REPORT OF THE 50TH MEETING OF

The Coordination Group For Meteorological Satellites

50 YEARS 1972–2022

CGMS

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REPORT OF THE 50TH PLENARY SESSION OF THE COORDINATION GROUP FOR METEOROLOGICAL SATELLITES

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PLENARY SESSION

1. OPENING SESSION

Welcome and opening remarks, CGMS flag hand-over ceremony

Prof. Petteri Taalas, WMO Secretary-General and host, welcomed all participants to the 50th plenary session and anniversary of the CGMS (CGMS-50-CGMS-WP-22) , noting the importance of the CGMS activities and welcoming the opportunity of WMO, as a CGMS member, to host this anniversary event. This meeting provides an excellent opportunity to strengthen the interactions between WMO and the operational space agencies, with mutual benefits.

He referred to the World Economic Forum, where climate change and extreme weather have been recorded as the first two biggest risks for the global economy in the next decade. He noted that CGMS is a key contributor to the WMO Integrated Global Observing System's space component, and in particular the provision of the three backbone polar orbiting satellite planes (early morning, mid-morning and afternoon) and the provision of the full geostationary meteorological satellite ring. The coordination through the CGMS with WMO and the WIGOS Vision has enabled a number of other contributions ranging from provision of data and products for a vast range of applications, to frequency coordination, training, GHG/carbon monitoring and new capabilities and responses to NWP requirements. He noted the early warning/climate adaptation initiative for COP-27 to be led by the WMO, and recalled the associated and recently created Systematic Observation Financing Facility (SOFF).

The Head of the CGMS Secretariat, Mr Phil Evans (EUMETSAT), welcomed all participants to the 50th plenary session of the CGMS.

Concluding the session, and following two years of virtual meetings CMA, the CGMS-49 host, handed over the CGMS flag to WMO.

2. NEW DEVELOPMENTS AND LONG TERM PLANS BY CGMS SPACE AGENCY MEMBERS SINCE CGMS-49

Main developments since CGMS-49 and an outlook for the future

CGMS-50-CMA-WP-01: CMA updates since CGMS-50 and report on the medium to long-term future plans (J. WANG, virtually)

The CMA FENGYUN Meteorological Satellite Program includes both geostationary and polar orbit satellite missions. The FENGYUN (FY) satellites consisting of the odd numbered series of polar-orbiting satellites, and the even numbered geostationary satellites. The capital letter after the serial number refers to the order of a particular satellite in the launch sequence.

FY-4B, CMA's first operational new generation geostationary satellite, was launched on 3 June 2021. FY-3E, the first early-morning orbit satellite in China's polar-orbiting meteorological satellite family was launched on 5 July 2021. The FY-3E data are available for trial mode applications from the CMA NSMC portal since 1 June 2022.

Currently, five FY satellites are operational on-orbit, including two polar orbit satellites and three geostationary satellites. FY-3E and FY-4B are in trial operation since 1 June 2022.

The CMA National Center for Space Weather celebrated its 20th anniversary in 2022, continuing the CMA Space Weather activities.

CGMS-50-CNSA-WP-01: CNSA updates since CGMS-50 and report on the medium to long-term future plans

CNSA presented the status of its satellite programmes. CNSA has launched the following satellites since CGMS-49:

- HY-2D ocean dynamics satellite, launched 19 May 2021
- FY-4B, GEO-meteorological satellite, launched 2 June 2021
- FY-3E, EM-orbit meteorological satellite, launched 5 July 2021
- GF-5-02, atmospheric composition and land observation satellite, launched 20 Dec 2021
- ZY1-02E, optical land resource satellite, launched 26 Dec 2021
- LT-1 A/B L-band SAR satellite, launched in Jan/Feb 2022
- GF-3 02/03 C-Band SAR satellite, launched in Nov 2021 and April 2022
- DQ-1 Atmospheric Environment Monitoring satellite, launched in April 2022

In June 2019, CNSA joined the CNES-initiated Space Climate Observatory (SCO). CNSA has so far submitted 13 projects to SCO. In 2021, SCO China Office joined the Charter drafting group and has contributed to the preparation of the Charter with CNES and UNOOSA colleagues, which will be previewed in June 2022.

The China Earth Observation Strategy covers satellites for:

Land Observation

- High Resolution Optical Satellite
- Medium Resolution Optical Satellite
- SAR Satellite

Ocean Observation

- Ocean Colour Satellite
- Marine Dynamics Satellite
- Costal Environment Monitoring Satellite

Weather Observations

- Weather Satellite
- Climate Satellite
- Atmospheric Composition Satellite

Earth Science

- Seismo-Electromagnetic Satellite

In January2022 the Chinese Government released a White Paper on Space: "China's Space Program: a 2021 Perspective", http://www.cnsa.gov.cn/english/n6465652/n6465653/c6813088/content.html.

In April 2022, CNSA released "Interim Provisions for the International Cooperation on National Civil Remote Sensing Satellites Data".

CGMS-50-EUMETSAT-WP-14: EUMETSAT updates since CGMS-50 and report on the medium to long-term future plans (P. Evans)

In the period, EUMETSAT has updated its strategy "Destination 2030 – From resource mobilisation, development and risk management, to delivery, innovation and preparation for the future". This new strategy focuses on: delivery of new programmes; continuity of services; development of new opportunities: new space, big data, AI/ML, partnerships in Europe and globally, and to keep a modern and gender-balanced organisation.

EUMETSAT currently exploits ten satellites of which six are EUMETSAT's own (Meteosat-8 to -11 and MetOp-B and MetOp-C with the remaining in partnership (Sentinel-3A/-3B and Jason-3 and Sentinel-6A/Michael Freilich 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 now located at 45.5°E, will take over from Meteosat-8 at 41.5°E, the support, on a best effort, the multi-partner service for the continuation of the Indian Ocean Data Coverage (IODC). Launched on 19 October 2006, the deorbiting and end-of-life operations of MetOp-A took place between November and December 2021. Dual-MetOp operations with MetOp-B and MetOp-C are planned to continue up until 2027.

Regarding future satellites: The development continues for the Meteosat Third Generation (MTG) satellite system with the operational exploitation expected for the 2023-2040s 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, and water vapour, with profiles for every 30 minutes over Europe in synergy with the Copernicus Sentinel-4 mission. MTG-I1 launch is now planned for November 2022 and MTG-S1 planned for launch in 2023.

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 2024-2040s 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 for launch in 2024 and MetOp-SG

B: a microwave imaging mission, planned for launch in 2025. There will be three successive pairs of satellites with 21 years of operations.

EUMETSAT is also preparing for the operation of Sentinel-3C and-3D in 2023 and 2028, for the continuity of the reference ocean altimetry observations. EUMETSAT will also support CNES's MicroCarb mission planned for launch in the 2023 timeframe, a precursor to a European CO2 and GHG monitoring mission CO2M.

The continuation of oceanography missions has now been agreed with the European Commission and ESA with the Sentinel-3 NG Topo, Sentinel-3 NG OPT and Sentinel-6 NG operations. Additionally, the ground segment development, operations, data processing and products dissemination of the future Copernicus C02M mission and the global data processing and products dissemination of future CIMR and CRISTAL missions. Discussions are ongoing at a European level for an Arctic Weather Satellite, and a follow-on Aeolus mission potentially for the next decade.

New data access mechanisms are becoming operational to deliver the increased volume of data expected from the new satellites systems including 'pull services': the EUMETSAT Data Store, EUMETView, and a data customisation tool, the Data Tailor. EUMETSAT is also participating, along with ECMWF and the National Meteorological Services of their respective Member States, in the European Weather Cloud, which will deliver data access and cloud-based processing capabilities for the European Meteorological Infrastructure (EMI) and their users. EUMETSAT is also contributing to Destination Earth (DestinE), along with ESA and ECMWF, EUMETSAT being responsible for the Data Lake.

CGMS-50-ESA-WP-06: ESA updates since CGMS-50 and report on the medium to long-term future plans (I. Petiteville, virtually)

CGMS was informed of the current status of the European Space Agency Earth Observation missions currently in-orbit. Two of them, MSG and MetOp are in co-operation with EUMETSAT.

Copernicus represents the major continuing 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 in October 2017, Sentinel-3B in April 2018 and Sentinel-6 Michael Freilich on 21 November 2020. Other Sentinels will follow in the coming years. Sentinel operations continued nominally apart from the major Sentinel-1B anomaly that occurred on 23 December 2021, affecting the satellite power system. The satellite remains under control with regular orbit control manoeuvres routinely performed. A long-term unavailability of data provision (several months) is assumed, but it is still too early to consider a permanent unavailability of Sentinel-1B.

Sentinel missions are developed, launched and operated in partnership with the European Union and EUMETSAT. 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.

The 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 SMOS satellite was launched on 2 November 2009. The CryoSat-2 satellite was launched on 8 April 2010 and the Swarm satellites on 22 November 2013. Aeolus is the latest Earth Explorer satellite put into orbit on 21 August 2018 and its Doppler Wind Lidar technique used for measuring wind profiles from space has already been fully demonstrated. The positive impact of Aeolus on the weather forecast has been also seen by multiple Numerical Weather Prediction centres world-wide, in particular by ECMWF.

The Proba-V small satellite was launched on 7 May 2013. Its coarse resolution imager has together with Sentinel-3, continued the data acquisition of the Vegetation payload on-board SPOT-4 and 5, during the reporting period. However, from July 2020, owing to its orbital drift, Proba-V Vegetation instrument has ended its operations on 31 October 2021 as planned; the satellite continues to be operated for ensuring the operations of the EPT instrument. The Proba-V Cubesat Companion (PV-CC) development within the GSTP programme now envisages a launch with Vega-C at end 2022 / early 2023.

CGMS was further informed of the current status of the future European Space Agency Earth Observation missions. Two of them, MTG and MetOp-SG, are in cooperation with EUMETSAT. The Living Planet Programme has three lines of implementation: Earth Explorer satellites, Earth Watch satellites plus services and applications demonstration.

The report describes the progress in the preparation of the forthcoming Explorer missions, EarthCARE, Biomass, FLEX, and FORUM. FORUM was selected for implementation as Earth Explorer 9 (EE-9) on 23-25 September 2019. The Phase B2/C/D/E1 space segment contract for FORUM has been finalised and signed at the beginning of April 2022.

The Phase A studies - two parallel system studies - supporting science studies and campaigns for Harmony have progressed nominally.

On 25 May 2020, ESA issued a Call for Ideas for Earth Explorer 11 (EE-11). The science requirement consolidation (SciReC) studies have been kicked-off for the four Phase 0 mission candidates CAIRT, Nitrosat, SEASTAR, and WIVERN. The tender evaluation of the System Studies for all four mission candidates have been conducted in the March- April 2022 timeframe and those activities are expected to kick-off by mid-May.

Activities related to Aeolus Follow-On, Arctic Weather Satellite (AWS), TRUTHS, SCOUTs and ALTIUS are ongoing. Each of these missions are planned contribute routine, operational monitoring data to improve our understanding of the Earth system and climate change.

Looking to the future, the six Copernicus Expansion missions are currently in phase B2/C/D/E1, addressing EU policy and gaps in Copernicus user needs, and each expanding the current capabilities of the Copernicus space component: CHIME, CIMR, CO2M, CRISTAL, LSTM, and ROSE-L. The Sentinel development activities, including Copernicus Expansion missions and Next Generation missions, continued in line with Segment 4 of the Copernicus Space Component (CSC) Programme, the FutureEO Programme and the CSC Long Term Scenario. Sentinel development activities, including Copernicus

Expansion missions and Next Generation missions, continued in line with Segment 4 of the Copernicus Space Component (CSC) Programme, the FutureEO Programme and the CSC Long Term Scenario.

Prototype development (Phase B2/C/D/E1 of both Sentinel-1 NG and Sentinel-3 Topography NG) including accompanying scientific studies, processor prototype development, and cal/val activities are ongoing.

CGMS was 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 has continued to progress very well since its inception in 2008. In 2016, a second phase of the programme, CCI+, was approved by ESA member states which is allowing to study and monitor 23 essential climate variables (ECV) derived from satellite data, fulfilling GCOS objectives. Out of these 23 ECVs, 16 have been handed over to the Copernicus Climate Change Service (C3S) lead by ECMWF, for operational use.

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 has much as possible, while overall, the operations of ESA satellites currently in orbit and services to users have been kept nominal.

CGMS-50-CNES-WP-01: CNES updates since CGMS-50 and report on the medium to long-term future plans (O. Marsal)

Important milestones have been successfully met in the development of three missions by CNES and of particular interest for CGMS:

- The MicroCarb payload, based on a grating spectrometer using 4 spectral bands for CO2 concentration measurements, has been integrated and currently undergoes thermal vacuum tests before being delivered for integration with the platform. The satellite will be ready for launch end of 2023. EUMETSAT is involved in the data processing and distribution;

- The IASI-NG instrument (PFM model), developed in cooperation with EUMETSAT in the frame of the EPS-SG programme, entered final thermal vacuum tests mid-2022. Its delivery to EUMETSAT for integration with the Metop-SG-A1 platform is planned in September 2022. This new generation of infra-red sounding interferometer (IASI) opens the perspective of more than 50 years of continuous measurements of atmospheric parameters from Space, offering a unique opportunity for climate studies, thanks to the remarkable stability of the three IASI instruments; and

- The SWOT satellite is undergoing final tests, the launch being planned end of 2022. This wide-swath altimetry mission, developed in cooperation with NASA, will allow the characterisation of ocean mesoscale circulation, and will open extremely promising opportunities for hydrology applications.

Important missions like Calipso, SARAL, CFOSAT (cooperation with NASA, ISRO, CNSA) continue to be operated successfully, providing scientific results of exceptional value and a wide range of operational applications. CNES remains strongly involved in the operations of the altimetry reference missions (Jason 3, Sentinel 6), with our European and US partners.

ISRO and CNES jointly decided to stop operating the Megha-Tropiques satellite, because of technical anomalies. Megha-Tropiques has provided 10 years of data of outstanding impact for science studies and numerical weather prediction.

CNES is preparing future missions in cooperation with R&D and operational agencies. In particular, CNES is strongly involved in the preparation of AOS (Atmospheric Observing System), a NASA programme in cooperation with JAXA and CSA. CNES is considering contributing to the satellites with the delivery of microwave radiometers.

All these activities are being performed in the framework of international cooperation, most CNES partners being CGMS partners. This importance of international cooperation for CNES is illustrated by our strong involvement in CEOS, CNES having taken the role of CEOS Chair in 2022.

CGMS-50-joint-IMD-ISRO-WP-01: Joint IMD/ISRO updates since CGMS-50 and report on the medium to long-term future plans (N. Desai, ISRO/M. Mohapatra, IMD).

ISRO reported progress on its missions relevant to CGMS.

ISRO has recently reviewed the activities related to CGMS and updated the representatives to Working Groups and Task Teams. This is expected to accelerate the contribution of ISRO to CGMS. ISRO intend to participate in the WGI collision avoidance and debris management Task Group with nominations to be sent soon. ISRO has a strong group working on this subject.

ISRO welcomes the WMO unified data policy for International data exchange and hope to work out the details soon in discussions with WMO.

ISRO further welcomes the incorporation of socio-economic impacts of satellite missions, as one of the CGMS objectives. ISRO will be contributing to this activity in the near future. The remote sensing data policy of India is under review. Data above 5 meter spatial resolution is proposed to be distributed free of cost and without any restriction.

The future mission approval and funding is under review. Updates on continuity for missions (Oceansat and INSAT-3D series) will be provided in due course. Since January 2021, the ISRO-IMD team validates INSAT-3D/3DR products in the Multi-Mission Data Reception and Processing System (MMDRPS, developed by ISRO) which is operational at IMD.

SCATSAT-1 with a Ku-band scatterometer completed its mission in February 2021. ISRO-CNES joint mission SARAL/AltiKa is functioning in mispointing mode and the mission has been extended till December 2022, provided the health of the satellite is satisfactory. The mission will be further reviewed in December 2022. ISRO-CNES joint mission Megha-Tropiques was launched into orbit in October 2011. Due to an on-board anomaly in March 2019, the data availability has become low. The ISRO-CNES JSC therefore decided to announce the end of the mission.

ISRO's GSICS activities will be shortly extended to MetOp-C/IASI and JPSS/CrIS for IR Channels and Ray-Matching method for Vis/SWIR channels using Aqua/MODIS and JPSS/VIIRS.

Oceansat-3 is scheduled for launch in September 2022 with Ku-band scatterometer, Sea Surface Temperature Monitor (SSTM), and Ocean Colour Monitor (OCM-3). INSAT-3DS is getting ready for launch and the schedule will be announced shortly.

IMD reported on progress on its activities relevant to CGMS.

Validation activities are ongoing for all derived INSAT-3DR products recently installed in the latest state of art MMDRPS system. New customised Imager products are generated operationally like, LST for National Capital Region (NCR) to monitor the high temperature episodes. Uninterrupted 24X7 operation of the MMDRPS system is performed for INSAT-3DR.

IMD and SAC/ISRO cooperates on validation/inter-comparison of all the INSAT 3D/DR imager/sounder products. CF compliance of all satellite data in IMD has been established. 1D-Var SST products with better accuracy (RMSE reduced from ~0.9K to ~0.6K) is implemented and validated in INSAT-3DR operational chain. State–Wise Snow variation map from INSAT-3DR is produced for mountain region (J&K, Ladakh, Himachal Pradesh, Uttrakhand & Sikkim) along with LST map to identify the fresh snow, melting snow area and potential vulnerability area of landslide/flash flood in mountain regions also implemented in operational chain. The RAPID Scans (~5-minute) have conducted successfully for monitoring the cyclonic activities for 2021-2022. INSAT-3D/3DR wind products are being disseminated in BUFR format through the WMO Global Telecommunication system (GTS) network for international agencies in real time basis. GNSS network of IMD (25 locations) for monitoring the real time Integrated Precipitable Water Vapour (IPWV).

RAPID beta version will be operationalised from monsoon season of year 2022. It will have the provision to visualise the NWP, radar, in-situ observational data on a real time basis overplayed on satellite data with georeferencing information and compatible to mobile users.

IMD thanked EUMETSAT for providing Meteosat data services over the Indian Ocean (IODC) through the EUMETCast terrestrial link and enhancing the cooperation with EU in future development of GEO and LEO blended products, the nowcasting tool in collaboration with the EUMETSAT Nowcasting Satellite Application Facility (NWC-SAF) and CAL/VAL activities, and for relocating Meteosat-9 over the Indian Ocean.

CGMS-50-JMA-WP-01: JMA updates since CGMS-50 and report on the medium to long-term future plans (K. Bessho)

The Japan Meteorological Agency (JMA) operates two geostationary meteorological satellites, Himawari-8 and -9, equipped with Advanced Himawari Imager (AHI). Himawari-8 has been stable and operational since July 2015. Operations is planned to be taken over by Himawari-9 around December 2022. Prior to the switchover, Himawari-9 data will be provided in parallel with Himawari-8 data for user readiness (non-operational purposes).

In FY 2018, JMA has started considering the next geostationary satellite programme. JMA will pursue a seamless geostationary satellite system, keeping in mind the CGMS baseline and the Vision for WIGOS in 2040. A hyper-spectral infrared sounder is under consideration, with the OSSEs showing positive impacts for typhoon track forecasts.

CGMS-50-JAXA-WP-03: JAXA updates since CGMS-50 and report on the medium to long-term future plans (T. Hirabayashi)

JAXA operates various kinds of satellite sensors and opens the products to the public. JAXA continually develops and improves the products to address climate issues.

The major updates since CGMS-49 is that the pre-project team of Precipitation Measuring Mission, follow-up to the Global Precipitation Measurement (GPM) mission, was organised in JAXA in January 2022. JAXA would appreciate the support by CGMS and IPWG.

GOSAT-GW, joint mission of GOSAT-2 follow-on (TANSO-3) and GCOMW/AMSR2 follow-on (AMSR3) has been in development phase (Phase-B) since December 2019. TANSO-3 will be a mission of the Ministry of the Environment in Japan (MOE) and National Institute of Environment Study (NIES). New high frequency channels of 165.5 GHz, 183.31+-3 GHz, and 183.31+-7 GHz V-polarisation are available in AMSR3 for snowfall retrievals and water vapour analysis in numerical weather prediction in meteorological agencies. Also, additional 10.25 GHz V- and H-polarisation channels with wider band width and improved NEDT will be added to current 10.65 GHz channels to improve robustness of higher resolution SST retrievals especially for fisheries. TANSO-3 uses imaging spectrometer technology to measure CO2, CH4 and NO2 globally with medium and locally with high spatial resolution. GOSAT-GW is scheduled to be launched in JFY2023.

In terms of the WMO project for monitoring extremes, JAXA contributes to the WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) Project by providing GSMaP rainfall product with climate normal. JAXA improved the algorithm in December 2021 (algorithm version 8), and currently reprocesses the past GSMaP dataset since 1998, and will re-calculate the climate normal again. In February 2022, JAXA made three submissions, based on GOSAT-2 data, for the 1st global GHG Emission Stocktake.

CGMS-50-KMA-WP-01: KMA Report on current status and future satellites (Y. KIM)

GEO-KOMPSAT-2A (Meteorological and space weather mission; AMI (Advanced Meteorological Imager) and KSEM (Korean Space Weather Monitor) has been operated since 25 July 2019 by the Korea Meteorological Administration (KMA). GEO-KOMPSAT-2B (ocean and environmental mission; GOCI-II (Geostationary Ocean Colour Imager-II) operated by the Ministry of Oceans and Fisheries and GEMS (Geostationary Environment Monitoring Spectrometer) operated by the Ministry of Environment) was launched 18 February 2020 and its data have been released to the public since the 2nd half of 2021. On 23 July2020 KMA started a new marine weather broadcast service in L-band by the GK2A satellite.

Follow-on missions to both GEO-KOMPSAT-2A and GEO-KOMPSAT-2B are in the feasibility study phase.

KMA is planning the three studies to monitor climate change as follows:

1. Spatiotemporal variability monitoring for GHGs with satellite-based products;
2. Tracing the emission source of GHGs at the nation scale through inverse models in IG3IS; and
3. Validating space-based GHGs with in Anmyeon FTS data (a site of TCCON).

CGMS-50-NOAA-WP-01: NOAA updates since CGMS-50 and report on the medium to long-term future plans (S. Volz)

NOAA provided an update on the main developments since CGMS-49, including GOES-T launch and the first imagery from GOES-18, and an outlook for the future with an emphasis on the four pillars of NOAA's next-generation Earth observations: LEO, GEO, Space Weather, and Common Ground Services. Dr. Volz highlighted NOAA's plans for the GeoXO (Geostationary Extended Observations) programme and recent NOAA accomplishments. The GeoXO mission will continue and expand observations provided by the GOES-R Series as NOAA's next generation of geostationary satellites.

CGMS-50-NASA-WP-04: NASA updates since CGMS-50 and report on the medium to long-term future plans (J. Kaye)

NASA continues to provide operational support for twenty-two 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 programme of technology development, research, and applications.

During the past year, NASA and the U.S. Geological Survey (USGS) successfully launched the Landsat 9 mission. Though similar to its predecessors, Landsat 9 can transmit data with higher radiometric resolution, which enables it to detect subtle differences on Earth's surface. With two Landsat series satellites currently on orbit, NASA and USGS are able to image the globe every eight days.

In June 2021, NASA successfully launched the TROPICS Pathfinder satellite. It is a test satellite similar to the ones expected to be flown as part of the Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) mission. TROPICS Pathfinder enables real-world testing of the planned technology, communications, and data processing system, allowing adjustments to increase TROPICS mission success. The full TROPICS mission to study tropical cyclones will consist of six CubeSats equipped with small microwave radiometers stationed in three orbital plans. Three launches of two CubeSats each are expected to take place by the end of July 2022.

Earth System Observatory (ESO) missions in pre-Phase A are undergoing Mission Concept Reviews in preparation to enter Phase A, where they will develop a baseline mission concept, validate requirements, and establish mission architecture.

CGMS-50-joint-ROSCOSMOS-ROSHYDROMET-WP-02: ROSHYDROMET/ROSCOSMOS updates since CGMS-50 and report on the medium to long-term future plans (A. Uspensky, virtually)

The Russian hydrometeorological satellite constellation has not changed since the last year, except for the commissioning of the first highly elliptical orbit meteorological satellite Arctica-M N1.

Arctica-M satellites provide frequent observations similar to geostationary satellites, but over the Arctic region. The payload of Arctica-M satellites is similar to those of Russian geostationary satellites.

3. WMO MATTERS FOR COORDINATION WITH CGMS SPACE AGENCIES

WMO matters for coordination with CGMS space agencies

CGMS-50-WMO-WP-11: WMO report on WIGOS 2040 including GBON (A. Rea)

WMO presented the global meteorological infrastructure needed for delivering weather and climate services explaining what is needed from the WMO perspective to facilitate the international exchange of data - a key element and a major purpose of the WMO. The WMO Extraordinary Congress 2021 approved three major components: The WMO Unified Data Policy, the Global Basic Observing Network (GBON), and the Systematic Observing Financing Facility (SOFF). The SOFF has been jointly created by WMO, UNDP and UNEP. The persistent problem related to the data exchange is the insufficient observational data coverage and data gaps, which data policy, GBON and SOFF together are trying to tackle.

WMO further presented High Level Guidance (HLG) on the evolution of global observing systems during the period 2023-2027 in response to the Vision for WIGOS in 2040. The purpose of the document is to provide guidance to WMO members for key activities to be implemented within the next five years in order to accomplish the scenario of the Vision for WIGOS in 2040. It includes principles of general nature to be considered for the development of implementation plans by members, agencies, and other operators of observing networks and covers observations for which NHMSs are directly responsible, as well as other observations for which NHMSs are stakeholders (including satellite systems).

Discussion and review of new actions

Following a question from ISRO related to the need of making a source code of different NWP models available and used for nowcasting or assimilation purposes into new capabilities, it was noted that this should be addressed with the NWP community, i.e. global or regional NWP centres, rather than to WMO. It was further noted that WMO can provide best practices, guidance in collaboration with NWP centres to address this issue.

NOAA followed up on the comment highlighting that even though this should be an individual agency response, WMO does have a role in recommending the nations to undertake this work to accomplish the results for the community needs.

WMO commented on the WIGOS HLG document, pointing out that the new version of this document reflects the main programmatic decisions related to space systems, which will be taken within the next five years. WMO members can use this material in their contributions to these programmes as stakeholders.

WMO further highlighted that the new WMO Unified Data Policy is a new development, which covers all Earth system data: weather, climate, hydrology, etc., including model data.

CGMS-50-WMO-WP-02: Status of WMO Core Satellite Data Activities (K. Holmlund)

WMO presented the Unified Policy for International Exchange of Earth System Data introducing the major changes compared to the old WMO Data Policy resolutions 40, 25 and 60. An important change is that with the new data policy, WMO commits itself to broadening and enhancing the free and unrestricted international exchange of Earth system data.

WMO has started preparations for the bilateral discussion with space agencies to define "core" and "recommended") satellite datasets to be documented in the WIGOS manual, which is referred to the data policy related to the data exchange. After the bilateral discussions space agency commitments will be documented in the WMO WIGOS Manual and presented for INFCOM, WMO Executive Council and again for WMO Congress 2023 for the final approval by WMO members. WMO has nominated Sue Barrell as an overall data policy coordinator.

Discussion and review of new actions

CGMS Members took note of the status of WMO Core Satellite Data Activities.

NOAA noted that WMO works with members, not with space agencies. This makes the procedure of nominating the space agency's focal point for the definition of core satellite data for the member quite complicated, requiring national coordination and agreement through the national Permanent Representative.

WMO thanked NOAA for the concern expressed and responded that this is well understood. The WMO members are the ones who will finally have to approve the "core/recommended" satellite data. However, the current approach was chosen in order to avoid making unrealistic requests directly to WMO members since space agencies, as scientific and technical owners of the data, have strong understanding of what is reasonable and what is not.

4. WORKING GROUP REPORTS

4.1 Operational continuity and contingency planning - WGIII

CGMS-50-WGIII-WP-03: Outcome of the 4th CGMS risk assessment (A. Mehta, WGIII co-chair)

WGIII presented the outcomes of the 4th CGMS risk assessment. As a comparison to the 2021 risk assessment,it showed an improved risk posture as a result of CMA's plans for FY-3J beyond FY-3E, which provided continuity in the early morning orbit for a microwave sounder, hyperspectral sounder, and multi-mission imager. FY-3J also provided long-term continuity for short- and long-term radiometers. FY-3I provides continuity for precipitation radars beyond FY-3G. Existing risks in the 2022 risk assessment are risks for coronal imaging and plasma analysers at L1 until the SWFO-L1 mission is launched and lack of geographically dispersed radio occultations; especially in the equatorial regions due to missing plans for low-inclination radio occultation observations after COSMIC-2.

CGMS-50-WGIII-WP-04: Update of the CGMS baseline - for plenary endorsement (A. Mehta, WGIII co-chair)

WGIII presented the latest CGMS baseline updates. The key updates proposed to the Plenary were updates to reference documents, new text on hosted payloads and commercially sourced data and new space weather sensors to capture energetic particle measurements. These changes were approved by the Plenary.

CGMS-50-WGIII-WP-05: Update of WGIII Terms of Reference - for plenary endorsement (A. Mehta, WGIII co-chair)

WGIII presented updates of the WGIII Terms of References document. The key updates proposed to the Plenary were the proposal of the scope of WGIII to expand to include oceans, atmospheric composition and space weather (in addition to weather and climate monitoring) and the specific reference to conducting risk assessments and coordinating contingency actions. These changes were approved by the Plenary.

Plenary thanked Mr Ajay Mehta (NOAA) for his significant contributions to the WGIII over the past few years securing the establishment of the risk assessment and baseline review process. This being Mr Mehta's last plenary session, the Plenary endorsed Ms Irene Parker (NOAA), to take over the co-chairing of the WGIII together with ZHANG Peng (CMA).

4.2 Satellite systems and operations - WGI

CGMS-50-WGI-WP-03: Report on the outcome of WGI activities since last plenary (D. KIM, WGI co-chair)

WGI provided an overview of the current working group objectives and task groups.

WGI informed plenary of the status of discussions on frequency matters and preparations for the WRC-23. By the end of 2022, the Space Frequency Coordination Group (SFCG) representative will circulate the updated WMO preliminary position paper on WRC-23, after which CGMS members need to ensure the updated WMO positions are known to its members' national and international preparation processes for WRC-23. WMO has implemented a new structure of space frequency data recorded in the OSCAR/Space database. The implementation of the frequency data records is now supporting the interest of the SFCG to use OSCAR/Space as an information source for the passive and active remote sensing bands and to identify future remote sensing spectrum needs. The CGMS SFCG representative and WMO will propose a process for providing accurate and timely updates on satellite frequencies recorded in the OSCAR/Space database. The proposed process is to be presented by October 2022.

WGI also informed plenary on the main outcomes and future work of each of the WGI Task Groups:

WGI has taken the initial steps in forming the WGI Task Group on RFI detection, monitoring and mapping. WGI will continue forming the Task Group on RFI, establishing the Terms of Reference, and

collectively investigating mechanisms for detection and long-term monitoring and mapping of RFI. CGMS agencies were invited to nominate additional members.

The WGI Task Group on Satellite Data and Codes has been actively supporting the coordination of work on satellite product format issues within the CGMS community and providing support to the work of WMO's Expert Teams. As of 2022, the activities of the CGMS WGI ad hoc team on coordination of CF-netCDF conventions have been assimilated into the work of this Task Group. The Task Group will continue to work on coordinating format standardisation for satellite data, implementation of WIGOS station identifiers for satellite platforms, and providing subject matter expertise to WMO Expert Teams.

The WGI Task Group on Direct Broadcast Systems had presented a well-received SWOT analysis on low latency data access from LEO meteorological satellites. The Task Group will perform further study on the possible usage of the identified emerging technologies by the SWOT analysis, to complement the data rate limitation of the traditional direct broadcast for future LEO meteorological satellites programmes, and present the outcomes to CGMS-51.

The WGI Task Group on the Coordination of LEO Orbits has drafted best practices for the Coordination of Data Acquisition for Low Earth Orbit Satellite Systems. The Task Group on the Coordination of LEO Orbits and Task Group on Direct Broadcast Systems will review the overlap between their best practices, and propose a way forward to CGMS-51. The two Task Groups will also propose a consolidated direct broadcast and global data access SWOT analysis to CGMS-51.

The WGI Task Group on DCS had presented a well-received SWOT analysis on the Data Collection Service from geostationary meteorological satellites. The Task Group is working on an evolution of the existing DCP standards taking into account user feedback. A workshop with the manufacturers is planned to detail this standard taking into account the SWOT analysis and the results of the survey commissioned by ESA. Based on the SWOT analysis, the Task Group had put forward five proposals for further work, which it will continue to evaluate and develop in the lead up to CGMS-51.

The WGI Task Group on Space Debris and Collision Avoidance has been established. The preliminary Task Group activity performed between NOAA and EUMETSAT had identified the potential for establishing several best practices in performing collision avoidance and debris mitigation with the potential to benefit all CGMS members and the wider space-faring community. This Task Group will work on proposed best practices in performing collision avoidance and debris mitigation for recommendation to CMGS-51. All CGMS members involved in spacecraft operations were strongly encouraged to nominate participants for this activity.

WGI also informed plenary that, starting with CGMS-51, WGI had agreed to adopt the approach of each of the Task Groups to regularly present their latest best practices and status of best practices implementation, as well as proposals for future activities. Each of the WGI Task Groups will also present its latest version of its Terms of Reference to CGMS-51.

All CGMS agencies were invited to consider nominating additional members for all the WGI Task Groups, especially ones where no representatives of the agencies are currently participating in the Task Group(s).

WGI presented nominations for changes in WGI leadership:

Vanessa Griffin (NOAA), retired in May 2022. The CGMS-50 Plenary thanked Vanessa for her valuable contributions and leadership as WGI Co-chair.

The CGMS-50 Plenary endorsed Sean Burns (EUMETSAT), as interim WGI Co-chair, until a new Co-chair is nominated.

The CGMS-50 Plenary endorsed Karolina Nikolova (EUMETSAT), as Rapporteur of WGI. CGMS Agencies were invited to nominate candidates for a second WGI rapporteur.

Discussion and review of new actions

Following an enquiry by ISRO about the protection of radio frequency bands on remote sensing, the WGI interim co-chair responded that CGMS inputs are represented via the SFCG. SFCG and WMO are working on preparation for the WRC-23, in close collaboration with CGMS. WMO responded that the Expert Teams will meet in August 2022 to finalise the position paper for WRC-23. The CGMS-50 Plenary recognised the importance of continuing to closely follow issues related to radio frequency protection for remote sensing bands. It was highlighted that CGMS agencies are welcome to propose additional experts to contribute to the ongoing work on these issues.

4.3 Data access and end user support, incl. key outcomes of the CGMS cloud technology workshop (WGIV)

CGMS-50-WGIV-WP-01: Report on the outcome of WGIV activities since last plenary, including major outcomes of the CGMS cloud technology workshop (K. Bessho, WGIV co-chair)

WGIV presented the key activities of the WGIV plenary session in April 2022, including summary and highlights from the WGIV Cloud Service Expert Group workshop.

The Expert Group on Cloud Services' main goals are to establish a suite of best practices for cloud use and define how to make cloud-based dissemination more interoperable. To meet these goals, the group hosted a cloud workshop to increase awareness of the current and future trends in cloud services amongst CGMS members and understand key capability gaps that the cloud can fulfil so participants can fully leverage the advantages the cloud can offer. As a result of industry presentations, open discussions, and agency-only roundtables, CGMS cloud services experts have increased their knowledge of industry cloud trends and will take back best practices and lessons learned to their respective organisations. Best practices, trends, and common themes were identified amongst workshop presentations, and will be incorporated into the group's best practices document for presentation and endorsement at the CGMS-51 Plenary in 2023.

In the context of disaster service support, CMA, JMA and KMA all offer disaster support mechanisms to the international community (FY_ESM, HimawariRequest, GK2A AMI Rapid Scan observations respectively). These services can be requested by the international community in support of emergency management activities. CMA, JMA and KMA plan to continue to work closely together on disaster support activities.

Following the inquiry from ISRO on HimawariRequest service and International Disasters Charter, JMA clarified that they are not a member.

WGIV also informed Plenary that the newly created Task Group on Cyber Security did not have opportunity to meet since March 2021. WGIV recommended to the Plenary which concurred to suspend the activities of the Task Group on Cyber Security, and to revisit the role of the Task Group for CGMS-52.

In the context of the coordination of metadata, the Task Group on Metadata held an initial kick-off meeting in February 2022. A follow-on kick-off meeting is planned for summer 2022.

In the context of user readiness for new satellite systems, the VLab report was presented. Since CGMS-49, VLab members have offered a variety of training opportunities addressing the new generation of satellites, which continues to be the major training need identified by VLab members. The VLab Management Group (VLMG) continued to coordinate its activities and support for training events via regular online meetings. NOAA summarised three stages of user engagement during the satellite's life cycle. And WMO-CGMS Best Practices for Achieving User Readiness for New Meteorological Satellites were discussed.

Discussion and review of new actions

WMO thanked WGIV and space agencies for addressing many items of WMO Space Programme's interests, specifically training and engagement with the Regional Associations.

WGIV requested CGMS agencies to consider nominating additional members for all the WGIV Task Groups, especially ones where no representatives of the agencies are currently participating in the Task Group(s).

Plenary endorsed Natalia Donoho (NOAA) and Simon Elliott (EUMETSAT) as new WGIV co-rapporteurs and thanked NOAA and EUMETSAT for those nominations.

4.4 Space Weather Coordination Group (SWCG)

CGMS-50-SWCG-WP-04: Report on the outcome of SWCG activities since last plenary (T. Nagatsuma, SWCG co-chair)

The SWCG co-chair provided a summary report of the SWCG session and the Joint WGI-WGIV-SWCG session. The updated CGMS Baseline aspects relevant to space weather were agreed, and updates on space-based observational capabilities and space weather activities are reported from the member agencies. International space weather data user activities are reported from ISES, and the identification of services for space surveillance and tracking users was discussed.

It was noted that WMO has now established an Expert Team on Space Weather (ET-SWx) with a broader mandate than the former IPT-SWeISS, and that WMO is preparing the establishment of core satellite data for space weather following the new WMO Unified Data Policy.

Progress is being made on ensuring the correct structuring of space weather data within the WMO OSCAR/Space database, and the GSICS Executive Panel decided to form a sub-group on space weather instrument inter-calibration at their annual meeting. Activities of the task groups on space weather spacecraft anomaly database and ionospheric radio occultation system optimisation were reported, and the new Task Group on improving user data access to space weather data from orbital sensors was presented. Issues of ITU radio regulations related to space weather were also noted.

4.5 Satellite Data and Products (WGII)

CGMS-50-WGII-WP-01: Report on the outcome of WGII activities since last plenary (M. Goldberg)

WGII provided an overview of its activities undertaken since CGMS-49, as well as of its CGMS-50 discussions.

WGII serves as an important link between the annual CGMS plenary sessions and the CGMS International Science Working Groups which provide regular reports and feedback to CGMS.

These groups are currently:

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

In addition, the International Earth Surface Working Group (IESWG) had prepared a proposal for the Terms of Reference for establishing a new CGMS International Science Working Group. Based on the first analysis by WGII, WGII proposed to plenary:

- That the IESWG finalises these Terms of reference, circulates them to WGII first and once WGII has reviewed it, circulate to CGMS members for consideration and comments. WGII leads will then interface with the IESWG lead to complete the ToRs.

- WGII will then bring the Terms of Reference to CGMS-51 Plenary for endorsement.

- In parallel, WGII will engage with IESWG in discussions on future priorities for CGMS Science Working Groups.

WGII is also the primary interface between CGMS and other international initiatives, such as the CEOS-CGMS Joint Working Group on Climate, GSICS and SCOPE-CM and user communities, such as those organised in the areas of oceanography and marine meteorology, and atmospheric composition.

WGII recommended to plenary to endorse the upcoming and Third International Operational Satellite Oceanography Symposium (OSOS-3), planned for spring 2023 and to be held in South Korea. (See chapter on support to operational ocean observations and monitoring).

WGII presented to plenary:

- recent results on FSOI contributions from POES versus other selected observing systems
- agency reports on highlights and issues in data and product generation
- activities of the CGMS International Science Working Groups that have held their respective plenary meetings since CGMS-49, i.e. ITWG and ICWG
- discussions on the proposal of a new CGMS International Earth Surface Working Group (IESWG)
- approach for establishing best practices in response to recommendations from the International Science Working Groups
- progress on carbon tracking and GHG emission monitoring

Discussion and review of new actions

On the IESWG, the Plenary endorsed the way forward regarding the potential establishment of the IESWG as proposed by WGII.

In conclusion, the Plenary noted the following actions:

CGMS-50 actions - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
CGMSSEC, WMO	4.5	A50.01(a)	CGMSSEC and WMO to consider if night-time light capabilities should be covered in HLPP, the CGMS Baseline, and should be reflected in the WMO Gap Analysis.	CGMS-51 WGIII, CGMS-51
WMO	4.5	A50.01(b)	If night-time light capabilities shall be covered in the HLPP and the CGMS Baseline, WMO to reflect this in the WMO Gap Analysis.	CGMS-51

CGMS-50 actions for the working groups - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
IESWG co-chairs	4.5	IESWG/(P)A 50.01	The IESWG to finalise its draft Terms of Reference, and provide them to the WGII lead	Dec 2022
WGII lead	4.5	WGII/(P)A5 0.02	WGII to review and discuss the ToRs and once finalised, circulate to CGMS members for consideration and comments. WGII leads will then interface with the IESWG lead to complete the ToRs.	Q1 2023, CGMS-51 WGII, CGMS-51

CGMS-50 actions for the working groups - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
			WGII will then bring the Terms of Reference to CGMS-51 Plenary for endorsement.	
WGII lead	4.5	WGII/(P)A50.03	WGII will engage with IESWG in discussions on future priorities for CGMS Science Working Groups	Q1 2023
CGMS members	4.5	WGII/(P)A50.04	CGMS WGII members are invited to nominate candidates for positions of Vice-Chairs for GSICS-EP and GRWG. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Dec 2022
CGMS members (WGII and SWCG)	4.5	WGII+SWCG / (P)A50.05	CGMS WGII and SWCG members are invited to nominate candidates for a subgroup within GSICS on Space Weather Cal/Val and Intercalibration, which will be focused on providing intercalibration for Space Weather. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Dec 2022

4.6 ITWG key recommendations to CGMS

CGMS-50-ITWG-WP-02: Key recommendations from the ITWG to CGMS plenary (V. Guidard)

The International TOVS Working Group (ITWG) was established in 1983 as a working group of the International Radiation Commission (IRC) of the International Association of Meteorology and Atmospheric Physics (IAMAP). ITWG was formally adopted as sub-group of CGMS in 2012.

ITWG Provides a forum where providers and users of atmospheric infrared and microwave sounder data exchange information on:

- Satellite and sensor status
- Processing methods and derived products
- Data use in Numerical Weather Prediction
- Radiative transfer developments
- Climate studies
- Real-time satellite data reception and processing

ITSC-23 was held as a virtual meeting 24-30 June 2021. Material from ITSC-23 is available at https://cimss.ssec.wisc.edu/itwg/itsc/itsc23/index.html. Key recommendations from ITSC-23 have been considered by WGII.

ITWG interim working group virtual meetings were held March-April of 2022:

https://cimss.ssec.wisc.edu/itwg/itsc/2022interim/

ITSC-24 will be an in-person meeting in Tromsø, Norway, March 16-22, 2023.

Discussion and review of new actions

The plenary took note of key recommendations with regard to small satellites:

1) Consider climate requirements in terms of stability and length of life cycle when designing small satellite sensors;

2) Continue to employ the traditional longwave infrared spectral radiance measurement band on all future hyperspectral infrared satellite sensors; and

3) Providers of data from constellations of smaller satellites should work towards standardization of data downlink frequencies and protocols to ease provision of near real-time (NRT) data.

ITWG continues to stress that a backbone system of at least 3 orbits should continue to anchor future constellations of small satellites which are designed to complement the backbone by providing higher temporal resolution. ECMWF presented studies on the optimal design for small satellite constellations with respect to weather forecast impacts. More studies are needed to assess the right mix of small satellites and backbones for weather forecasting and other applications including nowcasting.

4.7 ICWG key recommendations to CGMS

CGMS-50-ICWG-WP-02: Key recommendations from the ICWG to CGMS plenary (A. Heidinger)

The International Clouds Working Group (ICWG) held a virtual intersessional meeting in September 2021. The meeting was hosted by EUMETSAT. ICWG plans for another intersessional meeting in 2022 and an in-person meeting in 2023.

ICWG continues to be organised with 4 semi-permanent sub-working groups (Algorithms, Assessments, Weather Applications and Climate Applications).

ICWG reported very good progress on the CGMS High-Level Priorities under its oversight.

Intercomparisons of cloud products remain an important activity of ICWG. The ICWG maintains a library of Golden Days that includes SEVIRI, HIMAWARI-8 and now GOES-16.

Cloud height performance is key driver of the accuracy of Atmospheric Motion Vectors and their impact on NWP. In recognition of this interdependence, the IWWG and ICWG have formed a joint group to address the optimization of the cloud heights for the AMV application.

ISCCP-Next Generation is a pilot project from WCRP/GEWEX to make a next generation of the International Cloud Climatology Project (ISCCP). ICWG urges CGMS members to participate as desired in the formulation and testing of the ISCCP-NG gridded L1 product and the testing of L2 Cloud products.

ICWG provided a set of new recommendations and proposed actions to CGMS, and these have been considered by WGII.

New co-chairs of ICWG will need to be installed at ICWG-3, as both current co-chairs will resign at that time. There are two candidates: Kerry Meyer (NASA) and Martin Stengel (DWD). Andrew Heidinger (NOAA) is volunteering to become the new ICWG rapporteur.

ICWG has a new web site: https://www.icare.univlille1.fr/hosted-content/crew/index.php/Welcome

Discussion and review of new actions

WMO expressed its appreciation of the ICWG efforts to establish joint activities with other working groups like the IWWG and ITWG, and its efforts for developing best practices for cloud products.

EUMETSAT noted that application of Machine Learning methods for derivation of cloud properties has good potential and could be adopted as a future topic of the ICWG.

Plenary endorsed the nomination of Andrew Heidinger (NOAA) as the ICWG rapporteur to CGMS.

4.8 Other international science working groups

CGMS-50-IROWG-WP-02: Future GNSS radio occultation data needs (S. Healy, virtually)

The paper summarises recent community discussions held in preparation for a presentation by Rick Anthes to the NOAA System Performance Assessment Team, 27 June 2022. NOAA has asked for input on future RO needs to help inform their planning. The key questions include how many RO are needed, what is the best coverage, required quality, and whether an agency led “backbone” RO constellation is required.

The team emphasised the importance of free exchange of data, where there are no limitations on use in near-real-time applications. There remain good arguments for an agency-led backbone RO constellation. A new RO observation campaign, “ROMEX”, assessing the impact of up to 30,000 observations per day, is suggested.

The main issues presented here will be discussed further at IROWG in September 2022.

6. SUPPORT TO OPERATIONAL OCEAN OBSERVATIONS AND MONITORING

CGMS-50-NOAA-WP-20: Operational satellite oceanography (OSOS) (V. Lance/M. Goldberg)

The international Operational Satellite Oceanography symposia (OSOS) biennial series is intended to facilitate the efficient exploitation of satellite observations to substantially improve ocean and coastal environmental applications and decision making. The series was conceived by EUMETSAT and NOAA in 2017 for the purpose of bringing together the international community of providers and users of operational satellite oceanographic data and products.

The 2nd OSOS meeting was held virtually in May 2021, and the meeting material is available at Second International Operational Satellite Oceanography (eventsforce.net). Key recommendations from OSOS-2 were:

Data and Products:

- Reduce latency for NRT but maintain non-time critical higher quality products;
- Fill gaps in observations: currents, waves, salinity, bathymetry;
- Generate consistently processed, accurate, state-of-the-art, operational multi-mission long-term time-series, especially needed for analysing climate trends.

Data usage:

- Expand use of satellite observations for initialisation or data assimilation in models.

Data "democratisation":

- Improve outreach, training and communication;
- Adopt methodologies to assess the value of satellite observations and apply them consistently and systematically.

OSOS-3 is planned for spring 2023, tentatively in Korea, and will have a geographical focus on Asia, Australia and the Pacific, including blue water oceanography and climate (how satellite data can be applied to understanding trends and addressing impacts).

The paper requested CGMS endorsement for OSOS-3 in 2023.

CGMS-50-EUMETSAT-WP-17: CGMS support framework for operational marine observations. (B. Bojkov)

The paper recalled the discussions on the CGMS coordination in the ocean context at the CGMS-42 plenary in 2014 (CGMS-42-CGMS-WP-06):

"Plenary supported the proposed short- and medium-term actions of the CGMS Secretariat to optimise the contributions of CGMS to the ocean community, in particular in the areas of operational continuity, near real-time distribution of data and products and protection of ocean-relevant sensing frequencies

CGMS shall not replace or duplicate existing groups working on oceans monitoring – mainly in international science working groups and the CEOS Virtual Constellations context.

CGMS representatives are generally participating in these groups and shall ensure that operational requirements are brought back to the attention of CGMS.

CGMS shall handle these operational requirements through its existing WGs."

