over the next decade and into the 2030s in geostationary orbit, by exploiting new business models, private sector advances in technology and capabilities of our strategic partners. As part of this effort, NOAA recently awarded contracts to organisations in industry and academia to complete instrument and mission concept studies to inform the future architecture.

9. Any other business

There was no other business discussed.

10. Review and updating of the HLPP

CGMS-48-CGMS-WP-14WGI: Status of implementation of CGMS High Level Priority Plan (2019-2023)

WGI reviewed and provided updates to the HLPP.

11. Nomination and representatives at meetings

No changes were proposed.

12. Date/time of inter-sessional activities/meetings in 2018-2019 [CGMS-47 -> CGMS-48]

The following Intersessional Meetings were defined, meeting at 1200 UTC.

Best Practices for Direct Broadcast NOAA (J. McNitt (NOAA) & A. Soerensen (EUMETSAT):

- June 16 (to complete BP.10 prior to Plenary)
- September 8, 2020
- November 10, 2020
- February 9, 2021
- April 20, 2021

Data formats and formatting standards (Daniel Lee (EUMETSAT)):

- September 23, 2020
- January 27, 2020

Data Collection Systems: (Nick Coyne (EUMETSAT)):

- June 15 2020
- July 27, 2020
- September 14, 2020
- November 2, 2020
- January 18, 2021
- March 1 2021
- April 12 2021

Space Debris and Collision Avoidance Task Group (Scott Leonard (NOAA)

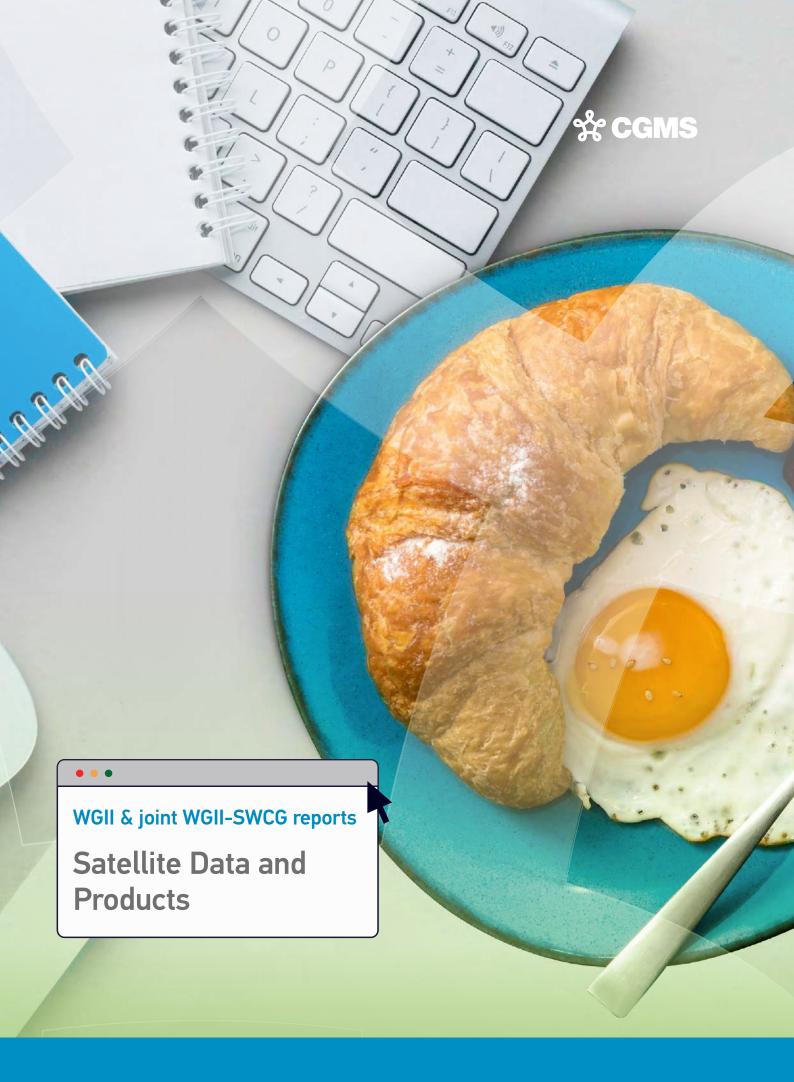
- Dates will be defined following the formation of the Group

Coordination of LEO Orbits Task Group (Andrew Monham (EUMETSAT))

- 15 October 2020
- 10 December 2020
- Meetings in Feb and April dates TBD.

13. Review of actions/conclusions, preparation of WG report for plenary

The summary list of WGI actions and recommendations resulting from CGMS-47 is included in Annex II of this report.



WG II AND JOINT WGII-SWCG REPORTS

Co-chairs: Dohyeong Kim (KMA), Werner Balogh (WMO)

Rapporteurs: Mitch Goldberg (NOAA), Kenneth Holmlund (EUMETSAT)

1. Welcome and opening

The Co-chairs Dohyeong Kim (KMA) and Werner Balogh (WMO) opened the meeting and welcomed all participants for joining the online meeting.

2. Review of actions and recommendations from previous meetings

The Co-chairs reviewed the actions and recommendations from previous meetings. The updates were provided to the CGMS Secretariat.

3. Working papers on international groups/initiatives: IWWG, IPWG, ICWG, ITWG, IROWG, ILSWG, JWGCLIM, WMO, SCOPE CM, ISCCP

CGMS-48-IWWG-WP-01: Status Report of the International Wind Working Group Activities

This working paper reports on the current status of the IWWG actions and recommendations from CGMS-47. Several activities like the adoption of the new AMV BUFR sequence and the definition of common QI process are still ongoing and match very well the HLPPs, aiming to move toward more homogeneity between all the AMV products.

Also, other activities, such as a clearer understanding of AMV requirements for use in Global NWP, Regional NWP and Nowcasting applications, are ongoing. It was foreseen to discuss these activities at IWW15, but the workshop has been unfortunately postponed, potentially until September 2020, due to COVID-19.

The continued success of IWWG is greatly helped by the collaborative projects ongoing within the community, and especially the intercomparison studies. A fruitful collaboration was initiated with the ICWG during the third intercomparison study. Both groups are highly encouraged to continue this collaboration in the future given the number of common scientific questions shared by the two groups.

IWWG also continues to advocate that CGMS agencies provide support for future IWWG workshops, especially IWW15, tentatively scheduled for September 2020, including travel for its scientists to attend and participate in them.

As there has been no Winds Workshop since CGMS-47, there were no new actions or recommendations presented.

CGMS-48-ICWG-WP-01: Status report of ICWG

This working paper presents a summary report of ICWG activities since CGMS-47. The ICWG last met in 2018 in Madison, Wisconsin, USA (ICWG-3) and has not met since CGMS-47.

The ICWG continues to be organised with four semi-permanent sub-working groups (Algorithms, Assessments, Weather Applications and Climate Applications). Within these sub-groups, more transient topical groups are formed to address the relevant issues at the time of the meeting. The formation and retirement of topical groups for ICWG-3 is ongoing.

At the request of CGMS, a topical group was formed focus on application of the geostationary lightning imagers.

Intercomparison of cloud products remain an important activity of ICWG. The ICWG maintains a library of Golden Days that includes SEVIRI and HIMAWARI-8. This library is updated each meeting. The ICWG plans to adopt the same GOES-16 Golden Day as the IWWG. The IWWG will select a Golden Day with good GOES-16/Aeolus comparisons. ICWG seeks guidance in how to support this analysis and its reporting going forward.

The following new Action was raised:

| CGMS-48 ACTIONS - WGII | | | | | | | | |
|------------------------|-------|----------|---|----------|--------|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | |
| | item | | | | | | | |
| ICWG | WGII/ | A48.01 | ICWG to establish a liaison with EUMETSAT | Nov-2020 | | | | |
| | 3 | | Convective Working Group or | | | | | |
| | | | SCOPE Nowcasting. | | | | | |

CGMS-48-IPWG-WP-01: Summary and Highlights from the IPWG

Since CGMS-47, IPWG has worked on the scientific and logistical organisation aspects of the IPWG10 meeting, originally planned for June 2020 in Colorado, as a joint meeting with the IWSSM community, similar to the IPWG8 meeting in Bologna, Italy. To this end, a joint science committee was defined and the abstract submission was opened to both IPWG and IWSSM communities. Between Dec 2019 and mid-February 2020, 125 abstracts have been collected. Unfortunately, the meeting was postponed by of one year due to the COVID-19 situation. The next meeting will be held in June 2021, still hosted by Colorado State University, USA.

Several other steps have also been taken:

- Regarding IPWG validation activities, significant progress has been made with a new validation site over South Korea thanks to KMA's efforts. This new site will be declared operational very soon and linked to the IPWG website. The work on a validation site over India is pending due to the loss of a PoC. IPWG is waiting for a PoC from CMA as well. There is interest from Israel as well.
- Regarding training activities, discussions are ongoing with the Virtual Laboratories to better define
 how IPWG experts could contribute to VLab training activities related to precipitation. A
 teleconference was held in November 2019, to make specific plans for the IPWG10 meeting: a
 plenary session on training, a working group with IPWG and VLab trainers, as well as an interactive
 session on visualisation tools was planned. This will be postponed to 2021 as well.

Despite the postponement of the meeting to 2021, it was found important to hold discussions on several aspects of interest to the IPWG community. Several online meetings will be organised along the year; two first topics have been identified, on the continuity of the passive microwave constellation and on validation. A discussion on the first aspect is being organised and will be held at the end of June 2020.

As there has been no Precipitation Workshop since CGMS-47, there were no new actions or recommendations presented.

CGMS-48-IROWG-WP-01: Report of IROWG Activities: Outcome and Recommendations from the IROWG-7

This report summarises the IROWG-7 meeting held on September 19-25, 2019 in Elsinore, Denmark, in conjunction with the 6th ROM SAF User Workshop. It provides the recommendations from the four IROWG sub-groups: Numerical Weather Prediction; Climate; Receiver Technology and Innovative Occultation Techniques; and Space Weather. The key recommendations for CGMS – endorsed by the IROWG community at the plenary session – are:

- IROWG encourages all providers of RO observations to classify these as essential in the sense of WMO Res 40. IROWG stresses the importance of free and unrestricted access to essential RO data including archived raw data.
- IROWG recommends that WMO and CGMS should co-ordinate any GNSSRO data purchases to avoid duplication amongst agencies. If purchased, the commercial GNSS-RO data should be bought with a world license, so that the data are equally available to all agencies.
- IROWG recommends that GNSS-RO data with at least 20,000 occultations per day are globally distributed and provide good sampling of the diurnal cycle. This is important for NWP, Climate, and Space Weather.

On the issue on assessment of commercial weather data and sharing of such data, WG II felt that whilst co-ordination of data purchases to avoid duplication amongst agencies would be beneficial it will be very difficult to achieve.

It seems unlikely that the target number of 20,000 occultations/day will be met with "agency led" missions in the 2020's. Finally, we encourage more collaboration and exchange of results when assessing the results of commercial data buys.

Full workshop minutes and this CGMS working paper from IROWG-7 are/will be made available at http://irowg.org/workshops/irowg-7/. All given workshop presentations can be found at http://www.romsaf.org/romsaf-irowg-2019/en/.

| CGMS-48 ACTIONS - WGII | | | | | | | | |
|------------------------|------------|----------|---|------------|--------|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | |
| | item | | | | | | | |
| Space Agencies | WGII/ 3 | A48.02 | Data providers to document data processing QC processes (including a month of QC statistics, e.g. | April 2021 | OPEN | | | |

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|------|---------|--|----------|--------|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | |
| | item | | | | | | |
| | | | rejection percentage at each QC step) and space sampling information and provide to IROWG. | | | | |

| CGMS-48 RECOMMENDATIONS - WGII | | | | | | |
|--------------------------------|-------|--------|--|-------------------|--|--|
| Lead | AGN | Rec# | Description | Status | | |
| | item | | | | | |
| Space | WGII/ | R48.01 | IROWG recommends that GNSS-RO data with at | Review at CGMS-49 | | |
| Agencies | 3 | | least 20,000 occultations per day - globally | | | |
| | | | distributed and providing good | | | |
| | | | sampling of the diurnal cycle | | | |

CGMS-48-ITWG-WP-01: Status report of ITWG

This working paper presents a summary of ITWG activities since CGMS-47.

The Twenty-second International TOVS Study Conference (ITSC-22) was hosted by Environment and Climate Change Canada at the Manoir Saint-Sauveur in Saint-Sauveur, Québec, Canada, between 31 October and 6 November 2019. ITSC-22 was attended by 152 participants from 45 organisations, providing a wide range of scientific and technical contributions. The technical program included 16 sessions where 80 oral presentations and 125 posters were presented. ITSC-23 is planned for late 2021.

The ITWG permanent working groups met during ITSC-22 to discuss issues of importance to the satellite sounding and numerical weather prediction communities. The working groups include:

- Radiative Transfer;
- Climate;
- Data Assimilation and Numerical Weather Prediction;
- Advanced Sounders;
- International Issues and Future Systems;
- Products and Software.

The Working Groups reviewed recent progress in the above areas, made recommendations on key areas of concern and identified items for action. These were further reviewed in a plenary session at the end of the conference.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|-------|----------|--|----------|--------|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | |
| | item | | | | | | |
| ITWG | WGII/ | A48.03 | ITWG to send a report demonstrating the value of | CGMS-49 | OPEN | | |
| | 3 | | temperature sounding of the upper stratosphere | (CGMS-48 | | | |
| | | | and mesosphere (as for the SSMIS UAS channels). | Plenary) | | | |

| CGMS-48 R | CGMS-48 RECOMMENDATIONS - WGII | | | | | | |
|-------------------|--------------------------------|--------|---|----------------------|--|--|--|
| Lead | AGN item | Rec# | Description | Status | | | |
| Space Agencies | WGII/3 | R48.02 | On Climate-6 the group recommends satellite agencies to keep and/or establish a 2-satellite configuration for the same sensor in the same orbit (same equator crossing time) to improve the confidence in derived CDRs and to also provide a measure to assess the stability and health of the instruments on the two satellites. | Review at CGMS-49 | | | |
| Space Agencies | WGII/3 | R48.03 | Space Agencies to consider building in as much RFI screening and mitigation into their ground segment processing as possible, noting efforts already starting at ESA and in research groups in the US, Japan and China. | Review at CGMS-49 | | | |
| NASA | WGII/3 | R48.04 | NASA to continue to provide AIRS Aqua data in real-time to NWP centers for as long as calibration of the instrument is possible. | Review at CGMS-49 | | | |
| Space Agencies | WGII/3 | R48.05 | All Agencies to consider to make available full spectral resolution for all bands, e.g. HIRAS. This also applies to all future hyperspectral sounders. | Review at CGMS-49 | | | |

CGMS-48-ISWG-WP-01: Report from International Surface Working Group

The working paper gives an overview of background and activities of The Surface Working Group. The initiative started as a follow-up of a recommendation of the Remote Sensing and Modelling of Surface Properties workshop in 2016. Based on positive feedback and with Sponsorship support from ESA and CESBIO first ISWG Workshop was organised in July 2017 in Monterey, California. A second Workshop was held together with the 8th EUMETSAT LSA-SAF Workshop in June 2018 and followed-by a third Workshop jointly with SnowWATCH-GCW-WMO in July 2019 in Quebec. A fourth Workshop had been planned for September 2020, but has been postponed due to COVID-19.

The ISWG is a coordinated community effort for enhanced use of Earth observations and covers the following Scientific Topics:

- Earth-Observations for Use in Earth Surface Modelling & Data Assimilation: IR/MW active/passive sensors;
- Land Data Assimilation Systems LDASs; Radiative transfers and emissivity/reflectivity models;
 Retrievals of surface biosphere and cryosphere parameters: land surface temperature, soil moisture, snow & ice, albedo, water-body extent;
- Sea surface wind, temperature, salinity;
- Canopy parameters, vegetation water content, vegetation state, surface fluxes.

The ISWG sees its activities a central to CGMS and for the efficient use of operational satellite data. It is therefore proposed the ISWG would become a new CGMS International Science Working Group in parallel to ITWG, IPWG and others under the name of International Land Surface Science Working Group.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|---|------------|---------|---|----------|--------|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | |
| | item | | | | | | |
| Internation al Surface Working Group | WGII/ 3 | A48.04 | International Surface Working Group were asked to report to CGMS-49 with a well-defined draft Terms of Reference of a proposed new International Land Surface Working Group, which could be reviewed by WG II and, if endorsed by CGMS Members, subsequently adopted by the CGMS Plenary. | Nov 2020 | OPEN | | |

CGMS-48-GSICS-WP-01: Report from GSICS EP

The GSICS priorities for 2020 include the 1) release of the GSICS annual state of the observing system report, 2) establishing a partnership with the ISCCP-NG to provide the necessary geostationary intercalibration coefficients required for ISCCP-NG creating integrated seamless geostationary products, 3) Engage WMO WIGOS to coordinate GSICS' contribution to WIGOS for monitoring the performance of the space-based observing system, 4) GSICS review of the Space Weather Task Group's white paper of space weather intercalibration needs and assess whether the GSICS framework is applicable, 5) Approval of the new GSICS data working group chair, Dr. Kamaljit Ray of Ministry of Earth Sciences (MoES) of India, on behalf of IMD. GSICS EP endorsed the use of the 4th quarter GSICS newsletter to be a special issue on the State of the Observing System. GSICS EP will also revisit the roles and responsibilities of the GSICS data working group. The GSICS research working group charter will be updated to provide more detail on the roles and responsibilities of GSICS research subgroups. GSICS state of the observing system needs be expanded to go beyond GEO to LEO and should include assessment of the other subgroup's activities including LEO to LEO performance monitoring.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|-------------|----------|--|----------|--------|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | |
| GSICS | WGII/ 3 | A48.05 | GSICS to establish a partnership with the ISCCP-NG to provide the necessary geostationary intercalibration coefficients required for ISCCP-NG creating integrated seamless geostationary products, | Nov 2020 | OPEN | | |

CGMS-48-JWGCLIM-WP-01: Status report of JWGClimate

This document describes the progress in the implementation of the Joint CEOS/CGMS Working Group on Climate (WGClimate) objectives since CGMS-47.

Major items addressed in this report are:

 The endorsement of leadership changes for WGClimate: WGClimate #12 has unanimously recommended Dr Jeff Privette as next WGClimate Vice Chair for endorsement by CGMS-48 Plenary;

- The achievements since last meeting: WGClimate successfully delivered the Space Agency Statement to SBSTA-51 and participated in the Earth Information Day that forms a good basis for communication to the UNFCC Parties. It has delivered the first version of the GHG Roadmap. The publication of the ECV Inventory, the Gap Analysis Report and the updated Coordinated Action Plan is delayed to summer 2020.
- Climate Data Record Definitions: WGClimate has developed new definitions for Fundamental, Thematic and Interim Climate Data Records and has started to write a report/publication that should appear in the peer reviewed literature. The report is planned for Autumn 2020.
- The interaction with GCOS: The GCOS Secretariat gave a presentation at WGClimate#12 on the update of the GCOS requirements and the plans for the development of the next GCOS Implementation Plan, which still does not accommodate application-specific requirements. WGClimate#12 discussed this and is convinced that the next IP should include application-specific requirements, as this is needed to stay relevant. WGClimate will send another statement on the requirements to GCOS by June/July 2020 encouraging the WMO GCOS study team to find a way forward. GCOS and WGClimate agreed on direct interaction on the relevant part of the GCOS Status Report.
- The ECV Inventory, Gap Analysis, Coordinated Action Plan: Due to several reasons the publication of the ECV Inventory #3, the Gap analysis report and the updated Coordinated Action Plan is delayed. It is planned now to be ready for endorsement by CGMS-48 Plenary in August. The 2019 version fills previously identified gaps. Space agencies have started to address data records for lightning, sea-surface salinity, aboveground biomass, and permafrost, the latter two having significance for the study and analysis of the Earth's carbon cycle. This version of the Inventory will be published by the end of 2019.
- The use cases activity: WGClimate will put more weight on the use cases from now on to develop it into a continuous activity with new use cases every year. WGClimate#12 has set up the objectives and the procedure how to collect information for the use cases. A joint report with WMO on prime use cases is planned for 2021. Other use cases will appear on the WGClimate web page (https://climatemonitoring.info).
- The GHG Coordination (Task Team, roadmap): The WGClimate GHG Task Team (TT) has delivered the first version of the GHG Roadmap that matured the GHG Roadmap and Project Plan developed specifying deliverables, responsible organisations, schedules and resources. The GHG TT is establishing interfaces with National Inventory community, e.g., worked with the Copernicus H2020 VERIFY Project to organise an atmospheric inventory workshop @ Global Emissions IniAtive (GEIA). In addition, it continues establishing interfaces with stakeholders (UNFCCC/SBSTA & GCOS), e.g. through the support to the UNFCCC/SBSTA & GCOS at COP-25 & Earth Information Day. At CGMS-48 the GHG Task Team is encouraging CGMS Members to engage with the Task Team, in particular.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|------------|---------|---|--------------------------------|--------|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | |
| | item | | | | | | |
| WG Climate | WGII/ 3 | A48.06 | WGClimate to establish with the CGMS WGs interfaces with the WGClimate GHG Task Team (TT) with a definition of anticipated support from the WGs. | Sep 2020 (WGClimat e-13) | OPEN | | |
| WG Climate | WGII/ 3 | A48.07 | WGClimate to provide the publication of the ECV Inventory #3, the Gap analysis report and the updated Coordinated Action Plan for endorsement by CGMS-48 Plenary in August. | CGMS-48 Plenary | OPEN | | |

| CGMS-48 RE | CGMS-48 RECOMMENDATIONS - WGII | | | | | | | |
|------------|--------------------------------|--------|---|-------------|--|--|--|--|
| Actionee | AGN | Rec# | Description | Status | | | | |
| | item | | | | | | | |
| Plenary | WGII/3 | R48.06 | Endorsement of leadership changes for WGClimate: | For CGMS-48 | | | | |
| | | | WGClimate #12 has unanimously recommended Dr Jeff | Plenary | | | | |
| | | | Privette as next WGClimate Vice Chair. CGMS-48 | endorsement | | | | |
| | | | Plenary is asked to endorse the proposal. | | | | | |

CGMS-48-WMO-WP-19: Advances in WMO Integrated Global Greenhouse Gas Information System (IG3IS)

To assist the countries, states, cities and industries in meeting their contributions under the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement the World Meteorological Organization (WMO) and its partners have initiated the development of an Integrated Global Greenhouse Gas Information System (IG3IS). The IG3IS serves as an international coordinating mechanism to establish and propagate consistent methods and standards to help assess emission reduction actions.

The document summarises the status of IG3IS implementation, including IG3IS Science Implementation plan finalisation, IG3IS project office activities, engagement with UNFCCC, National Emission Inventory protocol refinement and a way forward.

WMO invites CGMS members to be fully engaged with WMO in the implementation of the IG3IS initiative, capitalising on the intergovernmental policy-level recognition and established partnerships. In particular, the implementation of the space-based observing component for Green House Gas observations should be fully coordinated with IG3IS to ensure that it meets established user requirements.

| Lead | AGN | Rec# | Description | Status | | |
|---------|------|--------|---|-----------|--|--|
| | item | | | | | |
| CGMS | WGII | R48.07 | CGMS members to be fully engaged with WMO in the | Review at | | |
| Members | /3 | | implementation of the IG3IS initiative, capitalising on the | CGMS-49 | | |
| | | | intergovernmental policy-level recognition and established | | | |
| | | | partnerships. In particular, the implementation of the space- | | | |
| | | | based observing component for Green House Gas observations | | | |
| | | | shall be coordinated with IG3IS to ensure that it meets | | | |
| | | | established user requirements. | | | |

CGMS-48-SCOPE-CM-WP-02: Status report of SCOPE-CM

The WMO Space Programme is working with all parties (e.g. EUMETSAT, WGClimate, NOAA) to define options for Phase III Implementation Plan. It is seen that the next phase is rather a steady state than a fixed length project. A key element would be the interaction with GSICS and WGClimate in defining the activities. Hence, a detailed implementation plan is heavily dependent on the WGClimate gap-analysis that is being finalised for CGMS-48. Some of the issues that are considered and where SCOPE-CM can play a coordination and facilitation role for the next phase are:

- Support to the ISCCP Next Generation;
- Identification of WGClimate gaps that benefit from interagency collaboration;
- Support to WGClimate for product quality evaluation;
- Identification of existing CDRs that would benefit from interagency collaboration.

The implementation plan will also build on lessons learned from Phase 2 and a close-out report for Phase 2 is under preparation. It should be noted that the current Chair, J. Privette is stepping down and a new Chair has to be identified.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|-------|----------|---|----------|--------|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | |
| | item | | | | | | |
| WMO and | WGII/ | A48.08 | WG II and WMO to develop a mature Strategic | CGMS-48 | OPEN | | |
| WGII | 3 | | Implementation Plan for SCOPE-CM for | Plenary | | | |
| | | | endorsement by CGMS-48 Plenary. | | | | |

CGMS-48-ISCCP-WP-01: ISCCP-NG/JWGClimate White Paper on clouds

The Next Generation of the International Satellite Cloud Climatology Project (ISCCP-NG) is proposed as a follow-on to the classic ISCCP, which would commence in 2022 once the EUMETSAT Meteosat 3rd Generation (MTG) Imager is launched.

Once MTG is operational, the entire geostationary ring will be encircled by imagers which offer capabilities far superior to those from the previous generation of imagers. These sensors will provide full-disk scans every 10-15 minutes with roughly 12 common channels and with spatial resolutions of 2 km for thermal channels and finer spatial resolutions for selected solar channels.

The data volume and fidelity represent a significant advance beyond that available at the start of ISCCP in the early 1980's. The challenge facing ISCCP-NG is to define a new baseline from this data and processing methods to extract meaningful information for the scientific community in the coming decades.

This report discusses the outcome of the First ISCCP-NG workshop held in Fall of 2019 at EUMETSAT and progress since then to define the project. It marks the start of a discussion with CGMS on the involvement of CGMS Members, in particular, in the generation of consistent 'geo-ring' radiances for cloud property and other parameter retrievals.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|------------|---------|---|----------|--------|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | |
| | item | | | | | | |
| ISCCP- NG TT | WG((/ 3 | A48.09 | ISCCP-NG task team to meet every two months with SCOPE-CM and GSICS, to develop a complete plan for ISCCP-NG expanded to full global coverage including the poles and identifying roles and responsibilities of GSICS and SCOPE-CM. | CGMS-49 | OPEN | | |

4. Working papers on other international science community reports - oceans, CEOS VCs

CGMS-48-GUEST-WP-03: Report from OSVW

The paper discussed the CEOS Ocean Surface Vector Winds (OSVW). OSVW-VC fosters the availability of best quality ocean surface wind vector data for applications in short, medium and decadal time scale in the most efficient manner through International collaboration, scientific innovation, and rigour. Improve coordination, consolidation, and development of the collective OSVW capability; Maintain a strong and mutually supportive relationship with the International Ocean Vector Winds Science Team (IOVWST); Provide an interface to CEOS for the IOVWST; Develop recommendations on the driving requirements to create, validate, and sustain the development of an international ensemble of Essential Climate Variable (ECV) measurements; Provide advice on and advocate to the international community for the importance of OSVW measurements; Develop and consolidate training on the use of scatterometer winds for different applications, as well as outreach to the general public to demonstrate the societal benefit of these data

Currently, the OSVW Constellation is mainly anchored by the scatterometer missions of EUMETSAT and ISRO, with a large number of upcoming Chinese scatterometer missions.

The CEOS OSVW-VC advocates:

- Open and near real-time data access;
- Coordination of orbits to optimise temporal sampling;
- Cross calibration of missions;
- Cal/Val and data product standards;
- Outreach and education.

Additional information including Terms of Reference can be found at http://ceos.org/ourwork/virtual-constellations/osvw/

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|------------|----------|--|--|--------|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | |
| | item | | | | | | |
| OSVW | WGII/ 4 | A48.10 | OSVW to present at next GSICS meeting the potential and potential benefits and issues of crosscalibration of scatterometer data. | GSICS Annual meeting (March- 2021) | OPEN | | |

5. Cross- Space weather matters: SWCG interactions with WGII

The Space Weather Coordination Group and WG-II joint session started with an overview of the GEO cross-calibration activities performed by SWCG members. The approaches are based to the extent possible on GSICS methodologies and showed good agreement across the sensors concerned, with some differences, which are understood. The Joint session also discussed the current SWCG White Paper for cross-calibration. It was noted that it is following some GSICS principles, but that differences between the available techniques for SWx instrument cross-calibration and those used for EO instruments remain.

In conclusion, it was found that the White Paper is now progressing well, and will benefit from a review by GSICS and WG-II, once it becomes mature as per existing Actions and Recommendations.

6. Selected topics of high priority to members

CGMS-48-joint-ESA/ECMWF-WP-01: Aeolus Mission and NWP impact assessment status

ESA's Wind Mission, Aeolus, was launched on 22 august 2018. Aeolus is an ESA Earth Explorer Core mission, hosting a single payload -the first space-based Doppler Wind Lidar (DWL) world-wide. The primary mission objective is to demonstrate the DWL technique for measuring wind profiles from space, intended for assimilation in Numerical Weather Prediction (NWP) models. The wind observations will also be used to advance atmospheric dynamics research and for evaluation of climate models. Mission spin-off products are profiles of cloud and aerosol optical properties. The Aeolus Atmospheric LAserDoppler Instrument (Aladin) instrument switch-on was completed with first high energy output in wind mode on 4 September 2018. The on-ground data processing facility worked excellent, allowing L2B wind product output in near-real-time (NRT) from the start of the mission. Data acquisition performance has been excellent, with a performance above 98% and on average 99.5% since October 2018. Since 20 December 2018, the Aeolus CAL/VAL teams (also including NWP centers across the world) have had access to the Aeolus L1 and L2 data. Since February 2019, more than 98% of the data have been available in NRT. On 12 May 2020 the Aeolus L1B and L2B NRT data were publically released.

Aeolus was commissioned between August 2018 and January 2019, and the early operational phase started in February 2019. Instrument and product calibration, validation and refinements started at the time of the launch, and continues throughout the mission lifetime. A major mission milestone was reached with the deployment of a new processor baseline on 20 April 2020, where the major part of the L2B wind biases have been successfully removed by characterisation and calibration of an unintended telescope temperature variability. This bias correction method was developed and tested by the Aeolus DISC consortium under ESA contract, and integrated and deployed by the ESA Aeolus PDGS. With this correction, the L2B wind biases are mostly within 1 m/s, and hence close to the Mission systematic error requirement of 0.7 m/s. The Aeolus L2B product is therefore considered to be of suitable quality for operational NWP and scientific exploitation, which triggered the release of the Aeolus L1B (not fully calibrated/processed data) and L2B (fully processed wind profiles) data (in ESA Earth Explorer format) to the general public on 12 May 2020 on the Aeolus Data Dissemination Facility (see http://www.esa.int/Applications/Observing_the_Earth/Aeolus/Aeolus_goes_public). The distribution of the Aeolus L2B wind data in BUFR format started 19 May on EUMETCast and the GTS. This service is kindly

provided by ECMWF and EUMETSAT. Most of the Aeolus mission requirements are already being met, with the exception of the random and systematic errors. As mentioned before, the systematic errors are almost met with the most recent processor update. The higher than expected random errors (on the order of 3-6 m/s in the free troposphere as opposed to the required 2.5 m/s) are caused by a lower instrument out-and input photon budget than designed. This has also caused a larger than anticipated sensitivity to solar background, and hence a significant noise contribution in polar summer conditions. The instrument out and input photon budget has also been shown to slowly drop with time, which is of concern for the random error performance over the mission lifetime. ESA and industry are continuously working on mitigating actions to ensure that the mission lifetime will be met and allowing acceptable L2B wind random errors ensuring NWP impact.

The optical properties spin-off product (L2A) is being compared e.g. to NWP model clouds, air quality model forecasts, and collocated ground-based observations. The L2A CAL/VAL results show that the product is reasonable, but less mature and needs more work to give robust results. A release of the Aeolus near-real-time aerosol and cloud profile product is expected in Q1 2021.

The first batch of Aeolus reprocessed data will become available in September 2020, covering the time from July-December 2019. The remaining dataset will be reprocessed in early 2021.

As reported on CGMS-47 in 2019, several centers have reported significant positive impact of Aeolus on global NWP forecasts in OSE and FSO experiments. Positive impact has in particular been reported in the upper tropical troposphere and in the southern hemisphere. This has led to the operational assimilation of Aeolus data at ECMWF since January 2020, and operational assimilation is expected to follow at DWD, Météo-France and the UK Met Office soon. A small but positive impact has also been reported in regional models by Met Norway and SMHI on behalf of the HARMONIE-AROME consortium.

CGMS-48-NOAA-WP-06: Status of NOAA's VOLCAT Product

Multi-satellite product development is critical for meeting emerging ICAO requirements; NOAA/VOLCAT development is driven by the needs of the ICAO International Airways Volcano Watch (IAVW) (see CGMS-48, WG II, Session 8, WP 5). Traditional ash/SO2related geophysical parameters represent an intermediate step and generally are not designed for use in higher-order applications such as alerting and state-of-theart modelling. NOAA/NESDIS welcomes new and continued collaboration on efforts to prepare for future ICAO IAVW requirements, while improving volcanic cloud capabilities for climate and weather applications.

The paper recommends that CGMS agencies ensure that volcanic cloud product development efforts are consistent with the actual needs of the IAVW and re-visit L2+ product requirements as needed.

In the discussion the benefits of consistent retrieval of volcanic ash across the full GEO ring was emphasised. This would not only benefit the data providers, but also the data users as the source may change moving from one area to another. It was also noted that volcanic ash products may benefit from the use of multiple instruments like combined GEO imagery with LEO hyperspectral infrared and UVN

sounders in a similar fashion to multisensory precipitation estimates that combine GEO imagery data with LEO microwave sounder data.

| CGMS-48 RECOMMENDATIONS - WGII | | | | | | |
|--------------------------------|--------|--------|---|---------|--|--|
| Lead | AGN | Rec# | Description | Status | | |
| | item | | | | | |
| CGMS | WGII/6 | R48.08 | CGMS agencies ensure that volcanic cloud product | CGMS-49 | | |
| Agencies | | | development efforts are consistent with the actual needs of | | | |
| | | | the IAVW and re-visit L2+ product requirements as needed. | | | |

CGMS-48-JMA-WP-06: Data assimilation of Himawari-8/9 aerosol product for operational dust analysis and prediction model

JMA retrieves Himawari-8 and -9 Aerosol Optical Depth (AOD) data using an algorithm developed by JAXA, and began assimilating aerosol data into its Dust Analysis and Prediction model on January 29 2020. Statistical score verification using SYNOP reports shows assimilation-related accuracy improvements of up to around 10% for Threat Score (TS), especially in the first half of the analysis and forecast period (up to around two days).

CGMS-48-IMD-WP-03: Monitoring of Cyclones through Rapid scan of INSAT 3DR for the year of 2019

At present, two INSAT Meteorological satellites are in operation i.e. INSAT-3D and INSAT-3DR. INSAT-3D is India's advanced weather satellite located at 82°E and was launched on 26 July 2013 from Kourou, French Guiana and INSAT-3DR was launched on 8 September 2016 from SDSC SHAR, Sriharikota using GSLV-F05 and positioned at 74°E. They are dedicated meteorological satellites and carries four payloads: imager (six channels), sounder (19 channels), Data Relay Transponder (DRT) and satellite aided search and rescue (SAS & R).

With the launch of INSAT3DR satellite over the Indian subcontinent, Imager payloads of INSAT-3D & INSAT-3DR are used in a staggered mode to achieve 15-minute temporal resolution for getting cloud imaging which is essential for severe weather applications such as nowcasting and tropical cyclone analysis. For the utilisation in weather applications, a Standard Operating Procedure (SOP) has been finalised by ISRO and IMD for conducting the Rapid scan from the INSAT-3DR Imager payload.

RAPID scan helps in better detection of low-level cloud motions which is highly useful in analysis of early stages of cyclones when the systems are not well organised. These imageries imagery can be useful in creation of higher resolution cloud motion winds. Such higher resolution winds aids in better diagnosis of associated wind fields that can impact the development and movement of the system. Better visualisation of eye structure also helps in the analysing the tilt and associated convection in the eye-wall region.

In IMDPS, there are three modes of operations in which INSAT-3DR, IMAGER payload can be operated: Full Frame Mode, Programmed Normal Scan Mode, Programmed Sector Scan Mode. In this study, the use of INSAT-3DR in Programmed Sector Scan Mode also known as Rapid Scan Mode is discussed. The "Rapid Scan" were conducted for all Tropical Cyclone system starting from TC LUBAN and all TCs were tracked with INSAT-3DR and the data received was used as an input for issuing forecasts. It will be demonstrated

that, with Rapid Scan mode the movement of Cyclones and associated convective cloud mass can be seen at a regular interval of 06 minutes. Rapid Scan precisely captured the landfall locations for both the cyclones. Rapid Scan mode is a very useful mode, which can be used for motoring and tracking various convective systems.

CGMS-48-KMA-WP-04: Atmospheric environment monitoring from GK2A Satellite

KMA is operating atmospheric environment parameters such as aerosol detection (dust, haze and volcanic ash), optical properties (depth, Angstrom exponent) and wildfire products (Forest Fire (FF), Fire Risk (FR) and Fire Radiative Power (FRP)) from GK2A satellite. In order to improve the atmospheric environment monitoring system, KMA has plan to cooperate with other national environment and ocean satellite centers for merging or blending the GK2A and GK2B satellite data. Especially, aerosol information over East Asia region can be improved through merging the corresponding GK2A AMI and GK2B GEMS and GOCI-2 data.

In order to monitor the air quality due to Asian dust event and anthropogenic pollutions, KMA developed the aerosol algorithms such as aerosol detection with three categories (dust, haze and volcanic ash), aerosol optical depth and size index (Angstrom Exponent). These products are producing in East Asia region and full disk every 10 minutes. The preliminary validation results of a few events in this spring season are 60% (ocean) and 72% (land) of POD and 12% (ocean) and 42% (land) of FAR for aerosol detection products, and 0.29 of RMSE for aerosol optical thickness product.

KMA has developed the prototype algorithm of dust peak height by using GEMS UV/VIS hyperspectral data and AMI cloud and aerosol level 2 products. Currently, Aura/OMI data is used for this algorithm as a proxy and we will complete this algorithm development after the GK2B GEMS IOT period.

The KMA has developed an output that can detect forest fires using observation data from GK2A. This forest fire detection is determined as the FF by comparing the difference in brightness temperature variation with the surrounding pixels based on a 2 km spatial resolution pixel using a short wave infrared (SWIR) and thermal infrared (TIR) channels. When compared to the TIR channel, SWIR radiation is much stronger at high temperatures. Thus, the radiation difference in high-temperature targets between the SWIR and TIR channels has been used to detect fires. In addition, in order to reduce false detections in this FF products, variables in altitude correction and solar zenith angle are also applied. The fire detection represented pixels determined to be forest fire in the full disk images observed at geostationary orbit of 128.2E longitude every 10 minutes. Finally, FF product has been available operationally since March 2020.

KMA has plans to extend GK2A satellite applications into non-meteorological parts. Especially, we will focus the ill-conditioned atmospheric and surface environment monitoring from GK2A/B satellites to reduce the hazardous effects. To do these activities, KMA will endeavor to increase output accuracy and promote utilisations by producing the value-added information.

CGMS-48-CMA-WP-11: Progress of Fengyun Satellite FCDR

The paper introduces the progress of Fengyun satellite fundamental climate data record (FCDR). The efforts include the reprocessing of the sensor data records (SDR) including geolocation and recalibration for 7 instruments including VIRR (FY-1A/B/C/D), MERSI/IRAS/MWTS/MWHS/MWRI (FY-3A/B/C) and VISSR (FY-2A/B/C/D/E/G). Three versions dataset are planned (beta, trial and formal) with the release times of 2019, 2020 and 2021, respectively. At present, the beta version (V1) datasets are finished through the lifetime recalibration of each instrument. In this version, the consistent calibration framework is applied for each instrument.

| CGMS-48 RECOMMENDATIONS - WGII | | | | | | | |
|--------------------------------|--------|--------|--|---------|--|--|--|
| Actionee | AGN | Rec# | Description | Status | | | |
| | item | | | | | | |
| CMA and WG Climate | WGII/6 | R48.09 | CMA to coordinate with WGClimate and GSICS to host workshop on reprocessing. | CGMS-49 | | | |
| CMA | WGII/6 | R48.10 | To provide CDRs/ECVs for the WGClimate inventory | CGMS-49 | | | |

CGMS-48-JMA-WP-05: JMA report on historical satellite data re-calibration for climatological application

The Japan Meteorological Agency (JMA) has re-calibrated conventional infrared (IR; approx. $11 \mu m$) and water vapor (WV; approx. $6 \mu m$) channel data from the imagers on the GMS, -2, -3, -4, -5, GOES-9, MTSAT-1R and -2 satellites to support climate research in collaboration with the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). The work contributes to the Inter-calibration of passive imager observations from time-series of geostationary satellites (IOGEO) project conducted under WMO's Sustained, Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM). The recalibration dataset will contribute to climatological researches such as reanalysis projects, through the IOGEO framework. The outcomes are posted on the web page of Meteorological Satellite Center of JMA.

7. CGMS agency reports on highlights and issues in dataset and product generation

CGMS-48-CMA-WP-07: CMA agency report on highlights and issues in dataset and product

The report highlights the current status and progress of CMA four aspects of products including the atmospheric temperature and humidity vertical profile (AVP), radio occultation (RO), Atmospheric Motion Vector (AMV) and cloud products.1) there are two kinds of operational atmospheric temperature and humidity profile products in China, which are from the polar orbit FY-3D and geostationary FY-4A satellites, and have obvious advantages in time and spatial resolution. The validation results show that the data with a quality control mark of zero achieves high accuracy, which can basically meet the various requirements of applications. However, the temperature and humidity profiles retrieved from the regression method have a more massive bias when it is close to the ground. In the future, a new retrieval algorithm combining the statistical and physical methods will be used for processing FY-4B data.2) CMA continues to support radio occultation (RO) activities. This working paper outlines the current issues including instrument development, POD for Beidou and assimilation study in reanalysis model. The next

generation RO sounder GNOS II mounted on FY3E will be enhanced with higher antenna gain and multifunctional probing with reflective signals. In order to improve the timeliness, CMA collaborates with CAS (Chinese Academy of Sciences) to establish a new center for processing Beidou POD (Precise Orbit Determination) data. Assimilation tests show that FY3C GNOS data is ready for the Chinese reanalysis system CRA-40. Reprocessing for the long term historic GNOS RO data is likely to initiate at this year. 3) The current satellite constellation for operational AMVs processing includes FY-2G (99.5oE), FY-2H (79oE) and FY-4A(104.7oE). Several new enhancements in the NSMC/CMA AMVs operational processing are implemented and being implemented. These main enhancements include replacement of 6-hour FY-2H AMV to 30-minute in northern hemisphere, and of 6-hour FY-4A AMV to 3-hour in full disk. 4) The status of current cloud products of all Fengyun operational satellites are introduced, including their types, specifications, quality status, as well as newly developed cloud quality inspection tools.

CGMS-48-ISRO-WP-03: Highlights and Issues in datasets and products generation

This paper gives an overview of the satellites developed by ISRO for weather and climate (INSAT-3D, INSAT-3DR and Megha-Tropiques) and for ocean (Oceansat-2, SARAL and SCATSAT-1). ISRO has also developed a Multi-Mission Data Reception and Processing System for operational implementation at IMD. This system now provides 14 new and improved products. The paper then gives and update on satellite and instrument status with product examples. It also describes the data visualisation and analysis system, MOSDAC, which can be accessed over mosdac.gov.in. ISRO has also implemented a GSICS THREDDS Server which is also accessible over the MOSDAC site.

CGMS-48-JMA-WP-03: JMA agency report on highlights and issues in dataset and products

Details of radiometric calibration and image navigation performance for JMA's Himawari-8 geostationary satellite (which started operation on 7 July 2015) are provided on the JMA/MSC website. The monitoring pages show the image navigation errors are within 600 m at the subsatellite point, while radiometric calibration biases are less than 5% in reflectivity for visible and near-infrared bands and less than 0.3 K in brightness temperature for infrared bands. The slope and intercept for correcting sensor sensitivity for visible and near infrared bands were updated on 8 July 2019.

The AMV-based sea surface winds (ASWinds) product was released on the MSC website for tropical cyclone monitoring in July 2019. The frequency of High-resolution Cloud Analysis Information (HCAI) product provision was increased from once an hour to every 10 minutes in December 2019.

The test bed webpage used for comparing multiple volcanic ash retrieval algorithms was terminated at the end of March 2020. The Volcanic Cloud Analysis Toolkit (VOLCAT) developed by NOAA/NESDIS is currently used for volcanic ash product output.

