Report of the 52nd Meeting of

THE COORDINATION GROUP FOR METEOROLOGICAL SATELLITES

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CGMS


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REPORT OF THE 52ND PLENARY SESSION OF THE COORDINATION GROUP FOR METEOROLOGICAL SATELLITES

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PLENARY SESSION

1. OPENING SESSION

Welcome and opening remarks: NOAA, WMO, CGMS Secretariat

Dr. Volz, Assistant Administrator for NOAA's National Environmental Satellite, Data and Information Service (NESDIS) welcomed the participants to Washington DC and noted NOAA's pleasure in hosting the 52nd plenary session. He noted that JMA and JAXA set a very high standard in hosting CGMS-51 and NOAA will strive to also host a similarly productive week of discussions in the plenary session as well through the bilateral and other side meetings. Dr. Volz encouraged those in attendance and online to participate actively in the discussion and to challenge ourselves to focus on how to position CGMS to address some of the daunting challenges facing the world, including supporting the WMO Early Warnings for All initiative, monitoring a changing climate and the WMO Global Greenhouse Gas Watch initiative, evolving our future architecture and dissemination mechanisms to take advantage of the opportunities presented by the changing landscape of the space and IT sectors, and meeting the growing suite of observation variables needed to monitor the Earth system.

Dr. Michael Morgan, Assistant Secretary of Commerce for Environmental Observation and Prediction, NOAA, welcomed the participants to Washington DC. Dr. Morgan noted that satellites provide critical information that help us better understand our Earth system and the impacts of the challenges of climate change. He highlighted that while NOAA is proud of its robust satellite programmes, NOAA recognises it can only succeed in partnership with international partners, including all of the CGMS members attending the CGMS-52 plenary session.

Dr. Morgan discussed multiple examples illustrating how things that humans depend upon and value — water, energy, transportation, wildlife, agriculture, ecosystems, and human health — are experiencing the effects of a changing climate, including the increasing number of natural disasters. He underscored the importance of CGMS sharing that knowledge with others including shared missions to understand and predict changes in climate, weather, and oceans.

Dr. Morgan further described how NOAA is helping to build a climate-ready nation, one hallmark of which is ensuring communities and decision makers have equitable access to the climate information, products, and services they need, and a clear understanding of what this information means for their communities, economies, and natural resources. In doing so, NOAA is expanding its work with existing and new partners to equitably meet the needs of those facing hazardous weather events and long-term climate impacts.

Dr. Morgan next highlighted that, fundamental to NOAA's efforts, are the satellite observations which underpin NOAA's science and services. Dr. Morgan recognised that the rapid changes in the space sector will impact how those satellite observations will be provided in the future. With the increasing breadth of observations to forecast weather and monitor climate, it necessitates reimagining the future satellite architecture. Dr. Morgan also highlighted the significant challenge for NOAA of integrating disaggregated systems and that the challenge grows ever more complicated when seeking to integrate disaggregated networks across multiple global agencies. For this reason, Dr. Morgan

indicated he was looking forward to CGMS members continuing the discussion on how to develop more advanced and agile systems by harnessing new space to make technology, platform, and business model innovations operational on more rapid timescales.

Being his first CGMS plenary session, **Mr. Nir Stav, WMO**, highlighted the opportunity to engage with all CGMS partners. He noted the many mitigation challenges across the globe, and that CGMS corresponds to several significant actors that provide information for decision makers for adaptation and mitigation purposes. He looked forward to working with everyone during the week and for CGMS to address the WMO Early Warnings for All and Global Greenhouse Gas Watch initiatives, and GCOS, to support a foundation for building mitigation strategies.

Mr. Phil Evans, Head of the CGMS Secretariat and Director-General of EUMETSAT, welcomed all participants to the 52nd plenary and sincerely thanked NOAA for hosting the plenary session and the excellent organisational arrangements. The focus of the plenary will be to address ways to enhance our cooperation for the benefit of the WMO global user community. The meteorological community is highly impacted by the emergence of new technologies, including e.g. AI/ML on NWP, and this offers more opportunities of cooperation to continue to deliver the observations needed by the modelling community. CGMS has a contributing role to support these new avenues and there is a need to adapt and reinforce the way CGMS works together. He highlighted it would be important to identify concrete responses by the CGMS space agencies to the WMO initiatives EW4ALL, G3W, and the WIGOS Vision update, as well as to the CGMS International Science Working Groups. Plenary will also consider the future strategic orientation of the WMO-CGMS Virtual Laboratory (training and education) a most important element to secure the use of our data, especially those generated by the new generation of satellites. Finally, the plenary will be requested to endorse the CGMS high-level statement on optimum composition of hybrid architectures for fulfilling the operational observation requirements by CGMS in the future and agree on the CGMS statement to be made to the WMO EC-78 the week after plenary.

2. WMO MATTERS FOR COORDINATION WITH CGMS SPACE AGENCIES

WMO matters for coordination with CGMS space agencies

CGMS-52-WMO-WP-01p: WIGOS Vision 2040 update - implications and expectations for CGMS space agency members (Albert Fischer)

The WIGOS 2040 Vision document adopted by the World Meteorological Congress in 2019 has been an influential document for space agencies, providing an architecture for collective planning, the framing of the WMO gap analysis, and the framing of the WMO definition of core and recommended data from space for NWP in particular. It has also been criticized for being too constraining for evolving space agency responses to requirements. At its 3rd session, the WMO's Infrastructure Commission (INFCOM-3, 15-19 April 2024) requested an update to the WMO 2040 Vision, to be considered by INFCOM-4 in late 2026 and for adoption by the 20th World Meteorological Congress in 2027. A Task Team will be formed in INFCOM (under SC-ON) to first consider the scope of the update and then to propose changes, including particularly to the expression of the space component. The CGMS member agencies are invited to suggest members to support the work of this Task Team, which will involve a

wide range of stakeholders including in particular the NWP community. This is including the approach with CGMS Task Team representative agreed in the CGMS-52 working group meetings.

Discussion, tour de table

NOAA asked how WMO would address the much-broadened scope of observations for Earth Systems Prediction, covering the whole range of applications. WMO responded that the revised WIGOS Vision will address all WMO application areas but recalled that the core business of WMO members remains weather forecasting, with an increasing importance of climate. EUMETSAT supported this, emphasising the need for a balance between the core meteorology and climate areas versus the other application areas.

NOAA asked WMO on its view on the coordination of the space- and surface-based components of WIGOS. WMO responded that the planning timescale are widely different for space- and ground-based components, and that the WIGOS Vision must remain long-term and high-level.

CGMS-52 plenary action					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	2	A52.01	**WIGOS Vision 2040 update:** CGMS members invited to nominate a CGMS representative to the WMO Task Team for the updating of the WIGOS Vision 2040. CGMS members are requested to send nominations to CGMSSEC@eumetsat.int by end June.	30 Jun 2024	**OPEN**

CGMS-52-WMO-WP-03p: Key recommendations to CGMS space agencies following CM-15 and INFCOM-3, and for the OCP (Natalia Donoho)

WMO recalled the outcome of the 15th Session of the Consultative Meetings on High-level Policy on Satellite Matters (CM-15) held at WMO on 6-7 February 2024. The purpose of CM meetings is to facilitate a formal and substantive communication between the leadership of space agencies and representatives of the WMO.

The associated round table discussion addressed:

1. Increasing benefits of satellite data for developing countries;
2. High data volumes;
3. Coordinated involvement of the private sector through the Open Consultative Platform (OCP);
4. Coordination for Greenhouse gas monitoring;
5. The WIGOS Vision update; and
6. AI technology for improved satellite data exploitation.

WMO also recalled matters of relevance for CGMS resulting from its INFCOM-3 meeting in April 2024:

- Amendments to the WIGOS Manual, update of WIGOS Guide, and plan for update to the WIGOS Vision for 2040;

- Update of the WMO-CGMS Guidelines on Best Practices for Achieving User Readiness for new satellites;
- Draft recommendation on the priority activities and action plan for the Early Warnings for All (EW4ALL) initiative (including use of satellite data);
- Composition of the management group of the Commission, including request to CGMS to nominate a representative as ex-officio member; and
- Relations with United Nations and other organizations (including CGMS).

The key priorities being:

- The importance of working together to support the regional needs of WMO members in light of the EW4ALL initiative, including support to training activities;
- Facilitating a dialogue with space agencies for the WIS 2.0 implementation; and
- Supporting a three-way dialogue, WMO - space agencies - private sector, related to the space-based observing systems through the Open Consultative Platform (the 5th OCP being held on the occasion of WMO EC-78 the week after CGMS-52 plenary).

Discussion

NOAA thanked the WMO Space Programme leadership for strengthening the dialogue with the satellite operators, both through the December 2023 Core Data Workshop and the CM-15 meeting and asked which priority actions should be taken by CGMS members in support of the WMO space activities.

In response, WMO emphasised the importance of operators' support to the satellite data requirements groups and the regional mapping of priority hazards. The core data definition for Nowcasting is also a priority for engagement with satellite operators.

ISRO informed plenary regarding the announcement of the Indian Government to G20 nations on the opportunity to fly payloads under the theme of environmental and climate change monitoring as G20 satellites. G20 nations are invited to contribute payloads, and the satellite bus integration and launch will be provided by ISRO. ISRO further noted that the total payloads which can be accommodated are around 300 kg, with a power availability of 400 W, and the available footprint area is 1 m x 0.75 m.