The well-established and functioning "ocean themed" working groups, include space agency representatives, have since CGMS-42 continued to discuss scientific issues, algorithms, Cal/Val, some levels of standardisations (uncertainties, formats, measurement protocols), operational applications,

etc. The frequency of meetings ranges from annual to every two years. The core members also meet in other fora such as AGU, EGU, the CEOS Virtual Constellations, etc.

It is therefore imperative that the CGMS engagement on Ocean issues complements the existing activities, and in order not to disrupt what is established and working well, a focused/minimalistic approach for CGMS is proposed:

Having the existing ocean working groups to:

- specifically address future missions, potential gaps, etc., as part of their working group meeting cycle – with a focus on operational requirements relevant to CGMS agencies; and

- provide information to the CGMS Secretariat every 2 years on the state of marine observation from space (a collated "CGMS marine report").

The following actions were proposed:

- CGMS to formally request the GHRSST, IOCCG, OSTST, and OSTWG to analyse the state of the current and future ocean missions by analysing and contributing to the appropriate CGMS WGs (WG III in particular for observational gaps, and WG IV for data access) with a focus on operational requirements relevant to CGMS agencies, as part of their routine ocean WG activities.
- CGMS Secretariat to collate the inputs from the Ocean WGs and prepare a bi-annual co-authored report on the "State of operational satellite missions" describing the state of the operational missions and identifying any potential issues for the next 20 years (in cooperation also with the IOC and the WMO SC-MMO).

Discussion and review of new actions

It was clarified that OSOS addresses all sustained satellite observations supporting operational ocean applications and that R&D satellites can make important contributions.

WMO asked for better recognition of GOOS, as this is a WMO co-sponsored programme.

ISRO asked for continued coordination with CEOS on the ocean activities. Regarding the future CGMS engagement with the ocean community, NOAA also emphasised the need to recognise the role of CEOS.

CGMS-50 recognised the value of OSOS as a forum for satellite observations support to operational ocean applications and endorsed OSOS-3 tentatively to be held in South Korea in 2023.

With respect to the proposed actions, WMO asked that the reference to WMO activities be made somewhat more generic and not refer to specific expert teams.

NASA expressed concern about CGMS making a formal request to otherwise autonomous science groups. It was clarified that the request would be for the groups to express their concerns about the future provision of satellite data on a consultative basis and the working groups have informally expressed support to the approach.

It was agreed to reword the proposed actions and after resumption of the plenary session the following actions were proposed and agreed by CGMS-50:

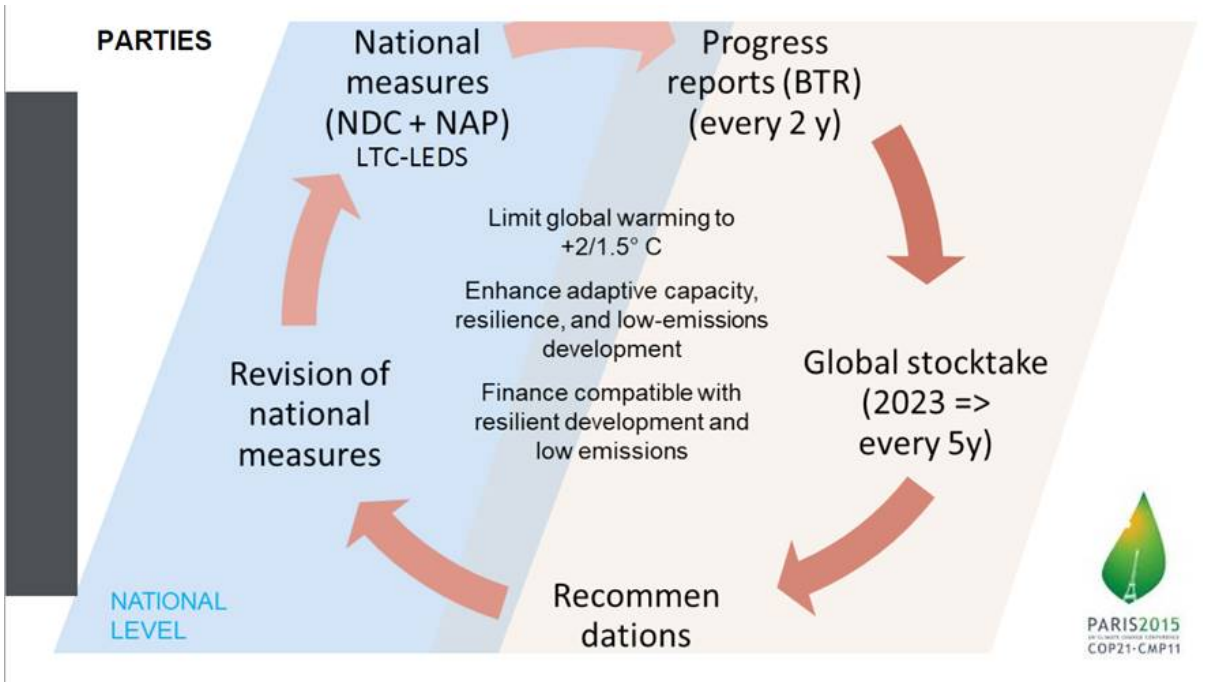
CGMS-50 actions - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
CGMSSEC	5	A50.02	CGMS (SEC) to formally request the GHRSST, IOCCG, OSTST, and OSTWG to analyse the state of the current and future ocean missions by analysing and contributing to the appropriate CGMS WGs (WG III in particular for observational gaps, and WG IV for data access) with a focus on operational requirements relevant to CGMS agencies, as part of their routine ocean WG activities.	Sep 2022
EUMETSAT (CGMSSEC)	5	A50.03	The CGMS Secretariat to collate the inputs from the Ocean WGs and prepare a co-authored report on the "State of operational satellite missions" describing the state of the operational missions and identifying any potential issues for the next 20 years (in cooperation also with the IOC and the WMO).	April 2023

5. SUPPORT TO OPERATIONAL CLIMATE AND GREENHOUSE GAS MONITORING

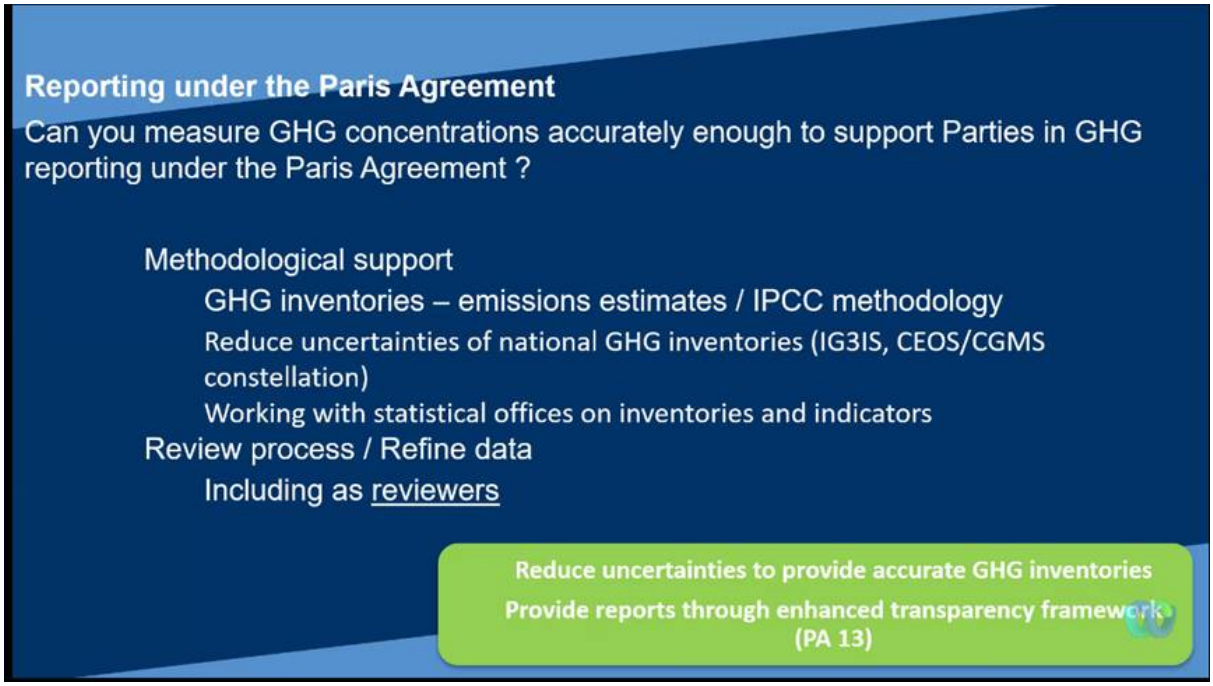
5.1 User perspective and plans and space agency contributions

CGMS-50-GUEST-WP-02: The relevance of the observation backbone for UNFCCC (J. Post, virtually)

On behalf of UNFCCC Joanna Post informed that the long data sets produced by the observational community are essential for the work of UNFCCC and the support to the implementation of the Paris Agreement. This involves all players present in the CGMS plenary session. The presentation introduced the working cycle of the Global Stocktake (GST) that determines how observational information can be delivered into the GST process (GST web page https://unfccc.int/topics/global-stocktake/global-stocktake).



For greenhouse gas concentrations in the atmosphere the contribution from the observation side can be directed by the question:



For adaptation lots of questions exist on how to monitor progress in adaptation such as city greening, reduction in forest fires plus a lot of economic and societal elements. We are at the beginning of the process to understand what information is required and how we ensure that people representing the Parties can understand what is provided to them. In this context Joanna mentioned the systematic observation paper provided to the UNFCCC (detailed in CGMS-50-JWGCLIM-WP-03). However,

consistency in baselines and messages must be reached in communications to the Parties. This isn't always the case and everybody should pay attention to it.

Looking towards COP-27 and the publication of the next GCOS Implementation Plan, there is an opportunity for the observation community to come together with the Parties to recognise and define a global goal on observation that can provide the information needed to reach the Paris Agreement goals.

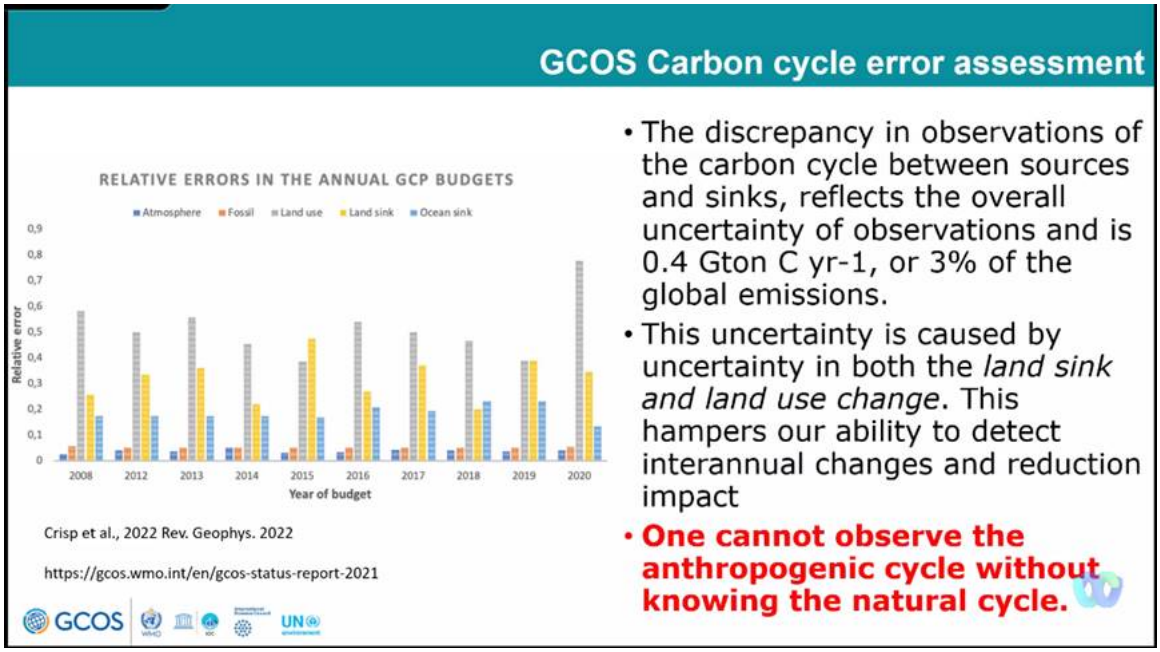
Discussion and review of new actions

JAXA asked if there were any updates on the Global Stock Take meetings just held in Bonn, Germany. The UNFCCC responded that there had been a GST technical dialogue with a series of round tables among other and there is a table of guidance resulting from the meeting to guide Parties who have not yet been engaged. Earth observation parties are invited to attend the next GST technical dialogue at COP-27 in Sharm El Sheikh, Egypt, on 8-20 November this year. (Draft conclusions from the SBSTA-56 on the GST are available here: https://unfccc.int/sites/default/files/resource/sb2022_L03E.pdf).

CGMS-50-WMO-WP-12: How GCOS will contribute to the Global Stocktake and the GCOS Implementation Plan (H. Dolman, virtually)

Chairman of the GCOS Steering Committee Han Dolman presented the GCOS-IP and said that it considers energy, water and carbon cycle including gaps for specific satellite missions where GCOS does not see succession planning.

On the carbon cycle, the complexity is that the anthropogenic emissions are embedded within the natural carbon cycle and current measurement uncertainties hamper our ability to detect year-to-year changes and the impact of emission reduction.



Discussion and review of new actions

NOAA asked to what degree GCOS considers existing commercial assets of routine land use monitoring. GCOS responded that ensuring access to the data is the issue, but GCOS is aware of the private sector and need to deal with them.

WMO noted that GCOS needs to engage stronger with CEOS and GEO on the land use and particularly in the GCOS TOPC panel. For CGMS the atmospheric composition side is more relevant.

NOAA asked why NRT data are mentioned in the GCOS presentation. GCOS answered that for in situ data there is a significant amount of quality control needed and that poses a problem for the delivery into NRT monitoring. Currently in-situ data has a typical 3-month delivery delay.

WMO noted that the WMO GHG workshop participants considered it important to deliver data as quickly as possible, although it did not mean NRT in the sense of meteorology but rather at scales of days instead of months and years. It is important to understand that the COP parties get confused by updated information, e.g. if calibration drift is detected after a few years the data set will lose credibility. The WMO GHG workshop argued that one should go the route of NWP.

The EC noted that the ambition is not only to contribute to the Global Stock Stake (GST), but that actual actions of parties to reduce emission should also be supported. This needs information on much shorter timescales than required for the GST. This is important as well and should be kept in mind, as it is important for decision making.

NOAA noted that requirements should carefully balance latency and accuracy requirements. The first priority should be accuracy, and the system delivering it can grow over time in providing this and with better latency over time. One must be careful about the latency as this is a huge difference in cost going from a day to a minute. GCOS concurred with this observation.

CGMS-50-WMO-WP-03: WMO GHG and carbon monitoring activities and outcome of the WMO workshop "The case for a coordinated Global Greenhouse Gas (GHG) Monitoring Infrastructure" (LP. Riishojgaard)

Integrated greenhouse gas monitoring done on a sustained global basis is critical to strengthening the scientific basis for the implementation of the Paris agreement and to measuring its effectiveness. WMO is therefore currently exploring the interest of the GHG monitoring community in establishing an operational global greenhouse gas monitoring infrastructure consisting of four main components:

a) Comprehensive global surface-based observations of CO2, CH4 and N2O concentrations routinely exchanged in near-real time[1];

b) Space-based near-real time global coverage of CO2 and CH4 column observations (and profiles to the extent possible);

[1] The interpretation of “near-real“ time may be less strict than typically applied for instance in NWP, but maintaining routine 24/7 operations of the monitoring infrastructure will be critical to its success.

c) Global GHG transport modeling, including required source and sink terms, driven by high-resolution global NWP output;

d) Assimilation of the observations (a) and b)) into the model (c),

The main output would be continuous, near-real time estimates of global greenhouse gas concentrations based on available observational information, along with localised discrepancies between all observations and the corresponding model prior ("observation minus background" residuals). This will help constrain estimates of carbon fluxes and help improve understanding of the overall carbon cycle, including regional and local aspects that remain poorly understood.

Reemphasising the points made by Han Dolman on the need to understand anthropogenic emissions and the natural carbon cycle, WMO showed some examples from the WMO workshop and explained the role of WMO for coordinating the vast amount of ongoing measurement and modelling activities, e.g., making all the data available.

Discussion and review of new actions

JAXA remarked that the workshop at WMO had been very interesting and asked how WMO envisions helping with the coordination with the national actors. WMO responded that primary engagement is with the National Meteorological Services and WMO relies on its members to facilitate the engagement. With Japan (NIES) it works very well and they were represented at the workshop. WMO remains in dialogue with the national representatives, but is well aware of the difficulties.

WMO noted that it is working with other UN agencies and GEO etc., to facilitate the top-down and bottom-up approach for the carbon monitoring.

EUMETSAT asked which kind of services are envisioned. At this stage there are different approaches for monitoring CO2 emissions. As an example, the Copernicus Atmospheric Monitoring Service (CAMS) needs NRT products to be assimilated in their modelling system, targeting a future full service that will provide CO2 emission proxy. National entities (i.e., national statistical services) run a bottom-up analysis every year producing yearly emissions per sectors. Therefore, a GHG operational framework needs to position itself in a complex landscape and needs to first answer the question "who are the users". Based on a user's analysis, one can better identify what are the boundaries of a GHG operational framework.. WMO responded that it at the moment considers infrastructure, and not end user services as those were identified in CGMS-50-GUEST-WP-02/Post and CGMS-50-WMO-WP-12/Dolman. There is a clear need to work out service requirements. WMO also noted that we do not currently have enough information on the carbon cycle (i.e. sources and sinks) to provide clear guidance for supporting emission verification. The EC mentioned that in the Copernicus initiative, the EC is very careful to use the language "support to verification".

ISRO noted that it has started designing and Indian satellite system for carbon observations and asked which orbit, GEO or LEO, is more needed, or even both. WMO answered that the CEOS whitepaper on CO2 constellation outlines the needs for space-based observations. See https://ceos.org/observations/documents/CEOS_AC-VC_GHG_White_Paper_Publication_Draft2_20181111.pdf.

CGMS-50-JWGCLIM-WP-02: CEOS-CGMS WGClimate status report and future plans (A. von Bargen) and Plenary endorsement of new vice Chair from 2023

The JWGClimate is continuously updating the ECV Inventory and the group released version 4.0 last autumn.

The Inventory Gap Analysis Report for version 3.0 remains delayed due to the pandemic. The Gap Analysis exercise for version 4.0b was focused on the carbon cycle, especially the Global Stocktake components. Experts participated in a very successful workshop held in EUMETSAT on May 18-20 2022 in hybrid format. The related report is under development and will be merged with the version 3.0 report to ensure the publication of a single document. A draft document will be shared during the CEOS SIT Technical Workshop in mid-September. GCOS participated in the discussions, allowing some early feedback on the updated GCOS Implementation Plan. The publication is expected by end of 2022.

The JWGClimate continuously produces use cases for Climate Data Records. The use cases demonstrate CDR value in applications and decision making, and in providing feedback on quality. The use cases are published on the web (https://climatemonitoring.info/use-cases/). The number of cases is growing, and arrangements with ESA / CCI and ECMWF / Copernicus will be made to link their climate application use cases.

The Global Stocktake activities are ongoing (see GHG Task Team), especially in relation to AFOLU (IPCC: Agriculture, Forestry and Other Land Use).

The WGClimate Chair also presented recent activities of the JWGClimate including the recent gap analysis on carbon related variables. The report will become available to the autumn round of CEOS body meetings and will also be provided to CGMS.

Dr. Wenying Su (NASA) was nominated by the WGClimate as new Vice-Chair and WGClimate, and fully endorsed by the CGMS-50 plenary.

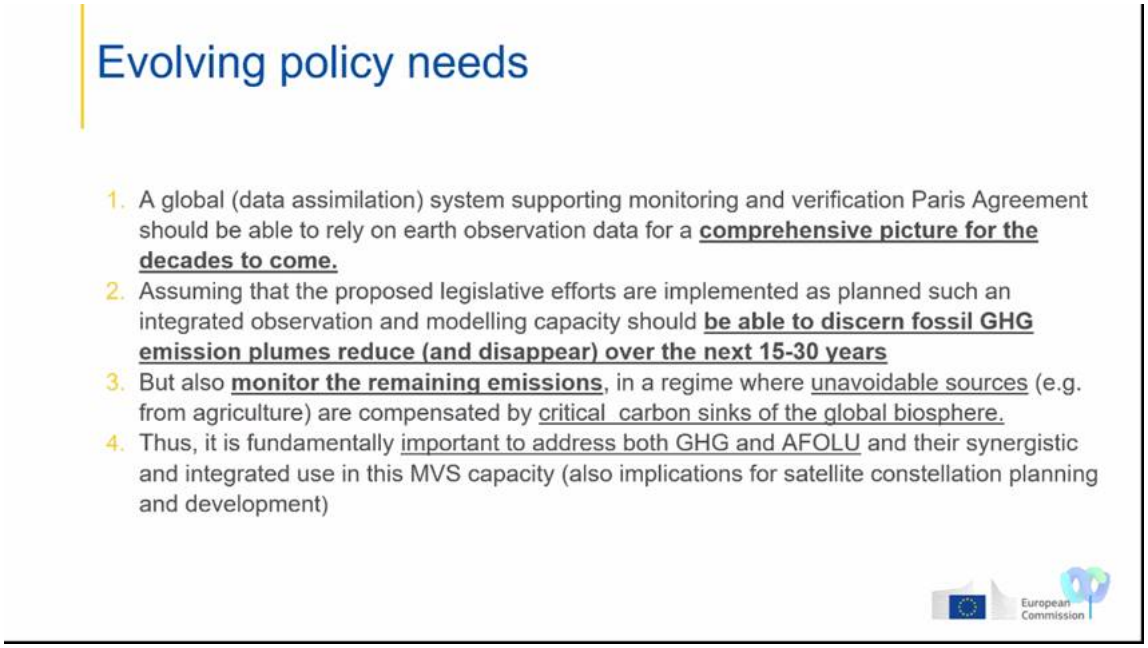
CGMS-50-JWGCLIM-WP-03: CEOS-CGMS WGClimate: GHG Task Team status and future plans (including CGMS agency support to the global stocktake 2023/2028) (M. Dowell, virtually)

The paper provided information on the pilot inventories as an input to COP-26. The GST work cycle for the UNFCCC Parties presented in CGMS-50-GUEST-WP-02 was reemphasised, and it is also very useful for the space agencies as it determines the way of working. Salient points to be noted on how CGMS members support the GST:

- Space Agency support to the generation of pilot products for the first Global stocktake (GST) – at COP-26
- Space agency support to the Systematic Observation guidance to the GST synthesis and technical assessment process
- The evolving policy context & complementarity of GHG & AFOLU Earth Observation support to the Paris Agreement (including the dedicated workshop in Nov 2021)
- Continued implementation of the GHG Roadmap towards the second GST
- Transition of research capacity to operations – what needs to be done

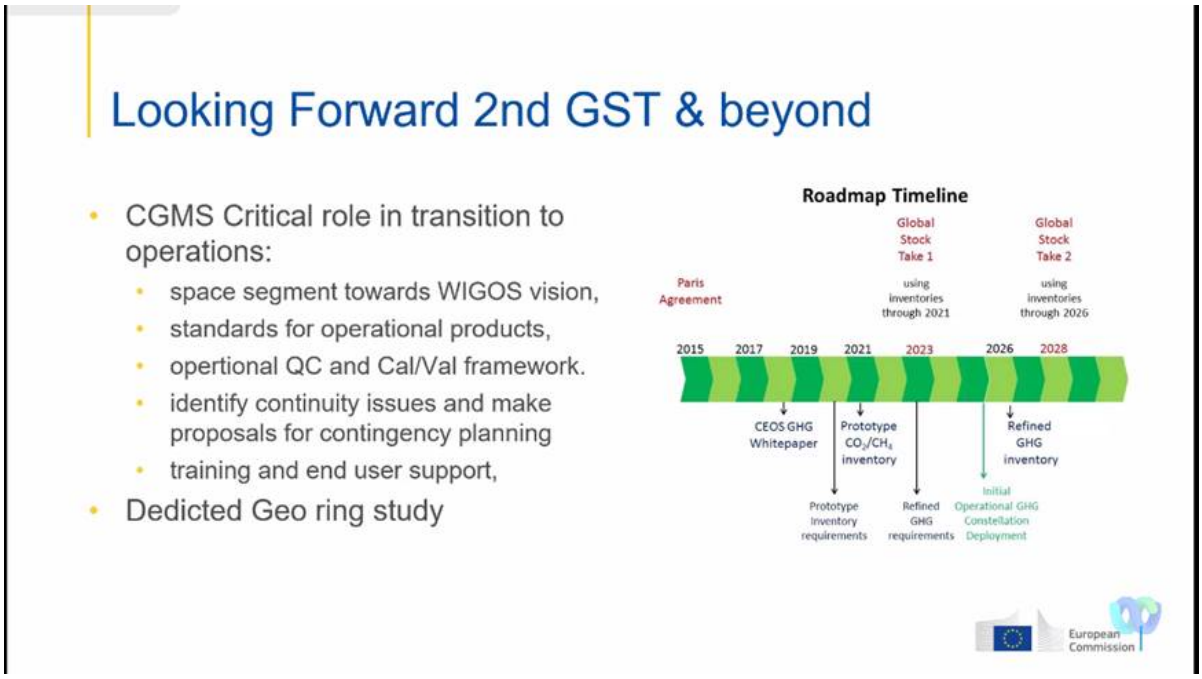
- Dedicated CGMS competence, studies, e.g. on the opportunities for a Geo-ring constellation
- Space agency support to WMO integrated GHG system framework, establishing: standards, best practices and interface to modelling and in-situ communities

The evolution of the observing system needs to take into account the evolving policy needs at a scale of a decade and more. This should also become part of the discussion in CGMS.



The GHG Task Team welcomed the coordination activity by WMO that the Task Team will contribute to. The leadership arrangement for the GHG task team is in need of a new chairperson, expected to be in place by end 2022. Nominations have been put forward to this purpose. The appointment was delayed due to the need to have the new WGClimate vice-chair in place, and the ex officio co-lead of the GHG Task Team is still open.

The GHG Task Team need to look forward to the second global stocktake and the CGMS contribution can be sketched as follows:



Discussion and review of new actions

EUMETSAT stated that the high frequency variability of the land surface parameters is important. Studies have shown that with new instruments such as the ABI, greening of forests can be detected. CGMS needs to work out what the missing elements in observations from geostationary orbit are. There is agreement that this should be done and the CEOS white paper for a GHG constellation serves as a good entry point for a discussion on GEO contributions.

CGMS-50-EUMETSAT-WP-16: Presentation of joint EUMETSAT-JMA-NOAA initiative on using cloud infrastructure for global GEO-ring climatology (J. Schulz)

The presentation addresses a joint initiative of EUMETSAT, JMA and NOAA that addresses the former CGMS plenary action A48.05 to make better use of geostationary ring observations for climate. EUMETSAT also provided a presentation on this to the CGMS WGIV Cloud Services Expert Group Workshop on Cloud Technologies dedicated to the link between the science and the use of cloud infrastructure.

Progress has jointly been made on a number of items:

- Better quality control for GEO data detecting radiometric anomalies and incorporating the information into the images with an ongoing study for GOES and Himawary-8/9 data at EUMETSAT;
- Improved cross-calibration of historic geostationary sensors using an improved HIRS data record; and
- ISCCP-NG has developed a prototype for a mapped radiance product (L1g) that will be reused.

Two planned projects will address:

- Data rescue and reprocessing of early GOES data: SMS and GOES 1-7 at the University of Wisconsin (UW) Cooperative Institute for Meteorological Satellite Studies (CIMSS) and the Space Science and Engineering Center (SSEC);
- Joint activities between EUMETSAT, JMA and NOAA to utilise cloud infrastructure to produce a consistent GEO-ring radiance data record and provide it to users via the clouds.

Discussion and review of new actions

EUMETSAT emphasised the significance of the GEO orbit and the increased capabilities for characterising the high-frequency part of the carbon cycle, including land surface parameters, and the need to understand which new GEO measurements can improve this understanding.

WMO highly welcomed the initiative and emphasised the impact of GEO observations for climate applications. In this respect, the Indian Ocean coverage from geostationary orbit is important and agencies should guarantee it. GEO-ring data usage for solar energy applications is also important. WMO further noted that the GEO coverage does not extend to the poles and that this could be considered in the project.

EUMETSAT noted that this is a success story. In Europe the incoming solar radiation at the surface derived from geostationary measurements are used in a PVGIS system for solar energy consulting developed by the EC that apparently has millions of users. This nicely shows the amplification of usage if the original data are in good shape. The inclusion of polar orbiting data into the GEO ring data set is also important to arrive at a truly global data set. EUMETSAT further stated that this is feasible and will be attempted at some point, but the partners need to watch affordability and therefore will start with the GEO ring.

WMO added that WGII will also follow up on the combined GEO-LEO products in the future.

CGMS-50 actions - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
GHG TT (JWG-Climate, WGII)	8.1	To be monitored by WGII WGII/(P)A50.06	Once the new GHG TT chairperson is in place, the GHG TT to invite CGMS WG I-IV points of contact for a dedicated discussion on specific CGMS WG contributions	Q1 2023

7. EDUCATION, TRAINING AND OUTREACH ACTIVITIES

Reports on outreach activities

CGMS-50-VlLab-WP-01: VLab (B. Connell, virtually)

The WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) provided a report on activities undertaken 2021 and its future plans. Since CGMS-49, VLab members have offered a variety of training opportunities which highlight training efforts addressing the new generation of satellites. This continues to be the major training need identified by VLab members. Strong 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 co-chairs representing CGMS satellite operators and VLab Centres of Excellence. In 2021 the two VLab Co-Chairs, Dr. Mark Higgins (EUMETSAT Training Manager) and Dr. Marinés Campos (Director of the RTC WMO-SMN Argentina), stepped down. Subsequently, the CGMS Plenary in May 2021 endorsed Dr. Bernadette Connell from the Cooperative Institute for Research in the Atmosphere of Colorado State University as the new VLab co-chair representing the CGMS space agencies. Mr. Wen Bo, from the CMA Training Center, was endorsed by the WMO as a representative of the Centres of Excellence.

The VLab Trust Fund continues to receive yearly contributions from NOAA/NWS, EUMETSAT, and KMA. A larger number of contributing CGMS agencies is desired 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 essential to maintain the VLab training activities.

CGMS plenary strongly recommended that all CGMS members contribute to the VLab Trust Fund to secure the continuity of these essential training activities.

CGMS-50 actions - Plenary Session – For WGIV to monitor and manage				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
CGMS members	6	WGIV/(P)A50.01	(Action to be monitored by WGIV) CGMS members are invited to contact WMO to 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-51

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 September 2022 (Darmstadt, Germany). CGMS members active in VLab are invited to send representation to participate in the meeting.

Discussion and review of new actions

WMO thanked Bernie Connell (CIRA/NOAA) for the support and guidance she has been providing to VLab as a new Co-Chair and as a member of the VLab community for more than 20 years. It was further noted that it would be important to broaden the scope of VLab covering a wide range of application areas, which is in line with a strategic shift to a more integrated "Earth system" approach taken by WMO. In addition, it was highlighted that VLab as a network of satellite operators, national meteorological services and some of the universities are very well positioned to provide support for achieving user readiness for the new generation of satellites, which should be considered as a very important focus for VLab. It was concluded that the views from the CGMS members are critical in defining the priorities for the coming years.

CGMS-50-joint-JMA-KMA-WP-01: RAII WIGOS project

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 Third Joint Meeting of RA II WIGOS Project and RA V TT-SU for RA II and RA V NMHSs was held online, on 5 November 2021. The outcomes of the meeting as well as key activities for the next two years were presented.

In addition, the updates on the RA II WIGOS project webpage as a common gateway for access to rapid scan imagery from CMA, JMA and KMA were presented. The Portal provides links to: CMA Emergency Support Mechanism of FENGYUN Satellite (FY ESM); JMA HimawariRequest Service; KMA GEO-Kompsat-2A AMI Rapid Scan (ARS) Service. For further details, please visit https://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro_en_jma.html#request.

CGMS plenary took note of the report.

8. CONFERENCE ANNOUNCEMENTS

CGMS-50-EUMETSAT-WP-10: EUMETSAT Meteorological Satellite Conference, 19-23 September 2022

The EUMETSAT Meteorological Satellite Conference will be held in Brussels on 19-23 September 2022, under the theme: "A digital ecosystem for Earth observing". For further information, please visit https://www.eumetsat.int/eumetsat-meteorological-satellite-conference-2022.

CGMS-50-JMA-WP-09: AOMSUC-12, 14-18 November 2022 (K. Bessho)

Japan Meteorological Agency is happy to be the host of the 12th Asia-Oceanic Meteorological Satellite Users Conference. AOMSUC-12 will be held in Japan, from Sunday 13 to Friday 18 November 2022. Further announcements will follow in due course. Further information is available here:

https://www.ssec.wisc.edu/meetings/meeting/aomsuc-12/. [NB due to the pandemic, the conference will be fully virtual, status as of September 2022].

CGMS-50-NOAA-WP-21: CMM, 8-12 August 2022 (N. Donoho)

NOAA will host the Collective Madison Meeting on 8-12 August 2022. It is the joint NOAA-American Met Society (AMS) meeting. Further information is available here: https://www.ametsoc.org/index.cfm/ams/meetings-events/ams-meetings/collective-madison-meeting/.

CGMS-50-WMO-WP-17: GCOS Climate Observation Conference, 17-19 October 2022 (H. Dolman)

The 2nd Climat Observing Conference will be held in Darmstadt, Germany, on 17-19 October 2022. Please visit the conference website here:

https://www.eventsforce.net/eumetsat/frontend/reg/thome.csp?pageID=14409&eventID=34&CSPCHD=000001000000c7ZvkFjd6jG94cuLvlF1ovfEPGeFwyx1llkza.

14. FUTURE DIRECTION OF CGMS

CGMS-50-CGMS-WP-20: Future direction of CGMS – proposal by the CGMS Secretariat; and CGMS-50-CGMS-WP-38: Considerations for the review of the future directions of CGMS (P. Evans)

The Head of the CGMS Secretariat presented a proposal to plenary on the future direction of CGMS with the objective to have a strategic review of CGMS activities and processes and ensure that CGMS continues to best serve its members and users, in a rapidly changing environment.

The objective would be to:

- Take into account the impact of the changing environment and user requirements;
- Take into account changes in the CGMS leadership;
- Set the priorities for the next 10 years and beyond; and
- Regularly assure CGMS activities address issues of importance to space agencies and users in the long term.

The considerations for setting the future direction of CGMS entail:

- Future strategic topics which will impact activities of CGMS agencies and interactions with users:
  - Evolution of user requirements – focus on NWP and operational interests from weather, climate and environmental communities – need for data to support adaptation and mitigation under a warming climate;
  - Evolution of space architecture with increasingly integrated approach towards Earth System observations, and potential impact on users;
  - Evolution of ground segment and potential impact on users;
  - Future combined LEO/GEO products;
  - Roadmap towards inclusion AI/ML and Cloud technologies in operations;
  - Interactions with commercial providers;

- Evolution of WMO requirements and role of WMO in defining CGMS priorities (i.e. GHG Observing;
- System,...) – the increasingly integrated approach to the Earth system Sustained interactions and definition of high level scientific requirements with International Science Working Groups;

- Function and priorities CGMS working groups;
- How WGs fit into CGMS and also how CGMS WG outcomes are/should be used by Agencies;
- Good practices (current systems), future focused on new systems;
- Interfaces with other international groups (CEOS/GEO) to optimise synergies and avoid duplications; and
- Tuning of the CGMS high level priority plan (HLPP) and possible revision of the CGMS Charter.

To address all these issues, the CGMS Secretariat proposed the establishment of a task team based on to-be-agreed Terms of Reference, and a one year project for completion by CGMS-51 plenary.

Discussion and review of new actions

The overall feedback and proposal on future direction of CGMS can be summarised as follows:

- Consistent support for a review of key strategic direction;
- Interest in implications of new opportunities and challenges for community;
- Reprioritisation and focussing of activities;
- Interfaces with other bodies and activities;
- Needs to be strategic rather than entirely bottom up;
- Biggest question was what is focus of review proposal;
- Consult with delegations on 'key questions' to frame work of task team – over summer;
- Synthesise into summary – end August; and
- Host an on-line meeting a 'strategic' level with CGMS agencies to agree strategic framing – September.

NOAA supported the idea for a strategic review and welcomed the proposed process allowing time for addressing these key questions.

WMO welcomed the proposal to have a strategic and visionary review of CGMS. CGMS members represent a large community for the WMO users. Congress has approved the WMO 10-year strategic plan 2020-2030, and WMO invited the space agencies to review the plan. All space agencies also have long-term plans, and WMO requested that all space agencies share their strategic plans and documents. This would also help with orienting the common and future direction of CGMS.

WMO further suggested it would be important to consider this in the broader picture with other relevant groups, e.g. like CEOS. The Head of the CGMS Secretariat responded that this is in principle a good suggestion and that the mechanics would need to be considered how to best such secure the interactions. However, the agreement on the strategic directions would need to be solely for the CGMS members.

In conclusion, the Plenary Chair noted that CGMS-50 plenary agreed on the way forward, and that the CGMS Secretariat would take an action to secure the implementation. The Head of the CGMS Secretariat noted that this activity would be important to secure the continued success of CGMS.

CGMS-50 actions - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
CGMSSEC/ CGMS members	8	A50.04	CGMSSEC to invite CGMS members to nominate participants to the CGMS future direction 2022+ Task Team and review the associated draft ToRs	Sep 2022
CGMS future direction Task Team	8	A50.05	The CGMS future direction Task Team to report to the final conclusion to plenary for plenary endorsement (according to the to-be-agreed Terms of Reference)	CGMS-51

9. CGMS HIGH LEVEL PRIORITY PLAN (HLPP)

Endorsement of the CGMS High Level Priority Plan (HLPP) 2021-2025

CGMS-50-CGMS-WP-15: Status of implementation of CGMS High Level Priority Plan (2021-2025) and CGMS-50-CGMS-WP-26: Revised HLPP 2022-2026 - for plenary endorsement (M. Rattenborg)

As part of the agreed revision cycle for the CGMS HLPP, CGMS-WP-16 presented a proposed HLPP covering the period 2022-26. The plan is based on the following intersessional activities:

- Meetings of the International Science Working Groups
- Recommendations from of WGI, WGII, WGIII, WGIV, SWCG, and JWGClimate

WGI, WGII, WGIII, WGIV, and SWCG considered the draft revision at the WG meetings in April-May 2022 and proposed a number of amendments, all highlighted in this document.

The CGMS-50 plenary session endorsed the proposal for a revised HLPP covering the period 2022-2026.

Following CGMS-50, a final version of the updated HLPP will be published on the CGMS website.

10. REVIEW OF CGMS-49 PLENARY ACTIONS AND RECOMMENDATIONS

Review of actions from CGMS-49

CGMS-50-CGMS-WP-36: Status of list of CGMS-49 actions

Status of CGMS-49 actions following CGMS-50 discussions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
WMO	H	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.	**2022 17 June: Closed on the occasion of CGMS-50** **2022 Mar:** Likely to be postponed to CGMS-51 **2021 May 16**: Postponed to CGMS-50 (CGMS-49 being virtual) **2021 Apr:** WMO expected to report to plenary. (JCOMM activities have been refocused following the WMO reform) **2020 Aug:** CGMS-48-WMO-WP-15 (WMO reform and coordination with JCOMM). WMO is requested to report to CGMS on the implementation, status and plans at CGMS-49. 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	CGMS-51 (CGMS-47)	**CLOSED**	3.6

Status of CGMS-49 actions following CGMS-50 discussions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				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 members • CMA • CNES • CNSA • ESA • EUMETSAT • IMD • IOC-UNESCO • ISRO • JAXA	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	**2022 20 May:** Ref. CGMS-50-JWGCLIM-WP-02 (V3 will be integrated into Gap Analysis 4 Report expected for publication end of 2022). **2021 29 Oct:** The new version of the ECV Inventory (v4.0) is available on **https://climatemonitoring.info/ecvinventory/** EXT. **2021 27 Sep:** Version 3.0 expected to be published end 2021 and will be endorsed via written/e-mail procedure. (Version 4.0 is under preparation, CGMS-49-JWGCLIM-WP-01 and CGMS-49-JWGCLIM-WP-03)	Dec 2022 (Oct 2019)	**ONGOING**	5.1.1

Status of CGMS-49 actions following CGMS-50 discussions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
• JMA • KMA • NASA • NOAA • ROSCOSMOS • ROSHYDROMET • WMO • IWWG • IROWG • IPWG • ICWG • ITWG • JWGCLIM				**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 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.			
Chairs of WGClimate/ GHG TT	6.2	A48.07	WGClimate/GHG TT Chair together with the CGMS WG representatives to define priorities for CGMS WGI-IV contributions.	**2022 20 May:** Ref. CGMS-50-JWGCLIM-WP-03. Ongoing, there will be a change in the Task Team lead and once this is in place, the response to the action can progress. **2021 May 19:** Partially complete. Each CGMS WG has nominated a liaison who will be invited to participate in future WGClimate meetings. Before and during the next WGClimate meeting	CGMS-51 (Nov 2020)	**OPEN**	5.1.4

Status of CGMS-49 actions following CGMS-50 discussions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				(August/September), WGClimate will work with these representatives on priorities. Expected to be addressed at CGMS-49 WGII and in the plenary climate session (and at the next GHG Task Team meeting) Representatives from CGMS: WGI sean.burns@eumetsat.int WGII jeff.privette@noaa.gov, mitch.goldberg@noaa.gov WGIII Peng ZHANG zhangp@cma.gov.cn WGIV sean.burns@eumetsat.int			
Co-chairs of WGI, WGII, WGIII, WGIV	6.2	A48.08	CGMS WGs I-IV to reflect the operationalisation of the GHG monitoring system and to discuss with the WGClimate GHG Task Team the roles of each WG for the implementation that becomes part of the roadmap's work plan (deadline CGMS-49 Plenary to serve as input for next WGClimate presentation)	**2022 20 May:** Ref. CGMS-50-JWGCLIM-WP-03. Open, linked to A48.07 (and the need for a new Task Team lead). **2021 27 Sep:** No further progress. See action Plenary A48.07 **2021 24 Feb:** To be addressed initially on the occasion of the CGMS-49 working groups in April and at the next GHG TT meeting	CGMS-51 (CGMS-49)	**OPEN**	5.1.4

Status of CGMS-49 actions following CGMS-50 discussions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
IOC-UNESCO	2	A49.01	IOC-UNESCO to provide CGMS-50 guidance of the Global Ocean Observing System (GOOS) for improved IOC and WMO ocean and atmosphere predictions and other services.	**2022 May:** CGMS-50 plenary session on operational ocean monitoring under preparation. Pending feedback by IOC UNESCO.	CGMS-51 (CGMS-50)	**OPEN**	3.6
CGMS members • CMA • CNES • CNSA • ESA • EUMETSAT • IMD • IOC-UNESCO • ISRO • JAXA • JMA • KMA • NASA • NOAA	4.1	A49.02	CGMS members to endorse the IPWG paper "A review of the different operational applications of spaceborne precipitation radars within the International Precipitation Working Group(IPWG) community" by 15 June (e-mail procedure) following review and recommendation by WGII by 7 June	**CLOSED** The IPWG paper was endorsed by CGMS plenary through a written (e-mail) endorsement procedure and circulated on the CGMS list server.	7 and 15 Jun 2021	**CLOSED**	1.1.3

Status of CGMS-49 actions following CGMS-50 discussions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
• ROSCOSMOS • ROSHYDROMET • WMO							
CGMSSEC	4.1	A49.03	CGMS to provide a letter of support to JAXA on the DPR follow-on mission/ precipitation radar efforts and following endorsement of IPWG paper (see A49.02)	**CLOSED** The CGMS Secretariat submitted the letter of support to JAXA on 6 July 2021 (CGMS/LET/21/122972) JAXA response letter (S1OC No.0830001) of 13 Sep 2021. Joint studies with NASA are ongoing. Progress reports will be made to CGMS sessions.	End June 2021	**CLOSED**	1.1.3
CGMSSEC	4.1	A49.04	CGMS to provide a letter of support to NOAA on the implementation of the GEO-XO ACX mission, for the purpose of mitigating the gap for geo air quality measurements post NASA's Tempo observations.	**CLOSED** The CGMS Secretariat submitted the letter of support to NOAA and NASA on 4 November 2021 (CGMS/LET/21/1229754)	Aug 2021	**CLOSED**	1.2.3

Status of CGMS-49 actions following CGMS-50 discussions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
CGMS members • CMA • CNES • CNSA • ESA • EUMETSAT • IMD • IOC-UNESCO • ISRO • JAXA • JMA • KMA • NASA • NOAA • ROSCOSMOS • ROSHYDROMET • WMO	6.2	A49.05	CGMS members to nominate scientific experts (not necessarily agency staff) in order to support the upcoming ECV inventory gap analysis with respect to the Carbon Cycle ECVs, including Global Stocktake aspects.	Addressed at the WGClimate workshop in EUMETSAT, May 2022 and therefore closed. (To also be addressed within the framework of WGII)	CGMS-50 (Aug 2021)	**CLOSED** (Ref. WGII LOA)	5.1.1

11. SUMMARY OF CGMS-50 PLENARY ACTIONS AND RECOMMENDATIONS

List of actions resulting from CGMS-50 discussions

Summary list of plenary actions following CGMS-50 discussions						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CGMS members • CMA • CNES • CNSA • ESA • EUMETSAT • IMD • IOC-UNESCO • ISRO • JAXA • JMA • KMA • NASA • NOAA • ROSCOSMOS • ROSHYDROMET • WMO • IWWG • IROWG	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	**2022 20 May/June:** Ref. CGMS-50-JWGCLIM-WP-02 (V3 will be integrated into Gap Analysis 4 Report expected for publication end of 2022). **2021 29 Oct:** The new version of the ECV Inventory (v4.0) is available on **https://climatemonitoring.info/ecvinventory/** EXT. **2021 27 Sep:** Version 3.0 expected to be published end 2021 and will be endorsed via written/e-mail procedure. (Version 4.0 is under preparation, CGMS-49-JWGCLIM-WP-01 and CGMS-49-JWGCLIM-WP-03) **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).	Dec 2022 (Oct 2019)	**ONGOING**

Summary list of plenary actions following CGMS-50 discussions						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
• IPWG • ICWG • ITWG • JWGCLIM				**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 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.		
Chair of WGClimate/GHG TT	6.2	A48.07	WGClimate/GHG TT Chair together with the CGMS WG representatives to define priorities for CGMS WGI-IV contributions.	**2022 20 May/June:** Ref. CGMS-50-JWGCLIM-WP-03. Ongoing, there will be a change in the Task Team lead and once this is in place, the response to the action can progress. **2021 May 19:** Partially complete. Each CGMS WG has nominated a liaison who will be invited to participate in future WGClimate meetings. Before and during the next WGClimate meeting (August/September), WGClimate will work with these representatives on priorities. Expected to be addressed at CGMS-49	CGMS-51 (Nov 2020)	**OPEN**

Summary list of plenary actions following CGMS-50 discussions						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				WGII and in the plenary climate session (and at the next GHG Task Team meeting)		
Co-chairs of WGI, WGII, WGIII, WGIV	6.2	A48.08	CGMS WGs I-IV to reflect the operationalisation of the GHG monitoring system and to discuss with the WGClimate GHG Task Team the roles of each WG for the implementation that becomes part of the roadmap's work plan (deadline CGMS-49 Plenary to serve as input for next WGClimate presentation)	**2022 20 May/June:** Ref. CGMS-50-JWGCLIM-WP-03. Open, linked to A48.07 (and the need for a new Task Team lead). **2021 27 Sep:** No further progress. See action Plenary A48.07 **2021 24 Feb:** To be addressed initially on the occasion of the CGMS-49 working groups in April and at the next GHG TT meeting	CGMS-51 (CGMS-49)	**OPEN**
IOC-UNESCO	2	A49.01	IOC-UNESCO to provide CGMS-50 guidance of the Global Ocean Observing System (GOOS) for improved IOC and WMO ocean and atmosphere predictions and other services.	**2022 May/June:** A brief CGMS-50 plenary session was held on operational ocean monitoring. Pending feedback by IOC UNESCO + WMO to reach out to IOC.	CGMS-51 (CGMS-50)	**OPEN**
CGMSSEC, WMO	4.5	A50.01 (a)	CGMSSEC and WMO to consider if night-time light capabilities should be covered in HLPP, the CGMS Baseline, and should be reflected in the WMO Gap Analysis.		CGMS-51 WGIII, CGMS-51	**OPEN**

Summary list of plenary actions following CGMS-50 discussions						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
WMO	4.5	A50.01 (b)	If night-time light capabilities shall be covered in the HLPP and the CGMS Baseline, WMO to reflect this in the WMO Gap Analysis.		CGMS-51	**OPEN**
CGMSSEC	5	A50.02	CGMS (SEC) to formally request the GHRSST, IOCCG, OSTST, and OSTWG to analyse the state of the current and future ocean missions by analysing and contributing to the appropriate CGMS WGs (WG III in particular for observational gaps, and WG IV for data access) with a focus on operational requirements relevant to CGMS agencies, as part of their routine ocean WG activities.		Sep 2022	**OPEN**
EUMETSAT (CGMSSEC)	5	A50.03	The CGMS Secretariat to collate the inputs from the Ocean WGs and prepare a co-authored report on the “State of operational satellite missions” describing the state of the operational missions and identifying any potential issues for the next 20 years (in cooperation also with the IOC and the WMO).		April 2023	**OPEN**

Summary list of plenary actions following CGMS-50 discussions						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CGMSSEC/ CGMS members	8	A50.04	CGMSSEC to invite CGMS members to nominate participants to the CGMS future direction 2022+ Task Team and review the associated draft ToRs		Sep 2022	**OPEN**
CGMS future direction Task Team	8	A50.05	The CGMS future direction Task Team to report to the final conclusion to plenary for plenary endorsement (according to the to-be-agreed Terms of Reference)		CGMS-51	**OPEN**

See also WGII and WGIV list of actions for actions placed by plenary on these working groups to monitor.