CGMS-48-NOAA-WP-07: NOAA agency report on highlights and issues in dataset and products

The report highlighted calibration and validation activities for JPSS and GOES-R, particularly how to access information from their respective website. Most of the report focused on the JPSS and GOES-R Proving Ground summit held February 24-28, 2020. This meeting focused on delivering user-inspired science to

maximise the utility of the NESDIS operational and research products. The weeklong event featured individual sessions on various proving ground initiatives. The sessions provided opportunities for algorithm developers and users to share information on ongoing activities and future needs within each product group. It was designed to enable satellite scientists, data users, and algorithm developers to meet face-to-face with key partners including academic users, researchers, federal, state, and local decision makers, and other stakeholders. It focused on delivering user-inspired science to maximise the utility of operational and research products from the JPSS/GOES-R programs, and informing the National Environmental Satellite, Data, and Information Service (NESDIS) about underserved user needs as it develops future architectures. There were 15 application sessions, and this report focused on fires, aviation and oceans. Oceans discussions included access to data using NOAA's Coastwatch data portal which includes data products from NOAA satellites and the broader international constellation, including NASA products. The report also discussed the joint NOAA NASA FireX Air Quality campaign and activities in NOAA for monitoring COVID-19 environmental changes from satellites and ground-based observations, which will be used to improve emission inventories to improve air quality forecasting. All data collected will be accessible by user communities.

CGMS-48-IMD-WP-01: Update on INSAT 3D/3D R data products at IMD

At present, two INSAT Meteorological satellites are in operation i.e. INSAT-3D and INSAT-3DR. INSAT-3D is India's advanced weather satellite located at 82°E and was launched on 26 July 2013 from Kourou, French Guiana and INSAT-3DR was launched on 8 September 2016 from SDSC SHAR, Sriharikota using GSLV-F05 and positioned at 74°E. They are dedicated meteorological satellites and carries four payloads: imager (six channels), sounder (19 channels), Data Relay Transponder (DRT) and satellite aided search and rescue (SAS & R). The DRT payload of INSAT-3DR has 300 kHz bandwidth to support a higher number of unattended meteorological platforms (AWS) of the stations network while INSAT-3D DRT payload have 200 Khz bandwidth. INSAT-3D/3DR have the capability of providing vertical profiles of temperature and humidity, along with several products.

Imager payload of INSAT-3D & INSAT-3DR are used in a staggered mode to achieve 15-minute temporal resolution for getting cloud imaging. An integrated scan strategy of the sounder payload of INSAT-3D & 3DR satellites has been implemented to get data of the Indian region on an hourly basis and the ocean region data every 1.5 hours.

IMD has established the Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS) for INSAT-3D, INSAT-3DR and INSAT-3DS. The system has three dedicated earth station and data receiving system. Each Earth station is receiving the data in redundant mode from each payload (Imager, Sounder and DRT) and Raw data archival storage facility. MMDRPS have very high-end processing system which cut down the processing time from 15 minutes to 7 minutes and has provision to update calibration coefficient in operational chain using Cal/ Val site & GISCS data. System is capable to process RAPID scan data of INSAT-3DR Imager payload conducted during Extreme weather events. MMDRPS have storage capacity of the order of 2.0/2.0PB (Main/ Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy. All available past satellite datasets starting from 1983 will be kept in online mode in due course of time. The

MMDRPS system is being used to Receive & process the INSAT-3D and INSAT-3DR satellites data since 1st October 2019. IMD has started the generation two new types of satellite Imageries IR-1 BT Blended & IR-1 BT & Visible Sandwich for monitoring Thunder-storm events. All the sector Images of Visible and SWIR bands are being generated in native resolution(1x1Km) in MMDRPS. IMD has started the generation of these new set of products in MMDRPS: CSBT (Imager & Sounder), CTP/CTT(Imager & Sounder), Cloud Microphysics(Cloud Effective Radius, Cloud Optical Thickness), Potential Evapotranspiration, Actual Evapotranspiration, Net Surface Radiation, Land Surface Albedo, Short Wave Radiation over Ocean, MIR Reflectance, Biomass Burning Emission product, improved IMSRA, Merged wind (INSAT 3D/3DR), 5 day composite winds and high resolution visible winds. The output generated by the system is used for efficient and successful forecasting the major weather events. The satellite data is assimilated in numerical weather prediction models and the outputs are further used to issue short range and medium range weather forecast. INSAT 3DR and new set of products are integrated in both of the dedicated webpages (http://satellite.imd.gov.in/insat.htm & http://satmet.imd.gov.in/insat3d.htm) and RAPID. The webpages are being updated every 15 minutes. These Web sites now being assessed using user Name "guest" and password may be obtained through email from virendra61.singh@imd.gov.in.

INSAT-3DR Imager payload is used to conduct rapid scans during four Tropical Cyclones namely: SuCS Kyarr, ESCS Maha, VSCS Bulbul and VSCS Pawan during June 2019 to May 2020. Each Rapid scan cover up 3 degree in N-S direction (6 Blocks/234 scan lines) in 4.5 minutes. Rapid scan data has been used to track these cyclones in real time basis. The processed data is being disseminated on a dedicated webpage (http://satellite.imd.gov.in/rapid/rapid_scan.htm)

India will launch INSAT-3DS, the third exclusive meteorological satellite of this series, by second quarter of 2021 and the first hyper-spectral satellite GISAT-1 by first quarter of 2021. OCEANSAT is scheduled to be launched by third quarter of 2020 and OCEANSAT-3A is scheduled to be launched by first quarter of 2021 carrying the additional SSTM payload along with all exiting payload of Oceansat series satellite. Due to COVID 19 pandemic, the launch schedule has been delayed for time being.

CGMS-48-NASA-WP-02: NASA Research and Data Product Highlights

The National Aeronautics and Space Administration (NASA) is a significant contributor to global knowledge of the Earth's environment. It supports 21 operating satellite missions and the scientific infrastructure that includes surface and airborne assets that allow calibration/validation of remotely sensed imagery, analysis, Earth system models, data storage, processing and delivery. Rigorous quality assurance standards ensure delivery of high-quality data suitable for acquiring an improved quantitative understanding of Earth system parameters and processes. This working paper presents a summary of various NASA activities that may be of interest to CGMS members. It includes highlights of NASA's ongoing work with partners, including its support for the expansion of the global insitu ground networks, recent airborne field campaigns to understand the physical and chemical processes that govern the transport and transformation of trace gases and particles, and newly released techniques and datasets that reliably track changes to the Earth system.

CGMS-48-EUMETSAT-WP-10: Harmonised product suite for GEO products

Satellite observations are one of the most important sources of information in Earth observation and are routinely also assimilated to NWP. Every year new instruments provide more data filling the gaps and improving the coverage in the global observing system. Current GEO satellite operators produce a large set of products with significant commonality like various cloud products, Atmospheric Motion Vectors (AMVs), Clear-Sky and All-Sky Radiances (CSR and ASR), instability indexes, and volcanic ash. Some of these products like AMVs and CSRs/ASRs are being routinely assimilated in many NWP centres. However, there are also discrepancies in the availability of the GEO products in terms of generation, formats, temporal frequency and distribution mechanisms. Today various CGMS initiatives like AMV and cloud intercomparisons, and the implementation of common algorithms alleviate some of the issues, however a common baseline product suite from GEO has not yet been articulated by CGMS.

This document presents the status of the EUMETSAT product generation with a view to initiate a discussion to develop a CGMS baseline for GEO satellite products with common characteristics in term of availability, formats and distribution mechanisms, and to the extent possible common algorithms and derivation approaches. Such a baseline would benefit the providers in terms of easier intercomparisons and the users in terms of interoperability and harmonised use in their applications.

WG II is recommended to establish a harmonised baseline GEO imager Level-2 product suite.

WGII welcomed the presentation by EUMETSAT and noted it's importance and implications. The discussion focussed on the benefits of common products generated by all satellite agencies. It was noted that this "GEO Product Baseline" should not be mixed with the CGMS baseline, which is focussing on the satellites and instruments and their continuity and availability. It was noted that there are already some collaborative efforts, like AMV algorithm and cloud product intercomparisons and volcanic ash work within SCOPE-NWC and some relevant CGMS recommendation, e.g. on ASR, are in place. However, it was seen as beneficial to further consolidate a common understanding on the critical products, their parameters, generation frequency, dissemination format and means. Hence, it was agreed to prepare survey to collect the current and foreseen status of the various providers GEO products to get a detailed understanding of the current commonalities and differences. It was also noted that to the extent possible this should also consider polar orbiting imagers for a truly global view.

The importance to engage with the user community was noted in order to ensure most important elements are covered e.g.

Global NWP: GODEX_NWP, ITSC;Volcanic Ash: SCOPE-CM, ICAO;Climate: SCOPE-CM, WGClimate.

A proposal for adoption by CGMS Members will be presented to CGMS-49 Plenary.

| CGMS-48 A | CGMS-48 ACTIONS - WGII | | | | | | | |
|-----------|------------------------|---------|--|----------------------|--------|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | |
| | item | | | | | | | |
| WMO | WGII/ 4 | A48.11 | WMO to prepare a survey to collect the current and planned status of GEO product providers to achieve a detailed understanding of the current characteristics, commonalities, differences, access and formats. | CGMS-49 | OPEN | | | |
| WGII | WGII/ 4 | A48.12 | WG II to propose a GEO Product Baseline for endorsement by CGMS-49 Plenary | Feb 2021, CGMS-49 | OPEN | | | |

CGMS-48-KMA-WP-03: KMA report on highlights and issues in dataset and products

This document is KMA report on highlights and issues in dataset and products.

KMA started to utilise Geo-KOMPSAT-2A (GK-2A) data in the operational global NWP model based on Unified Model (UM) in this April as the COMS (Communication, Ocean, and Meteorological Satellite) data service ended in March 31, 2020. The global NWP model utilises two products, of CSR (Clear Sky Radiance) and AMV (Atmospheric Motion Vector) among the GK-2A outputs.

The GK-2A data gives a positive impact on the Northern and Southern hemisphere geopotential height and wind fields of analysis verification, in particular, improved lower temperature all of the regions. And the improvement of typhoon track forecast error is significant.

Following the quality analysis and the development of data assimilation technology of GK-2A data in the UM based NWP model, the impact assessment of GK-2A data will be carried out in the KMA's new global NWP model based on KIM (Korean Integrated Model).

GK2A AMI can produce high spatio-temporal measurements with 0.5~2 km resolutions every 2 min around Korean Peninsula and 10 min for full disk area. To maximise the application of these rapid observational data for weather and climate monitoring, KMA has led to develop retrieval algorithms of the value-added products in cooperation with universities in Korea as well as the support from the internationally distinguished experts of satellite meteorology. From experiences learned in COMS operations, we focused the applications as well as the accuracy in the algorithm development to help satellite data interpreters, weather forecasters, typhoon forecasters and the users of satellite data in many other areas. The application areas include nowcasting, typhoon and ocean, surface, hydrology, fire, climate and atmospheric environment, and numerical weather prediction. Analysis skills and their guidance, some challenging products are included, which are not in 52 baseline products. In parallel with this process, we have several users meeting to facilitate the level 2 products for hazardous weather, climate and atmospheric environment monitoring and NWP model. KMA is in preparation to disseminate the BUFR formatted data of atmospheric motion vectors (AMVs) and clear sky radiance (CSR) via GTS for NWP model data assimilation in the first-half of this year.

CGMS-48-ROSHYDROMET-WP-02: Satellite data and product applications in Roshydromet

The document presents an overview of operational and research activity in Roshydromet related to the derivation and application of remote sensing products from satellite data. The sample products are presented based on measurements of Russian LEO (Meteor-M N 2 & N 2-2, Kanopus-V, Resurs-P) and GEO (Electro-L N 2 & N 3) satellites.

CGMS-48-JAXA-WP-02: JAXA Earth Observation Program and Data Product

JAXA operates various kind of satellite sensors and opens the products to the public. We keep developing and improving the products to address the climate issues. The major updates since CGMS-47 is the project team of the Global Observing SATellite for Greenhouse gases and Water cycle (GOSAT-GW), which will carry the GCOM-W follow-on instrument (Advanced Microwave Scanning Radiometer 3; AMSR3) and GOSAT-2 follow-on instrument (Total Anthropogenic and Natural emissions mapping SpectrOmeter-3; TANSO-3), has been organised since December 2019.

In terms of the extremes monitoring, JAXA contributes to the WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) Project by providing GSMaP rainfall product with climate normal. JAXA plans to improve the algorithm in December 2020 (algorithm version 8). After the release of the version 8, we will reprocess the past 20-year dataset, and re-calculate the climate normal again.

As for the next generation precipitation radar following to the TRMM/PR and GPM/DPR, JAXA is joining the ACCP Architecture Study in U.S. and proposing the advanced Ku-band Precipitation Radar with doppler capability, higher sensitivity and wider swath.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|-------------|----------|--|------------------------------|--------|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | |
| IPWG | WGII/ 7 | A48.13 | IPWG to review the operational utilisations of spaceborne precipitation radar and to submit a report regarding the necessity of the precipitation radar. | By CGMS- 49 or IPWG-11 | OPEN | | |

8. Working papers responding to or raising CGMS actions

CGMS-48-WMO-WP-08: Status of landing pages in OSCAR/Space

Since 2017 (CGMS-45), the WMO OSCAR/Space database records links to the Landing Pages conceived by GSICS and generated by space agencies on a routine basis to keep the user community abreast of 1) instrument specifications, 2) instrument events, 3) data outages, and 4) instrument monitoring, including GSICS calibration monitoring.

This working paper recounts the status of the Landing Pages recorded in OSCAR/Space, highlighting that some expected input is still missing from two out of nine agencies, that not all Landing Pages cover all expected items, and that the degree of detail is sometimes lower than needed.

Given that the Landing Pages are of interest not only to GSICS, but to the user community in general, CGMS Members are called upon to cooperate in providing the missing information.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|------------|----------|--|----------|--------|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | |
| | item | | | | | | |
| CGMS Members | WGII/ 8 | A48.14 | CGMS Members to review the contents of the Landing Pages accessible through the links recorded in OSCAR/Space and to provide the missing information as identified in working paper CGMS-48-WMO-WP-08. | CGMS-49 | OPEN | | |

CGMS-48-WMO-WP-04: Assessment of value of provision of spectral response functions from CGMS agencies

The International TOVS Working Group has been calling for accurate instrument Spectral Response Functions (SRFs) in support of more accurate radiative transfer for more than two decades (e.g. ITSC-XI report to CGMS-28 in 2000). This is well established for infrared instruments.

Recently it has become more critical to know precise passbands for microwave instruments, in the context of spectrum management. The Radio Regulations footnote 5.340 lists bands for which all emissions are prohibited. Without precise knowledge of the SRFs it is impossible to determine if radio frequency interference encountered by instruments operated by agencies participating in CGMS is due to in-band emissions in the RR5.340 bands or if the instrument itself is out of band.

Therefore, the International TOVS Working Group has called in its last three reports for provision of precise SRFs for both infrared and microwave instruments. This was reported to CGMS and was included in the CGMS best practice that was endorsed by CGMS plenary at CGMS-44. Several agencies are following this best practice and providing the required information. This has enabled studies to document compliance with the bands defined by RR5.340 and to study the impact of measured SRFs on the accuracy of radiative transfer models. These studies have shown that some instruments are being built that have channels that do not fully comply with the bands defined in RR5.340, though the majority do.

In this short paper studies of both aspects (radiative transfer and spectrum management) are briefly presented to reconfirm the value of the CGMS best practice in this respect and thus to encourage all agencies to follow the CGMS best practice.

| Actionee | AGN item | Action # | Description | Deadline | Status |
|-----------------|-------------|----------|---|----------|--------|
| CGMS Members | WGII/ 8 | A48.15 | CGMS Members shall make available their validated instrument SRFs together with uncertainty information through their instrument calibration landing pages. In addition, a document summarising the currently available SRFs and their status (accurate/inaccurate) as well as identifying any missing information shall be provided through the landing pages. | CGMS-49 | OPEN |
| WMO | WGII/ 8 | A48.16 | WMO will establish links to this information through the relevant instrument entries in the OSCAR/Space database. This information will be updated with the help of the OSCAR/Space Support Team though the regular requests for satellite status updates. | CGMS-49 | OPEN |

| CGMS-48 RECOMMENDATIONS - WGII | | | | | | |
|--------------------------------|--------|--------|--|-----------|--|--|
| Lead | AGN | Rec# | Description | Status | | |
| | item | | | | | |
| CGMS | WGII/8 | R48.11 | CGMS Members shall ensure that accurate channel | Review at | | |
| Members | | | Spectral Response Functions (SRFs) for all microwave and | CGMS-49 | | |
| | | | infrared instruments are measured and made available as | | | |
| | | | described in the CGMS Best Practise. | | | |

CGMS-48-WMO-WP-05: Meteorological Satellite Product Development in Support of the International Airways Volcano Watch

This working paper provides an overview of the international airways volcano watch (IAVW), a worldwide system overseen by the International Civil Aviation Organization (ICAO), the World Meteorological Organization (WMO) and partners comprising aeronautical, meteorological, volcanological, geological and other facilities and services with the objective to support continued safe and efficient aviation operations on the ground and in the air whenever and wherever volcanic eruptions are occurring and/or whenever and wherever volcanic ash clouds and gases are present in the atmosphere.

This working paper describes the evolving needs of the aviation user community (in particular a demand to transition from qualitative products to quantitative volcanic ash and gas information services over the next several years), the role of scientific and technological advancement (with a focus on satellite-based remote sensing), and the specific needs from the meteorological satellite provider community to enable the IAVW to evolve in line with meteorological capabilities and aeronautical requirements.

The CGMS agencies are invited to consider the following recommendations addressing meteorological satellite product development in support of the international airways volcano watch (IAVW):

- Ensure that the 'data overload' challenge is being addressed within volcanic cloud product development efforts.
- Prioritise development and operational transition of advanced capabilities such as human expert-like volcanic cloud detection, automated cloud tracking, and more sophisticated ash/SO2 characterisation, which are needed to support the evolving IAVW – over incremental improvements to existing operational products.
- Coordinate product requirements for volcanic ash and SO2 with ICAO's IAVW functional and performance requirements to enable integration into forthcoming amendments to ICAO Annex 3
 Meteorological Service for International Air Navigation.
- Ensure coordination between remote-sensing product development and operational modelling capabilities required for providing forecasts in accordance with ICAO's IAVW requirements.
- Recommend that geostationary satellite operators provide rapid scanning services (< 5 minutes)
 in support of VAAC operations when and where possible to ensure timely detection of new
 volcanic events.
- Recognise that no individual satellite sensor provides all of the needed measurement capabilities for volcanic cloud applications and, therefore, that a multi-sensor holistic approach is required to meet ICAO's evolving IAVW requirements (as concluded by a WMO Sustained, Coordinated Processing of Environmental Satellite Data for Nowcasting (SCOPE-Nowcasting) product intercomparison effort).

| CGMS-48 RECOMMENDATIONS - WGII | | | | | | |
|--------------------------------|--------|--------|--|-----------|--|--|
| Actionee | AGN | Rec# | Description | Status | | |
| | item | | | | | |
| CGMS | WGII/8 | R48.12 | The CGMS agencies to consider the needs and | Review at | | |
| Members | | | recommendations of the international airways volcano | CGMS-49 | | |
| | | | watch (IAVW) in implementing their volcanic ash | | | |
| | | | products. | | | |

8.1 Satellite data for agricultural applications (ref CGMS-47-WMO-WP-11)

CGMS-48-WMO-WP-07: Satellite Products for WMO Drought Monitoring Applications

Drought monitoring and early warnings are crucial parts of drought management which also includes impact and vulnerability assessments and drought mitigation and preparedness strategies. Satellite data are very important source of input monitoring for drought monitoring. Data-sparse areas can be covered and integrated with in- situ data.

This paper will focus on highlighting the following:

- Remote sensing applications for drought monitoring;
- Remotely sensed drought indices;
- Remotely sensed input parameters for drought monitoring.
- WMO has been involved in several donor projects and activities that are applying satellite products for drought monitoring products.

One of these main activities is the Integrated Drought Management Programme (IDMP), which is cosponsored by WMO and the Global Water Partnership (GWP) and has over 35 partner organisations. CGMS Members are invited to consider the WMO programmes and projects for drought monitoring applications and the benefits of a close collaboration between WMO and satellite providers to ensure data and product availability and accessibility for these activities, and to provide Points of Contacts for Drought monitoring.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|-------|----------|--|-----------|--------|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | |
| | item | | | | | | |
| CGMS | WGII/ | A48.20 | CGMS Members to provide Points of Contacts for | Review at | OPEN | | |
| Members | 8.1 | | collaboration with WMO on drought monitoring | CGMS-49 | | | |
| | | | activities. | | | | |

CGMS-48-NASA-WP-03: NASA science and satellite products for agricultural applications

NASA presented their comprehensive science application program related to agriculture. Earth observations (EO) from satellites are playing an increasingly central role across the agricultural sector and therefore EO and EO agencies need to understand decision making processes. Noting that EO is not an ultimate solution but a constraint on your decision process uncertainty, realising full potential & promise of satellite data requires: 1) Stakeholder communities driving the research and development, 2) Innovation in science and technology, and 3) Partnerships across countries, organisations, sectors, & disciplines. NASA Harvest program is building on decades of investments by NASA & international community to radically advance uptake of satellite data for informing agricultural decisions across the globe. More information on NASA Harvest can be found at: https://nasaharvest.org/

CGMS-48-NOAA-WP-08: NOAA-USDA use of Vegetation Health for assessing Agricultural Productivity

This report discussed the use of the NOAA Vegetation Health (VH) product by the United States Department of Agriculture (USDA). NOAA/NESDIS and USDA NOAA/NESDIS and USDA have collaborated over the past decades to use NOAA's Vegetation Health product as critical supporting information used in the USDA monthly agricultural productivity reports. USDA meteorologists monitor weather and climate worldwide. Crop weather assessments are prepared weekly using a variety of data and products, including precipitation, soil moisture, temperature, climate indices, snow cover, crop progress, reservoir level, crop condition, stream flow, and satellite imagery. At a minimum, assessments inform economists qualitatively how crop prospects are changing. Ideally, these assessments provide quantitative yield estimates. Simple crop models and analytical techniques aid yield analyses. Historically, satellite data were used primarily to visually corroborate weather data. In recent years, satellite imagery have taken on a much more robust role in our assessments. The USDA finds NOAA vegetation health index as an important information source for a number of reasons, including: VHI data have a long track record - support development of crop yield relationships; Data are available in a GeoTiff format – user friendly and GIS compatible; Data are updated weekly - when issues do arise, they are often addressed very quickly; Recalculated data incorporated in updates - removes noise, improving yield forecasts; Well-designed web site - easy to navigate and promotes automated downloads; Development of cropland specific data sets – significantly

reduces USDA processing time and greatly increases operational value. More information on NOAA's VH product can be found at https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/vh browse.php

CGMS-48-KMA-WP-05: Satellite based drought monitoring over the Korean Peninsular

This document is to describe the current status of Geo-Kompsat 2A/Advanced Meteorological Imager (GK2A/AMI) application products (drought index and soil moisture) for drought monitoring over the Korean Peninsula.

Drought monitoring is possible to monitor the drought situation in the broader area more continuously and to produce the drought information in a wide area quickly by using geostationary satellite such as GK-2A/AMI. To support the drought monitoring from GK2A, KMA has developed the drought index(PWSI, Potential land-surface Water Stress Index) and soil moisture retrieval algorithm and most of them are optimising from long-term GK-2A data to operation. Future plan will be 1) GK-2A based evapotranspiration will be provided in Q4 2020 and soil moisture will be provided in 2021, and 2) NMSC has plan to improve the GK-2A based drought indexes by changing the bias correction method

CGMS-48-CMA-WP-08: Status of QPE from Fengyun-4A Satellites

This paper briefly introduces status of operational FY-4A QPEs at NSMC/CMA. The paper first briefly introduces FY-4A QPE operational processing algorithms in the NSMC/CMA being implemented. The paper also presented the comparison results with GPM DPR precipitation to show the validation status of QPE.

8.2 Satellite data and products for bathymetry and coastal inundation (ref CGMS-47 WMO-WP-12)

CGMS-48-CEOS-WP-01: CEOS-COAST: A Pathfinder to Address Stakeholder Product and Information Needs in the Coastal Zone

The presentation was made pursuant to CGMS-47 WMO-WP-13: Satellite-Derived Coastal Bathymetry and requested engagement by CGMS and key partners (WMO et al.) in CEOS-COAST to address satellite bathymetry product needs and broader coastal flooding & inundation pilot activities. WMO thanked for the presentation, which outlines opportunities for collaboration to address the needs for satellite bathymetry products that could be beneficial to users in the WMO Tropical Cyclone Programme.

CGMS-48-ESA-WP-01: Use of SAR (S-1) and L-band radiometer (SMOS) for improved wind retrieval in strong to extreme storm conditions

Extreme wind events associated to rapidly rotating storm systems occupy an increasing place in the mass media as they have direct societal and economic implications and are expected to become more destructive in the future as a consequence of global warming. There is therefore a strong need for improving the monitoring and forecasting of such events in order to anticipate appropriate risk mitigation and emergency response at landfall including flooding.

Oceanographic field measurements in such extreme wind events conditions are rare and satellite data therefore provide a very unique and extremely useful source of information. However, spaceborne wind

retrieval in extreme storm events has been a long-standing issue as sensors classically used for wind retrieval (altimeter, radiometer, scatterometer) suffer a number of limitations due to signal contamination and/or saturation in strong to extreme wind and rain conditions.

In the recent years new sensors have been put into orbit, and new algorithms have been developed allowing to partly overcome these limitations. This includes L-band radiometers, which are significantly less affected by rain and atmospheric effects than higher microwave frequencies and cross-polarised C-band Synthetic Aperture Radar which exhibit largely improved sensitivity compared to conventional co-polarised instruments.

The objective of this paper is to present the capacity of these existing satellite missions, in particular Sentinel-1 and SMOS, to provide accurate wind measurements in strong to extreme storm conditions. A number of past, present and future projects and activities run by ESA are introduced, including R&D activities aiming at the development of new algorithms and products, dedicated hurricanes observation campaigns, and preparatory activities for new potential operational services. All those activities contribute to several CGMS High Level Priority tasks and are strongly recommended to be pursued in the future, also taking advantage of new space missions.

WMO thanked for the presentation which outlines opportunities for collaboration to address the needs for improved wind retrieval that could be beneficial to users in the WMO Tropical Cyclone Programme.

CGMS-48-NOAA-WP-09: Update on NOAA-CMA flood mapping pilot project and the new CEOS initiative

NOAA/NESDIS and USDA have collaborated over the past decades to use NOAA's Vegetation Health product as critical supporting information used in the USDA monthly agricultural productivity reports. This report provides an overview of the need by USDA and examples how they use the VH product from NOAA. Also reported is Information on how to access the product from NOAA.

CGMS-48-WMO-WP-06: Use of satellite data in Flash Flood Guidance System

Comprehensive coverage of the entire surface of the earth can only be obtained with observations from meteorological satellites. The relatively high spatial and temporal resolution is critical since heavy rain often covers a relatively small area and can change very quickly. In addition, because of short latency, data can be made available to the forecasters in less than half an hour. These are all reasons why satellite precipitation estimates form is an important part of the Flash Flood Guidance System (FFGS).

Recognising the disastrous impact on lives and properties of affected populations by flash floods, the World Meteorological Organization (WMO), in collaboration with the project partners have created the FFGS with global coverage project to assist forecasters in providing the guidance needed to issue timely and accurate flash flood warnings. Currently, the FFGS serves approximately 40% of the world's population covering almost 3 billion people in over 60 countries.

Satellite products in FFGS include the bias corrected precipitation estimates from satellites in geostationary and polar orbits, and snow coverage area. Methods that combine microwave (MW) data

with frequent and low latency infra-red (IR) data are expected to have potential utility. To improve the forecast accuracy, the plan is to incorporate nowcasting data and high-resolution satellite data.

CGMS Members are invited to consider the WMO programmes and projects for flood monitoring applications and the benefits of a close collaboration between WMO and satellite providers to ensure data and product availability and accessibility for these activities, and to provide Points of Contacts for flood monitoring.

| CGMS-48 ACTIONS - WGII | | | | | | |
|------------------------|-------|----------|---|----------|--------|--|
| Actionee | AGN | Action # | Description | Deadline | Status | |
| | item | | | | | |
| CGMS | WGII/ | A48.17 | to provide Points of Contacts for collaboration | CGMS-49 | OPEN | |
| Members | 8.2 | | with WMO on flood monitoring activities. | | | |

8.3 Arctic observations (as per CGMS-47 discussions)

A thematic session was held at CGMS-47, however due to the compressed schedule and as no major evolutions in the Arctic space based observation system took place, there were no follow-up presentations or discussions at CGMS-48 WG II meeting.

9. Review and updating of the WGII TOR (due 2020)

CGMS-48-CGMS-WP-13: Review of WG II Terms of Reference

CGMS Working Group II on "Satellite Data and Products", meets at the annual CGMS meeting usually held before the plenary session. It is the CGMS forum where aspects of technical and scientific nature related to satellite data and products are discussed.

WG II membership consists of satellite data and products experts drawn from CGMS Members and Observers.

The Working Group serves as the link between CGMS and the CGMS International Science Working Groups (ISWGs), which provide regular reports and feedback to CGMS through WG II:

- International Clouds Working Group (ICWG)
- International Precipitation Working Group (IPWG)
- International Radio Occultation Working Group (IROWG)
- International Satellite Winds Working Group (IWWG)
- International TOVS working group (ITWG)

WG II is also the primary interface between CGMS and other relevant international initiatives, such as the Global Space-based Inter-Calibration System (GSICS), the CEOS-CGMS Joint Working Group on Climate (WGClimate) and user communities, such as those organised in the WMO Application Areas.

During its inter-sessional work in 2020, WG II reviewed the Terms of Reference for Working Group II (WG II) as endorsed by Plenary at CGMS-44 (see CGMS-44-CGMS-WP-34).

WG II reviewed the working paper CGMS-48-WP-13 and provided several suggestions for updating the Terms of Reference. The revised WG II Terms of Reference will be submitted to Plenary for their endorsement.

| CGMS-48 ACTIONS - WGII | | | | | | | |
|------------------------|-------|----------|---|----------|--------|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | |
| | item | | | | | | |
| CGMS | WGII/ | A48.18 | Plenary to endorse the updated WG II Terms of | CGMS-48 | OPEN | | |
| Plenary | 9 | | Reference | Plenary | | | |
| | | | | Session | | | |

10. Review and updating of the HLPP

CGMS-48-CGMS-WP-14WGII: Status of implementation of CGMS High Level Priority Plan (2019-2023)

The status of implementation of CGMS High Level Priority Plan (2019-2023) were presented in the respective presentations from:

- International Science Working Group chairs and rapporteurs;
- GSICS project;
- SCOPE-CM project;
- CEOS-CGMS Joint Working Group on Climate.

CGMS-48-CGMS-WP-15WGII: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2020-2024

As part of the agreed revision cycle for the CGMS High Level Priority Plan, this document presents a proposed HLPP covering the period 2020-24. The plan is based on the following inter-sessional activities:

- Meetings of the International Science Working Groups
- Recommendations from of WG-I, -II, -III and -IV as well as SWCG

WG-II provided updates to the HLPP.

11. Any other business

There were no other business discussed.

12. Review Nomination and representatives at meetings

There is a need to fill a number of vacancies (or upcoming ones in the near future) for co-chairs and rapporteurs in some of the CGMS Working Groups, rapporteurs in the CGMS international science working groups, and the co-chair position in VLab. The current status is provided in this working paper indicating either existing vacancies or upcoming ones in the near to medium term future. CGMS members are invited to nominate candidates for the co-chair and rapporteur vacancies (or upcoming vacancies) for endorsement by CGMS-48 plenary.

No new nominations were considered at this session.

13. Date/time of inter-sessional activities/meetings in 2019-2020 [CGMS-48 -> CGMS-49]

The following dates and times for inter-sessional meetings were agreed:

- 19 November 2020, 12:00-14:00 UTC
- 11 March 2021, 12:00-14:00 UTC

14. Review of actions/conclusions, preparation of WG report for plenary

The summary list of WGII actions and recommendations resulting from CGMS-48 is included in Annex III of this report.



WG III REPORT

Co-chairs: Peng Zhang (CMA), Ajay Mehta (NOAA) **Rapporteur:** Lars Peter Riishoigaard (WMO)

1. Welcome and review of agenda with objectives of the meeting

Co-chairs Ajay Mehta and Peng Zhang welcomed all participants to the WGIII session and related joint sessions. They briefly presented the objectives of the meeting related to the CGMS baseline and the CGMS risk assessment.

WGIII participants approved and adopted the agenda proposed by the CGMS Secretariat prior to the meeting. Agenda items from no. 5 and onward were moved from Thursday to Friday due to the tight schedule of the meeting.

Additionally, a joint WGII and WGIII session took place covering the status of preparations of the CGMS baseline and risk assessment documents and establishment of way forward for science questions raised during baseline and risk assessment review including the following topics: hyperspectral infrared sounder and the impact of spectral gaps, how to characterise CGMS' radio occultation contribution, how to characterise CGMS' radiation balance contribution, and visible/UV spectrometer trace gases observations from GEO.

2. Review of actions and recommendations from previous meeting

WGIII discussed the actions and recommendations from previous CGMS plenary sessions (CGMS-47 and earlier) and the final status is provided in Annex IV of this report.

3. CGMS risk assessment

3.1 CGMS risk assessment - second revision (verbal)

CGMS-48-EUMETSAT-WP-07: Outcome of EUMETSAT study on IODC GEO meteorological imager observations

In response to WGIII/A47.08 EUMETSAT performed an analysis of the current and future sources of geostationary imagery over the Indian and Pacific Oceans, and the anticipated availability of new satellites in the 2022-2025 timeframe. The analysis aimed to assess the priorities, from a user perspective, for time-critical third-party geostationary data services for the Indian and Pacific Oceans in the context of the preparation of the EUMETSAT NRT dissemination baseline to be adopted for 2022. The prioritisation is needed due to the substantial evolutions expected from partners' satellites in terms of coverage and observation capabilities, and possible redundancies or overlaps over some regions of both oceans. The analysis concluded that there is now sufficient coverage and resilience over the Indian Ocean with regards GEO imaging satellites up to at least 2025. GEO imagery data are available via a combination of telecommunication satellite redistribution (EUMETCast, CMACast, HimawariCast) and Internet. Action WGIII/A47.08 was closed.

3.2 Finalise WGIII risk assessment findings (incl. SWCG elements)

CGMS-48-CGMS-WP-10: Draft update of the CGMS risk assessment

In response to action WGIII/47.15 NOAA presented CGMS baseline update and related risk assessment. The CGMS Baseline constitutes the CGMS response to the WIGOS 2040 Vision to document what missions are currently being, or planned on, flown. The risk assessment provides a qualitative analysis for all orbits and satellite missions that contribute to the CGMS Baseline. The assessment is given from a CGMS member prospective and may not include contributions from non-CGMS agencies and commercial providers. It is based on the planned launch dates, design lifetime, and updated operational experience recorded in OSCAR/Space. However, there is uncertainty in planned launch dates, satellite lifetimes (e.g., satellites often operate beyond their design life), operational readiness, and on-orbit health — all of which impact the risk assessment and ultimately the users. Input on quality and availability of the data is provided by WGII.

The CGMS Risk Assessment is completed every year forming the basis for CGMS actions to ensure continuity. WG III held a workshop 19-21 February 2020, hosted by EUMETSAT and attended by representatives of WGII and Space Weather Coordination Group. The findings and actions from this Workshop were sent to other Working Groups for review and discussed at Working Group III Intersessional.

The following top-level risk assessment focus areas were reported:

- There is a long term continuity risk for critical sensors (e.g., Microwave and Hyperspectral Sounders and Multipurpose Imagers) in the early morning orbit towards the end of the current decade (2020's).
 - CMA's planning is underway for a follow-on to FY-3E in the early morning orbit. After the launch of FY-3E, the WMO/CGMS Tiger Team will be reconvened to assess the benefit of the early morning orbit to inform CMA's plans (Action WGIII/A47.07).
- There is a continuity risk for the number and geographic distribution of radio occultations;
 especially in the low to mid-latitudes
 - WGIII recommends that CGMS members fly RO sensors providing coverage in the low- to midlatitudes
- WGIII noted that long term plans for Atmospheric Chemistry observations need to be confirmed
- Long term continuity was at risk for Microwave Imager in the early morning orbit; especially ~6GHz capability for all-weather sea surface temperatures is critical
 - WG III recommended that NOAA to confirm U.S. plans for early morning coverage
 - NSOAS data availability was discussed as there was no commitment to provide data for the global community. EUMETSAT was asked to discuss the topic with NSOAS (SOA/MNR) to

confirm if the HY missions can be included in the CGMS baseline and risk assessment (Action WGIII/48.02).

- WG III noted that there were no long-term plans for a Precipitation Radar sensor
 - JAXA noted the operation of GPM mission through the period of the risk assessment
 - WG III recommended that CMA should confirm plans beyond FY-3RM-1. In the meeting CMA reported that the plans beyond FY-3RM-1 are still open and funding for the follow up mission was not approved.
- WG III noted that there were no-long term plans for a Scatterometer senor in the afternoon orbit
 - WG III recommended that ISRO confirm plans beyond Oceansat-3 (Action WGIII/A47.11).
- WG III noted the risk of a gap in Coronagraph and Plasma Analyser sensors in the near term
 - WG III recommended that ISRO confirm launch plans and capabilities of Aditya-L1 mission
 - WG IIII recommended that CGMS members should develop contingency plans for potential gaps in solar imagery from the Earth-Sun line, and solar wind measurements at L1 orbit

3.3 Contingency actions/recommendations (as needed)

Based on the report in Section 3.2 the following actions and recommendation were recorded.

| CGMS-48 a | ctions – V | VGIII | | | |
|-----------|------------|----------|--|-----------|--------|
| Actionee | AGN | Action # | Description | Deadline | Status |
| | item | | | | |
| CGMS | WGIII/ | WGIII/A | WGIII to reflect the aspect of latency in the CGMS | Feb 2021 | OPEN |
| space | 3.2 & | 48.01 | baseline/risk assessment. | | |
| agencies | 4.1 | | (Ref. from IPWG CGMS-47 plenary item 5.7 R47.06, | | |
| | | | passed to WGIII as a recommendation and | | |
| | | | converted to an action at CGMS-48 WGIII, 29 May | | |
| | | | 2020: Latency and quality of satellite data should | | |
| | | | be improved, from both operational and research | | |
| | | | missions, to fit in the data assimilation high | | |
| | | | temporal resolution cycle). | | |
| EUMETSAT | WGIII/ | WGIII/A | CGMS-48 WGIII discussions May 2020 (and the | Feb 2021 | OPEN |
| (NSOAS) | 3.2 & | 48.02 | now closed 1RAWS2019.4): | (2020 May | |
| | 4.1 | | WGIII recognised the need for a long term plan for | 28, CGMS- | |
| | | | ~6Ghz frequency microwave imaging in at least | 48 WGIII) | |
| | | | one LEO orbit for all weather Sea Surface | | |
| | | | Temperature observations. | | |
| | | | Recommended Mitigating Action #4: [EUM and | | |
| | | | SOA] to ensure data availability for HY-2B MWI. | | |
| | | | (CGMS-48-CGMS-WP-10, EUMETSAT to reach out to | | |
| | | | NSOAS (SOA/MNR) to confirm if the HY missions | | |
| | | | can be included in the CGMS baseline and risk | | |
| | | | assessment). | | |

| CGMS-48 actions – WGIII | | | | | | | | |
|-------------------------|--------|----------|---|-----------|--------|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | |
| | item | | | | | | | |
| EUMETSAT | WGIII/ | WGIII/A | CGMS-48 WGIII discussions May 2020 (and the | Feb 2021 | OPEN | | | |
| (NSOAS) | 3.2 & | 48.03 | now closed 1RAWS2019.8): | (2020 May | | | | |
| | 4.1 | | WG III recognised that there is no radar altimetry | 28, CGMS- | | | | |
| | | | data availability in the early morning orbit in the | 48 WGIII) | | | | |
| | | | short term and that there are no plans in the long | | | | | |
| | | | term for coverage. | | | | | |
| | | | Recommended Mitigating Action #8: [EUM and | | | | | |
| | | | SOA] to ensure data availability for HY-2B ALT. | | | | | |
| | | | (CGMS-48-CGMS-WP-10, EUMETSAT to reach out | | | | | |
| | | | to NSOAS (SOA/MNR) to confirm if the HY missions | | | | | |
| | | | can be included in the CGMS baseline and risk | | | | | |
| | | | assessment). | | | | | |
| EUMETSAT | WGIII/ | WGIII/A | EUMETSAT to explore with NIER of GEO KOMPSAT | Feb 2021 | OPEN | | | |
| (NIER) | 3.2 & | 48.04 | 2B GEMS observations can be considered for the | | | | | |
| | 4.1 | | CGMS baseline and risk assessment. | | | | | |

4. CGMS baseline

4.1 Status of the CGMS baseline - second revision (verbal)

4.2 Finalise CGMS Baseline revision (incl. SWCG elements)

CGMS-48-CGMS-WP-12 WGIII: Draft update of the CGMS Baseline

In response to action WGIII/A47.15 NOAA presented the draft text of the second revision of the CGMS baseline. The text was reviewed by relevant working groups during CGMS-48 on 25-29 May 2020, in order to conclude on a final text for endorsement by CGMS-48 plenary on 25-26 August 2020. The 2nd CGMS WGIII risk assessment workshop was held in EUMETSAT on 19-21 February 2020 on whose occasion the CGMS baseline and related risk assessment was conducted. The working group reviewed the CGMS baseline and proposed revisions. Following the CGMS-48 working group discussions, CGMS members are requested to recommend the 2nd revision of the CGMS baseline to CGMS-48 plenary for endorsement and, at that stage, for WMO to take into account the new baseline in forthcoming updates of the Manual on WIGOS and related materials.

Several comments on Section 2. "Observations and orbits" were received. The comments were reviewed in the meeting and document was edited accordingly.

| CGMS-48 recommendations - WGIII | | | | | | | | | |
|---------------------------------|-------|--------|------------------------------------|---|--|--|--|--|--|
| Lead | AGN | Rec# | Description | Recommendation feedback/closing | | | | | |
| | item | | | document | | | | | |
| CGMS | From | R47.05 | (From IPWG): Higher spatial and | 2020 May 28, CGMS-48 WGIII: CGMS | | | | | |
| space | plena | | temporal (sub-hourly) resolution | members to take note/consider in the | | | | | |
| agencies | ry | | and higher spectral sampling in | preparation of new programmes. To be | | | | | |
| | 5.7 | | the microwave measurement of | further addressed within the framework of | | | | | |
| | | | clouds and precipitation should be | the CGMS baseline/risk assessment (Q1 | | | | | |
| | | | considered in future observing | 2021). | | | | | |
| | | | systems. [Recommendation | | | | | | |
| | | | transferred from plenary]. | | | | | | |

CGMS-48-WMO-WP-14: Status of Critical Satellite Data Paper/NWP

WMO reported that the progress on Critical Satellite Data Paper had been delayed due to the COVID-19 crisis and that the Technical Commission session planned for April 2020 had been postponed by at least seven months. The intention of WMO was to link the revision and updating of the Critical Satellite Data paper to the finalisation of the Global Basic Observing Network (GBON) regulatory material, and to submit both documents to the Extraordinary World Meteorological Congress in June 2021 for approval. It was noted that the reservations expressed earlier by NOAA on how the Critical Satellite Data paper was framed in particular vis-a-vis the role of the private sector would still be addressed during this process. WMO will come back with a consolidated update at CGMS-49.

5. WMO OSCAR space database - long term continuity

CGMS-48-WMO-WP-10a: OSCAR/SPACE database contents updating procedure

WMO reported on the OSCAR/Space database contents updating procedure. It relies on the OSCAR/Space Support Team (O/SST), which consists of the focal points nominated by CGMS members. The current composition of O/SST was presented. All members except CNSA have nominated a focal point in response to original request made at CGMS-45. The main mechanism for WMO to collect the relevant information is through templates submitted to the O/SST members, and the usual update frequency is three to four times per year. Some challenges have been recognised when updating the actual operational status of the satellites and their instruments from non-CGMS satellite operators and from commercial satellite operators.

WMO presented the current status of the database contents in the Appendix of the working paper CGMS-48-WMO-WP-10b: Status of satellites and instruments as recorded in OSCAR/SPACE. The indicated needs for the status updates will be included in the templates submitted to the O/SST members latest after CGMS-48 Plenary.