CGMS-52-WMO-WP-04p: Outcomes of the 8th WMO Impact Workshop (Sid Boukabara, Chair)

The 8th WMO Impact Workshop took place on 27-30 May 2024 in the Swedish Meteorological and Hydrological Institute (SMHI) in Norrköping, Sweden.

It was the first time the workshop scope was expanded beyond NWP to include all Earth system components:

- Global NWP and climate
- Short-Range/Nowcasting
- Hydrology and land applications
- Space weather
- Ocean applications

- Cryospheric applications

The chairman of the 8th WMO impact workshop noted the following general comments on the outcome of the workshop:

- Multiple applications have either demonstrated (or have potential to) benefit from coupling with other applications (e.g. NWP/Ocean, High-Resolution NWP/Hydrology): Earth system prediction (ESP) is encouraged;

- This ESP approach is leading to an increase in the value of some observations that were not necessarily valuable for NWP before (e.g. soil moisture, sea-ice, etc.);

- The landscape of 'Impact of Observing Systems on NWP/ESP' is changing rapidly: increasing diversity of new observing systems, evolving ESP, AI, ML, non-traditional players, etc. Results today could change tomorrow.

The high-level take-aways from the workshop were:

1. Significant impact from PMW, IR, RO, radiosondes and aircraft data (without specific order);
2. Coupled Earth system approaches emphasize emerging significant impact of ocean, land and snow observations on NWP;
3. There has been an increase in the (quantitative and qualitative) use of many observations in high resolution NWP;
4. New Observations have been tested (i.e. HR radar wind profilers, ground-based lightning detection, etc.) with demonstrated positive impact for high-resolution NWP;
5. Increased use of satellite data in LAMs. Generally positive and increasing impact, with some exceptions noticed;
6. Increased use of satellite data over land, over complex surfaces, and in all-sky conditions;
7. Positive Impacts from assimilating multiple constellations of smallsats of MW and IR sensors were demonstrated in simulation;
8. Positive Impacts from assimilating space-based wind lidar, and its additive impact to MW sensors, were demonstrated in simulation;
9. There are a multitude of metrics used to assess impacts: OSE/DDE, OSSE, EDA, FSOI, EFSOI, ESA, PAI. These approaches serve both to assess impact but could serve the purpose of optimising the design and evolution of observing systems;
10. Combining LEO and GEO Sounders has been shown to have complementary positive impacts on global NWP, in simulation;
11. Several types of observations (Ocean Obs, UAS, Balloons, etc) have been demonstrated to add value to many applications;
12. Synergy between several types of Observation (e.g. in-situ and space) has been highly positive and encouraged; and
13. Several needs from the science community have been expressed (deep ocean, high density ground-based measurements, etc.).

The concluding recommendations from the workshop to the CGMS space agencies were:

Recommendation 2.1: Recommend sustaining critical observations that are now considered fundamental to maintaining NWP skills, in particular passive microwave (MW), Infrared (IR) and Radio Occultation (RO).

Recommendation 2.2: Recommend sustaining observations that have been demonstrated to be increasingly important for Coupled NWP and Earth System Prediction (ESP). Such observations include surface sensitive channels of passive MW and IR, scatterometers, SARs and altimeters, for which strong evidence has been presented in this workshop to constrain ocean (e.g. SST, sea ice, sea-level anomaly) and land (e.g., soil moisture, land surface temperature, snow), with positive impact on ESP.

Recommendation 2.3: Recommend considering the extension of space-based Observing systems with capabilities with demonstrated positive impact on NWP and Earth System Prediction skills. Such capabilities that were demonstrated in this workshop (based on real data or simulations) to have such characteristics include:

- Lidar wind profiling from Space;
- Increased temporal resolution, coverage of MW/IR observations (both T, Q sounding);
- Increase number of radio occultation profiles.

Recommendation 2.4: When planning new instruments (especially research missions), observations availability timeliness should be considered. At a minimum, the design should allow relatively easy extension of the capability to provide observations with the desired timeliness.

Recommendation 2.5: Recommend early initiation of the process of considering follow-on options to research missions with significant (and evidenced) potential for being transformative to ESP-coupled systems. Such research missions identified in this workshop includes the Surface Water and Ocean Topography (SWOT) mission.

Discussion

EUMETSAT commented that AI/ML will have a profound impact on models and assimilation, for example for planetary boundary layer forecasting, and that the impact workshop needs to react to these developments.

ISRO noted the limited considerations of lightning sensors and encouraged this to be addressed in the future.

CMA asked for NWP considerations of the timeliness requirements, with WMO noting that timeliness requirements are addressed in the RRR process.

NOAA requested more instrument-specific documentation on the impact workshop outcomes, and WMO confirmed that this will be considered in the detailed report together with the specific outcomes related to the planetary boundary layer.

CGMS-52-WMO-WP-02p: WMO Early Warnings for All initiative (EW4ALL) - implications and expectations for CGMS space agency members (Nir Stav)

EW4All is a UN-wide initiative to ensure that every person on Earth will be protected by early warning systems, to reduce the impacts to life and property from natural hazards. The changing climate and

intensification of severe events add special urgency to tackle this challenge and build climate resilience.

An initial 30 countries have been identified as the first priority, mostly located in the tropical regions. Four UN agencies are leading the effort:

- UNDRR – disaster risk knowledge and management;
- WMO – detection, observation, monitoring, analysis, forecasting;
- ITU – warning dissemination and communications; and
- IFRC – preparedness and response.

WMO`s EW4All efforts are on two parallel complementary tracks:

- Enhancing the global infrastructure: Improvement of international data exchange; more and better products available worldwide; better guidance and training to the members – the main theme of the WMO`s technical commission.

- Technical support to regional and/or national interventions: Establishing regional support systems; targeted investments for closing national gaps – the main themes of WMO`s extrabudgetary projects, such as SOFF, CREWS etc.

WMO rapidly analysed the existing gaps in most of the priority countries, including status of use of satellite products, and identified the priority hazards. The WMO technical commission adopted an action plan focused on these gaps and hazards.

The satellite agencies provide substantial support to address the challenges of pillar 2:

- continuous monitoring of storms and severe weather including lightning (and improved accessibility and visualisation);
- improved NWP and use of AI forecasts;
- increased data exchange with the forecasting centers, adoption of core data policy;
- satellite-derived products such as precipitation and nowcasting (and improved accessibility/data exchange); and
- spaceborne precipitation radars.

Satellites could also support pillar 1 and 3 efforts.

Discussion:

JMA noted the possible contributions of satellites to pillar 1 and 3 and requested that coordination with UNDRR and ITU be strengthened. WMO responded that it is coordinating this with the other organisations and can help satellite operators in this regard by acting as contact point to UNDRR and ITU.

EUMETSAT emphasised the significance of blended products employing AI techniques for EW4ALL.

JAXA highlighted its precipitation activities as contributions to EW4ALL and urged WMO to provide feedback to JAXA, in particular regarding the contributions to the other pillars.

ISRO asked which cryosphere-related hazards are considered to which WMO responded that glacier stability is being addressed.

WMO emphasised the role of EW4ALL as a compass for developing the response of the WMO to disaster preparedness. The priorities for CGMS members as WMO sees the situation, are to support WMO members on improving data access, usage and interpretation.

CGMS-52-GUEST-WP-02: Special reports on activities in response to the EW4ALL (Sezin Tokar, USAID)

An introduction was given by the USAID Bureau for Humanitarian Assistance (BHA), the US government lead coordinator for international disaster assistance, covering:

- the US President's Emergency Plan for Adaptation and Resilience (PREPARE);
- the USAID Climate Strategy; and
- the BHA's climate action and examples on Early Warning Systems.

They noted that hydrometeorological data fragmentation and scarcity are critical for operational end-to-end early warning services including:

- lack of critical real time data for early warnings for NMHS, and especially for flash floods and urban floods;
- gaps in data due to limited maintenance of national hydrometeorological networks;
- limited data sharing and data restriction in transboundary basins, especially in short time-frames;
- reluctance to share raw or derived precipitation estimates from radar data;
- lack of supportive data, digital elevation models, land use, soil characteristics, exposure, vulnerability, etc.; and
- limited standard formats for hydrometeorological and other data.

Discussion, tour de table

ISRO emphasised the need for standard data formats for hydrological warnings.

USAID noted that there is a strong coordination with WMO and that exploiting synergies and avoiding overlaps are crucial.

CGMS-52-GUEST-WP-03: Feedback from a user on the benefits of VLab (Marcial Garbanzo-Salas, UCR, remotely)

The WMO Space Programme plays a crucial role in promoting the availability and utilisation of satellite data and products for weather, climate, water, and related applications among WMO members. Particularly, the support of the Satellite Data Requirements Groups (SDRGs) during the ET-SSU, has proven highly beneficial for regional implementation plans.

VLab, a global network of specialised training centres and meteorological satellite operators, works collaboratively to enhance the use of meteorological and environmental satellite data and products across WMO member countries. This network connects the satellite meteorology training community, fostering continuous improvement and innovation through global collaboration.

The benefits of VLab for its members are multifaceted. Firstly, VLab provides essential training and support on new satellite generations, product innovations, and their practical applications. This

training is crucial for capacity building and knowledge sharing within the meteorological community. Furthermore, VLab encourages collaboration and co-design, enabling members to engage as equal partners in larger projects, co-designing and delivering training programmes together with satellite operators.

Innovation is at the heart of VLab's mission. Historically, VLab has pioneered the use of the internet for training and team building, and it aims to continue this trajectory by incorporating cutting-edge technologies such as AI and augmented reality. These technologies are expected to further enhance training and user engagement, transforming traditional training methods into interactive and tailored experiences.