Working Group co-chairs and rapporteurs have access to the list of actions for monitoring purposes.

12. FUTURE CGMS PLENARY SESSIONS

CGMS-50-CGMS-WP-32: Tentative schedule of future CGMS plenary sessions (A. Taube)

The CGMS Secretariat informed plenary of the schedule for the future plenary sessions:

CGMS plenary #	Year	Location
CGMS-51 - confirmed	2023	Japan
CGMS-52	2024	North America
CGMS-53	2025	Europe
CGMS-54	2026	South Korea
CGMS-55	2027	India
CGMS-56	2028	Russian Federation
CGMS-57	2029	China
CGMS-58	2030	WMO
CGMS-59	2031	…

The CGMS Secretariat informed plenary that the date poll made showed a clear winner: 25-30 June 2023. This would be an in-person meeting with the working groups taking place immediately prior to plenary.

However, the working group representatives and the CGMS Secretariat have discussed and suggest to hold the plenary working group meetings 4-6 weeks prior to the plenary session itself, simply to allow for better preparation of the working group conclusions and presentations to plenary and as has been the case for CGMS-51. This to enable a significantly more focused plenary session, and in particular to reduce the significant pressure on the working group rapporteurs that need to prepare all the reports and presentations etc. There was also a wish for the plenary working group meetings to be in-person meetings, again to make them more effective and efficient. All five CGMS working groups voiced such a set-up.

ISRO noted that another way of implementing the plenary might be over 5 days (1-day plenary followed by 2 days' working groups and again followed by 1-day plenary). This was the case for committee meetings of the GNSS. This variant would also reduce the need for travel.

The Chairman noted that this will be addressed in the preparation for next meeting and together with the CGMS Secretariat and the working group leads.

CGMS-50-JMA/JAXA-WP-01: CGMS-51

JMA and JAXA announced that they will host CGMS-51 in June or July 2023 in Japan. The hosts of CGMS-51 look forward to seeing all delegation in-person in Japan. The precise location will be announced in due course.

13. ANY OTHER BUSINESS – AOB

The CGMS Secretariat recalled that on the occasion of the CGMS 50th anniversary, Heads of CGMS members, had been asked to respond to the following three questions:

- What should the priorities for CGMS be in the next 10 years?
- How has the CGMS cooperation benefitted your agency to date?
- What are the main challenges serving your own user community and in what way can CGMS support this?

The CGMS Secretariat expressed its sincere thanks to all the contributors and invited CGMS members to visit the CGMS website to listen to their responses: https://cgms-info.org/cgms-50-years-1972-2022/.

It was noted that this information would also be useful for the preparation of the future direction of CGMS 2022+.

14. CLOSING SESSION

Handover of CGMS flag

The WMO Secretary-General Professor P. Taalas, and CGMS-50 host, handed over the CGMS flag to the JMA and JAXA delegations, Mr Kotaro BESSHO and Mr Hirabayashi TAKESHI respectively in view of their hosting of CGMS-51 in 2023.

The Chairman expressed his sincere thanks to JMA and JAXA for confirming the hosting of the next plenary session in 2023.

Closing remarks

WMO thanked all attendees, in-person and online, for their enthusiasm and participation. The Chairman also thanked the support from the WMO and CGMS Secretariat teams to secure the success of the meeting. He further hoped that the entire CGMS community can gather face-to-face again at CGMS-51 next year.

The Head of the CGMS Secretariat, EUMETSAT Director-General, recalled that it was his first, full and in-person CGMS plenary, and an opportunity to finally getting to meet most of the members in person. He also noted the high level of the contents of the presentations and discussions enabling everyone to have a clear overview of the CGMS community's status of affairs and future outlook. He concluded by thanking WMO for hosting the meeting and for all those who had supported the preparation and execution of the meeting.

The plenary session ended at 12:08 (CEST).

15. CGMS 50TH ANNIVERSARY SPECIAL EVENT #SATELLITES4SOCIETY

The CGMS turns 50 years old in 2022. It started with geostationary meteorological satellites, gradually expanding to include polar and highly elliptic orbit observations for weather, oceans and climate. CGMS aims to provide an end-to-end system – from providers to the global user community.

On the occasion of CGMS-50 plenary a special event was held to commemorate the first 50 years.

Petteri Taalas, WMO Secretary-General, expressed the sensation of a "grandfather feeling". WMO, 149 years old, is happy to see that the "CGMS community son" is progressing well having reached the age of 50. He recalled how he himself, as a university student, heard of new satellite programmes with several voices considering it being a waste of money and that it would be better to invest in radio soundings rather than satellites. Today, we know a strong investment in the space-based component, supported by adequate qround-based observations, is key.

He continued by saying that the unique feature of meteorology is that we are able to *collaborate*. Many communities dream of free exchange of data, whereas in our field it is a reality.

There has been great progress in the satellite business, and albeit costs, the returns and benefits are manifold. There has been a significant increase of the resolution of satellite measurements and the future is promising with new monitoring capabilities for wind profiling and greenhouse gases to mentioned but a few.

WMO promotes early warning systems for its members; greenhouse gas budget monitoring; CGMS's contributions are considered an asset besides the classical ground-based observations, assimilation and modelling tools. WMO will bring this as guidance to the upcoming COP-27.

There was a successful WMO Extraordinary Congress October 2021, with a new data policy approved, the ground-based network – GBON (Global Basic Observation Network), and the financing mechanism – SOFF (Sustained Observations Financing Facility) - for the LDCs. This approval is at governmental level, and hence the data policy is also valid for CGMS space agencies.

The free exchange of data is crucial to the WMO community. New developments and opportunities are on the way such as microsatellites, and the private sector involvement. Therefore, securing the free and open data policy as well as handling the significant increase in data quantity is critical.

He iterated that WMO continues to need CGMS's expertise and concluded by thanking the organisers of and contributors to the event.

Phil Evans, Head of the CGMS Secretariat and EUMETSAT Director-General, highlighted what 50 years of successful cooperation has brought:

- 50 years of successful international cooperation;
- 50 years of space-based operational coordination;
- 50 years of exchange of scientific information, sharing lessons learnt and experiences;

- 50 years of providing and supporting services for the crucial protection of lives and property, increasingly to help supporting society to deal with climate change and to be involved with a community that plays such an important role.

He concluded by saying that whilst adapting to the changing environment, CGMS will continue to provide coordinated global satellite information on weather and climate change for the sake of society.

A short video shown, illustrated the importance of international cooperation and in the framework of CGMS.

Mr. Evans then welcomed the invited speakers including young professionals, to talk about their use of satellite data and an outlook to the future, perhaps feeding CGMS's thoughts for planning the next 50 years.

CGMS-50-GUEST-WP-10: The importance of making critical satellite data available for Earth observation, including weather forecasting and severe weather events (V. Otieno, Earth observation expert, IGAD Climate Prediction and Applications Centre – ICPAC)

Ms Otieno agreed that weather and climate are important components in protecting lives and livelihoods. She noted that in the last 50 years, 35 % of deaths resulting from hydro-meteorological disasters were recorded in Africa. Projections show an increased frequency and intensity of such extreme events as recorded in the latest IPCC report.

She highlighted that the benefits of coordinated satellite data observations are manifold:

- Abstracting the inherent complexities of satellite data from users allowing for **seamless** access and utilisation of highly varying data from different providers;
- Key-enabler of the proliferation of satellite-based services and products. It has also facilitated the growth of space-based start-ups and private companies including in Africa; and
- It is the backbone of integrated systems whether integrated monitoring or early warning system (multi-hazard early warning systems).

ICPAC's utilises various satellite data to provide much needed early warning information in the Eastern Africa region and their experience with the current ongoing 2020-2022 drought in the region. A region highly vulnerable to climate extremes and populations with the lowest adaptive capacity. Some of the systems that have been developed are East Africa Hazards Watch and the East Africa Drought Watch.

For the future, she identified the following needs:

- A focus on application and services development - as the volume of data continues to grow tremendously, data access including;
- Improved accuracy of satellite products, improved data processing, new products based on growing user needs;
- Improved lead time for forecasting products; and
- Continued and enhanced coordination and collaboration across the board between data providers, users and the intermediaries such as private sector and researchers.

CGMS-50-GUEST-WP-09: The importance of making critical satellite data available for Earth observation, including weather forecasting and severe weather events (R. Mena Speck, Director, UNDRR)

Mr. Mena Speck highlighted that satellite-derived information plays an important role in all phases of disaster management. Satellite data for impact-based forecasting and to better understand risk and inform risk-sensitive planning (priorities 1 and 4 of the Sendai Framework).

He further noted that advances in the possibilities for using Earth observation resources increases the understanding of social effects of disasters. This enables a nuanced analysis of highly localised processes due to the increasing granularity of images (e.g. illegal deforestation, EW, etc.), and permits a more detailed assessment of processes that change quickly due to the higher frequency of updates (e.g. humanitarian settlement patterns, fertiliser runoff into river deltas).

He also pointed out the associated challenges:

- Tendency to measure what we value (buildings, farms, humans);
- Missed chances to identify changes to ecosystems, social systems and existing connections (access to nutrition or cultural practices);
- Availability of and access to data; and
- Capacity of actors mandated to manage risk to access data or lacking the technical capacity to do so.

Mr. Mena Speck concluded by recommending the following to CGMS:

- Increasingly adopt a free and open data policy for Earth Observation data;
- Embrace open-source software, standards and data, where possible;
- Invest in training, capacity development, and the inclusion of stakeholders; and
- Be mindful of important considerations related to data ethics and protection.

Thereafter, three young professionals gave their view on their use of Earth observation data and their needs for the future:

CGMS-50-GUEST-WP-04: (M. Fonseca Mora, Universidad Nacional de Costa Rica)

Ms. Fonseca Mora has a degree in meteorology, has worked in the Costa Rican NMS, and now works for an international organisation that provides climate solutions in different areas. She participated in a meteorological research projects, which included satellite meteorology and acquired the skills to learn how to read processed satellite data and derive products. This was complemented with her participation as a technical assistance at a NOAA training session on satellite applications for Costa Rica. Recently she has been introduced to the GPM mission and precipitation measurements from satellites for the civil aviation of Costa Rica, and utilisation correlated with her current research. Precipitation has been identified in the IPCC report to be one of the major challenges for better understanding of climate and weather in Costa Rica.

There are few automated stations in remote areas and therefore Costa Rica needs satellite data to complement the data sets available, as well as to improve better information on remote parts of the country to enable appropriate decisions by authorities and for emergency response.

For the future, Ms Fonseca Mora emphasised the importance of continued and further training for users to use the satellite data, as well as free and open data for the research community including young professionals.

CGMS-50-GUEST-WP-06: (R. Salman, forecaster, Indonesia Agency for Meteorology Climatology and Geophysics (BMKG)

Mr. Salman is a forecaster at the Pattimura Meteorological Station of Ambon, a meteorology and climatology researcher, coupled with being a remote sensing and GIS enthusiast.

There is lack of observations in Indonesia, therefore weather satellite data are of great importance. BMKG is responsible for monitoring rainfall and oceans and, in particular for aviation for take-off and landing, this can be done thanks to the satellite data.

However, it is also necessary to understand how to use the satellite data to serve the people for several application areas such as crop monitoring, hydrology, Nowcasting, ocean, aviation, Numerical Weather Prediction, flooding, agriculture, and climate – this in order to save lives.

For the future, it would be important to develop satellites and observations to improve the forecast systems. Impact forecasting leads to reduced disasters which in turn is linked to the economy and stakeholder needs. He hoped his region will continue to receive support from WMO, CMA, JMA, KMA, NOAA and other meteorological satellite agencies in view of the impact of climate change. He concluded by sincerely thanking the satellite data providers.

CGMS-50-GUEST-WP-07: (K. A. Guenoukpati, forecaster/protectionist, Agency for Aviation Security and Navigation in Africa and Madagascar (ASECNA), Niger

Mr. Guenoukpati is an aeronautical meteorologist working in ASECNA, and at the special event bringing the voice of the meteorological aviation community to CGMS. He reminded the WMO and space agencies on the role of meteorology and expectations of observations for the aviation business.

Today, the NMSHs provide all meteorological information for the take-off and landing of flights whereby the cloud situation, punctuality and regularity of flights including cost impacts following the decisions of the airlines. There is a great role of responsibility for forecasters in providing the right information at the right time, and hence the importance of being able to access global observations.

Mr. Guenoukpati had several very clear messages to give to CGMS:

- More data are needed: No observations mean no forecast and no aviation!
- Insufficient observations equal insufficient forecasting equal unsafe navigation!

- Necessity for increased spatial resolution.
- Necessity for increased timeliness – rather than 15-minutes, every 2-5 minutes.
- Easy access to climate data products.
- Enhanced NWC products for Africa to assist with the navigation, and a challenge to maintain with radar.

Special greeting

John Morgan, the first Director of EUMETSAT, joined the 50th anniversary event virtually and told his CGMS story. Mr. Morgan attended many CGMS plenary sessions with the 4th CGMS plenary session being his very first. He recalled that the meeting report had to be prepared in near-real time together with actions to be presented to senior management for approval on the last day. The report was around 60 pages long and he innocently asked, who will do the report, a question he should never have asked – the task was put on him.

The meetings were very practical, nobody argued, it was more like a meeting with a club of friends. There were many similar items compared to today's agenda, albeit simpler: Satellite programme plans, processing, communications – plus close at heart – the *contingency planning* – Should a satellite fail in orbit, it was very difficult to replace, and therefore discussions were always held on this topic. It was called neighbouring satellite opportunities to fill the gaps. He highlighted this is an extremely important point as it saves money (and lives). The strength of CGMS is also the value of personal contacts, and at the start there were four satellite operators only, Japan, Russia, Europe and North America. There was a very close relationships and were there any problems it was just a matter of picking up phone, and extremely valuable so.

He concluded that there are many more players today but he hoped that the informal cooperation continues behind the scenes just as it did back then. He wished CGMS good luck for the future.

Concluding remarks

Mr. Evans congratulated CGMS on its 50th anniversary, inviting everyone to look forward to the next 50 years and to take due note of the user needs expressed and use it as a guide to the future.

The event was concluded by complementary happy birthday greetings.

The recording of the full event is available here.

Joint WGII-WGIII report

Parallel working groups

50 YEARS 1972–2022

CGMS

WORKNG GROUP 1 (WGI)

Satellite systems and operations

50 YEARS 1972–2022

CGMS

WG I REPORT

Chair: Vanessa Griffin (NOAA)
Acting Co-Chair: Dohyeong Kim (KMA)
Rapporteur: Karolina Nikolova (EUMETSAT, acting)

1. Opening, agenda, objectives / WGI co-chair and rapporteur status and confirmation

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

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

The WGI meeting was once again 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 participate also in the joint WGI-WGIV-SWCG Meeting.

2. Frequency management matters (incl. space weather matters)

2.1 Frequency management topics including WRC-19 and WRC-23

CGMS-50-CGMS-WP-11 Report from the CGMS/SFCG Liaison Officer

Due to Covid-19, SFCG-40, planned to be held in Palm Cove (Australia) in September 2020, was moved to October 2021. Due to the continuing Covid-19 situation the meeting could not be held physically in October 2021 either. Instead, the most important work was carried out by correspondence and in form of web meetings of the different Special Working Groups (SWGs) of the SFCG. To avoid confusion with document numbers, it was decided to call the web meetings still SFCG-40 so that the physical meeting planned in July 2022 would be called SFCG-41.

The issues of relevance for CGMS that were discussed and progressed by correspondence are:

- Update to SFCG Objectives for WRC-23 and beyond;
- Response to SFCG Action Item 39/7 regarding the SFCG review and response to keeping the OSCAR database up-to-date.

The revised preliminary SFCG Objectives for WRC-23 in Resolution SFCG 40-1R1 are still in-line with the WMO positions to WRC-23 as contained in CGMS50-WMO-WP-05. SFCG members were invited to bring the public version of the SFCG objectives for WRC-23 to the attention of their national administrations and the relevant regional groups for the preparation of WRC-23.

Based on SFCG Action Item 39/7, the relevant persons in WMO who manage the OSCAR database and SFCG determined a template to be used for sending updates and new information about remote sensors through a compiled SFCG report to WMO for update/inclusion into OSCAR. This action is ongoing since SFCG-39 in 2019. By March 2022, only four SFCG member agencies (ESA,

EUMETSAT, JAXA and NOAA) provided their updated and new information, using this agreed new format. Considering the limited number of responses, as opposed to the number of SFCG member agencies operating passive sensors, SFCG has agreed that the activity of reviewing and updating the information in OSCAR should be continued with more SFCG members contributing, using the agreed excel template, attached to a new SFCG action item 40/13. Further details on this activity and way forward are covered in paper on Space Frequency Data in WMO OSCAR/Space (CGMS-50-WMO-WP-04).

CGMS Members were invited to note this report and to provide feedback and information on its activities via the CGMS/SFCG Liaison Officer to SFCG-41 (July 2022) on any frequency related matter as appropriate.

CGMS-50-CGMS-WP-23 Report from Task Group on RFI detection, monitoring and mapping (Verbal)

In response to needs identified during WGI discussions at CGMS-49 and respective CGMS-49 WGI Action Item A49.01, the CGMS WG-I Task Group on RFI detection, monitoring and mapping is currently in the process of being established, and is expected to begin its activities in mid-2022.

In CGMS-49 CGMS requested agencies to nominate members of the Task Group on RFI to establish the initial ideas about mechanisms regarding the detection, monitoring and mapping of RFI, initially in the 24 GHz passive band. Initial membership has been established with members from CMA, EUMETSAT, KMA, NOAA and WMO. Agencies, especially ones that currently do not have a representative, are invited and encouraged to nominate additional members.

Task Group members would coordinate internally with relevant experts, and proposals could be presented at CGMS-51. The initial task of this Task Group could include the following:

- Establishing Terms of Reference for the Task Group on RFI
- Gathering the views and ideas members already developed and activities they have already undertaken in this context;
- Exchange on members' interaction with scientists and forecasters regarding ways for extracting data from existing instruments for impact assessments;
- Developing possible plans for approaching detection, monitoring and mapping of RFI and evaluate their feasibility;
- Summarising the findings of the group for presentation at CGMS.

WGI agreed to the proposal with the following action.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
WGI Task Group on RFI detection, monitoring and mapping	**2.1**	WGI/A50.01	Continue forming the Task Group on RFI, establish and confirm the ToR for the Task Group, and investigate collectively mechanisms for detection and long-term monitoring of and mapping of RFI (for example, but not limited to, from IMT-2020/5G into the 24 GHz passive band) at satellite or instrument level, or any other means, as the knowledge base for assessing the impact on the passive sensor measurements. The draft ToR is to be discussed in the intersessional meetings before CGMS-50 Plenary.	CGMS-51	**OPEN**

CGMS-50-CGMS-WP-10 Status of Preparations for WRC-23

The global pandemic situation continued to slow down the WRC-23 preparatory works at ITU, regional and national level with the effect that complex technical and regulatory issues could not be effectively discussed/negotiated/progressed in the virtual meeting set-up. First hybrid ITU meetings are scheduled for the March/April/May 2022 timeframe.

Consequently, the status on the issues presented in this paper has not significantly changed compared to the presentation to CGMS-49.

The agenda for WRC-23 contains again a number of items of potential concern to CGMS members as they could negatively affect the frequency usage of MetSat and EESS satellite systems and their active and passive sensors.

The WRC-23 agenda items of potential concern to CGMS members discussed in this document are:

- Agenda items 1.16, 1.17, 1.18 and 9.1 Topic D related to new frequency usage of commercial satellite systems;
- Agenda items 1.2, 1.4, 9.1 Topic C and Radio Regulations Article 21.5 all related to IMT (5G) systems.

It was specifically highlighted that one of the bands under discussion for an IMT identification under this WRC-23 agenda item 1.2 is the band 6425-7125 MHz. This is a frequency area, which is best suitable for sea surface temperature (SST) measurements. Unfortunately, these measurements are

not backed-up by an appropriate regulatory status. Instead, they are only covered by footnote 5.458 in the ITU Radio Regulations (RR). With this insufficient status in the RR, it is not possible to request the appropriate recognition/consideration of this application covered only by this footnote under this agenda item. Some ITU member states categorically refuse to consider EESS (passive) under this agenda item. However, other ITU member states see the need to improve the regulatory situation for the SST measurements in this spectrum area. CGMS member agencies interested in this subject are invited to contribute to WP 7C on this issue and to consider the approach of finding an appropriate additional frequency band that could complement the measurements at 6.925 GHz and for which a better regulatory status might be achievable in the long term.

Regarding WRC-23 agenda items of direct interest to CGMS, the status on namely 1.14 was presented. The objective of this agenda item is to ensure that passive microwave measurements in the frequency range 231.5-252 GHz are protected and the required spectrum is allocated to future passive microwave sensors, for example for the Ice Cloud Imager (ICI) instrument on Metop-SG satellites. A possible new primary allocation to the EESS (passive) requires to perform the relevant sharing and compatibility studies with the services to which these and the adjacent bands are already allocated. In order to facilitate the required new allocation to the EESS (passive) in the frequency bands 239.2-242.2 GHz and 244.2-247.2 GHz, a shift of the existing FS and MS allocations in the range 239.2-241 GHz (1.8 GHz of BW) to the band 235-238 GHz (3 GHz of BW) is proposed. This concept of shifting of the FS and MS service allocations is presented to WP 7C at the same time of this CGMS WGI meeting. If accepted in the framework of WP 7C, a significant step towards the identification of possible solutions for the new allocations to EESS (passive) in the bands 239.2-242.2 GHz and 244.2-247.2 GHz would be achieved.

The status of considerations on space weather under WRC-23 agenda item 9.1 Topic A is outlined in detail in CGMS-50-EUMETSAT-WP-03 (Frequency-related topics in support to space weather), part of the Joint WGI-WGIV-SCWG session.

Although not a WRC-23 agenda item, this paper also addressed the issues related to ITU-R Resolution 731 (Rev. WRC-19) which deals more generally with the consideration of sharing and adjacent-band compatibility between passive and active services above 71 GHz. Unfortunately, the listed bands also include bands covered by RR footnote 5.340 (100-102 GHz, 148.5-151.5 GHz, 190-191.8 GHz and 226-231.5 GHz), stating that all emissions are prohibited, in order to protect these specific passive bands. This is interpreted by some ITU member states that sharing could be envisaged in these purely passive bands, even against the ITU Rules of Procedure. Thus, the pressure for using bands above 71 GHz, either in shared bands with EESS (passive) or even in purely passive bands (FN 5.340), is significantly increasing.

As a conclusion, the WRC-23 preparatory works at regional and ITU-R level need to be carefully followed and contributed to by CGMS member agencies in order to protect the frequency resources to the maximum extent possible. However, there are also other issues and developments outside of the preparatory activities for WRC-23, that need to be carefully monitored by CGMS members, like the accelerating trend towards broadband usage of active services/applications in bands shared with EESS (passive) and even jeopardising the status of passive bands covered by the RR FN 5.340 (all emissions prohibited). In support of the WMO position, it will be important that CGMS members urge their national regulatory authorities, when establishing new regulations for use of

active services and applications, to appropriately take into account the protection requirements of passive sensors and that the bands listed in RR FN 5.340 will not be opened for a shared use with active services.

A comprehensive overview of all WRC-23 of potential interest to CGMS is contained in document CGMS-50-WMO-WP-05 which provides the preliminary position of WMO on relevant WRC-23 agenda items.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS Members	**2.1**	WGI/A50.02	CGMS members to urge their national regulatory authorities, when establishing new regulations for use of active services and applications, to appropriately take into account the protection requirements of passive sensors and that the bands listed in RR FN 5.340 will not be opened for a shared use with active services.	CGMS-51	**OPEN**

CGMS-50-WMO-WP-05 WMO Preliminary Position Paper for WRC-23

The WMO preliminary positions on WRC-23 were initially agreed in February 2020 and have been updated during the last meeting of the WMO Expert Team for Radio Frequency Coordination (ET-RFC) held 2 - 4 February 2021.

Since last consideration at CGMS-49, there was no update to the WMO preliminary positions on WRC-23. The next update to these positions is planned for the next meeting of ET-RFC, scheduled for 30 August – 2 September 2022. Nevertheless, the positions are still valid.

A subset of the agenda items listed in the WMO position paper, those that are of most relevance to CGMS, were presented.

In the Annex to this position paper also another issue currently worked on in ITU-R is addressed. This concerns ITU-R Resolution 731 (Rev. WRC-19) which deals more generally with the consideration of sharing and adjacent-band compatibility between passive and active services above 71 GHz.

It was proposed to circulate (by the end of 2022) the updated WMO preliminary position paper on WRC-23 after being updated by ET-RFC at its August/September 2022 meeting and afterwards adopted within WMO, so that CGMS members can make the updated WMO positions known to its members' national and international preparation processes for WRC-23.

WGI agreed to the proposal with the following action.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
SFCG Rep	**2.1**	WGI/A50.03	SFCG rep to circulate (by the end of 2022) the updated WMO preliminary position paper on WRC-23 after being updated by ET-RFC at its August/September 2022 meeting and afterwards adopted within WMO. CGMS members would then need to ensure the updated WMO positions known to its members' national and international preparation processes for WRC-23.	End of 2022	**OPEN**

CGMS-50-WMO-WP-04 Space Frequency Data in WMO OSCAR/Space

WMO has implemented new structure of space frequency data recorded in OSCAR/Space. The implementation of the frequency data records is now supporting the interest of Space Frequency Coordination Group (SFCG) (SFCG action item No. 39/7) to use OSCAR/Space as an information source for the passive and active remote sensing bands and to identify future remote sensing spectrum needs.

In the new structure telecommunication and microwave frequency records are divided into three different main categories: Frequencies for Satellite Management, Earth Observation Microwave Frequencies and Frequencies for Scientific Data Acquisition and Communication Services at Ground Stations. The details of the data fields in each category are presented in this working paper.

The frequency records in OSCAR/Space are updated with the support of the OSCAR/Space Support Team (O/SST) containing focal points nominated by CGMS Members. O/SST focal points are expected to collect missing or outdated information within their respective organization or agency and to return the information to WMO in a timely manner within the stated deadlines. CGMS members, through their O/SST focal points, shall provide accurate and timely updates on satellite frequencies recorded in OSCAR/Space database. CGMS agencies providing inputs to the database to WMO need to ensure these are aligned with SFCG inputs and activities. WMO will continue preparing and submitting update templates to O/SST including frequency information to be updated (this is performed approximately 3-4 times a year).

WGI agreed to the proposal with the following actions.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS Members	**2.1**	WGI/A50.04	SFCG Rep and WMO to propose a process for providing accurate and timely updates on satellite frequencies recorded in OSCAR/Space database. This process should ensure CGMS agencies inputs to the database to WMO are aligned with SFCG inputs and activities. The proposed process is to be presented by October 2022.	October 2022	**OPEN**
WMO	**2.1**	WGI/A50.05	WMO to include the frequency information in their updated templates to OSCAR/Space Support Team (O/SST)	October 2022	**OPEN**

2.2 Frequency-related topics in support to space weather

No papers reported under this agenda item.

3. Meteorological satellites Space to Ground Interface (Direct Readout) and LHRIT Global Spec. Global Specs (CCSDS based) and Best Practices for DR processing

3.1 CGMS agency best practices in support to local and regional processing of LEO direct broadcast data)

CGMS-50-CGMS-WP-08 SWOT analysis on Low Latency Data Access from LEO meteorological satellites

This paper presented a SWOT analysis on Low Latency Data Access from LEO meteorological satellites. Technical solutions for transmitting data from space to ground beyond direct broadcast are considered, including the use of data relay satellites and phased array.

A quantitative trade-off analyses of the SWOTs compared the three solutions (direct broadcast, data relay satellites, phased array). No technological changes are foreseen in the short term for low latency regional data access. Direct Broadcast systems will be part of the next generation of the CMA, EUMETSAT and NOAA satellites, with the agencies' roadmap plan on the usage of direct broadcast planned to carry on until the 2030s, at least.

It was agreed to perform further study on the possible usage of emerging technologies, as identified by the SWOT analysis, to complement the data rate limitation of the traditional direct broadcast for future LEO meteorological satellites programs. It was highlighted that the SWOT is also relevant for global data access considerations, so the further work will be covered under the WGI Task Group

on the coordination of LEO Orbits with the support from the Task Group on Direct Broadcast Systems, as detailed in the Report from the CGMS WGI Task Group on the Coordination of LEO Orbits (CGMS-50-EUMETSAT-WP-01).

CGMS-50-CMA-WP-02 CMA Status of Implementation of CGMS Best Practices in Support to Local and Regional Processing of LEO Direct Broadcast Data

This paper presents status of implementation at CMA of the CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data for each of the FY-3D and FY-3E LEO satellite missions.

CGMS-50-EUMETSAT-WP-06: Implementation of CGMS best practices for LEO direct broadcast data at EUMETSAT

This paper presents status of implementation at EUMETSAT of the CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data for each of the METOP and EPS-SG LEO satellite missions.

CGMS-50-NOAA-WP-02: Implementation of CGMS best practices for LEO direct broadcast data at NOAA

This paper presents status of implementation at NOAA of the CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data for the NOAA-15, NOAA-18, NOAA-19, S-NPP, NOAA-20 and the soon to launch JPSS-2 satellite missions.

Working Group I took note of the status of implementation of the best practices of CMA, EUMETSAT, and NOAA.

3.2 Development of efficient standardised data handling for high-resolution imaging and hyper-spectral instruments

CGMS-50-CGMS-WP-14: **Report from the CGMS WGI Task Group on Satellite Data and Codes**

CGMS established the Task Group on Satellite Data and Codes (TGSDC) in order to coordinate work on satellite product format issues within the CGMS community and to support the work of WMO's expert teams. The Task Group on Satellite Data and Codes has been actively supporting the coordination of work on satellite product format issues within the CGMS community and providing support to the work of WMO's expert teams since its first meeting in 2008. This paper reviewed the status of the Task Group and its forthcoming activities.

As of 2022, the activities of the CGMS WGI ad hoc team on coordination of Climate and Forecast (CF) netCDF conventions have been assimilated into the work of this Task Group. The current membership of the TGSDC is comprised of the existing membership, together with the participants in the ad hoc team on coordination of CF-netCDF. An additional member from ISRO would complement the current composition well.

The meetings of the ad hoc team on coordination of CF-netCDF have been used as a mechanism for collecting requirements. A larger initiative that recently completed led to additions in CF 1.9 dealing with data compression. This activity had been ongoing for 2 years and consumed effort

from multiple organisations due to the complexity of the changes themselves and that of the process for introducing the changes to the CF Conventions. This led to a new sub-chapter in the CF-netCDF standards and several other additions. After CGMS 50 the Task Group will re-examine the CF-netCDF convention topics and the associated priority list. The Group also noted the need to consider the situation with regard to HDF, noting that this is widely used for the exchange of satellite data and products.

That Task Group is continuing to work on the use of WIGOS Station identifiers for satellite products. The paper includes text prepared by WMO Secretariat for the guide on the WIGOS explaining the use of WIGOS Station Identifiers for satellites. This Task Group continues to assess the best use the Issue Number (currently fixed to 0) in the future.

The Group has worked on updating its Draft Terms of Reference (ToRs) to align them with the latest structure of WMO. The Task Group talked about the level of activities given in the document and found it appropriate. The latest version of the ToRs are provided in the paper.

Between CGMS-50 and CGMS-51, the Task Group will continue work on coordinating format standardisation for satellite data, implementation of WIGOS station identifiers for satellite platforms, and providing subject matter expertise to WMO Expert Teams. The group will also continue to refine its Terms of Reference.

CGMS agencies are invited and encouraged to nominate additional members of the Task Group.

4. Data collection systems

4.1 Task Group on Data Collection Service

CGMS-50-CGMS-WP-01: Report from CGMS WGI Task Group on Data Collection Services

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 is 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 Task Group on DCS, 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. Due to COVID none of the planned face-to-face meetings were possible. 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 Task Group on DCS activities and progress since CGMS-49. The discussions of the Enhanced DCP (E-DCP) standard have continued and is a major topic for the group and, covered by action A49.03. The group has developed a proposal for the way forward in developing a new IDCS/E-DCP standard. Rather than defining a completely new standard, the group would look at enhancing an existing standard taking into account user feedback. This would make

the implementation of the standard simpler, with for example firmware changes to existing platforms improving forward error correction and other modifiable parameters. It is proposed to hold a collaborative workshop between the agencies and the manufacturers, in order to identify new technologies. This would be a structured 2-day workshop, proposed to be hosted as part of or directly after the Met Tech Expo in Paris October 2022. After the completion of the face-to-face manufactures workshop, subsequent virtual meeting could be organised, which could focus the resources where they are needed. This could help by getting the manufactures' buy-in on the evolution of the DCP standard.

WGI agreed to update action A49.03 as follows "Analyse existing DCP standards taking into account user feedback, and propose a common standard that could be used as a future IDCS standard. This would be an evolution of an existing standard. There would also be workshops with the manufacturers to understand the best way to identify and implement this standard taking into account the SWOT analysis and the results of the survey commissioned by ESA."

The group carried out a SWOT analysis on the Data Collection Service from Geostationary Meteorological satellites, which is covered in a separate report (CGMS-50-CGMS-WP-09).

CGMS agencies are invited and encouraged to nominate additional members of the Task Group.

CGMS-50-CGMS-WP-09: SWOT analysis on the Data Collection Service from Geostationary Meteorological satellites

At CGMS-49 the Task Group on Data Collection Services (DCS) was given the action of performing a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis on the DCS. The group has been addressing the SWOT analysis during the regular intersessional meetings.

Many aspects were considered during the discussions and the output of the SWOT analysis and discussions is covered in this report. The focus of this paper is on the five proposals, which address areas for further work as an outcome of the SWOT analysis.

The five proposals for further work are in the areas of:

- Discussion of approaches and mechanisms for identifying and mitigating RFI to DCS with the WGI task group on RFI detection, monitoring, and mapping;
- Production of joint DCS Promotional materials presenting the global view of DCS;
- Production of a DCS introduction video for improved outreach;
- Hold a joint workshop between the DCP transmitter manufacturers and DCS agencies, to discuss future technologies / functionality and the evolution of international DCP standard;
- Improvements to DCS information made available to users across agencies, CGMS and WMO.

WGI agreed to the proposal with the following action.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
WGI Task Group on Data Collection Services	**4.1**	WGI/A50.06	Build on the work of the SWOT analysis on the DCS from Geostationary Meteorological satellites, and particularly progress on the five proposals for further work (covering RFI Mitigation, joint DCS PR materials, DCS introduction video, manufacturer workshop, discoverable information) and present the outcome to CGMS-51.	CGMS-51	**OPEN**

CGMS-50-NOAA-WP-03: Small Satellite DCS Use as an Operational Concept

The Satellite DCS Use Concept Validation project was originally scoped to determine if satellites can successfully interface with the Data Collection System (DCS) receivers (DCPR) and thus provide a low-rate data (100, 300, or greater bps) service to satellite users. This could potentially provide a new source and means of acquiring meteorological or climatology data to the science and meteorological community.

This project is designed to be hosted on two satellites (TechEdSat series). The first successful hosted payload was ejected from the International Space Station on 13 July 2020. This hosted payload successfully demonstrated that the concept of satellites using the DCS is fundamentally valid. Test messages were successfully sent from the hosted payload through the DCS and received by the user. The second hosted payload, planned for launch in February 2023, after being twice delayed due to launch issues, will focus on testing a more operational use of the capability. Specifically, this second test will demonstrate if a satellite can use the DCS at any time in any part of a low Earth orbit. The second hosted payload will demonstrate that DCS messages of varying sizes can be reliably transmitted from a LEO platform and received through the GOES, Himawari and Meteosat DCPR systems, error-free.

Satellite DCS users are good candidates for using the underutilized international DCS channels (iDCS). The iDCS is designed to allow use between the various geosynchronous located DCS receivers (i.e., GOES, METEOSAT, HIMAWARI) and so it's well suited for using with satellites. This would also mean that current regional DCS users will not be crowded by the additional users. It is expected that the satellite use of DCS may assist in decreasing the risk of interference from in-band satellite systems but will not eliminate it.

Regulatory controls and protections will need to be considered by CGMS and the DCS hosting agencies once this second test is successfully concluded. An agreement will need to be reached regarding the permitted use of DCS by satellite systems and under what conditions. It is expected that the task group on Data Collection Services under WGI will prepare for the agreement discussion at CGMS-51.

4.2 Operational DCS

CGMS-50-EUMETSAT-WP-11 : 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). The paper includes details of channel utilisation, DCP allocation, geographical distribution and DCP data dissemination mechanisms. It covers also details on expected changes to the EUMETSAT DCS service in 2022. Meteosat-9 is planned to take over Meteosat-8 as the prime IODC satellite and the EUMETSAT DCS will therefore be supported by Meteosat-9 at 45.5°E from 1 July 2022.

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 2022, there are 148 DCP operators located in 78 countries (Europe, Africa, Asia). There are a total of 1634 DCPs allocated, with 444 actively transmitting. Out of those DCPs allocated, 311 are HRDCPs transmitting at 1200 bps (286 supported by Meteosat-11 at 0° and 25 by Meteosat-8 at 41.5°E). The remaining 1323 are Standard Rate DCPs (1175 supported by Meteosat-11 at 0° and 148 by Meteosat-8 at 41.5°E). Since March 2021, 130 new DCPs have been assigned (122 HRDCP and 8 SRDCP). The EUMETSAT DCS has a typical reliability greater than 99%.

CGMS-50-ISRO-WP-02: ISRO DCS status report (verbal)

Verbal report from ISRO confirmed that there were no significant changes to the ISRO DCS since CGMS-49. Data Relay Transponder (DRT) payload is currently available on 3 Indian satellites – INSAT-3D, INSAT-3DR, and GSAT-17. DRT are supporting nearly 7000 Data Collection Platforms across India, with the Indian Meteorological Department (IMD) as the primary user of the service.

CGMS-50-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 important roles 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. Himawari-8's 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.

The Agency has decided that the planned Himawari-10 program, which is set to replace Himawari-8/9, will assume the same DCS.

CGMS-50-NOAA-WP-04: NOAA GOES DCS Status

The Geostationary Operational Environmental Satellite (GOES) Data Collection System (DCS) is an environmental data relay system supports approximately 670 user agencies, 3,140 individual users operating approximately 40,500 Data Collection Platforms (DCPs) in the western hemisphere. Almost 33,000 of these DCP platforms are actively utilized to collect and transmit data through a DCS transponder hosted on the GOES east or west satellites. The NOAA DCS Administrative and Data Distribution System (DADDS) is used to manage user channel access for distributing close to one million observations per day. A diverse group of users also receive their data via direct broadcast from the GOES satellites using their own Direct Readout Ground Stations (DRGS).

The GOES DCS Program has published a Random Reporting User Guide that will assist users in understanding and developing an effective strategy to take advantage of this capability. The program is also pursuing system enhancements in message protocols that will reduce message size, add data fields to confirm DCP data, and continue the quest to re-establish Two-Way communication in the system.

CGMS-50-ROSHYDROMET-WP-01: Status of Russian data collection system

This document addresses 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 geostationary meteorological satellites of Electro-L series (14.5W, 76E) with a backup option via Luch series communication satellite and highly elliptical orbit satellite Arctica-M. There are 689 DCPs currently deployed. DCPs are distributed all over the Russian territory, including 140 DCPs in hard-to-reach areas.

The Russian DCS will be further complemented with the launch of geostationary meteorological satellite Electro-L (166E) and the second highly elliptical orbit satellite Arctica-M.

5. System and operations aspects

5.1 Space debris and collision avoidance. Coordination with IADC

CGMS-50-WGI-WP-02: Report from the CGMS WGI Task Group on Space Debris and Collision Avoidance

This Paper outlines the preliminary work of the Task Group on Space Debris and Collision Avoidance which has taken place between NOAA and EUMETSAT since CGMS-49.

Terms of Reference for the Task Group, have been proposed. Their endorsement will be re-considered when there is wider participation from agencies, in addition to EUMETSAT and NOAA.

CGMS members are encouraged to confirm their participation in this Task Group prior to CGMS-50 Plenary. NOAA and EUMETSAT request the participation of the whole CGMS community involved

in spacecraft operations in this Task Group activity. ISRO, JMA and KMA confirmed that they would like to be involved in this activity and will nominate members after internal discussions.

The preliminary Task Group activity performed between NOAA and EUMETSAT has identified the potential for establishing several Best Practices in performing collision avoidance and debris mitigation with the potential to benefit all CGMS members and the wider space-faring community.

The Task Group shall deliver a Best Practice document on collision avoidance and debris mitigation, with supporting presentation to CGMS WGI for recommendation for endorsement in CGMS-51. CGMS members are strongly encouraged to participate in this activity to allow the formulation of the initial Best Practice before CGMS-51.

WGI agreed to the proposal with the following actions.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
Task Group on Space Debris and Collision Avoidance	**5.1**	WGI/A50.07	Deliver a Best Practice document on collision avoidance and debris mitigation, with supporting presentation to CGMS WGI, for recommendation for endorsement in CGMS-51.	CGMS-51	**OPEN**
CGMS Members	**5.1**	WGI/A50.08	All CGMS Members involved in spacecraft operations are strongly encouraged to nominate participants for the CGMS WGI Task Group on Space Debris and Collision Avoidance. The names of nominated participants are to be provided to the Task Group lead and CGMS WGI Co-chairs / rapporteur before CGMS-50 Plenary, so that the names of members can be reported to CGMS-50 plenary. This is to allow the formulation of the initial Best Practice on collision avoidance and debris mitigation before CGMS-51.	May 2022	**OPEN**

CGMS-50-NOAA-WP-06: Response to Space Debris and the Concerns on the Increasing Threat or Danger

In the preliminary work of the Task Group on Space Debris and Collision Avoidance, which has taken place between NOAA and EUMETSAT since CGMS-49, NOAA presented their breakdown of the framework for Safe Space Operations into the following areas:

- Space Situational Awareness
- Space Traffic Management (STM)
- Space Environment Management (SEM)

An overview of the NOAA and EUMETSAT satellite fleets was provided. NOAA operates a fleet of 15 environmental satellites in three orbital regions (Deep Space, GEO, and LEO). EUMETSAT operates a fleet of 9 environmental satellites in two orbital regions (GEO and LEO), including 3 Copernicus/Sentinel satellites.

The group presented an overview of the current space debris environment of objects in orbit in 2021 and highlighted the continuously increasing amount of space debris.

The group has conducted a comparison between EUMETSAT and NOAA space debris approaches for LEO Satellites, for each of the Best Practice areas in the proposed Task Group Terms of Reference.

5.2 Coordination of LEO Orbits

CGMS-50-EUMETSAT-WP-01: Report from the CGMS WGI Task Group on the Coordination of LEO Orbits

This paper outlines the work of the Task Group on the Coordination of LEO Orbits.

Three proposed Best Practices for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite Systems are provided in the dedicated paper CGMS-50-NOAA-WP-05.

The presentation included discussion on the approach for a SWOT Analysis which has the objective of maximising the return / minimising the cost taking into account new mission and reference mission concepts and associated technologies, highlighting the potential for inter-Agency cooperation.

It was highlighted that the Low Latency Data Access from LEO meteorological satellites (CGMS-50-CGMS-WP-08) by the Task Group on Direct Broadcast Systems is also relevant for global data access considerations. It is recommended to build on the work of the Task Group on Direct Broadcast Systems and broaden the scope of SWOT analysis on Low Latency Data Access from LEO meteorological satellites (CGMS-50-CGMS-WP-08) to include the following, thereby removing historical requirement and architectural boundaries between global data access and direct broadcast systems.

- global data coverage and access;

- temporal coverage over a given geographic area;
- low latency data delivery;

The analysis of this trade space could effectively model novel, unified architectural concepts which are optimised to meet the above combined requirements.

This work is recommended to be performed within the Task Group on the Coordination of LEO Orbits with embedded expertise from the Task Group on Direct Broadcast Systems.

WGI agreed to the proposal with the following action. All CGMS agencies are encouraged to nominate participants to contribute to this activity.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
WGI Task Group on the Coordination of LEO Orbits + WGI Task Group on Direct Broadcast Systems	**5.2 / 3.1**	WGI/A50.09	Build on the SWOT analysis on Low Latency Data Access from LEO meteorological satellites (CGMS-50-CGMS-WP-08) work and broaden its scope to include the following, thereby removing historical requirement and architectural boundaries between global data access and direct broadcast systems: • Global data coverage and access; • Temporal coverage over a given geographic area; • Low latency data delivery; Perform further study on the possible usage of emerging technologies identified by the SWOT analysis. The two Task Groups should hold meetings and agree on a proposed way forward for a consolidated SWOT analysis, and present to CGMS-51 for consideration. All CGMS agencies are encouraged to nominate participants to contribute to this activity.	CGMS-51	**OPEN**

CGMS-50-NOAA-WP-05: Proposed Best Practices for the Coordination of Data Acquisition for Low Earth Orbit Satellite Systems

During the CGMS-49 WGI meeting, the Task Group on the Coordination of LEO Orbits received an action item (WGI/A49.05) to issue Draft Best Practice on Coordination of Data Acquisition for LEO Satellite Systems (with uncoordinated / variable orbital phasing).

This paper presented three draft Best Practices (BP) for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite Systems that were prepared by the Task Group during the intersessional meetings after CGMS-49.

The BPs are intended to maximize the return and minimize the cost for using ground segments to coordinate data acquisition for LEO satellite systems with variable relative orbital phasing. The BPs are:

- BP.01 Preparation of Multi-Mission Ground Stations and Sizing Data Communication Networks
- BP.02 Definition of Operational Concepts for Satellite Downlink Efficiency
- BP.03 Analysis and Operational Planning Related to Avoidance of Radio Frequency Interference

Ground stations for global dumps and Direct Broadcast (DB) are in the scope of these BPs. Data relay satellite usage is excluded.

The CGMS agencies are invited to review the proposed Best Practices for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite Systems.

WGI encouraged the Task Group on the Coordination of LEO Orbits and Task Group on Direct Broadcast Systems to review the overlap between the proposed Best Practices for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite Systems and the already published Best practices in support to local and regional processing of LEO direct broadcast data (CGMS/DOC/18/1008274). It was agreed that the two task groups will work together on reviewing the overlap and propose a way forward for both best practices. The updated best practices drafts should be sent for review before CGMS-51 and presented to CGMS-51.

WGI agreed to the proposal with the following action.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
WGI Task Group on the Coordination	**5.2**	WGI/A50.10	Task Group on the Coordination of LEO Orbits and Task Group on Direct Broadcast Systems to review the overlap between the proposed (BP) for the Coordination of Data	CGMS-51	**OPEN**

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
of LEO Orbits + WGI Task Group on Direct Broadcast Systems			Acquisition for Low Earth Orbit (LEO) Satellite Systems and the already published Best practices in support to local and regional processing of LEO direct broadcast data (CGMS/DOC/18/1008274), and propose a way forward for both best practices. The updated best practices drafts should be sent for review before CGMS-51 and presented to CGMS-51.		

6. AOB

The WGI Chair noted the success of SWOT analyses and the importance of prioritising the future work.

It was highlighted that many of the WGI members are not participating in the Task Groups. It is proposed to add a recommendation urging CGMS agencies to nominate additional members for all the WGI Task Groups by CGMS-50 Plenary, especially ones where no representatives of the agencies are currently participating in the Task Group(s).

In order to capture the activities of the different WGI Task Groups, the status of Best Practices implementation and future work, and ensure overlaps are addressed, it was proposed that:

- Each of the WGI Task Groups presents its latest Terms of Reference to CGMS-51, which following endorsement should be added to the CGMS Website by CGMS Secretariat. The updated Terms of Reference of the Task Groups can then be used as inputs to the review of the WGI ToRs in 2023.
- Each of the WGI Task Groups continuously presents the following, starting with CGMS-51. All of the agencies are encouraged to provide inputs.
    - Existing / updated Best Practices
    - Status of implementation of Best Practices for each agency
    - Future work / recommendations / proposals (taking into consideration outcome of SWOT analyses)

Best Practices should be used as a guideline for current operational services and services under implementation, while in the meantime Task Groups continue their work on potential future technologies, as identified by the SWOT analyses.

WGI agreed to the proposal with the following actions.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS Members	**6**	WGI/A50.12	CGMS agencies to consider nominating additional members for all the WGI Task Groups (listed below) by CGMS-50 Plenary, especially ones where no representatives of the agencies are currently participating in the Task Group(s). - Task Group on Direct Broadcast Systems - Task Group on Satellite Data and Codes - Task Group on Data Collection Services - Task Group on Space Debris and Collision Avoidance - Task Group on the Coordination of LEO Orbits - Task Group on RFI detection, monitoring and mapping	May 2022	**OPEN**
All WGI Task Groups	**6**	WGI/A50.12	Each of the WGI Task Groups to present its latest Terms of Reference to CGMS-51, which following endorsement should be added to the CGMS Website by CGMS Secretariat. The updated Terms of Reference of the Task Groups can then be used as inputs to the review of the WGI ToRs in 2023.	CGMS-51	**OPEN**

WGI agreed to the proposal with the following recommendation.