CGMS-48-WMO-WP-10c: Coordination between WMO OSCAR/SPACE and CEOS MIM

In response to CGMS action WG III/A47.06b, WMO performed a study to analyse various related aspects of the WMO OSCAR/Space and CEOS MIM databases. The study concludes that merging the two systems would currently not be feasible, and that even coordination between them remains difficult. Cooperation should be attempted in the areas of updating the status of satellites and instruments and in seeking

convergence of the names of observed variables. The study results contained in this working paper have been delivered to CEOS, and as a result, further efforts to improve coordination are being made. Related action WG III/A47.06b was closed.

| CGMS-48 actions – WGIII | | | | | | | | | |
|-------------------------|---------|----------|--|-----------|--------|--|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | | |
| | item | | | | | | | | |
| WMO | WGIII/5 | WGIII/A4 | WMO to prepare templates on OSCAR/Space | July 2020 | OPEN | | | | |
| | | 8.05 | data that needs to be updated and submitting | | | | | | |
| | | | them to O/SST, approximately 3-4 times a year, | | | | | | |
| | | | for providing the missing information and to | | | | | | |
| | | | provide these to the CGMS space agencies. | | | | | | |
| | | | (Ref. CGMS-48-WMO-WP-10a) | | | | | | |
| WMO | WGIII/5 | WGIII/A4 | WMO to continue efforts to establish reliable | CGMS-48 | OPEN | | | | |
| | | 8.06 | O/SST focal points from CEOS, non- | | | | | | |
| | | | CGMS/CEOS and commercial satellites | | | | | | |
| | | | operators. | | | | | | |
| CGMS | WGIII/5 | WGIII/A4 | CGMS members, through their O/SST focal | July 2020 | OPEN | | | | |
| space | | 8.07 | points, to provide accurate and timely updates | | | | | | |
| agencies | | | on OSCAR/Space database content in response | | | | | | |
| | | | to requests made to them by the WMO Space | | | | | | |
| | | | Programme Office. | | | | | | |
| | | | (Ref. CGMS-48-WMO-WP-10a) | | | | | | |

CGMS-48-WMO-WP-11: OSCAR/Space database maintenance and evolution

WMO presented the progress made with OSCAR/Space maintenance and evolution. Following CGMS-47, WMO held an internal OSCAR/Space meeting on 2 and 3 July 2019, to review the most urgent OSCAR/Space development needs and to discuss and agree on a way forward. Subsequently, WMO placed a contract with an IT company with the technical skill set to further develop OSCAR/Space. The contract also includes an extension option for future developments over the next three years.

Work under this contract is presently ongoing and includes eight tasks related to OSCAR/Space development. In addition to functionality improvements, a main goal is to upgrade the underlying technical platform. In the next development phase, it is planned to make OSCAR/Space compatible with WIGOS metadata records. The implementation plan for this effort will be based on work conducted by ICG/WIGOS Task Team on the WIGOS Metadata. This development will integrate WIGOS metadata records into the OSCAR Space database, in a similar way as it has been done for OSCAR Surface, opening the door for future integration between the OSCAR components.

Action WG III/47.03 requesting WMO to hold a workshop on OSCAR/Space in order to develop plans for its sustainment and future development, both in terms of information content and system capability was left open. WMO will organise the workshop in 2021.

CGMS-48-WMO-WP-12: Use of OSCAR/Space to monitor progress of WIGOS implementation

WMO presented working paper as information to CGMS about the first study by WMO to measure progress towards implementing the WMO Strategic Plan 2020-2023. It proposes to measure the percentage of space-born instruments in orbit in relation to the Vision for WIGOS Vision in 2040 to quantify the degree of compliance of satellite programme plans with the Vision. This study indicates that for the Group 1 items referring to the core GEO and SSO systems, it has been possible to evaluate the degree of compliance of current and planned systems with the WIGOS Vision 2040. For the other items of Group 1 and for Groups 2, 3 and 4, in the absence of specific requirements, only a review of current and perspective availability has been possible. WMO aims to update OSCAR/space to use it as a tool to monitor the evolution of satellite and instrument programmes in line with the Vision.

CGMS-48-WMO-WP-13a: Risk Assessment Based on WMO OSCAR/Space Gap Analysis (Appendix CGMS-48-WMO-WP-13b)

In response to WGIII/A47.02 and WGIII/A47.15 the gap analysis performed by WMO compares the satellite information recorded in OSCAR/Space with the user requirements as recorded in OSCAR/Requirements. The gap analysis is extended to long-term requirements, including in the WIGOS Vision and not only CGMS baseline. The considered period is the 2021-2030 to be aligned with CGMS risk assessment. The report is split into working paper CGMS-48-WMO-WP-13a that includes recommendations, and an Appendix CGMS-48-WMO-WP-13b providing full details of the analysis.

The result outlines considerations in support of discussion at the 2nd CGMS WG III Risk Assessment Workshop according to the following "critical areas": Early-morning LEO, Coverage from GEO, Trace gas detection, Earth Radiation Budget, Aerosol observation, Precipitation measurement, Sea-surface wind, Ocean altimetry, Sea surface temperature and Ocean colour, Soil moisture, Snow, Sea-surface salinity, Sea ice and Space weather.

In discussion it was pointed out that the terminology (gap analysis vs. risk assessment) should be ensued. It was re-emphasised that gap analysis is a WMO-led activity reflecting capabilities provided by CGMS activities against WMO requirements, while the risk assessment is CGMS-led reflecting current and/or projected reality assessed against CGMS baseline.

6. Updates on significant observational missions

6.1 Operational missions

CGMS-48-ISRO-WP-05: ISRO Report on Operational Continuity and Contingency Plans

ISRO reported their operational missions including INSAT, Oceansat, Resourcesat, RISAT and NISAR. INSAT-3 Series and GISAT-1 are the current operational GEO satellites with imager and IR sounder payload. ISRO is operating radar satellite RISAT Series on drifting and sun-synchronous (RISAT-1A) orbits. NISAR (S-and L-band) will be launched in 2022 providing high-resolution all-weather imagery on oceans and on land, where suited for soil moisture. ISRO operates OCEANSAT-3 series satellites carrying also Argos-4 DCS

payload (CNES) on sun-synchronous orbit. In addition, ISRO operates Resourcesat-3 Series satellites for high resolution land observations on sun-synchronous orbit.

CGMS-48-CMA-WP-12: Status report on the FY-3 early-morning mission

In 2013 CMA decided to deploy FY-3E satellite into early morning orbit instead of mid-morning in order to help realise the WMO Vision for GOS 2025 and help optimise the current global operational polar-orbiting system to meet the requirement on the temporal and spatial distribution of sounding data.

Since 2013 FY-3E's satellite platform and all payloads have been developed. Currently the integration of the whole satellite is almost completed, and the prelaunch calibration and characterisation is ongoing before the readiness for the launch in early 2021. The ground data processing segment of FY-3E is being developed and established. The data assimilation for remote sensing utilisation of FY-3E satellite is pending and will be tested on the simulated data or proxy data on early orbit observation.

FY-3E application pathfinder plan was made by CMA recently for supporting core operational applications including numerical weather forecast, weather, climate, land surface, environment and disaster and Space weather.

CGMS-48-IMD-WP-02: Operationalisation of Multi Mission Meteorological Data Reception and Processing System at India Meteorological Department (IMD)

IMD has established the Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS) for INSAT-3D, INSAT-3DR and INSAT-3DS satellites and two data streams of AWS/ARG (IMD & ISRO Network) simultaneously. MMDRPS system comprise the following major components with three Earth receiving stations, Data Acquisition system, Data Processing System, Data storage & data supply system and Satellite Imagery Display System.

Each Earth station is receiving the data in redundant mode from each payload (Imager, Sounder and DRT) and Raw data archival storage facility. MMDRPS have very high-end processing system which cut down the processing time from 15 minutes to 7 minutes and has provision to update calibration coefficient in operational chain using Cal/ Val site & GISCS data. System is capable to process RAPID scan data of INSAT-3DR Imager payload conducted during Extreme weather events.

All available past satellite datasets starting from 1983 will be kept in online mode in due course of time. The MMDRPS system is being used to Receive & process the INSAT-3D and INSAT-3DR satellites data since 1st October 2019. The system is generating around 98 GB raw data and 125 GB processed data on daily basis. The MMDRPS has dedicated Web based Data supply System (DSS) in main &redundant mode to cater web-based data supply to cater user requirements in near real time basis as well as offline mode (both local and remote global) based on data dissemination policy of IMD. The web based -DSS is supported by a DJANGO Database Management System containing Metadata of all processed products available on the central storage. The MMDRPS system is hosting two website and online data visualisation facility (RAPID) in redundancy mode.

6.2 Research missions

CGMS-48-JAXA-WP-03: Update on the status of future Precipitation Radar mission

JAXA gave an update of the status of the next generation Precipitation Radar mission. JAXA has discussed the next generation precipitation radar mission with Japanese science team and user community since 2008. JAXA has large heritage of the TRMM PR and GPM DPR, and the data record of spaceborne precipitation radars for more than 20 years. Recently Japan experiences extreme rain and flood event almost every year, so that monitoring and forecasting heavy rain is crucial for our lives.

Against the background, continuous precipitation observations from TRMM PR and GPM DPR to the next generation precipitation radar is desirable from the applicational viewpoint as well as the scientific aspect. As discussed with Japanese science team and user community, JAXA raised three mission objectives for the next generation precipitation radar as follows; 1) Understanding of cloud-precipitation process, 2) Collaboration with high-resolution weather and climate numerical models, and 3) Monitoring the extremes and its applications.

On the U.S. side, the NASA Architecture Study is now ongoing in response to the observations of Aerosol, Cloud, Convection and Precipitation (ACCP), which are the "designated" targeted observables defined in the 2017-2027 Decadal Survey for Earth Science and Applications from Space (ESAS 2017) by the National Academies. The mission objectives discussed in Japan are synergetic to the Goals of the ACCP Study. Hence, JAXA joins the ACCP Architecture Study in U.S., and proposes the advanced Ku-band Precipitation Radar with Doppler capability, higher sensitivity, and wider swath. The ACCP Architecture Study is now ongoing.

7. Update on Socio-Economic Benefits Tiger Team (SETT)

CGMS-48-NOAA-WP-11: Update on Socio-Economic Benefits Tiger Team (SETT)

The CGMS established the Socioeconomic Benefits Tiger Team (SETT) at the 41st plenary session of CGMS in order to develop credible methodology and common terminology to assess and articulate the socioeconomic benefit of satellite observing systems, and to explore the most effective ways to communicate this information to desired stakeholders. SETT reported on their activities related to literature review, socio-economic expertise identification, workshops conducted and a guidance document for CGMS Members. Currently, they are undertaking a pilot socioeconomic benefit study, which is in progress.

8. Any other business

Nothing reported.

9. Review and updating of the HLPP

CGMS-48-CGMS-WP-14WGIII: Status of implementation of CGMS High Level Priority Plan (2019-2023)

The CGMS Secretariat presented the Status of implementation of CGMS High Level Priority Plan (2019-2023) including the implementation of HLPP targets overseen by WG III, targets proposed to be

considered achieved or removed from HLPP and considerations for HLPP revisions. There was progress on all targets with none fully achieved yet. Targets 1.1 and 1.2 were discussed more detailed in the meeting.

Target 1.1: Mitigate the impact of identified degradation or loss of capabilities of the CGMS baseline and ensure appropriate contingency measures are in place.

Related to target 1.1 the 2020 CGMS Risk Assessment concluded that the overall CGMS constellation is very robust, but that for a few observation areas risks have been identified to the provision of operational services in the next decade. Based on this analysis, CGMS will take actions to following:

- Ensure continuity of passive microwave imager measurements;
- Ensure long-term continuity of the Early Morning orbit, in particular for IR/MW sounding;
- Ensure long-term continuity of Precipitation Radar measurements;
- Ensure long-term continuity of Scatterometer measurements;
- Ensure that future missions in drifting orbits will carry Radio Occultation instruments;
- Analyse the potential of scientific space weather missions for operational gap filling.

Target 1.2: Advance the response to the Vision for WIGOS in 2040 vision for space, by the implementation of new capabilities beyond the CGMS baseline.

The 2020 review of the CGMS baseline concluded that the baseline is still a comprehensive response to the WIGOS vision, addressing the key application areas. However, in the coming years CGMS members will be launching several satellites with new capabilities expanding the response to the vision and CGMS therefore agreed to include the following measurement capabilities in the CGMS baseline:

- Imaging from Highly Elliptical Orbits for Arctic observations;
- Short Wave IR Spectrometers for monitoring of Greenhouse Gases (CO2 and CH4);
- Multi-viewing, multi-channel, multi- polarisation imaging for aerosols;
- UV limb sounding spectrometry for profiles of Ozone and trace gases.

In addition, a number of new satellite programmes are under consideration by CGMS members that offer the potential to expand the response to the WIGOS vision either through application of new technologies or through extending the coverage of existing capabilities. In this respect, CGMS will strive to:

- Advance the new generation of GEO satellites, including advanced imaging, lightning mapping and IR and UV sounding for the whole geostationary ring;
- Work towards ensuring low frequency microwave imagery for all-weather SST and ice monitoring from at least 2 sun-synchronous orbits;
- Increase geographical altimetry coverage, for example through wide-swath altimetry;
- Advance the atmospheric Radio Occultation constellation, with the long-term goal of providing 20000 occultations per day on a sustained basis;
- Move towards an operational space weather monitoring capability from the Lagrangian Point L-5.

CGMS-48-CGMS-WP-15WGIII: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2020-2024

According to status update of implementation of CGMS High Level Priority Plan (2019-2023) the meeting proposed following updates to be added to the CGMS High-Level Priority Plan (HLPP) for the period 2020-2024. Major updates are summarised below.

Chapter 1.1 Mitigate the impact of identified degradation or loss of capabilities of the CGMS baseline and ensure appropriate contingency measures are in place.

The 2020 CGMS Risk Assessment concluded that the overall CGMS constellation is very robust, but that for a few observation areas risks have been identified to the provision of operational services in the next decade. Based on this analysis, CGMS will take actions to:

- Ensure continuity of passive microwave imager measurements;
- Ensure long-term continuity of the Early Morning orbit, in particular for IR/MW sounding;
- Ensure long-term continuity of Precipitation Radar measurements;
- Ensure long-term continuity of Scatterometer measurements.
- Ensure that future missions in drifting orbits will carry Radio Occultation instruments;
- Analyse the potential of scientific space weather missions for operational gap-filling.

Chapter 1.2 Advance the response to the Vision for WIGOS in 2040 vision for space, by the implementation of new capabilities beyond the CGMS baseline.

The 2020 review of the CGMS baseline concluded that the baseline is still a comprehensive response to the WIGOS vision, addressing the key application areas. However, in the coming years CGMS members will be launching several satellites with new capabilities expanding the response to the vision and CGMS therefore agreed to include the following measurement capabilities in the CGMS Baseline:

- Imaging from Highly Elliptical Orbits for Arctic observations;
- Short Wave IR Spectrometers for monitoring of Greenhouse Gases (CO2 and CH4);
- Multi-viewing, multi-channel, multi- polarisation imaging for aerosols;
- UV limb sounding spectrometry for profiles of Ozone and trace gases.

In addition, a number of new satellite programmes are under consideration by CGMS members, that offer the potential to expand the response to the WIGOS vision either through application of new technologies or through extending the coverage of existing capabilities. In this respect, CGMS will strive to:

- Advance the new generation of GEO satellites, including advanced imaging, lightning, mapping and IR and UV sounding for the whole geostationary ring;
- Work towards ensuring low frequency microwave imagery for all-weather SST and ice monitoring from at least 2 sun-synchronous orbits;
- Increase geographical altimetry coverage, for example through wide-swath altimetry;
- Advance the atmospheric Radio Occultation constellation, with the long-term goal of providing 20000 occultations per day on a sustained basis;

- Move towards an operational space weather monitoring capability from the Lagrangian Point L-5.

In addition, WMO proposed to add following:

Ensure long-term continuity of OSCAR/Space as a primary tool to support the CGMS Risk assessment and the WMO Rolling Review of Requirements and gap analysis against observing system requirements for satellite data and make OSCAR/Space the primary repository for WIGOS satellite metadata records generated by CGMS operators.

10. Nomination and representatives at meetings

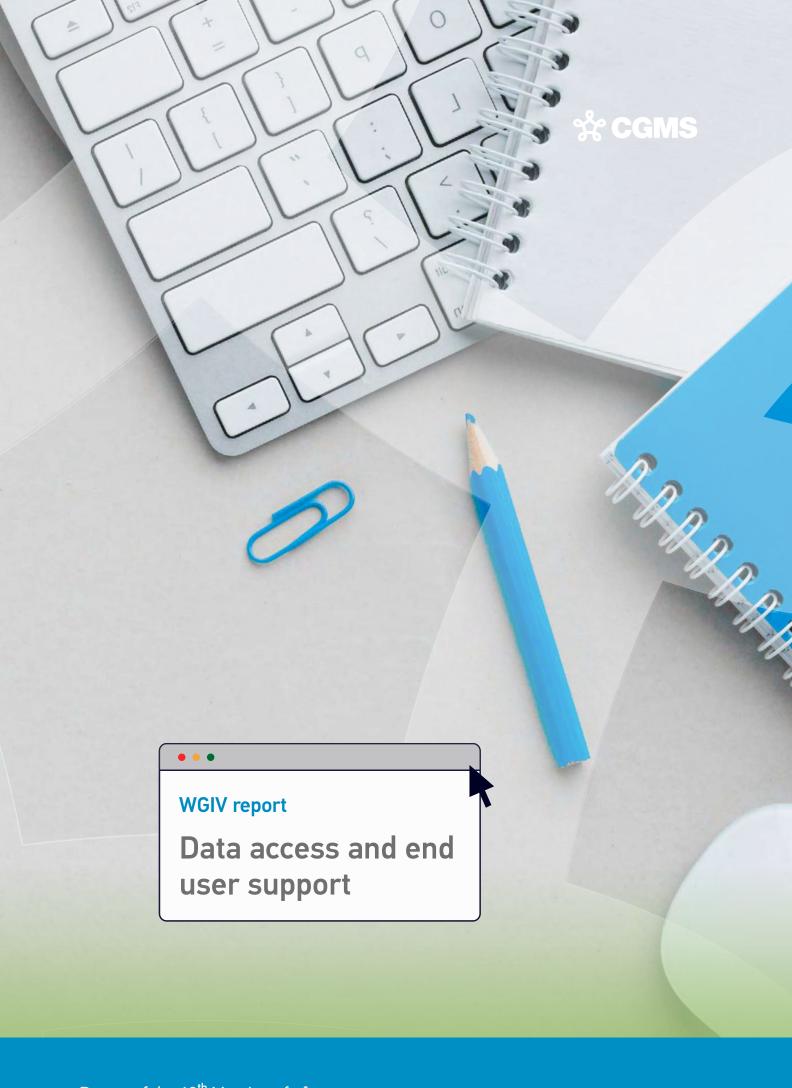
CGMS Secretariat presented the current situation related to the WG chairs, co-chair and rapporteurs. No changes were proposed related to WGIII. However, replacements of the VLab co-chair and the IROWG rapporteur need to be found prior to CGMS-48 Plenary.

11. Date/time of inter-sessional activities/ meetings 2020-2021 [CGMS-48 -> CGMS-49]

This agenda item was concluded in the wrap up session.

12. Review of actions/conclusions, preparation of WG report for plenary

The summary list of WGIII actions and recommendations resulting from CGMS-47 or earlier is included in Annex IV of this report.



WG IV REPORT

Co-chairs: Kotaro BESSHO (JMA)

Rapporteur: Klaus-Peter Renner (EUMETSAT)

1. Welcome, objectives of the meeting

WGIV reviewed and adopted the draft agenda proposed by the CGMS Secretariat prior to the meeting, which is in line with the Terms of Reference for WGIV.

Representatives of the following organisations attended the session: CMA, ESA, EUMETSAT, IMD, ISRO, JMA, KMA, NOAA, ROSHYDROMET and WMO.

The WGIV meeting was conducted by WebEx.

In view of the common items of interest in relation to Space Weather, the representatives of WGI, WGIV and the Space Weather Coordination Group participated in the joint WGI-WGIV-SWCG meeting.

Additionally a joint WGI and WGIV meeting took place covering Global coordination on handling future large data volumes and associated data circulation, Global or inter-regional data circulation and access, and Cloud Services interoperability.

2. Items from Joint Sessions

2.1 Space weather matters in WGIV

There were no papers presented. Topics related to data access and end user support were discussed in the context of the presentation of the space weather user survey with providers and users.

2.2 Global or inter-regional data circulation and access

2.2.1 Explore options for optimal data exchange of advanced data from new generation satellites

CGMS-48-IMD-WP-04: Update on satellite Data Dissemination at India Meteorological Department

At present, two INSAT Meteorological satellites are in operation i.e. INSAT-3D and INSAT-3DR. INSAT-3D/3DR have the capability of providing vertical profiles of temperature and humidity, along with several products. Imager payload of INSAT-3D & INSAT-3DR are used in a staggered mode to achieve 15-minute temporal resolution for getting cloud imaging. An integrated scan strategy of the sounder payload of INSAT-3D & 3DR satellites has been implemented to get data of the Indian region on an hourly basis and the ocean region data every 1.5 hours.

IMD has established the Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS) for INSAT-3D, INSAT-3DR and INSAT-3DS. MMDRPS have storage capacity of the order of 2.0/2.0PB (Main/Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy. The MMDRPS has dedicated Web based Data

supply System (DSS) in redundant mode to cater web-based data dissemination requirements in near real time basis to various users (both local and remote global) based on data dissemination policy of IMD.

The web based -DSS is supported by a DJANGO Database Management System containing Metadata of all processed products available on the central storage. All available past satellite datasets starting from 1983 will be kept in online mode in due course of time. The web based-DSS is in advanced stage of implementation and potential users will be informed. In addition to this the MMDRPS has provision to update all type of bands and Products images on dedicated webpages and RAPID. The webpages are being updated every 15 minutes. It also has provision to disseminate the requisite data set on GTS in real time basis. IMD has started the dissemination of INSAT-3DR winds on GTS w.e.f. 1st October 2019.

CGMS-48-CMA-WP-15: The update of Fengyun satellite data and application services

This document describes the data policy of FENGYUN satellite data, the status and future plan of the FENGYUN satellite data distribution and services. FENGYUN satellite data are open to NMSs and other international organisations and users for free charge via many ways.

For real-time users, FENGYUN satellite data can be accessed via direct broadcasting station, CMA data broadcasting system (CMACast), GTS, WIS and public cloud. For non-real-time users, FENGYUN satellite data can be accessed from the FENGYUN satellite data center website, downloading toolkits and offline data services. For emergency users, FENGYUN satellite emergency support mechanism is useful to NMSs.

2.2.2 Cloud Services interoperability

CGMS-48-NOAA-WP-12: NOAA report on usage of cloud services

The National Environmental Satellite, Data and Information Service (NESDIS) has traditionally owned, maintained, and operated the NESDIS Ground Enterprise (NGE) consisting of all of the computing and network infrastructure needed to perform end-to- end ground system functions. The NESDIS vision is to implement cloud-enabled end-to-end ground service capabilities that are secure, scalable, life-cycle cost effective, and data-source agnostic.

NESDIS will leverage commercial cloud services within the NGE and is evaluating a complete migration to cloud infrastructure for ingest, processing, storage and dissemination capabilities to the cloud. Operational cloud implementations will use the NESDIS Common Cloud Framework (NCCF) which is demonstrated to meet security, fault tolerance and availability requirements. The first version of the NCCF is operational within NESDIS for secure ingest of partner and commercial data.

Cloud computing will yield increased efficiency, agility, and innovation in providing end-to-end ground services and this requires NESDIS to rethink current organisational processes and how people work. Complete cloud adoption relies upon cloud service education and training, updated procurement and budgeting models and enterprise governance definitions. The cloud will be most impactful if NESDIS leverages agile and DevOps methodologies as they enable rapid deployment of value to the users.

NESDIS will continue to move data, science and stewardship operations to the cloud if the approach provides lower overall sustainment and operations cost while simultaneously providing increased agility to develop and deploy capabilities. NESDIS will pursue cloud transformation of the NGE and will continuously refine and mature its migration approach to optimise both cost and user value.

CGMS-48-JMA-WP-07: JMA report on usage of cloud services//Data dissemination and distribution of Himawari-8/-9 and their recent updates

JMA mainly distributes Himawari-8/9 data in two ways. One is the HimawariCast service, by which primary sets of imagery are disseminated as operational meteorological services via a commercial communication satellite. The other is the HimawariCloud service, by which full sets of imagery are delivered to National Meteorological and Hydrological Services (NMHSs) via a private Internet cloud service. JMA also distributes Himawari-8/9 data to NMHSs via JDDS (the JMA Data Dissemination System) and, in conjunction with four other Japanese institutions, provides Himawari-8/9 data distribution/archive services for research, development and education purposes. In addition, to the private sector and other communities, JMA provides meteoroidal data including the Himawari-8/9 data via the Japan Meteorological Business Support Center. This working paper provides updates on individual Himawari data dissemination and distribution systems.

JMA launched the HimawariCloud service on 8 April 2015 with the distribution of Himawari-8 in-orbit-test imagery. Himawari Standard Data are used as master data from all 16 bands with the finest spatial resolution to create all products related to Himawari-8/9. True-color images composed of data from three visible bands are provided in Portable Network Graphics (PNG) format. In addition, images of Target Areas observation in Network Common Data Form (NetCDF) are also created and distributed. NMHSs in the Himawari-8/9 coverage area can access HimawariCloud and retrieve data using an HTTP 1.1 client such as a Web browser or Wget. A minimum of 20 Mbps throughput between HimawariCloud and the user client is needed to download all data provided via the HimawariCloud service. It should be noted that HimawariCloud is not a data archive service. Data can be downloaded for 72 hours after receipt by the HimawariCloud server, and are then deleted. JMA updated the HimawariCloud system on 26 February 2020 with a switch to a new service provider. The basic data download method remained unchanged, while HimawariCloud capacity was expanded to support new users such as NMHSs around Himawari observation area borders. JMA is working to implement L2 connection and HpFP (High-performance and Flexible Protocol) in addition to the current HTTP(S) for HimawariCloud connection. HpFP was developed by the National Institute of Information and Communications Technology (NICT) based on the User Datagram Protocol, and enables high throughput even with high latency and packet loss.

CGMS-48-KMA-WP-08: KMA report on usage of cloud services

This document is KMA report on GK-2A data dissemination via realtime FTP. It provides an introduction on GK-2A real-time FTP service (RFS) and the current status and plan of GK-2A RFS.

The number of GK-2A RFS users is getting increased since the GK-2A official operation. As the users increase, the data flow also gets increased, which can slow down the connection speed from RFS server to user side. In preparation for solving this problem, KMA is closely cooperating with users technically.

And to improve the GK-2A RFS, KMA is currently carrying out a user survey by circulating a questionnaire to the RFS users. Based on opinions of users, KMA will make plans and do actions for the better GK-2A service to users. To share the benefits of GK-2A full resolution data with more global users, KMA will keep trying to improve the GK-2A RFS and also to expand the RFS users.

CGMS-48-CMA-WP-14: CMA report on usage of cloud services

NSMC/CMA is working on solutions for FengYun series meteorological satellites data service and processing by using public cloud service. The applications are satellite data sharing based on Cloud Storage, satellite data processing based on Cloud Computing, NSMC/CMA Website speeding-up based on Cloud CDN, document sharing based on Cloud App service. By using public cloud service for FengYun satellite data service, NSMC/CMA provide a new solution for the users to obtain satellite data. The performance of NSMC/CMA website has improved by using Cloud service. NSMC/CMA will evaluate the cost and benefit of these cloud solutions as the next step.

CGMS-48-ISRO-WP-12: ISRO report on usage of cloud services Meteorological Data Dissemination through Cloud

This paper discusses the requirements, issues, challenges, and advantages of using cloud based infrastructure for dissemination of real-time meteorological data for its operational utilisation.

Meteorological data is acquired from different sources including satellites, ground sensors, and radars. The process of acquisition and dissemination of this data is quite complex and involves close coordination among different agencies for their effective and timely utilisation in models and applications. Currently these data sets are being disseminated using well-established data exchanges and data transfer protocols using terrestrial and satellite-based networks. Cloud computing is one of the evolving technologies and has seem a broad adoption in different sectors. Cloud-based infrastructure provides computing and resources (both hardware and software) on demand without worrying about the complexity and details of the underlying infrastructure. It also allows systems to scale-up and scale-down (both capacity and functionalities) based on requirements. Cloud-based infrastructure can be realised either by using a private cloud, public cloud, hybrid clouds, and multi-clouds. Hybrid and multi-clouds are still in experimental stages and will require some more time for their operational use. Multi-cloud will be one of the potential configurations in the future for operational dissemination of real-time data to multi agencies, who will be using clouds for their operations.

This is a study paper to address requirements and challenges in utilisation of cloud based infrastructure for the dissemination of meteorological data.

The conclusion is that cloud is becoming a preferred infrastructure for archival processing and dissemination of satellite data. It provides resources on demand and helps in the optimisation of cost and performance. There is a pressing need to address issues specific to meteorology such as cloud-optimised formats, standards and interoperability before adopting the cloud.

NOAA and EUMETSAT thanked the presenters for their interesting contributions, demonstrating that several agencies are already using cloud services for various purposes. Those agencies have also nominated points of contact such that the expert team on cloud services can be established and can start working on cloud services interoperability topics that were also highlighted in the presentations.

3. Review of actions and recommendations from previous meetings and status update

CGMS-48-CGMS-WP-03WGIV: CGMS-47 list of actions and recommendations (6 May 2020)

The WG reviewed the actions and recommendations of past CGMS sessions related to its work. The following 6 actions and 1 recommendation were proposed to be closed: A43.02, A45.02, A46.03, A46.05, A47.01, A47.02 and R44.02. Ten actions and two recommendations remained open. One new action was created as a follow-up on A43.02, to complete the IODC dissemination roadmap as defined in CGMS-43-EUM-14.

WGIV agreed to develop "best practises" documentation capturing (at a minimum) the lesson's learned from some of the ongoing, older recommendations. WGIV agreed to establish a dedicated inter-sessional subgroup and WGIV members are encouraged to nominate participants to this subgroup.

| CGMS-48 ad | CGMS-48 actions – WGIV | | | | | | | | |
|------------|------------------------|---------|--|----------|--------|--|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | | |
| | item | | | | | | | | |
| CMA, | WGIV | WGIV/A | To report on the status of data dissemination | CGMS-49 | OPEN | | | | |
| EUMET- | /3 | 48.01 | from Indian Ocean Data Coverage partners, as | | | | | | |
| SAT | | | identified in the roadmap in CGMS-43-EUM-WP- | | | | | | |
| | | | 14 | | | | | | |
| CGMS | WGIV | WGIV/A | To provide a point of contact for participation in | Sep 2020 | OPEN | | | | |
| members | /17 | 48.08 | regular inter-sessional teleconferences to convert | | | | | | |
| | | | identified WGIV recommendations into best | | | | | | |
| | | | practises. | | | | | | |

4. User-provider dialogue on regional/global scales

CGMS-48-joint-JMA-KMA-WP-02: Results of RA II and RA V Survey on the Use of Satellite Data 2018

The purpose of the present RA II and RA V Survey on the Use of Satellite Data 2018 is to collect up-to-date information on WMO Members' capabilities and needs regarding the use of satellite data in meteorological, climate, water and related environmental applications.

The survey, conducted in a spreadsheet format from 3 December 2018 to 31 January 2019, consisted of nine questions broadly addressing: (i) access to satellite data and products; (ii) use and application of satellite data and products; and (iii) education and training. A total of 33 valid and complete responses were received from RA II and RA V NMHSs in 32 WMO Member countries. In the meeting, outline of the survey was shown, and the full report of the survey can be downloaded from WMO website as below. https://library.wmo.int/index.php?lvl=notice_display&id=21723

The key results of the survey are as below.

- Himawari-8/9 data are used in these regions more than data from other satellites.
- GEO satellite data are mostly used for imagery application, nowcasting and forecast verification.
- Many respondents plan to use FY-4B and -4C data.
- Most institutions access satellite data online, but broadcast facilities are also used in countries with slow and unstable Internet connections.
- The survey outcomes especially from Q4-b are expected to provide satellite derived product developers with ideas for future development.
- A 10-minute observation frequency is sufficient for effective monitoring of extreme weather events.
- Natural Color RGB, Day Convective Storm RGB, True Color RGB and other data support work practices significantly.
- The top three hazards in the RA-II/V areas are lightning, flash floods and tropical cyclones. New-generation GEO data have improved forecasting ability to detect and monitor such events.
- More training, faster/more reliable communications, and enhanced data and processing tools would be of value.
- FengYun general-purpose polar-orbiting satellite products are well known and widely used.
- Sea surface wind data are used by more than half of all NMHSs.
- GSMaP products are the most popular among precipitation-related output in these regions.
- Most NMHSs require training in climate, public weather services, aviation services and a variety of other areas. Face-to-face training is considered highly important.
- Many users require 10-minute multi-band data and products both online and via the satellite broadcast system.

CGMS-48-joint-JMA-KMA-WP-01: Progress Report on the RAII WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training

The WMO Regional Association (RA) II WIGOS Project to Develop Support for National Meteorological and Hydrological Services (NMHSs) in Satellite Data, Products, and Training is a regional framework formed to assist NMHSs in RA II for better use of satellite-related information in collaboration with relevant satellite operators, users and WMO.

The Second Joint Meeting of RA II WIGOS PROJECT and RA V TT-SU for RA II and RA V NMHSs was held in Melbourne, Australia on 7 December 2019. The meeting was hosted by the Australian Bureau of Meteorology (AuBoM). The final report from the meeting is attached to this working paper. CGMS is invited to take note.

5. Implementation and evolution of sustained and coordinated communication satellite broadcast systems

There were no discussions under this item.

6. Widening of data access, to new missions/providers as well as for other user communities

CGMS-48-JMA-WP-08: Status of JMA HimawariRequest service

In January 2018, JMA launched an international service "HimawariRequest", in collaboration with the Australian Bureau of Meteorology (AuBoM). The service allows NMHS users in Himawari-8/9 coverage area to request Target Area observation covering a 1,000 km x 1,000 km area every 2.5 minutes. As of 26 May 2020, JMA had taken registrations from 21 NMHSs in RA II and RA V, and opened the service to the seventeenth whose preparations for request submission were complete. In addition, there have been 93 international requests since the commencement of the service, among which 80 have been accepted. The target of requests are tropical cyclones in South Pacific, severe weather in Australia, volcano in Indonesia and so on. JMA expects the HimawariRequest service to support disaster risk reduction activities in the region.

Based on the request from AuBoM, the HimawariRequest was almost continuously utilised from November 2019 to February 2020 to monitor the bushfires in Australia. The observation results were shared not only with stakeholders in charge of disaster management of Australia but also with the public via SNS. According to AuBoM, the satellite imagery was invaluable in identifying the rapid development of the most dangerous bushfire activity.

CGMS-48-CMA-WP-13: CMA report on rapid scan service

China Meteorological Administration (CMA) introduced the Emergency Support Mechanism of FENGYUN (FY) Satellite (FY_ESM) in 2018, open to international users who made a request once visited by such extreme events as typhoon, heavy rain, severe convection, forest or grassland fire and sand and dust storm. In this case, the on-duty FY satellite is activated to initiate highly frequent observation of a given area at an interval of up to 5 minutes, processing and generating images and quantitative products, which are provided through such channels as CMACast, Internet and direct satellite broadcasting, to inform the processes of disaster preparedness, mitigation and relief in a timely fashion.

This document describes the update information of Rapid Scan Services under the Emergency Support Mechanism of FENGYUN Satellite (FY_ESM), including the update of the FY_ESM webpage, rapid scan products, working flow and suggestions on cooperation with JMA and KMA.

Suggestions for further cooperation between CMA, JMA, and KMA are to add rapid scan website links in each portal site and to improve rapid scan observation data exchange in three agencies.

JMA asked if the user can select the satellite if the target area is covered by multiple satellites. CMA answered that this will be decided by CMA, taking into account the target location and other observation requests.

CGMS-48-KMA-WP-07: KMA rapid scan imagery service

This document is a KMA report on Geo-KOMPSAT-2A (GK2A) rapid scan imagery service, including plan of the GK2A AMI Rapid Scan (hereafter, ARS) Request. The GK2A (Geostationary Korea Multi-Purpose Satellite-2A) was launched successfully in December 2018. After launch, we conducted in-orbit test until June 2019, and have been in formal operation since July 2019. GK2A operates the Advanced Meteorological Imager (AMI) payload for meteorological observation. The Korea Meteorological Administration (National Meteorological Satellite Center) has a plan to implement the GK2A AMI Rapid Scan (ARS) service. Experimental tests of ARS have been done six times for typhoons in the 2nd half of 2019 and for long-lasted Australian forest fires in the 1st half of 2020. The observed ARS data was displayed on the KMA/NMSC's web in real time, and provided for KMA internal users as well as the Australia BoM (Bureau of Meteorology) forecasters. The ARS request website of the KMA/NMSC is now under development and will be completed by the 2nd quarter of 2020. Experimental operation of the web will be started in the 3rd quarter of 2020. Therefore, the ARS services for the RA-II and RA-V region can be available from the 3rd quarter of this year.

CGMS-48-NOAA-WP-15: GOES-R Series International Mesoscale Domain Sector (MDS) Request Process

The GOES-16 and -17 satellites respectively operate in the GOES-East and GOES-West positions. Both satellites carry the Advanced Baseline Imager (ABI). It is the primary instrument on the GOES-R Series of satellites and its primary use is for imaging Earth's weather, oceans, and the environment. The ABI instrument views the Earth with 16 different spectral bands (compared to five on the previous generation of GOES), including two visible channels, four near-infrared channels, and ten infrared channels. The normal operating mode of each ABI provides a full disk image every 10 minutes, a CONUS (GOES-16) / PACUS (GOES-17) image every five minutes, and images from both mesoscale domains every 60 seconds (or one subdomain every 30 seconds). The ABI mesoscale domain sector (MDS) capabilities may be exploited in an operational and research setting whereby the positions of each MDS from both GOES-16 and -17 may be changed to different center point locations allowing users to request targeted ABI observations covering a 1000km x 1000km area.

The purpose of this report is to describe the international MDS request process for operational and research MDS requests to promote awareness of this resource and maximise the application of this capability by international users. As of May 1, 2020, NOAA has taken registrations for nine countries across RA-III, RA-IV, and RA-V. The registered countries include Brazil, Paraguay, Canada, Mexico, Chile, Panama, Haiti, Ecuador and also includes EUMETSAT for most parts of Europe. Other countries that have not yet registered are encouraged to do so. NOAA expects the GOES-R Series ABI MDS Request Service to support disaster risk reduction activities across the western hemisphere and it may be used to monitor and conduct research on the regional occurrence of extreme events such as tropical cyclones and volcanic eruptions using targeted observations.

Several questions were asked about lead-time for requests, difference between operational and research requests, latency and access to data. NOAA answered that operational requests shall be done via phone and are immediately processed and accessibly via cloud (BDP), whereas research requests require a form with a

lead-time of 10 days before the observation. Requests are open to international and national, commercial and research users. The MDS products are not available via Geoneticast-Americas, but surveys are planned with RAIII/IV users.

WMO recalled a question from the 10th Asia Oceanic Meteorological Satellite Users Conference "... participants (CMA, JMA, KMA) would implement a coordination mechanism to minimise duplication and maximise efficiency in the event of multiple requests for the same time".

KMA responded that the complexity is in the details and there is no easy solution in sight.

JMA referred to an existing action for the same topic, which is still open, and also reported on feedback from users. In fact, users have implemented interfaces based on the current solutions and would not be ready to change the current status, because of the potential large effort involved. The short-term consideration is to upgrade the WIGOS project WEB page as described in CGMS-48-joint-JMA-KMA-WP-01.

6.1 Disaster mitigation purposes - International Charter on Space and Major Disasters

This agenda item was not addressed at CGMS-48.

6.2 Support to the Ocean user community

This agenda item was not addressed at CGMS-48.

6.3 Support for Arctic observations

This agenda item was not addressed at CGMS-48.

7. Data formats and standards (use of open standards)

This agenda item was not addressed at CGMS-48.

8. Coordination of Metadata

CGMS-48-WMO-WP-16: Implementation of WIS Metadata Standards for Satellite Data

WMO Core Metadata Profile 1.3 (WMCP 1.3) is the official standard to be adopted by all WIS Centres.

Effectiveness of the search experience of a GISC or DCPC user depends on the quality of metadata and their compliance with WMCP 1.3 There are two issues when users are searching for satellite data in GISC portals:

- 1. The search is returning a huge number of records and not providing enough information to decide if the product is suitable for a purpose or does not provide a valid URL to access the data.
- 2. Only some satellite operators have registered their data in the GISC portals and the users cannot search the full range of satellite products available.

WMO has started an activity of metadata scoring with the purpose to provide indication on the metadata quality and provide corrective actions to improve it. This information will be provided to the satellite operators publishing data in WIS.

The WG agreed on the recommendations proposed in the paper aimed at improving the WIS metadata records and created two new actions.

| CGMS-48 ac | CGMS-48 actions – WGIV | | | | | | | | | |
|------------|------------------------|---------|---|----------|--------|--|--|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | | | |
| | item | | | | | | | | | |
| Satellite | WGIV | WGIV/A | To provide focal points for WIS Metadata to | Dec 2020 | OPEN | | | | | |
| Operators | /8 | 48.02 | support WMO in the review of the metadata | | | | | | | |
| | | | records inserted in the WIS catalogue and to | | | | | | | |
| | | | identify any gaps. | | | | | | | |
| | | | The focal points (names and email address) shall be | | | | | | | |
| | | | sent to CGMS Secretariat. | | | | | | | |
| TFMI | WGIV | WGIV/A | TFMI to analyse the proposed approach to the | CGMS-49 | OPEN | | | | | |
| | /8 | 48.03 | improvement of the WIS catalogue and the | | | | | | | |
| | | | publication of new metadata records and to | | | | | | | |
| | | | provide its feedback. | | | | | | | |

8.1 Product metadata standards within ocean communities

This agenda item was not addressed at CGMS-48.

9. User readiness for new satellite systems - WG-IV key issue

CGMS-48-VLab-WP-01: VLab Progress Report

This document reports on activities within the WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) along with future plans. Since CGMS-47, VLab members have offered a variety of training opportunities, with highlight to training efforts addressing the new generation of satellites, which continues to be the major training need identified by VLab members. Furthermore, stronger collaboration and coordination of efforts between VLab members resulted in increased opportunities for user training during the past year.

The VLab Management Group (VLMG) continued to coordinate its activities with support from cochairmanship representing CGMS satellite operators and VLab Centres of Excellence. Dr Mark Higgins (EUMETSAT Training Manager) has been a VLab co-chair on behalf of CGMS satellite operators since 2017. This co-chairmanship was established for a period of up to 3 years. Nominations need to be considered by CGMS satellite operators in order to ensure the continuation of this partnership after October 2020 (Action i). The VLab Trust Fund continues to receive yearly contributions from NOAA/NWS, EUMETSAT, and KMA. However, a larger number of contributing CGMS agencies is required to expand VLab activities to meet WMO-CGMS Members' requirements and needs for training and to improve the long-term sustainability of VLab activities. Regular financial contributions from CGMS Members are critical to maintain the VLab training activities (Action ii). VLMG continued to coordinate its activities and support for training events via regular online meetings. Due to travel restrictions caused by the COVID-19 pandemic, the tenth meeting of VLMG was postponed to 2021 (Darmstadt, Germany). CGMS members active in VLab are invited to send representation to participate in the meeting (Action iii).

The WG is supporting the proposed three actions emphasising the importance and high efficiency of the VLab work, and the need for CGMS members to provide human resources (in form of Co-Chairs), funding and contributions to meetings.

| CGMS-48 ac | CGMS-48 actions – WGIV | | | | | | | | | |
|------------|------------------------|----------|--|----------|--------|--|--|--|--|--|
| Actionee | AGN | Action # | Description | Deadline | Status | | | | | |
| | item | | | | | | | | | |
| CGMS | WGIV | WGIV/A | CGMS members active in VLab to nominate the | Aug 2020 | OPEN | | | | | |
| members | /9 | 48.04 | next Co-Chair to represent CGMS satellite | | | | | | | |
| | | | operators in the VLab (starting October 2020). | | | | | | | |
| | | | Nominations to be presented to VLab during | | | | | | | |
| | | | CGMS-48 plenary. | | | | | | | |
| CGMS | WGIV | WGIV/A | CGMS members are invited to contact WMO to | CGMS-49 | OPEN | | | | | |
| members | /9 | 48.05 | provide contributions to the WMO VLab Trust | | | | | | | |
| | | | Fund to ensure the continuation of technical | | | | | | | |
| | | | support to the VLab through the VLab Technical | | | | | | | |
| | | | Support officer as well as to the implementation | | | | | | | |
| | | | of VLab projects. | | | | | | | |
| CGMS | WGIV | WGIV/A | CGMS members active in VLab to send | Feb 2021 | OPEN | | | | | |
| members | /9 | 48.06 | representation to participate in the Tenth VLab | | | | | | | |
| | | | Management Group Meeting (VLMG-10) to be held | | | | | | | |
| | | | in Darmstadt, Germany, 13-17 September 2021. | | | | | | | |

10. Notification of changes (and alerts) in satellite data and/or products impacting users

This agenda item was not addressed.