Several regional activities exemplify the practical benefits of VLab. For instance, in Guatemala, AWS is utilised for GOES ABI and real-time volcano monitoring, while Peru has developed a GOES Library for data processing. In Mexico, Python is used for satellite data processing, demonstrating the diverse applications of satellite data across different regions. Additionally, regional focus groups in the Americas, Australia-Indonesia, and emerging groups in Africa and other regions emphasise the practical application of satellite data to address local needs using case studies and non-traditional training during the events.

Looking to the future, VLab aims to expand its use of AI and other advanced technologies to create a more interactive and customised training experience. Further support from CGMS and WMO for pilot programmes, training events, materials, and courses will be pivotal in achieving significant impact and advancing the operational capabilities of its members.

The gears connecting the satellite operators, VLab Centres of Excellence, and SDRGs drive the engine of readiness and effective utilisation of satellite data. The ongoing support and innovation within VLab ensure that members can leverage satellite data for weather, climate, and environmental monitoring, thereby enhancing their operational capabilities and resilience.

Marcial Garbanzo further highlighted that there is a significant opportunity for CGMS: Examining the SDRs and the final stages of data utilisation reveals a pressing need for enhanced technical coordination and support. While the RGB workshops have made commendable strides in addressing this issue, more comprehensive efforts are required. Providing appropriate development tools, utilisation programmes, and high-level support in collaboration with satellite operators and VLab CoEs could greatly enhance the use of satellite data in meteorological applications.

For instance, satellites from JMA, NOAA, and other agencies offer extensive capabilities that can benefit numerous countries. However, despite the availability of tools for downloading, processing, and utilising this data, individual countries often struggle to adapt these resources independently. Establishing a technical coordination group to offer regional support tailored to the needs identified by the SDRs, and in alignment with VLab, would significantly improve data utilisation. This coordinated approach would ensure that countries are not left to navigate these challenges alone, thereby maximising the impact and efficiency of satellite data use in meteorology.

CGMS-52-VLab-WP-01p: Education and training - Virtual Laboratory (VLab) strategic orientation for the future (Bernie Connell)

During the past year, the Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) Management Group (VLMG) coordinated efforts through quarterly online meetings. On 20-

23 January 2025, they will convene for the 11th VLMG meeting in Muscat, Oman. The Directorate General of Meteorology (DGMET) will host the meeting at the VLab Oman Centre of Excellence.

Since CGMS-51, VLab members offered a variety of training opportunities, focusing on accessing data and enhancing skills related to the utilisation of various satellite systems, including the new generation of satellites. Additionally, specialised training efforts were dedicated to support the Early Warnings for All (EW4ALL) initiative. Stronger collaboration and coordination of efforts between VLab members resulted in increased opportunities for user training during the past year.

Plenary reviewed the VLab strategic goals and objectives and the frameworks used to identify and meet these objectives. A new VLab project supports the UN EW4All initiative and will be piloted in RAIII and RAIV. The project focuses on creating regional online training materials to support the use of satellite data for priority hazards (flood, drought, tropical cyclone, thunderstorm/squall lines). It is critical that VLab coordinate and collaborate with CMGS and WMO to reach a wide audience.

The VLab is grateful for the annual contributions to the trust fund from NOAA/NWS, EUMETSAT, and KMA. Training is ongoing: it takes the whole community of managers, researchers, trainers, and users to increase the impact and return on effort and monetary investment. In order to keep up with WMO-CGMS member requirements and needs for training, and to improve the long-term sustainability of VLab activities, continued support by CGMS agencies is required.

The VLab strongly recommended to CGMS space agency members to:

1. 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.

2. Review and sustain support to their own satellite programmes that offer international training.

Discussion

EUMETSAT informed plenary that its new 5-year training plan had been approved by its member states including support to the VLab activities and the training of trainers for Africa.

The CGMS Secretariat noted the potential for VLab to generate significant value for a number of new areas for the whole community and that a wider support from CGMS members would be very desirable.

3. NEW DEVELOPMENTS AND LONG-TERM PLANS BY CGMS SPACE AGENCY MEMBERS SINCE CGMS-51

Main developments since CGMS-51 and an outlook for the future

CGMS-52-CMA-WP-09 - CMA updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Shihao Tang)

CMA currently exploits nine FengYun (FY) satellites. The operational FengYun LEO satellites in orbit are FY-3C, FY-3D, FY-3E and FY-3G. The operational FengYun GEO satellites in orbit are FY-2G, FY-2H, FY-4A and FY-4B.

Since CGMS-51, CMA successfully launched FY-3F on 3 August 2023. This satellite enhances Earth observation capabilities by improving detection of atmospheric components such as ozone and sulphur dioxide across the stratosphere and troposphere, as well as refining the Earth's radiation energy balance. FY-3F is currently undergoing in-orbit testing and is scheduled to become operational on 1 July 2024. FY-3F will replace the FY-3C and join FY-3D, FY-3E, and FY-3G in orbit, forming a comprehensive low orbit meteorological satellite observation network.

FY-3G, which is the first precipitation measurement satellite of the FY-3 series, became operational on 1 May 2024. Following the addition of active radar detection capabilities of FY-3G, new types of remote sensing products have been developed, including three-dimensional raindrop spectral parameter profiles, three-dimensional phase states, and three-dimensional precipitation rate profiles, to detect the fine structure of precipitation.

FY-4B has drifted from 133°E to 105°E, replacing FY-4A in providing the operational observation services since 5 March 2024. FY-4A has drifted from 104.7°E to 86.5°E (degraded operation).

Regarding the future plans, FY-3H in LEO orbit and FY-4C and FY-4MW in GEO orbit will be launched in the next 1-2 years, with the aim to maintain continuous and stable in-orbit operations of FengYun satellites. The third generation FengYun meteorological satellites including FY-5 and FY-6 series are under planning, and CMA has begun to undertake a requirement survey.

CMA has introduced FengYun satellite data and products across seven categories. The FengYun Earth platform, a lightweight and optimised platform for forecasters, offers over 100 quantitative products across five categories. CMA NSMC has developed an international version of the FengYun Earth enabling prompt access to meteorological satellite and numerical forecast data, rapid production of quantified products, and provision of international services.

CMA also highlighted their active involvement in CGMS and WMO activities, supporting WMO initiatives, promoting exchanges of data and products, and fostering collaboration with members.

CGMS-52-EUMETSAT-WP-12 - EUMETSAT updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Phil Evans)

EUMETSAT currently operates 10 satellites. Of its mandatory GEO programme there are three geostationary Meteosat (second generation) satellites located at 0°, 9.5°E and 45.5°E and the latest Meteosat (third generation) MTG-I1 is undergoing commissioning with promising new prospects for fire detection and monitoring. MTG-S1 is scheduled for launch in the 2025 timeframe and will host Copernicus Sentinel-4.

The mandatory LEO programme currently covers Metop-B and -C in low Earth sun-synchronous orbits. EPS-SG, Metop second generation, to follow in the 2025-timeframe. It will carry the Copernicus Sentinel-5

Further, EUMETSAT operates several oceanographic missions, Jason-3, and the Copernicus missions on behalf of the European Commission and international partners (including CNES, ESA, NASA, NOAA), notably Sentinels-3A, -3B, -6/Michael Freilich with the addition of Sentinel-3C confirmed in the meantime. If approved, EUMETSAT expects to operate Sentinels-3D and -6/MF/B. Further, EUMETSAT's planned contributions to CO2M, Sentinel-3 and -6 NG, CIMR and CRISTAL includes ground segment developments and processing activities.

The enhanced EUMETSAT response to the implementation of WIGOS 2040 is currently under consideration with decisions expected in the 2025 timeframe, covering:

- EPS-Aeolus, unique European technological expertise to improve Numerical Weather Forecasts (instrument developed by ESA);
- EPS-Sterna, a constellation of micro satellites for testing new space in an operational environment (instrument based on the ESA-developed AWS);
- Ocean altimetry follow-on programme highly relevant for the detection of global sea level rise and of climate change;
- Provision of complementary commercial Radio Occultation data.

EUMETSAT is seeking to establish itself as an operational space weather data hub for global data exchange, and in the medium to longer term to process and deliver NRT data from EUMETSAT satellites, and to consider space weather observations as part of Meteosat 4th generation (M4G) and Metop 3rd generation (EPS-TG).

Following the approval of a EUMETSAT AI/ML roadmap in 2022, the development of an AI/ML project by the European meteorological community will be presented for approval to EUMETSAT's Council in June 2024.

EUMETSAT also noted the following topics deserving addressing in the framework of CGMS:

- The preparation of future programmes and the need for international coordination in their implementation, new architecture concepts;
- An internationally coordinated response to the WMO WIGOS 2040;
- A roadmap towards the evolution of data services using cloud technologies and AI/ML - exploitation and coordination opportunities to enhance accessibility and usability of satellite data;
- The assessment of evolution of requirements from users in preparing for the processing of vast amounts of new data including support to users; and
- The evolution of relationships with commercial meteorological data providers complementary to the "CGMS backbone" and secure the free and open data access as per the WMO data policy Res. 1.

Discussion:

ISRO asked EUMETSAT for its views on analysis ready data (ARD) and EUMETSAT responded it will contribute to the definition of common ARD formats.

CGMS-52-ESA-WP-08 - ESA updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Marie-Claire Greening, remotely)

CGMS is informed of the status of the European Space Agency's Earth Observation missions currently in-orbit. Three of them – MSG, MTG and MetOp – are in co-operation with and developed on behalf of EUMETSAT, as are the future EPS-Aeolus and EPS-Sterna programmes.