CGMS-50 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
All WGI Task Groups	**6**	WGI/R50.01	Each of the WGI Task Groups to continuously present the following, starting with CGMS-51. All of the agencies are encouraged to provide inputs. - Existing / updated Best Practices - Status of implementation of Best Practices for each agency - Future work / recommendations / proposals (taking into consideration outcome of SWOT analyses)	CGMS-51	**OPEN**

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

7.1 System technical aspects (sharing/rationalisation of orbits) and operational aspects on the implementation of contingency plans

CGMS-50-CGMS-WP-07WGI: CGMS Baseline - draft revision following the 4th risk assessment workshop (for recommendation to CGMS-50 plenary)

The 4th CGMS WGIII workshop was held on 22-24 February 2022 on whose occasion the CGMS baseline and related risk assessment was conducted. The baseline is reviewed annually instead of every 4 years. The WMO manual on WIGOS will be updated every year based on the revised CGMS Baseline. The working group reviewed the CGMS baseline and proposed revisions. The draft text of the revision of the CGMS baseline is included in the paper.

The text was reviewed by CGMS-50 WGI and other WGs in April-May 2022, in order to conclude on a final text for endorsement by CGMS-50 plenary in June 2022.

CGMS-50-WGIII-WP-01: Status and outcome of the 4th CGMS risk assessment

The objective of the Risk Assessment Workshop is to:

- Update the 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 HLPP;
- Identify ways to integrate satellite data into the CGMS Baseline and characterise CGMS' contribution.

The Working Group III held a virtual workshop from 22-24 February 2022, hosted by EUMETSAT.

WGI reviewed the draft update of the CGMS Risk Assessment.

8. Review and updating of the HLPP

CGMS-50-CGMS-WP-15WGI: Status of implementation of CGMS High Level Priority Plan (2021-2025)

WGI reviewed and provided inputs to the current status of the HLPP.

CGMS-50-CGMS-WP-26WGI: Proposed update to the CGMS High Level Priority Plan (HLPP) for the period 2022-2026

WGI provided inputs for updates to the relevant sections of the HLPP.

The Task areas of WGI in the HLPP include:

- Coordination of Data Collection Services – only a minor change of the wording is proposed
- Radio Frequency (RF) Protection – revised text proposed to better reflect the priorities for WRC-2023. RF Protection for Space Weather will be discussed further in the joint WGI-SWCG session in May 2022.
- Direct Broadcast Systems and Data Processing – implementation progressing well, in particular for the implementation of the DB Best Practices.
- Operational issues related to Space Weather – Space Weather is on the agenda for SpaceOps 2023 and CGMS priorities should be reassessed afterwards.

Additional activity areas of WGI, that could be considered for inclusion in the HLPP:

- Coordination of LEO Orbits – concept for Best Practices for the Coordination of Data Acquisition for Low Earth Orbit Satellite Systems.
- Space Debris and Collision avoidance – Task Group on Space Debris and Collision Avoidance has been formed and presented a report in WGI proposing to establish Best Practices on Collision Avoidance and Debris Mitigation.

A review of the HLPP implementation was held in March 2022 with WGIV Chair and rapporteurs. WGIV is proposing that the following priorities are addressed by WGI:

- Provide coordinated CGMS inputs to WMO on satellite and instrument identifiers for data representation and metadata within the WIS – to be addressed by the Task Group on Satellite Data and Codes (TGSDC), which has now been moved back to WGI.
- Develop efficient standardized data handling for high-resolution imaging and hyperspectral instruments – this matter will be discussed in the Task Group on Satellite Data and Codes (TGSDC) and if necessary the Terms of Reference will be modified.

9. Future WGI sessions

CGMS-50-WGI-WP-04: Nomination for the WGI co-chairperson (verbal)

Vanessa Griffin from NOAA is retiring in May 2022 and will step down as the WGI Co-chair before CGMS-50 Plenary. The WGI participants thanked Vanessa for her valuable contributions and leadership as WGI Co-Chair.

CGMS Agencies are invited to nominate candidates for Co-Chair of WGI.

Sean Burns from EUMETSAT will step in as an interim WGI Co-chair, supporting until a new Co-Chair is nominated.

CGMS-50-CGMS-WP-19WGI: Nominations and representatives at meetings (CGMS, ISWGs, VLAB - Co-chairs and rapporteurs)
Karolina Nikolova from EUMETSAT was nominated as the Rapporteur of WGI for Plenary endorsement.

CGMS Agencies are invited to nominate candidates for Co-Rapporteur of WGI.

CGMS-50-CGMS-WP-12: Future CGMS WG plenary sessions (verbal)

Should the CGMS-51 plenary session take place virtually, a virtual WGI plenary meeting in 2023 was tentatively agreed to take place on 24-25 April 2023.

CGMS-50-WGI-WP-01: Decision on dates of inter-sessional activities/meetings in 2022-2023 (CGMS-50 to CGMS-51)

The following WGI intersessional meetings were agreed:

WGI	Proposed CGMSG-50 to CGMS-51 WGI intersessional dates
WGI Intersessional meetings	Tuesday 27 September 2022 at 13 UTC Tuesday 24 January 2023 at 12 UTC Tuesday 21 March 2023 at 12 UTC

The following WGI Task Group intersessional meetings were agreed:

WGI Task Group	Task Group Lead	Proposed CGMSG-50 to CGMS-51 WGI intersessional dates
Task Group on Direct Broadcast Systems	Antoine Jeanjean	Tuesday 30 August 2022 at 12 UTC Tuesday 15 November 2022 at 12 UTC Tuesday 14 February 2023 at 12 UTC Tuesday 11 April 2023 at 12 UTC
Task Group on Satellite Data and Codes	Simon Elliott	Tuesday 13 September 2022 at 12 UTC Tuesday 14 February 2023 at 13 UTC

WGI Task Group	Task Group Lead	Proposed CGMSG-50 to CGMS-51 WGI intersessional dates
Task Group on Data Collection Services	Nicholas Coyne	Thursday 9 June 2022 at 11 UTC Thursday 21 July 2022 at 11 UTC Thursday 1 September 2022 at 11 UTC Thursday 13 October 2022 (FTF MTI) Thursday 24 November 2022 at 12 UTC Thursday 5 January 2023 at 12 UTC Thursday 16 February 2023 at 12 UTC Thursday 16 March 2023 at 12 UTC
Task Group on Space Debris and Collision Avoidance	Brian Walling	Thursday 22 September 2022 Tuesday 22 November 2022 Monday 23 January 2023 Thursday 23 March 2023
Task Group on the Coordination of LEO Orbits	Andrew Monham	Tuesday 28 June 2022 Wednesday 21 September 2022 Tuesday 29 November 2022 Tuesday 31 January 2023 Thursday 16 March 2023
Task Group on RFI detection, monitoring and mapping	Simon Elliott	Tuesday 31 May 2022 at 13 UTC Next intersessional meetings will be defined in the first intersessional

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

CGMS-50-CGMS-WP-13: CGMS-49 status of actions and recommendations (13 April 2022)

WGI discussed the actions and recommendations from previous CGMS plenary sessions (CGMS-49 and earlier). The status of the open actions on and recommendations for WGI were reviewed and updated as needed. The final status is provided in a table attached to this report.

STATUS OF WGI CGMS-49 ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
WMO and CGMS SFCG rep (CGMS members)	WGI/3.1	WGI/A48.01	WGI to review the status of information on the 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-50: WMO has implemented new structure of space frequency data recorded in OSCAR/Space. The implementation of the frequency data records is now supporting the interest of Space Frequency Coordination Group (SFCG) (SFCG action item No. 39/7) to use OSCAR/Space as an information source for the passive and active remote sensing bands and to identify future remote sensing spectrum needs. Action proposed for closure and new actions opened to cover future updates for inclusion into the OSCAR database.* 2022 22 Mar: September 2021 update still valid. The OSCAR update will be completed in Q2 2022. 2021 13 Sep IS: Meeting between SFCG and WMO agreed the process, format and data elements to be provided by SFCG members to be complied and provided to WMO.	CGMS-50 (CGMS-49)	CLOSED	2.2

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				CGMS-49: Action ongoing Status on this action was discussed at the WMO ET-RFC meeting in February 2021 It was noted during that OSCAR became a global reference for sensor characteristics and therefore there is an obligation to ensure that it is accurate. Once this first action is completed, it is on the SFCG members to submit their information based on the agreed format. SFCG would then merge the information in a single SFCG Report. Such a report could then be submitted as an SFCG input to WMO for inclusion into the OSCAR database.			
WGI Task Group on Direct Broadcast Systems	WGI/4.1	WGI/A48.03	CGMS Direct Broadcast operators to consider if the 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	*2022 11 Apr: NOAA completed this action and described the CSPP LEO approach in CGMS-48-NOAA-WP-03* *2022 22 Mar: Item 4 in Best Practice includes a wording on user friendly interface, so the proposal is to close this action.* CGMS-49: Action ongoing 2021 10 Feb IS: Remains open	CGMS-50 (CGMS-49)	CLOSED	2.3.3

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
NOAA	WGI/6	WGI/A48.07	Form a Task Group on Space Debris and Collision Avoidance to produce a Best Practice on Collision Avoidance	*CGMS-50: The initial Task Group has been formed, but wider membership from other agencies (in addition to EUMETSAT and NOAA) is required before the proposed Terms of Reference can be endorsed. The preliminary Task Group activity performed between NOAA and EUMETSAT has identified the potential for establishing several Best Practices in performing collision avoidance and debris mitigation with the potential to benefit all CGMS members and the wider space-faring community.* *The Task Group shall deliver a Best Practice document on collision avoidance and debris mitigation, with supporting presentation to CGMS WGI for recommendation for endorsement in CGMS-51. CGMS members are strongly encouraged to participate in this activity to allow the formulation of the initial Best Practice before CGMS-51. This action can be closed and two new actions have been opened to cover the request for wider participation of CGMS agencies and the delivery of best practice for CGMS-51.* 2022 11 Apr: NOAA is working with	Dec 2021 (CGMS-49)	CLOSED	

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				EUMETSAT on the TOR. Plan to have a kick off meeting of the Task Team after CGMS 50 2022 22 Mar: Can be closed after the Task Group presentation in CGMS-50 WGI. 2021 24 Sep: The space debris Task Group will hold a kickoff, Q4 2021 CGMS-49: Need for Task Group reaffirmed. Future of task group to be discussed in CGMS-49 WGI meeting in April and need reaffirmed. Action ongoing Lead scott.leonard@noaa.gov, EUM: andrew.monham@eumetsat.int, PierLuigi.Righetti@eumetsat.int			
WGI Task Group on RFI detection, monitoring and mapping	3.1	WGI/A49.01	CGMS via a dedicated Task Group to investigate collectively mechanisms for detection and long-term monitoring of and mapping of RFI (for example, but not limited to, from IMT-2020/5G into the 24 GHz passive band) at satellite or instrument level, or any other means, as the knowledge base for assessing the impact on the passive sensor measurements.	*CGMS-50: Initial membership for the Task Group has been established. Additional representative nominations were invited and new action was opened to cover the continued formation of the Task Group and establishing its Terms of Reference.* 2022 11 Apr: NOAA has named Beau Backus as the NOAA Task Team member. Task Team has not yet started. Working on TOR. PLan to hold an initial organizational meeting prior to	CGMS-50	CLOSED	2.2.1

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				CGMS 50 2022 22 Mar: Action can be closed. The Task Group has been formed. 2021 13 Sep IS: First meeting of the Task Group planned for October 2021 Task Group lead: simon.elliott@eumetsat.int			
Task Group on Direct Broadcast Systems	4.1	WGI/A49.02	Perform a SWOT analysis of low latency data access from LEO meteorological spacecraft	*CGMS-50: The SWOT analysis was presented to CGMS-50 WGI and well received. The action is proposed to be closed.* *It was agreed to perform further study on the possible usage of emerging technologies, as identified by the SWOT analysis, to complement the data rate limitation of the traditional direct broadcast for future LEO meteorological satellites programs. It was highlighted that the SWOT is also relevant for global data access considerations, so it has been agreed the further work will be covered under the WGI Task Group on the Coordination of LEO Orbits with the support from the the Task Group on Direct Broadcast Systems, as detailed in the Report from the CGMS WGI Task Group on the Coordination of*	CGMS-50	CLOSED	2.3.3

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				LEO Orbits (CGMS-50-EUMETSAT-WP-01). 2022 22 Mar: Presentation to be presented at CMGS-50 WGI, so it can be closed after that. 2021 13 Sep IS: Analysis ongoing Task Group lead: Antoine.Jeanjean@eumetsat.int			
WGI Task Group on Data Collection Services	5.1	WGI/A49.03	Analyse existing DCP standards taking into account user feedback and requirements, and propose a common standard that could be used as a future IDCS standard. The standard could include improving forward error correction and other modifiable parameters.	*CGMS-50: WGI agreed to update action as follows "Analyse existing DCP standards taking into account user feedback, and propose a common standard that could be used as a future IDCS standard. This would be an evolution of an existing standard. There would also be workshops with the manufacturers to understand the best way to identify and implement this standard taking into account the SWOT analysis and the results of the survey commissioned by ESA."* 2022 22 Mar: Discussions have been held in the DCS Task Group intersessionals. An update will be provided in the CGMS-50 WGI Task Group Report, including a proposal of approaching manufacturers. A DCS Workshop planned in the Satcom Forum.	CGMS-51	OPEN	2.1.2/2.13

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				2021 13 Sep IS: Discussions at next intersessional in December 2021/January 2022 The DCS Sub Group are working on this and plan to provide a report to CGMS 50. It was envisaged to organise a face to face meeting to discuss this topic but this has not been possible due to COVID. We are indeed looking to adapt and existing standard rather than start with a new one from scratch. It is hoped that following this path will mean existing platfors could be updated with firmware patches. Task Group lead: Nick.Coyne@eumetsat.int			
WGI Task Group on Data Collection Services	5.1	WGI/A49.04	Perform a SWOT analysis on the Data Collection Service from Geostationary Meteorological satellites.	*CGMS-50: The output of the SWOT analysis were presented. Five proposals for further work were made, which were agreed and will be covered by a new action. This action can be closed.* 2022 22 Mar: The SWOT Analysis has been performed. A paper will be presented in CGMS-50 WGI, so it can be closed after the	CGMS-50	CLOSED	2.1.1

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				meeting. 2021 13 Sep IS: The DCS Sub Group have started a SWOT analysis. The outcome of this will be presented to CGMS-50 Task Group lead: Nick.Coyne@eumetsat.int			
Task Group on the Coordination of LEO Orbits	6.1	WGI/A49.05	Issue Draft Best Practice on Coordination of Data Acquisition for LEO Satellite Systems (with uncoordinated / variable orbital phasing)	*CGMS-50: Three draft Best Practices (BP) for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite System were presented. The CGMS agencies were invited to review the proposed Best Practices for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite Systems.* *WGI encouraged the Task Group on the Coordination of LEO Orbits and Task Group on Direct Broadcast Systems to review the overlap between the proposed (BP) for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite Systems and the already published Best practices in support to local and regional processing of LEO direct broadcast data (CGMS/DOC/18/1008274). It was agreed that the two task groups will work together on reviewing the overlap and propose a way forward for both best*	Feb 2022	CLOSED	

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				practices. The updated best practices drafts should be sent for review before CGMS-51 and presented to CGMS-51. *A new action was opened to cover this.* 2022 22 Mar: The Best Practice will be presented at CMGS-50 WGI. Action can be closed after WGI and a separate action would be opened to address future work. 2021 13 Sep IS: The existing draft Best Practice (See Annex in link: CGMS-49-EUMETSAT-WP-05) to be checked to assess the potential application of new technologies provided in the SWOT analysis. Task Group lead: Andrew.Monham@eumetsat.int			
Task Group on the Coordination of LEO Orbits	6.1	WGI/A49.06	Perform a broad SWOT analysis for maximising the return / minimising the cost taking into account new mission and reference mission concepts and associated technologies, highlighting the potential for inter-Agency cooperation	*CGMS-50: Taking into account the overlap between the SWOT work for global and DB data access, It was agreed to closed this action and open a new one to Build on the SWOT analysis on Low Latency Data Access from LEO meteorological satellites (CGMS-50-CGMS-WP-08) work and broaden its scope to include the following, thereby removing historical requirement and architectural boundaries between global data access and*	CGMS-50	CLOSED	

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				direct broadcast systems: *• Global data coverage and access;* *• Temporal coverage over a given geographic area;* *• Low latency data delivery;* *The analysis of this trade space could effectively model novel, unified architectural concepts which are optimised to meet the above combined requirements.* 2022 22 Mar: There will be an update presented in CGMS-50 WGI. It is expected that this action would remain open after WGIto follow up remaining activities. 2021 13 Sep IS: Analysis ongoing in conjunction with DB SWOT analysis Task Group lead: Andrew.Monham@eumetsat.int			
Transferred from WGIV:							
CGMS Task Force on Satellite Data and	WGIV/5	WGIV/A49.02	The CGMS Task Force on Satellite Data and Codes to work closely with WMO on addressing the following points:	*CGMS-50: This activity will now be covered in WGI.* 2022 11 Apr: Transferred to WGI. To be discussed with WMO (Simon, Chair, to follow	CGMS-50	OPEN	3.9.1

WGI actions from previous CGMS Plenary Sessions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
Codes, WMO			i. Linking between OSCAR/Space and the WSI and/or CCT C-5 identifiers (WMO internal) ii. Potential extension of the use of the Issue Number in the WSI for satellites in order to explicitly indicate metadata which are otherwise only implicitly embedded in the Local Identifier (CGMS-50) iii. Identification of when and how the WSI should be included in the satellite products exchanges in the context of the WIGOS (CGMS-50) (ref CGMS-49-WMO-WP-08)	up). WMO will first complete the ongoing WSI for satellites design and documentation in WIGOS Guide and its implementation in OSCAR/Space. CCT-C5 will be tentatively covered by that work. 2022 18 Jan: WMO to address latest on 27 October, ongoing work, done through WGI			

STATUS OF WGI ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 PLENARY SESSION

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
WGI Task Group on Data Collection Services	5.1	WGI/A49.03	Analyse existing DCP standards taking into account user feedback and requirements, and propose a common standard that could be used as a future IDCS standard. The standard could include improving forward error correction and other modifiable parameters.	*2022 27 Sep: The EDCP Standard will be the main topic of the DCS Workshop, which will take place on 12 October in Paris, as part of Satcom Forum 11-13 October, held in conjunction with the Met Tech Expo. WGI members are invited to join the DCS Workshop. The plan would be to have an outline of the EDCP Standard for CGMS-51 and a proposed EDCP Standard for CGMS-52.* CGMS-50: WGI agreed to update action as follows "Analyse existing DCP standards taking into account user feedback, and propose a common standard that could be used as a future IDCS standard. This would be an evolution of an existing standard. There would also be workshops with the manufacturers to understand the best way to identify and implement this standard taking	CGMS-51	OPEN	2.1.2/2.13

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				into account the SWOT analysis and the results of the survey commissioned by ESA." 2022 22 Mar: Discussions have been held in the DCS Task Group intersessionals. An update will be provided in the CGMS-50 WGI Task Group Report, including a proposal of approaching manufacturers. A DCS Workshop planned in the Satcom Forum. 2021 13 Sep IS: Discussions at next intersessional in December 2021/January 2022 The DCS Sub Group are working on this and plan to provide a report to CGMS 50. It was envisaged to organise a face to face meeting to discuss this topic but this has not been possible due to COVID. We are indeed looking to adapt and existing standard rather than start with a new one			

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
				from scratch. It is hoped that following this path will mean existing platforms could be updated with firmware patches. Task Group lead: Nick.Coyne@eumetsat.int			
CGMS Task Force on Satellite Data and Codes, WMO	WGIV/5	WGIV/A49.02	The CGMS Task Group on Satellite Data and Codes to work closely with WMO on addressing the following points: i. Linking between OSCAR/Space and the WSI and/or CCT C-5 identifiers (WMO internal) ii. Potential extension of the use of the Issue Number in the WSI for satellites in order to explicitly indicate metadata which are otherwise only implicitly embedded in the Local Identifier (CGMS-50)	*2022 27 Sep: First intersessional meeting was held in September 2022. Participation was very low. Broader participation in intersessional meetings is encouraged, but communication is handled also via offline email communication.* CGMS-50: The Task Group is continuing to work on the use of WIGOS Station identifiers for satellite products. CGMS-50-CGMS-WP-14 includes text prepared by WMO Secretariat for the guide on the WIGOS explaining the use of WIGOS Station Identifiers for satellites. The Task Group continues to	CGMS-50	OPEN	3.9.1

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
			iii. Identification of when and how the WSI should be included in the satellite products exchanges in the context of the WIGOS (CGMS-50) (ref CGMS-49-WMO-WP-08)	assess the best use the Issue Number (currently fixed to 0) in the future. 2022 11 Apr: Transferred to WGI. To be discussed with WMO (Simon, Chair, to follow up). WMO will first complete the ongoing WSI for satellites design and documentation in WIGOS Guide and its implementation in OSCAR/Space. CCT-C5 will be tentatively covered by that work. 2022 18 Jan: WMO to address latest on 27 October, ongoing work, done through WGI			
WGI Task Group on RFI detection, monitoring and mapping	2.1	WGI/A50.01	Continue forming the Task Group on RFI, establish and confirm the ToR for the Task Group, and investigate collectively mechanisms for detection and long-term monitoring of and mapping of RFI (for example, but not	*2022 27 Sep: In the intersessional meetings so far, NOAA, EUMETSAT and CMA presented their work in these areas. KMA have reached out to KARI and KASI.*	CGMS-51	OPEN	

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
			limited to, from IMT-2020/5G into the 24 GHz passive band) at satellite or instrument level, or any other means, as the knowledge base for assessing the impact on the passive sensor measurements. The draft ToR is to be discussed in the intersessional meetings before CGMS-50 Plenary.				
CGMS Members	2.1	WGI/A50.02	CGMS members to urge their national regulatory authorities, when establishing new regulations for use of active services and applications, to appropriately take into account the protection requirements of passive sensors and that the bands listed in RR FN 5.340 will not be opened for a shared use with active services.		CGMS-51	OPEN	2.2.2

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
SFCG Rep	2.1	WGI/A50.03	SFCG rep to circulate (by the end of 2022) the updated WMO preliminary position paper on WRC-23 after being updated by ET-RFC at its August/September 2022 meeting and afterwards adopted within WMO. CGMS members would then need to ensure the updated WMO positions known to its members' national and international preparation processes for WRC-23.	*2022 27 Sep: The paper has been updated and will be circulated to WGI shortly - timeline to be confirmed with Markus.*	End of 2022	OPEN	2.2
CGMS Members	2.1	WGI/A50.04	SFCG Rep and WMO to propose a process for providing accurate and timely updates on satellite frequencies recorded in OSCAR/Space database. This process should ensure CGMS agencies inputs to the database to WMO are aligned with SFCG inputs and activities. The proposed	*2022 27 Sep: Heikki will follow up with Markus on documenting the process.*	October 2022	OPEN	

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
			process is to be presented by October 2022.				
WMO	2.1	WGI/A50.05	WMO to include the frequency information in their updated templates to OSCAR/Space Support Team (O/SST)	*2022 27 Sep: Completed, this is now standard procedure. Action closed.*	October 2022	**CLOSED**	
WGI Task Group on Data Collection Services	4.1	WGI/A50.06	Build on the work of the SWOT analysis on the DCS from Geostationary Meteorological satellites, and particularly progress on the five proposals for further work (covering RFI Mitigation, joint DCS PR materials, DCS introduction video, manufacturer workshop, discoverable information) and present the outcome to CGMS-51.	*2022 27 Sep: RFI, DCP Standard and DCS Outreach will be discussed in the DCS Workshop on 12 October.*	CGMS-51	OPEN	2.1
Task Group on Space Debris and	5.1	WGI/A50.07	Deliver a Best Practice document on collision avoidance and debris	*2022 27 Sep: Task Group meeting to be held*	CGMS-51	OPEN	

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
Collision Avoidance			mitigation, with supporting presentation to CGMS WGI, for recommendation for endorsement in CGMS-51.				
CGMS Members	5.1	WGI/A50.08	All CGMS Members involved in spacecraft operations are strongly encouraged to nominate participants for the CGMS WGI Task Group on Space Debris and Collision Avoidance. The names of nominated participants are to be provided to the Task Group lead and CGMS WGI Co-chairs / rapporteur before CGMS-50 Plenary, so that the names of members can be reported to CGMS-50 plenary. This is to allow the formulation of the initial Best Practice on collision avoidance and debris mitigation before CGMS-51.	*2022 27 Sep: KMA have nominated a member for the task group. Reminder for further nominations to be sent.*	May 2022	OPEN	

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
WGI Task Group on the Coordination of LEO Orbits + WGI Task Group on Direct Broadcast Systems	5.2 / 3.1	WGI/A50.09	Build on the SWOT analysis on Low Latency Data Access from LEO meteorological satellites (CGMS-50-CGMS-WP-08) work and broaden its scope to include the following, thereby removing historical requirement and architectural boundaries between global data access and direct broadcast systems: • Global data coverage and access; • Temporal coverage over a given geographic area; • Low latency data delivery; Perform further study on the possible usage of emerging technologies identified by the SWOT analysis. The two Task Groups should hold meetings and agree on a proposed way forward for	*2022 27 Sep: One joint task group meeting has taken place, work ongoing.*	CGMS-51	OPEN	2.3.3

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
			a consolidated SWOT analysis, and present to CGMS-51 for consideration. All CGMS agencies are encouraged to nominate participants to contribute to this activity.				
WGI Task Group on the Coordination of LEO Orbits + WGI Task Group on Direct Broadcast Systems	5.2	WGI/A50.10	Task Group on the Coordination of LEO Orbits and Task Group on Direct Broadcast Systems to review the overlap between the proposed (BP) for the Coordination of Data Acquisition for Low Earth Orbit (LEO) Satellite Systems and the already published Best practices in support to local and regional processing of LEO direct broadcast data (CGMS/DOC/18/1008274), and propose a way forward for both best practices.	*2022 27 Sep: One joint task group meeting has taken place, work ongoing.*	CGMS-51	OPEN	

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
			The updated best practices drafts should be sent for review before CGMS-51 and presented to CGMS-51.				
CGMS Members	6	WGI/A50.11	CGMS agencies to consider nominating additional members for all the WGI Task Groups (listed below) by CGMS-50 Plenary, especially ones where no representatives of the agencies are currently participating in the Task Group(s). - Task Group on Direct Broadcast Systems - Task Group on Satellite Data and Codes - Task Group on Data Collection Services - Task Group on Space Debris and Collision Avoidance - Task Group on the Coordination of LEO Orbits - Task Group on RFI	*2022 27 Sep: Reminder for nominations to be sent.*	May 2022	OPEN	

WGI actions and recommendations following CGMS-50							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
			detection, monitoring and mapping				
All WGI Task Groups	6	WGI/A50.12	Each of the WGI Task Groups to present its latest Terms of Reference to CGMS-51, which following endorsement should be added to the CGMS Website by CGMS Secretariat. The updated Terms of Reference of the Task Groups can then be used as inputs to the review of the WGI ToRs in 2023.	*2022 27 Sep: Integrated in the draft CGMS-51 WGI agenda*	CGMS-51	OPEN	

CGMS-50 WGI Recommendations							
Actionee	**AGN item**	**Action #**	**Description**	**Recommendation feedback/closing document**	**HLPP**		
All WGI Task Groups	6	WGI/R50.01	Each of the WGI Task Groups to continuously present the following, starting with CGMS-51. All of the agencies are encouraged to provide inputs. - Existing / updated Best Practices - Status of implementation of Best Practices for each agency - Future work / recommendations / proposals (taking into consideration outcome of SWOT analyses)	*2022 27 Sep: Integrated in the draft CGMS-51 WGI agenda*			

Working Group II (WGII)

Satellite data and products

50 YEARS 1972–2022

CGMS

WGII REPORT

Co-chairs: Jayaprakash V Thomas (ISRO), Kenneth Holmlund (WMO)
Rapporteurs: Mitch Goldberg (NOAA), Paolo Ruti (EUMETSAT)

1. Opening, objectives and expected outcomes

CGMS-49-CGMS-WP-09: Recalling the purpose of WGII and expected outcomes of the session

CGMS Working Group II is focused on "Satellite Data and Products". It is the CGMS forum where aspects of technical and scientific nature related to satellite data and products are discussed. The Working Group serves as the link between CGMS and the CGMS International Science Working Groups, 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 organized in the WMO Application Areas.

One of the key purposes of WG II highlighted by the Co-Chairs is to review progress made by CGMS WG II members as well as CGMS International Science Working Groups since the last WG II meeting in 2021. In this regard, the importance of HLPP was noted. In addition, the WG II session on climate and greenhouse gas monitoring was specifically pointed out as there was the GHG/Carbon Monitoring Workshop (10-12 May 2022) hosted by WMO as well as there will be a dedicated session at the CGMS-50 Plenary. So, it was concluded that the support of greenhouse gas monitoring and other climate activities from CGMS members should be considered.

Finally, the importance of identifying a short, but very precise list of High-Level Priority actions, which will be brought to the Plenary for further discussions was stressed.

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

CGMS-50-CMA-WP-09: CMA agency report on highlights and issues in FY-3E and FY4B dataset and products

The report highlights the current status and progress of CMA Fengyun (FY) meteorological satellite datasets and products. The overview of FY satellite earth observations products from FY-3 and FY-4 satellite are introduced, including:

1) The second and also the first operational satellite of FY-4 series, launched on June 3, 2021, is located at 133°E. Instruments performance and L1 data testing has been basically completed, and L2 products testing is in progress. Geostationary High-speed Imager (GHI) allows scanning the selected segments of the Earth disk at one-minute rate;

2) The first civil meteorological satellite in early morning orbit FY-3E was launched on July 5, 2021. Instruments performance and L1 data testing has been basically completed, and L2 products testing is in progress. There are three newly developed instruments onboard FY-3E (Wind Radar, Solar X-ray and Extreme Ultraviolet Imager, Solar Spectral Irradiance Monitor);

3) FY3E/ MERSI-LL Night-time Lights (NTL) allows showing the night-time visible artificial lights on land, which could characterize urban structures and indicate socio-economic activities;

4) 35 baseline L2 products of FY-4B and 41 baseline L2 products of FY-3E have been developed and are now under validation, are expected to finish in Q2 2022;

5) According to the new observation capability of early morning orbit, new remote sensing products such as low-light near constant contrast and night-time light, sea surface wind field, sea ice edge and type, etc., have been developed;

6) Multiple satellite image products of FY-4B AGRI and GHI are developed for monitoring and nowcasting of (severe) convective storms.

Discussion

WG II highlighted a very impressive list of products and outcomes from FY-3E, noting that images demonstrated from the night-day band of MERSI-LL is very detailed and look very promising. It was also noted that having night-day band capability available for both JPSS (ECT 13:30) and FY-3E (ECT 05:40) make it an effective constellation, highlighting the upcoming NOAA's GEO-XO mission with similar capabilities.

Following the question about the WMO position in terms of night-time lights capability reflected in the Vision for WIGOS in 2040 and/or the WMO Gap Analysis, it was noted that this capability was not explicitly highlighted in the WMO Gap Analysis (**Action WGIIA50.01**).

In addition, it is worth mentioning that “VIS/IR imagery, realization of a day/night band” is in the list of instruments of the Sun-synchronous core constellation satellites in three orbital planes (morning, afternoon, early morning) as part of the Subcomponent 1. Backbone system with specified orbital configuration and measurement approaches of the Vision for WIGOS in 2040.

CGMS-50 actions – WGII						
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**	**Colour coding**
CGMSSEC & WMO		WGIIA50.01	CGMSSEC and WMO to consider if night-time light capabilities should be covered in HLPP, the CGMS Baseline, and should be reflected in the WMO Gap Analysis	CGMS-51	**Open**	High Level Priority

CGMS-50-IMD-WP-01: IMD reports on highlights and issues in dataset and product generation

The report presents the status of the Multi-Mission Meteorological Data Receiving & Processing System (MMDRPS) of Satellite Meteorology Division along with highlights and issues in dataset and product generation. Report highlights the ongoing activities of MMDRPS such as Monthly validation of INSAT-3D & 3DR satellites products and recent INSAT-3D/3DR calibration campaign in Great Rann of Kutch, a Joint Campaign with SAC/ISRO. The online Data Supply system of INSAT series of satellites which will be soon available to public and users was also shown. The GNSS data of IMD is also getting assimilated in the NWP models on a real time basis. Furthermore, the Rapid SCAN utility from INSAT-3DR satellites during Cyclone events over North Indian Ocean of 2021 was demonstrated.

Discussion

Working Group II took note. Following the question about the availability of the Calibration and Validation report, which would be very useful for all users of INSAT-3D/3DR around the globe, it was reported that this document should be finalized soon, and it would be made available at the IMD website (**Rec WGIIA50.01**).

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
IMD		WGIIA50.01	IMD to make the Calibration and Validation report available for all interested users of INSAT-3D/3DR on the IMD website as soon as the document is finalized	Internal WG business

CGMS-50-ISRO-WP-03: ISRO Report on Highlights and Issues in Datasets and Products

The report highlighted the following key points:

1) Joint ISRO-IMD Team validated products in Multi-Mission Data Reception and Processing System (MMDRPS) which is operational at IMD, since Jan 2021 for INSAT-3D/3DR;
2) SCATSAT-1 with Ku-band Scatterometer completed the mission in February, 2021;
3) ISRO-CNES joint mission SARAL/AltiKa is functioning in mispointing mode and the mission is extended till December 2022 provided the health of the satellite is satisfactory. The mission will be further reviewed in December 2022;
4) ISRO-CNES joint mission MeghaTropiques was launched into orbit in October 2011. Madras payload was switched off in May 2013. SAPHIR and ScaRaB has provided useful data for more than a decade. Due to an onboard anomaly in March 2019, the data availability has become low. ISRO-CNES JSC decided to announce the end of mission;
5) Under GSICS, inter-calibration of IR channels are in demo phase with IASI-A/B and will be shortly extended to IASI-C and CrIS. Ray-Matching method has been developed for inter-calibration of Vis/SWIR channels using MODIS and 6 years (2016-2021) of matchup data for INSAT-3D/3DR VIS/SWIR channels is prepared;

6) Oceansat-3 is scheduled for launch this year with Ku-band scatterometer, Sea Surface Temperature Monitor (SSTM), and 13-band Ocean Color Monitor (OCM);
7) GISAT-2 is scheduled for launch in March 2023;
8) INSAT-3DS is scheduled for launch in March 2024.

Discussion

Working Group II took note and had no further comments.

CGMS-50-JAXA-WP-01: JAXA Earth Observation Program and Data Product

JAXA operates various kind of satellite sensors and opens the products to the public. JAXA keeps developing and improving the products to address the climate issues. The major updates since CGMS-49 is that the pre-project team of Precipitation Measuring Mission, following to the Global Precipitation Measurement (GPM) mission, was organized in JAXA in January 2022. JAXA appreciates the supports by CGMS and IPWG. In terms of the WMO project for monitoring extremes, JAXA contributes to the WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) Project by providing GSMaP rainfall product with climate normal. JAXA improved the algorithm in December 2021 (algorithm version 8), and currently reprocesses the past GSMaP dataset since 1998, and will re-calculate the climate normal again.

Discussion

WG II welcomed the presentation noting very important contribution from JAXA to greenhouse gas / carbon monitoring as well as the importance of reprocessing activities carried out by JAXA. In addition, the progress made by JAXA to secure a new precipitation radar was specifically highlighted, noting that CGMS, IPWG, and WMO would be happy to provide further support of this mission If needed. This data is vitally important as an in-orbit reference, the source of information for areas where ground-based radars are not available as well as a calibrator for passive rain retrievals.

Following the question about the architecture planned for a follow up precipitation radar mission, it was reported that JAXA does not consider novel SmallSat/CubeSat types of architecture, there is a plan to have big spacecraft. More detailed information can be provided to CGMS after the completion of the JAXA System Requirements Review scheduled for June 2022.

CGMS-50-JMA-WP-04: JMA agency report on highlights and issues in dataset and products

JMA plans to add the results of its reprocessing – the Atmospheric Motion Vector (AMV) for Japanese Reanalysis for Three Quarters of a Century (JRA-3Q) dataset – to the ECV-Inventory.

An aerosol retrieval algorithm update in January 2022 also enables retrieval of aerosol parameters featuring more consistency with in-situ observation data than with the old algorithm.

To support the Tokyo 2020 Olympic and Paralympic Games (held in 2021 due to COVID), JMA's Himawari-8 satellite observed the Tokyo metropolitan area every 30 seconds, and the resulting imagery was provided to the Tokyo Organizing Committee for the Olympic and Paralympic Games (TOCOG) and the JMA Tokyo 2020 Weather Portal.

For reporting on pumice generated during the August 2021 eruption of the undersea volcano Fukutoku-Okanoba in Japan, JMA applied RGB compositing to facilitate identification of marine drift matter in visible and near-infrared data collected by the Himawari-8 AHI. The resulting imagery was provided to the JMA pumice portal site.

Discussion

WG II welcomed the presentation noting very impressive high resolution rapid scan imagery.

CGMS-50-KMA-WP-02: KMA Report on Highlights and Issues in Dataset and Products

This document describes the update and issues of GK2A products retrieval and their application in KMA. KMA has tried to improve accuracy and application of GK2A products through fusion of different satellite sensors, RTM, AI technique etc.

KMA has expanded AAP (AMI Atmospheric Profile) of GK2A by utilizing the microwave sounder (ATOVS, ATMS) data to get all sky profiles. The result showed that the accuracy of the lower layer temperature was improved, in particular, the lowest temperature bias was improved by about 0.7 K and RMSE by about 0.8 K compared to AAP in the case of the ocean. We have experienced frequently smog and dust in winter and spring and found that use of single scattering albedo of GEMS/GK2B improved the accuracy of AOD product of AMI GK2A with updated aerosol type information.

In spring 2022, dry and strong wind season, Korea had several big devastating forest fires. To detect wildfire earlier, KMA has tried to produce wildfire product every 2 minutes and reduce false alarm by removal of heat source such as chemical plants.

KMA has been providing forecaster with simulated true colour RGB image and day-night RGB image with simulated visible data estimated from RTM model which can be used in evaluation of NWP performance and its physical characteristics. As well as, KMA started to give to users AI generated GK2A Surface Solar Irradiance (SSI) which is in good with in-situ data agreement of 0.98 of correlation over all sky with spatial resolution of 2km x 2km and play a principal role in climatological and renewable energy applications.

Discussion

Working Group II took note and had no further comments.

CGMS-50-NASA-WP-02: NASA research and data product highlights

The National Aeronautics and Space Administration (NASA) is a major contributor to global knowledge of the Earth's environment. Its scientific infrastructure includes almost two dozen satellite missions; surface and airborne observational platforms that enable calibration and validation of remotely sensed imagery; and computing systems for data processing, storage, research, and analysis. Rigorous quality assurance standards ensure delivery of high-quality data to the scientific community for Earth systems science research and application. This working paper presents a summary of NASA activities during the last twelve months that may be of interest to Coordination Group for Meteorological Satellites (CGMS) members. It includes highlights of NASA's ongoing work with partners, including its

support for the expansion of the global in situ ground networks, newly developed technologies and techniques, recent airborne field campaigns, and datasets that are capable of reliably tracking changes to the Earth system.

Discussion

Working Group II took note.

CGMS-50-NOAA-WP-15: NOAA Highlights and issues in dataset and product generation

NOAA's operational Earth observation systems are among the world's most advanced polar and geostationary weather satellites. Our Joint Polar Satellite System (JPSS) and Geostationary Operational Environmental Satellite R series (GOES-R) are the backbone of satellite remote observations for the United States. JPSS and GOES-R distribute a combined 29 terabytes of data every day through NOAA's ground systems to users such as the National Weather Service, international weather observation partners, and commercial sectors including farming, fishing, transportation, energy and telecommunications industries.

By 2030, the world will be far different from the one in which we live today. The trends that are shaping the world around us include:

- An unprecedented pace of innovation and disruption in technology to support advancements in forecast modeling, through artificial intelligence, quantum computing and machine-learning;
- Increasing demand from American people and businesses for timelier and more accurate predictions of extreme weather events, delivered in faster, user-friendly communications;
- Increasing demand for environmental assessments and projections to inform infrastructure and commercial investments in response to accelerating climate changes;
- Emerging capabilities for both launch and remote sensing among the U.S. aerospace industry and our international partners, offering opportunity for NOAA to augment and even revolutionize our existing capability; and
- Increasing vulnerability of our technological society to the magnetic, electrodynamic, and particle effects of space weather.

The architecture of 2030 will be built with an agility to quickly seize technological and scientific advancements at the earliest opportunity, generating new observations and products to meet the demands and challenges of our swiftly transforming planet.

Discussion

During the discussion it was noted that spatial and temporal resolution of satellite data have been improved recently that poses a significant challenge in terms of assimilating this data into NWP models (especially considering the Earth system approach). So, this might require significant efforts from the modelling community to figure out the best way how high-resolution satellite data can be digested by assimilation systems (applying various techniques, e.g., thinning the data). It was also noted that the NOAA Modeling Board had been discussing resolution discrepancies between NWP models and satellite data assimilated into those models as well as potential solutions for different types of models.

Following the question from JAXA about the availability of the CMORPH-2 precipitation rate product in NRT mode, it was noted that the NRT production of CMORPH2 is released to public through the NOAA/NESDIS web page (with temporal resolution of 30 min, with a latency of about 2 hours): https://www.star.nesdis.noaa.gov/jpss/EDRs/products_blended_cmorph.php.

In responding to a clarification from WG II, it was noted that after GOES-18 takes over operations, GOES-17 would be on 'hot standby', serving as a WEST backup; it might be also used for some scientific studies.

CGMS-50-ROSHYDROMET-WP-02: Roshydromet report on highlights in meteorological satellite – based products generation and application

Roshydromet as operational agency is responsible for the exploitation of existing Russian meteorological satellites. The working paper focuses on the generation of new products based on Russian meteorological satellites of Arktika-M, Electro-L and Meteor-M series. The following sample products are presented:

- cloud images and cloud analysis products generated from MSU-GS/ Arktika-M No1 data;
- precipitation zones and other weather phenomena in the Arctic region detected using MSU-GS/Arktika-M No.1 data;
- MSU-GS/ Arktika-M No.1 based atmospheric motion vectors;
- retrievals of total water vapour content (TWVC) in the atmosphere from MSU-GS/ Arktika-M No1 data;
- atmospheric CO2 concentration retrievals from hyperspectral IR sounder IKFS-2/ Meteor-M N2 data;
- TWVC retrievals from MTVZA-GY/ Meteor-M №2-2 data;
- steppe and forest fires monitoring from Meteor-M & Canopus-V.

Discussion

In responding to a clarification from WG II, it was reported that Arktika-M No.2 satellite is planned to be launched in December 2023.

CGMS-50-WMO-WP-01: WMO report

The presentation gives a summary update of the WMO activities, mainly presented in other papers during the various CGMS-50 Working Group meetings, in particular:

- Progress on defining core satellite data (WGII: CGMS-50-WMO-WP-02WGII);
- GHG/Carbon Workshop (WGII: CGMS-50-WMO-WP-03WGII);
- Space Weather activities (SWCG: CGMS-50-WMO-WP-10);
- Frequency protection (WG I: CGMS-50-WMO-WP-05);
- OSCAR Updates (WG III: CGMS-50-WMO-WP-07);
- Consultative Meeting on High-Level Policy on Satellite Matters (a way forward to be decided in June 2022).

Discussion

During the discussion the importance of the close coordination within WMO, specifically between the satellite community (Space Systems and Utilization Division) and the research community (Research and Innovation Department) was highlighted, which would help the community to better plan future Earth observation missions, joint field campaigns etc. It was specifically noted that a prime example of such a collaboration might be the GHG/Carbon monitoring initiative, where there is a great need not only for ground-based data itself, but this data is also critically important for Cal/Val activities undertaken by the satellite community.

3. CGMS International Science Working Groups

3.1 GSICS

CGMS-GSICS-WP-01: GSICS Annual report

Global Space-based Inter-Calibration System (GSICS) is an international collaborative effort initiated in 2005 by the World Meteorological Organization (WMO) and the Coordination Group for Meteorological Satellites (CGMS) to monitor, improve and harmonize the quality of observations from operational weather and environmental satellites of the Global Observing System (GOS). GSICS aims at ensuring consistent accuracy among space-based observations worldwide for climate monitoring, weather forecasting, and environmental applications.

GSICS produced its latest State of the Observing System assessment which will be included in upcoming GSICS quarterly newsletters. Relevant current topics includes expanding GSICS to provide intercalibration for 1) Space Weather, GHG constellation, and Ocean Surface Vector Winds, and adding commercial providers as members.

Discussion

During the discussion it was highlighted by WMO that extending the framework of GSICS to provide intercalibration for GHG constellation should be considered as very important in the coming years. The close collaboration with the CEOS Cal/Val Working Group was pointed out as very important in this regard.

It was also noted that GSICS is looking for a Vice-Chair for GSICS-EP and also for a Vice-Chair for the GSICS Research Working Group (GRWG). It was emphasized that it is important to rotate the leaderships positions. CGMS WG II members are encouraged to consider nominating people for these leadership roles, noting that it is a good opportunity for young people to take a leading role (**Action WGIIA50.02**).

In addition, it was reported that GSICS had been working with the Space Weather Task Team on the needs for intercalibration for space weather. So, it was agreed to establish a Subgroup within GSICS on Space Weather Cal/Val and Intercalibration. CGMS WG II members are encouraged to consider nominating people for this Subgroup, noting that the subgroup is preliminary set up for a 2-year period (**Action WGIIA50.03**).

There was a recommendation, which also goes from the CEOS Working Group on Cal/Val, that the Total and Spectral Solar Irradiance Sensor-1 (TSIS-1) Hybrid Solar Reference Spectrum (HSRS) should be used as the Solar Reference Dataset (**Rec WGIIA50.02**).

CGMS-50 actions – WGII						
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**	**Colour coding**
CGMS WGII members		WGIIA50.02	CGMS WGII members are invited to nominate candidates for positions of Vice-Chairs for GSICS-EP and GRWG. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Sept 2022	OPEN	High Level Priority
CGMS WGII members		WGIIA50.03	CGMS WGII members are invited to nominate candidates for a Subgroup within GSICS on Space Weather Cal/Val and Intercalibration, which will be focused on providing intercalibration for Space Weather. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Sept 2022	OPEN	High Level Priority

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
CGMS Members		WGIIA50.02	CGMS Members are encouraged to use "TSIS-1 HSRS" as the Solar Reference Dataset	Best Practices and Periodic actions

3.2 ICWG

CGMS-50-ICWG-WP-01 Summary Report of International Clouds Working Group (ICWG) Activity

This working paper presents a summary report of ICWG activities since CGMS-49. Due to the Pandemic, the ICWG did not meet in 2020 or 2021. The ICWG held a virtual intersessional meeting on

2 days in September 2021. The meeting was hosted by EUMETSAT. ICWG plans for another intersessional meeting in 2022 and an in-person meeting in 2023. The ICWG continues to be organised with 4 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. As requested by CGMS, a session was held on the status and application of the geostationary lightning imagers. Intercomparisons 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 has adopted the same GOES-16 Golden Day (October 20, 2022) as the IWWG. ICWG seeks guidance in how to support this analysis and its reporting going forward.

Discussion

At the presentation, it was noted that there is a recommendation from the Climate Working Group of ICWG that the Climate Data producers should adopt a uniform data description as the climate community are struggling to put together various climate data from various producers. It was added that ICWG would like to continue to promote the uniform climate datasets.

Following further discussion, it was noted by EUMETSAT that there have been a number of attempts to accomplish this ambitious task, but data descriptions have never been harmonized or homogenized. So, it was agreed that this action would be of great value if one would develop a best practices guidance on how to do that (**Action WGIIA50.04**).

CGMS-50 actions – WGII						
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**	**Colour coding**
ICWG		WGIIA50.04	To develop a Best Practices guidance for climate data producers on a uniform data description (e.g., in the form of standardized fact sheets) to ensure the uniform climate datasets	CGMS-51	**OPEN**	Best Practices and Periodic actions

During the discussion it was also noted that the Satellite Cloud Climatology Project (ISCCP) are mainly focused only on GEO data, so polar-orbiting satellites, which allow having temporal resolution of about 30 min in polar regions if they are used collectively, are not considered for the time being. It was further noted that polar orbiting imagers and sounders have become so capable, so they are not a gap filler anymore, so they should have their own optimized version of ISCCP. So, it was concluded that ISCCP – Next Generation should extend its efforts to include polar-orbiting capabilities as well.

In addition, the question was posed with respect to the lack of funding for the intercomparison study reported in the presentation. It was noted that intercomparison studies should be part of the agency science programs for all CGMS agencies. It was further highlighted that even though this topic has

been raised before (see **WGII/R47.02**), there is a need to bring up this recommendation again as intercomparison studies should be part of the baseline science activities (**Rec WGIIA50.03**).