11. Cyber security towards end users - WG-IV key issue

CGMS-48-EUMETSAT-WP-13: EUMETSAT report on relevant aspects of cyber security for CGMS

Information security changes can lead to interruption of services for both ends of the inter-organisation data flows, and also for users, if they are not well coordinated between the involved organisations. Without information security incident notification, the risk of propagation from one Organisation to the other is significant and can also lead to interruption of services for users.

It is recommended to CGMS to create a Security Working Group with security representatives from each CGMS Organisation with the aim:

- to gather inputs about any relevant information security topic where coordination would benefit all Organisations, i.e. coordination of information security changes affecting inter-organisations

data flows, and coordination of information security incident investigation affecting interorganisations data flows;

- to propose best practices for addressing these topics.

NOAA supports idea of further discussion in a dedicated expert group. Currently many agreements are bilateral, but really are multi-lateral coordination issues.

CGMS-48-ISRO-WP-13: ISRO report on relevant aspects of cyber security Security Challenges in a Data Centre

This paper discusses the security challenges and their mitigation in a Data Centre. It includes best practices that are proven to minimise the risks associated with Data Centre cyber security. It discusses the need of practicing security in layered manner and give a glimpse of holistic approach practiced at MOSDAC.

CGMS-48-KMA-WP-09: KMA report on relevant aspects of cyber security

This document is KMA report on relevant aspect of cyber security for GeoKOMPSAT-2A(GK-2A) ground segments and resource.

The Korea Meteorological Administration (National Meteorological Satellite Center) performs the security tasks as follows.

- Security zones (satellite operation room, computer room, antenna building, etc.) are physically set to control the access of outsiders.
- In order to strengthen cyber security, we have established and operated a firewall, network separation, and backup system for all computing equipment used for satellite operation.

CGMS-48-ROSHYDROMET-WP-03: ROSH report on relevant aspects of cyber security

The document presents an overview of data access and network protection for the ground segment for Russian meteorological satellites in Roshydromet.

Roshydromet also welcomes to discuss this topic in a dedicated expert group.

The WPs highlighted the area of cyber security at various levels and the WG agreed to address this topic in an expert group during inter-sessional meetings. CGMSSEC received nominations from EUMETSAT, ISRO, JMA, NOAA and ROSHYDROMET such that the work can start. Further nominations by CGMS members are welcome.

12. Long term data preservation

This agenda item was not addressed.

13. Aspects on the implementation of the global contingency plan from Plenary (as proposed by WGIII)

CGMS-48-CGMS-WP-12: Draft update of the CGMS Baseline

CGMS endorsed the first CGMS baseline, commitment of observational missions synchronised with the development of the WMO Vision for WIGOS 2040, at CGMS-46 in Bengaluru (ref. CGMS-46 CGMS-WP-04, and -27). The 2nd CGMS WGIII risk assessment workshop was held in EUMETSAT on 19-21 February 2020 on whose occasion the CGMS baseline and related risk assessment was conducted.

The working group reviewed the CGMS baseline and proposed revisions. The draft text of the second revision of the CGMS baseline is included in this paper.

The text will be reviewed by relevant working groups during CGMS-48 on 25-29 May 2020, in order to conclude on a final text for endorsement by CGMS-48 plenary on 25-26 August 2020. Following the CGMS-48 working group discussions, CGMS members are requested to recommend the 2nd revision of the CGMS baseline to CGMS-48 plenary for endorsement (and, at that stage, for WMO to take into account the new baseline in forthcoming updates of the Manual on the Global Observing System and related materials).

The sections related to WGIV are "3.1 Data Sharing Services" and "4.5 System Compatibility and Interoperability". The WG agreed that both sections are fully applicable and do not need any update. It was also clarified that WGIV will create documented "Best Practices" where needed within the scope its objectives and that this will be reflected in the HLPP. The actions A47.01, A47.05 and A48.08 are related.

14. Any other business

Nothing reported.

15. Review and updating of the HLPP

15.1 Proposal for revision of the HLPP to cover the next four years period

CGMS-48-CGMS-WP-14WGIV: Status of implementation of CGMS High Level Priority Plan (2019-2023)

CGMS-48-CGMS-WP-15WGIV: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2020-2024

New HLPP items 3.1.1 and 3.1.2 related to short range NWP and Nowcasting were moved under the responsibility of WGIV and it was agreed to address these items first in inter-sessional meetings. Item 3.6 (data access for the Ocean user community) needs to be followed up when Task Team on Satellite Data requirements has been re-established. Item 3.9.2 (product metadata standards).

No targets overseen by WGIV are proposed to be considered achieved, therefore all HLPP items remain valid.

Three new topics were discussed as potential additions to the HLPP. The development of Best Practices on Global Data Exchange was agreed to be included in the agenda for the new intersessional sub group

on best practices (see new action WGIV/A48.08). The new areas of cloud services and cyber security will be followed up by the respective expert groups and therefore it was not proposed to add them the HLPP. It was also agree to discuss the three topics in joint WGI/IV working group meetings at CGMS-49.

16. Nomination and representatives at meetings

CGMS-48-CGMS-WP-17: CGMS, ISWGs, VLAB - Co-chairs and rapporteurs

WGIV discussed nominations for CGMS-48 and reconfirmed the current Co-chairs Kotaro Bessho (JMA), Vasily Asmus (ROSHYDROMET), the rapporteur Klaus-Peter Renner (EUMETSAT), and the WGIV liaison contact to WGIII for contingency related issues Sean Burns (EUMETSAT).

17. Date/time of inter-sessional activities/meetings in 2020-2021 [CGMS-48 -> CGMS-49]

The following intersessional meetings were proposed:

- Cloud services expert group, led by NOAA; initial meeting before CGMS-48 plenary, further meetings to be defined by the expert group.
- Cyber security expert group, led by EUMETSAT, initial meeting before CGMS-48 plenary, further meetings to be defined by expert group
- Best Practises sub group, to be established after nominations have been received
- WGIV inter-sessional I, status of actions, HLPP, Q4 2020
- WGIV inter-sessional II, CGMS-49 agenda preparation, Jan 2021
- WGIV inter-sessional III, CGMS-49 preparation, Feb/Mar 2021, if needed

18. Review of actions/conclusions, preparation of WG report for plenary

All open and new actions were reviewed and updated where needed. The existing action A45.03 related to Space weather data formats and metadata was discussed in more detail. The aspect related to data formats will be followed up by the space weather user survey and that aspect can therefore be closed. The second aspect related to metadata remains open and it was concluded to have a discussion with TFMI, SWCG and WMO to clarify the intention before refining the action.

The summary list of status of WGIV actions and recommendations from CGMS-47 and earlier is included in Annex V.



SWCG REPORT

Co-chairs: Tsutomu Nagatsuma (NICT/JMA), Elsayed Talaat (NOAA)

Rapporteur: Andrew Monham (EUMETSAT)

SCOPE

This report deals with the agenda items from the main SWCG meetings as well as the Joint SWCG-WGI-WG-IV, all conducted through WEBEX on Monday 25 May and Tuesday 26 May. The single agenda point from the Joint WGII-SWCG meeting on which took place on Friday 29 May is integrated into the SWCG main report (Agenda Point 8 on Inter-calibration).

SWCG REPORT (MAIN MEETING)

1. Welcome and review of agenda with objectives of the meeting

SWCG Co-Chairs, Dr. Elsayed Talaat and Dr. Tsutomu Nagatsuma, supported by Rapporteur Mr. Andrew Monham, welcomed the participants, consisting of representatives from CMA, ESA, EUMETSAT, ISRO, JMA, KARI, KMA, NICT, NOAA, ROSCOSMOS, ROSHYDROMET and WMO (see Annex 1 for full list of participants).

SWCG reviewed and adopted the draft agenda proposed by the CGMS Secretariat prior to the meeting, which is in line with the Terms of Reference for SWCG.

2. Review of actions and recommendations from previous meeting

SWCG briefly discussed the actions and recommendations from previous CGMS plenary sessions (CGMS-47 and earlier), noting that most were being specifically addressed in the dedicated agenda items. The final status is provided in Annex VI of this report.

3. Update on the CGMS baseline

CGMS-48-CGMS-WP-12SWCSG: Draft update of the CGMS Baseline

Ajay Mehta presented the draft update paper.

CGMS endorsed the first CGMS baseline, commitment of observational missions synchronised with the development of the WMO Vision for WIGOS 2040, at CGMS-46 in Bengaluru (ref. CGMS-46 CGMS-WP-04, and -27). The second CGMS WGIII risk assessment workshop was held in EUMETSAT on 19-21 February 2020 on whose occasion the CGMS baseline and related risk assessment was conducted. The working group reviewed the CGMS baseline and proposed revisions. The draft text of the second revision of the CGMS baseline is included in this paper.

The text was reviewed in the SWCG meeting, in order to conclude on a final text for endorsement by CGMS-48 plenary on 25-26 August 2020. Following the CGMS-48 working group discussions, CGMS members are requested to recommend the 2nd revision of the CGMS baseline to CGMS-48 plenary for

endorsement (and, at that stage, for WMO to take into account the new baseline in forthcoming updates of the Manual on the Global Observing System and related materials).

Specifically, the SWCG confirmed that LEO Magnetometer Data shall not be included in the CGMS Baseline due to the absence of operational instrument in orbit, but will be considered for the HLPP (Agenda Point 10) and also CGMS-48-SWCG-WP-05 presented in the Joint WGI-WGIV-SWCG meeting (refer to WGI report).

Concerning the Section 2 Table entry Sensor Type - Radiation Monitoring, it was decided to rename "Radiation Monitoring" to "Energetic Particle Monitoring".

Concerning the Section 2 Table entry Sensor Type – Radio Occultation, the TBC statement on ionospheric electron density profiles up to 500 km could not be confirmed during the meeting and an action is raised. A further action is raised on SWCG to provide a consolidated list of CGMS Member RO capabilities with measurement profiles (e.g. altitude of measurements) for both current and planned missions.

Concerning the Section 2 Table entry Sensor Type - Radiation Monitoring, it was decided to rename "Radiation Monitoring" to "Energetic Particle Monitoring".

Concerning the proposal to add space weather lunar orbits, SWCG decided that this is not yet established on a sustained, operational basis and therefore will not be added to the Baseline. It should be considered for the HLPP (Agenda Point 10). SWCG Members were invited to the WGIII meeting on 28 May to finalise the input to the Baseline based on the above inputs.

| CGMS-48 ACT | CGMS-48 ACTIONS SWCG | | | | | | | | |
|------------------------------------|----------------------|------------------|--|-----------|--------|--|--|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | | | |
| SWCG | SWCG /3 | SWCG/A4 8.01. | Verify the requirement in CGMS Baseline for electron density measurements up to 500km with CGMS Members and IROWG. What is feasible and actually useful? | July 2020 | OPEN | | | | |
| NOAA, EUM, KMA, CGMS Members | SWCG /3 | SWCG/A4 8.02 | Provide a consolidated CGMS Member RO capability table indicating the measurement profile (e.g. altitude of measurements) supported. This should include current and planned missions (COSMIC, GEO KOMPSAT, others?) | July 2020 | OPEN | | | | |
| EUM | SWCG /3 | SWCG/A4 8.03 | Report on the testing of Metop-A GRAS RO measurements to include ionospheric data and resulting plans for inclusion in the operational NRT data dissemination for all GRAS instruments. | Nov 2020 | OPEN | | | | |
| CMA | SWCG /3 | SWCG/A4 8.04 | Investigate whether RO measurements from the FY-3 GNOS instruments can be enhanced to include ionospheric data | CGMS-49 | OPEN | | | | |

4. Updates on space-based observational capabilities

CGMS-48-ESA-WP-02: ESA Lagrange L5 mission update

Juha-Pekka Luntama presented the above Paper.

After a successful Space 19+ Ministerial Council in November 2019 ESA has continued the development of the Lagrange mission during a bridging phase until the foreseen start of the Phases B2/C/D for the instruments and the spacecraft. For the instrument procurements this means that the pre-development and de-risking activities for the instrument technologies have been continued without a gap after the completion of Phase B1 with a successful System Requirements Review in 2019. The start of the instrument Phase B2/C/D is planned in autumn 2020. For the Lagrange spacecraft, a Concurrent Design Facility (CDF) study was carried out in March 2020 by ESA to reassess the Lagrange mission concept and to identify options for reducing the mission cost and making the space weather measurements from L5 more sustainable. An updated mission concept has been produced in collaboration with European industry and this will be the baseline for the mission implementation in Phase B2/C/D that is planned to be started after a consolidation phase in spring 2021. The updated baseline remains in line with the Lagrange mission objectives and will fulfil the measurement requirements defined in the Mission Requirements Document. The Lagrange payload instruments include a coronagraph, heliospheric imager, magnetograph, EUV imager, X-ray flux monitor, solar wind plasma analyser, magnetometer and a high energy particle radiation monitor. The coronagraph is foreseen to be the Compact Coronagraph (CCOR) provided by NOAA and flying also with the SWFO-L1 mission in 2024. For the magnetograph ESA is planning to start a development of a new, compact instrument that is targeting specifically the requirements of operational space weather applications. The targeted Lagrange launch date is in early 2027.

CGMS-48-KMA-WP-06: The preliminary results of GK2A/KSEM (Korean Space Weather Monitor)

Dohyeon Oh presented the Paper describing the recent updates of GK2A's space weather mission, KSEM (Korean Space wEather Monitor) project and KMA's space weather data services. KSEM for space weather monitoring was successfully launched on 5 December 2018, and finished its initial activity test and in-orbit test. KMA is trying to increase quality of data both particle flux and magnetic intensity. For this purpose, cross-comparison of KSEM with data measured by other satellites was conducted. KMA presented the specification and briefly the result of cross-comparison.

KMA is providing KSEM data service since 25 July 2019 in txt and netCDF format through dedicated FTP, DCPC, and NMSC webpage. Currently only Level 1 data is available and KMA has a plan to release Level 2 data in July 2020.

CGMS-48-NOAA-WP-13: NOAA Space Weather Observations Update

Elsayed Talaat presented the NOAA update.

In the last two years, NOAA has made significant progress on several fronts in the space weather arena. This talk reviews this progress with emphasis in the areas of solar/heliospheric monitoring and ionospheric effects.

Space Weather Follow On Program: The agency has established the Space Weather Follow On (SWFO) Program as a baseline operational program to provide continuity to legacy missions at L1 such as SOHO, ACE, and DSCOVR which are nearing their end of life. The program will provide coronal imaging and solarwind measurements by the Space Weather Follow On – Lagrange 1 (SWFO-L1) observatory which will operate from the Lagrange 1 (L1) point. SWFO-L1 will manifest in situ instrumentation and a compact coronagraph (CCOR) developed by the Naval Research Laboratory. Resilient coronal imaging capability will also be provided by manifesting a CCOR on the GOES-U satellite that will operate at geosynchronous orbit.

In addition to CCOR, SWFO-L1 will manifest a Solar Wind Instrument Suite (SWIS) composed of a plasma sensor from the Southwest Research Institute; a suprathermal-particle detector from the University of California, Berkeley; and a set of magnetometers from the University of New Hampshire. SWFO-L1 will also manifest the X-ray Flux Monitor (XFM) an instrument contributed by ESA. SWFO-L1 and GOES-U are scheduled for launch in 2024. So far there has been no significant impact on development due to the COVID-19 pandemic. NOAA is also developing a robust ground architecture and services to ensure 24/7 coverage of SWFO-L1 downlink. Data will be processed at the Space Weather Prediction Center (SWPC) and will be further processed and stored in the National Centers for Environmental Information (NCEI).

NOAA and NASA have agreed to establish a joint project office for SWFO and to have SWFO-L1 fly as a rideshare to NASA's IMAP mission. At the same time, NOAA and ESA are coordinating their efforts on data sharing, potential ground-station coverage, and instrument cooperation.

COSMIC-2: NOAA launched the COSMIC-2 mission in partnership with Taiwan in June 2019. COSMIC-2 is a six-satellite constellation mission at a 24-degree-inclination orbit, that provides key measurements of the Earth's ionosphere needed to monitor and forecast a wide range of space weather effects. Each satellite has three instruments: a TriG GNSS-RO receiver (TGRS), the primary sensor, an Ion Velocity Meter (IVM), and an RF Beacon. The ionospheric occultation data from the TGRS are extensive (>4,000/day) and are provided with a 30-min data latency. The mission design life is 5 years.

In February 2020, the mission went through a data validation phase as part of its initial operating capability. Next steps include development of absolute TEC measurements (summer and early fall 2020), scintillation products (fall 2020), and beacon and IVM plasma-drift products (2021). The NASA Jet Propulsion Laboratory is working to incrementally upgrade TGRS flight software in parallel with Space Weather Cal/Val efforts to meet ionospheric profile count requirements.

Space Weather Program: NOAA initiated a next generation Space Weather (SWX) Program in May 2020 that is being developed alongside the geostationary (GEO) and low Earth orbit (LEO) programs. The three programs will share NOAA's extensive Common Ground Services which are being upgraded to a flexible, scalable platform. The new SWX program would implement several of the recommendations of the NOAA Satellite Observing Systems Architecture (NSOSA) study of 2018 obtaining space weather observations from various vantage points.

Other activities: NOAA also initiated several activities related to space weather designed to inform the SWX program formulation. These include sponsoring the Space Weather Operations and Research Infrastructure workshop by the U.S. National Academy of Sciences. The first of the two workshops was held on June 16-17 with a second following up on September 9-11, 2020. These workshops will consider options for continuity and future enhancements of the NOAA space weather operational architecture. NOAA also funded the development of Broad Agency Announcement (BAA) studies which will help define the future of the GEO and SWX Programs. These include a project on high-latitude observations of auroral activity, commercial options for an interplanetary monitor, and an evaluation of space architecture options for NOAA and partner organizations.

CGMS-48-ISRO-WP-04: Real-time Space weather network and updates from India

Taran Kumar presented this paper.

India, with ISRO and the various scientific institutions under its ambit, has been an active partner in almost all the major international programs that had thematic links with space weather, viz. past programs like the International Geophysical Year (IGY), and the International Space Weather Initiative (ISWI) recently. As is understood today, the Space Weather typically describes the physical state of the space environment inclusive of the sun and the solar wind, the earth's magnetosphere, the ionosphere and the thermosphere. The terrestrial magnetosphere, ionosphere and the thermosphere being the system that eventually receives a major part of the energy in terms of solar radiation and wind.

The space weather disturbances after originating from the Sun, evolve during their propagation through the interplanetary medium before reaching the near-Earth space. There, these disturbances impact the Earth's geomagnetic field and commence a range of induced effects in the magnetosphere and ionosphere. The extreme manifestations of the space weather on Earth are the geomagnetic storms. The temporal and spatial variations of currents generated during geomagnetic storms in the Earth's upper atmosphere that encompasses the ionosphere and magnetosphere, can cause large variations in timerate of change of magnetic field as seen at the Earth's surface. Today there are a whole lot of technological and social infrastructures that are directly/indirectly affected by the space weather. Among these, the most vulnerable are satellite missions, navigation and communication, electric power grids, among many others. As a consequence, there are stake holders across various segments of our society that have interests in the space weather processes and their manifestations.

In the space weather science community in India, the following four aspects of the space weather interactions have emerged as the primary research areas. These are (1) probing and understanding of the

generation and evolution of magnetic field structures on the sun and solar wind disturbances, (2) the investigation of Solar and interplanetary origin of geomagnetic disturbances, (3) the day-to-day variability of terrestrial magnetosphere-ionosphere-atmosphere system, (4) understanding the effect of these disturbances on space based technological systems and manifestations thereof.

India has an impressive set of ground based solar, aeronomy and magnetic observatories across India that can make systematic measurements on various essential solar -terrestrial parameters. For instance, regular Optical and radio measurements are now made from these observatories on various solar and terrestrial thermosphere-ionosphere parameters simultaneously.

The observed weather of the Sun-Earth system is then looked into within the context of geo-effective events and events on the Sun. For instance, many solar events have been observed from observatories in India. The ground magnetometer measurements of terrestrial magnetic field are obtained at stations maintained by Indian Institute of Geomagnetism (IIG). The data thus obtained are also put in international repositories like the World data centre (WDC) Kyoto. The Space Physics Laboratory (VSSC/ISRO) maintains a nationwide chain of ground stations presently with dual frequency, multi-channel GPS Receiver systems, and Low-Earth Orbiting satellite beacon radio receivers, with Ionosonde, Magnetometers and Airglow photometers/imagers to be added in near future.

To help make significant progress not only in advancing the space weather research in the country, but also to develop an infrastructure to cater to space weather forecast, the research community in India is being actively supported by ISRO through technologies developed while pursuing its space program. Networking of all the space weather measurements in the country is being strengthened, with an idea of ultimately having an operational, possibly real time, Indian network for Space Weather impact monitoring. With these ground based observatories across India and experiments in space like the ASTROSAT (in orbit) & Aditya-L1 (currently in development, to be launched soon), ISRO in particular and India in general, is well poised to contribute to the global effort in the direction of Space weather research/forecast in a big way in coming years.

5. Updates on space weather activities

CGMS-48-CMA-WP-16: CMA Update on Space Weather Activities

Jianguang Guo presented the paper describing the recent space weather activities of CMA in associated with the space weather observation, forecast and services. CMA has performed the orbit cross-calibration for relativistic electron (> 2 MeV) observations in the drift shell Lm coordinate and got the systematic deviation between the FY4A and GEOS' observations. As the one of the regional space weather information centres designated by ICAO, China/Russian Federation consortium is working on the cooperation mechanisms, data sharing, product processing and other issues to ensure space weather services support for aviation safety. NMSC/CMA also has developed the aviation space weather information service system to meet demand of ICAO on the space weather information. CMA also participates in the Phase II of the Chinese Meridian Space Weather Monitoring Project (Meridian Project) which has kicked off on July. 2019. Phase II of the Meridian Project will has the observation capability

covering all spheres of the solar-terrestrial system, including solar surface, interplanetary space, magnetosphere, ionosphere, and atmosphere.

CGMS-48-ROSHYDROMET-WP-04: Running a Space Weather Center to Benefit International Air Navigation: improvements, consolidation

Kirill Kholodkov presented the Paper.

The Space Weather Center at Fedorov Institute of Applied Geophysics established it's full-time service two years ago. Since then the operational capabilities and decision-making algorithms have changed several times. Heeding METP's SWXCCG meetings we've been able to adjust the setpoint of the development process to facilitate consistency in the future. Along with working with pioneering global centers, we work on integrating with National Space Weather Center CMA.

In answer to a question, it was confirmed that Electro-L data is accessible from the Roshydromet website. Furthermore, an iteration with the Inter-calibration TG leader (Nagatsuma-san) will be made.

CGMS-48-NASA-WP-05: NASA Space Weather Activities

Jim Spann presented the activities in the context of the NASA Heliophysics Space Weather Strategy. This strategy outlines the goals and objectives of NASA Heliophysics Division with respect to space weather. It is consistent with the goals and agency responsibilities articulated in the 2019 National Space Weather Strategy and Action Plan, as well as the Agency's efforts in human and robotic exploration.

Vision: Advance the science of space weather to empower a technological society safely thriving on Earth and expanding into space.

Mission: Establish a preeminent space weather capability that supports robotic and human space exploration and meets national, international, and societal needs by advancing measurement and analysis techniques, and by expanding knowledge and understanding for transitioning into improved operational space weather forecasts and nowcasts.

Context: Understanding space weather is the domain of Heliophysics. Space weather is the applied expression of Heliophysics. In Priority 1 of the 2020 NASA Science Plan, Strategy 1.4 pertains directly to space weather:

- Develop a Directorate-wide, target-user focused approach to applied programs, including Earth Science Applications, Space Weather, Planetary Defense, and Space Situational Awareness.

Goals: NASA plays a vital role in space weather research by providing unique, significant, and exploratory observations and data streams for theory, modeling, and data analysis research, and for operations. NASA's contributions to observing and understanding space weather are critical for the success of the National and International space weather enterprise. NASA has a preeminent space weather capability through the pursuit of the following goals:

- **Observe**: Advance observation techniques, technology, and capability
- Analyse: Advance research, analysis and modeling capability
- Predict: Improve space weather forecast and nowcast capabilities
- **Transition:** Transition capabilities to operational environments

- **Support**: Support Robotic and Human Exploration

- Partner: Meet National and International needs consistent with U.S. Government directives

CGMS-48-NICT-WP-01: NICT Space Weather Activities

Tsutomu Nagatsuma (NICT) presented NICT space weather activities (CGMS-47-NICT-WP-01). NICT is responsible for operational space weather forecast in Japan. Since Nov. 07, 2019, NICT have started a regular service for ICAO as a part of ACFJ global center.

They have developed a new 3D radio propagation model HF-START (HF Simulator Targeting for All-users' Regional Telecommunications), an estimation system of human exposure, WASAVIES (Warning System for Aviation Exposure to Solar energetic particles). To produce user-oriented information about risks of satellite anomaly for satellite operator, NICT have been developing Space Environment Customized Risk Estimation for Satellite (SECURES).

CGMS-48-NOAA-WP-14: NOAA Space Weather Activities

Brent Gordon of NOAA Space Weather Prediction Center (SWPC) provided an update on space weather activities over the past year and a look ahead to predicted activities levels for Solar Cycle #25 that will be beginning soon. Details were provided on the addition of new observations to SWPC's forecast operations and numerical modeling capabilities. In late 2019, data from NOAA GOES-16 became the primary source of information for SWPC's forecast, watch, warning, and alert process. It is anticipated that data from NOAA GOES-17 will be available to SWPC operations to supplement NOAA GOES-16 before the end of 2020.

NAA SWPC reported that the data from the DSCOVR spacecraft at L1 was once again being used operationally as of March 2020. DSCOVR had been placed into a safe-hold status and its data unavailable due to a gyroscope issue since July 2019. Finally, SWPC reported that it was beginning cal/val activities with data from the COSMIC-2 satellites and working to integrate them into several of its operational and developmental models.

NOAA SWPC described its role in the provision of global space weather services for the International Civil Aviation Organization and the critical role that space-based observations play in the delivery of those services. It then described its ongoing development of a sun to earth modeling framework with advances being made in several models that focus on discrete areas of this domain and the space-based observations they require to be fully successful. Finally, NOAA SWPC discussed the steps it is taking with NASA to enhance the rate of transition for new observations, models, and applications into operations. NOAA SWPC envisions the development of a Space Weather Prediction Testbed at its facility in Boulder that will work with Space Weather Proving Grounds led by NASA to help funnel new capabilities into its operations.

6. International Space weather activities

CGMS-48-WMO-WP-17: Update on WMO Space Weather Activities

Werner Balogh reported that the 18th World Meteorological Congress (Cg-18), the supreme decision-making body of the World Meteorological Organization (WMO), was held in May 2019 and approved a package of sweeping reforms to embrace a more comprehensive Earth system approach and took important decisions on the strategy, policies, standards, budget and office holders of WMO. In line with this, the governance structure of WMO is being overhauled to ensure that it is better equipped to tackle mounting challenges as reflected in the global development agendas. As the implementation of the reform continues, it is anticipated that by the end of 2020, a new Expert Team will be established under the new governance structures and succeed the InterProgramme Team on Space Weather Information, Systems and Services (IPT-SWeISS), which until the end of 2019 had been the responsible Expert Team for the space weather related activities of WMO.

It is expected that most of the membership and tasks of IPT-SWeISS will be transferred to the new Expert Team, to facilitate to the largest extent possible the continuation of activities envisioned under the WMO "Four-Year Plan for WMO Coordination of Space Weather Activities 2020-2023".

The working paper includes a brief summary of discussions at the third and final meeting of IPTSWeISS, which was held 25-27 November 2019 in Brussels, Belgium. The IPT-SWeISS-3 meeting documents are available from the following link: https://community.wmo.int/meetings/ipt-sweiss-3.

CGMS-48-GUEST-WP-01: Implementation of the Space Weather Information Service for International Air Navigation.

Raul Romero presented, informing the CGMS Space Weather Coordination Group on the implementation by the International Civil Aviation Organization (ICAO), as of 7 November 2019, of the space weather information service to support international air navigation.

The presentation provides background information concerning the process leading to the implementation of the service provision of information on space weather phenomena and review the requirements included in Annex 3 to the ICAO Convention, Meteorological Service for International Air Navigation and the Manual on Space Weather in Support of International Air Navigation.

The core part of the presentation offers detailed information about the operation of three global centres provided by ACFJ consortium (comprising Australia, Canada, France and Japan); PECASUS consortium (comprising Austria, Belgium, Cyprus, Finland, Germany, Italy, Netherlands, Poland and the United Kingdom); and United States.

Concerning new developments, the presentation highlights the recent designation, by the ICAO Council, of the China/Russian Federation consortium (CRC) as the fourth global space weather information service provider.

Finally, necessary future steps towards a successful information service provision are considered.

CGMS-48-SWCG-WP-03: Space Weather Services by members of the International Space Environment Service (ISES)

The International Space Environment Service (ISES) is an organisation that brings together space weather service providers from around the globe with the aim to cooperate and improve their services towards the end users. It has been active since 1962, and it has seen a steady increase in members over recent years, with the number of "Regional Warning Centres" (the issuing centres endorsed by their national governments) now adding up to 20.

The operation of a space weather service involves three layers in general: from a layer collecting sensor data, over a processing layer, on to an end-user dissemination layer. ISES is active in each of those layers, and fosters cooperation both in terms of day-to-day operations and in terms of working towards future improvements. In general, ISES also works actively with the WMO on the integration of Space Weather aspects within the WMO framework.

The focus of the operations of the different members varies both topically (Ionospheric, Solar and Heliospheric, Geomagnetic,...) and over the three mentioned system layers. Many of the centres control sensor data acquisition systems, both ground based and space based. And obviously, this space-based component of the sensor data layer is in particular where collaboration with the CGMS is important. Data sharing has historically been an important focus of ISES.

Nowadays, data sharing itself has become so easy that the challenge is more on standardising metadata for discoverability and accessibility and on standardising data formats for interoperability. Looking beyond sensor data, data sharing is needed and beneficial in each of the three mentioned layers.

This in particular also applies to the processing layer with many interconnections between automated feature or event detection algorithms, (forecast) models and human assessments, and which can hence benefit significantly from connections across the boundaries of individual centres. It must therefore be emphasised that the cooperation in data sharing should not be reduced to its more restrictive interpretation of the sharing of sensor data.

| CGMS-48 ACTIONS SWCG | | | | | | | | |
|----------------------|--------|---------|---|-----------|--------|--|--|--|
| Actionee | AGN | Action# | Description | Deadline | Status | | | |
| | item | | | | | | | |
| NOAA, NICT, | SWCG/6 | SWCG/ | Establish an information exchange with ICAO | July 2020 | OPEN | | | |
| CMA, ROSH | | A48.07 | data service providers to understand | | | | | |
| ESA | | | requirements on CGMS Members' data | | | | | |
| | | | delivery mechanisms and formats. | | | | | |

7. OSCAR review for space weather – Completeness and suitability of space weather related content

CGMS-48-WMO-WP-18: Update on Space Weather Information Recorded in OSCAR/Space

The WMO OSCAR/Space database (see https://www.wmo-sat.info/oscar/spacecapabilities) includes a considerable amount of information on space weather satellites and instruments. Approximately 50 satellites and 350 instruments are described, covering missions launched and planed for the time period between approximately 1990 and 2030, including instruments on dedicated satellites or hosted on Earth observation satellites, including operational missions. In addition, a total of 64 geophysical variables are included in the database. This working paper describes how space weather information is managed in OSCAR/Space: in the Programme Pages, the Satellite Pages, the Instrument Pages, and in the Gap Analyses by Variable and by Mission. It also acknowledges some current limitations and considerations for future improvements.

CGMS-48-WMO-WP-20: Space weather requirements in the Vision for WIGOS in 2040

WMO is attempting to monitor the compliance of the current and planned satellite programmes with the WIGOS Vision for 2040 (WMO-No. 1243), see CGMS-48-WMO-WP-12. For some items, this task is relatively easy, however, for space weather satellites and instruments it is particularly difficult because of the different ways in which space weather requirements are formulated in the Vision for WIGOS in 2040 and in the nomenclature of observable variables in OSCAR/Space.

This working paper attempts to implement a look-up table to help comparing the system performances as recorded in OSCAR/Space with the space weather requirements as formulated in the Vision for WIGOS in 2040.

| CGMS-48 A | CGMS-48 ACTIONS SWCG | | | | | | | | |
|-----------|------------------------------|--------|---|-----------|------|--|--|--|--|
| Actionee | onee AGN Action# Description | | Deadline | Status | | | | | |
| | item | | | | | | | | |
| CGMS | SWCG/7 | SWCG/A | Check content of OSCAR/Space and populate | July 2020 | OPEN | | | | |
| Members | | 48.05 | with the missing information before CGMS-48 | | | | | | |
| | | | Plenary | | | | | | |
| SWCG | SWCG/7 | SWCG/A | SWCG to fill out the WIGOS Vision Template | July 2020 | OPEN | | | | |
| | | 48.06 | shown in CGMS-48-WMO-WP-20 | | | | | | |

8. Task Group on space weather calibration (and Agenda Point 1 of Joint WGII-SCWG session)

CGMS-48-SWCG-WP-04: Task Group Report on Inter-calibration of High Energy Electron Sensor and CGMS-48-CGMS-WP-16: Draft White Paper - Space-Based High Energy Electron Observation for Space Weather Forecast

Tsutomu Nagatsuma (NICT) reported that the task group have set up a campaign period for intercalibration, and some TG members provided data of high energy electron sensor during the period. Based on these data, TG members try to work for inter-calibration, and to discuss about the results and problems about inter-calibration. They are also writing a first draft of white paper about space-based high energy electron observation for space weather forecast to get feedback from GSICS. It is required the continuation of the task group activity for the usefulness, and the review of the white paper by GSICS and CGMS members.

Tsutomu Nagatsuma presented this report again to the joint WGII/SWCG Meeting on 29 May. It was pointed out in discussion that this TG is a temporary arrangement and it is important that CGMS members commit to provide the necessary resources and associated effort to perform inter-calibration both retrospectively on existing instruments and include in their plans for future instruments.

| CGMS-48 ACTIONS SWCG | | | | | | | | |
|----------------------|----------|----------|---|----------|--------|--|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | | |
| SWCG | SWCG/8 | SWCG/A | CGMS members to provide sustained | CGMS-49 | OPEN | | | |
| | | 48.19 | resources to perform energetic particle sensor | | | | | |
| | | | inter-calibrations both retrospectively on | | | | | |
| | | | existing instruments and to include it in their | | | | | |
| | | | plans for future instruments | | | | | |

9. Any other business

No other business was identified

10. Review and updating of the HLPP

CGMS-48-CGMS-WP-14SWCG: Status of implementation of CGMS High Level Priority Plan (2019-2023)

The status of implementation of CGMS High Level Priority Plan (2019-2023) is presented. It incorporates inputs from:

- WG I, II, III and IV chairs and rapporteurs
- International Science Working Group chairs and rapporteurs
- GSICS project
- SCOPE-CM project
- CEOS-CGMS Joint Working Group on Climate
- CGMS Space Weather Coordination Group.

The SWCG was requested to:

- identify priorities within their area of focus that can be considered achieved and should be removed from the HLPP
- identify new or modified priorities, that should be considered by CGMS for inclusion in the revised HLPP. Some recommendations have already been identified during the preparation of this document and are reflected in the HLPP tables
- consider whether priorities where no actions can be identified should be retained in the HLPP.
- The Status was updated following discussion accordingly.

CGMS-48-CGMS-WP-15SWCG: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2020-2024

As part of the agreed revision cycle for the CGMS High Level Priority Plan, this document presents a proposed HLPP covering the period 2020-24. The plan is based on the following inter-sessional activities:

- Meetings of the International Science Working Groups
- Recommendations from of WG-I, -II, -III and -IV as well as SWCG

SWCG agreed on wording to be proposed and endorsed by the Plenary Meeting.

11. Nomination and representatives at meetings

No changes to the existing representatives have been requested.

12. Next meetings 2020-2021 period

5 August 2020: Special Pre-Plenary CGMS-48 Intersessional #5

25-26 August 2020: CGMS-48 Plenary

Between CGMS-48 and CGMS-49:

- Intersessional #1: 29 September 2020

- Intersessional #2: 3 December 2020

Intersessional #3: 21 January 2021

- Intersessional #4: 23 March 2021

13. Review of actions/conclusions, preparation of WG report for plenary

The summary status list of SWCG actions and recommendations from CGMS-47 and earlier is provided in Annex VI.



JOINT WGI-WGIV-SWCG REPORT

Co-chairs: Tsutomu Nagatsuma (NICT/JMA)

Rapporteur: Sean Burns (EUMETSAT), Andrew Monham (EUMETSAT)

1. Welcome and review of agenda with objectives of the meeting

The Joint Meeting Chair, Dr. Tsutomu Nagatsuma, supported by Rapporteurs Mr. Sean Burns and Mr. Andrew Monham, welcomed the participants, consisting of representatives from CMA, ESA, EUMETSAT, ISRO, JMA, KARI, KMA, NICT, NOAA, ROSCOSMOS, ROSHYDROMET and WMO (see Annex VIII for full list of participants).

The respective WG Chairs reviewed and adopted the draft agenda proposed by the CGMS Secretariat prior to the meeting which is in line with the Terms of Reference for each WG.

2. Review of actions and recommendations from previous meeting

The Joint WGs briefly discussed the actions and recommendations from previous CGMS plenary sessions (CGMS-47 and earlier), noting that these were being specifically addressed in the dedicated agenda items. The final status is provided in Annex VI of this report. It was decided that the Space Weather related actions previously tracked under WGI should be managed instead directly by the SWCG.

3. Benefits of space weather data usage for satellite operators and role of anomaly report database

Spacecraft space weather anomaly inputs by members:

CGMS-48-EUMETSAT-WP-14: EUMETSAT spacecraft space weather anomaly report

Andrew Monham briefly introduced the report on suspected Space Weather related anomalies on all operational missions operated by EUMETSAT, covering Meteosat (Geostationary), EPS/Metop (LEO Polar), Sentinel-3 (LEO Polar).

All CGMS members are requested to provide their reports prior to the Plenary Meeting, preferably using the similar template as the EUMETSAT report, which follows the guidance of CGMS-47-EUM-WP-14. These will be compiled by SWCG into a dedicated Plenary Paper: CGMS-48 Member Space Weather Anomaly Data Inputs, which will collect all the forms with a Section for each member agency.

CGMS-48-SWCG-WP-01: Terms of Reference of the Space Weather Database Task Group, Status and Next Steps

Andrew Monham presented this Paper defining the Terms of Reference for the Space Weather Database Task Group. This forms the first part of the response to the Action WGI/A47.08. The current status of membership is also provided. Due to insufficient requests for TG participation, there have been no dedicated TG meetings held and discussions limited to SWCG intersessional meetings.

Assuming the TG membership can be increased, the remaining tasks in the Action are addressed in the section on foreseen next steps. In particular, CGMS members are encouraged to state their potential interest in leading the prototyping of the Space Weather Data Base as foreseen in the TOR, once WGI/A47.08 has been completed. Since this Paper does not fully respond to all tasks listed in Action WGI/A47.08, it is proposed to set the due date to November 2020.

| CGMS-48 AC | CGMS-48 ACTIONS – SWCG | | | | | | | | |
|------------|------------------------|----------|---|----------|--------|--|--|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | | | |
| SWCG/WGI | Joint WGI- | SWCG/A | Space Weather Spacecraft Anomaly Database | CGMS-49 | OPEN | | | | |
| | WG-IV- | 48.11 | Task Group: | | | | | | |
| | SWCG/3 | | Establish the requirements of the Space | | | | | | |
| | | | Weather Database parameters | | | | | | |
| | | | Establish the requirements for the Security / | | | | | | |
| | | | Confidentiality aspects | | | | | | |
| | | | Establish the process and rules for access the | | | | | | |
| | | | Database content | | | | | | |
| CGMS | Joint WGI- | SWCG/A | CGMS members are encouraged to nominate | CGMS-48 | OPEN | | | | |
| Members | WG-IV- | 48.12 | participants to the Space Weather Spacecraft | | | | | | |
| | SWCG/3 | | Anomaly Database Task Group | | | | | | |
| CGMS | Joint WGI- | SWCG/A | CGMS members to state their potential interest | CGMS-48 | OPEN | | | | |
| Members | WG-IV- | 48.13 | in leading the prototyping of the Space Weather | | | | | | |
| | SWCG/3 | | Spacecraft Anomaly Database Task Group | | | | | | |
| CGMS | Joint WGI- | SWCG/A | CGMS Members to provide their Space Weather | CGMS-48 | OPEN | | | | |
| Members | WG-IV- | 48.14 | Anomaly Data Forms in dedicated template as | | | | | | |
| | SWCG/3 | | input to the Plenary Paper: CGMS-48 Member | | | | | | |
| | | | Space Weather Anomaly Data Inputs, which will | | | | | | |
| | | | collect all the forms with a Section for each | | | | | | |
| | | | member agency. | | | | | | |

4. Requirements and feasibility of low latency RO data dissemination for space weather data users through direct broadcast

CGMS-48-EUMETSAT-WP-06: Progress status and way forward on efforts to define requirements and feasibility of low latency RO Data Dissemination.

Andrew Monham presented an overview of the work performed so far to progress on addressing the HLPP

6.2.4: In coordination with IROWG establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring.

The need for low latency (<=30 mins) has been well documented by IROWG and it is considered that this can be handled at a system end-to-end level through acquisition, processing and dissemination of products. Iterations taking place within EUMETSAT and the ROM SAF, as well as other user groups show that latencies of <15 mins would be welcomed.

A five-step action plan is proposed as follows:

- Step 1: Identify CGMS Members with current or planned RO data provision capability and possibly able to support low latency provision (coordinated by SWCG/WGI).
- Step 2: Clarify and iterate the high level requirements with IROWG & IPT-SWeISS based on the EUMETSAT ROM SAF inputs.
- Step 3: Analyse technical feasibility at system, end-to-end level identified space systems from Step 1. Considerations include space segment, ground stations, data and product processing, dissemination networks. Inputs: High level requirements from Step 2. Output: E2E system concept with target and threshold requirements to go into OSCAR and CGMS Baseline / HLPP. Coordinated by a Task Group with SWCG, IROWG, IPT-SWeiSS members plus technical / user support from each responsible Agency. In case of >1 Agency involvement, TG to harmonise / prioritise the E2E System concepts.
- Step 4 CGMS Members operating the instruments to respond to requirements according to agreed System Concept (acceptance / implementation plan).

| _ | Step 5 | 5: Impleme | ent/Validate | /Accept. |
|---|--------|--|---------------|---|
| | JULD | ,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | ,,,,, vanaate | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |

| CGMS-48 AC | CGMS-48 ACTIONS –SWCG | | | | | | | | |
|------------|-----------------------|----------|---|-----------|--------|--|--|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | | | |
| NOAA, | Joint WGI- | SWCG/ | Identify CGMS Members with current or planned | July-2020 | OPEN | | | | |
| EUM, CMA, | WG-IV- | A48.15 | RO data provision capability and possibly able to | | | | | | |
| KMA, | SWCG/4 | | support low latency provision (Step 1 in CGMS- | | | | | | |
| CGMS | | | 48-EUMETSAT-WP-06) | | | | | | |
| Members | | | | | | | | | |
| SWCG | Joint WGI- | SWCG/ | Clarify and iterate the high level RO | Nov- | OPEN | | | | |
| | WG-IV- | A48.16 | requirements with IROWG & WMO based on the | 2020 | | | | | |
| | SWCG/4 | | EUMETSAT ROM SAF inputs. (Step 2 in CGMS-48- | | | | | | |
| | | | EUMETSAT-WP-06) | | | | | | |
| SWCG | Joint WGI- | SWCG/ | Analyse technical feasibility at RO system, end- | Feb-2021 | OPEN | | | | |
| | WG-IV- | A48.17 | to-end level for the identified space systems | | | | | | |
| | SWCG/4 | | from Step 1. (Step 3 in CGMS-48-EUMETSAT-WP- | | | | | | |
| | | | 06) | | | | | | |
| NOAA, | Joint WGI- | SWCG/ | CGMS Members operating the RO instruments | CGMS-49 | OPEN | | | | |
| EUM, CMA, | WG-IV- | A48.18 | to respond to requirements according to agreed | | | | | | |
| KMA, | SWCG/4 | | System Concept (req. acceptance / | | | | | | |
| CGMS | | | implementation). (Steps 4,5 in CGMS-48- | | | | | | |
| Members | | | EUMETSAT-WP-06). | | | | | | |

5. Expansion of space weather user survey

CGMS-48-SWCG-WP-05: Space Weather User Data Provider and User Surveys Outcomes and Next Steps

Andrew Monham presented the Paper that reported on the Space Weather Data Provider and User Surveys performed by the SWCG, with involvement of WGI and WGIV and related progress on analyses and follow-up actions (SWCG AI 47.05, AI 47.06, AI 47.07). Results of a preliminary analysis based on the

user survey responses received so far are presented. Furthermore, the Paper reports on the findings related to LEO Magnetometer data within the surveys, providing a recommendation to close AI 47.02 through removal of this data type from the CGMS Baseline and to consider it for inclusion in the HLPP. Additional survey responses are encouraged in order to complete the Gap Analysis and identify pilot projects at ground segment level to improve data provision and the overall user experience. A series of recommendations are provided in order to progress:

Related to SWCG AI 47.02

- Remove the LEO Magnetometer measurements from the CGMS Baseline and close this action.
- Determine steps necessary to assess the need for LEO Magnetometer operational data provision and assess whether it should be included in the HLPP as aspirational data.