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 series of satellites until Sentinel-6 Michael Freilich in November 2020. Others will follow in the coming years

from the next generation of Sentinels and from the expansion missions. Sentinel operations continued nominally throughout 2023.

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 – SMOS, CryoSat-2 and Swarm – currently in orbit are 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. End-Of-Life Activities were conducted from 3 April to 5 July 2023, and Aeolus was successfully deorbited on 23 July 2023. Aeolus was the first satellite mission to successfully acquire wind profiles at a global scale and a follow-on EPS-Aeolus mission is in the planning, in collaboration with EUMETSAT.

The Proba-V Cubesat Companion (PV-CC) was launched on 9 October 2023 as part of the Small Satellites Mission Service (SSMS) rideshare mission, on board Vega flight VV23. The PV-CC successfully concluded its LEOP activities less than 24 hours after launch and its commissioning activities began straight afterwards.

CGMS is further informed of the status of the European Space Agency's Earth Observation future missions. While ESA has a wealth of experience under its belt in observing Earth from space, the sector is changing rapidly – becoming increasingly competitive, but also offering new opportunities as concepts like New Space evolve and the digital revolution gathers pace. Through its Future Earth Observation programme (FutureEO), ESA is committed to remaining ahead of the game. Progress in the preparation of the forthcoming Explorer missions – EarthCARE, Biomass, FLEX, FORUM and Harmony – is described in this report.

In November 2023 two candidates for the next and 11th Earth Explorer (EE11) research mission were selected to proceed to Phase A feasibility - CAIRT and WIVERN.

A call for ideas was issued for Earth Explorer 12 (EE12) proposals in February 2023, and 4 mission ideas were selected in March 2024 to proceed to Phase A assessment – CyroRad, ECO, Hyrdoterra+ and Keystone. Notably, each of the four EE12 recommended mission ideas were variants/improvements of previously submitted Earth Explorer proposals.

Activities related to Aeolus-2, Arctic Weather Satellite (AWS) in cooperation with EUMETSAT, TRUTHS, SCOUTs and ALTIUS are ongoing. Each of these missions are planned to contribute routine, operational monitoring data to improve our understanding of the Earth system and climate change.

Six Copernicus Expansion Missions – CHIME, CIMR, CO2M, CRISTAL, LSTM, and ROSE-L – are being studied to address EU policy and gaps in Copernicus user needs, and to expand the current capabilities of the Copernicus space component. The System Requirements Reviews for all 6 missions have been completed.

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 focuses

on the exploitation of data records primarily, but not exclusively, from past ESA satellite missions, for the benefit of climate monitoring and climate research. Specifically, the CCI supports the study and monitoring of 23 essential climate variables (ECV) derived from satellite data, thereby helping to fulfil the objectives of the WMO Global Climate Observing System (GCOS).

Discussion:

ISRO asked about the status of the P-band SAR BIOMASS mission and ESA responded that the launch is planned for 2025.

CGMS-52-IMD-WP-04 - IMD updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (R K Giri, remotely)

INSAT-3D and -3DR are the operational Indian GEO satellites. IMD are generating a set of operational INSAT imager and sounder products like net radiation, improved INSAT multispectral rainfall, land surface Albedo, short wave radiation over ocean, total precipitable water over ocean, potential evapo-transpiration over land, actual evapotranspiration and from sounder cloud top pressure, effective emissivity, cloud top temperature etc. Rapid scans (every ~ 5 minutes) are successfully conducted for monitoring the cyclonic activities and can be operated for any intensive observational period with the joint consultation of IMD and ISRO. Dissemination of near real time INSAT-3D/-3DR products in BUFR format through the WMO GTS network for international agencies and soon INSAT-3DS data will also be available.

The Oceansat-3 Ku-band scatterometer data and products have been used and assimilated in NWP models for operational forecasting especially during cyclone time. The near real time reception of scatterometer data is available (at 12 and 25 km resolutions) at IMD through the Indian National Remote Sensing Centre (NRSC) in Hyderabad.

IMD processes integrated precipitable water vapour daily (every 15 minutes) from a GNSS network of 25 stations and will be further enhanced with 49 more stations following a survey of India. The network will be further enhanced with data from more than 100 SOI and CORS stations. The station-wise IPWV data is available in the public domain on an hourly basis.

Recalibration of past historic INSAT data from a climatology perspective is in progress jointly by IMD and ISRO. Domain specific ($10^oS/10^oN$ and $64^oE/84^oE$) inter-calibration with past INSAT and NOAA data for the International Satellite Cloud Climatology Project (ISCCP) is ongoing. Regular joint calibration campaign activities of IMD and ISRO for VIS/SWIR channels continue at the Great Rann of Kutch (GROK) area in Gujrat.

IMD is thankful to EUMETSAT for providing Meteosat-8 services over the Indian Ocean (IODC) through the EUMETCast terrestrial link and the cooperation with EUMETSAT is expected to be enhanced in future development of GEO and LEO blended products, as well as using a nowcasting tool in collaboration with the EUMETSAT Nowcasting Satellite Application Facility (NWC-SAF) and CAL/VAL activities.

IMD transfers seamless data of INSAT-3D/-3DR and in future -3DS to the Hong Kong Observatory for the regional SIGMET coordination platform. IMD and ISRO jointly and regularly validate the INSAT data

and products and make updates available on the IMD website. The IMD and ISRO development of a joint data supply and analysis platform is in progress and will be completed soon and users world-wide can utilise and analyse past and present INSAT data for research and development purposes.

IMD also informed plenary that they will host the next AOMSUC conference in New Delhi in November 2024.

Discussion

JMA thanked IMD for hosting the next AOMSUC conference.

CGMS-52-ISRO-WP-02 - ISRO updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Nilesh Desai)

Currently India is operating two GEO satellites: INSAT-3D and INSAT-3DR. INSAT-3DS was launched on 17 February 2024, with many improvements to mitigate the issues related to the blackbody calibration and mid-night sun-intrusion in INSAT-3D/3DR. INSAT-3DS will replace INSAT-3D at 82°E after IOT. Six years (2014-2021) of INSAT-3D data has been reprocessed for VIS/SWIR channels.

EOS-06 (Oceansat-3), launched on 26 November 2022, is operational with Ku-band scatterometer, and 13-band Ocean Colour Monitor (OCM-3). The ocean bio-physical products include Chl-a concentration, remote sensing reflectance, aerosol optical dept, total suspended matter and diffuse attenuation coefficient. Land biophysical products such as NDVI and vegetation fraction are also derived from the OCM sensor. Sea surface wind vectors are operationally available from Oceansat-3 scatterometer. Data from the scatterometer and the OCM-3 have been released to the users through the BHUVAN web portal.

EOS-07 (Microsat-2B), launched on 10 February 2023 in low-inclination orbit, with an indigenous 6-channel Microwave Humidity Sounder (MHS). MHS L1 and L2 data are available through the MOSDAC web portal.

The upcoming satellites include:

(i) Oceansat-3A, similar to Oceansat-3 with a 13-channel ocean colour monitor, Ku-band pencil-beam scatterometer, Sea Surface Temperature Monitor and a Millimeter-wave Atmospheric Temperature and Humidity Sounder (MATHS) payloads;

(ii) Microsat-2C GNSS-R with dual frequency operation utilising both GPS and IRNSS constellations;

(iii) INSAT 4th Generation with Advanced Imager, Lightning mapper and Hyperspectral Infrared Sounder; and

(iv) ISRO has also planned launches of RISAT-1B (C band), NISAR (L&S band, in collaboration with NASA), HRSAT (three high resolution satellites), Resourcesat 3&3A (land imagery with 10m & 20 m resolution), Resourcesat 3S &3SA (Stereo images at 1.25 m resolution) and TRISHNA (high resolution TIR mission in collaboration with CNES).

CGMS-52-NASA-WP-02 - NASA updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Jack Kaye)

NASA continues to operate more than two dozen Earth-observing satellites and instruments. During the past year, NASA and its partners launched the Plankton, Aerosol, Cloud ocean Ecosystem (PACE) mission. The three instrument aboard the satellite are aimed at advancing our understanding of how the ocean and the atmosphere exchange carbon dioxide, and benefit society by improving the quality and timeliness of decisions related to fisheries health, harmful algal blooms, air pollution, and carbon sequestration.

In addition, NASA launched two small satellite technology demonstration missions to the International Space Station (ISS): the Hyperspectral Thermal Imager (HyTI) and the Signals of Opportunity P-band Investigation (SNOOPI). While HyTI will demonstrate the use of a 6U CubeSat for acquiring high-spectral and spatial resolution images in the long-wavelength infrared range, SNOOPI will show how a 6U CubeSat can use direct and Earth's reflected signals of opportunity in the P-band from geostationary telecommunications satellites to retrieve root zone moisture (RZSM) and snow water equivalent (SWE).

In early 2024, the NASA Earth Science Division introduced a "decouple, partner, and compete" approach that provides greater flexibility and maximizes the science achievable from the Surface Biology and Geology (SBG) and Atmospheric Observing System (AOS) missions. As a result, management of the two SBG instruments will be decoupled to allow the Thermal Infrared (TIR) component to launch when ready ahead of the Visible Short-Wave Infrared (VSWIR) component.