CGMS-47 recommendations – WGII			
Actionee	**AGN item**	**Rec**	**Description**
CGMS space agencies	5.8	Plenary R47.07 & 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

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
CGMS Members		WGIIA50.03	CGMS members are encouraged to ensure that intercomparison studies are part of their baseline science activities to ensure there is sufficient funding available	Internal WG business

In responding to a clarification from WG II, ICWG noted that the action item on collaboration with SCOPE-Nowcasting (see **WGII/A48.01**) has been addressed via establishing a pathway of collaboration between SCOPE-Nowcasting and ICWG. Dr Michael Pavolonis of NOAA, the lead of SCOPE-Nowcasting, will serve as an ongoing liaison between SCOPE-Nowcasting and the ICWG Topical Group on Severe Weather. Thus, there is a plan to strengthen the interactions with SCOPE-Nowcasting as a vehicle for ensuring validation of cloud products for nowcasting, which is very important.

CGMS-48 actions – WGII						
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**HLPP ref**	**Status**
ICWG	WGII/3	WGII/ A48.01	ICWG to establish a liaison with EUMETSAT Convective Working Group or SCOPE Nowcasting	Aug 2021	HLPP 4.2.6	**CLOSED**

3.3 IPWG

CGMS-50-IPWG-WP-01: Report from IPWG since CGMS-49, and key recommendations to CGMS

This report presents the key activities implemented by IPWG:

1) After postponement in 2020 and 2021, the IPWG-10 workshop is on track, scheduled for June 13-17, 2022. A working group with IPWG and VLab trainers, with an interactive session on visualization tools, will be organized as part of IPWG10;
2) Despite the meeting postponement, several online workshop sessions were organized during 2021;

3) Several small satellite missions relevant to precipitation were deployed in 2021, with the TROPICS constellation to follow this year;
4) Several reports or manuscripts targeting CGMS actions were published during the past year, in particular "The Global Satellite Precipitation Constellation: Current Status and Future Requirements" (AMS, Bull. Amer. Meteor. Soc.);
5) It is expected that 2022-2023 to be active years for assessment of small satellite precipitation-sensing capabilities.

Discussion

WG II welcomed Dr. Joe Turk, JPL/Caltech, as a new IPWG Rapporteur, following the retirement of Ralph Ferraro/NOAA.

During the discussion it was agreed that IPWG would present a short report from the upcoming IPWG-10 workshop (13-17 June 2022) at the first WGII Intersessional meeting (**Action WGIIA50.05**).

CGMS-50 actions – WGII						
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**	**Colour coding**
IPWG		WGIIA 50.05	IPWG to present updates from the upcoming IPWG-10 workshop (13-17 June 2022) at the first WGII Intersessional meeting	CGMS IS#1	OPEN	Internal WG business

It was noted that there are plans to engage the WMO radar activities with IPWG and to look at synergies here. There should be some potential not only for Cal/Val related activities, but also some commonalities in product structure, metadata, climate data etc.

Following the question about the need for a critical gap analysis of the current CGMS baseline with respect to the requirements for precipitation monitoring identified last year, it was noted that there is a plan to take this action at the upcoming IPWG-10 workshop (13-17 June 2022).

3.4 IROWG

CGMS-50-IROWG-WP-01: Update from the International Radio Occultation Working Group

The IROWG community has not met since CGMS-49. Therefore, we re-state the four key recommendations previously presented at CGMS-49, endorsed by the IROWG community at IROWG-8 (virtual conference, hosted by NOAA and UCAR), April 7-13, 2021.

The four key recommendations carried forward from IROWG-8 are:

IROWG reaffirms that all providers of RO observations should classify these as essential in the sense of WMO Resolution 40. IROWG stresses the importance of free, timely and unrestricted access in real-time to essential RO data, and free and unrestricted access to archived raw data (including auxiliary data) (**Rec WGIIA50.04**).

IROWG continues to recommend that WMO and CGMS should coordinate any GNSS-RO data purchases. Specifically, we suggest convening a meeting of all agencies considering procuring these data, in order to discuss if, how and when the current 20,000 daily target will be met with global and full local time coverage (**Rec WGIIA50.05**).

IROWG recommends that CGMS encourages technology and retrieval developments for improving planetary boundary layer profiling from GNSS-RO and their utilization in NWP data assimilation – and the further exploration of RO-derived water vapor as a climate variable (**Rec WGIIA50.06**).

Per CGMS priority HLPP 1.1.4 (optimized system for atmospheric and ionospheric RO observations), IROWG recommends that CGMS encourages on-going and future GNSS-RO and non-RO missions, including commercial providers of RO observations, to incorporate a complete set of ionospheric measurements (**Rec WGIIA50.07**).

The CGMS-49 working paper from IROWG-8 is available at http://irowg.org/workshops/irowg-8/. All given workshop presentations can be found at https://cpaess.ucar.edu/meetings/2021/irowg-8.

The next IROWG-9 workshop will be held on September 8-14, 2022 in Seggauberg, Austria. It will be combined with the 7th Workshop on "Occultations for Probing Atmosphere and Climate".

Discussion

In responding to the question about the impact of RO data in NWP (slide 6), it was noted that IPWG believe that the relative impact of the number of RO profiles on the integrated measure of 24-hour forecast accuracy in the period of March-September 2020 demonstrated by ECMWF is due to the pandemic, which resulted in the reduction of the aircraft flights, i.e. it was a coincidence due to the trade-off between observing systems. IROWG responded that COSMIC-2 went operational at ECMWF during a period when aircraft numbers were in decline, but COSMIC-2 impact was tested prior to the reduction in aircraft numbers. RO impact on this measure (slide 6) has remained stable as the aircraft numbers have recovered. It would be incorrect to give the impression that the COSMIC-2 impact was because the aircraft numbers had fallen.

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
CGMS Members		WGIIA50.04	(IROWG) All providers of RO observations are encouraged to classify RO data as core data in the sense of the WMO Unified Data Policy (Res. 1). Therefore, free, timely and unrestricted access shall be provided to NRT RO data and free and unrestricted access shall be provided to archived raw data (including auxiliary data)	High Level Priority
WMO and CGMS Members		WGIIA50.05	(IROWG) WMO and CGMS are encouraged to coordinate any GNSS-RO data purchases to ensure the	High Level Priority

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
			current 20,000 daily target identified in HLPP is met with global and full local time coverage	
CGMS Members		WGIIA50.06	(IROWG) CGMS are recommended to encourage technology and retrieval developments for improving planetary boundary layer profiling from GNSS-RO and their utilization in NWP data assimilation – and the further exploration of RO-derived water vapor as a climate variable	Best Practices and Periodic actions
CGMS Members		WGIIA50.07	(IROWG) Purchasers of RO data for NWP is encouraged to document their access to raw data, so that such purchased data can be used reliably in climate applications, where traceability of the measurements to fundamental units (e.g. definition of the second) is essential. For climate, appropriate documentation and meta-data need to be available with the provision of raw data	Best Practices and Periodic actions
CGMS Members		WGIIA50.08	(IROWG) CGMS Members are encouraged to acquire information on the developments of GNSS radio jammers and monitor their impacts to the observing system. The reason for this recommendation is that the RO community has begun to document the resulting degradation on RO measurements from radio frequency interference caused by the use of these development in recent ongoing world events and conflicts	Internal WG business

3.5 ITWG

CGMS-50-ITWG-WP-01: Report from ITWG since CGMS-49, and key recommendations to CGMS

This working paper presents a summary of ITWG activities since CGMS-49.

The Twenty-Third International TOVS Study Conference, ITSC-23, was hosted by the University of Wisconsin–Madison and Météo France as a virtual conference from 24-30 June 2021. The conference was attended by 258 participants from 52 organizations, providing a wide range of scientific and technical contributions. Nineteen countries and three international organizations were represented: Argentina, Australia, Canada, China, Finland, France, Germany, India, Italy, Japan, Norway, Russia, Senegal, South Korea, Spain, Sweden, Switzerland, United Kingdom, United States, ECMWF, EUMETSAT, and the WMO. Working Groups were formed for key topic areas, leading to very

productive discussions. The technical programmewas organized in sixteen sessions containing 56 oral presentations and 76 posters.

The ITWG permanent working groups met during ITSC-23 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. Activities that had taken place since ITSC-22 in Saint-Sauveur, Québec, Canada (November 2019) were presented in a dedicated session of Working Group status reports. Technical sub-groups also met during ITSC-23 to discuss developments and plans concerning specific software packages, shared and in common use.

ITSC-24 will be an in-person meeting in Tromsø, Norway from 16-22 March 2023.

Discussion

With respect to choosing the potential small satellites constellations for microwave sounding observations, it was noted that the WMO Gap Analysis (presented at WG III CGMS-50-WMO-WP-08) allowed to identify that this is a key subject that should be addressed in the coming years. It was highlighted that WGIII would be more than keen to know more results from these studies to look at the potential benefits for data assimilation of 'hybrid' constellation of microwave satellites with both classical ATMS type and micro-satellites. So ITWG was encouraged to continue this work and report back to CGMS.

Following a follow up question with respect to the similar studies for infrared sounding observations, it was noted that this would be a very good idea to be suggested for NWP Working Group of ITWG.

It was further noted that there are some potential connections with IPWG activities and their needs in terms of using calibrated microwave observations for precipitation estimates. So, some cross-discussions between ITWG and IPWG were highly recommended. In responding to this comment, it was specifically highlighted that ITWG does recognize a strong need for collaboration with other International Science Working Groups and there have been a number of invited presentations from the representatives of these working groups and this would be continued in the future.

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
CGMS Members		WGII A50.09	(ITWG) In terms of international issues CGMS Members are encouraged: 1) to support the further development of Essential Climate Variables (ECVs) and Greenhouse Gas CDRs to	Best Practices and Periodic actions

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
			enrich the ECV inventory for climate change monitoring; 2) to explicitly consider instrument capabilities, data quality, and data provision in future updates of the CGMS baseline, particularly for the 3-orbit backbone system of LEO passive sounders which plays an important role as a reference-style system (*to be forwarded to WG III*); 3) the overlap period where one satellite resource is replacing another should be chosen after consultation with the user community and should follow WMO guidelines; 4) if a mission expects engagement from application areas with an NRT data requirement, budget should be allocated from the start to provide the required technical infrastructure; 5) to note that the benefits of Satellite Missions to the ITWG community are increased when early evaluation is undertaken by many independent centres (NWP centres in particular).	
CGMS Members		WGII A50.10	(ITWG) In terms of Data Dissemination CGMS Members are encouraged: 1) Climate Data Records (CDRs) should be citable by Digital Object Identifier (DOI) reference and all data records should be accompanied by metadata that follows WIGOS standards (*to be forwarded to WG IV);* 2) CDR development and stewardship should follow guidance similar to NOAA National Centers for Environmental Information (NCEI) data stewardship maturity matrix or the Copernicus Climate Change (C3S) convention (including recommendations for metadata) (*should be considered jointly with WG IV*); 3) when designing new or modified BUFR formats, circulate drafts to the NWP community via the NWP	Best Practices and Periodic actions

CGMS-50 recommendations – WGII				
Actionee	**AGN item**	**Rec**	**Description**	**Colour coding**
			Working Group for feedback prior to submission to WMO (*to be forwarded to WG I*); 4) to develop and maintain public instrument status monitoring web pages similar to the Integrated Calibration and Validation System (ICVS) from NOAA/NESDIS (*to be forwarded to WG IV*);	
CGMS Members		WGII A50.11	(ITWG) In terms of Evolution of the Observing Systems CGMS Members are encouraged: 1) to create intercalibration time series from overlapping satellites to allow a continuation of climate time series (including trend analysis) when transitioning from older to newer satellites; 2) to consider climate requirements in terms of stability and length of life cycle when designing small satellite sensors; 3) following the success of the Megha-Tropiques SAPHIR instrument, future microwave sensors operating in a similar low inclination orbit are recommended; 4) to continue to employ the traditional longwave infrared spectral radiance measurement band on all future hyperspectral infrared satellite sensors; 5) providers of data from constellations of smaller satellites should work towards standardization of data downlink frequencies and protocols to ease provision of near real-time (NRT) data.	Best Practices and Periodic actions

3.6 IWWG

CGMS-50-IWWG-WP-01: Status report of the International Wind Working Group Activities

This paper presents the activities and relevant discussion items of the IWWG since the CGMS-49 meeting. It includes an introduction to the CGMS of the planned new co-chairs (Iliana Genkova, NOAA/NCEP/IM Systems Group, Inc., and Feng Lu, CMA/NSMC/NARSSDC) of the IWWG, a brief update

of IWW16 (Spring 2023), a discussion of the HLPPs and related actions and an update from the Ocean Surface Winds Task Group (OSWTG).

Discussion

During the discussion the importance of getting a statement of endorsement of new co-chairs from their parent organizations before presenting the nominations to the Plenary was highlighted. It was agreed that a clear procedure for endorsement of new co-chair for the International Science Working Groups should be proposed and presented to the Plenary for approval so that this procedure would become a best practice in the future (**Action WGIIA50.06**).

It was further noted that it would be of interest if IWWG would provide a summary overview of different methodologies to measure atmospheric winds (e.g. wind lidars, wind surface scatterometer, AMVs and etc) and its pros and cons so that in the future space agencies might use it as a guidance (best practice document) to make priorities in designing their instruments (**Action WGIIA50.07**).

There was a follow up discussion with respect to the information announced recently that Aqua, Terra, and Aura are being retired that would affect not only 3D winds, but also MODIS winds and some other application areas. It was agreed that the current status and near future plans for these missions should be explored further to understand if there is a final decision made or if there is any chance to influence this decision at some level. It was also noted that this impacts other observations currently used by global NWP, like data from the AIRS and AURA/MLS.

It was further reported that NOAA is continuing NOAA-15, 18, and 19 at least until 2024. It was specifically highlighted that the impact studies were done for POES satellites to assess their impact on NWP and nowcasting applications before making a decision to continue its operation (**Rec WGIIA50.12**).

There was a recommendation from WGII to conduct a similar impact study for MODIS and/or look at the information already published (on removing MODIS winds and assessing its impact), which might serve as basis to provide some recommendations on continuing its operations (**Action WGIIA50.07**). But at the same time, it was further noted that there might be a mitigation plan in place, which should also be taken into account.

CGMS-50 actions – WGII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Colour coding**
CGMS WGII Chairs and Rapporteurs		WGIIA50.06	CGMS WGII Chairs and Rapporteurs to propose a procedure for endorsement of new co-chair / rapporteurs for the International Science Working Groups to be presented to the CGMS Plenary for approval	CGMS-51	High Level Priority
IWWG		WGIIA50.07	IWWG to provide a summary overview of different methodologies to measure atmospheric winds (e.g. wind	CGMS-51	Internal WG business

CGMS-50 actions – WGII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Colour coding**
			lidars, wind surface scatterometer, AMVs and etc) and its pros and cons so that in the future space agencies might use it as a guidance (best practice document) in designing their future instruments		
IWWG		WGIIA50.08	IWWG to conduct an impact study for MODIS and/or look at the information already published (on removing MODIS winds and assessing its impact on NWP or other application areas	Dec 2022	Internal WG business

CGMS-50 recommendations – WGII			
CGMS Space Agencies	WGIIA50.12	CGMS Space agencies are encouraged to maintain space-based assets beyond the design lifetime as long as they provide value added observations on a safe and affordable basis as determined by the operating agency	High Level Priority

5 Working papers on ocean monitoring

CGMS-50-CMA-WP-10: Introduction on the preliminary performance of ocean vector winds (OVWs) from the FY-3E WindRad

The presentation highlights the following key points:

1) The WindRad instrument on-board FY-3E works stable, current algorithm could achieve promising OVWs products for both C-band and Ku-band, and the quality could meet the designing target;
2) At present, C-band OVWs product quality is slightly better than Ku-band, although they show quite comparable results based on buoy data validation;
3) Further test and improvement will be carried out based on the long-term recalibrated data. Furthermore, the on-orbit data will be used to develop the ocean calibration algorithm and a new C-band HH GMF.

Discussion

Working Group II took note adding that it would be very useful data for the community.

CGMS-50-NOAA-WP-17: Operational Satellite Oceanography Symposium Report

The international Operational Satellite Oceanography symposia biennial series is intended to facilitate the efficient exploitation of satellite observations to substantially improve ocean and coastal environmental applications and decision-making. The series was conceived by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the National Oceanic and Atmospheric Administration (NOAA) in 2017 for the purpose of bringing together the international community of providers and users of operational satellite oceanographic data and products. These symposia have been co-organised and co-sponsored by NOAA and EUMETSAT and envisioned to span about 10 years (5 symposia). The role of primary host has alternated between the two agencies. The aim of these symposia is to increase the benefits of satellite data throughout the value chain by strengthening the links from data to knowledge, that is, between the "upstream" satellite data providers and the "downstream" users by helping users to identify fit-for-purpose data, by connecting stakeholders, including the private sector, and reinforcing international collaboration. The Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS) have endorsed OSOS-1 held June 2019 and OSOS-2 held in May 2021.

It was specifically highlighted that the geographical focus for the Third International Operational Satellite Oceanography Symposium (OSOS-3) would be Asia and the Pacific, including small islands, therefore the Symposium is planned to be held in South Korea. OSOS requests CGMS endorsement for the upcoming OSOS-3, planned for spring 2023 (**Action WGIIA50.09**).

Discussion

During the discussion WG II noted that there should be a discussion within CGMS on how effective OSOS can be in terms of CGMS related activities. It was specifically highlighted that references to HLPP (presented in the slide 10) is one area of how OSOS can help CGMS. It was further concluded that it is important to make sure that the Group is very effective not only in responding to items in HLPP, but can also be instrumental in identifying key activities and priorities that should be in HLPP in the future. So it was agreed that CGMS can leverage the outcomes of work done by OSOS, while OSOS would benefit from closer links with CGMS, which provides an operational context for oceanographic data use (**Action WGIIA50.10**).

It was further noted that at the CGMS-50 Plenary session there will be a dedicated session on "Support to operational ocean observations and monitoring", which would be a good platform to make a standalone contribution from OSOS, highlighting its links to CGMS, specifically to HLPP. Furthermore, the importance of making connections to the research communities was pointed out, especially with respect to transiting from research to operational oceanography, as well as ensuring that satellite data is easily accessible and usable by the research communities (as an important user group).

In response to the follow up question on the links between OSOS and IOC UNESCO with respect to the potential contribution from IOC UNESCO to the Plenary agenda, it was noted that even though there are some already existing links through the members of the OSOS Executive Steering Committee and Programme Committee, these links could be more formalized. It was further mentioned that CEOS Virtual Constellations focused on oceans potentially should have close links with IOC UNESCO, so it should be explored further.

A further question was raised with respect to biological oceanography and its relevance to CGMS. It was noted that the International Ocean-Colour Coordinating Group (IOCCG) is mostly focused on technical aspects of ocean colour rather than on the needs of downstream users, while OSOS through operational agencies has connections to decision makers and forecasters, so there are rather solid links with end-users there. With respect to the CGMS baseline and the Annual Risk Assessment, it was further noted that several ocean sensors are covered there, including ocean colour sensors (both from LEO and GEO).

CGMS-50 actions – WGII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Colour coding**
CGMS Plenary		WGIIA50.09	CGMS Plenary are requested to endorse the upcoming Third International Operational Satellite Oceanography Symposium (OSOS-3), planned for spring 2023 to be held in South Korea	CGMS-50	HLPP
OSOS		WGIIA50.10	OSOS Community is recommended to consider the relevance of outcomes from previous OSOS meetings to current HLPP as well as identify key activities and priorities that should be reflected in HLPP in the future	CGMS-51	Best Practices and Periodic actions

6 Selected topics of high priority to members (WPs will be pre-selected)

CGMS-50-CMA-WP-11: Introduction of Fengyun-4B Geosynchronous High-speed Imager

The presentation highlights the following key points:

1) The Geosynchronous High-speed Imager (GHI) is the experimental instrument imaging the Earth with 7 different spectral bands covering 6 visible/near-infrared (VNIR) bands and 1 infrared (IR) bands;
2) Although the Fengyun-4B GHI data are currently experimental and undergoing testing, in this study we focus on reporting some preliminary assessment results of the GHI radiometric calibration performance during the post-launch test (PLT) and post-launch product tests (PLPT) period;
3) Our results show that the GHI IR images mean brightness temperature (Tb) bias with respect to Metop-B/IASI of less than 0.7K;
4) The GHI VNIR radiometric calibration has a mean reflectance difference to SNPP/VIIRS of less than 5% for all the 6 VNIR bands except for B01 (the panchromatic band), which has large spectral mismatch with respect to all VNIR bands of VIIRS;
5) Also, the GHI VNIR radiometric calibration has a mean reflectance difference to FY-4B/AGRI of less than 5% for all the 6 VNIR bands;
6) Validations and investigations are still ongoing to improve the GHI imagery and data quality.

Discussion

WG II welcomed the presentation noting very impressive high resolution rapid scan imagery. It was further noted that in terms of operational configuration for GEO satellites, there should be at least two satellites in orbit.

CGMS-50-JMA-WP-03: JMA agency report on highlights and issues in dataset

JMA launched its Himawari-8 and Himawari-9 satellites in October 2014 and November 2016, respectively. Himawari-8 started operation in July 2015, and has since contributed to disaster mitigation in Asia and the Western Pacific region. Since both units have a mission lifetime of eight years, switchover of operations from Himawari-8 to Himawari-9 is scheduled for around December 2022 (exact date TBA). This paper details calibration and image navigation and registration (INR) performance based on observation data from the satellites.

Himawari-8 radiometric calibration bias and image navigation errors have been stable in recent years, and health checks on Himawari-9 have indicated consistent data quality. Evaluation based on observation performed in October 2018 indicated an INR performance of approximately 0.3 km (for reference mapping) and 40 m (between bands) for both Himawari-8 and Himawari-9. Radiometric calibration biases of less than 5% in reflectivity for VNIR bands and less than 0.3 K in brightness temperature for infrared bands were also observed.

Discussion

Following the question on switchover of operations from Himawari-8 to Himawari-9 scheduled for around December 2022, it was noted that there have been discussions about the parallel distribution of data from two satellites, as soon as the schedule is finalized, JMA would make an announcement.

It was further pointed out that Himawari provides very useful data for users globally.

CGMS-50-JMA-WP-05: Introduction of the project for Enhancing Utilization of HImawari-8/9 Data – Rapidly Developing Cumulus Area (RDCA) detection

The Japan Meteorological Agency (JMA) has provided a Japan-area version of Convective Cloud Information (CCI) since 2016 and an Asia and Western Pacific version since 2018 for aviation safety and air traffic control. One element of the product - Rapidly Developing Cumulus Area (RDCA) data – is determined using logistic regression analysis for a statistical approach with only Himawari-8/9 observation data as input. This technique has been adopted in Southeast Asia (Indonesia, Malaysia, Singapore, Thailand and Vietnam) via bilateral cooperation and an ESCAP/WMO Typhoon Committee project. This paper gives an overview of RDCA determination and the transfer of related technical expertise.

Discussion

During the discussion it was noted that NOAA would be very interested in this application area as well. NOAA supports aviation users within the NWS Aviation Weather Services, so it was concluded that it

would be good to bring this study back to GOES-R program for further comment and future collaboration.

Following the question on the lightning alerts provided by JMA for aviation users, it was noted that there is a ground-based lightning data available at the airports, as well as some other lightning nowcast products produced by JMA. It was further added that RDCA provides coverage for the full disk.

CGMS-50-JMA-WP-06: Observation system simulation experiments for a hyperspectral infrared sounder on-board geostationary satellite

The Japan Meteorological Agency (JMA) has been considering the Himawari-8/9 follow-on program since JFY 2018, keeping in mind the CGMS baseline and the Vision for WIGOS in 2040. Particular focus has been placed on the deployment of hyperspectral infrared sounders (HSSs) across the full GEO ring.

HSSs on board geostationary satellites (referred to here as a GeoHSSs) are highly regarded as potential payloads for global observation networking (as recommended by the Vision for WIGOS in 2040) and for their capacity to help improve JMA's services in relation to extreme weather monitoring, nowcasting and numerical weather prediction (NWP). As part of JMA's FY 2018 discussions on future geostationary satellite usage, HSS technology was proposed for significant improvement of weather forecasting accuracy. Against this background, a paper was published on preliminary results from the JMA Observation System Simulation Experiment (OSSE) performed to assess related effects on NWP.

The global data assimilation system (GDAS) was built on the basis of the operational NWP system in 2018. In the regional data assimilation system (RDAS), temperature and water vapor profiles were assimilated instead of the brightness temperature (BT) data of GeoHSS. JMA conducted experiments on recent cases using these systems until 2021.

Meanwhile, a significantly updated hybrid data assimilation system was incorporated into the operational NWP system in 2019. For appropriate conduct of OSSEs with recent cases, the systems used should ideally follow the latest operational NWP system. Accordingly, GDAS and RDAS were updated based on operational NWP systems as of December 2020, and the BT assimilation of GeoHSS was incorporated into the new RDAS.

This paper reports the results of experimentation with the new GDAS and RDAS. The outcomes did not differ significantly from those of previous systems, but showed that NWP was improved by GeoHSS assimilation.

Discussion

During the discussion, WGII congratulated JMA on the excellent results, which demonstrated positive impacts of HSIR data on-board GEO satellite on regional mesoscale data assimilation system. It was added that these results would support the global community that is planning to deploy their HSIR measurements on-board GEO satellites, which is an important part of the Vision for WIGOS in 2040. It was further noted that the presented outcomes would help NOAA in supporting the NOAA Geostationary Hyperspectral IR programme for GeoXO as there are also plans to conduct similar OSSEs.

CGMS-50-NOAA-WP-18: NOAA Next Generation Plans for LEO

The presentation highlights the following key topics:

1) In FY 2022, NOAA was authorized to establish the Low Earth Orbit (LEO) activity, which will set the stage for managing future polar and other low earth and medium earth orbit satellite observations as loosely coupled programs;
2) Future NOAA LEO missions are expected to be in a partially disaggregated architecture;
3) A disaggregated architecture is expected to exploit efficient and quick access to space. Launch what we want, when we want, where we want it;
4) The first LEO-OP mission is the "QuickSounder" mission that will carry the Advanced Technology Microwave Sounder (ATMS) on a small satellite (Expected to launch in 2025).

Discussion

In responding to a clarification about ECT for the planned LEO missions, it was noted that it is expected that the QuickSounder would be an early morning orbit, around 5-6 am. With respect to disaggregated architecture using small satellites, the importance of transition between the phases without breaks (ensuring continuous process) as well as having an agile ground system were highlighted. It was concluded that there are ambitious plans to get everything done within a two-year period (planning, design, launch), which explains the name of the mission – "QuickSounder".

CGMS-50-NOAA-WP-19: NWS Nowcasting Application Drivers for LEO and GEO Constellations

This working paper describes recent efforts at the United States National Weather Service to evaluate observational needs to support nowcasting applications.

Nowcasting-related applications for geostationary and low-earth orbiting satellites are explained.

- In general, the geostationary orbit provides the greatest support for nowcasting applications with rapid scanning capabilities on many new imagers.
- There are also opportunities to advance observations in the geostationary orbit with low-light imaging, greater spatial resolution imagery, and hyperspectral soundings.

The low-earth orbit can provide increased observations for nowcasting if they are regularly available every three hours or less.

- Microwave imaging provides a novel observation from the low-earth orbit that can support thunderstorm and tropical cyclone monitoring absent ground-based radars.
- Low-earth orbiting satellites are beneficial for nowcasting applications at high latitudes.

Finally, the importance of combined products is explained in the context of nowcasting applications.

Discussion

During the discussion it was noted that WMO is looking at developing a position paper on satellite data needs for nowcasting, so it was added that the working paper presented by NOAA NWC provides a relevant information in this context as well. It was further noted that the work demonstrated goes

beyond routine weather nowcasting, which is considered to be very important. It was further noted that EUMETSAT is currently looking at potential use of the planned Arctic Weather Satellite mission for nowcasting applications, so there will be a solid basis for collaboration.

CGMS-50-WMO-WP-02WGII: Status of WMO Core Satellite Data Activities

The presentation provides an update of the WMO activities to establish core satellite data as per the new WMO Unified Policy for the International Exchange of Earth System Data (Res. 1):

1) the process for establishing the core satellite data is presented;
2) the currently identified data types is introduced.

Discussion

Working Group II took note, adding that CGMS Members are looking forward to having bilateral communications with WMO with respect to agreeing on the core and recommended satellite data.

4 Working papers on climate and greenhouse gas (mitigation, adaptation, long-term monitoring)

CGMS-50-CMA-WP-12: CMA report on the progress of atmospheric carbon dioxide measurement by spaceborne LiDAR

The presentation highlights the following key points:

1) The Outlook of Chinese DQ-1;
2) The XCO2 inverse algorithm of IPDA LIDAR;
3) The Airborne IPDA LIDAR result;
4) The future work of DQ-1.

Discussion

WG II welcomed the presentation noting that DQ-1/ LiDAR is a very interesting mission that potentially would be a good contribution to the overall global GHG and carbon monitoring systems providing also night-time observations. So, it was added that CGMS would be looking forward to seeing the upcoming results.

In responding to a clarification, it was added that commissioning activities are expected to be completed at the end of 2022.

CGMS-50-EUMETSAT-WP-08: EUMETSAT's Contribution to Climate Science and Services

The presentation addresses recent progress at EUMETSAT for the support to climate science and services. Progress has been made on number of items:

1) Traceability of the use of observations in climate status reports and IPCC;
2) New agreement with ECMWF on support to the Copernicus Climate Change Service in force;
3) Several new data records are available at https://navigator.eumetsat.int;

4) EUMETSAT, together with NOAA and JMA, has started to address the CGMS plenary action to make better use of geostationary ring observations for climate.

Discussion

WG II welcomed the presentation, noting the impressive work done my EUMETSAT. It was further noted that it is important to have CGMS International Scientific Working Groups, including IWWG, engaging in 'georing' activities (**Action WGIIA50.11**).

Following the question from NOAA with respect to the international effort related to the 'georing', it was highlighted that it would be important to go beyond the scope of ISCCP-NG (i.e. delivering the L1g dataset from the time of Himawari, GOES-R, and MTG FCI onwards). It was further noted that it would be important to keep consistency with the past, so the additional thing to be done would be to use all available QC and cross-calibration methodologies to re-calibrate all the past GEO data and rescue the data which might be in danger of being lost. That would require some extra efforts. This work has already been done for Meteosat data, and the similar exercises are being currently done with the JMA and NOAA's GEO data (the methodologies developed by ISCCP-NG can be up to certain extent applied backwards in time). It was concluded that this effort would require about 5 years until the final FCDR can be presented but there will be intermittent releases in the meantime.

It was also highlighted that even if 'georing' is a top priority, it is important to plan for full global coverage, including polar regions as well.

CGMS-50 actions – WGII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Colour coding**
CGMS scientific WGs (ICWG, IPWG)		WGIIA50.11	CGMS scientific working groups (particularly ICWG and IPWG) are encouraged to engage with the producers of 'georing' FCDR datasets to maximize benefits for CGMS	CGMS-50	Best Practices and Periodic actions

CGMS-50-JAXA-WP-05: JAXA's Contribution for GHG Monitoring

Japan's Greenhouse gases Observing SATellite (GOSAT) was launched as the world's first GHG-dedicated satellite on 23rd of January 2009. Since then, GOSAThas monitored changes in atmospheric carbon dioxide (CO2) and methane (CH4) globally every 3 days and is frequently targeting the large cities over 50 locations to advance our understanding of the global carbon cycle and support climate monitoring. As follow up to the GOSAT mission, GOSAT-2 was launched in29 October 2018 and has been in normal operation. GOSAT and GOSAT-2 are equipped a single Fourier-transform interferometer and have simultaneously observed both reflected SWIR solar light and TIR emissions with the Thermal and Near-infrared Sensor for carbon Observation Fourier-Transform Spectrometer (TANSO-FTS) and TANSO-FTS-2, respectively.

JAXA Earth Observing Research Center (EORC) newly developed a retrieval algorithm to derive vertical concentration information by using TIR and two linear polarized SWIR spectra data simultaneously.

The product allows us to use concentration information for lower and upper troposphere (LT and UT) to assess surface emissions better. Global 12 years of our new research products are available at the JAXA GOSAT EORC website (https://www.eorc.jaxa.jp/GOSAT/index.html).

To contribute the first Global Stocktake (GST), JAXA continuously provide the observation data and our advanced research products in public. A decadal global GOSAT product clearly shows continued increases in global CO2 and CH4 from 2009 to 2021. In addition, we are developing the space-based surface GHG Emission Indicator (GEI) for tracking emission changes at key subnational policy-relevant levels, such as cities. The GEI is based on the difference between the upper and lower-tropospheric CO2 and CH4 concentrations, retrieved by GOSAT. The key for estimating the localized emission is how to identify the background concentration with discreet sources. We assume that the upper partial column results represent background CO2 concentrations, which are less affected by the city, while the lower partial column results track the CO2 concentration changes within the city. Of the six-year CO2 emission trends for the Greater Tokyo Area, the GEI indicate a large emission reduction in 2020, attributed to the significantly reduced economic activities during the COVID-19 pandemic.

In last February, JAXA submitted 3 papers to the first GST as JAXA's GHG monitoring contributions.

Discussion

In responding to a clarification about the procedure for submitting the documentation to Global Stocktake in 2023 (reported in the presentation), it was noted that it was done in response to the formal request from UNFCCC for agencies to provide supporting materials that would help with the guiding question for the global stocktake.

CGMS-50-NOAA-WP-16: NOAA's Contribution for GHG Monitoring

Findings from NOAA's Global Greenhouse Gas Reference network: NOAA's well-calibrated long-term records from the Global Greenhouse Gas Reference Network show record increases in the CH4 global growth rate and larger than average CO2 increases. Isotope measurements implicate biogenic emissions as the primary driver of recent CH4 increases.

Next generation GGGRN measurement technologies: Surface-to-stratosphere measurements at the new Colorado Atmospheric Observatory will provide comprehensive data for evaluating satellite retrievals of CO2 and CH4. Demonstration of GHG measurements on the Boeing/Alaska Airlines 737 Max 9 ecoDemonstrator aircraft shows potential for routine sampling on regional routes to greatly expand coverage over key regions such as the Arctic, tropics, and metropolitan areas.

CarbonTracker Data Assimilation system: NOAA's CarbonTracker data assimilation system leverages in situ and satellite datasets to track ecosystem emissions and removals, anthropogenic emissions, and carbon: climate feedbacks from regional to global scales to support mitigation efforts.

Long-term records of land cover and vegetation variables: NOAA records of land cover/change and vegetation biophysical characteristics support GHG inventories and products such as the Coastal Land Cover Atlas that inform estimates of Coastal Blue Carbon.

Discussion

WG II welcomed the presentation, highlighting the important role that space agencies can have in organizing/provision of ground-based observations. A close collaboration with NASA on carbon related activities was specifically pointed out in this regard.

Following the question about the complexity of integration of different observations (land, ocean and space) that needed to be brought together to provide monitoring of carbon cycle, it was noted that the global community do not currently have models that rigorously look across different kinds of datasets for carbon monitoring, so it would be important to continue to build more sophisticated models that can help to look across some of the interfaces to determine the best mixture of observations. It was further noted that NESDIS/NOAA has been working with the Oceanic and Atmospheric Research (OAR) to build a validation system to ingest all the GHG measurements and independently validate, intercompare, and quality control them to be ingested into the OAR carbon tracker system (i.e. similar to the approach taken for NWP).

It was noted by WMO that the carbon tracker demonstrated in the presentation looks very promising. Furthermore, it was added that similar discussions took place at the WMO GHG/Carbon monitoring workshop held on 10-12 May 2022. In particularly, there is a growing recognition in the community that this is a fantastic tool for integrating observations from various sources (like an NWP system that is run continuously). It was added that at the same time those who are engaged in this activity have been struggling to have the observations needed due to the lack of the coordinated exchange of these observations.

Following the question about the types of observations that are currently ingested into the Carbon Tracker Data Assimilation System, it was reported that NOAA is currently assimilating only in-situ atmospheric measurements (under the WMO Global Atmosphere Watch), as well as utilizing some apriori information (i.e. various observations are not assimilated all together). So, it was concluded that a lot of work to be done to build a comprehensive observational network with low-latency capability and Cal/Val comparability effort.

CGMS-50-WMO-WP-13: GCOS status report

The presentation highlights the updates on the GCOS Implementation Plans (GCOS IP). The GCOS Implementation Plans are prepared every 5 years to address gaps and improvements in the observing system. The 2022 GCOS IP will be the fourth such a plan submitted to the UNFCCC before COP27. It provides guidance to the component observing systems that contribute to global climate monitoring e.g. WMO, GOOS, WGClimate, Global Terrestrial Networks.

Discussion

Working Group II took note, adding that the CEOS/CGMS Joint WGClimate would provide their consolidated feedback to the 2022 GCOS Implementation Plan until 17th of June.

CGMS-50-WMO-WP-03WGII: WMO GHG Monitoring Activities

The presentation highlights the outcomes of the WMO GHG/Carbon Monitoring Workshop held on 10-12 May 2022.

1) International coordination of the effort; analogous to WMO's role in WIGOS, WIS, GDPFS - and to WCRP's role in AMIP, CMIP

    - Consolidated requirements for an integrated satellite- and surface-based observing system;
    - Potentially agreed design for a surface-based observing component, modeled on Global Basic Observing Network (GBON);
    - Potentially identifying funding sources for the observing network in the least-resourced Members, modeled on Systematic Observations Financing Facility (SOFF);
    - Timely exchange of all satellite- and surface-based GHG observations;
    - Collaboration on methodologies and practices for GHG modeling and data assimilation;
    - Common file formats and practice for exchange of model fields; common verification and validation methods;
    - Comparison of quantitative output data.

2) Greenhouse gas monitoring has significant policy implications and many actors and stakeholders; Avoiding fragmentation will be important, both between carbon monitoring stakeholders, and between major political and economic blocks;

3) Consultation with stakeholder groups currently proceeding:

    - International organizations, programs and coordination mechanisms, such as IPCC, UNFCCC, IOC, GOOS, GAW, GCOS, WCRP, ICOS, CEOS, CGMS, GEO,…
    - Individual countries or groups of countries with strong carbon-related efforts, e.g. USA, Japan, China, European Union (Copernicus); …
    - Individual labs/scientists/centers with applicable activities or capabilities, e.g. ECMWF, NASA Goddard, NASA JPL, JMA, CMA, KMA, CMIP participants,…

4) A few key recommendations from the Workshop:

    - Consensus on the need for a fully integrated, globally coordinated Greenhouse Gas Watch that encompasses
        - Integrated observing system, ground-based and space-based assets
        - Multi-center modeling and data assimilation systems (transport driven by NWP, including geospatially disaggregated sources and sinks terms);
    - Consensus that the World Weather Watch would be a useful paradigm for large parts of such a framework; however
        - Important elements of it are outside WMO's core mandate and expertise, e.g land surface and ocean observations and modelling.

5) Buy-in from WMO Members is essential:
    - Executive Policy Advisory Committee briefed (04/2022); expressed support;
    - Initiative to be introduced at EC-75 with decision document requesting further exploration of potential for stronger WMO involvement in Greenhouse Gas Monitoring;
6) Continued engagement with Workshop participants and broader community, with an initial focus on:
    - Establishing a consortium of modeling and data assimilation groups interested in participating in this;
    - Securing access to observational data;
    - Hosting a broader GHG Monitoring Conference in January 2023 (TBC).

Discussion

Working Group II welcomed the presentation adding that this work is highly relevant to the CGMS community.

During the discussion on the timescale differences for weather vs GHG/carbon monitoring systems, it was noted that even though GHG systems do not require the information down to the minutes, which is needed for weather monitoring, a GHG system should be perceived like a weather system in the sense that it should be run in near-real time and utilize all the observations, so the real-time data access is crucial. It was concluded that there is need to have a system that can address the user needs at different timescales (e.g. near-real time information is needed for oil leaks detection, etc), and this requirement needs to be considered at initial design of this system.

CGMS-50-WMO-WP-06: WMO Space-based Weather and Climate Extremes Monitoring (SWCEM) in the South-East Asia and the Western Pacific Ocean Regions

The Space-based Weather and Climate Extremes Monitoring (SWCEM) was established by the WMO in 2018 and implemented operationally in WMO Regions II and V from 2020, covering South-East Asia and the Western Pacific Ocean. Space-based precipitation estimates and derived products such as the Standardized Precipitation Index (SPI) and the Vegetation Health Index (VHI) are valuable for drought and heavy rainfall detection and monitoring, especially for regions where rain gauge observations are limited or unavailable. The JAXA GSMaP and NOAA CMORPH precipitation estimates provided by the SWCEM for East Asia and Western Pacific regions are used by WMO Regional Climate Centres and ASEAN Specialised Meteorological Centre (ASMC). In addition, drought monitoring, drought risk assessment and Early Warning Systems for drought have been developed for countries in the Asia-Pacific region (case studies for PNG and Viet Nam are presented) utilizing the JAXA and the NOAA products (SPI, VHI and soil moisture). Based on excellent results of the SWCEM in Asia-Pacific, the 18th World Meteorological Congress (Resolution 54, Cg-18) recommended to consider the possibility of implementing similar projects in Africa and South America.

The following actions were proposed:

- NOAA is kindly requested to support the SWCEM by providing satellite precipitation estimates and derived products (SPI, VHI and soil moisture) from high resolution second generation CMORPH (CMORPH2) for monitoring drought and heavy precipitation events (**Action WGIIA50.12**);

- JAXA is kindly requested to continue supporting the SWCEM by providing satellite precipitation estimates and derived products from new generation GSMaP (**Action WGIIA50.13**).

CGMS-50 actions – WGII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Colour coding**
NOAA		WGIIA50.12	NOAA is requested to support the SWCEM by providing satellite precipitation estimates and derived products (SPI, VHI and soil moisture) from high resolution second generation CMORPH (CMORPH2) for monitoring drought and heavy precipitation events	CGMS-51	Best Practices and Periodic actions
JAXA		WGIIA50.13	JAXA is requested to continue supporting the SWCEM by providing satellite precipitation estimates and derived products from new generation GSMaP	CGMS-51	Best Practices and Periodic actions

Discussion

Following the question about the prospects of implementing the SWCEM project in Africa and South America, it was noted that the first successful step has been already made for the African region as part of CREWS and its project for the South-West Indian Ocean (SWIO). It does not cover the entire region, so it should be expended in collaboration with regional climate centres in Africa. It was further added that there is a plan to expand the SWCEM initiative throughout the Region I (Africa) and then the Region III (South America) with support of WMO and EUMETSAT.

6.1 Report from the joint CEOS-CGMS WG Climate, GHG Task Team, and response to CGMS actions

CGMS-50-JWGCLIM-WP-01: Status report of WGClimate

The presentation highlights the following key points:

1) The population of ECV inventory is continuously ongoing and version 4.0 had been consolidated in fall 2021. The Gap Analysis Report related to version 3.0 is delayed due to the

pandemic situation. The Gap Analysis for version 4.0bis (update of entries related to Carbon) was focused on the carbon cycle, including the Global Stocktake aspect. A very successful workshop was held from May 18-20, 2022, in hybrid format (around 30 in attendance). The report on Gap Analysis 4.0 is now under drafting and the Gap Analysis Report of the cycle related to 3.0 will be included so that only one document will be published. Publication is foreseen for end of year 2022 with a draft during the CEOS SIT Technical Workshop in Mid-September 2022. GCOS had been directly involved in the discussion allowing also some first comments on the update of the GCOS Implementation Plan;

2) Use Cases for Climate Data Records is now a continuous activity of JWGClimate in order to demonstrate the value of the Climate Data Records for applications and decision making etc., but also in providing feedback towards quality improvements. Use Cases are published on the web. Amount of cases are now growing and arrangements with ESA / CCI and ECMWF / Copernicus will be made to link with their climate application use cases;
3) The Global Stocktake activities are ongoing, especially with respect the discussion of the relation to AFOLU;
4) A vice-chair had been nominated on May 19th, 2022, for CEOS and CGMS plenaries endorsement.

Discussion

Working Group welcomed the presentation. A great contribution of Dr Wenying Su (NASA) to the work of the WGClimate was specifically highlighted noting that she would be an excellent Vice-Chair of the WGClimate.

Further congratulations on the success of the GCOS Workshop (17-21 May 2021) that was organized as a hybrid event for the first time were expressed by CGMS WGII Members.

7 Working papers responding to or raising CGMS actions

CGMS-50-GUEST-WP-05: Framing of the proposed "International Earth Surface Working Group" in an operational context, including Terms of Reference

Following CGMS-49, the International Earth Surface Working Group (IESWG) has continued to accept comments and shape their terms of reference. In 2021, the IESWG held a 3-part virtual seminar and discussion series covering snow ice and cryosphere-atmosphere interaction (23 Sep2021), vegetation and land-atmosphere fluxes (21Oct2021), and soil moisture, river-discharge and water cycle (18Nov2021). In addition, the 4th IESWG meeting was convened 05-06Apr2022. Some key outcomes included that the IESWG-4 plenary identified a need for reporting and documentation of issues with in-situ surface observations, these issues then can be brought up to relevant existing groups to address the problems in the observing network for correction. Further, one of the critical observation gaps identified was with regard to Snow Water Equivalent (SWE) observations, for which new missions are being planned but at present is critically underrepresented and under observed in the EOS.

Discussion

During the discussion it was noted that the proposal on establishing of IESWG as a new CGMS International Science Working Group has been discussed for some time. WG II expressed their appreciation of the work done by IESWG. It was further noted that it would be important to make clear to Plenary that there is a strong request from operational community that this area is highly needed from operational perspective.

With respect to the endorsement of IESWG, it was concluded that the WG II Co-chairs and rapporteurs should have additional deliberations with this regard and decide if they agree to go forward to Plenary for endorsement of IESWG as a new CGMS International Science Working Group, then the full WGII should endorse this proposal, and in a parallel a formal proposal should be prepared by IESWG to be submitted to Plenary for their endorsement (**WGIIA50.14**).

CGMS-50 actions – WGII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Colour coding**
IESWG		WGIIA50.14	IESWG prepared a draft proposal on ToR for establishing a new CGMS International Science Working Group. Based on first outcomes, Working Group II proposes: - to finalize Terms of reference and circulate within CGMS in order to get feedback; - to be presented at CGMS-51 Plenary or endorsed off-line; - to engage IESWG in discussions on future priorities for CGMS Scientific Working Groups	3 June 2022	High Level Priority

8 Review of actions

A colour coding scheme developed for improving traceability and monitoring of WG II actions and for ensuring efficiency of action review procedure was introduced to WGII members. The proposed approach classifies all the WG II actions into the following categories: (1) High-Level Priority ("green colour") – actions to be considered by Plenary and discussed during WG II intersessional meetings by WG II members in details; (2) Best Practices and Periodic actions ("blue colour") – actions to be monitored by the related WGs; (3) Internal WG businesses ("orange colour") – actions related to scientific WGs established within WG II.

Working Group II reviewed the actions and recommendations raised at CGMS-50 WG II meeting as well as open actions of High-Level Priority from the previous CGMS-50 WG II meetings.

9 Review and updating of the HLPP

CGMS-50-CGMS-WP-15WGII: Status of implementation of CGMS High Level Priority Plan (2021-2025)

CGMS-50-CGMS-WP-26WGII: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2022-2026

CGMS SEC presented a summary status of implementation of HLPP targets overseen by WG II for all WG task areas as well as a proposed update to HLPP.

Task areas of WGII:

- Establish within GSICS a fully consistent calibration of relevant satellite instruments across CGMS agencies, recognising the importance of collaboration between operational and research CGMS agencies:
    - Priorities covered well by GISCS actions;
    - Note that it is the intention to extend the GSICS framework to support intercalibration of Space Weather energetic particle sensors.
- Establish commonality in the derivation of satellite products for global users where appropriate (e.g., through sharing of prototype algorithms):
    - Priorities covered well by actions in IWWG, ITWG and IPWG;
    - ICWG proposes to reword:
        - Assess the cloud properties generated from the geostationary and polar orbiting imagers and pursue best practices that lead to improved consistency and accuracy across the globe and the geo-ring.
    - IWWG will consider (re-)introduction of priority on AMV QI;
    - No status updates on priority for volcanic ash products;
    - ITWG reports significant progress on PC score priority, but agency response is limited.
- Foster the continuous improvement of products through validation and inter-comparison through international working groups and SCOPE-type mechanisms:
    - Priorities covered well by actions in ICWG, ITWG and IPWG:
    - ICWG will strengthen the interactions with SCOPE-Nowcasting;
    - ITWG reports NOAA intercomparison study NPROVS for atmospheric profile derivation.
- Maintain, enhance and improve the methods to describe the error characteristics of satellite data and products:
    - Priorities being addressed by ITWG, with a focus on climate aspects;
    - ITWG urges all CGMS members to provide calibration/validation monitoring at the level of NESDIS ICVS.
- Strengthen interaction with users in selected thematic areas by establishing a close relation with them as beta-testers and foster optimum use of satellite data:
    - Good progress from IPWG;
    - No progress reported on HSIR use by NWC, on novel GEO applications and on support to other WMO application areas.

- Foster and support research regarding enhanced radiative transfer capabilities, recognising the paramount importance of radiative transfer developments for satellite products.
    - Priorities are followed by ITWG Radiative Transfer and Surface Modelling Working Group;
    - Report from ITWG WG on Radiative Transfer Needs will be distributed to CGMS members, encouraging to identify funding opportunities.
- Stimulate trade-off analyses for the development of future passive sounding instruments:
    - ITWG proposes to reinstate the priority on conducting trade-off studies regarding the benefits of spectral, radiometric, and spatial resolution of infrared sounders, taking into account aspects such as scene inhomogeneity and uncertainties in spectroscopy.
- ITWG proposes to include a priority on establishing requirements for MW sounding capabilities beyond the CGMS baseline for NWP:
    - Synergy with MW requirements for precipitation, propose to merge priorities;
    - Lead ITWG, in coordination with IPWG.
- WGIII proposals:
    - New priority proposed by WMO through its Gap Analysis:
        - Work towards operational infrared/µwave limb sounding for climate monitoring and NWP applications.
    - New priority proposed by SWCG:
        - Work towards auroral monitoring capabilities.