Related to SWCG A47.05:

- Encourage responses from other known operators of space weather satellite instruments
- Compare the data providers' perspective with that of data users to identify gaps and areas for improvement.

Related to SWCG A47.06:

- Encourage responses from further users of data from space weather satellite instruments
- CGMS SWCG to engage with survey respondents on an individual basis to clarify inputs made, with support of ISES / IPT-SWeISS where appropriate.
- Complete Analysis of user versus data provision survey responses to identify gaps in the capabilities implemented and planned with respect to user expectations.
- Identify pilot projects to be funded by CGMS members. Examples of such pilot projects could be upgrades in ground system capabilities to improve data availability or timeliness, format changes etc.). This should be handled with the TG already actioned under SWCG AI47.07.

| CGMS-48 ACT | CGMS-48 ACTIONS –SWCG | | | | | | | | |
|-------------|-----------------------|----------|---|-----------|--------|--|--|--|--|
| Actionee | AGN item | Action # | Description | Deadline | Status | | | | |
| SWCG | Joint | SWCG/ | Follow-up on the User Survey interaction to get | July-2020 | OPEN | | | | |
| | WGI-WG- | A48.08 | more specific information on data formats / | | | | | | |
| | IV- | | availability constraints and check implication of | | | | | | |
| | SWCG/5 | | delivering the data on WIS/GTS with these users. | | | | | | |
| | | | Consider Task Force on Satellite Data and Codes | | | | | | |
| | | | taking a role in following up on this initial | | | | | | |
| | | | interaction (see Simon Elliott Paper EUM-WP-08 | | | | | | |
| | | | in WGI). | | | | | | |
| EUM/NOAA | Joint | SWCG/ | Request responses from additional users of data | Nov- | OPEN | | | | |
| | WGI-WG- | A48.09 | from space weather satellite instruments | 2020 | | | | | |
| | IV- | | | | | | | | |
| | SWCG/5 | | | | | | | | |
| EUM/NOAA | Joint | SWCG/ | CGMS SWCG to engage with survey respondents | Nov- | OPEN | | | | |
| | WGI-WG- | A48.10 | on an individual basis to clarify inputs made, with | 2020 | | | | | |
| | IV- | | support of ISES / IPT-SWeISS where appropriate. | | | | | | |
| | SWCG/5 | | | | | | | | |

6. Space weather matters in WGIV

6.1 Current data formats for space weather observations

All issues relating to data formats were addressed in the context of the user surveys agenda point reported on above.

6.2 Near-real-time access to and global exchange of space weather data, access via GTS

All issues relating to NRT access, global exchange and GTS were discussed in the context of the user surveys agenda point reported on above.

6.3 Feedback from SWCG discussions related to data access and end user support

All issues regarding data access and end user support were discussed in the previous agenda points of this joint meeting, reported on above.

7. Any other business

No other business was identified.



JOINT WGII-WGIII REPORT

1. Status of preparations of the second revision of the CGMS baseline & risk assessment (verbal)

Reporting on this agenda item is covered in Sections 3 and 4.

- 2. Establishment of way forward for science questions raised during baseline and risk assessment review
- 2.1 Hyperspectral Infrared Sounder (what is the impact of the spectral gap for applications?)

CGMS-48-NOAA-WP-17: Impact of HSIR and Direct Broadcast Data on Regional Modeling

NOAA/NESDIS and NOAA/OAR have collaborated on demonstration of use of direct broadcast sounder data in NOAA regional hourly updating forecast models. The reduced latency for the direct broadcast data is critical for the hourly updating models resulting in significant positive forecast impacts and use of the direct broadcast data has been operational since 2018. CrIS hyperspectral IR data are used in the RAP data assimilation system, as well as IASI and AIRS data. CrIS data are also used for model forecast verification.

For hourly updating models like the RAP, direct broadcast data feeds substantially increase the number of assimilated observations, leading to significant forecast error reductions. Verification of model forecasts against CrIS brightness temperatures, rather the radiosonde observations, reveals even larger data impacts from assimilation of satellite data and direct broadcast data. Adding CrIS-FSR data from N20 (72 channels) leads to further RAP forecast error reductions, especially for relative humidity.

CGMS consider underscoring the importance of low latency data for LEO satellites and implement as a firm requirement.

CGMS-48-NOAA-WP-18: Enabling Hyperspectral Shortwave IR Observations in NOAA NWP Presented to CGMS-48

Current NWP models do not assimilate shortwave (SW) IR channels for several reasons – e.g. potential solar contamination and non-Local Thermodynamic Equilibrium effects. However, there are advantages in SW being exploited, and it is also possible the LW band could have malfunctions. Furthermore, some CubeSat concepts are considering no-LW options.

CGMS should consider that Hyperspectral IR observations in the shortwave region provide valuable sounding information which is underutilised by NWP centers. These observations could play a vital role in filling gaps in the currently satellite global observing system. NWP centers should explore their value in terms of forecast impact from current hyperspectral sounders to help shape future satellite architectures.

CGMS-48-NOAA-WP-19: OSSEs for Assessment of Hyperspectral Infrared Measurements from Geostationary Orbit in Support of Potential Manifest of a Hyperspectral Radiometric Spectrometer on GEO-XO

NOAA reported on OSSE studies by the Assessment Team on three research groups developing independent OSSE/OSEs related to assessment of hyperspectral infrared measurements: NOAA NESDIS and OAR/AOML, Global Modeling and Assimilation Office (GMAO) as NASA-GSFC and Cooperative Institute for Meteorological Satellite Studies (CIMSS) at University of Wisconsin.

Assessment Team's path forward is to incorporate new findings from the Assessment Team and complete OSSE/OSE analysis to extend analytic record data, complete applications assessment, extend benefit analysis to include detailed societal benefit analytics and Document findings and report ensuring decision makers have timely value assessment to underpin strategy for future system formulation.

The schedule of the activities is to complete value assessment in Q3/2020 including the additional analyses and assessments into findings and extend value assessment to include comprehensive societal benefits. Then prepare the report and out-brief to be included in GEO-XO Milestone-1 Review.

CGMS-48-NASA-WP-04: NASA Infrared Hyperspectral Remote Sensing

NASA gave an introduction to NASA Infrared systems including airborne systems including Hyperspectral Thermal Emission Spectrometer (HyTES), Scanning High-Resolution Interferometer Sounder (S-HIS) and NPOESS Airborne Sounder Testbed - Interferometer (NAST-I), and space-borne systems including Crosstrack Infrared Sounder (CrIS), Tropospheric Emission Spectrometer (TES) and Atmospheric Infrared Sounder (AIRS).

It was discussed that baseline could be assessed to include as least one instrument for full spectral coverage.

2.2 Radio occultation – What is the best way to characterise current/planned performance for NWP and space weather. (Minimum 6,000 occultation from low inclination orbits, 1,000 occultation from drifting high inclination orbits, and 7600 occultation from sun-synchronous orbits? Electron density profiles up to 500 km?)

The definition on the best way to characterise current/planned RO performance for NWP and space weather was discussed. It was agreed that definition on space and time needs to be addressed. Now many satellites are operating in similar inclinations, which significantly increases the number of RO observations available, however, the geographical coverage is relatively non-uniform. The definition was updated in CGMS Baseline to better represent the requirements also for the geographical distribution of coverage.

2.3 Visible infrared - Action to WGII to review need for radiation balance observations in GEO/LEO

There were no discussions under this item.

2.4 Visible/UV spectrometer - WGII to discuss UV observations in GEO, and the inclusion of trace gases as an observation from GEO to which CGMS can commit

It was discussed that dedicated session for the Visible/UV spectrometer topics should be organised in the CGMS-49.



ANNEX I: STATUS OF PLENARY ACTIONS AND RECOMMENDATIONS FROM CGMS-47 OR EARLIER FOLLOWING CGMS-48 DISCUSSIONS

Status of plenary actions and recommendations resulting from CGMS-47 or earlier following CGMS-48 deliberations.

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|-------------|----------|--|---|----------------------|--------|
| CGMSSEC | E.6 | A46.21 | CGMS Secretariat to organise a special plenary session or a side event on operational oceanography at CGMS-47 to help advance the operational nature of ocean observation. (Ref. CGMS-46-NOAA-WP-11, CGMS-46-IOC-UNESCO-WP-02) | 2020 Jan 22 CGMSSEC #2: CLOSED and superseded by A47.04. A thematic session on scatterometers will be held at CGMS-48 plenary 2019 Nov: An initial dedicated session on scatterometer will be held at CGMS-48. Oceanography will be addressed at future plenaries. CGMS-47: Deferred to CGMS-48 in view of the WMO constituent body reform. The CGMS Secretariat will include this session at CGMS-48 taking into account the proposal in CGMS-47 IOC-UNESCO-WP-01: Receive annual briefing on the UN Decade of Ocean Science for Sustainable Development; Sustain satellite and in situ system of ocean observing systems; Utilise geostationary meteorological satellites for ocean observations; Enhance data acquisition for special observing periods; Add CGMS-relevant ocean measurements to tsunami watch infrastructure; Add HAB toxic aerosols to coastal air pollution forecasts. (In addition to WMO-IOC coordination following the WMO constituent body reform). | CGMS-48 (CGMS-47) | CLOSED |

| Status of pl | enary acti | ions from Co | GMS-47 or earlier following CGMS-48 discuss | ions | | |
|--------------|-------------|--------------|---|---|----------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| WMO | Н | A46.11 | On ocean variables: In view of the anticipated reform of JCOMM, WMO to provide a report with proposals on future coordination/cooperation between JCOMM and CGMS. | 2020 Aug: CGMS-48-WMO-WP-15. WMO to report to CGMS-49 on progress. 2020 Jan 22 CGMSSEC #2: Anticipated for CGMS-48 as far as is possible 2019 Nov: CGMS-48-WMO-WP-xx see also A47.04 CGMS-47: In view of the WMO constituent body reform, the action is deferred to CGMS-48. 2019 Mar 13: CGMSSEC IS#3: CGMSSEC has discussed this item with JCOMM. Likely to be premature for CGMS-47, currently expected to be explicitly addressed at CGMS-48. There will however, be a presentation on sea ice monitoring in the plenary session "Observations and monitoring of the Arctic". 2019 Jan 28, WMO: CGMS should work with the JCOMM co-presidents to develop closer coordination and cooperation on mutually beneficial subjects. This is an opportunity for CGMS to learn about the wide range of activities in JCOMM. Anticipated on the agenda | CGMS-49 (CGMS-47) | OPEN |
| WMO | 3.1.2 | A47.01 | On WIGOS Vision 2040: WMO to report to CGMS-48 on activities undertaken to respond to the new WIGOS Vision 2040 | 2020 Aug: CGMS-48-WMO-WP-13. Action closed following plenary discussions. | CGMS-48 | CLOSED |

| Actionee | AGN | Action # | Description | Action feedback/closing document | Deadline | Status |
|---------------------|-------|----------|--|--|----------------------|--------|
| | item | | | | | |
| WMO | 3.2.5 | A47.02 | On global NWP: WMO to provide a report at next CGMS on baseline requirements for satellite products for global NWP, to trigger a CGMS discussion on status of delivery of such observations and possible improvements in the future and inclusion in the CGMS baseline document. | 2020 Aug: See related CGMS-48-WMO-WP-13, CGMS-48-WMO-WP-15. Action carried over to CGMS-49 2020 May: Postponed due to the COVID-19 pandemic. WMO to report to CGMS-49 working groups and plenary. (Related to GBON and critical satellite data). 2020 Feb 19: CGMS/space agency to map the contributions towards meeting the WMO requirements. WGII and WGIII to look at the process wrt critical satellite data (supply of global NWP for WMO). Adressed at the 2nd CGMS risk assessment WS 19-21 Feb 2020 | CGMS-49 (CGMS-48) | OPEN |
| NOAA, WMO | 3.2 | A47.03 | On PP sector engagement: WMO and NOAA to report on the status of affairs and related issues on public private sector engagement to CGMS-48 | 2020 Aug: Due to the plenary being virtual, the agenda has been reduced. WMO will also address this point at the WMO Data Conference in November 2020. Action carried over to CGMS-49. | CGMS-49 (CGMS-48) | OPEN |
| WMO, IOC- UNESCO | 3.3 | A47.04 | On operational oceanography: WMO and IOC-UNESCO to report on their coordination following the WMO constituent body reform to CGMS-48 | 2020 Aug: Addressed in CGMS-48-WMO-WP-15. See also A46.11. 2020 Jan 22 CGMSSEC #2: Anticipated for CGMS-48 as far as is possible | CGMS-48 | CLOSE |
| IOC- UNESCO | 3.3 | A47.05 | On operational oceanography: IOC-UNESCO to provide to GCMS-48 guidance on satellite data requirement for improved coastal ocean prediction and services | 2020 Aug: Postponed to CGMS-49 | CGMS-49 (CGMS-48) | OPEN |

| Status of pl | enary act | ions from CO | GMS-47 or earlier following CGMS-48 discussi | ons | | |
|-----------------|-------------|--------------|---|---|----------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| CGMS members | 5.1 | A47.06 | WGI co-chair: CGMS members to propose candidates for the WGI co-chair | 2020 Aug: CGMS members are invited to nominate a co-chair for WGI | Q3 2019 | OPEN |
| CGMS members | 5.2 | A47.07 | Cloud services: CGMS agencies to analyse if existing cloud service activities can serve as a demonstration project, exploring at least two of the WMO Information Systems (WIS 2.0) principles. (Initially discussed in WGIV/8) CGMS-47-WMO-WP-20 | Closed following 2020 May CGMS-48 joint WGI/WGIV discussions. A small team has been created to address cloud services. 2020 Jan 22 CGMSSEC #2: Members to provide further points of contact NOAA: (vanessa.l.griffin@noaa.gov as initial PoC) EUM: Lothar Wolf lothar.wolf@eumetsat.int ISRO: Nitant Dube nitant@sac.isro.gov.in JMA: K Bessho kbessho@met.kishou.go.jp CMA: Zhe Xu xuzhe@cma.gov.cn KMA: Hyunjong Oh hyunjong.oh@korea.kr (To be addressed within the framework of WGIV) 2019 Nov 22: Reminder sent to WGIV and specifically to CMA, JMA, NOAA and EUM. Members are requested to contact Enrico Fucile, Chief Data Representation, Metadata and Monitoring Division, WMO, efucile@wmo.int, cc cgmssec@eumetsat.int | Dec 2019 | CLOSED |
| CGMSSEC | 7 | A47.08 | Arctic observations: CGMSSEC to secure the inclusion of Arctic observations on the plenary and working group agendas for future CGMS plenary sessions | 2020 Aug: Action closed in view of the reference to HEO in the baseline. Arctic observations to be added to future CGMS sessions (not addressed at CGMS-48 plenary due to virtual meeting and compressed schedule). | CGMS-48 | CLOSED |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|-----------------|-------------|----------|--|---|------------------------|--------|
| | | | | 2020 May: Addressed in the CGMS-48 working groups. The CGMS Baseline refers to HEO orbits. Relevant members are requested to add status/plans in their respective agency reports on Arctic observations. 2020 Jan 22 CGMSSEC #2: Relevant CGMS space agency members are requested to include a report on the status and plans in their agency report on plenary day 1 (in addition to the WG meetings). | | |
| CGMS members | 7 | A47.09 | Arctic observations: Provide product priorities for Arctic observations for a special Arctic session in WG II during CGMS-48 | 2020 Aug: Action closed in plenary. Transferred to WGII and for future WGII deliberations (as well as in plenary). Members with planned Arctic observation missions are requested to include a status report in the agency report (information document) 2020 Jan 22 CGMSSEC #2: Added to the WGII agenda. To be addressed in the report from WGII to plenary. | CGMS-48 | CLOSED |
| CGMSSEC, CMA | 7 (5.5) | A47.10 | Hyperspectral sounding: CGMSSEC together with CMA to organise a thematic session at CGMS-48 on hyperspectral sounding observations | A thematic session will be held in CGMS-48 plenary (see online agenda, plenary day 1, item 4). | CGMS-48 | CLOSED |
| CGMS members | 8.2 | A47.11 | Climate session: CGMS members to endorse (through a written procedure) the ECV inventory gap analysis report and updated coordinated action plan | 2020 Aug 17: Further delayed due to the COVID-19 pandemic. The ECV Inventory v3 has been released on 30 July 2020. The gap analysis report is expected in September 2020. Virtual endorsement planned at time of CEOS Plenary (20-22 October 2020). 2020 Jan 22 CGMSSEC #2: Delayed. 2019 Nov 18: Gap analysis report and updated action plan are still being drafted due to delays in the | Oct 2020 (Oct 2019) | OPEN |

| Status of pl | enary act | ions from Co | GMS-47 or earlier following CGMS-48 discuss | ions | | |
|-----------------|-------------|--------------|---|---|----------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | verification of ECV entries due to slow response from agencies and subsequently delayed start of gap analysis. Report and plan should be available for review by end of November. Virtual endorsement is planned for Dec/Jan timeframe depending on review results. | | |
| CGMS members | 8.2 | A47.12 | Climate session: CGMS members to endorse (through a written procedure) the CEOS/CGMS statement for SBSTA-51 | CLOSED 2019 Dec 3: Statement was presented on 3rd December to SBSTA-51 2019 Nov 18: Statement endorsement validated on 15 November and statement was submitted to UNFCCC Secretariat on 17 November. CGMSSEC e-mail to main pocs of CGMS Members on 28 Oct 2019 requesting endorsement by 7 November. | Nov 2019 | CLOSED |
| WMO | 8.2 | A47.13 | Climate session: WMO to present implications of the WMO constituent body reform to the interface between CGMS and the requirements/GCOS at CGMS-48. | 2020 Aug: CGMS-48-WMO-WP-13 plenary day 1, and CGMS-48-WMO-WP-09, plenary day 2, item 6.1. Action expected to be closed. (EUM is a member of the GCOS study group) | CGMS-48 | CLOSED |
| CGMS members | 8.2 | A47.14 | Climate session: CGMS members are invited to provide application case studies that use climate data record to support training | 2020 Aug 17: CGMS members (space agencies) to submit use cases for climate data records within their respective areas via WGClimate's use case collection tool https://climatemonitoring.info/use-cases that provides access to web based submission form developed together with WMO. Action to be carried forward to next plenary. 2020 Jan 22 CGMSSEC #2: Members are invited to provide case studies as necessary/available 2019 Nov 18: EUMETSAT has provided a few | CGMS-49 (CGMS-48) | OPEN |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|-----------------|-------------|----------|---|--|-----------------------------|--------|
| | | | | preliminary cases to WGClimate. CGMS members are invited to contribute. | | |
| SCOPE-CM | 8.2 | A47.15 | Climate session: SCOPE-CM to provide an implementation plan based on the agreed new concept (ref. CGMS-47-SCOPE-CM-WP-01) | 2020 Aug: Implementation plan was presented to and endorsed by CGMS-48 plenary (CGMS-48-SCOPE-CM-WP-01). Also addressed within the framework of WGII. | CGMS-49 (CGMS-48) | CLOSED |
| | | | | 2020 May CGMS-48 WGII: Addressed in WGII, status report to be included in the WGII report to plenary. 2020 Jan 22 CGMSSEC #2: Anticipated for CGMS-48 CGMS-48-WP-SCOPE-CM-01 This is also a WGII action (WGII 47.09) | | |
| WGClimate | 8.3 | A47.16 | Climate/GHG session: WGClimate to present the roadmap for the implementation of the recommendations from the GHG monitoring constellation | 2020 Aug: CGMS-48-JWGCLIM-WP-02/03. Action closed on the occasion of CGMS-48 plenary. New related actions have been raised. | CGMS-48 (31 Oct 2019) | CLOSED |
| | | | white paper (including resource implications) | 2020 May: A brief report on the roadmap was delivered to CGMS WG-II. The roadmap is a living document, in particular its Annex C that describes the work plan. However, it will be presented to CGMS-48 Plenary and the assessment of needed resources and the way | | |
| | | | | forward could be endorsed. 2020 Jan 22 CGMSSEC #2: Anticipated for CGMS-48 2019 Nov 18: Roadmap still under elaboration. Complete roadmap will be presented to CEOS SIT-35 | | |
| | | | | late March 2020 after a wider consultation of the community that needs to exercise the implementation. | | |
| CGMS members | 9.1 | A47.17 | On training and education: CGMS members active in VLab to propose the next Co-Chair to represent CGMS | 2020 May CGMS-48 WG discussions: Vlab matters have been transferred to WGIV on user preparedness. This action is critical! | Dec 2019 | OPEN |

| Status of pl | enary acti | ons from Co | GMS-47 or earlier following CGMS-48 discussi | ions | | |
|-----------------|-------------|-------------|--|--|-------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | satellite operators in the VLab (starting October 2020). Nominations to be presented to VLab by December 2019. | 2020 Jan 22 CGMSSEC #2: Critical! CGMSSEC to work with current co-chair to circulate a message also inviting CGMS agency representatives to the Vlab management meeting at EUMETSAT. | | |
| CGMS members | 11.1 | A47.18 | On the HLPP: CGMS members to comment on the revised HLPP text and provide feedback to CGMSSEC@eumetsat.int | New action following CGMSSEC review 27 May 2019 | 1 July 2019 | CLOSED |

| Plenary recomm | endations f | rom CGMS-4 | 47 or earlier | |
|---------------------|-------------|------------|---|---|
| Lead | AGN item | Rec # | Description | STATUS (feedback for completion) |
| CGMS space agencies | 5.7 | R47.01 | (From IPWG): IPWG strongly recommends to CGMS members to continue the constellation of PMW sensors to ensure quality satellite precipitation products for weather, climate, and hydrological applications. Additionally, IPWG would like to be kept informed of longer term plans for subsequent launches of microwave sensors to ensure continuity of long-term observations that meet the documented needs of the user community. | Transferred from plenary to WGIII |
| CGMS space agencies | 5.7 | R47.02 | (From IPWG): IPWG also recommends that there be a CGMS-wide coordination of the crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of diurnal cycle, convective systems lifecycles, and severe storms. | Transferred from plenary to WGI via WGIII |

| Plenary recomm | endations f | rom CGMS-4 | 17 or earlier | |
|---------------------|-------------|------------|---|--|
| Lead | AGN item | Rec # | Description | STATUS (feedback for completion) |
| CGMS space agencies | 5.7 | R47.03 | (From IPWG): As precipitation moves to higher temporal rates, we recommend to CGMS members to synchronise full-disk geostationary sampling schedules which will optimise GEO scans to improve temporal sampling of precipitation products and unknown future PMW imager availability for merged products. | Transferred from plenary to WGI via WGIII |
| CGMS space agencies | 5.7 | R47.04 | (From IPWG): Collaboration between space programs and data assimilation centers should be specifically encouraged to incorporate DA requirements as part of scientific requirements when developing new satellite / observing systems. This would reduce barriers for operational assimilation of observations, and potentially provide a greater range of utility for various sensors. | Transferred from plenary to WGIII |
| CGMS space agencies | 5.7 | R47.05 | (From IPWG): Higher spatial and temporal (sub-hourly) resolution and higher spectral sampling in the microwave measurement of clouds and precipitation should be considered in future observing systems. | Transferred from plenary to WGIII |
| CGMS space agencies | 5.7 | R47.06 | (From IPWG): Latency and quality of satellite data should be improved, from both operational and research missions, to fit in the DA high temporal resolution cycle. | Transferred from plenary to WGIII |
| CGMS space agencies | 5.8 | R47.07 | (From ICWG) : CGMS members to budget a baseline funding for the intercomparison study, given its importance and impacts on global cloud products. | 2020 Aug: Transferred from plenary CGMS-47 to WGII |
| CGMS space agencies | 5.8 | R47.08 | (From ICWG) CGMS members to consider introducing multisensor (satellite and ground-based measurements) applications for convective nowcasting when developing/updating product requirements. | 2020 Aug: Transferred from plenary CGMS-47 to WGII |
| CGMS space agencies | 5.8 | R47.09 | (From ICWG) CGMS agencies to continue operating conically- scanning passive MW sensors in an early afternoon orbit as well as in a dusk/dawn orbit in order to maintain this unique long- term time series. | 2020 Aug: Transferred from plenary CGMS-47 to WGIII |

| Plenary recommer | Plenary recommendations from CGMS-47 or earlier | | | | | | |
|------------------|---|--------|---|---|--|--|--|
| Lead | AGN | Rec # | Description | STATUS (feedback for completion) | | | |
| | item | | | | | | |
| CGMS members | 9.1 | R47.10 | On training and education: | 2020 Aug: Transferred to WGIV | | | |
| | | | CGMS members to provide contributions into the WMO VLab | 2020 May CGMS-48 WG discussions: VLab will in | | | |
| | | | Trust Fund to ensure the continuation of technical support to the | future be addressed in WGIV, user preparedness. | | | |
| | | | VLab. CGMS members considering to provide additional support | The plenary recommendation remains very valid! | | | |
| | | | should contact the WMO Space Programme Secretariat | 2020 Jan 22, CGMSSEC IS#2: To be addressed | | | |
| | | | | within the framework of Vlab, WMO, CGMSSEC | | | |
| | | | | plus communication to CGMS agencies | | | |

ANNEX II: STATUS OF WORKING GROUP I (WGI) ACTIONS AND RECOMMENDATIONS FROM CGMS-47 OR EARLIER FOLLOWING CGMS-48 DISCUSSIONS

Status of WGI CGMS-47 actions and recommendations resulting from CGMS-48 deliberations.

| WGI action | ns from pre | evious plena | ry sessions (CGMS-47 and earlier) | | | |
|-------------------------------|-------------|--------------|---|--|------------------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| DCS (WGI) sub- group | WGI/5.3 | A46.06 | The DCS sub group is invited to review and provide comments to this draft of the CGMS agency best practices in support to user DCS data access. | 2020 May CGMS-48 WGI: Closed following discussions in WGI. 2020, 28 Jan/24 March, IS: Updated Best Practice to be presentated to CGMS-48 CGMS-47 CGMS-WP-17. Proposed Best Practices to be further reviewed to take into account DCP data formats. | CGMS- 48 (CGMS- 47) | CLOSED |
| CGMS members | WGI/7.2 | A46.12 | Members to provide the status of their systems already in place and those planned, along with their overall approach to dealing with the challenges associated with handling and circulating large data volumes | 2020 May CGMS-48 WGI: EUM & NOAA presentations CGMS-48-EUMETSAT-WP-05 and CGMS-48-NOAA-WP-04, additionally presentations given in the joint WGI/WGIV session on Cloud Services. 2020, 24 Mar, IS: DCS Handbook published on 1 March 2020 (ref. CGMS/DOC/19/1054958 V1F) http://esww17.iopconfs.org/home 2020, 28 Jan, IS: Members are requested to provide information to CGMS-48 CGMS-47: EUMETSAT expects to report on progress to CGMS-48 in 2020. | CGMS- 48 (CGMS- 47) | CLOSED |

| WGI actio | ns from pre | evious plena | ry sessions (CGMS-47 and earlier) | | | |
|---------------------------|-------------|----------------|--|---|-------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| CGMS space agencies | WGI/1.1 | WGI/A47 .01 | CGMS members are requested to provide nominations to the CGMS Secretariat for the position of Co-Chair of CGMS Working Group I | 2020 May, CGMS-48 WGI: Nominations requested at the meeting. 2020, 28 Jan, IS: CGMSSEC to send out further reminders unless solution has been found in the course of February. | Q3 2019 | OPEN |
| WGI | WGI/4.1 | WGI/A47 .02 | Consider the advantages of using RHCP/LHCP against the simplicity/affordability of the Direct Broadcast stations and to formulate a CGMS Agency Best Practice on use of Circular Polarisation for Direct Broadcast | 2020 May CGMS-48 WGI: CGMS-48-EUMETSAT-WP-15 Future direct broadcast data rates from polar orbiting satellites. Closed and superseded by WGI A48.4 2020, 26 Feb. WGI IS: Action not explicitly discussed, but RHCP/LHCP discussed in the context of WGI/A47.03. 2020, 28 Jan, WGI IS: To be addressed in the Update of Best Practices document, section 3: Potential additional topics for consideration as CGMS Best Practice, noting that studies to be carried out in support of this work - therefore Agencies to explore the options for providing support with studies. | CGMS- 48 | CLOSED |

| WGI actio | ns from pre | evious plena | ry sessions (CGMS-47 and earlier) | | | |
|-----------|-------------|----------------|---|--|-------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| WGI | WGI/4.1 | WGI/A47 .03 | Analyse possible solutions to address the expected increase in instrument data from future polar orbiting satellites and to propose new DB standards and/or Best Practices as required | 2020 May CGMS-48 WGI: CGMS-48-EUMETSAT-WP-15 Future direct broadcast data rates from polar orbiting satellites. Closed and superseded by WGI A48.4 2020, 26 Feb. WGI IS: Updated list of possible ways to increase the bandwidth distributed prior to meeting and discussed during meeting. Agreed to turn the list into a WP for discussion in WGI during CGMS-48. 2020, 28 Jan, WGI IS: Based on the list of possible ways to increase the bandwidth provided at CGMS-47 in CGMS-47-EUMETSAT-WP-06, an updated/expanded list to be prepared prior to the next intersessional meeting on February 26. | CGMS- 48 | CLOSED |
| WGI | WGI/4.1 | WGI/A47 .04 | Initiate a peer review process between the agencies (e.g. NOAA, CMA and EUMETSAT) of the Implementation of CGMS Best Practices for LEO Direct Broadcast Data documents prepared by these agencies, with the aim of improving quality and consistency of these documents and references prior to presentation at the CGMS plenary sessions | 2020 May CGMS-48 WGI: Peer review of Agency papers for the status of BP implementation conducted for all CGMS 48 DB status presentations. Closed following CGMS-48 WGI discussions. 2020, 26 Feb. WGI IS: Point of contact with CMA (Lei Yang) now established. NOAA, CMA and EUMETSAT will conduct the peer review during March 2020. 2020, 28 Jan, WGI IS: process initiated. Point of Contact still required from CMA. Topic also on the | End 2019 | CLOSED |

| WGI action | ns from pre | evious plena | ry sessions (CGMS-47 and earlier) | | | |
|------------------|-------------|----------------|--|--|-------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | agenda at a bilateral meeting between CMA and EUMETSAT in February. | | |
| WGI | WGI/4.1 | WGI/A47 .05 | To review and if appropriate identify any common viewing geometries that are missing from the proposed list of NetCDF encoding good practices | CGMS-48 May WGI: Closed following WGI discussions. 2020, 4 Feb, WGI IS: proposed for closure after confirming that no viewing geometries are missing from the proposed list of netCDF encoding good practices | End 2019 | CLOSED |
| DCS sub group | WGI/5.1 | WGI/A47 .06 | To coordinate the elaboration of the user requirements, the technical specifications, and potential applications for a new DCP Standard and make a proposal to WGI | CGMS-48 May WGI: Presentation of progress at CGMS-48 in CGMS-48-CGMS-WP-09. Action closed with a new CGMS-48 action introduced and updated as A48.6 2020, 28 Jan, WGI IS: New standard document created describing possible application areas, user requirements and technical specification, initially based on ESA study. This document will be the basis for finalising the new standard. To be further elaborated at the DCS Sub-Group Meeting at the occasion of the NOAA TWG in April. Presentation of progress at CGMS-48. | CGMS- 48 | CLOSED |
| CGMS Member | WGI/5.1 | WGI/A47 .07 | Review and provide comments to Draft V1B of the DCS Handbook | CGMS-48 May WGI: The DCS handbook has been published on the CGMS website under publications. 2020, 28 Jan, WGI IS: Publication foreseen for Feb 2020 | Aug 2019 | CLOSED |

| WGI actio | ns from pre | evious plena | ry sessions (CGMS-47 and earlier) | | | |
|-----------|-------------|----------------|--|--|--------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| EUM | WGI/6.1 | WGI/A47 .08 | Form a Space Weather Database Task Group. A first report Form the TG on its activities would be presented at CGMS-48 including: • Establish the membership and ToR of the Task Group • Establish the requirements of the Space Weather Database parameters • Establish the requirements for the Security / Confidentiality aspects • Establish the process and rules for access the Database content | CGMS-48 May WGI: Terms of Reference of the Space Weather Database Task Group, Status and Next Steps presented in CGMS-48-SWCG-WP-01. Action closed and superseded by A48.6 2020, 29 Jan: ISWG rapporteur (A Monham) invited CGMS agencies to nominate participants (spacecraft operations experts; spacecraft design experts in space weather resilience / standards committees; space weather service providers) and circulated draft ToRs (on the SWCG list server) 2020, 28 Jan, WGI IS: - 2020 Jan 21 SWCG IS #3: A Monham email proposal sent to SWCG 20 January for review. 2018 Oct 8, SWCG IS#2 webex: WMO noted they are compiling a catalogue of hazardous events, including space weather events, with unique identifiers. EUM/Monham to propose the ToR of the task Group as next step. | CGMS- 48 | CLOSED |
| NOAA | WGI/6.2 | WGI/A47 .09 | Form a Task Group on Space Debris and Collision Avoidance to produce a Best Practice on Collision Avoidance | CGMS-48 May WGI: WGI considered that the action is still valid and solicited nomination for members from interested Agencies. 2020, 28 Jan, IS: Lead scott.leonard@noaa.gov, EUM: andrew.monham@eumetsat.int, PierLuigi.Righetti@eumetsat.int | ? (CGMS- 48) | OPEN |

| WGI action | ns from pre | evious plena | ry sessions (CGMS-47 and earlier) | | | |
|------------|-------------|--------------|--|--|----------|--------|
| Actionee | AGN | Action # | Description | Action feedback/closing document | Deadline | Status |
| | item | | | | | |
| EUM | WGI/7.1 | WGI/A47 | Perform a detailed analysis consisting of: | CGMS-48 May WGI: Coordination of LEO orbits – | CGMS- | CLOSED |
| | | .10 | Developing a simulation algorithm considering | Outcome of simulations CGMS-48-EUMETSAT-WP- | 48 | |
| | | | all variables affecting the LEO Orbit coordination | 04. See A48.7 | | |
| | | | Developing plots and other simulation outputs | 2020, 28 Jan, WGI IS: | | |
| | | | as tools for illustrating the potential | Inital similations performed by EUM, progress will | | |
| | | | coordination possibilities and improvements in | be reported at CGMS-48 | | |
| | | | both global and direct broadcast mission return | · | | |
| | | | in a cross-member coordinated mission analysis | | | |
| | | | approach. | | | |
| WGI | WGI/7.1 | WGI/A47 | Develop a Best Practice on the considerations | CGMS-48 May WGI: Coordination of LEO orbits – | CGMS- | CLOSED |
| | | .11 | to be made on orbital phasing between | Outcome of simulations CGMS-48-EUMETSAT-WP- | 48 | |
| | | | satellites, as a measure for reducing pass | 04. See A48.7 | | |
| | | | scheduling conflicts and maximising the amount | | | |
| | | | of instrument observation collected. | 2020, 28 Jan, WGI IS: No progress so far, awaiting | | |
| | | | | completion of A47.10 | | |

| WGI recommendat | WGI recommendations from CGMS-47 or earlier | | | | | | |
|-----------------|---|------------|--|---|--|--|--|
| Lead | AGN item | Rec# | Description | Recommendation feedback/closing document | | | |
| CGMS members | WGI/3.1 | WGI/R47.01 | CGMS members are recommended to take appropriate actions towards their national frequency regulatory authorities to support unwanted emission limits for IMT-2020/5G at 26 GHz in the order of -42 dB(W/200 MHz) for base stations and -38 dB(W/200 MHz) for terminal stations to protect passive sensors in the 23.6 – 24 GHz band. | COMPLETED 2020, 28 Jan, IS: Closed following WRC-19 | | | |

| WGI recommendati | WGI recommendations from CGMS-47 or earlier | | | | | | |
|------------------|---|------------|--|---|--|--|--|
| Lead | AGN item | Rec# | Description | Recommendation feedback/closing document | | | |
| CGMS members | WGI/3.1 | WGI/R47.02 | CGMS members are therefore are recommended to propose to their national frequency regulatory authorities not to support an identification for IMT-2020/5G in the bands 47.2-50.2 GHz and 50.4-52.6 GHz in order to protect passive sensors in the neighbouring passive bands 50.2-50.4 GHz and 52.6-54.25 GHz. | COMPLETED 2020, 28 Jan, IS: Closed following WRC-19 | | | |

ANNEX III: STATUS OF WORKING GROUP II (WGII) ACTIONS AND RECOMMENDATIONS FROM CGMS-47 OR EARLIER AFTER CGMS-48 DISCUSSIONS

Status of WGII CGMS-47 actions and recommendations resulting from CGMS-48 deliberations.

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|-------------|----------|---|--|---|--------|
| IROWG | 4 | A45.02 | IROWG to develop a detailed proposal for OSSEs regarding LEO-LEO MW occultation and GNSS-RO&-reflectometry. | 2020 May CGMS-48 WGII: Closed following discussions. This is now an internal IROWG activity. O Important progress has been made in the field of GNSS reflectometry (GNSS-R). O A key missing element has been identified: LEO-LEO OSSEs require the development of a LEO-LEO forward operator that can be used in NWP systems, it should operate up to at least 183 GHz to account for absorption, scattering and polarimetric capabilities. Development of the forward operator could be achieved with support for a two-year postdoctoral researcher, and 25% of senior researchers in the areas of (1) LEO-LEO instrument/observations, (2) radiative transfer, (3) microphysics and (4) NWP system integration (i.e. two senior researcher years in total), with nominal support for travel and publication. O IROWG recommends to close or reformulate action A45.02. For previous feedback on this action since CGMS-45, please see LOA of previous CGMS meetings. | Sept 2019 (CGMS- 47, 1 Nov 2017, CGMS- 46) | CLOSED |

| Actionee | AGN Action | # Description | Action feedback/closing document | Deadline | Status |
|----------|------------|---------------|---|------------------------------------|--------|
| IPWG | 4 A45.04 | · | 2020 May CGMS-48 WGII: As part of an interim approach to IPWG-10, a series of mini workshops will be held in the next year, and this will be one of the topics. Action open until IPWG-10 (now anticipated for 2021) 2020 Mar 6: IPWG-10 postponed 2020 Jan 9 WGII IS #1: Next opportunity to discuss will be IPWG-10 in June 2020. (R. Ferraro) CGMS-47: Ongoing. In conjunction with GEWEX, a precipitation assessment is underway and was discussed in detail at IPWG-9 through a dedicated session. The goal is to have the assessment completed in 2020. WGII IS#2 2019: IPWG engaged with SCOPE-CM, working closely with GEWEX. Proposed to be closed at CGM-47 due to progress as follows (Ralph Ferraro will make presentation): 1. IPWG maintains updated information on its web page regarding CDR quality data sets (and solicits this from its members). See http://www.isac.cnr.it/~ipwg/data.html This is done in concert with other groups such as CEOS, GEWEX, etc. 2. For the recommendation, this is where our precipitation assessment comes into play. One of our past co-chairs, Remy Roca, leads the GEWEX Data Working Group, and Remy, along with outgoing co-chair, Ziad Haddad, organised a precipitation assessment. WGII IS#1 Dec 2018: At IPWG-9 (in Nov 2018) updates were given on the joint precipitation work with GEWEX. Goal is to have this | CGMS- 49 (CGMS- 46 to 48) | OPEN |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|------------------|-------------|----------|--|--|-----------------------------------|--------|
| | | | | analysis on this theme led to a coordinated action to be considered by IPWG, CEOS PCVC and SCOPE-CM (coordinated action within JWG Climate). | | |
| | | | | CGMS-46: Action remains open following WGII discussions. | | |
| | | | | WGII IS#2 15 Mar 2018: ECV gap analysis on precipitation CDRs ongoing with involvement from IPWG. Part of IPWG report to CGMS-46. | | |
| | | | | 7 Mar 2018: In conjunction with GEWEX, a precipitation assessment is being planned; a mature outline, with associated section leads, have been identified and will be discussed further over the coming months and at IPWG-9. | | |
| | | | | WGII IS #1 20 Nov 2017: IPWG is organsing a precipitation assessment jointly with GEWEX - with a kick off meeting held in Oct. 2017. Co-Chair Haddad and former co-chair Roca (who serves as lead of the GEWEX Data Working Group) are co-organisers. | | |
| CGMS agencies | 4 | A45.06 | CGMS Agencies to implement Landing Pages on calibration events accessed via WMO- OSCAR. | 2020 May CGMS-48 WGII: Action closed following discussions. New action reformulated/raised. CGMS-48-WMO-WP-08 for actions required by CGMS Members. NOAA has provided the links so WMO has to add the link to OSCAR. | CGMS- 48 (CGMS- 47, -46) | CLOSED |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|-------------|----------|-------------|---|----------|--------|
| | Item | | | 2020 Jan 9 WGII IS #1: Status of Landing pages Reports were expected from 9 agencies: CMA, ESA, EUMETSAT, IMD/ISRO, JMA, KMA, NASA, NOAA andRosHydroMet; Reports are available from 7 agencies: CMA, ESA, EUMETSAT, JMA, KMA, NOAA and RosHydroMet; GSICS intercalibration practices have been reported by 5 agencies: CMA, EUMETSAT, JMA, KMA andRosHydroMet. The Landing pages whose links have been so far received and recorded in OSCAR/Space comply with the expected contents to a variable extent, depending on the agency. The most frequent type of non-compliance is the lack of coverage of some of the items supposed to be handled (it should be noted that some of the Landing pages are still under development at the responsible agency). Other frequent problems are clarity, and balancement of the level of detail across the various sections. IMD and NASA are still expected to provide their Landing Pages. (B.Bizzarro, H.Pohjola) CGMS-47: See CGMS-47-WMO-WP-15 for status update. Some agencies still to provide landing page information. WGII IS#1 Dec 2018: Ongoing - WMO is in the process of updating/implementing missing Landing Pages. EUMETSAT and the CGMS Secretariat will verify the CGMS agencies landing pages in OSCAR. Sep 2018: See also WGIII action A46.03 CGMS-46: Action remains open following WGII discussions. | | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|-----------------|-------------|----------|---|---|------------------|--------|
| | | | | CGMS-46 WMO-WP-02 | | |
| | | | | WGII IS#2 15 Mar 2018: Other agencies are requested to provide the URL to their respective landing pages. | | |
| | | | | KMA implemented the Landing Pages on COMS calibration events on June 2016. http://nmsc.kma.go.kr/html/homepage/en/landing/info.do#coms | | |
| | | | | IMD Dr. Ashim K. Mitra, Scientist-E (SR-Cal/Val) NASA charles.webb@nasa.gov | | |
| | | | | NOAA mitch.goldberg@noaa.gov ROSH z.andreeva@meteorf.ru http://planet.rssi.ru/calval/portalmain-en (the web-page is under construction) | | |
| ITWG (CGMS | WGII/5 | A46.01 | CGMS members to provide a summary of their known | 2020 May CGMS-48 WGII: Kept open, for ITWG to address. | CGMS- 49 (By | OPEN |
| members) | | | unfilled spectroscopy needs, and to develop a means of | 2020 Jan 9 WGII IS #1: Open | CGMS- 47, 48) | |
| | | | facilitating interaction | CGMS-47: No update. Mitch to go back and discuss with ITWG. | , , | |
| | | | between laboratory | Presentation to be given to CGMS-48. | | |
| | | | spectroscopy groups to spur cooperation and mitigate the lack of resources (financial and | WGII IS#2 2019: Ken/Mitch to check with CGMS-Secretariat if action has been taken to ask CGMS members to provide input. | | |
| | | | persons). (Ref. CGMS-46- ITWG-WP-01) | CGMS-47 EUM-WP-xx | | |
| CGMS members | WGII/5 | A46.02 | All AMV producers to implement the "Common QI | 2020 May CGMS-48 WGII: to be reviewed at the next IWWG. | By IWW15, | OPEN |
| | | | module" in their algorithms. | 2020 22 May: KMA has completed the intgration. 2020 Mar 12 WGII IS #2: Régis Borde (EUMETSAT, IWWG): JMA has completed the integration | CGMS- 48 | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| | | | | 2020 Jan 9 WGII IS #1: To be reviewed at the IWWG meeting in April 2020. (Régis Borde, Steve Wanzong) | | |
| | | | | CGMS-47: Common QI showed skill in filtering collocated AMVs and led to improved agreement between AMVs generated by satellite operators • Action 1 to IWWG co-chairs: Place the Common QI in a public repository. | | |
| | | | | Done -> https://github.com/swanzong/IWWG Send any questions to stevew@ssec.wisc.edu Recommendation 1 to AMV producers: Implement the software prior to IWW15 Partially complete: EUMETSAT and NWCSAF/HRW have included the Common QI in their repositories. NOAA, KMA and JMA have plans to complete the integration in late 2019. | | |
| | | | | WGII IS#2 2019: Request to developers to implement this. Ongoing. | | |
| | | | | WGII IS#1 Dec 2018: There is a Gitlab repository (who is the owner of it?), tested by a few people. An email needs to be sent out to the IWWG community asking them to add this to their software (Steve Wanzong, Co-Chair, IWWG) | | |
| CGMS members | WGII/5 | A46.03 | AMV producers to adopt the new AMV BUFR template. | 2020 May CGMS-48 WGII: to be reviewed at the next IWWG. 2020 May 22: KMA is working on the production of the new bufr data with the sequence 3.10.077 and will release in June 2020. | By IWW15, CGMS- 48 | OPEN |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| | | | | 2020 Jan 9 WGII IS #1: To be reviewed at the IWWG meeting in April 2020. (Régis Borde, Steve Wanzong) CGMS-47: The AMV sequence 3.10.067 endorsed by the WMO in November 2017 has been rejected by some users in early 2018 because it could not be used in automated framework. • The WMO corrected the sequence appropriately and endorsed the new AMV BUFR sequence 3.10.077 in November 2018. • NOAA, EUMETSAT and JMA are working on the production of the test data, planning an operational change early 2020. The NWCSAF will release a software patch later in 2019 which includes the new BUFR sequence. A new deadline to IWW15 (spring 2020) has been set to agencies to change their AMV BUFR sequence. • AMV producers to provide their users with a small test dataset (a few hours of data) encoded in the new BUFR format as soon as possible. • Nine months later, AMV producers will provide parallel dissemination of their AMV data in the new and old BUFR sequence over a 2-3 month period of time to allow the switch to take place. | | |
| NWP community | WGII/5 | A46.04 | NWP community to define the best configuration to be used by the AMV producers, for use in global and regional NWP models. | 2020 Mar 6: Pending IWW15, postponed until 14-18 Sept 2020 Jan 9 WGII IS #1: To be reviewed at the IWWG meeting in April 2020. (Régis Borde, Steve Wanzong) CGMS-47: The Met Office and Met Norway is planning to test various configurations of AMVs, via the NWC SAF software, to work towards optimal configurations. • There are no updates to report at this time. • We expect more discussion at the IWW15. | CGMS- 49 (By IWW15, CGMS- 48) | OPEN |