The AOS mission, with a reduced cost target, will now be pursued through a mix of directed and at least one competed mission with multiple international partners and decoupled schedules. The international partner contributions for AOS consist of a Japan Aerospace Exploration Agency (JAXA) Ku-band Radar and Centre National d'Études Spatiales (CNES) tandem microwave radiometers in the inclined orbit; and an Agenzia Spaziale Italiana (ASI) multi-wavelength Lidar, and a Canadian Space Agency (CSA) Near Infrared Imaging Radiometer and a Limb-imaging observatory in the polar orbit. The competed component(s) will focus on cloud and precipitation profiling from the polar orbit. NASA directed missions will provide a space vehicle to host one of the CNES radiometers, and a polar mission with a suite of passive instrumentation.

CGMS-52-JMA-WP-01 - JMA updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Kazuki Yasui)

JMA operates two geostationary meteorological satellites, Himawari-8 and -9, equipped with Advanced Himawari Imager (AHI). JMA conducted the operational satellite switchover from Himawari-8 (in operation since July 2015) to Himawari-9 in December 2022 for scheduled operation until FY 2029.

JMA also provided parallel distribution of experimental Himawari-9 products and observation data for several months as an alternative approach before the switchover for user readiness (non-operational purposes).

JMA contracted manufacturing of the follow-on satellite Himawari-10 in March 2023, with initiation of operation scheduled for FY 2029. Himawari-10 is scheduled to carry a visible/infrared imager as well as an infrared sounder and the high energy electron sensor, and high and very high energy proton sensor.

CGMS-52-JAXA-WP-02 - JAXA updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Riko Oki)

JAXA operates various kind of satellite sensors and opens the products to the public, and continues to develop and improve products to address the climate issues.

The major updates since CGMS-51 is that the reprocessing during about 25 years for the new version of the Global Satellite Mapping of Precipitation (GSMaP) was completed. JAXA improved the GSMaP algorithm in December 2021 (algorithm version 8) and released 25-year precipitation data in September 2023.

GCOM-C has achieved the 6-year in Dec. 2023. GCOM-W has achieved 12-year in May 2024 and several new research products are available. JAXA will launch three missions in JFY2024; the joint Japanese-European EarthCARE mission in May 2024; the ALOS-4 satellite with L-band SAR in June 2024; and the GOSATGW satellite with GHG sensor and microwave imager in JFY2024.

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 more than 25-yr GSMaP rainfall product with climate normal.

JAXA also contributes to the Global Greenhouse Gas Watch (G3W) by defining the role of satellite products. Since May 2023, JAXA is continuously providing JAXA/GHG products in public.

Moreover, JAXA will host the 11th Workshop of the International Precipitation Working Group (IPWG) at Tokyo Institute of Technology from 15-18 July 2024, in collaboration with the IPWG, which is co-sponsored by the CGMS and WMO.

CGMS-52-joint-ROSCOSMOS-ROSHYDROMET-WP-01 - ROSHYDROMET/ROSCOSMOS updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Konstantin Litovchenko, remotely)

The Russian hydrometeorological satellite constellation has been changed during the last year. The highly elliptical orbit meteorological satellite Arktika-M N2 was launched on 16 December 2023. Two polar-orbiting meteorological satellites were launched on 27 June 2023 (Meteor-M N2-3) and 29 February 2024 (Meteor-M N2-4).

Now the Russian constellation of GEO meteorological satellites is fully deployed. Three satellites of Electro-L series are placed in 3 points 14.5°W, 76°E and 165.8°E, approved by WMO in order to provide the coverage of the Atlantic, Indian and Pacific Ocean region.

The Russian constellation of LEO meteorological satellites consists of three Meteor-M series satellites. Meteor-M N2-2 is located in a sun-synchronous “afternoon” orbit (820 km, ascending, equator

crossing time ~15:00, inclination 98.8°). Meteor-M N2-3 is located in a sun-synchronous “morning” orbit (820 km, ascending, equator crossing time ~9:30, inclination 98.8°). Meteor-M N2-4 is also located in a sun-synchronous “morning” orbit (820 km, ascending, equator crossing time ~9:30, inclination 98.8°) satellites are operational with limitations.

Arktika-M N1 satellite is successfully functioning since its input in regular operation in September 2021 and provides observations over the Arctic and contiguous region daily, every 15 minutes, within two six-hour time frames successively from eastern (over Kamchatka) and western (over Iceland) orbit working sections. Routine operations of the Arktika-M N2 satellite started in April 2024, and with another six-hour time frame both HEO satellites provide continuous observations of the Arctic region.

According to the Russian Federal Space Program (2016–2025) the space system for hydrometeorology and environmental monitoring will consist of four polar orbit meteorological satellites, three geostationary meteorological satellites and four highly elliptical orbit satellites.

In the coming two years it is planned to launch the serial satellites Elektro-L N5 (GEO), Meteor-M N2-5 and N2-6 (LEO) and Arktika-M N3 (HEO). The payloads will be a continuity of the corresponding current satellites. The goal is to continue to secure a full operational meteorological constellation replenishing the retiring satellites.

CGMS-52-KMA-WP-04 - **KMA updates since CGMS-51 and report on the medium to long-term future plans on Earth observation (Dohyeong Kim)**

KMA operates GEO-KOMPSAT-2A (GK2A) equipped with meteorological payload, Advanced Meteorological Imager (AMI) and space weather payload, Korea Space wEather Monitor (KSEM).

The GEO-KOMPSAT-2B (GK2B) for the oceanic and environmental mission and equipped with Geostationary Ocean Color Imager-II (GOCI-II) and Geostationary Environment Monitoring Spectrometer (GEMS) is also operational, and data have been released since 2021.

KMA is also working on strengthening the usability of satellite data not only in weather forecasting but also in climate monitoring with a new approach. The new retrieval with GK2A data such as AI-based Convective Initiation (CI) detection, AI-based proxy radar, satellite-based insolation and Ultra Violet (UV) Index, flash drought, and so on.

KMA expanded its GK2A Marine Weather Broadcast Service (MWBS) to provide various digital marine weather information including emergency messages for shipping.

KMA has received approval from the government R&D evaluation for the GK2A follow-on satellite, GK5, and is now preparing to begin the programme.

ISRO asked about the concept of the AI-based proxy radar data. KMA explained that an AI-based GK2A precipitation product has been developed based on training with weather radar data to fill gaps in radar data availability.

CGMS-52-NOAA-WP-01 - NOAA updates since CGMS-51 and report on the medium to long-term (Stephen Volz)

This document summarises the status of NOAA's current and future LEO, GEO, and Space Weather satellite systems. The reporting period for the current satellite operations is 1 June 2023 to 15 June 2024. For future satellites, progress to date at the time of writing is included.

For each of the current satellite programmes, updates are provided for the status of the spacecraft(s), instruments on the spacecraft, ground segment(s), space weather effects, and data transmission. Current GEO missions include GEOS-15, -16, -17, and -18, as well as GOES-U, the last of the GOES-R mission series, which is preparing to launch soon. Current LEO missions include Jason-3, Suomi-NPP, NOAA-15, -18, -19, -20, -21, and plans for JPSS-3, and -4, which are part of the current JPSS-mission series, but have not yet been launched. Current space weather missions include DSCOVR.

For the future satellite programmes, updates are provided on the mission objectives, including spacecraft, payload, instruments, products; and programme status, including space, system and ground segments. Future GEO missions include GOES-U, the mission in the GEOS-R series. Further LEO missions discussed include JPSS -3 and -4, the final two missions in the JPSS series. Future space weather missions include the Space Weather Follow On Mission.

In response to the WMO, NOAA explained that a broad announcement of opportunity will be issued for a GEO-XO central satellite partner payload.

CGMS-52-ECCC-WP-01 - ECCC/CSA updates and reports on the medium to long-term future Earth observation plans (David Harper)

In 2022, Canada released Resourceful, Resilient, Ready: Canada's Strategy for Satellite Earth Observation, which describes how Canada will take full advantage of the unique vantage point of space to address climate change and other key challenges of our time.

With leadership from Environment and Climate Change Canada (ECCC), the Canadian Space Agency (CSA) and Natural Resources Canada (NRCan), Canada has been working to define and advance initiatives to address gaps in the up-, mid- and down-stream sectors of the Satellite Earth Observation (SEO) value chain.

The presentation provided an update on medium-term plans and long-term considerations related to four SEO missions: RADARSAT+ (RADARSAT Constellation Mission - RCM+), High-altitude Aerosols Water vapour and Clouds (HAWC), Terrestrial Snow Mass Mission (TSMM), and Arctic Observing Mission (AOM).

These four missions are intended to address observation gaps for many geophysical variables, including sea ice, ocean winds, snow, weather, greenhouse gasses, air quality, and space weather.

Funding has been secured for RADARSAT+ and HAWC, while TSMM and AOM continue their pre-formulation activities.

In response to ISRO, the ECCC noted that the RADARSAT+ portfolio will ensure C-band SAR data continuity and enable the diversification of SAR data through 2040.

In response to NICT, ECCC explained that the AOM space weather instrumentation will provide in-situ measurements of the space weather environment at the satellite's position.

4. SUPPORT TO OPERATIONAL CLIMATE AND GREENHOUSE GAS MONITORING

4.1 Support to operational greenhouse gas monitoring

CGMS-52-WMO-WP-15 - WMO Global Greenhouse Gas Watch (G3W) initiative and potential implications for the CGMS space agencies, including definition of reference support by CGMS (Gianpaolo Balsamo, remotely)

The WMO Global Greenhouse Gas Watch (G3W) flagship was approved by WMO INFCOM-3 on 19 April 2024 and following the WMO EC-78 on 10 June 2024 will enter its pre-operational phase until 2027, with the initial operations phase lasting from 2028-2031, and entering the enhanced operational phase in 2032. The implementation cost is expected to amount to ca USD 1 Billion. It is WMO's response to the UN sustainability call, via climate action (mitigation) for the climate neutrality goal.