Discussion

With respect to the proposal made to merge the activities on the requirements for MW capabilities and to include IPWG in the discussion as well, IPWG responded that this topic would be brought up at the upcoming IPWG meeting in June, so it was concluded that MW sounding capabilities would be an appropriate topic to consider by IPWG.

10 Future CGMS WGII meetings

CGMS SEC introduced the current way forward for CGMS-51, which will be hosted by JMA and JAXA

The proposed dates for CGMS WG intersessional meetings:

- WGII IS#1 Wednesday 12 October 2022 @ 11 UTC;
- WGII IS#2 Wednesday 23 November 2022 @ 12 UTC;
- WGII IS#3 Wednesday 25 January 2023 @ 12 UTC;
- WGII IS#4 Wednesday 18 April 2023 @ 11 UTC.

CGMS-51 planned as an in-person meeting. WGII is expected to decide on dates for a tentative virtual CGMS-51 WG meeting as a backup. Proposal: CGMS-51 WGII plenary session (if virtual) 15-17 May

WG II took note of the proposal and was requested to review it and get back to the CGMS SEC.

11 Any other business

There were no discussions under this item.

12 Conclusions, preparation of the WGII report for plenary

The Co-Chairs and rapporteurs wrapped up the meeting and thanked all participants. They expressed their hopes to meet WGII Members in person in Geneva at the upcoming CGMS-50 Plenary session.

STATUS OF WGII CGMS-49 ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

Please contact the WGII co-chairs and rapporteurs (via the CGMS Secretariat) for the status of the CGMS-49 actions following CGMS-50.

STATUS OF WGII ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

Actionee	Action	Description	Priority Level
CGMS Space Agencies	WGIIA50.12	CGMS Space agencies are encouraged to maintain space-based assets beyond the design lifetime as long as they provide value added observations on a safe and affordable basis as determined by the operating agency	High Priority
CGMS Members	WGIIA50.04	(IROWG) All providers of RO observations are encouraged to classify RO data as core data in the sense of the WMO Unified Data Policy (Res. 1). Therefore, free, timely and unrestricted access shall be provided to NRT RO data and free and unrestricted access shall be provided to archived raw data (including auxiliary data)	High Priority
WMO and CGMS Members	WGIIA50.05	(IROWG) WMO and CGMS are encouraged to coordinate any GNSS-RO data purchases to ensure the current 20,000 daily target identified in HLPP is met with global and full local time coverage	High Priority

Actionee	Action	Description	Deadline	Priority Level
CGMSSEC & WMO	WGIIA50.01	CGMSSEC and WMO to consider if night-time light capabilities should be covered in HLPP, the CGMS Baseline, and should be reflected in the WMO Gap Analysis	CGMS-51	High Priority
CGMS WGII Chairs and Rapporteurs	WGIIA50.06	CGMS WGII Chairs and Rapporteurs to propose a procedure for endorsement of new co-chair / rapporteurs for the	GCMS-51	High Priority

Actionee	Action	Description	Deadline	Priority Level
		International Science Working Groups to be presented to the CGMS Plenary for approval		
GCMS Plenary	WGIIA50.09	CGMS Plenary are requested to endorse the upcoming Third International Operational Satellite Oceanography Symposium (OSOS-3), planned for spring 2023 to be held in South Korea	CGMS-50	High Priority
IESWG	WGIIA50.14	IESWG to prepare a draft proposal on establishing a new CGMS International Science Working Group, adding an operational context, for review/endorsement by WG II Co-chairs and rapporteurs as well as its members and for further endorsement by Plenary	3 June 2022	High Priority
CGMS WGII members	WGIIA50.02	CGMS WGII members are invited to nominate candidates for positions of Vice-Chairs for GSICS-EP and GRWG. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Sept 2022	High Priority
CGMS WGII members	WGIIA50.03	CGMS WGII members are invited to nominate candidates for a Subgroup within GSICS on Space Weather Cal/Val and Intercalibration, which will be focused on providing intercalibration for Space Weather. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Sept 2022	High Priority
WG II Co-chairs and rapporteurs	WGIIA50.12	WG II Co-chairs and rapporteurs to review the Terms of References of IESWG and agree on the way forward with respect to submitting a proposal to Plenary to establish IESWG as a new CGMS International Science Working Group	3 June 2022	High Priority
WG II Members	WGIIA50.13	WGII Members to review/endorse the outcomes of deliberations (WGIIA50.12)	10 June 2022	High Priority

Actionee	Action	Description	Deadline	Priority Level
IESWG	WGIIA50.14	IESWG prepared a draft proposal on ToR for establishing a new CGMS International Science Working Group. Based on first outcomes, Working Group II proposes: - to finalize Terms of reference and circulate within CGMS in order to get feedback; - to be presented at CGMS-51 Plenary or endorsed off-line; - to engage IESWG in discussions on future priorities for CGMS Scientific Working Groups	3 Jun 2022	High Level Priority

ACTIONS RESULTING FROM CGMS-50 PLENARY DISCUSSIONS TO BE MONITORED AND MANAGED BY WGII:

CGMS-50 actions for the working groups - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
IESWG co-chairs	4.5	IESWG/(P)A50.01	The IESWG to finalise its draft Terms of Reference, and provide them to the WGII lead	Dec 2022
WGII lead	4.5	WGII/(P)A50.02	WGII to review and discuss the ToRs and once finalised, circulate to CGMS members for consideration and comments. WGII leads will then interface with the IESWG lead to complete the ToRs. WGII will then bring the Terms of Reference to CGMS-51 Plenary for endorsement.	Q1 2023, CGMS-51 WGII, CGMS-51
WGII lead	4.5	WGII/(P)A50.03	WGII will engage with IESWG in discussions on future priorities for CGMS Science Working Groups	Q1 2023
CGMS members	4.5	WGII/(P)A50.04	CGMS WGII members are invited to nominate candidates for positions of Vice-Chairs for GSICS-EP and GRWG. Please provide nominations to cgmssec@eumetsat.int and	Dec 2022

CGMS-50 actions for the working groups - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
			mitch.goldberg@noaa.gov	
CGMS members (WGII and SWCG)	4.5	WGII+SWCG/ (P)A50.05	CGMS WGII and SWCG members are invited to nominate candidates for a subgroup within GSICS on Space Weather Cal/Val and Intercalibration, which will be focused on providing intercalibration for Space Weather. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Dec 2022
GHG TT (JWG-Climate, WGII)	8.1	To be monitored by WGII WGII/(P)A50.06	Once the new GHG TT chairperson is in place, the GHG TT to invite CGMS WG I-IV points of contact for a dedicated discussion on specific CGMS WG contributions	

CGMS-50 recommendations – WGII			
Actionee	**Rec**	**Description**	**Colour coding**
IMD	WGIIR50.01	IMD to make the Calibration and Validation report available for all interested users of INSAT-3D/3DR on the IMD website as soon as the document is finalized	Internal WG business
CGMS Members	WGIIR50.02	CGMS Members are encouraged to use “TSIS-1 HSRS” as the Solar Reference Dataset	Best Practices and Periodic actions
CGMS Members	WGIIR50.03	CGMS members are encouraged to ensure that intercomparison studies are part of their baseline science activities to ensure there is sufficient funding available	Internal WG business
CGMS Members	WGIIR50.04	(IROWG) All providers of RO observations are encouraged to classify RO data as core data in the sense of the WMO Unified Data Policy (Res. 1). Therefore, free, timely and unrestricted access shall be provided to NRT RO data and free and	High Level Priority

CGMS-50 recommendations – WGII			
Actionee	**Rec**	**Description**	**Colour coding**
		unrestricted access shall be provided to archived raw data (including auxiliary data)	
WMO and CGMS Members	WGIIR50.05	(IROWG) WMO and CGMS are encouraged to coordinate any GNSS-RO data purchases to ensure the current 20,000 daily target identified in HLPP is met with global and full local time coverage	High Level Priority
CGMS Members	WGIIR50.06	(IROWG) CGMS are recommended to encourage technology and retrieval developments for improving planetary boundary layer profiling from GNSS-RO and their utilization in NWP data assimilation – and the further exploration of RO-derived water vapor as a climate variable	Best Practices and Periodic actions
CGMS Members	WGIIR50.07	(IROWG) Purchasers of RO data for NWP is encouraged to document their access to raw data, so that such purchased data can be used reliably in climate applications, where traceability of the measurements to fundamental units (e.g. definition of the second) is essential. For climate, appropriate documentation and meta-data need to be available with the provision of raw data	Best Practices and Periodic actions
CGMS Members	WGIIR50.08	(IROWG) CGMS Members are encouraged to acquire information on the developments of GNSS radio jammers and monitor their impacts to the observing system. The reason for this recommendation is that the RO community has begun to document the resulting degradation on RO measurements from radio frequency interference caused by the use of these development in recent ongoing world events and conflicts	Internal WG business
CGMS Members	WGIIR50.09	(ITWG) In terms of international issues CGMS Members are encouraged: 1) to support the further development of Essential Climate Variables (ECVs) and Greenhouse Gas CDRs to enrich the ECV inventory for climate change monitoring; 2) to explicitly consider instrument capabilities, data quality, and data provision in future updates of the CGMS baseline, particularly for the 3-orbit backbone system of LEO passive sounders which plays an important role as a reference-style system (*to be forwarded to WG III*);	Best Practices and Periodic actions

CGMS-50 recommendations – WGII			
Actionee	**Rec**	**Description**	**Colour coding**
		3) the overlap period where one satellite resource is replacing another should be chosen after consultation with the user community and should follow WMO guidelines; 4) if a mission expects engagement from application areas with an NRT data requirement, budget should be allocated from the start to provide the required technical infrastructure; 5) to note that the benefits of Satellite Missions to the ITWG community are increased when early evaluation is undertaken by many independent centres (NWP centres in particular).	
CGMS Members	WGIIR50.10	(ITWG) In terms of Data Dissemination CGMS Members are encouraged: 1) Climate Data Records (CDRs) should be citable by Digital Object Identifier (DOI) reference and all data records should be accompanied by metadata that follows WIGOS standards (*to be forwarded to WG IV);* 2) CDR development and stewardship should follow guidance similar to NOAA National Centers for Environmental Information (NCEI) data stewardship maturity matrix or the Copernicus Climate Change (C3S) convention (including recommendations for metadata) (*should be considered jointly with WG IV*); 3) when designing new or modified BUFR formats, circulate drafts to the NWP community via the NWP Working Group for feedback prior to submission to WMO (*to be forwarded to WG I*); 4) to develop and maintain public instrument status monitoring web pages similar to the Integrated Calibration and Validation System (ICVS) from NOAA/NESDIS (*to be forwarded to WG IV*);	Best Practices and Periodic actions

CGMS-50 recommendations – WGII			
Actionee	**Rec**	**Description**	**Colour coding**
CGMS Members	WGIIR50.11	(ITWG) In terms of Evolution of the Observing Systems CGMS Members are encouraged: 1) to create intercalibration time series from overlapping satellites to allow a continuation of climate time series (including trend analysis) when transitioning from older to newer satellites; 2) to consider climate requirements in terms of stability and length of life cycle when designing small satellite sensors; 3) following the success of the Megha-Tropiques SAPHIR instrument, future microwave sensors operating in a similar low inclination orbit are recommended; 4) to continue to employ the traditional longwave infrared spectral radiance measurement band on all future hyperspectral infrared satellite sensors; 5) providers of data from constellations of smaller satellites should work towards standardization of data downlink frequencies and protocols to ease provision of near real-time (NRT) data.	Best Practices and Periodic actions
CGMS Space Agencies	WGIIR50.12	CGMS Space agencies are encouraged to maintain space-based assets beyond the design lifetime as long as they provide value added observations on a safe and affordable basis as determined by the operating agency	High Level Priority

Working Group III (WGIII)

Contingency and continuity planning

50 YEARS 1972–2022

CGMS

WGIII REPORT

Co-chairs: Peng Zhang, CMA / Ajay Mehta, NOAA
Rapporteurs: Heikki Pohjola, WMO

1. Opening, objectives

Co-Chairs Ajay Mehta and Peng Zhang welcomed all participants to the WGIII session. They briefly presented the agenda and the objectives of the meeting related to the CGMS baseline and the CGMS risk assessment. The meeting participants were introducing themselves. The list of participants can be found in the Annex 1.

2. Status of and way forward for establishing core satellite data as per new WMO unified Data Policy

CGMS-50-WMO-WP-16: Status of and way forward for establishing core satellite data as per new WMO unified Data Policy

H. Pohjola presented the WMO Unified Policy for International Exchange of Earth System Data. He explained the major changes compared to old WMO Data Policy resolutions 40, 25 and 60. The important change is that with the new data policy WMO commits itself to broadening and enhancing the free and unrestricted international exchange of Earth system data. Thus, new data policy resolution emphasis on the Earth System and not only weather, hydrology and climate alone. New data policy has two categories: Core (data *shall* be exchanged) and Recommended (data *should* be exchanged).

WMO has started preparations for the bilateral discussion with space agencies to define Core and Recommended satellite datasets to be documented in WIGOS manual, which is referred to the data policy related to the data exchange. The invitation letters, together with WMO preliminary analysis of current space-based observation capabilities, were sent out requesting space agencies to contact WMO to facilitate bilateral discussion. After the bilateral discussions space agency commitments will be documented in WMO WIGOS Manual and presented for INFCOM, WMO Executive Council and again for WMO Congress 2023 for the final approval by WMO members. WMO has nominated Sue Barrell as a data policy coordinator.

In the discussion many space agencies confirmed that they have received the invitation letter to bilateral discussions from WMO.

3. Updates on significant observational missions (in response to/from a CGMS baseline/risk assessment point of view)

3.1 Operational missions

CGMS-50-CMA-WP-04: CMA Report on Next Precipitation Measurement and Early-morning Orbit Satellites (FY-3I and FY-3J)

M. Guan presented CMA´s plans for their first precipitation measurement mission (FY-3G and FY-3I) and the second early-morning orbit satellite (FY-3J). FY-3G is going to be launched in 2022. FY-3I and FY-3J are launched in 2026. Both FY-3G and FY-3I satellites have similar measurement capabilities, which are: Precipitation Measurement Radar (PRM), Microwave Radiation Imager (MWRI), Rainfall Measurement Optical Imager (RMOI), GNSS Radio Occultation Sounder (GNOS)and Neutral Atmospheric Density Detector. PRM is a dual-frequency, single-polarization one-dimensional phased array radar. The PRM frequencies are 13.35 GHz and 35.55 GHz with sensitivity 0.5 mm/h at 13.35 GHz, 0.2 mm/h at 35.55 GHz with swath ±20.3°. Horizontal resolution is 5.0 km, vertical resolution is 250 m. Overall the spectral channel settings of some instruments are further optimized, and the performance is upgraded from FY-3G and FY-3E. All these satellites further respond to the WIGOS Vision and CGMS Baseline, contributing to the operational continuity of the global space observing system.

In the discussion A. Mehta wanted to acknowledge CMA's significant contribution with these satellites to critical gaps in the risk assessment.

CGMS-50-ESA-WP-05: Status of the Current and Future ESA Earth Observation Missions and Programmes

Ivan Petiteville presented working paper on future ESA Earth observation missions and programmes. ESA has 15 satellites on orbit and around 40 in planning. Copernicus represents the major continuing initiative of European efforts in Earth Observation. The first Copernicus dedicated satellite ("Sentinel-1A") was launched in 2014, followed by Sentinel-2A in June 2015, Sentinel-3A and 1B in 2016, Sentinel-2B and Sentinel-5P satellites in 2017, Sentinel-3B in 2018 and Sentinel-6 Michael Freilich in 2020.

Sentinel operations continued nominally apart from the major Sentinel-1B anomaly that occurred late 2021 affecting the satellite power system. The satellite remains under control and regular orbit control manoeuvres are routinely performed. A long-term unavailability of data provision (several months) is assumed, but it is still too early to consider a permanent unavailability of Sentinel-1B. Sentinel missions are developed, launched and operated in partnership with the European Union and EUMETSAT. 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. Due to Sentinel 1B anomaly 1C launch will be postponed beyond 2022.

The 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 SMOS satellite was launched in 2009. The CryoSat-2 satellite was launched in 2010 and the Swarm satellites in 2013. Aeolus is the last Earth Explorer satellite put into orbit in 2018 and its Doppler Wind Lidar technique used for measuring wind profiles from space has already been fully

demonstrated. The positive impact of Aeolus on the weather forecast has been also seen by multiple Numerical Weather Prediction centres world-wide, in particular by ECMWF. Aeolus follow-on programme is under planning and the programme proposal will be provided until end of 2022.

The Proba-V small satellite was launched on in 2013. Its coarse resolution imager has, together with Sentinel-3, continued the data acquisition of the Vegetation payload on-board SPOT-4 and 5. However, Proba-V Vegetation instrument has ended its operations on 31 October 2021 as planned. The Proba-V Cubesat Companion (PV-CC) development within the GSTP programme now envisages a launch with Vega-C at end of 2022 or early 2023.

For the ESA future missions and their progress I. Petiteville reported the forthcoming Explorer missions, EarthCARE, Biomass, FLEX, and FORUM. The FORUM mission was selected for implementation as Earth Explorer 9 (EE-9) in 2019. The Phase B2/C/D/E1 space segment contract for FORUM has been finalised and signed at the beginning in 2022. The Phase A studies - two parallel system studies - supporting science studies and campaigns for Harmony have progressed nominally.

In 2020, ESA issued a Call for Ideas for Earth Explorer 11 (EE-11). The science requirement consolidation (SciReC) studies have been kicked-off for the four Phase 0 mission candidates CAIRT, Nitrosat, SEASTAR, and WIVERN. The tender evaluation of the System Studies for all four mission candidates have been conducted and those activities are expected to kick-off by mid-May 2022. Also, activities related to Arctic Weather Satellite (AWS), TRUTHS, SCOUTs and ALTIUS are ongoing. Each of these missions are planned contribute routine, operational monitoring data to improve our understanding of the Earth system and climate change.

Looking to the future, the six Copernicus Expansion missions are currently in phase B2/C/D/E1, addressing EU policy and gaps in Copernicus user needs, and each expanding the current capabilities of the Copernicus space component: CHIME, CIMR, CO2M, CRISTAL, LSTM, and ROSE-L. The Sentinel development activities, including Copernicus Expansion missions and Next Generation missions, continued in line with Segment 4 of the Copernicus Space Component (CSC) Programme, the FutureEO Programme and the CSC Long Term Scenario. Sentinel development activities, including Copernicus Expansion missions and Next Generation missions, continued in line with Segment 4 of the Copernicus Space Component (CSC) Programme, the FutureEO Programme and the CSC Long Term Scenario.

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 has continued to progress very well since its inception in 2008. In 2016, a second phase of the programme, CCI+, was approved by ESA member states which is allowing to study and monitor 23 essential climate variables (ECV) derived from satellite data, fulfilling GCOS objectives. Out of these 23 ECVs, 16 have been handed over to the Copernicus Climate Change Service (C3S) lead by ECMWF, for operational use.

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 has much as possible, while overall, the operations of ESA satellites currently in orbit and services to users have been kept nominal.

H. Pohjola asked about the funding status of the Copernicus expansion missions I. Petiteville responded that the funding was agreed with EC to continue with six expansion missions. However, final funding agreement to be completed needs 750 MEUR more. Thus, discussions with non-EU countries are ongoing to full fill the budget. He is confident that the budget will be completed, but the original schedule of the missions might be challenging. He confirmed that currently CIRM is aimed for launch 2028.

M. Rattenborg was asking about the support by missions for HLPP and robust system for low frequency MW SST observations. I. Petiteville responded that it is primary mission of CIRM supporting the Arctic policy of EC together with CHYRSTAL and C2M. He also reminded that launch dates are of course evolving in time.

CGMS-50-JAXA-WP-02: Update on the Status of Future Precipitation Radar Mission

Q. Ochiai presented an update on the JAXA's future precipitation radar mission. JAXA has studied a feasibility of a next generation precipitation radar with Japanese science team and user community. Their targets for the next generation precipitation radar will be high sensitivity instrument with scanning and Doppler capabilities.

In August 2021, JAXA Mission Definition Review (MDR) for the next generation Precipitation Radar satellite was completed. The review board confirmed that the JAXA mission with a spacecraft carrying Ku-band Doppler radar is a successor for GPM/DPR. The IPWG report and the support letter by CGMS members were well received as requirements from international user communities. JAXA appreciates the efforts by CGMS and IPWG.

In December 2021, Implementation Plan of the "Basic Plan on Space Policy" noted the Precipitation Radar Satellite Phase A activity and in January 2022 Precipitation Measuring Mission (PMM) Pre-Project Team was established for the JAXA Spacecraft including Ku-band Doppler Precipitation Radar. System Requirements Review (SRR) is now scheduled in June 2022. Further on, JAXA has participated in NASA's Atmosphere Observing System (AOS) Pre-Phase A activities and attended its Mission Concept Review (MCR) held in the NASA/GSFC in May 2022.

A. Taube was asking about the schedule of the next phases. O. Ochiai responded that exact schedule is not clear, but overall progress of the mission looks very positive.

CGMS-50-EUMETSAT-WP-15: Status report on the Doppler Wind Lidar (DWL) mission

R. Chalex from EUMETSAT gave a presentation on Doppler Wind Lidar (DWL). DWL capability was strongly requested by EUMETSAT members in 2003 during post-EPS user consultations. However, it was not selected at that time due to missing technology maturity. Later on, EUMETSAT Council identified DWL as an important and affordable contribution to the Vision for the WMO Integrated Global Observing System (WIGOS) in 2040. Then ESA Aeolus was launched mid-2018 with very positive

impact on NWP after Aeolus data were operationally assimilated by several global NWP centres. It also highlighted in orbit demonstration of technologies with challenges for an operational mission. In 2019 EUMETSAT and ESA agreed on a joint study roadmap to be prepare for affordable operational programmes and initiated system studies. As a result, ESA initiated pre-development activities in 2020 and will now propose Aeolus-2 cooperation programme together with EUMETSAT in 2022 ESA Council at ministerial level.

Aeolus-2 mission objectives are similar to original mission: Wind profiles measurement along the Line-Of-Sight direction throughout the troposphere and the lower stratosphere with a vertical resolution and accuracy meeting Numerical Weather Prediction (NWP) requirements. Also, aerosol profiling capability improvement is under assessment by ESA with possible piggyback of a Radio Occultation instrument requested by EUMETSAT. Overall goal is to make Aeolus an operational mission and not improve its performance. It will have two spacecrafts with 10-year mission time. The first launch is planned in 2030.

B. Kotaro was asking if the slightly higher orbit altitude has any impact of the measurement accuracy. R. Chalex responded that it has no impact, because instrument SNR can handle the increase of the altitude increase. R. Saunders was asking if it is going to be a two-satellite concept flying together. R. Chalex responded that there is only one satellite operating at the time. The second one is launched after the end of life of the first one.

J.V. Thomas was commenting that india is also looking at wind data observation capabilities, because it is very important for tropical region. He was curios that what is the effect of cloud cover related to Aeolus observation. R. Chalex responded that Aeolus signal does not penetration into cloud, so there are no observations below the cloud cover. J.V. Thomas was asking that why the lifetime of Aeolus-2 is 5 years instead of 3 years with Aeolus. R. Chalex responded that laser design was changed for Aeolus-2 and this is why it has longer life time extending then the instrument lifetime.

CGMS-50-SWCG-WP-09: SWCG: Space weather missions

This agenda item was withdrawn.

3.2 Research missions

CGMS-50-NASA-WP-03: NASA status report (Tempo) (Maudood Khan)

M. Khan gave a presentation on NASA's Tropospheric Emissions: Monitoring of Pollution (TEMPO) mission. TEMPO comprises UV and VIS Offner Grating spectrometer that is hosted on a commercial communication satellite for measuring athmospheric pollutions covering most of the North America at hourly temporal frequency, and high spetral resolution. It will measure ozone, nitrogen dioxide, sulfur dioxide, formaldehyde, glyoxal, aerosols, cloud parameters, and UV-B radiation. TEMPO will create a revolutionary dataset that provides understanding and improves prediction of air quality and climate forcing. TEMPO will be on GEO orbit and it will measure air pollution at 355 times the spatial resolution of the GOME-2 satellite, and 50 times the resolution of the OMI instrument aboard the Aura satellite.

Together with Sentinel-4 and Geostationary Environmental Monitoring Spectrometer (GEMS), TEMPO will form a virtual geostationary constellation for monitoring changes in atmospheric composition. Observations will advance the study of intercontinental air pollution transport across Atlantic and Pacific Oceans; help assess the impact of air pollution on public health, and improve the reliability of air quality forecasting systems.

TEMPO will be hosted on an Intelsat Commercial Satcom mission (IS40e) and launched to 91 deg W. Maxar Technologies holds the prime contract for hosting services and Intelsat is a subcontractor to provide host operations and data routing. The satellite launch is scheduled in Jan 2023 at the moment and data will be publcily available then in June 2023.

M. Rattenborg commented that HLPP has the objective on the operational continuation for this kind of mission (UV and emissions) togehter with Sentinel and GOME-2. P. Zhang was asking that what is the baseline definition for that M. Rattenborg confrmed that CGMS baseline is statement of two baseline instruments for UV spectropmeter.

4. CGMS baseline and risk assessment

4.1 Outcome and finalisation of 4th risk assessment (including mitigation actions for consideration by plenary)

CGMS-50-WGIII-WP-03: **Status and outcome of the 4th CGMS risk assessment**

A. Mehta presented CGMS Risk Assessment workshop outcome. He shortly presented the process and the steps before WGIII review including updates with member reports, risk assessment and actual Risk Assessment workshop. He stated that the current process is fairly smooth, and it works well. Further on, he explained the objectives of the workshops and the assumptions (same as 2021) used in CGMS Risk Assessment.

The Risk Assessment showed an improved risk posture as a result of CMA's plans for FY-3J beyond FY-3E, which provided continuity in the early morning orbit for a microwave sounder, hyperspectral sounder, and multi-mission imager. FY-3J also provided long-term continuity for short- and long-term radiometers. FY-3I provided continuity for precipitation radars beyond FY-3G.

The lack of geographically dispersed radio occultations; especially in the equatorial regions continues to be a risk. The CGMS Baseline commitment for RO observations is not being met until 2024, and there is a continuity risk from low inclination orbits in the later part of the decade as there are no plans for a follow-on to COSMIC-2. Long-term plans for scatterometers and SWIR Imaging Spectrometer are needed to ensure continuity in the afternoon orbit in the later part of the decade. There is also a Slight continuity risk for the VIS/UV Spectrometer in the 128.2E slot in the early 2030s. Related to space weather there continues to be a risk of a gap for coronal imaging and plasma analysers at L1 until the SWFO-L1 mission is launched.

The WGIII reviewed the results of the Risk Assessment, which included the 2022 Risk Assessment and updates to the CGMS Baseline Document with recommended actions.

Related actions were commented by M. Rattenborg stating that original issue was NRT access for space weather instruments. E. Talaat commented that IROWG shall define requirements they needed for space weather and ground resources. M. Rattenborg commented that tracking of STEREO and PUNCH shall be also included, which was agreed by E. Talaat. J.V. Thomas commented on OceanSat-3 follow-on mission that funding discussions are ongoing and plans beyond OceanSat-3A cannot be yet confirmed.

M. Goldberg noted that NOAA-15 to 19 satellites should have the same EoL dates in the risk assessment flight out charts. S. Burns also noted that MSG satellites have some incorrect details in the flight out charts. M. Johnson took a note and fixed the typos. Corrected Risk Assesment was provided to WG III members for further review.

K. Dohyeong commented that GK-2B VIS/UV spectrometer plans are not confirmed, but the expection is that follow-on missions will continue with the same capabilities.

CGMS-50 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
NOAA	4.1	WGIII/A50.01	NOAA to review additional ground resources needed to track STEREO-A and PUNCH to provide additional coverage in the near-term.	CGMS-51	**OPEN**
KMA	4.1	WGIII/A50.02	KMA to confirm plans beyond GK-2B for visible/UV spectrometer and Narrow Band imager.	CGMS-51	**OPEN**

CGMS-50-WMO-WP-08: WMO gap analysis

H. Pohjola presented WMO Gap Analysis. He explained the three different perspectives of Gap Analysis: CGMS Baseline, User Requirements and WIGOS Vision 2040. WMO Gap Analysis is a follow-on from the earlier work documented in CGMS-49-WMO-WP-13 (WMO Gap Analysis 2021) mostly under the user requirements viewpoint guiding future developments for the medium and long-term. It concludes finding in 16 gap areas listed below. Gap areas were presented together with related items in CGMS Baseline, HLPP or CGMS actions.

New areas recognized compared to earlier WMO Gap Analysis are green house gas monitoring (GHG) and wind profile measurement. For GHG the recognized gap is due to EoL of TES on Aura. After that the single cross-track IR spectrometer from LEO with substantially high spectral resolution is IASI-NG on EPS-SG. Other IR spectrometers are designed mainly for meteorological application and designed mainly for total column measurement. For the wind profile measurement, the gap is due to near real time observations of horizontally projected line-of-sight wind profiles from doppler wind lidar will

cease within a couple of years (Aeolus). There are no firm commitments for a follow-on. These measurements have been demonstrated to have clear positive impacts on global NWP forecasts.

01	Early-morning LEO	09	Sea surface temperature and Ocean colour
02	Coverage from GEO	10	Soil moisture, Snow, Sea-surface salinity, Sea ice
03	Trace gas and GHG monitoring	11	Space weather from L_1
04	Earth Radiation Budget	12	Space weather from the Ecliptic
05	Aerosol observation	13	Space weather from solar orbits
06	Precipitation measurement	14	Space weather from GEO and Molniya orbits
07	Sea-surface wind and wind profile	15	Space weather from HEO and MAG
08	Ocean altimetry	16	Space weather from LEO

In addition, WMO Gap Analysis was raising gaps in IR/MW limb sounding and µwave sounding capability to be considered to include in HLPP. IR/MW limb sounding is identified gap not only for atmospheric chemistry but climate observations (GCOS) for many years. It is high priority for operational services as MLS on Aura is close to EoL (2023).

Also, the continuation of µwave sounding capability after the EoL of NOAA-15-19 satellites, which have provided a pseudo constellation for the µwave sounding in recent years with significant positive NWP model impact. The new small sat constellations (e.g. TROPICS) are now being launched and they will provide new datasets to be evaluated for all-sky radiance assimilation of T/RH sounding, clouds and precipitation as key applications.

4.2 Any outstanding items on the baseline and risk assessment

None.

4.3 Outcome and finalisation of 4th CGMS baseline review - for recommendation to plenary

CGMS-50-CGMS-WP-07WGIII: CGMS Baseline - draft revision following the 4th risk assessment workshop (for recommendation to CGMS-50 plenary)

A. Taube presented the updated CGMS Baseline document for the meeting. Most of the changes in the document were editorial. The list of reference documents was updated to point to the current versions of the reference documents. Evolution of the Baseline chapter says that the document will be updated every four years, but recently the activity was taking place every year. This was updated in the document then.

In the Observation and Orbits chapter, the hosted payloads and commercial data were added:

"CGMS members may elect to host their sensors on platforms not owned by the member (hosted payloads). Hosted payloads will be reflected in the CGMS baseline and risk assessment when the CGMS Member commits to provide the sensor data consistent with the Baseline principles."

"CGMS members may provide commercially sourced data to meet their commitments to the CGMS Baseline [under licenses] that conform to CGMS principles."

The sensor type definition of the energetic particles was divided into three different classes: Low energy electrons and protons, high energy electrons and protons, very high energy protons and energetic heavy ions. These definitions should be followed also in OSCAR/Space. Also, for many space weather observations Sun-Earth line is more relevant definition than orbit itself. This should be again followed in OSCAR/Space.

A. Mehta was asking about the documentation of the commercially sourced capabilities in CGMS Baseline. M. Rattenborg was commenting that fly out charts in the risk assessment does not include commercial satellites. It is up to CMGS member agency if they commit to CGMS Baseline based on commercially sourced data. J.V. Thomas added that CGMS Baseline already says that members may provide commercially sourced data like edited above in the Observation and Orbit chapter.

M. Rattenborg was commenting that characteristics of the added energy ranges in the Sensor Type table need to be added. E. Talaat commented that the definitions are in his presentation. Space weather capabilities and their distinction between operational and science missions were discussed.

It was also discussed if the end of life beyond design lifetime should be mentioned in the baseline document. It was agreed that this should be kept in the contingency plan document.

Related to the end of life of MLS on Aura, it was discussed if continuation of MW limb sounding was considered by NOAA when planning JPSS. M. Goldberg responded that it was not considered at that time by NOAA, but he will reactivate that topic. He was also asking how MLS was used operationally. K.- Holmlund and R. Saunders responded that ECMWF was using it, but it was not assimilated. It was used as a verification dataset. It was not clear what ECMWF is using after MLS's EoL.

CGMS-50 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMSSEC	4.2	WGIII/A50.03	To add characteristics/definitions of the new energy ranges related to the high energy particles in the Sensor Type table of the CGMS Baseline document.	RA workshop 2023	**OPEN**

CGMS-50 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WMO	4.2	WGIII/A50.04	To implement energy ranges for high energy particle classification to OSCAR/Space as defined in the CGMS Baseline.	RA workshop 2023	**OPEN**

CGMS-50 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WMO	4.2	WGIII/A50.05	To implement the feature of Sun-Earth line instrument filtering for the OSCAR/Space Gap Analysis.	RA workshop 2023	**OPEN**

4.4 CGMS contingency plan

CGMS-50-CGMS-WP-25: CGMS contingency plan review

M. Rattenborg presented the contingency plan. It contains guidance and process identifying, mitigating and coping with risk to the continuity of the CGMS Baseline. It works as a reference for CGMS satellite operators and outlines a process for risk assessment. The content of contingency plan was introduced and the areas where improvements could be made. He listed following topics where it could be improved:

- Reference documents to be updated
- No discussion of role of CGMS instruments hosted on third-party satellites
- No discussion of role of Commercial data provision in Risk Mitigation
- No detailed consideration of help-your-neighbour scheme for GEO
- CGMS Risk Assessment description is very short, does not reflect experience from first three RA workshops

It was agreed that the outcomes of the M. Rattenborg's review are very relevant and they should be updated in the next version of the document.

CGMS-50 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMSSEC	4.4	WGIII/A50.06	Contingency to be updated according to the findings in the working paper CGMS-50-CGMS-WP-25 in WG III (presentation).	RA workshop 2023	**OPEN**

5. WMO OSCAR/Space database status update

CGMS-50-WMO-WP-07: Current Status of WMO OSCAR/Space

H. Pohjola presented the OSCAR/Space development completed in 2021 and the ongoing development to be completed this year. In addition, he presented the procedure in place for the content updates of OSCAR/Space.

The major development item completed last year was the implementation of the Restful JSON API to make OSCAR/Space machine readable. Also, the instrument classification according to WIGOS Vision 2040 was implemented making WMO Gap Analysis possible according to WIGOS Vision.

The ongoing development is implementing new frequency record structure to OSCAR/Space supporting SFCG interest of using OSCAR/Space as an information source for the passive and active remote sensing bands, and to identify future remote sensing spectrum needs. Also, in addition to many new features data latency record is implemented to support especially the gap analysis of space weather capabilities.

The main mechanism for the WMO Space Programme Office to collect the relevant information is through templates submitted to the OSCAR/Space Support Team (O/SST) members, usually three to four times per year. O/SST focal points are expected to collect missing or outdate information within their respective organization or agency and to return the completed templates in a timely manner within the stated deadlines. In addition to the information collected through templates, O/SST members are expected to provide to WMO short-term updates as necessary.

6. Socio-economic benefits and impacts of satellite data

There was no report on Socio-economic benefits. It was seen beneficial to have it included in the agenda for the next year, when it is expected that there will be more and more related topics to be reported in the future.

CGMS-50 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
EUM, NOAA and CMA	6	WGIII/A50.07	To present outcomes of the undertakings on socio-economic benefits and impact studies.	CGMS-51	**OPEN**

7. Review of CGMS WGIII Terms of Reference

A. Taube presented the proposed changes in the Terms of Reference document. In addition to editorial changes, item on socioeconomic impacts of satellite missions was added. Some additional editorial changes were proposed by the meeting participants. J.V. Thomas noted that socioeconomic impact should be added also under objectives. This was agreed by the meeting. The reference to weather forecasting, ocean etc. was replaced by the reference to the larger observation domains like Earth, Space Weather, Sun etc.

Review of WGIII actions and recommendations

GMS-50-CGMS-WP-36WGIII: Status of CGMS-49 WGIII list of actions (13 April 2022)
Actions were reviewed and updated accordingly in the list of actions (Annex 2).

8. HLPP implementation and update

CGMS-50-CGMS-WP-05WGIII: Status of implementation of CGMS High Level Priority Plan (2021-2025)

M. Rattenborg presented the status and the proposed updates of the HLPP targets. The HLPP targets are well covered by the CGMS actions except the target to establish observation requirements for the MW precipitation. He proposed that it should be discussed with WGII and IPWG.

Based on the WMO Gap Analysis presented earlier in the meeting, there are two new targets in HLPP to response the Vision for WIGOS 2040. The first new target is to work towards operational IR/MW limb sounding capability for climate monitoring and NWP applications and the second one is to coordinate the evaluation of small satellite constellations provide sufficient µwave sounding performance for the radiance assimilation. The second target is proposed to be done jointly with WG II/ ITWG.

For the space weather coordination group, the new target on auroral monitoring capabilities was proposed by SWCG related to new ESA mission to monitor auroral. Regarding the impact studies (scientific and socio-economic) activities will be restarted.

M. Rattenborg also presented the document indicating the changes for HLPP in period 2022-2026. He noted that in the risk mitigation area there are still several ongoing actions with slow progress.

A. Mehta commented that early-morning reference could be removed due to evolution of the risk assessment. It was agreed. He also noted that the HLPP target for small satellite constellations provide µwave sounding performance coordination is very specific task. M- Rattneborg commented that we could take this as an action to WG II to look at it, and then may be include it to HLPP only later.

It was commented if the Established observational requirements for precipitation is covering also missing MW precipitation. JAXA commented that realted IPWG report only covers the precipitation radar, and not the MW precipitation observation.

CGMS-50-CGMS-WP-26WGIII: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2022-2026

See previous agenda item.

CGMS-50 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMSSEC	9	WGIII/A50.08	To add proposed HLPP target for the work towards operational IR/MW limb sounding capability for climate monitoring and NWP application.	CGMS-50 plenary	**OPEN**
CGMSSEC	9	WGIII/A50.09	To add proposed HLPP target to coordinate the evaluation of small satellite constellations capability to provide sufficient µwave sounding performance for the radiance data assimilation.	CGMS-50 plenary	**OPEN**

9. Future WGIII meetings

CGMS-50-CGMS-WP-19WGIII: Nominations and representatives at meetings (CGMS, ISWGs, VLAB - Co-chairs and rapporteurs)

Not discussed due to limited time.

CGMS-50-WGIII-WP-06 (verbal/for decision): Decision on WGIII inter-sessional meetings (CGMS-50 to CGMS-51)

Intersessional meetings are taking place 28th Sep 2022, 18th Jan 2023 and 24th March 2023 online. The 5th Risk Assessment Workshop is taking place from 22nd to 23rd Feb 2023. It is planned to be in-person meeting.

CGMS-50-WGIII-WP-07 (verbal only): Next WGIII plenary session

CGMS-51 plenary session is tentatively taking place from 17th to 18th May 2023 (if a virtual meeting).

10. AOB

No additional topics were discussed.

11. Wrap-up, WGIII report considerations for plenary and conclusions

Co-chairs closed the meeting. Concluding documents for the plenary will be prepared and communicated by email.

STATUS OF WGIII CGMS-49 ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
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)	**2022 May:** EGOS-IP/WOS-IP does not exist anymore. Superseded by the WIGOS high level guidance document. Gap Analysis provides all the inputs needed at CGMS WG level. **2022 25 Mar:** This is dealt with within the framework of the rolling review of requirements and high level requirements document. The action is therefore CLOSED here. **2021 Jan:** Ongoing in WMO (re. Evolution of the GOS). Work kicked-off. Report expected to CGMS-50 (TBC) **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-50 (CGMS-48)	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
WMO	WGIII/ 7	WGIII/ A47.07	Early Morning Orbit: WMO to reconvene a 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).	**2021 Sep:** CLOSED in WGIII. Will be addressed by WGII (re. data assessment). **2021 16 April**: WMO (K Holmlund), together with CMA, working on establishing the tiger team CGMS-48-WGIII CMA-WP-12. FY-3E expected to be launched in the first half of 2021. NWP workshop postponed. **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	Oct 2021 (CGMS-49)	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				include space weather data in the impact analysis.		
VGIII co-hairs VGIII apporteur *Click to add new task...*	WGIII	WGIII/ A47.0	WGIII to review its ToRs in 2024 (The Terms of Reference of the CGMS Working Groups to be reviewed every 5 years. CGMSSEC/CGMS WGs to secure this is included on relevant future plenary meeting agendas).	**2022 16 June;** Updated WGIII ToRs endorsed by plenary **2022 17 May:** ToRs reviewed at the WGIII meeting CGMS-50-WGIII-WP-08 EXT - It will now be presented to plenary for endorsement, Next review is planned for 2027 unless needed earlier. **2021 28 Sep:** CGMSSEC and co-chairs/rapporteurs to review if ToRs need updating by CGMS-50 **2021 Jan:** Include on the WGIII AGN (or RA WS AGN) to review WGII-WGIII interactions for possible update of the WGIII ToRs.	2024	**CLOSED**
CGMS space agencies :MA	WGIII/ 3.2 & 4.1	WGIII/ A48.01	WGIII to reflect the aspect of latency in the CGMS baseline/risk assessment. (Ref. from IPWG CGMS-47	**2022 17 May:** Closed following discussion in WGIII: Data latency is implement in OSCAR/Space and will be incorporated in WMO Gap Analysis.	CGMS-50 (Mar/Apr 2021,	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
:NES :NSA SA UMETSAT SRO AXA MA .MA IASA IOAA .OSCOSMO .OSHYDRO MET *:lick to add* *new task...*			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).	**2022 25 Mar:** Closure expected on the occasion of CGMS-50 WGIII mtg. **2021 28 Sep:** WMO to provide OSCAR space update to WGIII IS#2 on 19 Jan (thereafter identify whether/how to address this with WGI, WGII, and/or WGIV) 2021 16 Apr: Ref. to CGMS-49-WMO-WP-02 Also to be addressed within the framework of WGI. 2021 1-3 Mar: WMO to consider addressing this in the status requests to O/SST to enable incorporation in the gap analysis (TBC). 2021 Jan: Data latency, quality, ... for WGII-WGIII joint session. 3rd risk assessment results to be shared with the other WGs (April 2021) for feedback/comments to WGIII. (WMO: Data latency/operational data - link to OSCAR space to enable filtering between operational and non-operational missions for improving gap analysis)	Feb 2021)	

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
EUM (NSOAS)	WGIII/ 3.2 & 4.1	WGIII/ A48.02	CGMS-48 WGIII discussions May 2020 (and the now closed 1RAWS2019.4): WGIII recognised the need for a long term plan for ~6Ghz frequency microwave imaging in at least 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.	**2022 17 May:** EUM in contact with NSOAS. NSOAS is currently positive that this will concretise but requires confirmation by its ministry. **2021 27 Sep:** Currently the data policy is not fully free and open. EUMETSAT is addressing this with NSOAS and expecting final confirmation by end 2021. 2021 Jan: No progress, action on CGMSSEC. 2020 May 28, CGMS-48 WGIII (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.	June 2022 (Feb 2021)	**ONGOING**
EUM (NSOAS)	WGIII/ 3.2 & 4.1	WGIII/ A48.03	CGMS-48 WGIII discussions May 2020 (and the now closed 1RAWS2019.8): WG III recognised that there is no radar altimetry data availability in the early morning orbit in the short term and that there are no	**2022 17 May:** EUM in contact with NSOAS. NSOAS is currently positive that this will concretise but requires confirmation by its **2021 27 Sep:** Currently the data policy is not fully free and open. EUMETSAT is addressing this with NSOAS and	June 2022 (Feb 2021)	**ONGOING**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
			plans in the long term for coverage. Recommended Mitigating Action #8: [EUM and SOA] to ensure data availability for HY-2B ALT.	expecting final confirmation by end 2021. 2021 Jan: No progress, action on CGMSSEC. 2020 May 28, CGMS-48 WGIII (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.		
UM MA (NIER) *lick to add new task...*	WGIII/ 3.2 & 4.1	WGIII/ A48.04	EUMETSAT to explore with NIER of GEO KOMPSAT 2B GEMS observations can be considered for the CGMS baseline and risk assessment.	**2022 17 May:** EUM and KMA in contact with NIER. Data expected to become available in second half of 2022. GEO KOMPSAT 2B GEMS observations already included in the CGMS baseline and risk assessment. **2021 29 Nov**: Some data available via NIER's website. Further data expected to be available end of 2021. Data policy TBC. KMA and EUMETSAT to continue to reach out to NIER. 2021 16 Apr: KMA to reach out to NIER 2021 1-3 Mar: EUMETSAT to continue reaching out to NIER (NIER expected to provide a status presentation to WGII at	Dec 2022	**ONGOI NG**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				CGMS-49). 2021 Jan: No progress, action on CGMSSEC.		
WMO	2	WGIII/ A49.01	WMO to implement the outcome of the Position paper on Satellite data Requirements for Global NWP to WMO activities like Rolling Review of Requirements, Gap Analysis, WIGOS Vision etc.	2022 17 May: Followed up within the discussions in WG III. RRR outcome to be reported in 2023. 2022 24 Feb: Closed on the occasion of the 4th CGMS risk assessment workshop/discussions. 2021 Sep 27: Will be addressed within the framework of the 4th risk assessment WS	TBD	**CLOSED**
ISRO	3.1	WGIII/ A49.02	ISRO to update CGMS-50 on their plans for a geostationary hyperspectral infrared sounder.	2022 May: Plans still unclear related to HIRS. 2022 24 Feb: Review ongoing. Update to be provided to plenary in June. 2021 Sep 27: Unclear if ISRO will have confirmed plans by CGMS-50. TBC.	CGMS-51	**OPEN**
WMO	3.1	WGIII/ A49.03		**CLOSED** Superseded by a CGMS-49 plenary action.	Aug-21	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
ISRO	4	WGIII/ A49.04		**CLOSED** Duplicate with WGIII/A49.04		**CLOSED**
CMA	4	WGIII/ A49.05	CMA to confirm plans to fly a precipitation radar beyond FY 3G.	**2022 May:** Closed. **2022 18 Jan**: Closed. CMA confirms this plan. It will be reflected in the risk assessment report. **2021 Sep 27:** To be addressed within the framework of the 4th risk assessment WS	Feb-22	**CLOSED**
AXA IASA *lick to add new task...*	4	WGIII/ A49.06	NASA and JAXA to confirm plans to fly a precipitation radar beyond the GPM Core.	**2022 May:** NASA and JAXA confirmed that this is ongoing. **2022 24 Feb:** Discussions ongoing between NASA and JAXA. Report to be provided to CGMS-50 plenary session. **2021 Sep 27:** To be addressed within the framework of the 4th risk assessment WS	CGMS-50 (Feb-22)	**ONGOI NG**
SA UM *lick to add new task...*	4	WGIII/ A49.07	EUMETSAT and ESA to report on plans for the CIMR (Copernicus Imaging Microwave Radiometer) Mission	**2022 17 May:** Report provided to CGMS-50 WG III meeting CGMS-50-ESA-WP-05 EXT **2021 Sep 27:** To be addressed within the framework of the 4th risk assessment WS	Feb-22	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
ISRO	4	WGIII/ A49.08	ISRO to confirm plans beyond Oceansat 3 series	**2022 17 May:** Plans still to be confirmed. **2021 Sep 27:** To be addressed within the framework of the 4th risk assessment WS	CGMS-51	**OPEN**
SWCG	4	WGIII/ A49.09	SWCG identify alternative data sources to mitigate potential unavailability of coronagraph observations	**2022 17 May:** Alternative sources recognized. Reflected in the risk assessment. **2022 24 Feb:** Closed on the occasion of the 4th CGMS risk assessment/ discussions. NOAA to provide a report to the SWCG. SWCG IS#2: Elsayed presented a slide indicating Coronagraph Gap mitigation based on US resources. Also noted Aditya data is not suitable for the models. Open questions as to whether GOES-U coronograph could be used in case of SOHO failure as de-storing the satellite in advance of plans could limit overall lifetime. High level NOAA decision would be required. 2021 20 Oct SWCG IS#1: NOAA to provide a report to SWCG	Jan-22	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
SWCG	4	WGIII/ A49.10	SWCG review baseline requirement for orbital positions as opposed to number of satellites for energetic particle observations	**2022 17 May:** Closed. This is reflected in the baseline and risk assessement **2022 24 Feb:** Baseline updated at 4th risk assessment WS. SWCG to provide feedback to CGMSSEC for inclusion in the baseline. SWCG IS#2: 2022 9 Feb: SWCG: SWCG IS#2: Report from the GEO Ring Energetic Particle Workshop to be supplied with proposed wording for baseline. Proposed action text update: SWCG review baseline requirement for orbital positions and energetic particle energy ranges and review WMO approach to highlighting data latency. **2021 17 Nov:** Dedicated meeting took place. Outcome TBC. **2021 20 Oct SWCG IS#1:** Proposed action text update: SWCG review baseline requirement for orbital positions and energetic particle energy ranges and review WMO approach to highlighting data latency.	Jan-22	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CMA	4.1	WGIII/ A49.11	For CGMS Baseline, confirm if FY-4 has a magnetometer.	**2022 17 May**: Closed earlier **2022 Feb:** CLOSED FY-4B, -4C have magnetometer instruments. 2021 Sep 27: To be addressed within the framework of the 4th risk assessment WS **2021 Sep 27:** To be addressed within the framework of the 4th risk assessment WS	Feb-22	**CLOSED**
WGIII	4.1	WGIII/ A49.12	CGMS Baseline Calibration and Validation section to be updated according to NWP position paper outcome.	**2022 17 May:** NWP paper needs to be considered in the WMO regulatory update. **2022 24 Feb:** Pending WMO regulatory update **2021 Sep 27:** To be addressed within the framework of the 4th risk assessment WS	End Oct 2022 (Feb-22)	**OPEN**
WGIII	4.1	WGIII/ A49.13	CGMS Baseline to be reviewed if aligned with WMO unified data policy when available.	**2022 17 May:** Closed following discussions in CGMS-50 WGIII **2022 24 Feb:** WMO presentation to the 4th risk assessment. Status report to be made to plenary. **2022 19 Jan:** Bilateral meetings between	Feb-22	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				WMO and space agencies needed prior to responding to this action. **2021 Sep 27:** To be addressed within the framework of the 4th risk assessment WS		
WGII	4.1	WGIII/ A49.14	The list of CGMS baseline sensor observations should be reviewed against the list of products required for NWP in the WMO's Position paper on Satellite data Requirements for Global NWP.	2022 17 May: Open following discussion in WGIII 2022 25 Mar: For WMO consideration (link to gap analysis/high level paper) 2022 24 Feb: Reminder to WGII by CGMSSEC when circulating the updated draft baseline and 4th RA 2021 Sep 27: To be addressed within the framework of the 4th risk assessment WS	Jan-22	**OPEN**
VGI VGII VGIV *Click to add new task...*	4.1	WGIII/ A49.15	Review of CGMS baseline Section 3. against the WMO's Position paper on Satellite data Requirements for Global NWP.	**2022 17 May:** Open following discussion in WGIII 2022 25 Mar: For WMO consideration (link to gap analysis/high level paper) 2022 24 Feb: Reminder to WGII by CGMSSEC when circulating the updated	Oct 2022 (Feb-22)	**OPEN**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				draft baseline and 4th RA 2021 Sep 27: To be addressed within the framework of the 4th risk assessment WS (and in WGI, WGII, WGIV)		
WGIII	4.1	WGIII/ A49.16	Review the mission planning related to irradiance, cloud/wind lidar and cloud radar observations related to the WMO's Position paper on Satellite data Requirements for Global NWP.	**2022 24 Feb:** Closed following discussions in the 4th risk assessment workshop. 2022 19 Jan: To be included in the WMO gap analysis. 2021 Sep 27: To be addressed within the framework of the 4th risk assessment WS	Feb-22	**CLOSED**
WMO	6	WGIII/ A49.17	Continue preparing and submitting to O/SST templates on OSCAR/Space data that needs to be updated, approximately 3-4 times a year.	**2022 17 May**, 24 Feb: Ongoing	CGMS-50	**OPEN**
WG III	7	WGIII/ A49.18	CGMS-49 Plenary to sunset Socioeconomic Task Team.	CLOSED Endorsed by CGMS-49 plenary.		**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
SETT/ NOAA	7	WGIII/ A49.19	SETT to provide presentation (in WG III intersessional) on possible synergies between CEOS and CGMS socioeconomic impact related activities	**2022 17 May**: Closed on the occasion of CGMS-50 WGIII, some CGMS members expect to provide reports to CGMS-51 **2022 24 Feb:** Open for CGMS-50 WGIII and CGMSSEC to remind members to contribute with reports on studies made (It is a standing item on the WGIII agenda) 2021 27 Sep: NOAA agreed to look into this action	Jan-22	**CLOSED**
WMO	7	WGIII/ A49.20	Clarify the situation between WMO and CMA related to the need of FY-3E Tiger Team.	CLOSED - see WGIII/A47.07		**CLOSED**
WGIII	11	WGIII/ A49.21	Plenary to endorse H. Pohjola (WMO) as WGIII rapporteur	CLOSED Endorsed by CGMS-49 plenary.	-	**CLOSED**
WGIII	Plenary IROWG report session	WGIII/ A49.23	IROWG comments on latency etc considerations at next Risk assessment WS: CGMS WGIII will update the RO data availability and potential future gap in the	**2022 17 May:** Closed. Included in latest risk assessment. Chart also available and shared. 2022 25 Mar: (IROWG updated chart to be included)	Feb-22	**CLOSED**