| WGII actions from previous plenary sessions (CGMS-47 and earlier) | | | | | | | |
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| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status | |
| | | | | No results to report yet. This topic and results will be re-visited at IWW15. WGII IS#1 Dec 2018: The two NWP contacts that will help with this action are: Mary Forsythe mary.forsythe@metoffice.gov.uk and Roger Randriamampianina rogerr@met.no (Steve Wanzong, Co-Chair, IWWG) | | | |
| IWWG | WGII/5 | A46.06 | IWWG to look at improving quality indicators for high resolution wind derivation for mesoscale and regional applications. (Ref. CGMS-46-IWWG-WP-01) | 2020 Mar 6: IWW15 postponed until 14-18 Sept 2020 Jan 9 WGII IS #1: To be reviewed at the IWWG meeting in April 2020. (Régis Borde, Steve Wanzong) CGMS-47: Research activities continue that aim to identify additional quality information from the AMV derivation that could be used to filter out poor quality AMVs and/or set observation errors for the AMV height assignment. • Quality measure associated with the correlation surface (addresses feature tracking) • Optimal estimation cost associated with cloud top temperature retrieval (addresses AMV height assignment) • Cloud top pressure error estimates (addresses AMV height assignment) • No results to report at this time. • We expect that some useful information relevant to this action may be extracted from work associated with A46.04. • This topic will be re-visited at IWW15. | CGMS- 49 (CGMS- 48/-47) | OPEN | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| IWWG | WGII/5 | A46.07 | IWWG to consider developing climate projects from Atmospheric Motion Vectors (AMVs) and to report to the CEOS/CGMS WGClimate with a potential pilot project. (Ref. CGMS-46-IWWG-WP-01) | 2020 Mar 6: IWW15 postponed until 14-18 Sept 2020 Jan 9 WGII IS #1: To be reviewed at the IWWG meeting in April 2020. (Régis Borde, Steve Wanzong) CGMS-47: IWWG has reviewed the gaps identified by the last Essential Climate Variables (ECV) inventory. • The international status of polar and geostationary AMV reprocessing has been updated and is presented in Annexe 1 of the IWWG Working Paper. • This topic will be discussed in a specific session at the next at IWW15. WGII IS#2 2019: no update | CGMS- 49 (CGMS- 48/-47) | OPEN |
| IROWG | WGII/5 | A46.08 | IROWG to develop process and principles for RO data quality control to ease intercomparison of data from different providers. | 2020 May CGMS-48 WGII: Closed following WGII discussions and new action reformulated. O IROWG acknowledges there are about 10-30% observations rejected during the data processing and retrieval procedures for current missions. However, the quality control (QC) procedures are not consistent among different data providers and processing centers. They are very likely to differ between the current and future missions as well. Providers should document their QC procedures (e.g., QC pertains to orbits, space sampling/ inhomogeneity, neutral atmosphere or space weather products, etc.) and share with IROWG. O IROWG recommends an action to data providers to document data processing QC processes (including a month of QC statistics, e.g. rejection percentage at each QC step) and space sampling | CGMS- 48? Sep 2019 | CLOSED |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| | | | | information and provide to IROWG. 2020 Mar 12 WGII IS #2: Included in the IROWG-7 workshop outcome report. Ulrich Foelsche, IROWG: * Estimated 10-30% rejected for some of the current missions, Expected and actual satellites, orbits, space sampling/inhomogeneous flag, neutral/space * Action: Data providers to document data processing QC processes (including a month of QC statistics, e.g. rejection percentage at each QC step) and space sampling information and provide to IROWG. 2020 Jan 9 WGII IS #1: First results will be included in the report of IROWG-7 Meeting of September 2019. (U. Foelsche) WGII IS#2 2019: to be raised at next IROWG in September 2019. 10 Oct 2018: Best practices to be developed. (WGII to consider extension to other areas e.g. winds/IWWG). | | |
| CGMS members | WGII/7 | A46.13 | CGMS members to provide comments on the impact studies conducted by ECMWF on OSES vs. FSOI and how CGMS members can benefit from the findings. (Ref. CGMS-46-WMO-WP-13 and WP-13_PPT) | 2020 May CGMS-48 WGII: Discussed. Comments to be provided by NOAA and if none close before plenary. 2020 Mar 6: ECMWF would like to close this action. The guidance has been given and remains. WGII to discuss on how to take this onboard. 2020 Feb 12 WMO-ECMWF discussion: ECMWF provided guidance to CGMS space agencies on how to interpret and | CGMS- 48? (CGMS- 47) | CLOSED |

| | | - | sessions (CGMS-47 and earlier) | Action foodbook/closing document | Dandling | Chahua |
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| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | present the FSOI stats in CGMS-46 WMO-WP-13. CGMS members are requested to note and follow these guidelines. ECMWF is ready to provide more guidance to CGMS members as necessary. To be discussed at CGMS-48 2020 Jan 9 WGII IS #1: - | | |
| CGMS members | WGII/10 | A46.14 | CGMS members to provide points of contact for GOFC-GOLD to the CGMS Secretariat (Ref. CGMS-46-GUEST-WP-02) | 2020 May CGMS-48 WGII: Provide focal point by 15 August 2020 - then close before Plenary (especially focal points from Asia-Pacific are sought) - for NASA, POC for GOFC-GOLD is Garik Gutman - Garik.Gutman@nasa.gov 2020 Mar 12 WGII IS #2: CGMS members to provide pocs. CGMS members interested are invited to attend meetings of these groups. NOAA is involved. Meetings to be added to the CGMS online calendar. NASA: ? NOAA: ? | 15 Aug 2020 (Aug 2019) | CLOSED |
| CGMS members | WGII/10 | A46.15 | CGMS members to provide points of contact for AEROSAT to the CGMS Secretariat (Ref. CGMS-46-GUEST-WP-01) | CGMS-47: WGII to reach out to GOFC-GOLD. 2020 May CGMS-48 WGII: Provide focal point by 15 August 2020 - then close before Plenary (especially focal points from Asia-Pacific are sought) 2020 Mar 12 WGII IS #2: CGMS members to provide pocs. CGMS | 15 Aug 2020 (Aug 2019) | CLOSED |
| | | | | members interested are invited to attend meetings of these groups. NOAA is involved. Meetings to be added to the CGMS online calendar. NASA: ? NOAA: ? | | |

| WGII action | ns from prev | ious plenary | sessions (CGMS-47 and earlier) | | | |
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| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | 2020 Jan 9 WGII IS #1: - CGMS-47: WGII to reach out to GOFC-GOLD. | | |
| GSICS | WGII/4 | A47.01 | GSICS to expand GSICS Report on the State of the Observing System to successively cover the calibration status of all instruments relevant GSICS. | 2020 May CGMS-48 WGII: Deferred to CGMS-49 2020 CGMS-48 WGII: 2020 Mar 6; GSCIS and GSCIS EP meetings postponed. Teleconferences expected for the WGs, first one on Tue 17 March. Face2face meetings likely to take place next year. 2020 Jan 9 WGII IS #1: To be reviewed by GSICS meeting in March 2020. (M. Goldberg) | CGMS- 49 (CGMS- 48) | OPEN |
| WMO | WGII/4 | A47.02 | WMO to remove current formulation of 'GSICS calibration' and to rename 'calibration and events' to 'instrument landing page' | 2020 Jan 9 WGII IS #1: WMO has implemented this. | Dec 2019 | CLOSED |
| CGMS Agencies | WGII/4 | A47.03 | Agencies assessing commercial radio occultation data are requested to present their efforts at IROWG-7 to facilitate community planning. | 2020 Jan 9 WGII IS #1: Presented at IROWG-7. (U. Foelsche) | Sep 2019 | CLOSED |

| Actionee | AGN | Action # | Description | Action feedback/closing document | Deadline | Status |
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| IDOMAG | item | 147.04 | IDOM(C) to a second | 2020 M. COMO 40 INCH | C | CI OCED |
| IROWG | WGII/4 | A47.04 | IROWG to provide | 2020 May CGMS-48 WGII: | Sep | CLOSED |
| | | | recommendation on orbital | O It is mandatory, that RO data are globally distributed and | 2019, | |
| | | | planes in order to improve | provide a good sampling of the diurnal cycle. This can be either | CGMS- | |
| | | | coverage. | achieved with a dedicated constellation with orbits that drift | 48 | |
| | | | | sufficiently fast in local time (such as COSMIC-2 equatorial + | | |
| | | | | polar), or with satellites in six or more sun-synchronous orbit | | |
| | | | | planes that provide an adequate sampling of the diurnal cycle. | | |
| | | | | o The current (and near future) situation is unsatisfactory: Due to | | |
| | | | | thecancellation of its polar component, COSMIC-2 data are | | |
| | | | | confined to | | |
| | | | | latitudes below ~40°, leaving a serious gap in local time coverage at high latitudes – even more pronounced for ionospheric data, | | |
| | | | | which are | | |
| | | | | not provided by the first generation of MetOp satellites. | | |
| | | | | not provided by the first generation of wetop satellites. | | |
| | | | | 2020 Jan 9 WGII IS #1: Discussed at IROWG-7 and will be reflected | | |
| | | | | in meeting report. (U. Foelsche) | | |
| IROWG | WGII/4 | A47.05 | IROWG to evaluate outcome | 2020 May CGMS-48 WGII: Discussed and closure agreed, | CGMS- | CLOSED |
| | | | of Agency funded commercial weather data pilot following | formulation of new recommendation. | 48 | |
| | | | IROWG-7 and report back to | o Status: This task cannot be taken by the IROWG as the results | | |
| | | | CGMS-48. | are not open to the community. | | |
| | | | | o IROWG encourages the institutes evaluating commercial data to | | |
| | | | | share their reports publicly. | | |
| | | | | It is noted that the following institutions are currently | | |
| | | | | performing an evaluation: | | |
| | | | | NOAA (Spire and GeoOptics, level 1-2, supported by EUMETSAT), | | |
| | | | | NRL (Spire and GeoOptics, level 2 bending angle, level 1 podTEC), | | |
| | | | | NASA, USAF, MetOffice (Spire, L1b), ESA (supported by EUMETSAT | | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| | | | | and U. Graz, Spire; level 1-2) | | |
| | | | | o IROWG recommends that CGMS makes a co-ordinated request | | |
| | | | | for results from all commercial data studies to be made public. | | |
| | | | | For closure? 2020 Mar 12 WGII IS #2: IROWG can only respond to | | |
| | | | | this action if the missions are flown. | | |
| | | | | 2020 Jan 9 WGII IS #1: Evaluation reports are not publicly shared | | |
| | | | | and therefore prevent evaluation by IROWG at this time. (U. | | |
| | | | | Foelsche) | | |
| ROSH | WGII/4 | A47.06 | Roshydromet to report on future plans for RO missions at | 2020 May CGMS-48 WGII: Closed following WGII discussions. | CGMS- 48 | CLOSED |
| | | | WG II. | 2020 May 22: As of May 2020, Russia does not have confirmed | | |
| | | | | plans for radio-occultation constellation. RO mission was | | |
| | | | | discussed in 2019, but no financing materialised. Tentatively it | | |
| | | | | can be included into the next Federal Space Programme after | | |
| MCII | MCII/A | A 47 07 | MCII to discuss with MAAAA | 2025. | CGMS- | CLOCED |
| WGII | WGII/4 | A47.07 | WGII to discuss with WMO the way forward to have access to | 2020 May CGMS-48 WGII: Closed following WGII discussions. To be dealt with in the framework of IPWG and WMO SG-RFC. | 48 | CLOSED |
| | | | telecommunications microwave link data in | 2020 Mar 12 WGII IS #2: Narrative was provided to WMO on 12 | | |
| | | | support of IPWG validation | March 2020. WMO connected IPWG to the chair of the WMO | | |
| | | | activities. | Steering Group on Radio Frequency Coordination (SG-RFC), Mr. | | |
| | | | detivities | Eric Allaix, to see if SG-RFC can provide advice on a way forward. | | |
| | | | | 2020 Mar 6: IPWG-10 has been postponed, should this matter be | | |
| | | | | adressed at that meeting. | | |
| | | | | 2020 Jan 9 WGII IS #1: IPWG will provide more specific | | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| | | | | information to WMO on what is actually required, so that WMO | | |
| SCOPE-CM | WGII/4 | A47.08 | SCOPE-CM to report back on the conclusion of the 9 pilot projects | can act upon this request. (R. Ferraro) 2020 May CGMS-48 WGII: SCOPE-CM leads have been contacted by WMO on 22 May 2020 to provide feedback on outcome of projects before 30 June 2020. Plan to publish results in WMO Bulletin. New deadline. 2020 Mar 12 WGII IS #2: WMO to report in May 2020 2020 Mar 6: Changes with SCOPE-CM ongoing? Chair stepping down? | Dec 2020 (CGMS- 48) | OPEN |
| SCOPE-CM | WGII/4 | A47.09 | SCOPE-CM to provide an implementation plan based on the agreed new concept including an agenda and updated ToRs. | 2020 Jan 9 WGII IS #1: No further information available 2020 May CGMS-48 WGII: See CGMS-48-SCOPE-CM-WP-02. Implementation Plan to be presented to Plenary. 2020 Mar 12 WGII IS #2: WMO to report in May 2020 2020 Mar 6: Changes with SCOPE-CM ongoing? Chair stepping down? 2020 Jan 9 WGII IS #1: No further information available This is also a plenary action A47.15. | CGMS- 48 | OPEN |
| CGMS Agencies | WGII/4 | A47.10 | Agencies to continue to support the WMO maintained trust-fund that enables the work of the VLAB technical officer and report to CGMS-48 | 2020 May CGMS-48 WGII: To be transferred to WGIV, now in charge of Vlab matters. Closed in WGII. 2020 Jan 9 WGII IS #1: CGMS agencies in addition to EUMETSAT, NOAA and KMA are invited to contribute to the Vlab Trust Fund. Please contact Werner Balogh at wbalogh@wmo.int. | CGMS- 48 | CLOSED |
| CGMA Agencies | WGII/4 | A47.11 | Agencies to endorse the VLAB 5-year strategy plan. | Endorsed by CGMS-47 plenary. | CGMS- 47 (CGMS- 46) | CLOSED |

| WGII actions | s from prev | ious plenary | sessions (CGMS-47 and earlier) | | | |
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| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| CGMS and VLAB | WGII/4 | A47.12 | Agencies to provide links to their training events and resources for VLAB communication. | 2020 Jan 9 WGII IS #1: CGMS agencies to follow-up on this action. Please send links to VLab Techncial Support Officer Ms. Luciane Veeck (Luciane Veeck <luveeck@googlemail.com>). VLab matters transferred to WGIV. JMA: JMA VLab webpage (http://www.jma.go.jp/jma/jma-</luveeck@googlemail.com> | Dec 2019 | CLOSED |
| CGMS Agencies | WGII/4 | A47.13 | Agencies to provide nominees for next VLAB co-chair starting in 2020 for three years. | eng/satellite/VLab.html) 2020 Mar 12 WGII IS #2: Still no nominations. Vlab matters transferred to WGIV. 2020 Jan 9 WGII IS #1: To date no nominations have been received. This is also a plenary action. | Dec 2019 | CLOSED |
| WGIII | WGII/5 | A47.14 | WGIII to provide their assessment and planning for the next risk assessment to the ISWGs, JWGClimate and GSICS. | 2020 May CGMS-48 WGII/WGIII joint session: Addressed in the joint session. WGIII to set up a dedicated intersessional meeting between WGII and WGIII co-chairs/rapporteurs to address this. Action closed here and addressed within the framework of WGIII actions. 2020 Mar 12 WGII IS #2: To be addressed in CGMS-48 WGII and WGII-WGIII joint session in particular. CGMSSEC will circulate the baseline and risk assessment as soon as finalised. 2020 Feb 19: Adressed at the 2nd CGMS risk assessment WS 19-21 Feb 2020. Risk assessment document to be shared with CGMS. Included in WGIII LOA | Mar/Apr 2019 | CLOSED |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| IROWG, ICWG, IWWG, IPWG, ITWG, GSICS, WGClim | WGII/5 | A47.15 | The ISWGs, WGClimate and GSICS to review WGIII Risk assessment and consider mitigation opportunities. | 2020 May CGMS-48 WGII/WGIII joint session: Addressed in the joint session. WGIII to set up a dedicated intersessional meeting between WGII and WGIII co-chairs/rapporteurs to address this. Action closed here to be addressed within the framework of WGIII actions. 2020 Feb 19: The outcome of the 2nd CGMS risk assessment WS | CGMS- 48 | CLOSED |
| | | | | 19-21 Feb 2020 to be distributed to the ISWGs, GSICS And WGClimate | | |
| ICWG | WGII/7 | A47.16 | ICWG to organise a dedicated session (0.5-1 day) on lightning observations from space (calval, algos, applications and products) | 2020 May CGMS-48 WGII: ICWG has been postponed, hence, new deadline. 2020 Mar 12 WGII IS #2: Progress ongoing. Once meeting held, ICWG expects to close the action. 2020 Jan 9 WGII IS #1: Session will take place at next ICWG meeting in September 2020. ICWG to report on session planning at CGMS-48. | CGMS- 49 (Dec 2019) | OPEN |
| CGMS space agencies | WGII/8 | A47.17 | CGMS agencies encouraged to present papers at CGMS-48 on use of satellite products for agricultural applications (ref CGMS-47-WMO-WP-11) | 2020 May CGMS-48 WGII session: CGMS-48 NOAA-WP-08. Closed following WGII discussions. 2020 Jan 9 WGII IS #1: included in CGMS-48 WG II agenda. CGMS agencies invited to present relevant topical papers. New action following WGII report preparation | CGMS- 48 | CLOSED |
| EUMETSAT | WGII/8 | A47.18 | EUMETSAT to provide PoC for NOAA for OSI SAF for discussion on future collaborative work/workshop for development of cryospheric products. | NOAA informed 28 Oct 2019 (E-mail A Taube-M Butler) Cécile Hernandez Météo-France, Centre de Métérologie Spatiale, av Lorraine, BP 50747, 22307 Lannion cedex, France Phone: +33 296 056 796 | Oct 2019 | CLOSED |

| WGII action | s from prev | ious plenary | sessions (CGMS-47 and earlier) | | | |
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| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | Fax: +33 296 056 737 cecile.hernandez@meteo.fr | | |
| CGMS space agencies | WGII/8 | A47.19 | CGMS agencies to present solutions at CGMS-48 for satellite-based bathymetry (CGMS-47-WMO-WP-13) | 2020 May CGMS-48 WGII session: Closed following WGII discussions. 2020 Mar 12 WGII IS #2: WMO tropical cyclone programme, users are looking for satellite based bathymetry. 2020 Jan 9 WGII IS #1: - New action following WGII report preparation | CGMS- 48 | CLOSED |
| СМА | WGII/8 | A47.20 | CMA to provide information on ILS and SRF and other relevant documentation to the user community for the development of necessary RTMs/tools for the exploitation of HIRAS and GIIRS data. (Reference: Action (SG3.22) from the NWP SAF Steering Group) | 2020 Jan 9 WGII IS #1: Information has been provided. (K. Holmlund) | Dec 2019 | CLOSED |
| GSICS, WGClim, SCOPE-CM | WGII/8 | A47.21 | GSICS, WGClimate and SCOPE-CM to organise a workshop on calibration supporting reprocessing. | 2020 May CGMS-48 WGII session: Postponed due to Covid-19 situation. 2020 Mar 12 WGII IS #2: To be discussed on 17 March within GSICS community. 2020 Jan 9 WGII IS #1: - (First review to take place at GSICS meeting in March 2020, Korea - meeting cancelled). | CGMS- 49 (Mar 2020, CGMS- 48) | OPEN |

| WGII action | WGII actions from previous plenary sessions (CGMS-47 and earlier) | | | | | | | | | |
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| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status | | | | |
| NOAA/ CMA | WGII/10 | A47.22 | NOAA/CMA to provide final report from the flood mapping pilot for CGMS-48. | 2020 May CGMS-48 WGII session: CGMS-48, NOAA-WP-09. Closed following WGII discussions. 2020 Mar 12 WGII IS #2: Report to CGMS-48. There will be a CEOS flood pilot project 2020 Jan 9 WGII IS #1: - | CGMS- 48 | CLOSED | | | | |
| SWCG | WGII/11 | A47.23 | SWCG to further develop white-paper on current instruments and their calibration and to provide report to GSICS for review | 2020 May CGMS-48 WGII session: to be addressed in plenary 2020 Jan 9 WGII IS #1: M. Goldberg to follow up with SWCG. | CGMS- 48 (Dec 2019) | OPEN | | | | |
| GSICS | WGII/11 | A47.24 | GSICS to review SWCG white- paper on calibration and consider opportunities for GSICS support to aforementioned activity. | 2020 May CGMS-48 WGII session: to be addressed in plenary 2020 Jan 9 WGII IS #1: M. Goldberg to follow up with SWCG. | CGMS- 48 (Mar 2020) | OPEN | | | | |
| WG II | WGII/12 | A47.25 | WG II to review its terms of references during intersessional meetings before CGMS-48. | 2020 May CGMS-48 WGII session: CGMS-48-CGMS-WP-13. Revised WGII ToRs were discussed and recommended to plenary for endorsement. | Nov 2019, Mar 2020 | CLOSED | | | | |
| JMA | WGII/13 | A47.26 | JMA to coordinate with related parties and close down the JMA Volcanic Ash algorithm Testbed. | 2020 Jan 9 WGII IS #1: JMA inquired any question or comment about the JMA Testbed closing down with the end of last year as a deadline. There were no questions or objections on the closing. | CGMS- 48 | CLOSED | | | | |
| СМА | WGII/13? | A47.27 | CMA to provide a PoC for the IPWG validation protocol (HLPP 4.3.1) | 2020 May CGMS-48 WGII session: CMA poc: ? 2020 Mar 12 WGII IS #2: Open 2020 Jan 9 WGII IS #1: No name provided yet to IPWG. (R. | Dec 2019 | OPEN | | | | |

| WGII actions from previous plenary sessions (CGMS-47 and earlier) | | | | | | | | | |
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| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status | | | |
| | | | | Ferraro) | | | | | |
| | | | | (included in the IPWG report section) | | | | | |
| WMO | WGII/14 | A47.28 | WMO to provide a preliminary report from the 7th WMO Impact Workshop (Seoul, May 12-15 2020) at CGMS-48 | 2020 May CGMS-48 WGII session: Workshop was postponed due to COVID-19 situation. 2020 Mar 12 WGII IS #2: TBD if workshop will be held. | CGMS- 49 (CGMS- 48) | OPEN | | | |
| | | | 12-13 2020) at CGN3-48 | 2020 Mai 12 WGII IS #2: 180 II WORKSHOP WIII be Held. | 40) | | | | |
| | | | | New action following CMGSSEC review 27 May 2019 (following input by WMO). | | | | | |
| GSICS | from WGIII | A47.29 | GSICS to continue cross calibration progress of microwave imagers. (WGII) | 2020 May CGMS-48 WGII session: GSICS microwave subgroup reported progress and activity is now integrated within the group. | CGMS- 48 | CLOSED | | | |
| | | | | 2020 Mar 12 WGII IS #2: 2020 Jan 9 WGII IS #1: To be reported at next annual GSICS EP meeting in May 2020. | | | | | |
| ESA | WGII/9 | A47.30 | ESA to present a paper on SAR applications for storms and flooding with information on | New action requested by WGIII 2020 May CGMS-48 WGII session: CGMS-48-ESA-WP-01. Closed following WGII discussions. | CGMS- 48 | CLOSED | | | |
| | | | enhanced acquisitions and latency. (ref CGMS-47 WMO- WP-12) | 2020 Jan 9 WGII IS #1: Included in CGMS-48 WGII agenda New action following WGII report preparation | | | | | |
| IROWG, WMO | WGII/4 (from WGIII) | A47.31 | CGMS baseline and RO: IROWG and 7th WMO Impact Workshop needs to validate the current Baseline requirements in terms of the coverage, number, quality and | 2020 May CGMS-48 WGII session: Impact workshop postponed. New deadline. o IROWG shares the concern, expressed in the recent WGIII risk assessment (March 2020), that there is "Continuity risk for the number and geographic distribution of radio occultations; especially in the low to mid-latitudes" | CGMS- 49 (CGMS- 48) | OPEN | | | |

| Actionee | AGN | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|--------|----------|-------------------------------|--|----------|--------|
| | item | | | , | | |
| | | | | o IROWG understands the "baseline" as the "missions that are | | |
| | | | | currently | | |
| | | | | being, or planned on being flown". | | |
| | | | | O This baseline is currently not sufficient to meet the HLPP | | |
| | | | | objective (1.2) to advance the atmospheric Radio Occultation | | |
| | | | | constellation, with the long-term goal of providing 20000 | | |
| | | | | occultations per day on a sustained | | |
| | | | | basis | | |
| | | | | 2020 Mar 6: Unclear if the impact workshop will be | | |
| | | | | held/postponed. | | |
| | | | | 2020 Feb 19: Pending the 7th impact WS. Dedicated telecon held | | |
| | | | | with IROWG. | | |
| | | | | 2020 Jan 9 WGII IS #1: - | | |
| | | | | CGMS-47: Action from WGIII to WGII | | |
| | | | | Added as action | | |
| IROWG | WGII/4 | A47.32 | IROWG to review the CGMS | 2020 May CGMS-48 WGII session: Closed following WGII and | 2019/ | CLOSED |
| | (from | | Baseline and validate wording | WGIII discussions. See baseline. | 2020 | |
| | WGIII) | | that captures CGMS Member | | | |
| | | | contribution to RO data in | 2020 Feb 19: The outcome of the 2nd CGMS risk assessment WS | | |
| | | | terms of coverage, number, | 19-21 Feb 2020 to be distributed to the ISWGs, GSICS And | | |
| | | | quality and sampling; and | WGClimate | | |
| | | | share impact studies of RO | | | |
| | | | data between the CGMS | 2020 Jan 9 WGII IS #1: - | | |
| | | | Baseline and WIGOS 2040 | CGMS-47: Action from WGIII to WGII | | |
| | | | vision observing targets. | Added as action | | |

| WGII recon | nmendation | s from CGMS-47 | or earlier | |
|-----------------|-------------|----------------|---|--|
| Lead | AGN item | Rec # | Description | Recommendation feedback/conclusions |
| ISWG Chairs | WGII/3 | WGII/R47.01 | ISWG Chairs to organise intersessional teleconferences amongst the co-chairs. | 2020 May CGMS-48 WGII session: No significance progress was reported. |
| CGMS members | WGII/4 | WGII/R47.02 | From ICWG: CGMS members to budget a baseline funding for the intercomparison study, given its importance and impacts on global cloud products. | 2020 May CGMS-48 WGII session: To be followed up with the ICWG. NB This was also marked as plenary rec. |
| CGMS | WGII/4 | WGII/R47.03 | From ICWG: CGMS members to consider introducing multi-sensor (satellite and ground-based measurements) applications for convective nowcasting when developing/updating product requirements. | 2020 May CGMS-48 WGII session: Completed as recommendation, new action raised. NB This is also marked as a plenary recommendation. |
| ICWG, IWWG | WGII/4 | WGII/R47.04 | ICWG and IWWG: ICWG to work with IWWG on the golden days observations to provide cloud height uncertainty for AMV applications | 2020 May CGMS-48 WGII session: Progress was reported at CGMS 48 WG II. Coordination with IWWG, however IWWG is reconsidering its Golden Day due to the COVID-19 delays |
| CGMS | WGII/4 | WGII/R47.05 | From ICWG: CGMS agencies to continue operating conically-scanning passive MW sensors in an early afternoon orbit as well as in a dusk/dawn orbit in order to maintain this unique long-term time series. Progress was made in the interaction of the ICWG | 2020 May CGMS-48 WGII session: The recommendation remains relevant as conically-scanning MW sensors still provide the best estimates of cloud liquid water path (LWP) over ocean. NB This was also marked as plenary rec. |
| WGII | WGII/4 | WGII/R47.06 | WGII recommends to Plenary the endorsement of the proposed new concept for SCOPE-CM. | COMPLETED. Endorsed by CGMS-47 plenary. |
| CGMS | WGII/4 | WGII/R47.07 | WGII recommends to Plenary the proposed approach for Leadership in WGClimate | COMPLETED. Endorsed by CGMS-47 plenary. |

| Lead | AGN item | Rec# | Description | Recommendation feedback/conclusions |
|-----------------|-------------|-------------|---|---|
| CGMS | WGII/4 | WGII/R47.08 | WGII recommends to Pleanry the adoption of the updated WGClimate ToRs | COMPLETED. Endorsed by CGMS-47 plenary. |
| CGMS | WGII/4 | WGII/R47.09 | WGII recommends to Plenary the inclusion of Greenhouse Gas Monitoring activities in WGClimate as presented in CGMS-47-JWGCLIM-WP-03WGII | COMPLETED. Endorsed by CGMS-47 plenary. |
| EC | WGII/8 | WGII/R47.10 | ESA and EC to explore the possibility of creating a European service (or a component within an existing service) to optimise SAR acquisitions over TCs, and to provide, in near real time, the SAR observations and surface wind field estimates to the Tropical Cyclone community at large, both with data formats | following 2020 May CGMS-48 WGII discussions: An exchange of letters took place between WMO and EC on this matter. EC may consider it in the future. 2020 May 22 ESA: This action needs to be addressed/confirmed with the EC prior to any ESA interaction. |
| ISRO | WGII/9 | WGII/R47.11 | ISRO is encouraged to consider follow-on missions on scatterometry to Oceansat-3/3A | 2020 May CGMS-48 WGII: ISRO will review the Oceansat programme in June 2020. |
| CMA | WGII/14 | WGII/R47.12 | CMA is encouraged to present their impact analysis work at the upcoming WMO NWP Impact Workshop in May 2020. | 2020 May CGMS-48 WGII: NWP impact workshop postponed. |
| CGMS members | WGII/5 | R46.02 | CGMS member are encouraged to take due consideration to climate applications requirements during the planning for new meteorological satellite missions. (Ref. CGMS-46-ITWG-WP-01) | 2020 May CGMS-48 WGII session: Done by many agencies, but Issue still remains relevant and is not for WG II but the agencies CGMS-47: ICWG invited IPWG representative Ben Johnson to present at ICWG-2 and engagement is developing. |
| | | | | WGII IS#2 2019: needs to be further precised/developed (GCOS?, FCDR). Possibly with WGClimate? |
| | | | | WGII IS#1 Dec 2018: WGII co-chairs to check with Mitch Goldberg |

| Lead | AGN item | Rec# | Description | Recommendation feedback/conclusions |
|---------------------------|-------------|--------|---|---|
| | | | | Sep 2018 CGMSSEC: WGII is requested to make this more specific. |
| ISRO | 7 | R45.07 | ISRO to consider adding a direct broadcast capability to future satellites. | COMPLETED 2020 May CGMS-48 WGII session: Noted in WGII, but should be addressed in WGI. |
| | | | | CGMS-47: recommendation maintained |
| CGMS agencies | 8 | R45.09 | CGMS agencies encouraged to document their products online, including ATBDs and validation reports, and link product page URLs to the WMO Product Access Guide following defined documentation criteria. (current agency focal points in WMO IPET-SUP: Sally Wannop (EUMETSAT), Natalia Donoho (NOAA), Geun-Hyeok Ryu (was Chu-Yong Chung) and Jin Woo (KMA), Xiang Fang (CMA), Shiro Ohmori (JMA)) | COMPLETED 2020 May CGMS-48 WGII session: Noted in WGII, but should be addressed in WGIV |
| CGMS members | WGII/4 | R44.05 | CGMS members to budget a baseline funding for the cloud intercomparison study, given its importance and impacts on global cloud products. | 2020 May CGMS-48 WGII session: Closed due to duplication.See WGII R47.02 |
| CGMS R&D agencies | WGII/4 | R44.07 | Research agencies to consider continuing space- borne lidar for ice/liquid water since they have proven very valuable to validate retrievals from passive sensors | COMPLETED 2020 May CGMS-48 WGII session: Noted in WGII but should likely be addressed in WGIII |
| CGMS space agencies | WGII/4 | R44.15 | Future satellite programmes should include the provision of high temporal frequency MW humidity sounding radiances (alongside cloud and precipitation sensitive observations). | COMPLETED 2020 May CGMS-48 WGII session: Noted in WGII but should likely be addressed in WGIII |
| ROSC, ROSH | WGII/4 | R44.16 | Roscosmos to develop and release a direct broadcast processing package (for level 1 data) for the MTVZA-GY microwave imager. Roshydromet to | 2020 May CGMS-48 WGII session: Closed. Noted in WGII, but should be followed by other WGs |

| Lead | AGN item | Rec# | Description | Recommendation feedback/conclusions |
|---------------------------|-------------|--------|--|---|
| | | | provide dissemination of this package to interested users. | |
| CGMS space agencies | WGII/4 | R44.18 | CGMS satellite operators to consider coordination of orbits for scatterometer instruments and to provide open and timely access to data in order to maximise independent coverage and benefits to nowcasting and NWP from assimilation of scatterometer wind data. | COMPLETED IN WGII 2020 May CGMS-48 WGII session: Adressed within the framework of WGIII. |
| CGMS space agencies | WGII/6 | R44.21 | Operators to take into account in the planning of their data distribution systems the emerging stringent requirements on data latency from SRNWP | 2020 May CGMS-48 WGII session: ??? CGMS-47: maintain recommendation WGII IS#2 15 Mar 2018: |
| CGMS space agencies | WGII/7 | R44.25 | For monitoring the Polar Regions, the Group stressed the importance of the deployment of HEO missions | 2020 May CGMS-48 WGII session: ??? CGMS-47: NOAA considering in its system studies and talking with potential partners. WGII IS#1 Dec 2018: Meeting on 5 Dec 2018 at EUMETSAT to discuss HEO missions. Sep 2018 CGMSSEC: This recommendation needs rephrasing/formulation, closing or other. Link to WGIII required |
| CGMS space agencies | WGII/8 | R44.26 | Satellite operating agencies should support proposals and programs to acquire high-accuracy characterisation measurements of the Moon, to develop a new, high accuracy, SI-traceable lunar reference standard for reflected solar wavelengths. | 2020 May CGMS-48 WGII session: ??? CGMS-47: Maintain 10 Apr 2019: Tom Stone who is the leader of lunar calibration in GSICS VINIR subgroup provided feedback see at end of this table. WGII IS#1 Dec 2018: KMA (Dohyeong Kim) to check with GSICS. WGII IS#2 15 Mar 2018: |

| WGII recon | WGII recommendations from CGMS-47 or earlier | | | | | | |
|------------|--|--------|--|---|--|--|--|
| Lead | AGN item | Rec# | Description | Recommendation feedback/conclusions | | | |
| | | | | Update expected at the March '18 GSICS meeting. SWTT is | | | |
| | | | | preparig a proposal on integrating space weather products into | | | |
| | | | | GSICS. To be discussed at CGMS-46. | | | |
| | | | | CGMS-45: GSICS discussed this issue | | | |
| CGMS | WGII/8 | R44.28 | Agencies to explore the possibilities to develop | 2020 May CGMS-48 WGII session: ??? | | | |
| space | | | suitable processing packages to support a direct | | | | |
| agencies | | | broadcast implementation of RO processing, within | CGMS-47: Recommended to be transferred to WG I. | | | |
| | | | the DBNet to improve timeliness for space weather | WGII IS#1 Dec 2018: To be maintained | | | |
| | | | applications | (See also CGMS-44 WGI action A44.08 related to IROWG) | | | |
| CGMS | WGII/3 | R43.02 | CGMS members to consider removing spectral | 2020 May CGMS-48 WGII session: To be addressed in the | | | |
| members | | | gaps from future hyperspectral sounders to support GSICS intercalibration of IR imagers. | intersessional between WGIII/WGII | | | |
| | | | | 2020 Feb 19: It was agreed that this recommendation shall be led | | | |
| | | | | by WGII. It could be addressed within the framework of | | | |
| | | | | WGII&WGIII discussions at CGMS-48. | | | |
| | | | | CGMS-47: recommendation maintained | | | |
| | | | | WGII IS#2 15 Mar 2018 | | | |
| | | | | To be discussed at second WGII inter-sessional meeting after | | | |
| | | | | CGMS-44. (For WG III to consider) | | | |
| CGMS | WGII/6 | R43.03 | CGMS members to consider include a water vapour | CGMS-48: To be discussed to at WG II/III gap analysis. To be | | | |
| members | | | channel and a CO2 channel to polar-orbiting | discussed with WG II and III as part of best practices document for | | | |
| | | | imagers, to maintain accuracy and coverage of | future missions. | | | |
| | | | polar winds and cloud height retrievals achieved by MODIS. | CGMS-47: recommendation maintained | | | |
| ISRO | WGII/5 | R43.10 | ISRO is encouraged to implement a multi-sensor | CGMS-48: recommendation maintained | | | |
| | | | precipitation estimate based on SAPHIR and INSAT- | CGMS-47: ISRO has carried out following activities: | | | |
| | | | 3D | (1) Using Bayesian formulations, a new rain retrieval algorithm for | | | |

| WGII recom | mendations | from CGMS-47 | or earlier | |
|------------|-------------|--------------|-------------|---|
| Lead | AGN item | Rec# | Description | Recommendation feedback/conclusions |
| | | | | SAPHIR is developed. (2) This algorithm is recently made operational on MOSDAC. (3) This is being used for merging the SAPHIR rain with INSAT measurements. INSAT-3D/3DR based Hydero-Estimator algorithm that provides pixel-scale and half-hourly precipitation is already operational. We will likely to complete the merging of precipitation from SAPHIR and INSAT-3D in near future. This recommendation may be kept open. WGII IS#2 15 Mar 2018: ISRO/IMD invited to report on this at CGMS-46. Nov 2017: IMD will coordinate with SAC (ISRO) to develop and implement the multi sensor precipitation estimate based on SAPHIR and INSAT-3D/3DR data on priority. CGMS-45: ISRO/IMD have plans |

ANNEX IV: STATUS OF WORKING GROUP III (WGIII) ACTIONS AND RECOMMENDATIONS FROM CGMS-47 OR EARLIER FOLLOWING CGMS-48 DISCUSSIONS

Status of WGIII CGMS-47 actions and recommendations resulting from CGMS-48 deliberations.