The G3W objective is to fill critical information gaps on greenhouse gases (GHGs), via an integrated operational framework that optimally combines Earth observations with Earth system models using data assimilation and artificial intelligence techniques to reduce uncertainty in assessing the efficacy of climate action. It is policy-relevant information on GHG concentrations and fluxes allowing to assess both the natural and human influence on climate change (https://wmo.int/activities/global-greenhouse-gas-watch-g3w). The Earth system approach is a must-have because Earth's climate responds to the laws of climate physics and depends atmospheric GHGs.

WMO asked CGMS to consider:

- EO satellite-based and surface-based requirements, e.g. for timeliness, the need to satisfy G3W operating centres;
- Provision of regular updates on existing and upcoming GHG satellite capabilities (public and private);
- Co-development of calibration/validation activities in collaboration with satellite agencies and national and regional efforts;
- Linking with private sector to establish data management agreements that preserve the WMO Resolution 1 (unified data policy); and
- The linkage between the G3W and CEOS-CGMS WGClimate GHG roadmap.

CGMS-52-JWGCLIM-WP-04p - WGClimate response to the WMO G3W initiative (Jeff Privette, Chair)

CGMS members contribute to GHG monitoring and the G3W through the following activities:

- The WGClimate is updating and restructuring the GHG monitoring roadmap to better meet the requirements of the G3W and other defined stakeholders;

- The G3W is a highly relevant initiative that will use space observations operationally provided through the CGMS and WMO infrastructures; and
- Pursuant to the Greenhouse Gas Roadmap, WGClimate and its GHG Task Team held its first coordination meeting with the CGMS Working Groups on 3 June 2024 to identify CGMS capabilities that could support the development of an operational space-observation backbone (space and ground) that meets the GHG data and information needs of defined users, including the UNEP's International Methane Emissions Observatory, WMO's Global Greenhouse Gas Watch, and UNEP's recurring Global Stocktake processes.

The WGClimate further noted the following for consideration by CGMS:

- WGClimate requests that the CGMS plenary nominate one individual to represent CGMS as a whole in the WGClimate's GHG Task Team to support the GHG roadmap update, and track the implementation of the roadmap with the respective CGMS Working Groups;
- WGClimate recommends a (bi)annual meeting of the chairs/leads of the WGClimate, its GHG Task Team, and the CGMS Working Groups, building on the success of the 3 June meeting; and
- WGClimate will take the responsibility to coordinate with the WMO G3W on behalf of CGMS and CEOS and will report on the results to future CGMS Plenary sessions.

Discussion on the role and priorities of CGMS in support to the WMO G3W and its relation to the WGClimate

Plenary discussed the following topics:

- The importance of ground-based L2 products and their timeliness, envisioning a timeliness of a month, in the monitoring of the measurement systems of CGMS agencies. The European CO2M mission is expected to be a game changer, and all going well will drive the G3W implementation plan. The monitoring needs to be performed operationally and GSICS has developed best practises how to do so. Nevertheless, this may involve some research elements that should be performed in collaboration with CGMS and CEOS.
- Timeliness requirements for ground-based measurements may be different for data acquisition and comprehensive quality control. At the moment the quality control can take up to as much as one year. WMO together with the CGMS WGI need to address the latency to improve it to the level of one month, to better support the G3W activities.
- The CEOS-CGMS WGClimate GHG roadmap contains several activities on the use of the ground-based data and those should be updated taking note of the operational and scientific needs. The operational parts could be supported particularly by CGMS via its WGs.
- CGMS WG representatives and the leadership of the CEOS-CGMS WGClimate emphasised that the coordination meeting held prior the plenary session has reenergised the relation and provides a better path for a collaboration of developments towards operational systems. Simon Elliott, EUMETSAT, was nominated by the plenary as the focal point between CGMS and the CEOS-CGMS WG on Climate. He will be involved in the update of the WGClimate GHG roadmap;
- To need for sufficient measurement capabilities defined in the upcoming update of the WIGOS Vision that deliver high enough accuracy for G3W purposes. This should include considerations of operational, research, and commercial mission and data providers, envisioning a hybrid architecture for the coming decade;

- Noted that through the CEOS-CGMS WGClimate, CEOS is involved in the GHG roadmap update and also a potential participation in the G3W Advisory Group in its scope.

Following the plenary discussions, the following was decided for the support of the greenhouse gas monitoring:

- The CGMS Working Groups will support the renewal of the GHG roadmap and agreed that Simon Elliott, EUMETSAT, will be the CGMS representative to the WGClimate GHG Task Team. He will support the GHG roadmap update and track implementation with the CGMS Working Groups.
- Further the following actions on greenhouse monitoring will be undertaken by the WGClimate:

  1. Update the GHG roadmap supported by CGMS working groups. Deadline: CGMS-53;

  2. Consult with the WMO G3W on the update of the GHG roadmap and function as reviewer to ensure fitness for purpose, e.g. on coordination and co-developments of calibration/validation activities. Deadline: CGMS-53 (it is expected that work is finished by end of 2024 but reporting and endorsement of the renewed roadmap will be in spring 2025);

  3. Discuss and agree on WGClimate involvement in the G3W planned workshop on optimal network design (as indicated on slide 8 of the G3W presentation). Deadline: Q4/2024;

  4. Discuss meaning and agree on potential content and frequences of GHG satellite capability communication. Deadline: CGMS-53;

  5. Based on existing plans of WGClimate for side meetings, develop joint activities with WMO G3W on contributions to the UNFCCC COP30 in 2025 focusing on common interest themes may also together with GCOS.

4.2 Support to operational climate monitoring

CGMS-52-JWGCLIM-WP-01p - WGClimate key recommendations for CGMS plenary (Jeff Privette, Chair)

In 2024, the Joint CEOS-CGMS Working Group on Climate (WGClimate) is updating three of its key business documents:

1. Its space agency response to the GCOS Implementation Plan (2022), which is exercised in a two-phased approach planned to be finalised at the end of 2024;
2. Its Essential Climate Variable (ECV) inventory gap analysis report and coordinated action plan implementing recommendations from the gap analysis (both documents will be circulated for review in late summer/early autumn 2024. The ECV inventory is currently under a technical restructuring in order to implement decisions on new processes on data-based populations and verification decided by the WGClimate in autumn 2023.

WGClimate seeks CGMS plenary endorsement of its new Vice-Chair nominee: Vincent-Henri Peuch, ECMWF. Following the autumn CEOS plenary, the WGClimate Chair, Jeff Privette, NOAA, will step down, and will be replaced by the current Vice-Chair, Wenying Su, NASA.

In addition, WGClimate proposed a number of smaller revisions to the CGMS High-Level Priorities, which are reflected in the final HLPP revision proposal.

In response to ISRO, WGClimate confirmed that the ECV inventory is based on the GCOS ECV and contains information about climate data records for ECVs but currently excludes model-based ECVs as available from global reanalyses. In addition, the ECV inventory does not rank data records based on absolute quality or applicability.

The CGMS-52 plenary endorsed the nomination of Vincent-Henri Peuch, ECMWF as the new vice chair of WGClimate.

CGMS-52-EUMETSAT-WP-01p – GEO-Ring - reprocessing of data for climate monitoring (Jörg Schulz)

The CGMS agencies EUMETSAT and NOAA started a bilateral activity to reconstruct radiance measurements into a Fundamental Climate Data Record (FCDR) from all historical measurements from imagers in geostationary orbit that form the Geostationary Ring or, in short, the GEO-Ring. The activity has been supported by data provided by JMA and, more recently, by IMD providing additional measurements over the Indian subcontinent and ocean mostly in the 1990s.
The envisioned resulting climatology will come with 30-minute temporal and approximately 0.05° spatial sampling containing all spectral channels. It would start with data in the mid-1970s and extend to today's much more advanced measurements spanning 50 years' worth of data. The FCDR enables the creation of a large amount of quasi-global atmospheric, atmospheric, oceanic, and terrestrial geophysical climate data records, has good potential of being used in NWP model-based re-analyses and can serve as an input to machine learning applications.

The presentation highlights the steps that need to be undertaken to generate the FCDR (data rescue, quality control, sensor re- and cross-calibration, production, and validation). In addition, it presents a new way of co-developing and distributing the data records using cloud environments. This new way requires a detailed consideration of applicable data policies of participating agencies to make this most beneficial for the users.

Agencies with interest in participating in the GEO-Ring work can contact Jörg Schulz (EUMETSAT, Joerg.Schulz@eumetsat.int) and Andrew Heidinger (NOAA, Andrew.Heidinger@noaa.gov) to discuss possible involvement. This can be on providing data, support integration of data into the L1 GEO-Ring, performing applications on the GEO-Ring data, e.g. deriving L2 and provide feedback to the project.

CGMS plenary asked the GEO-Ring project members to analyse the data policy situation for their historic and current geostationary imager data (inclusive of levels containing count data and calibration coefficients) for usage within cloud infrastructures and redistribution freely and without restrictions from cloud infrastructures and data stores to the benefit of users of and with agencies participating in the GEO-Ring project and to define a way forward. An action was raised accordingly:

CGMS-52 plenary action					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
GEO-Ring project members	4, 8	A52.03 (new)	**GEO-Ring:** CGMS asked the GEO-Ring project members to analyse the data policy situation for their historic and current geostationary imager data (inclusive of levels containing count data and calibration coefficients) for	CGMS-53	**OPEN**

CGMS-52 plenary action					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
			usage within cloud infrastructures and redistribution freely and without restrictions from cloud infrastructures and data stores to the benefit of users of and with agencies participating in the GEO-Ring project and to define a way forward.		