CGMS-49 WGIII action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
			CGMS baseline accordingly and at the next risk assessment workshop in February 2022.	2022 24 Feb: Results of 4th risk assessment to be shared with IROWG to enable them to provide an updated chart. 2022 19 Jan: Action edited for the sake of clarity. 2021 27 Sep: WGIII to assure this is updated at the 4th risk assessment WS		

CGMS-49 Joint WGII-III action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
WMO	3.1	JWGII-WGIII/A49.01	WMO to explore what is the need of establishing an international science working group in support of the atmospheric composition/air quality services, taking the existing initiatives e.g. under GAW and CEOS into account.	2022 16 Mar: CLOSED within the framework of WGIII, to be handled by WGII (WMO will provide a WP to CGMS-50 WGII "WMO GHG Monitoring Activities") 2021 28 Sep: WMO will discuss this - internally with GAW/IG3IS - In WGClimate - with other relevant groups in CEOS	CGMS-50	**CLOSED**

CGMS-49 Joint WGII-III action status following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				(CGMS and WGClimate / GHG TT pocs already established). TBD if science is probably sufficiently covered by GAW/IG3IS and CEOS.		
Presenters at CGMS-49 JWGII-III session,	3.2	JWGII-WGIII/A49.02	Provide updated information on observables/species, which can be committed by CGMS constellation and added to CGMS baseline. [Science questions related to atmospheric composition]	CLOSED 2021 27 Sep WGII IS#1: Updates provided for new baseline to CGMS-Plenary-49. See WGII LOA. WGII to consider any further observables/species that can be committed/added to the baseline if/as necessary		**CLOSED**
WGII						
CGMS-49 recommendations – Joint WGII-WGIII						
Actionee	**AGN item**	**Rec**	**Description**	**Feedback**		
CGMS members	3.2	JWGII-WGIII/R49.02	WG II recommends that CGMS members develop aerosol products capitalising on synergies across multiple instruments	CLOSED 2022 24 Mar: Closed in the framework of WGIII. Expected to be covered by future WGII discussions on aerosol products.		**CLOSED**

STATUS OF WGIII ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

CGMS-50 WGIII actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
NOAA	WGIII/ 4.1	WGIII/ A50.01	NOAA to review additional ground resources needed to track STEREO-A and PUNCH to provide additional coverage in the near-term.	**2022 28 Sep:** Ongoing	CGMS-51	**OPEN**
KMA	WGIII/ 4.1	WGIII/ A50.02	KMA to confirm plans beyond GK-2B for visible/UV spectrometer and Narrow Band imager.	**2022 28 Sep:** Feasibility studies ongoing (results together with special feasibility test expected to take +/-2 years overall)	CGMS-51	**OPEN**
WGIII lead (CGMSSEC)	WGIII/ 4.2	WGIII/ A50.03	To add characteristics/definitions of the new energy ranges related to the high energy particles in the Sensor Type table of the CGMS Baseline document.	**2022 28 Sep:** Information from SWCG to be included in the next version of the baseline. [*ACTION CGMSSEC to include the information in the baseline document*]	RA workshop 2023	**OPEN**
WMO	WGIII/ 4.2	WGIII/ A50.04	To implement energy ranges for high energy particle classification to OSCAR/Space as defined in the CGMS Baseline.		RA workshop 2023	**OPEN**

CGMS-50 WGIII actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
WMO	WGIII/ 4.2	WGIII/ A50.05	To implement the feature of Sun-Earth line instrument filtering for the OSCAR/Space Gap Analysis.		RA worksho p 2023	**OPEN**
CGMSSEC	WGIII/ 4.4	WGIII/ A50.06	CGMS Global Contingency Plan to be updated according to the findings in the working paper CGMS-50-CGMS-WP-25 in WG III (presentation).	2022 28 Sep: CGMSSEC to provide the update and present it to the risk assessment workshop	RA worksho p 2023	**OPEN**
CGMSSEC	WGIII/ 9	WGIII/ A50.08	To add proposed HLPP target for the work towards operational IR/MW limb sounding capability for climate monitoring and NWP application.	CLOSED (published)	CGMS-50 plenary	**CLOSED**
CGMSSEC	WGIII/ 9	WGIII/ A50.09	To add proposed HLPP target to coordinate the evaluation of small satellite constellations capability to provide sufficient µwave sounding perfor mance for the radiance data assimilation.	CLOSED (published)	CGMS-50 plenary	**CLOSED**

Working Group IV (WGIV)

Data access and end user support

50 YEARS 1972–2022

CGMS

WGIV REPORT

Co-chairs: Kotaro Bessho, JMA / Vasily Asmus, ROSHYDROMET
Rapporteurs (acting): Natalia Donoho, NOAA / Simon Elliott, EUMETSAT

1. Opening, objectives and expected outcomes / WGIV co-chairs and rapporteur status

Co-Chair, Kotaro Bessho (JMA), welcomed all participants to the WGIV session. He briefly presented the agenda and the 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: CIRA, CMA, ESA, EUMETSAT, IMD, ISRO, JMA, KMA, NASA, NICT, NOAA, NSSC, and WMO. See the list of participants in the Annex.

The WGIV meeting was conducted via 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 to address space weather related topics.

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

The WG reviewed the actions and recommendations of past CGMS sessions related to its work. The following 6 actions were proposed to be closed: 48.02, 48.04, 48.06, 49.02, 49.03, and 49.05. Nine actions and 6 recommendations remained open.

3.1 User-provider dialogue on regional/global scales

CGMS-50-joint-JMA-KMA-01WGIV: Progress Report on the RAII WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training in 2020-2021

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 Third Joint Meeting of RA II WIGOS PROJECT and RA V TT-SU for RA II and RA V NMHSs was held online, on November 5, 2021.

The final report of the meeting was presented and WGIV took note.

3.2 Implementation and evolution of sustained and coordinated communication satellite broadcast systems

CGMS-50-CMA-WP-07: CMA Report on the Update of CMACast

CMA gave an overview of their CMACast system and described its current status. The broadcast transponder of CMACast will change and users should turn their antenna to the new satellite (APSATR7) to receive CMACast data. The change will bring an increase in area of coverage to include a large part of Africa. CMACast Helpdesk will provide operation instructions and technical support to help users to switch their reception antenna.

EUMETSAT asked how full the transponder was at the moment. CMA explained that it is using new satellites and up to 90 Mbps.

CGMS-50-JMA-WP-07: Data dissemination and distribution of Himawari-8/9 and their recent updates

JMA presented an overview of Himawari-8/9 data dissemination and distribution in JMA, and reported on their recent updates. JMA provides Himawari-8/9 data via its HimawariCast and HimawariCloud systems. New developments such as HimawariCast enhancement and a new HimawariCloud connection method are under consideration. A seamless switch from Himawari-8 to -9 is planned for around December 2022.

Responding to ISRO's question, JMA confirmed that access to HimawariCloud is intended for NMHSs, with one point of access per country.

CGMS-50-NOAA-WP-07: NOAA Report on GEONETCast Americas (GNC-A)

NOAA presented the status of GEONETCast Americas. The GEONETCast Americas broadcast (GNC-A) is a NOAA funded commercially provided broadcast stream that's been operational since 2008 serving satellite, in-situ and various other earth observational data to North, Central and South American communities via the Intelsat-21 satellite at 58° West. In 2020, the satellite rebroadcast was moved to another transponder that could accommodate a higher data rate up to 20 Mbps. With the additional bandwidth, the GNC-A broadcast in 2021 underwent a significant product content change with expansion to include all 16 bands of GOES-16's Cloud Moisture Imagery (CMI), increased JPSS products such as the VIIRS Ocean Color, VIIRS Vegetative Index and Fraction as well as several other blended products.

NOAA confirmed that the requirement baseline will be updated to reflect the inputs collected via the ongoing questionnaire process. WGIV members took note.

3.3 Global or inter-regional data circulation and access, WIS

CGMS-50-CMA-WP-05: FENGYUN Satellite Data Services and Applications and their Updates in 2021

CMA gave a detailed presentation of the data policy, services and applications for their Fengyun satellites. The data policy with respect to FY-3E will be updated in mid-2022. Emergency support will be FY-2H to FY-4B once FY-4B becomes operational.

CGMS-50-KMA-WP-03: KMA report on the update of GK2A data services

KMA presented a report on GK2A data services. GK2A satellite has operated since July 25, 2019. The GK2A satellite, which produces 16 channels level 1b and many kinds of meteorological data, is operating for rapid scan local observation with an interval of 2 minutes, as well as normal observation at every 10 minutes for full disk. In order to provide the GK2A data to users, KMA has implemented the GK2A data service in several ways, such as real-time FTP, open API, WMO WIS DCPC and web-based download.

CGMS-50-EUMETSAT-WP-12: Update on EUMETSAT's space-based commercial data activities

EUMETSAT reported that it has established a pilot data service in which radio occultation observations are purchased from a private company, processed by EUMETSAT, and distributed to users. The initial preparation and validation phase started on August 12, 2021, and successfully concluded on February 14, 2022 with the service's transition into operations.

Since April 6, 2022, these data are disseminated on the WMO GTS for the unrestricted use of WMO Centres worldwide. In this way EUMETSAT currently contributes a minimum of 1000 quality controlled radio occultation bending angles to the global numerical weather prediction system per day. This number will grow throughout the duration of the pilot, which is planned to end in August 2024. Deconflicting measures have been taken in order to ensure that these observations are unique and therefore further contributions from other agencies are expected to provide additional improvements to weather prediction skill.

In response to NOAA's question, EUMETSAT explained that the pilot has delivered a minimum of 1000 quality controlled observations per day to users using EUMETCast and GTS, with an end to-end timeliness of less than 165 minutes from sensing.

CGMS-50-NOAA-WP-09: Update on NOAA's space –based commercial data activities

Between 2016 and 2018, NOAA conducted two rounds of the Commercial Weather Data Pilot (CWDP) Pilot-1 & Pilot-2 to assess the operational readiness of radio occultation (RO) data. Commercial RO data began to be assimilated operationally on May 22, 2021, with the implementation of GFS v16.1.

CDWP Pilot-3: A Request for Information (RFI) was posted in September 2021 seeking the commercial sectors (proposed) capabilities to deliver commercial data addressing NOAA/NESDIS Level Requirements to inform CWDP and other NOAA activities. A Sources Sought Notice (SSN) for Commercial Microwave (MW) Data (Pilot-3) was posted on July 6, 2021; On August 6, 2021, four vendors responded to the MW SSN; a Microwave Capability Assessment Team (MCAT) was stood up to evaluate vendor capability assessment statements based on a predetermined evaluation criteria NOAA/NESDIS plans to continue to evaluate commercial MW capability viability in FY23.

CDWP Pilot-4: As part of CWDP activities in FY22, NOAA/NESDIS was directed to conduct market research into the availability of commercial Space Weather (SpWx) data types and conduct Pilot Studies of any appropriate data sources. A targeted RFI, aimed at NOAA's space weather observational

needs, was issued on November 10, 2021, to solicit capability statements from all interested commercial vendors. Eleven (11) SpWx RFI responses were received on December 8, 2021. A SpWx Pilot RFP will be issued in the Spring 2023.

The group was reminded of the outcome from the CGMS 49 plenary meeting where it was noted that in developing services based upon the redistribution of commercially sourced data, it is more beneficial to reach a wider audience with less data that a smaller audience with more data.

CGMS-50-ROSHYDROMET-WP-03: Satellite Data Exchange in ROSHYDROMET

There being no participation from Roshydromet in WGIV, the submitted document was noted but left unaddressed.

CGMS-50-WMO-WP-02WGIV: Status of WMO Core Satellite Data Activities

WMO provided an update of their activities to establish core satellite data as per the new WMO Unified Policy for the International Exchange of Earth System Data (Res. 1). The process for establishing the core satellite data was presented. The currently identified data types were also introduced.

WGIV took note of the WMO activities. WMO may need to consult stakeholders (which may take time), it is the starting point for bilateral discussions.

3.4 Widening of data access, to new missions/providers as well as for other user communities

CGMS-50-CEOS-WP-01: Engaging regional communities of practice: progress report on the Earth Observation Training Education and Capacity Development (EOTEC DevNet)

In its effort to improve coordination of Earth observation-related capacity building, the Earth Observation Training Education and Capacity Development Network (EOTEC DevNet) made significant progress in its first year. Launched March 2021 and in Year 1 of a 2-year pilot, EOTEC DevNet set up global and regional structures, created an online prototype tool to track capacity building resources for flooding, and began work on its communications infrastructure. Global structures include a Leadership Team and Task Team. Regional structures include four Communities of Practice (CoPs) for Africa, the Americas, Asia-Oceania, and Europe, each with a task team and region-specific thematic working groups. The global and regional initiation meetings included government, academic, private sector, and international agency capacity development professionals and subject matter experts from some 30 countries. Meeting participants affirmed several EOTEC DevNet priorities:

- Increase the availability and accessibility of information, data, tools, and other EO specific resources, such as best practices, case studies, and training experiences
- Produce guidance and tools to help users match capacity building products to their needs
- Identify training needs and eliminate duplication among training providers
- Build a comprehensive library of regional thematic and technical capacity building materials for EO educators and practitioners
- Establish a network beyond government, especially the EO private sector

EOTEC DevNet's thematic focus: disaster risk reduction and climate mitigation and adaptation. In 2021 preparatory meetings, flooding was selected as a theme for start-up activities. The prototype flood tracker was developed by capacity development and floods experts representing providers and users of training from the leadership partners and CoPs. An example of how EOTEC DevNet hopes to support users, the online tracker will assist users in identifying training resources for flood management, response, and early warning. Key activities for Year 2 of the pilot are to: consolidate formation of the regional CoPs; continue to develop global products to help users discover data, and tools; roll out communications and collaboration platforms to support global and CoP work; produce best practice guidance on strategies for assessing needs; conduct stakeholder mapping; develop a monitoring and evaluation plan; and devise a sustainability plan.

WGIV, VLab and WMO supported this initiative and encouraged WGIV members to foster the growth of EOTEC. A related action was created.

CGMS-50 actions - WGIV					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMS Members	§3.4	WGIV/A50.01	CGMS members continue to foster the growth of EOTEC DevNet by, for example: joining the CoPs, identifying other experts for the CoPs, contributing to EOTEC DevNet products, and sharing EOTEC DevNet information within their network.	CGMS 51	**Open**

3.5 Disaster support

CGMS-50-CMA-WP-06: CMA Report on FY_ESM

CMA introduced the Emergency Support Mechanism of FENGYUN (FY) Satellite (FY_ESM) on April 24, 2018. It is open to international users, who may make a request if they are visited by such extreme events as typhoons, heavy rain, severe convection, forest or grassland fires, and sand and dust storms. In such cases, the on-duty FY satellite will be activated to initiate highly frequent observation of a given area at an interval of up to 5 minutes. The resulting images and quantitative products will be provided through channels such as CMACast, the internet and direct satellite broadcasting.

CMA reported that the external service of FY-2F observations and products had been stopped on 1 April 2022, due to the time spent in orbit being far beyond the design life.

CMA reported that there had been 18 FY-ESM activations in 2021, including 5 disaster types, with data and product services provided to 13 countries.

CMA reported that the newest FY-4B satellite could provide observations at one minute intervals, and they considered adding FY-4B into the on-duty satellite of FY_ESM after the conclusion of in-orbit tests.

In response to a question from JMA, CMA confirmed the specific differences between 2 payloads.

CGMS-50-JMA-WP-08: Status of JMA Himawari Request service

In January 2018, the JMA launched a new international service "HimawariRequest", in collaboration with the Australian Bureau of Meteorology. The service allows NMHS users in Himawari8/9 coverage area to request Target Area observation covering a 1,000km x 1,000km area every 2.5 minutes.

Target Area observation supports JMA's national/international services including the RSMC Tokyo - Typhoon Center and the Tokyo VAAC.

In response to a recommendation made at the 2015 Joint RA II/RA V Workshop on WIGOS for Disaster Risk Reduction, JMA developed the service through the RA II WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training.

As of 31 March 2022, JMA had taken registrations from 22 NMHSs in RA II and RA V, and 19 have completed preparation for their requests. There have been 159 international requests since the commencement of the service, among which 141 have been approved. Targets have included tropical cyclones in the South Pacific, extreme weather and bushfires in Australia, and volcanic activity in Indonesia.

JMA expects the HimawariRequest service to support disaster risk reduction activities in the Asia Oceania region based on the regional monitoring of extreme events such as tropical cyclones and volcanic eruptions using the Target Area observation.

In response to a question from VLab on the Tonga eruption, JMA explained that the targeted high frequency image data is available via HimawariCloud, but not via HimawariCast due to bandwidth constraints. Internet connectivity is required to acquire the data.

CGMS-50-KMA-WP-04: KMA report on the update for the rapid scan imagery service

KMA reported on its Geo-KOMPSAT-2A (GK2A) rapid scan imagery service and Marine weather broadcast service.

The GK2A satellite has been formally operated from 25 July 2019 and also the GK2A AMI Rapid Scan (ARS) observations based on users' requests in the Asia-Pacific region have been served from January 2021.

CMA, JMA and KMA stated their intention to continue to work closely together on disaster support activities.

3.6 Support to the Ocean user community

CGMS-50-KMA-WP-06: Marine weather broadcast service by GK2A satellite

KMA reported on its marine weather broadcast service. KMA started the marine weather broadcast service by GK2A satellite from July 23, 2020. The service provides high-quality digital marine weather information to ships operating at sea.

The marine weather broadcast service using GK2A's Low Rate Information Transmission (LRIT) is the world's only public satellite service dedicated to providing weather information free of charge with an aim of ensuring the safety of ships. It transmits marine meteorological information to ships not only in coastal and offshore areas, but also in high seas where they could have difficulties maintaining their maritime communication network.

The broadcast service is available for ships located within a 3,700 km radius of GK2A—East Asia and West Pacific. It provides 15 types of 360 products, including surface analysis and forecast charts, wave analysis and forecast charts, and satellite images.

KMA confirmed that training in the system was provided to domestic users.

CGMS Secretariat had a question about equipment/system on ships to receive the transmission.

3.7 Support for Arctic observations

There was no discussion under this topic during the WGIV meeting.

3.8 Support for Hyperspectral infrared instruments

There was no discussion under this topic during the WGIV meeting.

4. Coordination of Metadata (incl. standards within ocean communities)

The Task Group on Metadata held an initial kickoff meeting in February 2022. A follow-on kick-off meeting is planned for summer 2022.

5.1 User readiness for new satellite systems

CGMS-50-WMO-WP-15: VLab Progress Report

The WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) provided a report on activities in 2021. Since CGMS-49, VLab members have offered a variety of training opportunities which highlight training efforts addressing the new generation of satellites. This continues to be the major training need identified by VLab members. Strong 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 co-chairs representing CGMS satellite operators and VLab Centres of Excellence. In 2021 the two VLab Co-Chairs, Dr. Mark Higgins (EUMETSAT Training Manager) and Dr. Marinés Campos (Director of the RTC WMO-SMN Argentina), stepped down. Subsequently, the CGMS Plenary in May 2021 endorsed Dr. Bernadette Connell from the Cooperative Institute for Research in the Atmosphere

of Colorado State University as the new VLab co-chair representing the CGMS space agencies. Mr. Wen Bo, from the CMA Training Center, was endorsed by the WMO as a representative of the Centres of Excellence. In January 2021, Luciane Veeck, the VLab long-term TSO, resigned to take a position with the WMO Education and Training Office. Dr. Marcial Garbanzo, the Head of the Centre of Excellence in Costa Rica, was appointed as the new VLab TSO on 1 October 2021. The VLab Trust Fund continues to receive yearly contributions from NOAA/NWS, EUMETSAT, and KMA. A larger number of contributing CGMS agencies is desired 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 essential to maintain the VLab training activities. 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 September 2022 (Darmstadt, Germany). CGMS members active in VLab are invited to send representation to participate in the meeting.

The Vlab chair invited WGIV to make use of the VLab training calendar as a resource to publicise events to a wide number of communities.

WMO thanked VLab for the presentation.

CGMS-50-NOAA-WP-08: Preparing the Community for Data through Translation, Access and Discoverability

This presentation followed the user needs phase of user engagement and how the development of the mission value studies will help inform Phase 2 (User readiness) of user engagement. As NOAA continues to evolve this practice across NOAA missions, NOAA aims to improve how data and services are discovered, accessed and implemented in order to provide more comprehensive and innovative sets of information.

NOAA is a service organisation whose mission is to understand and predict changes in climate, weather, oceans, and coasts, to share that knowledge and information with others, and to conserve and manage coastal and marine ecosystems and resources as the Nation's authoritative environmental intelligence agency. To succeed in this mission, it is critical NOAA continuously advances their knowledge and understanding of user needs, user capabilities and how information fuels the decisions and actions that impact society.

User engagement is an evidence-based discipline that allows NOAA's Satellite Programs to learn about the needs, challenges, and work environment of those they serve to provide the most useful, usable, and used products and services to their customers. The discipline encompasses the collection of user needs, the readiness and training of the user community, the sustainment of mission products, and observations throughout the mission lifecycle and into the development of follow-on efforts. User engagement supports all aspects of their mission. User engagement is an ongoing, mutual exchange of information and ideas that fosters good relationships between NOAA, users, customers, and stakeholders.

JMA had a question about value studies. NOAA explained that they have an economist working on their team, and if there is a value in early detection, for example, it can translate to dollars.

CGMS-50-NOAA-WP-10: NOAAs User Engagement Framework: User Needs, User Readiness and User Sustainment

This paper summarised three stages of user engagement during the satellite's life cycle: User needs, user readiness and user sustainment. NOAA presented the framework used to inform policy and provide guidance to NOAA for developing effective user engagement strategies ensuring user needs, goals, and objectives are mapped to NOAA's mission areas. Through this renewed framework, NOAA aims to improve how data and services are ingested, harmonised and fused together from across different platforms and agencies in order to provide more comprehensive and innovative sets of information.

At NOAA, the development of user-driven solutions starts with the conception of new satellites. User engagement efforts leverages various communities and builds on the legacy of users' knowledge and best practices in areas of society. Topical focus areas such as fire, weather forecasting, agriculture, human health and ocean life are part of the thematic user applications approach to assessing needs, providing readiness and sustaining best practices that bridge into future missions, products and services. NOAA user engagement uses decision driven discussions to identify current and future needs from societal subject matter experts (SMEs) users known as the NOAA Pathfinders. The information collected and assessed is later translated into geophysical requirements to develop user driven solutions, define areas of value and to guide future products and services. Pathfinders are identified throughout the mission lifecycle to tell the story of how mission data will contribute to the evolving needs of society and quantify the return on mission investments.

EUMETSAT thanked NOAA for the presentation and asked about policy guidance at the beginning of the process. NOAA would be able to share the guidance.

5.2 Notification of changes (and alerts) in satellite data and/or products impacting users

There was no discussion under this topic during the WGIV meeting.

6 Cyber security towards and users

CGMS-50-EUMETSAT-WP-13: Report from the expert group on cyber security

After its first meeting on 17 March 2021, the newly created CGMS WG IV Cyber Security Task Group did not have the opportunity to meet again. It was explained that some external events affecting cybersecurity in general and within each member organisation, as well as some current limitations inherent to the task group, raise the need for re-discussing the group's scope/purpose and ways of working

It had been hoped that the Task Group could be used to share experience and good practices, but this has not proved to be tenable in practice. Rather than dissolving the group, the consensus was to recommend to Plenary the suspension of its activities, with a view to reviewing the situation for CGMS-52.

CGMS-50 recommendations - WGIV			
Actionee	**AGN item**	**Rec**	**Description**
CGMS Plenary	§4.3	WGIV/R50.01	CGMS WGIV recommends to the Plenary Session of CGMS 50 to suspend the activities of the Task Group on Cyber Security, and to revisit the role of the Task Group for CGMS 52.

7 Cloud Services interoperability

CGMS-50-CGMS-WP-34: Summary and Highlights from CGMS WGIV Cloud Service Expert Group Workshop

The Cloud Expert Group was established in July 2020 and is comprised of members from the National Oceanic and Atmospheric Administration (NOAA), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Korea Meteorological Administration (KMA), China Meteorological Administration (CMA), Japan Meteorological Agency (JMA), Indian Space Research Organisation (ISRO), and the World Meteorological Organization (WMO). The group was formed to share lessons learned while making use of cloud computing technologies and develop a set of best practices for each organisation to maximise the interoperability of systems that they build in the cloud. Over the past year, the team has focused on agency best practices, cloud optimised data formats, and how the group's cloud work aligns with WMO's Information System (WIS) 2.0 Strategy.

The group's main goals are to establish a suite of best practices for cloud use and define how to make cloud-based dissemination more interoperable. To meet these goals, the group hosted a Cloud Workshop to increase awareness of the current and future trends in cloud services amongst CGMS members and understand key capability gaps that the cloud can fulfil so participants can fully leverage the advantages the cloud can offer. As a result of industry presentations, open discussions, and agency-only roundtables, CGMS cloud services experts have increased their knowledge of industry cloud trends and will take back best practices and lessons learned to their respective organisations. The agency-only roundtables provided a forum for agencies to speak of lessons learned, best practices, opportunities for collaboration, and to make others aware of possible issues when adopting cloud services. Best practices, trends, and common themes were identified amongst workshop presentations, and will be incorporated into the group's Best Practices document for presentation and endorsement at the CGMS Plenary in 2023.

During the discussion, the working group concluded that, if possible, annual Cloud Service Workshops would be a sensible and effective way to advance activities and support collaboration in this important area. If such meetings could be held on an annual basis it was expected that the scheduling of the event could be shortened.

JMA thanked NOAA for its leadership.

CGMS-50 recommendations - WGIV			
Actionee	**AGN item**	**Rec**	**Description**
WGIV Cloud Service Expert Group	§4.3	WGIV/R50.02	WG IV recommends that Cloud Service Workshops are organised on an annual basis, the schedule being shortened to take advantage of the consequent recurrence.

8 Long term data preservation

CGMS-50-ESA-WP-08: CEOS WGISS Best Practices for Space Data Preservation

The CEOS Working Group on Information Systems & Services (WGISS) and its interest group on Data Preservation and Stewardship (DSIG) were introduced and their role in the establishment and implementation of best practices for space data preservation was explained. During the discussion, the applicability of the best practices to data in the cloud was explored, noting that applicability was essentially limited to archived data. The practices described could also be applied to ground based measurements given a little adjustment.

ISRO thanked WGISS for the best practices.

In response to the question about ground observations, WGISS added that there could be some tailoring.

VLab asked via chat that the naming convention for the adherence level is too close to the data processing level of the data and might confuse users. For example, there are satellite data processing Levels 1A, 1B. and 1C. WGISS to follow up offline.

WGIV agreed that a meeting should be arranged to discuss modalities and areas of common activities between WGISS and WGIV. It was noted that the guidelines from WGISS have already been adopted by CGMS, but that reporting on the progress in their implementation would be valuable. A related action was created.

CGMS-50 actions - WGIV					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMS Sec and CEOSS WGISS	§4.3	WGIV/A50.02	WGISS and WGIV to hold a joint meeting to discuss modalities and areas of common activities between WGISS and WGIV. This should include a report	CGMS 51	**Open**

CGMS-50 actions - WGIV					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
			on the implementation of the adopted guidelines.		

9 Aspects on the implementation of the global contingency plan from Plenary (as proposed by WGIII)

The risk assessment was performed in February 2022, and the results are handled in the scope of WGIII (16/17 May 2022). It was noted that some aspects would be dealt with at the joint meeting of WGI/WGIV/SWCG (24 May 2022), at which the formation of a new Task Group on Improving User Data Access to Space Weather Data from Orbital Sensors would also be addressed.

10 Review of actions/conclusions, preparation of WG report for plenary

CGMS-50-CGMS-WP-36WGIV: Status of CGMS-49 WGIV list of actions (13 April 2022)

The status of the open actions on and recommendations for WGIV were reviewed and updated as needed. The latest status, including the actions and recommendation arising from this CGMS-50 WGIV meeting is given in the attached table.

11 Review and updating of the HLPP

CGMS-50-CGMS-WP-15WGIV: Status of implementation of CGMS High Level Priority Plan (2021-2025)

CGMS Secretariat provided the status of implementation of CGMS High Level Priority Plan (2021-2025). It incorporated inputs from: WG I, II, III and IV Chairs and rapporteurs, CGMS Space Weather Coordination Group, International Science Working Group chairs and rapporteurs, GSICS project, SCOPE-CM project, and CEOS-CGMS Joint Working Group on Climate.

A reorganisation of HLPP is proposed to align the priorities better with the new work structure of WGIV:

- TG on Cloud Services
- TG on Metadata
- TG on User Readiness
- TG on Data Access/Exchange

The full establishment of the TGs and the active participation of WGIV members is vital to advance the CGMS priorities. SWCG is proposing to move two priorities from WGIV to SWCG. Note that no targets are proposed to be removed from HLPP.

The HLPP was updated following review of WGIV related matters:

Items 3.1 "...regional coordination groups.." and 3.13 "..exchange of characterisation data…"will be addressed by TG on User Readiness.

> Regional coordination groups on data requirements are established in all WMO regions (RAI to RAVI), and those groups are very active. As reported in CGMS-48, the results from joint meetings and user surveys in RA II and RA V are useful for policy makers of satellite product development, data dissemination and user training. A user survey for RA-III and –IV is being completed by WMO, results will be available in the course of 2022.

Items 3.9.1 "...support WIGOS…", 3.9.2 "...metadata standards within ocean communities…" will be addressed by TG on Metadata.

Items 3.7 "...WIS.." and 3.12 "...scatterometer data…" to be considered/addressed by TG on Data Access/Exchange.

Item 3.1.1 "...user capabilities…" to be considered in the review of Best Practices for User Readiness.

Item 3.1.2 "...operational nowcasting communities…": the responsibility for the priority is between agencies and nowcasting communities, not between Agencies. However, it is recognized that Agency interaction would facilitate further progress and some activities are happening here as well. Looking at some of the key players with key current and future capabilities it seems this is progressing reasonably. Whilst some interactions exist, also in the context of the EUMETSAT MTG, IRS Mission Advisory Group, a sustained regular interaction across all CGMS members planning to launch geo-satellites with hyperspectral infrared capabilities have not yet been established. Focus of SCOPE-Nowcasting Pilot Project 1 in RA II (Asia) and RA V (South-West Pacific). Note, however, that SCOPE-Nowcasting has been inactive since 2019. Activity to be coordinated with WGII, no progress so far.

For Item 3.2.1 "User Readiness for New Meteorological Satellites", a review has been initiated, also involving the WMO Expert Team on Satellite Systems and Utilization (ET-SSU).

Item 3.2.2 "...SATURN portal…": Continuous update of SATURN information to be included in Best Practice, by a to-be-established inter-sessional sub-group. Until the Best Practice sub-group is established, the target will be kept open. SATURN content updates provided for MTG and EPS-SG.

Item 3.3 "...Digital Video Broadcast (DVB) satellite services..", GEONETCast Americas, EUMETCast, CMACast and HimawariCast are well established and coordinated systems, and no significant issues are observed. Reporting on the broadcast systems was provided in the CGMS-50 WGIV meeting.

Item 3.4 "...R&D and pre-operational missions…" will be addressed by TG on Data Access/Exchange. EUMETSAT, supported by CGMS members, is actively increasing access of such data to its member states, and to other CGMS members through bilateral arrangements. It should however be noted, that the bilateral agreements for R&D satellites do not always allow unrestricted redistribution for operational use. There are ongoing activities, no specific issues reported.

Item 3.5 "...mitigate disasters…": the utilization of existing dissemination systems for disaster mitigation purpose is well established but still has room for expansion. The on-demand Rapid Scanning services of CMA, JMA and KMA are using existing dissemination systems for supporting disaster preparedness.

Item 3.6 "...ocean user community..": the future mechanism for structured dialogue between CGMS and the ocean community is still to be defined. Will be discussed in the Ocean session at the CGMS-50, after which concrete actions can be defined by WGIV.

Item 3.8 "...satellite identifiers…" addressed in WGI TG on Satellite Data and Codes. Proposed to move to WGI.

CGMS-50-CGMS-WP-26WGIV: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2022-2026

As part of the agreed revision cycle for the CGMS High Level Priority Plan, CGMS Secretariat presented a proposed HLPP covering the period 2022-26. The plan is based on the following intersessional activities:

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

12 Future WGIV sessions

CGMS-50-CGMS-WP-19WGIV: Nominations and representatives at meetings (CGMS, ISWGs, VLAB - Co-chairs and rapporteurs)

CGMS members are invited to nominate candidates for co-chair and rapporteur positions (or upcoming positions) as necessary and to inform cgmssec@eumetsat.int accordingly. Further the CGMS-50 working groups are requested to secure the nomination of candidates as far as is possible for recommendation to plenary for endorsement.

WGIV supported the nomination of Natalia Donoho (NOAA) and Simon Elliott (EUMETSAT) as WGIV Co-Rapporteurs. WGIV recommended to Plenary to endorse the new WGIV Rapporteurs.

CGMS-50 actions - WGIV					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WGIV	§12	WGIV/A50.03	WGIV recommends Plenary to endorse Natalia Donoho (NOAA) and Simon Elliott (EUMETSAT) as WGIV co-rapporteurs.	CGMS-50 Plenary	**OPEN**

CGMS-50-WGIV-WP-02: Decision on dates of inter-sessional activities/meetings in 2022-2023 [CGMS-51 to CGMS-52]

The following intersessional meetings via WebEx were agreed:

- Intersessional #1, Thursday 29 September 2022 at 13 UTC
- Intersessional #2, Thursday 26 January 2023 at 12 UTC
- Intersessional #3, Thursday 23 March 2023 at 12 UT

CGMS-50-WGIV-WP-03: Future CGMS WGIV plenary sessions

JMA will host the CGMS-51 plenary session. Should the CGMS-51 plenary session need to be virtual, it was agreed to hold CGMS-51 WGIV session on 27-28 April 2023.

13 Any other business

There was no other business discussed.

STATUS OF WGIV CGMS-49 ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
WGIV	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.	WGIV Apr 2022: needs update after IPWG meeting in June 2022. Due to potential schedule conflict this may not be possible until after CGMS-50 plenary 2022 18 Jan: needs an update from WGII and is still open waiting for input from the IPWG 2021 9 Nov: await the work from WGII on (WGII49.??) , then follow up CGMS-49: A common minimum baseline for Level-2 products generated from geostationary imagery data is proposed in CGMS-49-WMO-WP-14 2021 2 Feb: On hold 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 satellites, however:	CGMS-50 (CGMS-49)	ONGOING

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				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.		

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CMA, EUMETSAT	WGIV/3	WGIV/A48.01	To report on the status of data dissemination from Indian Ocean Data Coverage partners, as identified in CGMS-43-EUM-14 roadmap	WGIV Apr 2022: EUMETSAT verbally summarised the ongoing MET8→ MET9 transition. MET9 will operate at 40.5E. MET9 will become EUMETSAT primary IODC satellite from 01 Jun 2022 and will operate in parallel with MET8 until 01 Jul 2022 , at which point MET8 will stop. EUMETSAT confirmed that although there is a 4 degree longitude difference, the EUMETCast dissemination and data policy will not change. CMA stated that its Indian Ocean Data Coverage support remains unchanged, and is based upon FY-2H at 79E. EUMETSAT will present a summary report at a WGIV intersessional meeting before CGMS-51 2022 29 Apr: EUMETSAT to provide updates - proposed to close 2022 18 Jan: Ongoing CGMS-49: several related WP CGMS-49-CMA-WP-12, CGMS-49-ISRO-WP-01, CGMS-49-EUMETSAT-WP-10 EUMETSAT will compile a consolidated report summarising the status, taking into account changes in data access and data policy	CGMS-51	ONGOING

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				2021 2 Feb: Report to be provided to CGMS-49		
Satellite Operators	WGIV/ 8	WGIV/ A48.02	To provide focal points for WIS Metadata to 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.	2022 4 Feb: Closed. NOAA has named Paul Lemieux (NCEI) as Task Group on Metadata member. The Group held a kickoff meeting on February 17, 2022 2022 18 Jan: Candidate for closure. 2021 9 Nov: agreed to re-establish task team on metadata and include this topic in the discussions in the context of WIS 2.0 CGMS-49: status see below 2021 2 Feb: No feedback to date. CGMS agencies are requested to provide points of contact Pocs: NOAA: tbd (being addressed) EUMETSAT: Guillaume.Aubert@eumetsat.int	? (Nov 2021, Dec 2020)	CLOSED
CGMS members	WGIV/ 9	WGIV/ A48.04	CGMS members active in VLab to nominate the next Co-Chair to represent CGMS satellite operators in the VLab (starting October 2020). Nominations to be	NOAA nominated Ms Bernadette Connell to the position of the VLab Co-Chair. This was recommended to plenary by WGIV and CGMS-49 plenary endorsed this.	Aug 2020	CLOSED

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
			presented to VLab during CGMS-48 plenary.			
CGMS members	WGIV/ 9	WGIV/ A48.06	CGMS members active in VLab to send representation to participate in the Tenth VLab Management Group Meeting (VLMG-10) to be held in Darmstadt, Germany, 13-17 September 2021.	2022 29 Apr: close - look forward to nomination 2022 11 Apr: Mark Higgins has confirmed that EUMETSAT will be hosting the VLMG meeting in 26-30 September 2022 in Darmstadt (in person). 2021 Sept: Meeting postponed (due to Covid), tentatively to be hosted by EUMETSAT in 2022 2021 2 Feb: Open	CGMS-50 (Feb 2021)	CLOSED
CGMS members	WGIV/ 17	WGIV/ A48.08	To provide a point of contact for participation in regular inter-sessional teleconferences to convert identified WGIV recommendations into Best Practises.	WGIV Apr 2022: Suggestion made to exploit existing group used for review of user readiness 2022 11 Apr: NOAA has named Vanessa Escobar, Jason Taylor, Satya Kalluri as Task Group on User Readiness members. Task Group has not yet started. Plan to hold an initial organizational meeting prior to CGMS 50 2022 7 Feb: Email sent from CGMS Sec	CGMS-50	OPEN

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				seeking nominations for TG-UR by 28/02/2022 2022 18 Jan: Task group on user readiness 2021 9 Nov: dedicated task teams agreed to be established per topic and recommendations to be addressed there CGMS-49: will be addressed in intersessional meetings, starting 15 Sep 2021 2021 2 Feb: CGMS members to provide pocs ISRO: Nitant Dube (nitant@sac.isro.gov.in)		
WMO + EUM (CGMS space agencies)	WGIV/	WGIV/ A48.09	Noting the recent conclusions of the WMO IPET-DRMM and the concurrence expressed in CGMS WG III, WMO is encouraged to add the satellite 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 and WGIII/A47.05 and discussions at CGMS-48 WGIII, May 2020)	2022 11 Apr: Ongoing. To be clarified if OSCAR update is in progress (WMO) 2022 4 Feb: deadline changed to CGMS-50 (for CCT- C8) 2022 18 Jan: Wait until WIGOS Station Identifier discussions re CCT C-5 are concluded before addressing C-5 in OSCAR. Action can be addressed for CCT-C8 2021 9 Nov: not yet implemented (WMO) 2021 27 Apr: WMO to confirm 2021 22 Feb: EUMETSAT has addressed this with WMO. To be incorporated in the	CGMS-51 CGMS-49 (CGMS-48)	OPEN

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				OSCAR space database. Action recommended for closure. 2020 May 29: Action transferred to WGIV (lead EUM/Simon.Elliott@eumetsat.int). 2020 Feb 19: WMO now focuses on the NWP station identifiers.		
Satellite operators who launched new satellites since 2016	WGIV/ 2	WGIV/ A49.01	To provide updates for WMO "Guidelines on Best Practices for Achieving User Readiness for New Meteorological Satellites" https://library.wmo.int/doc_num.php?explnum_id=3553	2022 29 Apr: work is ongoing: ET-SSU and CGMS WG IV (to be endorsed by CGMS-51) 2022 11 Apr: To be addressed by the Task Group on User Readiness once established 2022 1 Mar: NOAA representatives: vanessa.escobar@noaa.gov; Jason.Taylor@noaa.gov; Satya.Kalluri@noaa.gov 2022 7 Feb: To be addressed by TG-UR (see action A48.08) 2022 18 Jan: Needs updating based on new satellite launch dates 2021 9 Nov: will be a key subject for the new task team on user readiness Relevant agencies: JMA, NOAA, EUMETSAT, KMA, CMA, IMD, ROSHYDROMET	CGMS-51	ONGOING

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CGMS Task Force on Satellite Data and Codes, WMO	WGIV/ 5	WGIV/ A49.02	The CGMS Task Force on Satellite Data and Codes to work closely with WMO on addressing the following points: i. Linking between OSCAR/Space and the WSI and/or CCT C-5 identifiers (WMO internal) ii. Potential extension of the use of the Issue Number in the WSI for satellites in order to explicitly indicate metadata which are otherwise only implicitly embedded in the Local Identifier (CGMS-50) iii. Identification of when and how the WSI should be included in the satellite products exchanges in the context of the WIGOS (CGMS-50) (ref CGMS-49-WMO-WP-08)	2022 11 Apr: Moved to WGI. To be discussed with WMO (Simon, Chair, to follow up). WMO will first complete the ongoing WSI for satellites design and documentation in WIGOS Guide and its implementation in OSCAR/Space. CCT-C5 will be tentatively covered by that work. 2022 18 Jan: WMO to address latest on 27 October, ongoing work, done through WGI	CGMS-50	CLOSED
CGMS members	WGIV/ 6	WGIV/ A49.03	To participate in the next EOTEC DevNet regional discussions planned in June, held online across time zones. Invitation will be sent to WGIV members by CGMS	2022 31 Jan: Email from Nancy Searby (NOAA) to Zoya (WMO) confirming they will give a presentation. Action closed (see also https://ceos.org/ourwork/other-ceos-activities/eotec-devnet/)	July 2021	CLOSED

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
			secretariat. (ref CGMS-49-CEOS-WP-01)	2022 18 Jan: No update but will be covered by the EOT DevNet item on the agenda. 2021 9 Nov: wider participation is welcome, proposed to create a recommendation for ongoing meetings, WGIV members to provide feedback at next plenary meeting 2021 15 Sep: WMO circulated on WGIV list server: As noted during the discussion at WGIV, EOTEC_DevNet is also reaching out to the regions (which in this case is not quite the same as the WMO Regional Associations). They are currently organising the next regional events on 21 September as follows: • Asia/Oceania: 8am EDT / 12pm UTC • Europe: 9:30am EDT / 1:30pm UTC • Africa: 11am EDT / 3pm UTC • Americas: 1pm EDT / 5pm UTC Additional information and registration link for the regional meetings are available on CEOS website The are also looking for candidates to lead or co-lead the EOTEC DevNet regional communities of practice in between the meetings. Please inform		

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				kholmlund@wmo.int if you know of interested candidates.		
CGMS members	WGIV/ 8	WGIV/ A49.04	to propose a candidate for the TFMI chair.	2022 29 Apr: no much progress 2022 4 Feb: To be addressed at TG-M KOM on 17 Feb 2022 - outcome? 2022 18 Jan: No progress 2021 9 Nov: will be address as part of (re-) establishing the Task Group on MetaData, and other Task Groups	CGMS-50	OPEN
CGMS members	WGIV/ 18	WGIV/ A49.05	to propose a candidate for WGIV rapporteur	2022 Jan: Acting until decision made at CGMS-50 NOAA: Natalia Donoho EUM: Simon Elliott	CGMS-50	CLOSED
CGMS space agencies	4.1	(R49.0 2)	Transferred from CGMS-49 plenary When pursuing data purchasing, CGMS recommends CGMS space agencies to consider an option for redistributing data to global NWP centres	2022 11 Apr: NOAA is currently distributing the Radio Occultation data we are purchasing under our current delivery order to National Meteorological and Hydrological Centers for non-commercial use WGIV to consider adding this to the WGIV CGMS-50 agenda. WGIV to collect input from CGMS space agencies on the data buy redistribution options to global NWP centres by end 2021.	CGMS-50	OPEN

Status of WGIV CGMS-49 actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				Feedback to WGIV to WGIII on the baseline/risk assessment (Feb 2022) for inclusion or not - TBD.		
Plenary	2	(WGIIR 49.)	Transferred from CGMS-49 WGII and plenary Working Group II recommends to CGMS Plenary the adoption of the proposed baseline products presented in CGMS-49-WMO-WP-14 with the addition of SSTs, to be considered for subsequent implementation by all Agencies.	2022 18 Jan: 2021 9 Nov: await the work from WGII, then follow up Endorsed by CGMS-49 plenary. WGII/Ken to send to WGIII and WGIV relevant parts of WGII report. Action to WGIII to update the baseline accordingly. (WGII action to WGIV on related redistribution mechanisms).	CGMS-50	OPEN

Status of CGMS-49 WGIV recommendations following CGMS-50				
Lead	AGN item	Rec #	Description	Recommendation feedback/closing document
CGMS members	2	WGIV/R49.01	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]	2022 11 Apr: NOAA: To be addressed by the Task Group on User Readiness once established 2021 9 Nov: to be addressed by the Task Group on User Readiness once established To be converted into a good practice document.
CGMS members	12	WGIV/R49.02	The WGIV Cyber Security Expert Group welcomes any other members who are not yet represented in the group, and to propose new security related topics to be addressed by the group	2022 11 Apr: NOAA: So far the cyber security group met only once, for establishing the terms of reference. They should have met in December 2021; however, the attendance was too low and all experts were busy. 2021 9 Nov: standing recommendation to support Task Group, outreach to be addressed
CGMS members	12	WGIV/R49.03	The Cloud Expert Group welcomes any other members who are adopting cloud services to discuss best practices, exchange information, and identify emerging coordination opportunities.	2022 11 Apr: NOAA: Ongoing 2021 9 Nov: standing recommendation to support Task Group, outreach is planned via a flyer by end of November
CGMS members	WGIV/ (PI 9.1)	WGIV/R48.01 (PI R47.10)	On training and education: 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	2022 11 Apr: NOAA: WMO has confirmed that NOAA contributed to the Trust Fund and the money was transferred in December 2021.