| WGIII actio | WGIII actions from previous plenary sessions (CGMS-47 and earlier) | | | | | | | |
|-------------|--|----------|---|--|------------------------------|--------|--|--|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status | | |
| WGIII | WGIII/4.2 | A46.02 | WGIII to consider how to account for the unique SST conical microwave imager in the CGMS Baseline and Risk Assessment | CGMS-48 plenary. Action closed. 2020 19 Feb: Reviewed at the 2nd risk assessment WS on 19-21 Feb 2020. Baseline revision and risk assessment documents will be presented to CGMS-48 for endorsement. CGMS-48 CGMS-WP-10 and -12 CGMS-47: Adressed within the scope of the initial CGMS baseline and risk assessment performed in spring 2019. 1 Mar 2019: Discussed at the risk assessment workshop. As for the Baseline, these should be included once future plans are clearer. Future plans will be discussed at CGMS-47 plenary. WGIII IS #2 6 Feb 2019: No update. Topic to be discussed at the Risk Assessment Workshop Feb/Mar 2019. 24 Oct 2018 WGIII IS: To be discussed at risk analysis WS at EUMETSAT Feb/Mar 2019. Might consider feedback/ongoing discussions from related CEOS VCs. CGMSSEC/EUM: preparing a CGMS baseline document for publication on the CGMS website (as per CGMS-46) - to include the contingency plan? | CGMS- 48 (CGMS- 47) | CLOSED | | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|-------------|--------------|--|---|------------------------------|--------|
| NOAA | F | A46.09 | On passive microwave observations: NOAA to inform CGMS on US's plans/frequency/ features of the post WindSat/SSMI MW radiometry missions (update on SSM/I) | 2020 May 28 CGMS-48 WGIII: Closed following discussions, and action is covered by WGIII A47.10. NOAA 21 May: This is related to A47.10 - we recommend the two actions be combined into one and this older action be closed. We hope to have answers from DoD by CGMS-48 Plenary. CGMS-47: Transferred from plenary to WGIII. Deferred. Expected to be presented to CGMS-48. | CGMS- 48 (CGMS- 47) | CLOSED |
| WMO | WGIII/4 | WGIII/A47.01 | Gap analysis, EGOS-IP/WOS-IP: WMO to report on the action it plans to undertake in response to the Vision for WIGOS in 2040 once it has been approved by the World Meteorological Congress (CGMS-47-WMO-WP-18: Update on WMO Gap Analysis and on status of EGOS-IP/WOS-IP) | CGMS-48 WG WMO-WP-12 Action open to CGMS-49 (pending WMO internal considerations) 2020 Feb 19: Addressed at the 2nd CGMS WGIII risk assessment WS 2020 29 Jan, IS #1: WMO to report to CGMS-48 | CGMS- 48 | OPEN |
| WMO | WGIII/5 | WGIII/A47.02 | Gap analysis and ISWG: WMO to conduct a Gap Analysis against the approved WIGOS Vision 2040 | CGMS-48 WG WMO-WP-13a/b. Action open to CGMS-49 (pending WMO internal considerations) 2020 Feb 19: WMO presented its document to the 2nd risk assessment workshop on 19-21 Feb 2020. 2020 29 Jan, IS #1: WMO to report to CGMS-48 | CGMS- 48 | OPEN |

| Actionee | AGN | Action # | Description Action feedback/closing document | | Deadline | Status |
|----------|---------|--------------|--|---|----------|--------|
| | item | 7100101111 | | 7.00.0.7.00.0.0.7.0.0.0.0.0.0.0.0.0.0.0 | | |
| | | | | To be addressed also at the 2nd risk assessment WS in Feb 2020 The | | |
| | | | | HLPP or in a CGMS vision document, this might be highlighted | | |
| WMO | WGIII/5 | WGIII/A47.03 | OSCAR/Space: | CGMS-48 WG WMO-WP-11 | 2021 | OPEN |
| | | | WMO to hold a | Workshop postponed to 2021 due to pandemic | (2020) | |
| | | | workshop on | 2020 Feb 19-21: 2nd CGMS WGIII risk assessment WS, WMO and | | |
| | | | OSCAR/Space in order | EUMETSAT discussions ongoing. System capability is secured in the | | |
| | | | to develop plans for its | short to medium term. Long term is under discussion. | | |
| | | | sustainment and future | | | |
| | | | development, both in | 2020 29 Jan, IS #1: Pending implementation of WMO reform. | | |
| | | | terms of information | Instructions included in guidelines for preparing CGMS working papers | | |
| | | | content and system | to be circulated by CGMSSEC. Workshop postponed pending WMO | | |
| | | | capability | reform. | | |
| CGMS | WGIII/5 | WGIII/A47.04 | CGMS members and | CGMS-48 WGIII WMO-WP-10a/10b. Closure agreed following WGIII | 30-Sep- | CLOSED |
| space | | | observers to provide | discussions. | 19 | |
| agencies | | | updated information on | 2020 21 May: NOAA - Further input pending confirmation (currently | | |
| | | | the status of their | expected around CGMS-48 plenary) | | |
| | | | satellites and | 2020 Feb 19: Ongoing, Members need to provide regular updates to | | |
| | | | instruments following | WMO | | |
| | | | the instructions and | 2020 29 Jan, IS #1: Templates sent by WMO (to list of focal points). | | |
| | | | tables in CGMS-47 | NOAA poc updated (from Matt Butler to Mary Ann Kutny). CGMSSEC to | | |
| | | | WMO-WP-17b | add list of pocs to this action. | | |
| | | | | New action following WGIII report preparation | | |
| WMO | WGIII | WGIII/A47.05 | Noting the recent | 2020 Feb 19: WMO now focuses on the NWP station identifiers. Action | CGMS- | CLOSED |
| | | | conclusions of the | transferred to WGIV (lead EUM/Simon Elliott). | 48 | |
| | | | WMO IPET-DRMM and | | | |
| | | | the concurrence | (Changed from recommendation to action. CGMS-47 WGIII discussion). | | |
| | | | expressed in CGMS WG | | | |
| | | | III, WMO is encouraged | | | |
| | | | to add the satellite | | | |

| Actionee | AGN | Action # | Description | Action feedback/closing document | Deadline | Status |
|-----------|---------|----------|-------------------------|--|----------|---------|
| | item | | | | | |
| | | | identifier (from | | | |
| | | | Common Code Table | | | |
| | | | C5) and satellite | | | |
| | | | instrument identifier | | | |
| | | | (from Common Code | | | |
| | | | Table C8) to OSCAR | | | |
| | | | Space. (This action | | | |
| | | | originates from WGIII | | | |
| | | | discussions at CGMS-44, | | | |
| | | | WGIII R44.02) | | | |
| CGMS | WGIII/5 | A47.06a | The OSCAR/Space | CGMS-48 WGIII discussions - Consolidated/transferred from the closed | July | ONGOING |
| space | | | Support Team (O/SST) | WGIII/A47.04: CGMS members and observers to provide updated | 2020 | |
| agencies, | | | to continue providing | information on the status of their satellites and instruments following | (Dec | |
| O/SST | | | information on their | the instructions and tables in CGMS-47 WMO-WP-17b | 2019) | |
| members | | | satellite programmes | | | |
| | | | for accurate recording | JMA focal point of O/SST from Mr. Akiyoshi ANDO (listed in Table 1 of | | |
| | | | in OSCAR/Space, | CGMS-48-WMO-WP-10a.pdf) to Ms. Hiromi OWADA (email: | | |
| | | | according to the | metsat@met.kishou.go.jp). | | |
| | | | recommended | | | |
| | | | procedure with | 2020 Feb 19: It was agreed to consolidate the actions (content and | | |
| | | | templates provided by | process) related to OSCAR/Space vis-à-vis the space agencies for further | | |
| | | | the WMO Space | addressing at CGMS-48 (WMO to consolidate the actions, Space | | |
| | | | Programme. | agencies to continue providing updates as requested). | | |
| | | | Instructions and | | | |
| | | | templates are available | Introduced following the draft CGMS-47 report review by WMO. | | |
| | | | in working paper CGMS- | | | |
| | | | 47 WMO-WP-17b. | | | |

| WGIII actio | ons from pr | evious plenary se | essions (CGMS-47 and earlie | er) | | |
|----------------------|-------------|-------------------|---|--|-----------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| CGMS space | WGIII/5 | A47.06b | O/SST to review the table of "differentials" | CGMS-48 WG WMO-WP-10c | 31 Aug 2019 | CLOSED |
| agencies, O/SST | | | in the contents between OSCAR/Space and CEOS | 2020 Feb 19: This exercise has been completed and is therefore closed. | | |
| members | | | MIM database on satellite instruments. (The MIM team has provided the list of differentials information | Introduced following the draft CGMS-47 report review by WMO. | | |
| CGMS space agencies, | WGIII/5 | A47.06c | previously). CGMS members to participate in the OSCAR/Space database | CGMS-48 WG WMO WP 11 2020 Feb 19: Refer to WGIII action A47.06a | 2021 (CGMS- 48) | CLOSED |
| O/SST members | | | maintenance and evolution workshop to be organised by WMO prior to CGMS-48 | Introduced following the draft CGMS-47 report review by WMO. | | |
| WMO | WGIII/7 | WGIII/A47.07 | Early Morning Orbit: WMO to reconvene a | CGMS-48-WGIII CMA-WP-12 | 2021 | OPEN |
| | | | wmo-cgms Tiger Team on the impact of the Early Morning orbit. (It is currently premature to convene this Tiger Team until an assessment of FY-3E is conducted). | 2020 Feb 19: It is important to timely reconvene the Tiger Team to enable the team to start working shortly after the launch (and prior to declaring the s/c operational). Launch is tentatively scheduled for 2020/2021. Side discussions to be held on the sides of the upcoming 7th NWP impact workshop 11-15 May (if held) and/or on the sides of CGMS=48 WG meetings. CGMS-47/SWCG: The WMO CGMS Early Morning Tiger Team is requested to include space weather data in the impact analysis. | | |

| Actionee | AGN | Action # | Description | Action feedback/closing document | Deadline | Status |
|-----------|---------|--------------|-------------------------|--|-----------|--------|
| Actionee | item | Action # | Description | Action reedbacky closing document | Deadillie | Status |
| EUM | WGIII/7 | WGIII/A47.08 | GEO coverage in the | CGMS-48-WGIII EUMETSAT-WP-07 | CGMS- | CLOSED |
| | | | IODC region: | 2020 Feb 19: EUMETSAT provided the status at the 2nd CGMS WGII risk | 48 | |
| | | | EUMETSAT to conduct a | assessment WS 19-21 Feb 2020 It is considered to be resilient. | | |
| | | | study on GEO Imager | EUMETSAT will briefly address this at CGMS-48. (CGMS-48-EUMETSAT- | | |
| | | | coverage, data quality, | WP-07) | | |
| | | | availability and | | | |
| | | | resilience in the IODC | | | |
| | | | region | | | |
| CGMSSEC V | WGIII/7 | WGIII/A47.09 | CGMSSEC to write to | 2019 Nov 22: CGMS/LET/19/1138229 sent to NSOAS (informing WGIII | Dec | CLOSED |
| | | | NSOAS stating the | Co-chairs and rapporteur by e-mail) | 2019 | |
| | | | importance of HY-2B | | | |
| | | | MWI and ALT data. | | | |
| NOAA | WGIII/7 | WGIII/A47.10 | MW imaging in LEO for | 2020 28 May CGMS-48 WGIII: This action is broader and well beyond | CGMS- | OPEN |
| | | | SST: | the SSMI. NOAA is in discussion with DOD on the follow on of the DMSP | 49 | |
| | | | NOAA to provide an | and hopes to have answers from DoD by CGMS-48 Plenary. (Reference | (CGMS- | |
| | | | update on SSMI status | is also made to the now closed WGIII A46.09). | 48) | |
| | | | and possible follow-on | A related action from plenary is likely to be transferred to WGIII (same action) | | |
| ISRO | WGIII/7 | WGIII/A47.11 | ISRO to provide an | 2020 May 28: ISRO will review the programme in June and expects to | CGMS- | OPEN |
| | | | update on its plans for | report to CGMS-48 plenary in August | 49 | |
| | | | follow-on mission to | | (CGMS- | |
| | | | Oceansat-3. | | 48) | |
| ISRO | WGIII/7 | WGIII/A47.12 | ISRO to confirm data | 2020 May 28: ISRO will review the programme in June and expects to | CGMS- | OPEN |
| | | | latency for Aditya-L1 | report to CGMS-48 plenary in August | 49 | |
| | | | mission | | (CGMS- | |
| | | | | | 48) | |

| WGIII actio | ons from pro | evious plenary se | essions (CGMS-47 and earlie | er) | | |
|---------------|--------------|-------------------|---|---|------------------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| ISRO | WGIII | WGIII/A47.13 | On passive microwave observations: ISRO is recommended to confirm its plans for a Megha-Tropiques follow up mission in low inclination and its plans for TSU and MSU MW sounders and to consider complementary orbits for the deployment of these sounders. (Formerly plenary | 2020 May 28: ISRO will review the programme in June and expects to report to CGMS-48 plenary in August (CGMS-47: transferred from plenary recommendation to WGIII action) | CGMS- 49 (CGMS- 48) | OPEN |
| JAXA, NASA | WGIII/7 | WGIII/A47.14 | recommendation R46.07) NASA and JAXA to provide future plans for precipitation measurement mission(s) | 2020 May 29, CGMS-48 WGIII: CGMS-48-JAXA-WP-03. Closed now. JAXA and NASA are requested to keep CGMS regularly informed on their future plans. 2020 29 Jan, IS #1: NASA and JAXA have extended their GPM agreement until 2029 (EUMETSAT's associated agreement is currently being extended accordingly). The JAXA next gen AMSR3 has been approved to fly on GOSAT-GW. | CGMS- 48 | CLOSED |
| WGIII | WGIII/7 | WGIII/A47.15 | WGIII to update the CGMS Baseline and conduct the annual Risk Assessment for submission to CGMS-48 | 202 May 28: CGMS-48-CGMS-WP-10, CGMS-48-CGMS-WP-12. Discussed in CGMS-48 WGs for final consolidation and presentation to plenary for endorsement in August (and action closure). 2nd CGMS WGIII risk assessment workshop held at EUMETSAT on 2020 | CGMS- 48 | CLOSED |

| WGIII acti | ons from pr | revious plenary se | ssions (CGMS-47 and earli | er) | | |
|------------|----------------|-----------------------------------|---|---|-----------------|---------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | Feb 19-21. Outcome/report to be discussed in WGIII at CGMS-48 for endorsement by plenary (CGMS-48 CGMS-WP-10 and -12). 2020 29 Jan, IS #1: To be reviewed at the 2nd risk assessment WS 19-21 Feb 2020. | | |
| EUM | WGIII/ | WGIII/A47.16 (WGIII R46.01) | CGMSSEC to enquire with EUMETSAT NWP SAF Radiative Transfer Model (RTM) support for FY-2E/H Indian Ocean coverage. (Formerly WGIII recommendation R46.01) | 2020 May 28: Closed following CGMS-48 WGIII discussions. 2020 Feb 19: RTTOV is supporting FY-2 VISSR sensors as can be seen in this web page: https://www.nwpsaf.eu/site/software/rttov/documentation/platforms-supported/ (Changed from recommendation to action. CGMS-47 WGIII discussion: Recommendation to be passed to EUMETSAT) | Dec 2019 | CLOSED |
| WGIII | from WGII/5 | WGIII/A47.17 (WGII/A47.14) | WGIII to provide their assessment and planning for the next risk assessment to the ISWGs, WGClimate and GSICS. (Action from WGII). | CGMS-48 joint WGII/WGIII session held 28 May. The WGIII report will be provided to plenary for guidance. It was also agreed to hold dedicated inter-sessionals to address specific inputs from these groups to the CGMS risk assessment. CGMSSEC to address this with WGII on how to organise such meetings. (CGMS-48-WGIII CGMS-WP-10 and WP-12) 2020 Feb 19: 2nd risk assessment workshop held on 19-21 Feb 2020.Will be addressed at inter-sessional meetings and at CGMS-48 | Apr/Mar 2020 | ONGOING |

| WGIII recommer | ndations from | CGMS-47 or | earlier | |
|---------------------|------------------------|------------|---|---|
| Lead | AGN item | Rec# | Description | Recommendation feedback/completion document |
| CGMS space agencies | From plenary 5.7 | R47.01 | (From IPWG): IPWG strongly recommends to CGMS members to continue the constellation of PMW sensors to ensure quality satellite precipitation products for weather, climate, and hydrological applications. Additionally, IPWG would like to be kept informed of longer term plans for subsequent launches of microwave sensors to ensure continuity of long-term observations that meet the documented needs of the user community. | CONCLUDED CGMS-48 WGIII discussions/Concluded. 2020 May 28, CGMS-48 WGIII: Addressed in the CGMS baseline, risk assessment, HLPP. Transferred from plenary |
| cGMS space agencies | From plenary 5.7 | R47.02 | (From IPWG): IPWG also recommends that there be a CGMS-wide coordination of the crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of diurnal cycle, convective systems lifecycles, and severe storms. | CONCLUDED 2020 May 28, CGMS-48 WGIII: To be transferred/addressed in WGI. Transferred from plenary |
| CGMS space agencies | From plenary 5.7 | R47.03 | (From IPWG): As precipitation moves to higher temporal rates, we recommend to CGMS members to synchronize full-disk geostationary sampling schedules which will optimize GEO full disk scans to improve temporal sampling of precipitation products and unknown future PMW imager availability for merged products. | CONCLUDED 2020 May 28, CGMS-48 WGIII: To be transferred/addressed in WGI. Transferred from plenary |
| CGMS space agencies | From plenary 5.7 | R47.04 | (From IPWG): Collaboration between space programs and data assimilation centers should be specifically encouraged to incorporate data assimilation requirements as part of scientific requirements when developing new satellite / observing systems. This would reduce barriers for operational assimilation of observations, and potentially provide a greater range of utility for various sensors. | CONCLUDED 2020 May 28, CGMS-48 WGIII: CGMS members to take note/consider in the preparation of new programmes. Recommendation proposed to be closed. Transferred from plenary |

| WGIII recommenda | tions from | CGMS-47 or earl | ier | |
|---------------------|------------------------|-----------------|---|--|
| Lead | AGN item | Rec# | Description | Recommendation feedback/completion document |
| CGMS space agencies | From plenary 5.7 | R47.05 | (From IPWG): Higher spatial and temporal (subhourly) resolution and higher spectral sampling in the microwave measurement of clouds and precipitation should be considered in future observing systems. | 2020 May 28, CGMS-48 WGIII: CGMS members to take note/consider in the preparation of new programmes. To be furher addressed within the framework of the CGMS baseline/risk assessment (Q1 2021). Recommendation raised within the framework of WGII (by Ken&Mitch (e-mail on 4 June 2020). Transferred from plenary |
| CGMS space agencies | From plenary 5.7 | R47.06 | (From IPWG): Latency and quality of satellite data should be improved, from both operational and research missions, to fit in the data assimilation high temporal resolution cycle. | CONVERTED TO A WGIII CGMS-48 ACTION (May 2020) 2020 May 28, CGMS-48 WGIII: See CGMS baseline (cal/val). Latency is not currently reflected in the baseline - proposed to convert into an action on WGIII how to reflect this matter in the baseline. (Transferred from plenary) |

ANNEX V: STATUS OF WORKING GROUP IV (WGIV) ACTIONS AND RECOMMENDATIONS FROM CGMS-47 OR EARLIER FOLLOWING CGMS-48 DISCUSSIONS

Status of WGIV CGMS-47 actions and recommendations resulting from CGMS-48 deliberations.

| WGIV action | | | | | | T a |
|-------------|----------|-------------|--|--|--------------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| EUM | WGIII/2 | A43.02 | (Action transferred from WGIII) EUMETSAT to propose dissemination plan for data from Indian Ocean Data Coverage partners identified in CGMS-43-EUM-14 roadmap. | CGMS-48 WGIV: activity is considered completed, closed in favour of new action: "CMA/EUM to report on the status of data access/dissemination from Indian Ocean Data Coverage partners, as identified in CGMS-43-EUM-14 roadmap" 2019, 10 Dec, IS WGIV: Pending: CMA-EUM bilateral Feb 2020 Elektro-L2 product availability 2019 Nov: Further feedback expected by Feb 2020. CGMS-47: Availability of Elektro-L N2 meteorological products to be discussed with Roshydromet. CMA to provide status of implementation of IODC products on CMACast. Implementation of all other products on EUMETCast Africa and provision to CMA completed. 5 Dec 2018: Elektro-L N2 meteorological products not yet available. Implementation of all other data at EUMETSAT side (EUMETCast Africa) completed. | CGMS-48 (CGMS- 44) | CLOSED |

| Actionee | AGN item | Action # | Description | Action feedback/closing document Deadline | Status |
|----------|----------|-------------|-------------|--|--------|
| | | | | Access for CMA via EUMETCast Terrestrial in | |
| | | | | progress, to be completed latest Jan 2019. | |
| | | | | CGMS-46: Progress reported in | |
| | | | | CGMS-46-EUMETSAT-WP-08 | |
| | | | | CGMS-46-ISRO-WP-05 | |
| | | | | and closure expected in autumn 2018. | |
| | | | | WGIV IS-1, Oct 2017: | |
| | | | | EUMETSAT: work in progress, pending | |
| | | | | dissemination facility upgrade and EUMETCast | |
| | | | | Africa contract renewal in 2018, and pending | |
| | | | | decision to add more data | |
| | | | | Status at CGMS-45: | |
| | | | | CGMS-45-EUMETSAT-WP-37 | |
| | | | | CGMS-45-ISRO-WP-05 | |
| | | | | Ongoing work, deadline extended. | |
| | | | | WGIV webex 9 Dec 2015: WMO seeking to assure | |
| | | | | that the dissemination to users will be equivalent | |
| | | | | to the current one (EUMETSAT, CMA, ROSH and | |
| | | | | ISRO to collaborate and clarify this in view of | |
| | | | | CGMS-44. | |
| | | | | EUMETSAT makes FY-2E data available through | |
| | | | | EUMETCast. | |
| | | | | EUM expects its Council to take a decision on | |
| | | | | moving Meteosat-8 to ca 40° E in June 2016. | |
| | | | | CGMS-44 EUM-WP-14 | |
| | | | | WG-IV webex/communication 18 Jan 2017: | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|---------------------------------------|----------------|-------------|--|--|--------------------------------|--------|
| | | | | Status of IODC Service by CMA: The CMA FY-2E at 86.5E is undertaking IODC service. CMA shall keep continuity of IODC service at 86.5E, on assumption: - FY-2G, launched 31 December 2014, currently operating at 105E; - Launch of FY-2H is planned for the end of 2017 or early 2018. | | |
| CGMSSEC, WMO, space agencies | WGIV (WGII) | A44.05 | From CGMS-44 WGII: CGMS operators and WMO to work with GODEX-NWP to explore options for optimal data exchange of advanced data from next-gen GEOs. | 2020 22 May: NOAA will host GODEX-NWP virtually early July 2020 to address this action. 2019, 10 Dec, IS WGIV: Included in the WGIV agenda for CGMS-48. 2019 Nov: Currently no specific requirements from GODEX-NWP. To be discussed in future WGIV intersessionals. CGMS-47: Current situation is ok, no specific requirements. Satellite operators will certainly address regional requirements for their next-gen satellites. Future global (next-gen satellite) requirements will be addressed in an intersessional meeting with GODEX-NWP participation and CC Matt Buttler and Simon Eilliott 12 Nov 2018: Pending outcome of the GODEX-NWP meeting. At CGMS-46: No further input, feedback from GODEX-NWP required. 22 May 2018: To be discussed in WGIV at CGMS-46, which needs participation/representation from | CGMS-48 (CGMS- 45/46/47) | OPEN |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|----------|----------|--|---|--------------------------|--------|
| | | | | WGII to explain the background and purpose to enable WGIV to move forward. The next GODEX-NWP meeting will be held 27-30 Nov 2018 in New Delhi, India. WG-IV WEBEX 18 Jan 2017: WMO: GODEX-NWP scheduled May 2017, needs will be addressed there, WMO will provide feedback. CGMS-45: GODEX-NWP not yet ready to provide feedback. | | |
| TFMI | WGIV/9 | A45.02 | TFMI to work on the WIGOS metadata standard, in particular to assess the WIGOS Metadata OGC Observations and Measurements standard, and recommend possible adjustments for satellite observations to the WMO WIGOS team. | CGMS-48: WIGOS review published in https://github.com/CGMS-TFMI/CGMSTFMI-Teleconferences/tree/master/CGMS-TF-MI-Publications/WIGOS-Review 2019, 10 Dec, IS WGIV: TFMI report to be made to CGMS-48 CGMS-47: included in work plan of TFMI Oct 2018: A WIGOS metadata assessment provision to IPET WIGOS by March 2019 is feasible. The work is divided in two steps. In the first step an assessment to be done of the abstract (the standard), and an assessment from satellite providers. (March 2019) The second step is the assimilation in XML, i.e. the transport level. (July 2019) CGMS-46: No progress due to lack of resources by TFMI key members, will be addressed with TFMI in inter-sessional meetings. | CGMS-48 (CGMS- 46) | CLOSED |

| Worv action | VGIV actions from previous plenary sessions (CGMS-47 and earlier) | | | | | | | | |
|-------------|---|-------------|---|---|--------------------------|--------|--|--|--|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status | | | |
| TFMI | WGIV/12.1 | A45.03 | CGMS satellite operators to provide documentation on the data formats for space weather observations, and to forward related space weather metadata to the WIS. | WMO/TFMI/WGIV rapporteur 6-Jul-2020: In order to progress in the definition of space weather discovery metadata for the WIS we must have a meeting with SWCG / TFMI / WMO to refine the action. EUMETSAT/KP Renner to follow up. 2020, 5 Feb: Use of GRIB-2 format had been approved (WMO). T Onsager stated that this format is not the best way forward for transfer of SpWx information and that the NETCDF format would be a better choice. Please refer to the email exchange "GRIB-2 data format for Space Weather data" following the meeting. The formats required by the SpWx community (currently and for the future) need to be compiled and this can be addressed by SWCG together with CGMS WG-IV (taking account of the survey results) 2020 Jan 21 SWCG IS #3: Werner Balogh pointed out the SPASE model (http://www.spase- group.org/about.html) is being used within the International Space Weather Initiative (ISWI) data policy. Toshi Kurino recalled that the GRIB2 data format usage for space weather remains to be clarified. Note that on this subject, the CGMS-47 SWCG report states: "The request from WMO-CM to SWCG concerning the usage of the GRIB Edition 2 format was discussed. SWCG requested WMO to | CGMS-48 (CGMS- 46) | OPEN | | | |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|----------|-------------|---|--|----------|--------|
| | | | | recommend that IPT-SWeISS give their feedback in the first instance." - Elsayed and Nagatsuma-san will follow up on this with IPT-SWeISS 2019, 10 Dec, IS WGIV: TFMI report to be made to CGMS-48 CGMS-47: Space weather metadata aspect to be assessed by TFMI. Remaining action superseded by ongoing Space Weather data provider survey (SWCG/A47.05) Nov 2018: A survey is ongoing by TFMI to be concluded by end 2018 for the establishement of a best practice. 2018 Oct 8, SWCG IS#2 webex: WMO pointed out the SPASE model (http://www.spase-group.org/about.html) is used within the International Space Weather Initiative (ISWI) data policy. CGMS-46-NICT-WP-02 see also CGMS-46 WGIV/12.1 | | |
| WG IV | WGII/4 | A45.05 | Action from WGII: Ensure timely (< 1 hr) and free access to all geostationary visible, IR and water vapour data that is required to improve global hydrological prediction. | At CGMS-48/47: Pending response from WGIV/A46.02 Put on hold until requirements are clarified (see new action A46.02) 29 May 2018: NOAA provides this data at the requested latency. 14 Mar 2018: IPWG recognises it is not feasible having all channel data from the new era of GEO | CGMS-49 | OPEN |

| WGIV action | ns from prev | ious plena | ry sessions (CGMS-47 and earlier) | | | |
|-------------|--------------|------------|-----------------------------------|--|----------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | satellites, however: a) At a minimum, sustained 30-min refresh full disk longwave IR (10 to 15-min desired), near realtime access; b) Given the expanded spectral bands of the operational global geo constellation, additional 6.2 um water vapor channel data, at the same refresh as IR c) Finally, visible channel data desired 25 Oct '17: CGMSSEC has sent a message to IPWG co-chairs to this purpose asking for more details to enable WGIV to react. [enquiry sent to R Ferraro 19 Feb 2018] WGIV IS 11 Oct '17: This action was discussed and WGIV concluded the request is too open and would have a significant impact on the data access in this form. The following clarification was formulated and CGMSSEC is asked to pass this on to the IPWG: The precipitation community to clarify what data are needed, in terms of time/spatial resolution, spectral channel selection, and sub-setting. CGMSSEC to follow this up with IPWG. | | |

| WGIV action | ons from prev | ious plena | ry sessions (CGMS-47 and earlier) | | | |
|-------------|---------------|-------------|---|--|---|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| WMO | WGIV/3.2 | A46.02 | WMO to further refine the requirement from IPWG for GEO image data, in terms of users and geographical resolution | 2020 Jan 24 from WMO: A stated requirement for global GEO imagery to support precipitation monitoring to be provided by SCOPE-NowCasting Pilot Project 3 (point of contact Daniel Vila daniel.vila@inpe.br) at IPWG-10 in June 2020. The IPWG meeting should also consider any needs to further refine the global requirements in terms of identified users and geographical resolution. 2019, 10 Dec, IS WGIV: Pending information from WMO 2019 Nov 18: CGMSSEC contacted WMO & IPWG by e-mail. | June 2020 (Dec 2019, CGMS-47) | OPEN |
| WMO | WGIV/6 | A46.03 | WMO to liaise with GSICS on implementing GSICS monitoring capabilities in WDQMS, to include incident management capabilities, and report back to WG-IV, proposing a way forward | CGMS-48 (WMO): The work on GISC monitoring will be started with the new sub structures of INFCOM. This action should not stay there as it is purely WMO activity and is not going to involve CGMS. Incident management capabilities are under development, but they don't involve satellite data in particular. 2019, 10 Dec, IS WGIV: Pending information from WMO Side Meeting between GSICS and WMO regarding WDQMS. WMO will invite GSICS to attend next TT-WDQMS meeting. | CGMS-48 | CLOSED |

| WGIV actio | ns from prev | ious plena | ry sessions (CGMS-47 and earlier) | | | |
|--------------------------------|--------------|-------------|--|---|-------------------------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| CGMS satellite operators | WGIV/7 | A46.04 | To consider an enhancement of advance notifications of processing changes as specified below and provide feedback to WG-IV. If a planned change to data processing results in a change in brightness temperature of 0.1K or 20% of NEdT (whichever is smaller), this should be made clear in notifications to users. These notifications should be made no later than 8 weeks before the change and test data should be provided if possible. [From the ITWG ITSC-21 Report] | 2020 May 12: NOAA has proposed a formal notification policy that advocates for the recommendations of WGIV. The policy provides 8 weeks notification for "Expected maximum change (temporally, geographically) in the observed brightness temperature of any channel of the instrument exceeds 0.1K or 20% of NEdT". The policy is currency in review by NOAA leadership. 2019, 10 Dec, IS WGIV: Clarified that this action is about developping specific thresholds for notifications, not about the notification system itself. CGMS-47: EUMETSAT: A general change and user notification process is in place. An analysis is in progress w.r.t. the requested specification. Results to be discussed in an inter-sessional meeting. 5 Dec 2018: It was clarified that "instrument changes" means changes w.r.t. performance, and not changes vs specification. Nov 2018: EUMETSAT has an implemented process. | ? 2020 (Dec 2019, CGMS-47) | OPEN |
| CMA | WGIV/7 | A46.05 | To consider implementing a subscription-based anomaly/event notification service, similar to that provided by NOAA and EUMETSAT and provide feedback to WG-IV. | CGMS-48 J-WGI-WGIV: CGMS-48-CMA-WP- 15(PPT), implemented as RSS service. CGMS-47: System is under construction. | CGMS-48 (CGMS- 47) | CLOSED |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
|----------|-------------------|-------------|--|--|---------------------------|--------|
| WGIV | (Plenary E.10) | A46.06 | Following CGMS-46 plenary discussions related to IROWG and GCOS IP: CGMS WGIV to consider the GCOS IP actions on long-term data preservation (LTDP). Ref. GCOS IP action G 26. | 2019, 10 Dec, IS WGIV: CEOS BP doc exists. The adopting the CEOS LT preservation guidelines under finalisation. ISRO/Nitant Dube to share the URL once ready. 2019 Nov 20: EUM and NOAA input provided. Get response from other agencies if possible, then prepare Best Practise on this basis. CGMS-47: NOAA: Under federal law, supported by a suite of policies and procedures (see below for a summary), NOAA ensures through its National Environmental Satellite, Data, and Information Service (NESDIS) and the National Centers for Environmental Information (NCEI) that level 0 and level 1 satellite data, along with metadata and derived level 2 and higher products, are preserved for the long term and made available to the public at no more than the cost of reproduction. EUM Nov 2018: EUMETSAT fully recognises the importance of early satellite data for climate activities and follows the CEOS Preservation Guidelines, documented in "Long Term Preservation of Earth Observation Space Data". In adopting these guidelines and the relevant operational processes EUMETSAT ensures the long-term preservation and usability of (early) satellite raw and level 1 data, including metadata. | Dec 2020 (Dec 2019) | OPEN |

| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
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| | | | | For all EUMETSAT missions, the raw data and metadata as well as the derived level 1 and level 2 products are archived and preserved in the EUMETSAT Data Centre. The level 1 and level 2 data are accessible online and free of charge by users. The generation of high quality FCDRs and TCDRs from the preserved raw extending back to the first availability of data is an important part of EUMETSATs climate activities, e.g. Meteosat First Generation (MVIRI) FCDR covering the time period from 1981-2017). | | |
| CGMS satellite operators | IS-2 | A46.08 | CGMS members to review the "CGMS/WMO best practices for achieving user readiness for new meteorological satellites" (https://www.cgms- info.org/documents/CGMS- BP_user_readiness_Apr2016.pdf) and to provide feedback and make recommendations on updates. | (Addressed in the latest version of the HLPP) 2020 May: Members to review and provide feedback to cgmssec@eumetsat.int. CGMSSEC to remind members 2019, 10 Dec, IS WGIV: To be discussed in dedicated WGIV IS before CGMS-48 2019 Nov 20: To be reviewed and addressed at a dedicated intersessional meeting for follow-up in a dedicated sub-group. CGMS-47: action refined | Dec 2020 (CGMS- 48) | OPEN |
| CGMS members | WGIV/8 | A47.01 | Big data/cloud services: To provide a point of contact for participation in regular inter-sessional teleconferences lead by NOAA, starting discussions to establish an expert group on cloud services interoperability. | Agencies to provide PoCs. NOAA: (vanessa.l.griffin@noaa.gov) EUM: lothar.wolf@eumetsat.int ISRO: Nitant Dube nitant@sac.isro.gov.in JMA: K Bessho kbessho@met.kishou.go.jp CMA: Zhe Xu xuzhe@cma.gov.cn KMA: Hyunjong Oh hyunjong.oh@korea.kr | CGMS-48 | CLOSED |

| WGIV action | ns from prev | ious plena | ry sessions (CGMS-47 and earlier) | | | |
|-------------------------|--------------|------------|---|---|----------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| CGMS members | WGIV/8 | A47.02 | To analyse if existing cloud service activities can serve as a demonstration project, exploring at least two of the WMO Information Systems (WIS 2.0) principles. | CGMS-48 WGIV (WMO): Unfortunately WMO did not have any demonstration project for WIS2 and this can be closed. Agencies to provide PoCs. EUM: lothar.wolf@eumetsat.int JMA: Kotaro Bessho (kbessho@met.kishou.go.jp) | CGMS-48 | CLOSED |
| CMA, JMA,KMA, WMO | WGIV/9 | A47.03 | To liaise with WMO and prepare the report of RSS observation activities including user readiness and notification. | CGMS-48 WGIV: CGMS-48-joint-JMA-KMA-WP-01 refers, work in progress JMA-CMA-KMA discussion held at recent AOMSUC and will report progress to next CGMS. | CGMS-48 | OPEN |
| NOAA | WGIV/12 | A47.04 | To support enabling the connectivity between the OAI PMH NESDIS repository and GISC Washington, to be able to harvest metadata. | CGMS-48 WGIV: 2019, 10 Dec, IS WGIV: M Butler to follow up. | Aug 2020 | OPEN |
| CGMS members | WGIV/15 | A47.05 | To provide a point of contact for participation in regular inter-sessional teleconferences on cyber security including related training aspects. | Agencies to provide pocs. NOAA: (vanessa.l.griffin@noaa.gov) EUM: guillaume.texier@eumetsat.int ISRO: Utkarsh Tyagi (utkarsh@sac.isro.gov.in) Nitant Dube (nitant@sac.isro.gov.in) JMA: K Bessho kbessho@met.kishou.go.jp ROSH: Nikita Ekimov (nikitaekimov@planet.iitp.ru) KMA will report back | Aug 2020 | OPEN |

| WGIV Recommend | lations from (| GMS-47 or ea | arlier | |
|---------------------|----------------|--------------|---|---|
| Lead | AGN item | Rec# | Description | Recommendation feedback/closing document |
| CGMS | WGIV/12 | R47.01 | CGMS-47 Plenary to endorse the recommendations available from CGMS-TFMI-WIGOS-Standard-Review (link see CGMS-47-CGMS-WP-07). | CONCLUDED Endorsed by CGMS-47 plenary. |
| CGMS | WGIV/12 | R47.02 | CGMS-47 Plenary to endorse the presented working plan regarding the assessment of the WIGOS Metadata Representation Format and allow the task force to proceed on the defined tasks. | CONCLUDED Endorsed by CGMS-47 plenary. |
| CGMS | WGIV/13 | R47.03 | CGMS-47 Plenary to endorse the Five-year Strategy document proposed by VLab, w.r.t. items in the scope of WG-IV. | CONCLUDED CGMS-47 plenary endorsed the Vlab 5-year strategy. |
| CGMS members | WGIV/3.2 | R44.02 | CGMS members to continue the provision of up-to- date User Readiness information in the SATURN portal | CONCLUDED CGMS-48: contained in best practise of user readiness |
| CGMS space agencies | WGIV/7 | R42.01 | Satellite operators to provide WIS Discovery Metadata Records, compliant to WIS requirements and following the guidance to be provided by the CGMS-WMO Task Force on metadata implementation, in order to facilitate satellite information discovery and access | CGMS-48: to be converted into Best Practise by IS sub-group at CGMS-47: consider conversion into best practise during inter-sessional meeting |
| CGMS space agencies | WGII/10 | R43.07 | CGMS agencies to make available a non real-time cache of satellite level 1 data over the previous 2-3 months, similar to the NOAA CLASS system. | CGMS-48: to be converted into Best Practise by IS sub-group at CGMS-47: consider conversion into best practise during inter-sessional meeting |

ANNEX VI: STATUS OF SWCG ACTIONS AND RECOMMENDATIONS FROM CGMS-47 OR EARLIER FOLLOWING CGMS-48 DISCUSSIONS

Status of SWCG CGMS-47 actions and recommendations resulting from CGMS-48 deliberations.

| SWCG act | ions from pre | evious pler | nary sessions (CGMS-47 and earlier) | | | |
|----------|-------------------|-------------|---|--|------------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| SWCG | SWCG/3 | A47.01 | CCMS members to assess whether magnetorquer TM can be extracted to allow assessment for magnetic field derivation | CGMS 48: SWCG confirmed closure based on IS#4 meeting. | Apr 2020 (Jul 2019) | CLOSED |
| SWCG | SWCG/3 (WGIII) | A47.02 | Survey ISES on need for operational spaceborne LEO magnetometer data and propose updates to CGMS Baseline as appropriate. | CGMS-48: SWCG Recommend LEO Magnetometer should not be in the Baseline, but considered for HLPP 2020 Jan 21 SWCG IS #3/2020 Feb 5: Action on ESA/NASA/Russia – Provide the plans for future magnetometer missions in LEO (scientific or operational objectives). LEO magnetometer data is not integrated into operational SpWx services – more research / modelling analysis required. Action on ISES - Survey the ISES members further to assess their need for the magnetometer data and timeline for these needs. Can then decide on whether to remove the magnetometer in LEO from Baseline and identify it instead as an aspirational mission type. Risk Assessment Workshop (WGIII) – Taking place at EUMETSAT from 19-21 February. Andrew Monham will represent SWCG related issues there. Included in the user survey (Ref. SWCG/ A47.06). | Apr 2020 (Jul 2019) | CLOSED |

| SWCG act | ions from pre | vious pler | ary sessions (CGMS-47 and earlier) | | | |
|----------|---------------|------------|---|---|-----------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | Survey is completed, some data users realise the importance of magnetometer data for model comparison, and producing the global distribution of high energy particle – should we include magnetometer data in the baseline? Part-1 conclusion: Action on ESA/NASA/Russia – Provide the plans for future magnetometer missions in LEO (scientific or operational objectives). Action on ISES - Survey the ISES members further to assess their need for the magnetometer data and timeline for these needs. Can then decide on whether to remove the magnetometer in LEO from Baseline and identify it instead as an aspirational mission type. 2018 Oct 8, SWCG IS#2 webex: Included in the ongoing survey (issued on 26 Sep 2019). | | |
| SWCG | SWCG/3 | A47.03 | Encourage WMO CGMS Early Morning Tiger Team to include Space Weather data in their impact analysis. | CGMS-48 WGs: Closed following discussions in SWCG. 2018 Oct 8, SWCG IS#2 webex: It is noted that this request has already been made in the WGIII action list (WGIII/A47.01). E Talaat is a member of WGIII and will help ensure this is followed up. However, discussions are not foreseen to take place in the near future. The SWCG action can be closed, as it is pursued through the WGIII action. (CGMS-47: The study is expected to be carried out in 2020/2021 timeframe, launch ~2021) | CGMS- 48/-49 | CLOSED |

| SWCG act | ions from pre | evious plei | nary sessions (CGMS-47 and earlier) | | | |
|----------|---------------|-------------|--|--|----------------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| SWCG | SWCG/7 | A47.04 | Propose improvements to the space weather parameters in the OSCAR DB and request support for implementation from WMO. The parameters available in the existing DB may not be sufficient to properly describe measurement capabilities of SW instrumentation. | CGMS-48: NOAA proposal presented at IS#3 will be re-circulated to SWCG members and sent to WMO for review. 2020, 5 Feb: OSCAR database was updated by NOAA in Fall 2019 – NOAA/NASA "OSCAR NOAA-NASA SpWx update2019. WMO have sent a table to SWCG for feedback on the various SpWx missions: "Space Weather-OSCAR-template-11Nov2019". Background information is contained in the IPT-SWEISS doc: Space-weather-in-OSCAR-10Nov2019. ACTION on all SWCG Members to fill this out. Debate concerning the separation of scientific and operational usage – not viewed as a feasible categorisation by WMO. Better to record the actual data latency as provided by the satellite operator/data provider. Same with reliability. See if can use a searchable field rather than free text. | July 2020 (CGMS- 48) | OPEN |
| SWCG | SWCG/8 | A47.05 | CGMS Members to complete the on-going Space Weather data provider survey | CGMS-48: Remaining Data Provider Survey responses requested, in particular from Roshydromet, CMA and KMA. 2020 Jan 21 SWCG IS #3: Data providers survey inputs received from NOAA, NICT and ESA.CGMS members invited to provide remaining responses. Proposed to close action based on results received at CGMS-48. 2018 Oct 8, SWCG IS#2 webex: - Roshydromet, CMA and KMA are kindly requested to provide a response to the Data Providers Survey issued on 1 March 2019 as soon | May 2019 | OPEN |

| SWCG act | ions from pre | evious pler | nary sessions (CGMS-47 and earlier) | | | |
|----------|---------------|-------------|---|---|--------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | as possible, as these organisations are important providers of space weather data from their satellites (refer to the NOAA input to help with understanding of the level of information required. - The GNSS RO WG has a subgroup dealing with Space Weather and should be requested to provide inputs to the data provider survey. Examples are NASA Cosmic-2. For KOMPSAT, it is not clear weather ionosphere data is provided for SpWx usage. The Spanish PAZ satellite also operates a RO mission, although it is also unclear whether any ionospheric data is acquired. Elsayed to contact the GNSS RO WG / NASA /KMA with the survey and request this information. - It is noted that commercial RO data evaluations are ongoing, including ionospheric measurements (NOAA /EUMETSAT activity). | | |
| SWCG | SWCG/8 | A47.06 | Identify Space Weather Data and Services Users and send survey including findings from the Data Providers Survey for their comment. | CGMS-48: Survey issued and 12 responses received. Recommendations from CGMS-48-SWCG-WP-05 - Encourage responses from further users of data from space weather satellite instruments (new action raised) - CGMS SWCG to engage with survey respondents on an individual basis to clarify inputs made, with support of ISES / IPT-SWeISS where appropriate. (new action raised) - Analysis: See Action A47.04. | June 2019 | CLOSED |

| SWCG act | ions from pre | evious pler | nary sessions (CGMS-47 and ea | arlier) | | |
|----------|---------------|-------------|-------------------------------|--|----------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | 2020, 5 Feb: Summary of the inputs received was | | |
| | | | | made using the ESWW presentation "TDM CGMS | | |
| | | | | presentation". Further attempts to get survey | | |
| | | | | inputs will be made by Werner Balogh / Jussi, | | |
| | | | | when attending the UN Expert Committee in | | |
| | | | | Vienna, 4-6 February. Also to be followed-up with | | |
| | | | | ISES to encourage more inputs (Jesse Andries) and | | |
| | | | | at the US SpWx Workshop 20-24 April. Discussion on the actions / focus of the various SpWx | | |
| | | | | groupings: CGMS/SWCG, ISES, IPT-SWeISS, ISWI, | | |
| | | | | etc.— need to ensure that we remain coordinated. | | |
| | | | | Action on Andrew Monham and Terry Onsager to | | |
| | | | | review user survey responses received and clarify | | |
| | | | | open points with respondents on an individual | | |
| | | | | basis (before CGMS-48). | | |
| | | | | | | |
| | | | | 2020 Jan 21 SWCG IS #3: Data User Survey – 11 | | |
| | | | | inputs from BDV (Czech), BOM (Australia), China | | |
| | | | | (NAOC), DLR (Germany), NICT (Japan), NOAA | | |
| | | | | SWPC, Qinetic (UK), SES (Luxemburg), | | |
| | | | | SWIFtS_LAPAN (Indonesia), Met Office MOSWOC | | |
| | | | | (UK), UKRI STFC RAL Space (UK). Various levels of | | |
| | | | | completeness. See attached presentation with | | |
| | | | | summary presented at ESWW. | | |
| | | | | - Will need to contact these institutions | | |
| | | | | individually. | | |
| | | | | - Clearly some issues getting access to reliable / | | |
| | | | | timely in-situ data. | | |
| | | | | 2018 Oct 8, SWCG IS#2 webex: | | |
| | | 1 | | ZUIO UCI O, SWCG IS#Z WEDEX: | | |

| SWCG act | | | nary sessions (CGMS-47 and earlier) | | | |
|---------------|----------|-------------|---|---|---------------------------|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| | | | | - Survey of Space weather service providers (as the primary users of space weather instrument data provided by the CGMS Members) issued on 26 Sep 2019 for completion by 21 Oct 2019. WMO/Balogh has forwarded this further to ISWI. Target is to discuss all survey results data providers and users (service providers) in the meeting scheduled for the ESWW in November 2019. Review meeting of results scheduled for 4 November (Elsayed, Nagatsuma-san, Jussi, Ken and Andrew). | | |
| SWCG | SWCG/8 | A47.07 | Establish a small task group to identify gaps and disconnects from service and perspective of operational space weather communities (e.g. ICAO, ISES, etc.) with objective to report out in Jan 2019 | CGMS-48: Awaiting implementation of recommendations from CGMS-48-SWCG-WP-05 2020 Jan 21 SWCG IS #3: Pending the outcome of SWCG A47.05 and SWCG A47.06 2018 Oct 8, SWCG IS#2 webex: Pending outcome of actions SWCG A47.05 and SWCG A47.06. | CGMS-49 (July 2019) | OPEN |
| SWCG IC TG | SWCG/9 | A47.08 | Space Weather Inter-calibration Task Group members to agree on a specific period of data for validating the inter- calibration approach for high energy particle sensors on-board GEO satellites. | CGMS-48: TG focus on high energy electron data between Apr. 2017- Jun. 2017. See CGMS-48-SWCG-WP-04 2020, 18 Feb: SW IC Task group inter-sessional - outcome? 2020 Jan 21 SWCG IS #3: Nagatsuma-san email of 29 November following satellite data was provided to this task group. - Himawari 8 - FY satellites | Nov 2019 (Jul 2019) | CLOSED |

| SWCG acti | SWCG actions from previous plenary sessions (CGMS-47 and earlier) | | | | | |
|---------------|---|-------------|---|--|--|--------|
| Actionee | AGN item | Action # | Description | Action feedback/closing document | Deadline | Status |
| SWCG IC TG | SWCG/9 | A47.09 | Space Weather Inter-calibration Task Group to produce a "White Paper" with the objective of getting feedback from GSICS on issues faced by CGMS members concerning inter-calibration of high-energy particle sensors, including, how to share data, use of each sensor for space weather products, identified problems and associated estimates of effort. Consider also the inter-calibration issues of other space-based space weather observation. | - Integral IREM Terry Onsager provided info on GOES-16 data on 8 January. 2018 Oct 8, SWCG IS#2 webex: There will be an IC TG teleconference om the period 10-17 Oct 2019 at 12 UTC. CMA and KMA participation is requested. Action due date postponed to November 2019. CGMS-48: Draft White Paper presented. Address feedback in next IC TG session. Discuss next steps with GSICS. 2020 Jan 21 SWCG IS #3: Open (TBC if sufficient progress on the SpWx inter-calibration activity will be made in ime for the GSICS mid-March 2020 meeting). 2018 Oct 8, SWCG IS#2 webex: Due date Feb 2020 to provide input in time for GSICS meeting in March 2020. | Aug 2020 (Feb 2020, Jul 2019) | OPEN |

ANNEX VII: INFORMATION DOCUMENTS – AGENCY STATUS REPORTS

REPORTS ON NEW DEVELOPMENTS AND LONG TERM PLANS BY MEMBERS SINCE CGMS-47

CMA

CGMS-48-CMA-WP-01: Updated report on Feng Yun satellite program and development

China Meteorological Administration (CMA) is operating six FENG YUN satellites now, including four geostationary meteorological satellites and two polar orbiting meteorological satellites. FENG YUN satellites, or FY in acronym, take place in series. The odd number series is the polar-orbiting series, while the even number series is the geostationary. The capital letter in the serial number refers to the seat of a particular satellite in the launching sequence.