In the discussion, CGMS plenary also encouraged the GEO-Ring project leading entities (and applicable CGMS space agencies) to consider the wider impact of its work, e.g. on data policies in future lesson learnt exercises.

In addition, CGMS plenary encouraged the GEO-Ring project leading entities (and applicable CGMS space agencies) to evaluate production and dissemination of GEO-Ring data at low latency (~5 days), which will support climate services with timely data delivery and explore further extensions with imager data from polar orbit to become truly global, and with atmospheric sounding instrument data to further increase the capabilities of such a data record.

5. WORKING GROUP REPORTS

5.1 SATELLITE DATA AND PRODUCTS – WGII

CGMS-52-WGII-WP-02 - **WGII key recommendations to CGMS plenary incl. ITWG, IPWG, IWWG, IESWG and AI matters (J V Thomas)**

WGII presented the main highlights from its meeting last April related to agency reports, the commercial sector and Earth observation, AI/ML survey and updates, salient points from GSICS, and the CGMS International Science Working Groups.

WGII acknowledged the work performed by GSICS, highlighting its significant relevance to the CGMS community since it fully supports ongoing activities and newly proposed teams. Relevant topics under the International Science Working Groups include the support of an open data policy for purchasing commercial Radio Occultation (RO) data, acknowledging the growing capacity of commercial companies, the new cloud product intercomparison, the encouragement to CGMS agencies to develop model-independent quality information for the Atmospheric Motion Vector (AMV) 3D winds.

WGII recommended to plenary for endorsement Clara Draper (NOAA) as new co-chair and rapporteur of IESWG, Lihang Zhou (NOAA) as new rapporteur of ITWG, and Vincent-Henri Peuch (ECMWF) as Vice-Chair of the joint WGClimate.

The working group also proposed a number of smaller changes to the CGMS High-Level Priority Plan, that were endorsed by the CGMS-52 plenary.

The AI survey analysis was presented and discussed during the WGII meeting. Nearly all agencies have some experience with AI, though their experiences vary, and the regular use of current models is mixed. Agencies are still developing model types and acquiring expertise and computing resources,

especially for machine learning. Data curation, particularly obtaining high-quality, training-ready data, is a priority. Members express a desire for cooperation through information sharing and joint activities focused on data curation and model development. The AI/ML activity will continue to be followed by WGII in coordination with other WGs.

The ROMEX initiative is currently an important international cooperation effort to support CGMS members' future choices. It would be useful to continue analysing the broader picture of satellite radio-soundings, considering both MW and IR. The development of several AI-related datasets, such as those for precipitation, will necessitate a careful analysis of the level of observational reliability of such datasets.

CGMS members were requested to nominate candidates to take on the WGII co-chair role and CGMS-52 plenary thanked JV Thomas, ISRO, for his years as WGII co-chair. Plenary further endorsed Lihang Zhou, NOAA, as the new rapporteur for the ITWG, and noted that plenary had endorsed Vincent-Henri Peuch as the new Vice-Chair of WGClimate from late 2024.

The main actions include following up on the selection of a new co-chair, ensuring the proper linkage between the CGMS International Science Working Groups and GSICS for better analysis of calibration issues, co-leading the AI data curation under CGMS, and providing feedback on data and methodological standards.

CGMS-52 plenary actions					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	5	A52.02	**WG reports to plenary:** Members to provide nominations for the WGI co-rapporteur, WGII co-chair position, and WGIV co-chair in particular, as well as other open positions as per https://www.cgms-info.org/Agendas/WP/CGMS-52-CGMS-WP-11p	30 Jun 2024	**OPEN**

CGMS-52-WGII-WP-04 - AI-ML next steps: proposed use cases for CGMS (Paolo Ruti)

In the framework of WGII, the group proposed to take the AI/ML discussion forward in the framework of CGMS by applying it to selected use cases encompassing:

- Data curation activities to build best practices for AI readiness, considering also standards for data processing and formats;
- Cooperation across international working groups on ML applications; and specific collaborative projects under CGMS.

WGII proposed to start focusing on a few use cases, i.e.:

a) Constructing robust data sets for training of ML prediction systems, especially at regional scale
b) Supporting ML Nowcasting development
c) (at a later stage, this could be expanded to Space weather use cases)

In order to do so, one would need to select satellite parameters, re-grid functions, assess the impact on ML systems, and work with ML experts to build lesson learnt on standards.

In terms of responsibilities, WGI need to address standards; WGII for selection, quality and methods; and WGIV for ML operations.

To assure this is taken forward, a CGMS leading entity is needed to take on the coordinator role across relevant working groups.

During the discussion, CGMS community agreed on the relevance of this topic and suggested to have two leading entities to be engaged into the next steps. Additionally, the extension to a Space Weather use case could already be planned and implemented involving the Space Weather Coordination Group.

CGMS-52 plenary actions					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	5 (8)	A52.04	**AI-ML next steps: proposed use cases for CGMS** CGMS members to provide comments and feedback on the proposals in https://www.cgms-info.org/Agendas/PPT/CGMS-52-WGII-WP-04 CGMS members to nominate two focal points of contact as leading entity to pursue this activity. Following feedback, CGMSSEC will address next steps with WGI, WGII and WGIV leading entities.	30 Jun 2024	**OPEN**

CGMS-52-ICWG-WP-01p - ICWG key recommendations to CGMS plenary (CGMS International Cloud Working Group) (Andrew Heidinger, rapporteur)

The ICWG held its 3rd meeting in EUMETSAT on 26-28 February 2024. There were two main recommendations to CGMS resulting from the meeting:

Recommendation 1:
Need for continued support from CGMS agencies for their algorithm teams' involvement in the cloud property intercomparison, which has been identified as a high priority activity of ICWG and is seen as a key pathway to evaluate and provide feedback on the ISCCP-NG/GEO-Ring development activities.

Recommendation 2:
Encourage collaboration between the IWWG and ICWG on identifying ISCCP-NG golden days that can make available cloud height retrievals for evaluation by the AMV community.

Discussion

The ICWG and the CGMS Plenary noted that the success of the intercomparisons operated by the ICWG requires effort by the space agencies and there is no dedicated funding to perform this analysis. The

ICWG stresses that the past intercomparisons have helped drive the improvements in cloud products and their usage seen in the last decade. The ICWG is also very interested in the application of AI/ML algorithms and noted that several agencies have already moved in that direction. The ICWG reiterated the desire for the ISCCP-NG/GEO-RING data to be available without restriction from all participating space agencies.

CGMS-52-GSICS-WP-01p - GSICS Executive Panel report to CGMS (Bojan Bojkov, Chair)

The GSCIS EP Chair reported on the recent Global Space-based Inter-calibration System – GSICS activities:

The annual meeting of GSICS took place at EUMETSAT from 11-15 March 2024 with participation from operational and R&D space agencies, as well as with representatives from commercial companies. In addition, to the GSICS working sub-group meetings, two plenary sessions were organised to address specific topics, including lunar calibration, polarimeters, microwave calibration, commercial data challenges, etc. The GSICS EP will continue to be held in conjunction with the annual meeting starting from this year (carbon footprint savings). The newly established Space Weather sub-group started its work within GSICS over the last year and held its first in-person Space Weather subgroup meeting on the occasion of the annual meeting.

GSICS is very active and there is a growing interest in the GSICS activities as well as an increased participation across space organisations.

The current GSICS achievements for level-1 monitoring are:

• GSICS tools and SOPs implementations at EUMETSAT
• Combination of 10+ years of GSICS efforts and developments
• Operational monitoring in place at EUMETSAT for MSG/Seviri, Sentinel-3 optical, MTG/FCI

Available GSICS tools are important for the monitoring and interoperability of the global observing system, standardised reporting of agency performance is essential for usability; the tools can also help characterise a mission with significant calibration issues; further, GSICS developed best practises and tools which are being implemented across new instrument areas such a microwave constellation, polarimeters, and lunar model characterisation.

CGMS-52-IROWG-WP-03 - ROMEX - Status and first lessons learned (Hui Shao (Co-chair))

During the 2022 IROWG Workshop, the IROWG community proposed a collaborative effort to explore the impact of RO observations: the so-called Radio Occultation Modeling Experiment (ROMEX). ROMEX is currently underway and seeks to quantify the benefit to NWP of increasing the quantity of RO observations using additional observations that were not available to weather centres for their real-time operational systems. While ROMEX is advancing towards NWP experiments, the following first lessons learned are noted:

- Acquiring and licensing data required extensive efforts with commercial providers and agencies;
- All datasets exhibit high quality sufficient for NWP experiments with proper data processing and quality control;

- Mixing datasets from different providers requires expertise on the customer/user side;
- Rawer-level data (e.g. Level 0 and Level 1) are needed for consistent data quality; and
- Commercial data may face critical risks in global coverage and uniform distribution in space and time due to "launches of opportunity".