				2020 Aug: Transferred to WGIV 2020 May CGMS-48 WG discussions: VLab will in future be addressed in WGIV, user preparedness. The plenary recommendation is critical! 2020 Jan 22, CGMSSEC IS#2: To be addressed within the framework of Vlab, WMO, CGMSSEC plus communication to CGMS agencies
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	2022 11 Apr: NOAA: To be addressed by the Task Group on Metadata once established 2021 9 Nov: to be addressed by the Task Group on MetaData once re-established CGMS-48: to be converted into Best Practise by IS sub-group (NOAA: NCEI? See also WGIV/A48.02) 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.	2022 18 Jan: 2021 9 Nov: to be addressed by the Task Group on Data Access/Exchange once established 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 members	WGIV/6	new recommend-ation	On training and education: CGMS members to participate in the EOTEC DevNet regional discussions planned in the future, held online across time zone". Information for the upcoming regional meetings is available at https://ceos.org/ourwork/other-ceos-activities/eotec-devnet/ and more	2022 18 Jan: 2021 9 Nov: WGIV proposed to create a recommendation for ongoing meetings, to

			detailed information for the most recent regional meetings at https://ceos.org/meetings/eotec-devnet-regional-meetings/.	strengthen cooperation between CEOS and CGMS-WMO VLab communities.

STATUS OF WGIV ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

CGMS-50 WGIV actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
WGIV	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.	WGIV Apr 2022: needs update after IPWG meeting in June 2022. Due to potential schedule conflict this may not be possible until after CGMS-50 plenary 2022 18 Jan: needs an update from WGII and is still open waiting for input from the IPWG	CGMS-50 (CGMS-49)	ONGOING

CGMS-50 WGIV actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CMA, EUMETSAT	WGIV/3	WGIV/A48.01	To report on the status of data dissemination from Indian Ocean Data Coverage partners, as identified in CGMS-43-EUM-14 roadmap	WGIV Apr 2022: EUMETSAT verbally summarised the ongoing MET8→ MET9 transition. MET9 will operate at 40.5E. MET9 will become EUMETSAT primary IODC satellite from 01 Jun 2022 and will operate in parallel with MET8 until 01 Jul 2022 , at which point MET8 will stop. EUMETSAT confirmed that although there is a 4 degree longitude difference, the EUMETCast dissemination and data policy will not change. CMA stated that its Indian Ocean Data Coverage support remains unchanged, and is based upon FY-2H at 79E. EUMETSAT will present a summary report at a WGIV intersessional meeting before CGMS-51	CGMS-51	ONGOING
CGMS members	WGIV/17	WGIV/A48.08	To provide a point of contact for participation in regular inter-sessional teleconferences to convert identified WGIV recommendations into Best Practises.	WGIV Apr 2022: Suggestion made to exploit existing group used for review of user readiness	CGMS-50	OPEN

CGMS-50 WGIV actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
WMO + EUM (CGMS space agencies)	WGIV/	WGIV/ A48.09	Noting the recent conclusions of the WMO IPET-DRMM and the concurrence expressed in CGMS WG III, WMO is encouraged to add the satellite 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 and WGIII/A47.05 and discussions at CGMS-48 WGIII, May 2020)	2022 11 Apr: Ongoing. To be clarified if OSCAR update is in progress (WMO)	CGMS-51 CGMS-49 (CGMS-48)	OPEN

CGMS-50 WGIV actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
Satellite operators who launched new satellites since 2016	WGIV/ 2	WGIV/ A49.01	To provide updates for WMO "Guidelines on Best Practices for Achieving User Readiness for New Meteorological Satellites" https://library.wmo.int/doc_num.php?explnum_id=3553	2022 29 Apr: work is ongoing: ET-SSU and CGMS WG IV (to be endorsed by CGMS-51) 2022 11 Apr: To be addressed by the Task Group on User Readiness once established 2022 1 Mar: NOAA representatives: vanessa.escobar@noaa.gov; Jason.Taylor@noaa.gov; Satya.Kalluri@noaa.gov 2022 7 Feb: To be addressed by TG-UR (see action A48.08) 2022 18 Jan: Needs updating based on new satellite launch dates 2021 9 Nov: will be a key subject for the new task team on user readiness Relevant agencies: JMA, NOAA, EUMETSAT, KMA, CMA, IMD, ROSHYDROMET	CGMS-51	ONGOING
CGMS members	WGIV/ 8	WGIV/ A49.04	to propose a candidate for the TFMI chair.	2022 29 Apr: no progress 2022 4 Feb: To be addressed at TG-M KOM on 17 Feb 2022 - outcome?	CGMS-50	OPEN

CGMS-50 WGIV actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CGMS space agencies	4.1	(R49.02)	Transferred from CGMS-49 plenary When pursuing data purchasing, CGMS recommends CGMS space agencies to consider an option for redistributing data to global NWP centres	2022 11 Apr: NOAA is currently distributing the Radio Occultation data we are purchasing under our current delivery order to National Meteorological and Hydrological Centers for non-commercial use WGIV to consider adding this to the WGIV CGMS-50 agenda. WGIV to collect input from CGMS space agencies on the data buy redistribution options to global NWP centres by end 2021. Feedback to WGIV to WGIII on the baseline/risk assessment (Feb 2022) for inclusion or not - TBD.	CGMS-50	OPEN

CGMS-50 WGIV actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
Plenary	2	(WGIIR 49.)	Transferred from CGMS-49 WGII and plenary Working Group II recommends to CGMS Plenary the adoption of the proposed baseline products for geostationary satellites presented in CGMS-49-WMO-WP-14 with the addition of SSTs, to be considered for subsequent implementation by all Agencies.		CGMS-50	OPEN
CGMS members	WGIV/ 16	A47.06	CGMS members, through WGIV, to review CGMS members' adherence levels to the CEOS Data Preservation Guidelines on a regular basis (every 2-5 years). For review at CGMS in the 2023-2024 timeframe.		2023-2024	
			The Terms of Reference of the CGMS Working Groups to be reviewed every 5 years. WGIV to review its ToRs in 2023.		2023	OPEN

CGMS-50 WGIV actions and recommendations following CGMS-50						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CGMS Members	§3.4	WGIV/ A50.01	CGMS members continue to foster the growth of EOTEC DevNet by, for example: joining the CoPs, identifying other experts for the CoPs, contributing to EOTEC DevNet products, and sharing EOTEC DevNet information within their network.		CGMS 51	OPEN
CGMS Sec and CEOSS WGISS	§4.3	WGIV/ A50.02	WGISS and WGIV to hold a joint meeting to discuss modalities and areas of common activities between WGISS and WGIV. This should include a report on the implementation of the adopted guidelines.		CGMS 51	OPEN
WGIV	§12	WGIV/ A50.03	WGIV recommends Plenary to endorse Natalia Donoho (NOAA) and Simon Elliott (EUMETSAT) as WGIV co-rapporteurs.		CGMS 50 Plenray	OPEN

ACTIONS RESULTING FROM CGMS-50 PLENARY DISCUSSIONS TO BE MONITORED AND MANAGED BY WGIV:

CGMS-50 actions - Plenary Session – For WGIV to monitor and manage				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
CGMS members	6	WGIV/(P)A50.01	(Action to be monitored by WGIV) CGMS members are invited to contact WMO to 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-51

CGMS-50 WGIV recommendations				
Lead	AGN item	Rec #	Description	Recommendation feedback/closing document
CGMS Plenary	§4.3	WGIV/R50.01	CGMS WGIV recommends to the Plenary Session of CGMS 50 to suspend the activities of the Task Group on Cyber Security, and to revisit the role of the Task Group for CGMS 52.	
WGIV Cloud Service Expert Group	§4.3	WGIV/R50.02	WG IV recommends that Cloud Service Workshops are organised on an annual basis, the schedule being shortened to take advantage of the consequent recurrence.	

(SWCG)

Space Weather Coordination Group

50 YEARS 1972–2022

CGMS

SWCG report

Co-chairs: Tsutomu Nagatsuma (NICT/JMA), Elsayed Talaat (NOAA)
Rapporteur: Andrew Monham (EUMETSAT)

1. Welcome, objectives and review of the agenda

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. 3rd CGMS risk assessment and baseline update: Status and outcome of the 3rd CGMS risk assessment

CGMS-50-WGIII-WP-02: Status and outcome of the 3rd CGMS risk assessment

CGMS-50-CGMS-WP-07SWCG: CGMS Baseline – draft revision following the 3rd risk assessment workshop

Elsayed Talaat summarised the key space weather related points from the 3rd CGMS risk assessment workshop, held 22-24 February 2022 and the related updates to the CGMS Baseline

The main risk continues to be the continuity of Coronagraph sensors, there is an increasing risk of a gap until GOES-U and SWFO-L1 are launched, as SOHO is operating well beyond its design lifetime. NOAA should review additional ground resources needed to track STEREO-A and PUNCH to provide additional coverage in the near-term in case of unavailability of SOHO data.

The categorisation of particle sensors into different energy ranges has now been integrated into the risk analysis, including definition of GEO ring slots.

Elsayed also summarised the key points from the corresponding draft revision of the CGMS Baseline. The 'Baseline' constitutes the commitments and plans of CGMS members to provide particular observations and services. CGMS members plan to maintain the capabilities and services described below to support the global observing system. This document will remain consistent with the principles of the WMO Integrated Global Observing System (WIGOS) Vision and the WIGOS Vision serves as important input in the development of CGMS members' plans.

Of particular note were the changes introduced to cover the possibility of hosted payloads (as already being implemented for space weather energetic particle measurements by ESA) and the split of energetic particle energy ranges and identification of GEO orbital ranges.

The text was reviewed in the SWCG meeting, in order to conclude on a final text for endorsement by CGMS-50 plenary on 15-17 June 2022. Following the CGMS-50 working group discussions, CGMS members are requested to recommend the revision of the CGMS baseline to CGMS-50 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).

WGIII has included an action on NOAA to review additional ground resources needed to track STEREO-A and PUNCH to provide additional coverage in the near-term in case of unavailability of SOHO data.

3. Update on space-based observational capabilities

CGMS-50-CMA-WP-08: CMA update on FENGYUN satellite SWx sensors

J.Guo summarised the space weather sensors deployed on the latest Fengyun satellites FY-3E and FY-4B, both launched in 2021, with details of their performance specifications. The FY-3E satellite carries the Solar X-EUVI X-Ray and EUV Imager, which is the first Chinese space-based solar telescope. Also embarked are the Ionospheric PhotoMeter (IPM) and Space Environment Monitor. The FY-4B satellite carries the Particles and FGM instrument. An example of a coordinated observation of a November 2021 solar storm event from the two satellites is provided.

The SWCG expressed interest in access to the data and to perform data comparisons and inter-calibrations.

CGMS-50-ESA-WP-04: ESA Vigil (L5) and D3S missions update

J. Pekka-Luntama summarised the latest status of the ESA space weather missions. It was noted that the mission to Lagrange Point 5 (L5), previously known as “Lagrange” has been renamed to “Vigil” and is planned for launch in 2028. This is expected be the first of a series of operational missions to ensure continuity of observations from L5. In order to save cost and improve the likelihood of programme approval at the Ministerial Council in 2022, a rebaselining of the payload has been conducted in coordination with the Mission Advisory Group, taking into account the primary objectives and priorities. The paper contains a full description of the revised proposed baseline. It is also to be noted that instrument exchange has been agreed with NOAA (XFM provided for L1 SWFO and NOAA’s CCOR to be provided for Vigil. Discussions are also ongoing with NASA concerning an EUV imager.

Further ESA space weather mission activities include:

- hosting several space weather sensors on third party agency and commercial platforms
- A SSTL nanosat constellation under definition to monitor the magnetosphere, ionosphere and thermosphere
- A smallSat mission under definition for Auroral oval monitoring: “Aurora”
- A Nanosatellite Community Challenge inviting proposals for space weather monitoring from which 5 will be selected for further definition. Commercial launch opportunities are being considered.

SWCG discussion highlighted the need for missions to allow adequate time for preparation of data ingestion by service providers. ESA noted that the first two SSTL nanosats will be a demonstration which should then be increased to 6 satellites with a replacement strategy to keep an operational service.

CGMS-50-KMA-WP-05: KMA Report on the update of space weather activities

J.Kim described the update for KMA's space weather activities. The inter-comparison of GK2A KSEM PD data with GOES-16 MPS-HI and Himawari-8 SEDA were carried out. The result shows that KSEM PD data is well correlated with them. KMA will actively participate in the inter-calibration activities by the SWCG Inter-Calibration Task Group. And KMA has a plan to develop a new space weather payload to be equipped on the GK2A Follow-on satellite. New sensors such as particle detector, magnetometer, and X-ray monitor are considered to be included in the payload

CGMS-50-NOAA-WP-12: NOAA Space Weather Observations Update

Elsayed Talaat summarised the status and planning of NOAA/NESDIS space weather observations:

- GOES-18 Operational
- First Compact CORonagraph (CCOR) integrated on GOES-U
- SWFO-L1 development on track for rideshare with NASA IMAP mission
- Established agreement with ESA on data sharing, potential ground-station and instrument cooperation
- COSMIC-2 space weather products available and TEC latency objective met
- NOAA establishing Space Weather Next Program to implement next generation space weather observations
- NOAA is planning to issue an RFP for commercial space weather data

4. Updates on space-weather activities

CGMS-50-ESA-WP-02: ESA space weather service network: progress and next steps

J.Pekka-Luntama introdcued the latest status of the ESA space weather service network which now has 29 pre-operational services based on >200 products supporting >50 Expert Groups and > 2200 registered users. Enhancements to ground-based sensor systems are on-going and refinements and validation activities are on-going to provide readiness for transition into operational framework, including:

- R2O and O2R environment enhancement
- Service scope and concept evolution
- End-to-end space weather modelling

CGMS-50-NASA-WP-01: NASA Space Weather Activities

Jim Spann presented the NASA space weather update, introducing the NASA Space Weather Strategy Vision, Mission and Supporting Implementation Pillars.

NASA supports space weather research through the Heliophysics Division. One of the Division's objectives is to understand the Sun and its interactions with the Earth, and the solar system, including space weather. Mapping out this interconnected system requires a holistic study of the Sun's influence

on space, Earth and other planets. NASA has a fleet of spacecraft strategically placed throughout our heliosphere. These include the Parker Solar Probe and Solar Orbiter orbiting the Sun and observing the very start of the solar wind, to satellites around Earth such as MMS investigating the fundamental processes of magnetic reconnection that drive the explosive accelerations that cause space weather and GOLD and ICON that observe the impacts of space weather near Earth, to Voyager, the farthest human-made object, which is sending back observations on interstellar space. Each mission is positioned at a critical, well-thought out vantage point to observe and understand the flow of energy and particles throughout the solar system.

Recent Accomplishments include:

- NASA space weather strategy and implementation plan
- NOAA and DoD Framework to transition NASA research, techniques and technology relevant to space weather operations
- NSF-NASA Space Weather Quantification of Uncertainty grant solicitation
- Research to Operations to Research (R2O2R) grant solicitation
- Additional Transition Step for efforts that show promise to use in an operational space weat her environment at NOAA or DoD
- HERMES instrument package in support of Gateway and Artemis and space weather confirm ed for flight – 1/27/2022
- In Nov. 2021, HPD announced the selection of eight Cubesats within the HFORT 2019/HFOR T 2020 ROSES elements.
- Completed Space Weather Science Gap Analysis, managed by APL.

On-going and future activities are listed, including the interaction with international partners on future collaborations (e.g. ESA Vigil, CSA AOM, ESA Daedalus, KASI SNIPE, ISRO Aditya) and the multi-agency (DoD/NOAA/NSF/NASA) effort on R2O2R activities.

Gateway and the Artemis Program: The NASA space weather instrument suite, led by HPD, will observe solar particles and the solar wind. The Paper details the science goals and objectives. The second scientific investigation is a radiation instrument package, built by the European Space Agency:

- NASA Suite: HERMES (Heliophysics Environmental and Radiation Measurement Experiment Suite)
- ESA Suite: ERSA (ESA Radiation Sensors Array)

CGMS-50-NICT-WP-01: NICT Space Weather Activities

T. Nagatsuma presented that the NICT Space Environment Laboratory routinely operate space weather services on 24/7 bases as a part of ICAO's global centers, ACFJ. The operational space weather information is also provided to domestic users. Domestic alert level of space weather has been reviewed and summarized with considering the magnitude of the social impact. SECURES (Space Environment Customized Risk Estimation for Satellite) are updated based on requests from satellite operators. For operational space environment monitoring at Japanese meridian of geostationary orbit, we have started developing engineering model of new space weather sensors, CHARMS (Charging And Radiation Monitors for Space weather)

CGMS-50-NOAA-WP-13: NOAA Space Weather Activities

Brent Gordon of SWPC began with an update on space weather activity. Since CGMS-49, Solar Cycle 25 has continued to make its presence known. We have already had 5 X-class X-ray events since July 2021. There have been three 100 MeV proton events, 28 geomagnetic storms of G1 (Kp=5) or greater, and SWPC has issued over 500 Watches, Warnings, Alerts, and Summaries in the past six months alone. Solar Cycle 25 progressing more rapidly than the consensus forecast. We are already seeing impacts from the early stages of this solar cycle. A prolonged low-level geomagnetic storm in early February led to the loss of 39 Starlink spacecraft. SWPC has been working closely with SpaceX to better understand this storm and how it impacted them. We really appreciate SpaceX's willingness to share the details on this. This has been quite a refreshing change from the satellite industry. SWPC continues to expand its base mission, with a newly signed agreement with NASA, SWPC will be increasing its support to the NASA Human Exploration and Operations (HEO) Mission Directorate. SWPC also continues to build an in-house and distributed capability that will drastically enhance the rate of transfer of operations ready Research into Operations. This includes new and enhanced Observations, Models, applications, and forecast techniques. Later this year, we plan to host what we are terming a testbed experiment where industry, researchers, and forecasters will get together to discuss our new ICAO mission products Finally, SWPC continues to move forward with several modeling enhancements as well. These are all driven, and improved by the satellite-based observations our partners in CGMS provide.

CGMS-50-WMO-WP-10: WMO Space Weather Activities

The document provides of the WMO Space Weather activities which are based on the Four-year Plan for WMO's Coordination of Space Weather Activities 2020 – 2023 (FYP2020-23). WMO will be cooperating with ISES and COSPAR to improve international coordination of Space Weather activities. WMO has established an Expert Team on Space Weather (ET-SWx) with a broader mandate than the predecessing Inter-Programme Team on Space Weather Information, Systems and Services (IPT-SWeISS). WMO is preparing the establishment of core satellite data for Space Weather following the new WMO Unified Policy for the International Exchange of Earth System Data (Res. 1).

Elsayed Talaat, as Co-Chair of CGMS SWCG is proposed in the list of Ex-officio members on the Expert Team on Space Weather.

5. International space weather data user activities

CGMS-50-GUEST-WP-01: Status update of the International Space Environment Service (ISES)

Jesse Andries, ISES Director, introduced the mission of ISES:

- to deliver, coordinate and improve operational space weather services.
- This is accomplished through the rapid exchange of space environment information; the sharing of best practices for data analysis and product development; and the open dissemination of products and services.
- ISES is organized and operated for the benefit of the international space weather user community.

- Formal mutual support Letters established between ISES and the World Meteorological Organisation (WMO) 2014-2015.

ISES is growing to 21 RWC (Regional Warning Centres): Argentina, Australia, Austria, Belgium, Brazil, Canada, China, Czech Republic, Finland, India, Indonesia, Japan, Korea, Mexico, Norway, Poland, Russia, South Africa, Sweden, United Kingdom, United states (an application for 22nd member is currently being processed)

- Endorsed by National Governments as Space Weather Service Providers
- 1 CEC (Collaborative Expert Centres): European Space Agency (ESA) + 4-5 AWCs (Associated Warning Centres)

Current activities include actions on data exchange:

- Cataloguing products and services from all centres
- Collect metadata to aid discoverability and access
- Provide access (through website)
- Cross centre standardisation of products and product-formats (e.g. probabilistic flare forecast)

And actions on best practices:

- Improve communication (means) between OPS-centres (i.e. to support consolidation of Extreme Event response)
- Verification and validation - Many forecast verification studies were sparked by the 2015 ISES verification workshop.

As a core entity of operational space weather organisations, ISES remains committed to supporting international entities, UN/COPUOS, WMO, ITU, ICAO, ISWI and ISO, as well as CGMS.

- It is noted there is a lot of overlap and many of the same people supporting these groups.
- ISES stress need for rationalisation and better coordination between those efforts.

In discussion, WMO noted that the Terms of Reference of the Expert Team on Space Weather is also going to address the rationalisation of activities amongst the various space weather groups.

CGMS-50-ESA-WP-03: Space Traffic coordination needs for space weather inputs

J. Pekka-Luntama explained that the Space Weather services requirements for Space Surveillance and Tracking have been taken into account from the start of the Space Situational Awareness Programme. Targeted end users comprise:

- Personnel involved in the Space Surveillance and Tracking operation of SSA system
- Collision warning services
- Re-entry risk assessment services
- Spacecraft operators

Related services in the ESA Space Weather Portal comprise:

- Atmospheric Estimates for Drag Calculation
- Forecast of geomagnetic and solar indices for drag calculation
- Archive of geomagnetic and solar indices for drag calculation
- Nowcast of ionospheric group delay (under development).

Issues to be tackled on the space weather observation and modelling needs are further listed in the paper.

In discussion, it was explained this information is used by the Space Debris Office in ESA for re-entry forecasts and it was noted that error bars for uncontrolled re-entry are very large.

Concerning the latency of drag information, for analysis purposes, a continuous input is required. However, the F10.7 product is a daily average, so varying activity is not well covered by these models. New telescopes will be able to provide measurements every minute, so analysis can be performed whether higher data cadence would be operationally beneficial.

6. OSCAR review for space weather – Completeness and suitability of space weather related content

CGMS-50-WMO-WP-09: Updates on space weather information in OSCAR review for space weather

Heikki Pohjala presented the on-going OSCAR/Space platform development with reference to screenshots from the OSCAR tool, including:

- the WIGOS subcomponent gap analysis,
- the Data latency implementation in response to A49.03

and the Gap analysis process and outcome on space weather was presented, noting:

- WIND, SOHO, DSCOVR, STEREO-A are close to EoL.
- ACE, Aditya and Parker Solar Probe close to EoL in four years' time.
- Most of the sectors covered for the full decade by one or another GEO satellite and Arktika in Molniya orbit

With further remarks as follows:

Orbit	Remarks
L1, L5	The planned NASA SWFO-L1 and the ESA initiative for a satellite at L5 are very important.
Ecliptic	No plan for the NASA STEREO follow-on. Solar NASA Parker Solar Probe and ESA/NASA Solar Orbiter missions, in orbit, are very important contributions.
GEO	NOAA plan for a CCOR coronagraph on GOES is very important
MAG	Concern for missing plans for follow-on missions flying cross the magnetosphere, especially in cluster
LEO	Concern for the lack of information on progress of the planned Roscosmos Ionozond constellation

It was noted in discussion that some of the missions mentioned are not supporting operational services. Also the classification of energetic particle monitoring as "solar wind" should be addressed in coordination with SWCG.

Concerning the Action A49.03, it was highlighted that the CGMS Member agencies need to input this data into OSCAR and there may be differences for different sensors / data types from the same satellite.

CGMS-50 ACTIONS - SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMS Members	SWCG/6	SWCG/A50.	Supply latency information to OSCAR DB with granularity of each relevant space weather sensor on their space missions.	Oct. 2022	**OPEN**

7. Task Group on space weather calibration

CGMS-50-SWCG-WP-07: Task Group Report on Inter-calibration of High Energy Electron Sensor

T. Nagatsuma presented. The roles of task group on intercalibration of high energy electron sensor are how to apply inter-calibration of energetic particle sensor onboard meteorological satellite, discussing standard method of inter-calibration, and considering product using energetic particle sensor data. We keep working for cross calibration using long period (1 year) of data. Data availability (NRT/Archive) is still key issue to be solved for producing space weather products and continuous inter-calibration. Method of NRT calibration is also important for producing NRT products of space weather. The white paper is summarized and submitted to GSICS EP. Although we received several comment to the white paper, more communication between GSICS and TG is necessary to formulate operational framework,

SWCG discussion noted that the SWCG Co-Chairs will be participating in the GSICS Executive session on 10 May where the possibility of a GSICS sub-group on space weather will be discussed. *Post Meeting note: the GSICs sub-group on space weather was confirmed.*

8. Any other business

There was no other business discussed.

9. Review and updating of the HLPP

CGMS-50-CGMS-WP015SWCG: Status of implementation of CGMS High Level Priority Plan (2021-2025)

CGMS-50-CGMS-WP-26SWCG: Proposed update to the CGMS High-Level Priority Plan (HLPP) for the period 2020-2026

SWCG provided inputs for updates to the relevant sections of the HLPP.

10. Future SWCG sessions

CGMS-50-CGMS-WP-19SWCG: Nominations and representatives at meetings (CGMS, ISWGs, VLAB - Co-chairs and rapporteurs)

SWCG noted that there were currently no changes foreseen in the SWCG. The CGMS Secretariat informed SWCG members of the status of nominations and representatives related to CGMS.

CGMS-50-CGMS-WP-16: Decision on dates of inter-sessional activities/meetings in 2022-2023 (CGMS-50 to CGMS-51)

Space Weather Coordination Group

- IS#1: Wednesday 21 September 2022
- IS#2: Wednesday 30 November 2022
- IS#3: Thursday 26 January 2023
- IS#4: Wednesday 22 March 2023

Dates for Task Groups:

- Space Weather Inter-calibration TG (all dates TBD)
- Spacecraft Space Weather Anomaly Database TG (all dates TBD)
- Space Weather Data Access TG (all dates TBD):
    - June / July 2022: Agree on Terms of Reference / Top Level Priorities
    - October 2022: Coordination according to defined priorities
    - December 2022: Coordination according to defined priorities
    - February 2023: Coordination according to defined priorities
    - April 2023: Round-up of progress for CGMS-51 report
- Ionospheric Radio Occultation System Optimisation Task Group
    - TG#1: 29 September
    - Remaining dates TBD.

CGMS-50-CGMS-WP-18: Future CGMS WG plenary sessions

JMA will host the CGMS-51 plenary session in 2023. Should the CGMS-51 plenary session need to be virtual, it was agreed to hold the CGMS-51 SWCG session on 24-25 April 2023.

11. Review of actions/and recommendations

CGMS-50-CGMS-WP-36SWCG: CGMS-49 list of actions and recommendations

Note the tables further below include outcomes on SWCG managed actions from the Joint WGI-WGIV-SWCG meeting from 24 May.

12. Conclusions

Please refer to the plenary report for the conclusions.

STATUS OF SWCG CGMS-49 ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

Actions previously open at CGMS-49 – SWCG (including from Joint Meeting)					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
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-50	**CLOSED**
SWCG	SWCG/7	SWCG/ A48.06	SWCG to fill out the WIGOS Vision Template shown in CGMS-48-WMO-WP-20	July-2020	**CLOSED**
NOAA, NICT, CMA, Roshydromet, ESA	SWCG/6	SWCG/ A48.07	Establish an information exchange with ICAO data service providers to understand requirements on CGMS Members' data delivery mechanisms and formats.	July-2020	**CLOSED**
SWCG	Joint WGI-WG-IV-SWCG/5	SWCG/ A48.08	Follow-up on the User Survey interaction to get more specific information on data formats / availability constraints and check implication of 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 intial interaction (see Simon Elliott Paper EUM-WP-08 in WGI).	July-2020	**CLOSED**
SWCG/WGI	Joint WGI-WG-IV-SWCG/3	SWCG/ A48.11	Space Weather Spacecraft Anomaly Database Task Group:	CGMS-50 (CGMS-49)	**CLOSED**
			• 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 Members	Joint WGI-WG-IV-SWCG/3	SWCG/ A48.13	CGMS members to state their potential interest in leading the prototyping of the Space Weather Spacecraft Anomaly Database	Nov-20	**CLOSED**
NOAA, EUM, CMA, KMA, CGMS Members	Joint WGI-WG-IV-SWCG/4	SWCG/ A48.15	Identify CGMS Members with current or planned RO data provision capability and possibly able to support low latency provision (Step 1 in CGMS-48-EUMETSAT-WP-06)	CGMS-50 (July-2020)	**CLOSED**
SWCG	Joint WGI-WG-IV-SWCG/4	SWCG/ A48.16	Clarify and iterate the high level RO requirements with IROWG & WMO based on the EUMETSAT ROM SAF inputs. (Step 2 in CGMS-48-EUMETSAT-WP-06)	Nov-2020	**CLOSED**
SWCG	Joint WGI-WG-IV-SWCG/4	SWCG/ A48.17	Analyse technical feasibility at RO system, end-to-end level for the identified space systems from Step 1. (Step 3 in CGMS-48-EUMETSAT-WP-06)	CGMS-50 (Feb-2021)	**CLOSED**
NOAA, EUM, CMA, KMA, CGMS Members	Joint WGI-WG-IV-SWCG/4	SWCG/ A48.18	CGMS Members operating the RO instruments to respond to requirements according to agreed System Concept (req. acceptance / implementation). (Steps 4,5 in CGMS-48-EUMETSAT-WP-06).	CGMS-50 (CGMS-49)	**CLOSED**
SWCG	SWCG/2	SWCG/ A49.01	Review the RO Capability Table and add to CGMS website for configuration control and confirm content in OSCAR.	Oct. 2021	**CLOSED**
EUMETSAT	SWCG/3	SWCG/ A49.02	EUMETSAT to request expression of interest from SWCG and ISES for the possible Metop GRAS RO TEC product	Sept. 2021	**CLOSED**
SWCG	SWCG/6	SWCG/ A49.03	Propose improvements to the space weather parameters in the OSCAR DB with respect to energetic particle energy ranges and review WMO approach to highlighting data latency.	Nov. 2021	**CLOSED**
SWCG	SWCG/6	SWCG/ A49.04	Check content of OSCAR/Space and populate with the missing information on quarterly basis	July 2022	**OPEN**

SWCG (Anomaly TG)	Joint WGI-WG-IV-SWCG/3	SWCG/ A49.05	Poll CGMS Members on reasons for sparse anomaly data supply to CGMS.	CGMS-50	**OPEN**

STATUS OF SWCG ACTIONS AND RECOMMENDATIONS FOLLOWING CGMS-50 DISCUSSIONS

SWCG CGMS-50 ACTIONS AND RECOMMENDATIONS (Including from Joint Meeting)					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
SWCG	SWCG/6	SWCG/ A49.04	Check content of OSCAR/Space and populate with the missing information on quarterly basis	July 2022	**OPEN**
SWCG (Anomaly TG)	Joint WGI-WG-IV-SWCG/3	SWCG/ A49.05	Poll CGMS Members on reasons for sparse anomaly data supply to CGMS.	CGMS-50	**OPEN**
CGMS Members	SWCG/6	SWCG/ A50.01	Supply latency information to OSCAR DB with granularity of each relevant space weather sensor on their space missions.	Oct. 2022	**OPEN**
SWCG (Anomaly TG)	Joint WGI-WG-IV-SWCG/3	SWCG/ A50.02	Task Group on Improving User Data Access to Space Weather Data from Orbital Sensors to identify work priorities and report on achievements	CGMS-51	**OPEN**
SWCG (RO TG)	Joint WGI-WG-IV-SWCG/4	SWCG/ A50.03	Establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring	CGMS-51	**OPEN**
SWCG (Data Access TG)	Joint WGI-WG-IV-SWCG/5	SWCG/ A50.04	TG to Review Terms of Reference to: - Agree additional activities related to Best Practices on spacecraft operators usage of space weather data - Agree on updates to required anomaly input data content and formats - Recommend to CGMS-51 whether to continue TG activities based on progress made.	CGMS-51	**OPEN**

SWCG CGMS-50 ACTIONS AND RECOMMENDATIONS (Including from Joint Meeting)					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMS Members	Joint WGI-WG-IV-SWCG/6	SWCG/ A50.05	CGMS members are invited to support the WRC-23 preparatory process on agenda item 9.1 Topic A (space weather) through its national regulatory authorities, regional WRC-23 preparations or directly in the relevant ITU fora, as appropriate	CGMS-51	**OPEN**

ACTIONS RESULTING FROM CGMS-50 PLENARY DISCUSSIONS TO BE MONITORED AND MANAGED BY WGII:

CGMS-50 actions for the working groups - Plenary Session				
Actionee	**AGN item**	**Action**	**Description**	**Deadline**
CGMS members (WGII and SWCG)	4.5	WGII+SWCG/ (P)A50.05	CGMS WGII and SWCG members are invited to nominate candidates for a subgroup within GSICS on Space Weather Cal/Val and Intercalibration, which will be focused on providing intercalibration for Space Weather. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Dec 2022

(WGI-WGIV-SWCG)

Joint working group WGI-WGIV-SWCG

50 YEARS 1972–2022

CGMS

JOINT WGI-WGIV-SWCG REPORT

Co-chairs: Tsutomu Nagatsuma (NICT/JMA), Vanessa Griffin, (NOAA)
Rapporteur: Andrew Monham (EUMETSAT). Karolina Nikolova (EUMETSAT)

1. Welcome, objectives and review of the agenda

The joint meeting Co-Chairs, Dr. Tsutomu Nagatsuma and Vanessa Griffin, supported by Rapporteurs Andrew Monham and Sean Burns, 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).

The joint meeting reviewed and adopted the draft agenda proposed by the CGMS Secretariat prior to the meeting.

2. Review of interactions and activities between WGI, WGIV and the SWCG (incl. action review)

It was agreed that all relevant interactions and review of actions would be covered in the relevant agenda items.

3. Benefits of space weather data usage for satellite operators and role of anomaly report database

CGMS-50-SWCG-WP-02 – Report on progress of the Space Weather Spacecraft Anomaly Database Task Group

Andrew Monham reported that the Space Weather Spacecraft Anomaly Database objective is to be the data source for space weather actors to analyse the impact of space weather on satellite systems, in order to improve tools modelling space weather effects, spacecraft design robustness and support the spacecraft operations community with space weather warnings and improved post-event anomaly analysis.

The blocking issue concerning the lack of input data highlighted at CGMS-49 has continued to be problematic and it has been discussed whether or not it makes sense to continue with this effort at CGMS level. As a result, some potential courses of action relating to confidentiality concerns and workload have been identified which may help improve the situation, overcoming the perceived issues which are preventing the supply of data.

Further engagement with the spacecraft operations community is also proposed through an updated survey (following the last one performed in 2018) and consideration of whether Best Practices in usage of space weather data for post-event anomaly analysis and risk mitigation based on forecasts can be formulated.

It is therefore recommended to continue with the TG effort with these actions and decide prior to CGMS-51 whether sufficient progress has been made to justify the continuation of this TG effort.

CGMS-50 ACTIONS - JOINT WGI-WGIV-SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
SWCG (Anomaly TG)	Joint WGI-WG-IV-SWCG/3	See SWCG report	TG to Review Terms of Reference to: - Agree additional activities related to Best Practices on spacecraft operators usage of space weather data - Agree on updates to required anomaly input data content and formats - Recommend to CGMS-51 whether to continue TG activities based on progress made.	CGMS-51	**OPEN**

CGMS-50-SWCG-WP-06 – CGMS agency spacecraft space weather anomaly reports compilation

Andrew Monham provided an overview of the content of the report containing a compilation of all suspected Space Weather related anomalies on all operational missions operated by CGMS Agencies reported to CGMS-50 and explained that the content structure has been revised in order to address anonymity concerns and that further changes to the presentation of information in the report may be considered by the Task Group. The structure now includes reported space weather events on:

- GEO satellites
- LEO satellites
- Satellites in other Earth orbiting domains

CGMS-50-NICT-WP-02 – Analysis of Spacecraft Anomalies Reported in Logs of Service Outages

Nagatsuma-San presented that space-based meteorological observations are an indispensable part of our social infrastructure, but they are always face the risk of malfunction due to space radiation enhancement. To assess the impacts of space radiation on meteorological imagery observation services, NICT investigated energetic particle variation during meteorological imagery service alerts, particularly on Himawari-8, MET-7, and MET-8 between 2015 and 2017. NICT found that about forty percent of the geostationary meteorological satellite anomalies occurred when 24-hr fluence of energetic electrons increased. The occurrence probability of spacecraft anomaly markedly increases when the energetic electron fluence exceeds a threshold value. The results are important for planning safety operation of and developing robust next-generation spacecraft. The results also suggest that recording spacecraft anomaly report as database is quite important.

4. Requirements and feasibility of low latency RO data dissemination for space weather data users through direct broadcast

CGMS-50-EUMETSAT-WP-07 – Update on efforts to define requirements and feasibility of low latency RO Data Dissemination

Andrew Monham reported that following the recommendation of CGMS-49 for a task group on the provision of low latency ionospheric radio occultation data to users, progress has been made with an exploratory meeting of SWCG, IROWG and ROM SAF participants where it has been agreed to:

- Expand the remit of the Task Group to cover the full scope of HLPP (6.4):
  - "*In coordination with IROWG establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring*."
  - Thereby addressing the following aspects:
    - Data Latency
    - Number of ionospheric measurement counts for the whole system
    - Observational Simulation Experiments to address sensitivity of operational applications to changes in latency / counts for establishment of requirements.
    - Potential improvements in CGMS Member RO measurement capabilities and / or data access in support of such requirements.
  - Include the participants of the exploratory meeting as regular TG representatives (nominations are welcome for additional TG members)
  - Terms of Reference to address the Actions SWCG/A48.15, 16, 17, 18
  - Hold 4 TG meetings prior to CGMS-51 to address these aspects.

CGMS-50 ACTIONS - JOINT WGI-WGIV-SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
SWCG (RO TG)	Joint WGI-WG-IV-SWCG/4	See SWCG report	Establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring	CGMS-51	**OPEN**

CGMS-50-NOAA-WP-14 – COSMIC-2 RO latency

Elsayed Talaat presented the progress made on improving the data latency of ionospheric RO data by COSMIC-2 which now fully meets or exceeds requirements to the benefit of the operational community. Further enhancements in latency may be forthcoming in the near-future.

5. Space Weather Data Access (outcome of User Survey)

CGMS-50-SWCG-WP-01 - Status of Space Weather Data Access including data formats - formation of Task Group

Andrew Monham reported that the SWCG has undertaken a number of outreach activities with the operational space weather user community since 2018 in order to identify potential improvements which could be implemented by CGMS members to better service the user needs. This has included a number of surveys and dedicated discussion forums held in the context of annual space weather workshop events in Europe and the US.

In order to help glue this feedback together and focus on the priorities, a Task Group is now proposed with the objective of identifying and acting on the needs of the operational Space Weather Service community (referred to here as "Users") including consideration of both in-orbit needs as well as improvements to data formats and ground segment dataflow. Due to the wide scope of aspects under consideration, the TG will firstly prioritise the main areas to address until CGMS-51 with the aim of providing some short-term returns as well as ensuring the basis for improvements in the longer-term.

Proposed TG members are drawn from CGMS members as well as representatives of the user community in order to improve the level of interactions and mutual understanding.

CGMS-50 ACTIONS - JOINT WGI-WGIV-SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
SWCG (Data Access TG)	Joint WGI-WG-IV-SWCG/5	See SWCG report	Task Group on Improving User Data Access to Space Weather Data from Orbital Sensors to identify work priorities and report on achievements	CGMS-51	**OPEN**

6. Frequency-related topics in support to the space weather

CGMS-50-EUMETSAT-WP-03 – SFGC Frequency-related topics in support to space weather

Marcus Dreis presented that the international regulatory framework, the ITU Radio Regulations (RR), so far do not contain any recognition or provisions related to space weather observations using radio frequencies.

The World Radiocommunications Conference 2023 (WRC-23) will now deal with space weather frequency related issues under agenda item 9.1 Topic A.

This agenda item is actually twofold with preparatory studies, with no regulatory actions at WRC-23, followed by a WRC-27 agenda item with the aim to actually establish regulatory conditions in the Radio Regulations in support of space weather observations.

The ultimate goal under these agenda items at two consecutive WRCs is to:

- define space weather in the context of ITU Radio Regulations;
- determine the appropriate "radiocommunication service" under which space weather should be considered (Meteorological Aids Service or Radioastronomy Service);
- identify space weather sensors/stations, that need to be protected by appropriate regulations;
- conduct necessary sharing studies with incumbent services for active and receive-only usage of space weather sensors/stations, as appropriate;
- establish at WRC-27 appropriate recognition of space weather in the ITU Radio Regulations through regulatory provisions to protect space weather observations while not placing undue constraints on incumbent services.

Resolution 657 (Rev. WRC-19) determines what has to be studied in preparation for WRC-23 under agenda item 9.1 Topic A.

This document provides an overview of the status of discussions in the framework of the WRC-23 preparations.

CGMS members are invited to note the information in this document and to support the WRC-23 preparatory process through its national regulatory authorities, regional WRC-23 preparations or directly in the relevant ITU fora (Working Party 7C), as appropriate.

CGMS-50 ACTIONS - JOINT WGI-WGIV-SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMS Members	Joint WGI-WG-IV-SWCG/6	See SWCG report	CGMS members are invited to support the WRC-23 preparatory process on agenda item 9.1 Topic A (space weather) through its national regulatory authorities, regional WRC-23 preparations or directly in the relevant ITU fora, as appropriate	CGMS-51	**OPEN**

7. AOB

No other business was identified.

8. Next steps, conclusions and reporting to plenary

Please refer to the plenary report for the conclusions.

For the list of actions, please see the SWCG report.

Report of the 50th Meeting of CGMS

Annexes

50 YEARS 1972–2022

CGMS

ANNEX I: ABBREVIATIONS

Abbreviation	Meaning
ACE	Advanced Composition Explorer
AMV	Atmospheric Motion Vector
AOD	Aerosol Optical Depth
AWS	Automatic Weather Station
CAMS	Copernicus Atmosphere Monitoring Service
CCI	Convective Cloud Information
CCOR	Compact Coronagraph
CDR	Climate Data Records
CFOSAT	Chinese-French Oceanography Satellite
CRC	China-Russia Consortium
CSR	Clear Sky Radiance
D3S	Distributed Space Weather Sensor System
DCP	data collection platform
DCS	Data Collection Service
DRS	Direct Relay Satellite
DRT	Data Relay Transponder
DWL	Doppler Wind Lidar
E-DCP	Enhanced DCP
EARS	EUMETSAT Advanced Retransmission Service
ECV	essential climate variables
EO	Earth Observation
EORC	JAXA Earth Observing Research CenteR
EOSC	Earth-observing satellite constellation
EOTEC DevNet	Earth Observation Training, Education, and Capacity Development Network
ERSA	ESA Radiation Sensor Array
ESA PB-EO	ESA Programme Board for Earth Observation
ESC	Expert Service Centres
ESD	NASA's Earth Science Division
ET-SWx	Expert Team on Space Weather
EUVST	Extreme Ultraviolet HighThroughput Spectroscopic Telescope
EZIE	Electrojet Zeeman Imaging Explorer
FCDR	fundamental climate data record
FDR	Fundamental Data Records
FOC	Full Operational Capability
FRP	Fire Radiative Power
FY	FengYun
FY_ESC	Emergency Support Mechanism of FY Satellite
GAW	WMO Global Atmospheric Watch
GBON	Global Basic Observation Network
GEO-XO	Geostationary and Extended Orbits
GeoHSS	Hyper Spectral Sounding instrument on a geostationary satellite
GNC-A	GEONETCast Americas broadcast
GNSS	Global Navigation Satellite System
GOES	Geostationary Operational Environmental Satellites
GOLD	Global-scale Observations of the Limb and Disk
GSICS	Global Space-based Inter-Calibration System

Abbreviation	Meaning
GST	2023 Global Stocktake
GTS	Global Telecommunication system
HAPS	High Altitude Platform Systems
HERMES	Heliophysics Environmental and Radiation Measurement Experiment Suite
HSS	Hyperspectral IR Sounder
ICON	Ionospheric and Connection Explorer
IDA	Internal Dosimeter Array
IDCS	international DCS channels
INFCOM	WMO Commission for Observation, Infrastructure and Information Systems
INPE	Brazilian Ministry of Science, Technology, and Innovations
IOC	Initial Operational Capability
IODC	Indian Ocean Data Coverage
IPWV	Integrated Precipitable Water Vapour
IS40e	Intelsat Commercial Satcom mission
ISCCP-NG	Next Generation of the International Satellite Cloud Climatology Project
ISES	International Space Environment Service
KSEM	Korean Space wEather Monitor
MAP	Multi-mission Aerosol product
MMDRPS	Multi-Mission Meteorological Data Receiving and Processing System
MODIS	Moderate Resolution Imaging Radiometer Suite
MOSDAC	Meteorological and Oceanographic Satellite Data Archival Center
MTG-S	Meteosat Third Generation Sounding
NCMRWF	National Centre for Medium Range Weather Forecast (India)
NGRM	Next Generation Radiation Monitor
NKN	National Knowledge Network
NREN	National Research and Education Network
NSF	National Science Foundation (USA)
NWP	Numerical weather prediction
OGC	Open Geospatial Consortium
OMI	Ozone Monitoring Instrument
OSOS	First International Operational Satellite Oceanography Symposium
OSSEs	Observing System Simulation Experiment
OSW TG	Ocean Surface Wind Task Group
OVW	ocean vector winds
PMAp	Polar Multi-mission Aerosol product
PSTEP	Project for SolarTerrestrial Environment Prediction
RDCA	rapidly developing cumulus areas
RO	radio occultation
ROSES	Research Opportunities in Space and Earth Science
RRR	Rolling Requirements Review
RTSWnet	Real-Time Solar Wind network
S2P	Space Safety Programme
SAN	SWFO Antenna Network
SAS & R	satellite aided search and rescue
SBIR	Small Business Innovation Research
SCO	Space Climate Observatory
SDR	sensor data records

Abbreviation	Meaning
SETT	Socio Economic Tiger Team
SOHO	Solar and Heliospheric Observatory
SOSMAG	Service Oriented Spacecraft Magnetometer
SSA	single scattering albedo
SST	Sea Surface Temperature
STEREO	Solar Terrestrial Relations Observatory
SWCEM	WMO Space-based Weather and Climate Extremes Monitoring
SWFO	Space Weather Follow-On
SWO	Space Weather Observations
SWORM	the Space Weather Operations, Research and Mitigation team
SWOT	Strengths, Weaknesses, Opportunities, and Threats
SWxSA	Space Weather Science Application
TANSO-FTS	Thermal And Near-infrared Sensor for carbon Observation Fourier-Transform Spectrometer
TEMPO	Tropospheric Emissions: Monitoring of Pollution
ToR	Terms of Reference
VLab	WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology
VLMG	VLab Management Group
WIS	WMO's Information System
WSI	WIGOS Station Identifiers

ANNEX II LISTS OF PARTICIPANTS

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Annex III

Photographs

Courtesy of Samhita Bharadwaj, WHO

GENERAL CGMS INFORMATION

CGMS Agenda and Working Papers

The agenda and Working Papers (WPs) are available at:

List of actions and recommendations

The working group actions and recommendations are maintained on dedicated confluence pages currently accessible to the five CGMS working group co-chairs and rapporteurs. The plenary actions and recommendations are maintained by the CGMS Secretariat. CGMS members, observers and relevant actionees are requested to provide feedback as necessary to the working groups (L-WGI [at] LISTSERV.EUMETSAT.INT; L-WGII [at] LISTSERV.EUMETSAT.INT; L-WGIII [at] LISTSERV.EUMETSAT.INT; L-WGIV [at] LISTSERV.EUMETSAT.INT; L-SWCG [at] LISTSERV.EUMETSAT.INT) and the CGMS Secretariat (CGMSSec [at] eumetsat.int), and when preparing Working Papers to refer to relevant actions and recommendations if needed.

CGMS List Servers

There are currently eight CGMS list servers:

- Plenary, WGI, WII, WGIII, WGIV, and SWCG; and
- WGI Task Group on direct broadcast systems and Task Group on data collection services.

Information on points of contact and list servers is available upon request from the CGMS Secretariat at CGMSSec [at] 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.

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