In the past year, no new FENG YUN Satellite launched. The current operating LEO satellite system of CMA is the FY-3 series satellites flying on AM and PM orbits. The latest one, FY-3D, launched 15 Nov 2017, is in service since Jan 2019. Observational capability of FY-3D includes VIS, IR and MV imaging, IR and MV atmospheric sounding, greenhouse gas detection, radio occultation sounding, and space weather monitoring.

CMA operates four geostationary meteorological satellites, three FY-2s and one FY-4. FY-2H is the latest one of FY-2 constellation. It is position at 79° especially for Indian Ocean observation.

FY-2F and FY-2G are positioned at 112°E and 99.5°E respectively. FY-2 satellites transmit 5-channel S-VISSR imagery. The second generation of GEO satellite of CMA is FY-4 series. The first unit FY-4A was launched in 11 December 2016. It has much enhanced capability in imaging, it is also designed to have sounding, lightning mapping, and space weather monitoring capabilities.

In 2020, China plans to launch two satellites, FY-3E and FY-4B. FY-3E, which is the first early-morning orbit satellite in China's polar-orbiting meteorological satellite family, is equipped with 11 advanced remote sensing instruments. Its local time at descending node is 5:30. FY-4B is the first operational geostationary satellite in FY4 series. The main observation capabilities are similar to those of FY-4A, with some significant performance improvements.

ESA

CGMS-48-ESA-WP-01: Latest status and developments at ESA since CGMS-47

CGMS is informed of the status of the current European Space Agency Earth Observation missions. Two of them, MSG and MetOp are in co-operation with EUMETSAT. The Gravity field and steady state Ocean Circulation Explorer, GOCE, the first Explorer satellite launched on 17 March 2009, ended its mission in November 2013. The SMOS satellite was launched on 2 November 2009. The CryoSat-2 satellite was launched on 8 April 2010, the Swarm satellites on 22 November 2013, and Aeolus was launched on 21 August 2018.

These Earth Explorer missions currently in orbit (SMOS, CryoSat, Swarm, Aeolus) are all performing extremely well and the related data exploitation is based on continuous data of excellent quality. The

three missions all feature strong elements of international collaboration and a growing synergy between them.

The Proba-V small satellite was launched on 7 May 2013. Its coarse resolution imager has continued the data acquisition of the Vegetation payload on-board SPOT-4 and 5, during the reporting period but from July 2020, Proba-V is no more be considered as a mission providing an operational role, owing to its orbital drift, but will instead be dedicated to experimental activities, with a reduced data acquisition scheme.

CGMS is further informed of the status of the future European Space Agency Earth Observation missions. Two of them, MTG and EPS SG, are in co-operation with EUMETSAT. The Living Planet Programme has three lines of implementation: Earth Explorer satellites, Earth Watch satellites plus services and applications demonstration.

Progress in the preparation of the forthcoming Explorer missions, EarthCARE, BIOMASS, FLEX, and FORUM is described. FORUM was selected on 23-25 September 2019 as Earth Explorer 9, in place of SKIM. FORUM is currently at the middle of Phase B1, spanning over 12 months from 9 October 2019.

The Phase 0 system studies related to Earth Explorer 10 have been kicked between July and September 2019 and are progressing for the three selected Earth Explorer 10 (EE-10) candidate missions, Daedalus, Harmony (formerly STEREOID) and Hydroterra (formerly G-CLASS:H20), with two parallel system studies for each of the missions.

On 25 May 2020, ESA issued a Call for Ideas for Earth Explorer 11. The deadline for submitting the final proposal is 4 December 2020. Earth Explorer 11 is foreseen to be launched in the 2031–2032 timeframe.

Following the decisions taken at Space19+ (ESA's Council at Ministerial Level), activities related to Aeolus Follow-On, Arctic Weather Satellite (AWS), TRUTHS and Altius have been initiated. All those new missions will contribute to improve our understanding of climate change.

Copernicus represents the major new initiative of European efforts in Earth Observation. The first Copernicus dedicated satellite ("Sentinel-1A") was launched on 3 April 2014, followed by Sentinel-2A in June 2015, Sentinel-3A in February 2016, Sentinel-1B in April 2016, Sentinel-2B in April 2017, Sentinel-5P satellite on 13 October 2017 and Sentinel-3B on 25 April 2018; other Sentinels will follow in the coming years. Sentinel missions are developed in partnership with the European Union. The Sentinel-4 and 5 instruments developed by ESA will fly respectively on the MTG-S and Metop-SG missions also developed by ESA in cooperation with EUMETSAT.

Looking to the future, the following six Copernicus high-priority candidate missions (HPCM) are being studied to address EU policy and gaps in Copernicus user needs, and to expand the current capabilities of the Copernicus space component.

CGMS is also informed of the status of the Earth Watch Programme Element, Global Monitoring of Essential Climate Variables (also known as the 'ESA Climate Change Initiative' or CCI). The CCI Programme has continued to progress well. The existing project teams have made significant progress on algorithm development and on specifying a future operational system. The Programme achieved

its Phase 1 objectives end-2013, continued in Phase 2 starting since early 2014 and represents a strong source of ECV data sets for the Copernicus Climate Change Services.

As a general observation, the COVID-19 pandemic has affected several activities related to the procurement of satellites and instruments at different degrees. Thanks to appropriate measures, the impacts on development projects have been mitigated as much as possible, while overall, the operations of ESA satellites currently in orbit and services to users have been kept nominal.

EUMETSAT

CGMS-48-EUMETSAT-WP-01: EUMETSAT report on the status of current and future satellites systems

EUMETSAT currently exploits ten satellites, of which eight are EUMETSAT's own (Meteosat-9 to -11 and Metop-A to -C), with the remaining three in partnership (Sentinel-3A/-3B and Jason-3 missions). Since February 2018, Meteosat-11 provides the 0° service and Meteosat-10 at 9.5°E the 5-minute rapid scanning service. Meteosat-9 is on standby at 3.5°E. Meteosat-8 continues to be operational at 41.5°E to support, on a best effort, the multi-partner service for the continuation of the Indian Ocean Data Coverage (IODC), expected to be reorbited in autumn 2022.

The trident phasing for the 3-Metop (A, B and C) constellation was achieved on 19 February 2020. The second end-of-life test campaigns for Metop-A is ongoing, with deorbiting planned for autumn 2021 at the latest. EUMETSAT continues to support the Jason-3 mission with product distribution.

Regarding future satellites:

The development continues for the Meteosat Third Generation (MTG) satellite system with the operational exploitation expected for the 2022-2042 timeframe. The MTG imagery mission, MTG-I, will provide 10-minute full disc imagery and carries a lightning imager (LI). The MTG sounding mission, MTG-S, will carry a hyperspectral infrared sounder (IRS, temperature, water vapour, profiles for every 30 minutes over Europe) in synergy with the Copernicus Sentinel-4 mission. MTG-I1 and MTG-S1 are now planned for launch in 2022 and 2023 respectively. The LEO EPS-SG programme is under development and will provide a continuation and enhancement of the service from the mid-morning polar orbit in the 2023-2040 timeframe. The space segment is composed of a twin satellite in-orbit configuration with: Metop-SG A: an optical imagery and sounding mission which also will host the Copernicus Sentinel-5 instrument, planned for launch in 2023, and Metop-SG B: a microwave imaging mission, planned for launch in 2024. There will be three successive pairs of satellites with 21 years of operations in the period 2023-2043.

EUMETSAT is preparing the ground segment for the Sentinel-6A/Michael Freilich programme with the satellite scheduled for launch on 10 November 2020, ensuring continuity of the reference ocean altimetry after Jason-3. This satellite will be followed by Sentinel-3C in June 2023, and Sentinel-3D in December 2028.

EUMETSAT addressed CO2 monitoring observations with the need for space-, air-, and in-situ observations together with modelling requirements. EUMETSAT uses Metop's IASI to monitor CH4 and CO.

Preparations are ongoing in EUMETSAT for the evolution of data access and cloud infrastructure.

IMD/ISRO

CGMS-48-IMD-WP-01: IMD Agency Report

At present, two INSAT Meteorological satellites are in operation i.e. INSAT-3D and INSAT-3DR. INSAT-3D is India's advanced weather satellite located at 82°E and was launched on 26 July 2013 and INSAT-3DR was launched on 8 September 2016 and positioned at 74°E. They are dedicated meteorological satellites and carry four payloads: imager (six channels), sounder (19 channels), Data Relay Transponder (DRT) and satellite aided search and rescue (SAS & R). INSAT-3D/3DR has the capability of providing vertical profiles of temperature and humidity, along with several products.

Imager payload of INSAT-3D & INSAT-3DR are used in a staggered mode to achieve 15-minute temporal resolution for getting cloud imaging. An integrated scan strategy of the sounder payload of INSAT-3D & 3DR satellites has been implemented to get data of the Indian region on an hourly basis and the ocean region data every 1.5 hours.

IMD has established the Multi-Mission Meteorological Data Receiving and Processing System (MMDRPS) for INSAT-3D, INSAT-3DR and INSAT-3DS. The system has three dedicated earth stations and a data receiving system. Each Earth station is receiving the data in redundant mode from each payload (Imager, Sounder and DRT) and Raw data archival storage facility. MMDRPS have a very highend processing system which cuts down the processing time from 15 minutes to 7 minutes and has provision to update calibration coefficient in operational chain using Cal/ Val site & GISCS data. System is capable of processing RAPID scan data of INSAT-3DR Imager payload conducted during Extreme weather events. MMDRPS have storage capacity of the order of 2.0/2.0PB (Main/ Mirror) & 324TB SSD which will facilitate online sharing of processed data for all Indian meteorological satellites to the registered users as per IMD data policy. All available past satellite datasets starting from 1983 will be kept in online mode in due course of time. The MMDRPS system has been used to Receive & process the INSAT-3D and INSAT-3DR satellites data since 1st October 2019. IMD has started the generation of two new types of satellite Imageries IR-1 BT Blended & IR-1 BT & Visible Sandwich for monitoring Thunder-storm events. All the sector Images of Visible and SWIR bands are being generated in native resolution (1x1Km) in MMDRPS. IMD has started the generation of these new set of products in MMDRPS: CSBT (Imager & Sounder), CTP/CTT(Imager & Sounder), Cloud Microphysics(Cloud Effective Radius, Cloud Optical Thickness), Potential Evapotranspiration, Actual Evapotranspiration, Net Surface Radiation, Land Surface Albedo, Short Wave Radiation over Ocean, MIR Reflectance, Biomass Burning Emission product, improved IMSRA, Merged wind (INSAT 3D/3DR), 5 day composite winds and high resolution visible winds. The output generated by the system is used for efficient and successful forecasting the major weather events. The satellite data is assimilated in numerical weather prediction models and the outputs are further used to issue short range and medium range weather forecast. INSAT 3DR and new set of products are integrated in both of the dedicated webpages (http://satellite.imd.gov.in/insat.htm & http://satmet.imd.gov.in/insat3d.htm) and RAPID. The webpages are being updated every 15 minutes. These Web sites now being assessed using user Name "guest" and password may be obtained through email from virendra61.singh@imd.gov.in.

INSAT-3DR Imager payload is used to conduct rapid scans during four Tropical Cyclones namely: SuCS Kyarr, ESCS Maha, VSCS Bulbul and VSCS Pawan during June 2019 to May 2020. Each Rapid scan cover up 3 degree in N-S direction (6 Blocks/240 scan lines) in 4.5 minutes. Rapid scan data has been used to track these cyclones in real time basis. The processed data is being disseminated on a dedicated webpage (http://satellite.imd.gov.in/rapid/rapid scan.htm).

JAXA

CGMS-48-JAXA-WP-01: JAXA report on the status of current and future Earth observation program

JAXA operates various kind of satellite sensors and opens the products to the public. We keep developing and improving the products to address the climate issues. The major updates since CGMS-47 is the project team of the Global Observing SATellite for Greenhouse gases and Water cycle (GOSAT-GW), which will carry the GCOM-W follow-on instrument (Advanced Microwave Scanning Radiometer 3; AMSR3) and GOSAT-2 follow-on instrument (Total Anthropogenic and Natural emissions mapping SpectrOmeter-3; TANSO-3), has been organised since December 2019.

In terms of the extremes monitoring, JAXA contributes to the WMO Spacebased Weather and Climate Extremes Monitoring (SWCEM) Project by providing GSMaP rainfall product with climate normal. JAXA plans to improve the algorithm in December 2020 (algorithm version 8). After the release of the version 8, we will reprocess the past 20-year dataset, and re-calculate the climate normal again.

As for the next generation precipitation radar following to the TRMM/PR and GPM/DPR, JAXA is joining the ACCP Architecture Study in U.S. and proposing the advanced Ku-band Precipitation Radar with doppler capability, higher sensitivity and wider swath.

JMA

CGMS-48-JMA-WP-01: JMA report on the status of current and future satellite systems

The Japan Meteorological Agency (JMA) operates two geostationary meteorological satellites, Himawari-8 and -9, equipped with Advanced Himawari Imager (AHI). Himawari-8 has been stably operational since July 2015, and the operation is planned to be taken over by Himawari-9 in 2022.

In FY 2018, JMA has started considering the next geostationary satellite program. JMA will pursue a seamless geostationary satellite system, keeping in mind the CGMS baseline and Vision for WIGOS in 2040.

KMA

CGMS-48-KMA-WP-01: KMA Report on the status of current and future satellite

COMS (128.2ºE) MI is currently operational and data are distributed via landline and satellite over Western Pacific region, and COMS GOCI over East Asian region.

GEO-KOMPSAT-2A (meteorological mission; AMI and KSEM) was launched in 4 December 2018, commissioning during 7 months, and now provide public service since 25 July 2019.

GEO-KOMPSAT-2B (ocean and environmental mission; GOCI II and GEMS) was launched 18 February 2020 and now under the commissioning phase and will provide public service in the 2nd half of 2020.

*COMS: Communication, Ocean and Meteorological Satellite

*AMI: Advanced Meteorological Imager

*KSEM: Korean Space wEather Monitor

*GOCI: Geostationary Ocean Colour Imager

*GEMS: Geostationary Environment Monitoring Spectrometer

NASA

CGMS-48-NASA-WP-01: NASA report on the status of current and future Earth satellite systems

The National Aeronautics and Space Administration (NASA) continues to provide operational support for twenty-one Earth-observing satellites. Guided in its efforts by the recommendations of the decadal survey, Thriving on our Changing Planet, NASA's Earth Science Division (ESD) continues to execute a balanced and robust program of technology development, research, and application.

During the past year, data newly released by ESD included those acquired by the Ice, Cloud, and Land Elevation (ICESat-2) satellite, ECOsystem Spaceborne Thermal Radiometer Experiment (ECOSTRESS), Global Ecosystems Dynamics Investigation (GEDI), and the Orbiting Carbon Observatory-3 (OCO-3).

The division decommissioned the Jason-2/Ocean Surface Topography Mission (OSTM) and Solar Radiation and Climate Experiment (SORCE) after operating them successfully for eleven and seventeen years respectively.

The Commercial Smallsat Data Acquisition Program (CSDAP) completed the evaluation of data acquired from three private sector vendors—Planet, Maxar, and Spire Global. The evaluation focussed on the usefulness of data for NASA research and applications. The program released a solicitation to enable research aimed at sustained use of imagery from private sector providers.

A number of Earth-observing missions are undergoing the Senior Review process, where Earth Science missions that have completed their prime mission seek to extend their operations. NASA invited thirteen missions to submit proposals to the 2020 Senior Review. The review committee has reviewed the proposals, and expects to release its final report in August 2020.

NOAA

CGMS-48-NOAA-WP-01: Status of current and future programs - report to CGMS-48

This document summarises the status of NOAA current and future LEO and GEO satellite systems.

NOAA currently operates four geostationary satellites, two of which are operational on behalf of NOAA. GOES-16 provides service at 75.2°W as GOES East, and GOES-17 provides service at 137.2°W as GOES West. While all GOES East operations are nominal, GOES West had an Advanced Baseline Instrument (ABI) performance issue due to the instrument's cooling system; however, following

efforts to optimize the performance of the GOES-17 data, the instrument is currently delivering 98 percent of the data. GOES-14 (105° W) and GOES-15 (128°W) serve as standby spacecraft with all GOES-14 instruments operating nominally, while for GOES-15 a yaw-flip maneuver is required at equinox to mitigate Sounder temperature control blanket anomaly, and it is operating with a single star tracker. The GOES-15 SXI and XRS are backup instruments for the Space Weather Prediction Center (SWPC). GOES-13 was transitioned to the U.S. Air Force and will be operated by NOAA on their behalf as the Electro-Optical/Infrared (EO/IR) Weather System (EWS-G).

NOAA operates six low earth operating (LEO) satellites. NOAA's primary afternoon operational spacecraft, NOAA-20, is operating within specifications. NOAA's previous primary satellite, NOAA-19, remains the primary afternoon satellite only for services such as SARSAT and the Argos Data Collection System (DCS). Two secondary spacecraft, NOAA-18 and NOAA-15 provide additional payload data. NOAA-18's instruments are mostly fully operational, though the Solar Backscatter Ultraviolet Instrument (SBUV/2), Microwave Humidity Sounder (MHS) and High-resolution Infrared Radiation Sounder (HIRS) are inoperative. SAR and Argos DCS payloads are both fully functional. Most of the instruments on NOAA-15 are operating in a degraded mode, with the HIRS and Advance Microwave Sounding (AMSU) B non-operational, the SAR instrument operations degraded, and the Space Environment Monitor (SEM), AMSU-A2 and Argos DCS remaining fully operational. The Suomi National Polar-orbiting Partnership (S-NPP) vehicle and instruments are all operating within specifications. In addition, NOAA operates two satellites on behalf of the U.S. Military: DMSP-18 for which all primary instruments are fully functional with some degradation of secondary SSMIS, SSI-ES2/3, and SSULI instruments; and DMSP-17 for which all primary instruments are functional with some degradation secondary instruments SSMIS, SSI-ES2/3, and SSUSI instruments, and a non-operational SSULI instrument.

Jason-2, ended on 1st October 2019 following a joint termination decision made by the four mission partners (NASA, CNES, NOAA, and EUMETSAT).

The six COSMIC-2 spacecraft, a joint U.S.-Taiwan satellite mission being conducted under an agreement between the American Institute in Taiwan (AIT) and the Taipei Economic and Cultural Representative Office in the United States (TECRO), have completed initial checkout and are scheduled to achieve their evenly spaced mission orbit by February 2021.

NOAA's DSCOVR mission, which monitors solar wind activity from L1, is operational with all instruments operating as intended.

Regarding future satellites:

NOAA's GOES-R series is a four-satellite program (GOES-R/S/T/U) extending the availability of the operational GOES satellite system through 2036. Work on GOES-T and GOES-U continues with respective launches planned for

NOAA's Polar Follow-On Missions, JPSS-3 and JPSS-4, were approved in 2016 to extend JPSS' capabilities to at least 2038. Each satellite will be launched approximately every 5 years with a design life of 7 years.

Also, NOAA is managing the integration, launch, and operation of an Argos Data Collection System (Argos-4) instrument, provided under international agreement with the French space agency Centre National d'Etudes Spatiales (CNES), utilizing the US Air Force Hosted Payload Solution (HoPS) contract to provide a commercial payload hosting solution for the Argos-4 instrument in 2021.

In addition, NOAA is planning a Space Weather Follow On (SWFO) program, which is comprised of two projects: a Compact Coronograph (CCOR) on the GOES U spacecraft and the the Space Weather Follow-On L1 mission (SWFO-L1) planned for launch in 2024.

Moreover, NOAA is evolving its data access and data distribution processes to the cloud. NOAA's Data Agnostic Common Services (DACS) will include the Operational Secure Ingest System (OSIS) for NOAA's ingest of data from partner agencies and NOAA's Big Data Project will eventually replace our PDA system for data distribution.

ROSHYDROMET/ROSCOSMOS

CGMS-48-ROSHYDROMET-WP-05: Report on the status of current and future Russian satellite systems

This document addresses the current status of the Russian satellite systems: Meteor-M N2, N2-2 polar-orbiting meteorological satellites (launched on July 8th, 2014 and July 5th, 2019) and Electro-L N2, N3 geostationary meteorological satellites (launched on December 11th, 2015, December 24th, 2019).

Future Russian geostationary meteorological constellation will consist of three Electro-L series satellites. The satellites are to be placed at 14,5W, 76E and 166E orbital positions. The mission objectives, payload and ground segment details are presented. Working paper provides an overview of future Meteor-3M polar-orbiting satellite system, which will comprise of four meteorological satellites; the next generation series of Meteor-MP satellites is briefly described.

Arctica-M constellation of highly elliptical orbit satellites is to be deployed in 2020-2025. The system will consist of four spacecrafts. These satellites will provide continuous observations over the Arctic region. An overview of the mission objectives, payload and ground segment details is presented.

ANNEX VIII: LIST OF PARTICIPANTS

| CGMS-48 – Plenary Session - List of Participants | | | | |
|--|-------------|-------------|--|--|
| Organisation | Last name | First name | | |
| CGMS Secretariat | Betencourt | Joana | | |
| CGMS Secretariat | Counet | Paul | | |
| CGMS Secretariat | Miechurska | Sylwia | | |
| CGMS Secretariat | Ratier | Alain | | |
| CGMS Secretariat | Rattenborg | Mikael | | |
| CGMS Secretariat | Taube | Anne | | |
| CMA | GUAN | Min | | |
| CMA | GUO | Qiang | | |
| CMA | LIN | Weixia | | |
| CMA | LU | Qifeng | | |
| CMA | WU | Xuebao | | |
| CMA | XU | Wanzhi | | |
| CMA | ZHANG | Peng | | |
| CMA/NSMC | GUO | Jianguang | | |
| CMA/NSMC | LIU | Weiyi | | |
| CMA/NSMC | QI | Chengli | | |
| CMA/NSMC | QIN | Danyu | | |
| CMA/NSMC | XIAN | Di | | |
| CMA/NSMC | XIE | Lizi | | |
| CMA/NSMC | XU | Zhe | | |
| CMA/NSMC | XU | Na | | |
| CMA/NSMC | YIN | Honggang | | |
| CMA/NSMC | ZHANG | Xingying | | |
| CNES | Deniel | Carole | | |
| CNES | Tabary | Pierre | | |
| EC | Dowell | Mark | | |
| ECMWF | McNally | Tony | | |
| ESA/ESRIN | Petiteville | Ivan | | |
| EUMETSAT | Bojinski | Stephan | | |
| EUMETSAT | Burns | Sean | | |
| EUMETSAT | Coppens | Dorothee | | |
| EUMETSAT | Higgins | Mark | | |
| EUMETSAT | Holmlund | Kenneth | | |
| EUMETSAT | Husband | Robert | | |
| EUMETSAT | Linow | Stefanie | | |
| EUMETSAT | Mastroddi | Livio | | |
| EUMETSAT | Monham | Andrew | | |
| EUMETSAT | Obligis | Estelle | | |
| EUMETSAT | Renner | Klaus-Peter | | |

| CGMS-48 – Plenary Session - List of Participants | | | |
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| Organisation | Last name | First name | |
| EUMETSAT | Schulz | Joerg | |
| EUMETSAT | Simon | Elliott | |
| EUMETSAT | Venn | Rachel | |
| EUMETSAT OSI SAF/KNMI | Stoffelen | Ad | |
| IMD | Goyal | Suman | |
| IMD | Mitra | Ashim Kumar | |
| IMD | Mohopatra | Mrutyunjay | |
| IMD | Singh | Virendra | |
| IMD/NCMRWF | Vijapurapu | Srinivasa Prasad | |
| IROWG | Foelsche | Ulrich | |
| ISRO | Dube | Nitant | |
| ISRO | Kumar | Raj | |
| ISRO | Pant | Tarun | |
| ISRO | Srinivasa Rao | Goru | |
| ISRO | Varma | Atul | |
| IWWG | Borde | Regis | |
| JAXA | Hirabayashi | Takeshi | |
| JAXA | Kachi | Misako | |
| JAXA | Kubota | Takuji | |
| JAXA | Kurino | Toshiyuki | |
| JAXA | Kuze | Akihiko | |
| JAXA | Ochiai | Osamu | |
| JAXA | Oki | Riko | |
| JAXA | Tsuruma | Hitoshi | |
| JAXA | Umezawa | Kazuo | |
| JAXA | Yamaji | Moeka | |
| JMA | Akaishi | Kazuhide | |
| JMA | Bessho | Kotaro | |
| JMA | Hasegawa | Masaki | |
| JMA | Hokase | Yasutaka | |
| JMA | Murata | Hidehiko | |
| JMA | Okamoto | Kozo | |
| JMA | Omori | Shiro | |
| JMA | Owada | Hiromi | |
| JMA | Sakashita | Takuya | |
| JMA | Sato | Yoshiaki | |
| JMA | Takahashi | Masaya | |
| JMA | Yamada | Kazutaka | |
| JMA | Yamamoto | Mikito | |
| JMA | Yokota | Hironobu | |
| JMA | Yoshida | Ryo | |

| CGMS-48 – Plenary Session - Lis | t of Participants | |
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| КМА | Kim | Jiyoung |
| КМА | Kim | Dohyeong |
| КМА | Yi | Wonhyeong |
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| NASA | Kaye | Jack |
| NASA | Olonoff | Molly |
| NASA | Skofronick-Jackson | Gail |
| NASA | Viongradova-Shiffer | Nadya |
| NICT | Nagatsuma | Tsutomu |
| NOAA | Backus | Beau |
| NOAA | Goldberg | Mitch |
| NOAA | Griffin | Vanessa L. |
| NOAA | Kutny | Mary Ann |
| NOAA | Leonard | Scott |
| NOAA | Mehta | Ajay |
| NOAA | Privette | Jeff |
| NOAA | Renkevens | Thomas |
| NOAA | Talaat | Elsayed |
| NOAA | Volz | Stephen M. |
| NOAA | Walsh | Tim |
| NOAA | Wooldridge | Charles |
| NOAA | LIN | Haidao |
| NOAA | Cuff | Thomas |
| NOAA | Schrab | Kevin |
| NOAA | Lindsey | Dan |
| NSOAS | AN | Wentao |
| Roshydromet | Litovchenko | Konstantin |
| ROSCOSMOS | Trofimov | Dmitry |
| SRC "Planeta" | Andreeva | Zoya |
| SRC "Planeta" | Asmus | Vasily |
| SRC "Planeta" | Rublev | Alexei |
| SRC "Planeta" | Uspenskyi | Sergey |
| SRC "Planeta" | Uspenskyi | Alexander |
| WMO | Balogh | Werner |
| WMO | HE | Guangxin |
| WMO | Heikki | Pohjola |
| WMO | Rea | Anthony |
| WMO | Riishojgaard | Lars Peter |
| WMO | Rixen | Michel |

| CGMS-48 - WGI List of Participants | | | | |
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| CGMS Secretariat | Rattenborg | Mikael | | |
| CGMS Secretariat | Taube | Anne | | |
| СМА | Lin | Weixia | | |
| CMA | Wu | Xuebao | | |
| CMA | Xian | Di | | |
| CMA | Xie | Lizi | | |
| CMA | Yang | Lei | | |
| EUMETSAT | Burns | Sean | | |
| EUMETSAT | Coyne | Nicholas | | |
| EUMETSAT | Dreis | Markus | | |
| EUMETSAT | Elliott | Simon | | |
| EUMETSAT | Holmlund | Kenneth | | |
| EUMETSAT | Lee | Daniel | | |
| EUMETSAT | Mastroddi | Livio | | |
| EUMETSAT | Nikolova | Karolina | | |
| EUMETSAT | Renner | Klaus-Peter | | |
| EUMETSAT | Soerensen | Anders | | |
| IMD | Balakrishnan | Shibin | | |
| IMD | Mitra | Ashim | | |
| IMD/NCMRWF | Vijapurapu | Srinivasa Prasad | | |
| ISRO | PV | Kumaramohan | | |
| JMA | Bessho | Kotaro | | |
| JMA | Hokase | Yasutaka | | |
| JMA | Kitajima | Toshiyuki | | |
| JMA | Moriya | Masami | | |
| JMA | Owada | Hiromi | | |
| JMA | Sakashita | Takuya | | |
| JMA | Takahashi | Masaya | | |
| JMA | Umekubo | Takashi | | |
| JMA | Yamamoto | Mikito | | |
| JMA | Yokota | Hironobu | | |
| JMA | Yoshida | Ryo | | |
| JMA | Yamada | Kazutaka | | |
| KMA | Kim | | | |
| KMA | Shin | Dong-kee | | |
| KMA | Oh | Hyunjong | | |
| NASA | Eckman | Richard | | |
| NOAA | Antoine | Richard | | |
| NOAA | Backus | Beau | | |

| CGMS-48 - WGI List of Participants | | | |
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| Organisation | Last name | First name | |
| NOAA | Donoho | Natalia | |
| NOAA | Griffin | Vanessa | |
| NOAA | Kutny | Mary Ann | |
| NOAA | McNitt | James | |
| NOAA | Mistichelli | Alfredo | |
| NOAA | Paquette | John | |
| NOAA | Turner | Mark | |
| NOAA (Alion Science and | | | |
| Technology) | Wagner | Benjamin | |
| ROSHYDROMET | Ryzhkova | Olga | |
| ROSHYDROMET/SRC Planeta | Uspensky | Sergey | |
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| CGMS-48 - WGII List of Participants | | | |
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| Organisation | Last name | First name | |
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| CGMS Secretariat | Miechurska | Sylwia | |
| СМА | Guo | Jianguang | |
| СМА | Kang | Hejung | |
| CMA | Lei | Yang | |
| CMA | Li | Xiaoqing | |
| CMA | Li | Во | |
| CMA | Li | Xiaoqing | |
| CMA | Xu | Na | |
| CMA | Zhang | Xiaohu | |
| CMA/NSMC | Sun | Ling | |
| CMA/NSMC | Wu | Xuebao | |
| CMA/NSMC | Xu | Na | |
| CMA/NSMC | You | Ran | |
| CMA/NSMC | Zhang | Peng | |
| CMA/NSMC | Zhang | Xiaohu | |
| EC | Dowell | Mark | |
| ECMWF/WMO | Duncan | David | |
| ESA | Mecklenburg | Susanne | |
| ESA | Petiteville | Ivan | |
| ESA | Rio | Marie-Helene | |
| ESA | Straume-Lindner | Anne Grete | |
| EUMETSAT | Holmlund | Kenneth | |
| EUMETSAT | Husband | Robert | |
| EUMETSAT | Joro | Sauli | |
| EUMETSAT | Marquard | Christian | |
| ICWG | Heidinger | Andrew | |
| ICWG | Karlsson | Karl-Göran | |
| IMD | Balakrishnan | Shibin | |
| IMD | Giri | Ram Kumar | |
| IMD | Kumar | Amit | |
| IMD | Lal F | Vigin | |
| IMD | Mitra | Ashim | |
| IMD | Mohanty | Manorama | |
| IMD | Ramashray | Yadav | |
| IMD | Singh | Virendra | |
| IMD | Yadav | Ramashray | |
| IPWG | Ferraro | Ralph | |
| IROWG | Foelsche | Ulrich | |
| IROWG | Mannucci | Anthony | |
| ISRO | Kumar | Raj | |

| CGMS-48 - WGII List of Participants | | | |
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| Organisation | Last name | First name | |
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| ISRO | Singh | Raghavendra | |
| ISRO | Thapliyal | Pradeep | |
| ISWG | Ruston | Benjamin | |
| ITWG | Gumley | Liam | |
| IWWG | Borde | Regis | |
| IWWG | Daniels | Jaime | |
| IWWG | Wanzong | Steve | |
| JAXA | Kachi | Misako | |
| JAXA | Kubota | Takuji | |
| JAXA | Kurino | Toshiyuki | |
| JAXA | Ochiai | Osamu | |
| JAXA | Oki | Riko | |
| JAXA | Yamaji | Moeka | |
| JMA | Inazawa | Tomoyuki | |
| JMA | Kitajima | Toshiyuki | |
| JMA | Maruyama | Takumi | |
| JMA | Mouri | Kouki | |
| JMA | Omori | Shiro | |
| JMA | Owada | Hiromi | |
| JMA | Sasaki | Masayuki | |
| JMA | Shiraishi | Shun | |
| JMA | Suzue | Hiroshi | |
| JMA | Yoshida | Ryo | |
| JMA | Okuyama | Arata | |
| JMA | Shimoji | Kazuki | |
| JMA | Takeuchi | Yoshiaki | |
| JMA | Yamada | Kazutaka | |
| JMA | Yoshizaki | Yoshito | |
| JWGCLIM | Schulz | Jörg | |
| KMA | Chung | Sung-Rae | |
| KMA | Kim | Dohyeong | |
| KMA | Lee | Soobong | |
| KMA | Ryu | Geun-Hyeok | |
| KMA | Yi | Wonhyeong | |
| NASA | Doorn | Bradley | |
| NASA | Kaye | Jack | |
| NASA | Khan | Maudood | |
| NASA | McCorkel | Joel | |
| NASA | Eckman | Richard | |
| NICT | Nagatsuma | Tsutomu | |

| CGMS-48 - WGII List of Participants | | | | |
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| Organisation | Last name | First name | | |
| NOAA | Chang | Paul | | |
| NOAA | Goldberg | Mitch | | |
| NOAA | Kutny | Mary Ann | | |
| NOAA | Lin | Haidao | | |
| NOAA | Mangin | Joseph | | |
| NOAA | Mehta | Ajay | | |
| NOAA | Pavolonis | Michael | | |
| NOAA | Privette | Jeff | | |
| NOAA | Schrab | Kevin | | |
| NOAA | Talaat | Elsayed | | |
| NOAA | Weygandt | Steve | | |
| NSOAS | Lu | Yunfei | | |
| ROSHYDROMET | Litovchenko | Konstantin | | |
| ROSHYDROMET | Nikolaev | Petr | | |
| ROSHYDROMET/SRC Planeta | Andreeva | Zoya | | |
| ROSHYDROMET/SRC Planeta | Uspensky | Alexander | | |
| WMO | Balogh | Werner | | |
| WMO | Brock | Greg | | |
| WMO | Dordevic | Milica | | |
| WMO | Не | Guangxin | | |
| WMO | Stefanski | Robert | | |
| WMO | Tarasova | Oksana | | |
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| CGMS Secretariat | Rattenborg | Mikael | |
| CGMS Secretariat | Taube | Anne | |
| CMA | Guan | Min | |
| CMA | Hu | Xiuqing | |
| CMA | Wu | Xuebao | |
| CMA | Xian | Di | |
| CMA | Zhang | Peng | |
| ESA | Luntama | Juha-Pekka | |
| ESA | Petiteville | Ivan | |
| EUMETSAT | Burns | Sean | |
| EUMETSAT | Elliot | Simon | |
| EUMETSAT | Holmlund | Kenneth | |
| EUMETSAT | Mastroddi | Livio | |
| EUMETSAT | Monham | Andrew | |
| EUMETSAT | Renner | Klaus-Peter | |
| EUMETSAT | Soerensen | Anders | |
| IMD | Biswas | Habibur Rahaman | |
| IMD | Giri | Ram Kumar | |
| IMD | Mitra | Ashim | |
| IMD | Singh | Virendra | |
| IMD | Yadav | Ramashray | |
| IMD | Vijapurapu | Srinivasa Prasad | |
| ISRO | Kumar | Raj | |
| ISRO | Pant | Tarun | |
| ISRO | Srinivasa Rao | Goru | |
| ISRO | Thapliyal | Pradeep | |
| JAXA | Kubota | Takuji | |
| JAXA | Kurino | Toshiyuki | |
| JAXA | Ochiai | Osamu | |
| JAXA | Oki | Riko | |
| JAXA | Yamaji | Moeka | |
| JMA | Bessho | Kotaro | |
| JMA | Date | Kenji | |
| JMA | Owada | Hiromi | |
| JMA | Sakashita | Takuya | |
| JMA | Takahashi | Masaya | |
| JMA | Yamamoto | Mikito | |
| JMA | Yokota | Hironobu | |
| JMA | Yoshida | Ryo | |

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| КМА | Kim | Jiyoung | |
| КМА | Shin | Dong-kee | |
| КМА | Yi | Wonhyeong | |
| NASA | Spann | Jim | |
| NICT | Nagatsuma | Tsutomu | |
| NOAA | Backus | Beau | |
| NOAA | Donoho | Natalia | |
| NOAA | Griffin | Vanessa | |
| NOAA | Kutny | Mary Ann | |
| NOAA | Mangin | Joseph | |
| NOAA | Mehta | Ajay | |
| NOAA | Shontz | Kathryn | |
| NOAA | Talaat | Elsayed | |
| NOAA | Weygandt | Steve | |
| NOAA | Wooldridge | Charles | |
| NSOAS | An | Wentao | |
| NSOAS | Lin | Minseng | |
| NSOAS | Lu | Yunfei | |
| ROSHYDROMET | Nikolaev | Petr | |
| ROSHYDROMET/SRC Planeta | Uspensky | Sergey | |
| WMO | Не | Guangxin | |
| WMO | Peng | Taoyoung | |
| WMO | Pohjola | Heikki | |
| WMO | Pohjola | Heikki | |
| WMO | Riishojgaard | Lars Peter | |
| WMO/WCRP | Rixen | Michel | |

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| CGMS Secretariat | Taube | Anne | |
| CMA | Guo | Jianguang | |
| CMA | Hu | Xiuqing | |
| CMA | Wu | Xuebao | |
| CMA | Xian | Di | |
| CMA | Xu | Zhe | |
| CMA | Zhang | Xiaoxin | |
| ESA | Petiteville | Ivan | |
| EUMETSAT | Aubert | Guillaume | |
| EUMETSAT | Burns | Sean | |
| EUMETSAT | Elliott | Simon | |
| EUMETSAT | Higgins | Mark | |
| EUMETSAT | Holmlund | Kenneth | |
| EUMETSAT | Monham | Andrew | |
| EUMETSAT | Renner | Klaus-Peter | |
| EUMETSAT | Texier | Guillaume | |
| IMD | Balakrishnan | Shibin | |
| IMD | Das | Sunit | |
| IMD | Giri | Ram Kumar | |
| IMD | Singh | Virendra | |
| IMD/NCMRWF | Vijapurapu | Srinivasa Prasad | |
| ISES/Royal Observatory of Belgium | Andries | Jesse | |
| ISRO | Dube | Nitant | |
| ISRO | Kumar | Raj | |
| ISRO | Tyagi | Utkarsh | |
| JMA | Akaishi | Kazuhide | |
| JMA | Bessho | Kotaro | |
| JMA | Hokase | Yasutaka | |
| JMA | Owada | Hiromi | |
| JMA | Sakashita | Takuya | |
| JMA | Sasaki | Masayuki | |
| JMA | Takahashi | Masaya | |
| JMA | Yamamoto | Mikito | |
| JMA | Yokota | Hironobu | |
| JMA | Yoshida | Ryo | |
| JMA | Shimoji | Kazuki | |
| KMA | Kim | Jiyoung | |
| KMA | Shin | Dong-kee | |
| NASA | Eckman | Richard | |

| CGMS-48 - WGIV List of Participants | | |
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| Organisation | Lastname | Firstname |
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| NOAA | Backus | Beau |
| NOAA | Donoho | Natalia |
| NOAA | Gordon | Brent |
| NOAA | Griffin | Vanessa |
| NOAA | Jankot | Josh |
| NOAA | Kutny | Mary Ann |
| NOAA | O'Connors | Chris |
| NOAA | Paquette | John |
| NOAA | Talaat | Elsayed |
| NOAA | Taylor | Jason |
| NOAA | Turner | Mark |
| NOAA | Young | Alisa |
| NSOAS | Lan | Youguo |
| ROSHYDROMET/SRC Planeta | Uspensky | Sergey |
| WMO | Chen | Xiaoxia |
| WMO | HE | Guangxin |
| WMO | Milan | Anna |
| WMO | Peng | Taoyoung |
| WMO | Pohjola | Heikki |
| WMO | Rea | Anthony |
| WMO/WCRP | Rixen | Michel |

| CGMS-48 - SWCG List of Participants | | |
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| Organisation | Lastname | Firstname |
| CGMS Secretariat | Andrieux | Anne-Marie |
| CGMS Secretariat | Betencourt | Joana |
| CGMS Secretariat | Rattenborg | Mikael |
| CGMS Secretariat | Taube | Anne |
| CMA | Guo | Jianguang |
| ESA | Luntama | Juha-Pekka |
| EUMETSAT | Holmlund | Kenneth |
| EUMETSAT | Monham | Andrew |
| EUMETSAT | Williams | Mike |
| ICAO | Romero | Raul |
| ISES/Royal Observatory of Belgium | Andries | Jesse |
| ISRO | Kumar | Tarun |
| ISRO | Pant | Tarun |
| JMA | Owada | Hiromi |
| JMA | Takahashi | Masaya |
| JMA | Yamamoto | Mikito |
| JMA | Shimoji | Kazuki |
| кма | Kim | Dohyeong |
| кма | Yi | Wonhyenong |
| кма | Oh | Daehyeon |
| NASA | Spann | James |
| NICT | Nagatsuma | Tsutomu |
| NOAA | Gordon | Brent |
| NOAA | Mehta | Ajay |
| NOAA | Talaat | Elsayed |
| ROSHYDROMET | Kholodkov | Kirill |
| ROSHYDROMET | Litovchenko | Konstantin |
| WMO | Balogh | Werner |
| WMO | Не | Guangxin |
| WMO | Peng | Tayong |
| WMO | Pohjola | Heikki |
| WMO/WCRP | Rixen | Michel |



GENERAL CGMS INFORMATION

CGMS Agenda and Working Papers

The agenda and Working Papers (WPs) are available at:

https://www.cgms-info.org/agendas/agendas/CGMS-48

List of actions and recommendations

The list of actions and recommendations are kept on the related plenary session web page (see e.g. https://www.cgms-info.org/index_.php/cgms/meeting-detail/cgms-47).

CGMS members, observers and relevant actionees are requested to provide feedback as necessary to the CGMS Secretariat (CGMSSec@eumetsat.int), and when preparing Working Papers to refer to relevant actions and recommendations if needed.

CGMS List Servers

There are currently six CGMS list servers for plenary, WGs I-IV and SWCG respectively. Information on points of contact and list servers is available upon request from the CGMS Secretariat at CGMSSec@eumetsat.int.

CGMS Charter, members and observers

Other information such as the CGMS Charter and the current list of members and observers are available at http://www.cgms-info.org/index .php/cgms/page?cat=ABOUT&page=INDEX.

General enquiries

Please contact the CGMS Secretariat at CGMSSec@eumetsat.int in case of any enquiries related to CGMS.





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