5.2 SATELLITE DATA AND PRODUCTS - WGII - GNSS DATA BEYOND RO

CGMS-52-CGMS-WP-17 - Potential applications of GNSS data (reflectometry, polarimetry) (Christian Marquardt, remotely)

This presentation provided an overview on GNSS-based remote sensing methodologies beyond ordinary Radio Occultation (GNSS-RO) soundings. These include:

- Polarimetric RO (GNSS-PRO): Heavy precipitation and ice particles in clouds;
- GNSS Reflectometry (GNSS-R): Grazing GNSS-R, sea ice extent, freeboard height and ice characteristics; altimetry over (very) calm surfaces;
- Near-Nadir GNSS-R: Over ocean: surface winds, mean square slope, sea ice extent and characteristics; Over land: soil moisture, flooding and inundation, biomass;

These methodologies currently experience considerable scientific evolution but are not yet as mature as ordinary RO. GNSS-R measurements, in particular, strongly depend on calibration, which is difficult for GNSS signals.

CGMS-52-NOAA-WP-10 - Other data applications - Status in the US (Ed Grigsby)

NOAA discussed GNSS data applications beyond Radio Occultation, in particular, on NOAA's use of GNSS Reflectometry (GNSS-R). It covered current and upcoming commercial and government GNSS-R systems and products, and the ongoing NOAA Ocean Surface Winds (OSW) Pilot activities.

CGMS-52-joint-ESA/EUM-WP-01 - Other GNSS Data Applications – Status in Europe (Christian Marquardt, remotely)

EUMETSAT and ESA described their recent and future activities focusing on GNSS-based remote sensing techniques other than RO in Europe. The highlights include:

- HydroGNSS: A 2-satellite near-Nadir GNSS-R mission focusing on land applications (but with ocean products as well) to be launched in late 2024; and
- Studies on the impact of GNSS-R and -PRO data in NWP have been kicked off or are under discussion; and
- European scientists collaborate on the evaluation of commercial GNSS-R data within NOAA's Ocean Surface Winds pilot procurement.

CGMS-52-CMA-WP-19 - GNSS reflectometry data applications - Status in China (Na Xu)

CMA noted that the use of GNSS observation instruments is a very promising technique which can easily be implemented on various satellite platforms. Beyond RO, GNSS reflectometry has experienced great growth recently in China. Notably,

- Each Fengyun-3 satellite is equipped with GNSS remote sensing instruments (GNOS), and since FY-3E, each satellite has both RO and reflectometry instruments.
- GNSS observation also has a good development in commercial satellites, most of them have both RO and reflection instruments.
- The application of GNSS reflectometry in China basically focuses on NWP supporting ocean, land and cryosphere research.

CMA indicated that GNSS-R in China is able to cover three crucial hydrological variables in order to model the Earth's climate in the following areas: soil moisture, ocean winds, and ice identification. However, GNSS-R applications are not limited to these three uses but extend to other applications as well. Land applications have evolved considerably in the past few years for vegetation opacity, and wetland detection and flood inundation monitoring.

Further, GNSS-R applications with either a single or a limited number of satellites, could mainly be used to support NWP assimilation. More commercial constellations and global data sharing need to be encouraged to maximise its benefits.

CGMS-52-ISRO-WP-04 - Other applications - Status in India (verbal) (Rashmi Sharma)

GNSS-reflectometry has opened a new era of space technology with low cost and complimentary to conventional remote sensing sensors. In this context, ISRO's first GNSS-R mission is the first of its kind with dual frequency (L1+L5) operation utilising both GPS and IRNSS constellations as Technology Demonstration Satellite (TDS) EOS-08 (Microsat-2C) will be launched using Small Satellite Launch Vehicle (SSLV)-D3 and is planned to be injected into 480 km Low Earth Orbit (LEO), its orbital plane will be inclined at 37° from the Earth equatorial plane.

GNSS-R is designed to receive GPS signals in the L1 band (1575.42 MHz ± 1.25 MHz) and IRNSS signals in the L5 band (1176.45 MHz ± 1.25 MHz) through Precise Orbit Determination (POD) and the reflectometry antennas. POD receives direct GNSS signal and is mainly meant for positioning and direct signal strength estimates. The reflectometry antenna receives reflected signals from the Earth surface and is meant to estimate the surface roughness of Earth. The major advantage of this payload is using signals of opportunity for remote sensing of land, ocean and the cryosphere. This payload can complement traditional Earth observation satellite data for ocean surface winds, soil moisture, inland-waterbody detection etc. Observations are planned over globally selected targets including Indian regions.

Discussion

NOAA pointed out that GNSS-R provides a wide range of research applications apart from NWP, although a lot of research will be required before the potential of these measurements can be fully exploited. As the need for large occultation numbers is common to all GNSS-based observation technologies, the challenges identified by ROMEX will apply to these new techniques as well.

5.3 OPERATIONAL CONTINUITY AND CONTINGENCY PLANNING - WGIII

CGMS-52-WGIII-WP-05 - WGIII key recommendations to CGMS plenary (Irene Parker, co-chair)

Irene Parker (NOAA) presented Working Group III key recommendations to plenary related to the WGIII activities since CGMS-51. Following the presentation, plenary:

- endorsed Dr. TANG Shihao to serve as new co-chair of WGIII;
- accepted the CGMS Risk Assessment (outcome of the 6th CGMS Risk Assessment workshop);
- adopted the WGIII proposed changes to the CGMS Baseline
    - Add L5 to the list of orbits considered by CGMS for exploitation
    - Adjust the attributes for the following Sensors:
        - Hyperspectral Infrared Sounder: Update GEO Range to 86.5˚E - 140˚E
        - Multipurpose Meteorological Imagers: Add “A day-night visible channel in the
        - LEO early morning and afternoon orbits”
        - Coronagraph: Add L5 and remove references to a GEO Range
        - EUV Imager: Remove reference to specific GEO positions; and
- endorsed the CGMS Best Practices for Commercial Data Buys.

WGIII had also agreed to further discuss about the use cases of day-night visible channel in the upcoming WGIII intersessionals.

The group also proposed a number of changes to the CGMS High-Level Priority Plan, that were endorsed by the CGMS-52 plenary:

Proposed for closure:

1.1.2 Ensure continuity of precipitation radar observations;

1.1.5 Ensure continuity of coronagraph, plasma analyser and magnetometer observations from L-1 through exploitation of scientific space weather missions for operational gap filling;

1.2.12 Move towards an operation space weather monitoring capability from the Lagrangian Point 5;

1.2.15 Work towards auroral monitoring capabilities; and

1.6.3 Develop best practices/templates: for End User License Agreements/Procurements, for considering the value of public access and the additional costs of data sharing rights, Incl. quality control consideration.

Proposed for removal:

1.2.5 Work towards optimising the distribution of planned scatterometer missions across different polar and inclined non-synchronous orbits to achieve the 6-hour sampling requirement of the WIGOS and resolve diurnal variations; and

1.4.2 Develop capacity to assess socio-economic benefits of CGMS satellite missions.

Proposed edits:

1.2.9 Advance the atmospheric radio occultation constellation, with the long-term goal of providing 20000 occultations per day **with uniform spatial and local time coverage** on a sustained basis.

WGIII further encouraged CGMS Members to participate in the 7th Risk Assessment Workshop on 25-27 February 2025 (virtual meeting) and to consider presenting under the two WGIII standing agenda items: Socio-economic benefits and Relationship with the private sector.

CGMS-52-WGIII-WP-01p - Key outcomes of the 6th risk assessment (Melissa Johnson)

The main findings of the 6th risk assessment identified potential risks as concerns commitment for low-inclination RO observations after COSMIC-2 towards the end of the decade, as there is no commitment for a follow-on to COSMIC-2, as well as for long term continuity (early/mid 2030) of SAR and high-resolution optical imager observations, solar energetic particles, magnetometer and plasma analyser observations on L1.

Plenary took note of the further details of the latest risk assessment updates presented.

CGMS-52-WGIII-WP-02p - Future direction 2022+: Best practice on CGMS commercial data procurements (Mara Browne)

The overarching goal of the CGMS Futures 2022+ Project: Relationship with the Private Sector theme is to leverage the opportunities of a rapidly growing commercial space sector while maintaining operational data standards and open data sharing. The best practice document on CGMS commercial data procurements is intended to help CGMS members and observers develop a shared understanding of the range of member agencies' views and practices in relation to operational use of commercial Earth observations. Although the practice of government agencies purchasing commercial data is still in its relatively early stages and most CGMS members are not purchasing data at this time, this document is intended to provide a snapshot of members' current commercial data purchase programs and to present some guidance regarding best practices based on the experiences of those agencies to date. The best practices document focuses on operational commercial data purchases. While commercial data purchased for research purposes is out of scope of this document, many of the practices outlined here would also apply. These eight best practices below for commercial data purchases have been identified by WGIII and were approved at CGMS Plenary-52:

- Best Practice BP.01: Ensure that international data policies are upheld, especially pertaining to the free and unrestricted sharing of government earth observations data.
- Best Practice BP.02: Include language to purchase unique data sets when purchasing commercial data.
- Best Practice BP.03: Ensure service standards.
- Best Practice BP.04: Facilitate interoperability between private and public sector data.
- Best Practice BP.05: When procuring commercial data, consider using standard open data licenses to define any restrictions on use.
- Best Practice BP.06: CGMS Members should communicate their commercial space policy to other (all) CGMS Members.
- Best Practice BP.07: Ensure the best value when deciding whether to enter into a contract.

- Best Practice BP.08: Ensure a vibrant research enterprise.

CGMS-52-WGIII-WP-07 - **Update of the CGMS baseline**

The proposed update to the CGMS baseline was presented by WGIII and endorsed by the CGMS-52 plenary (see CGMS-52-WGIII-WP-05 **-** WGIII key recommendations to CGMS plenary).

5.4 SATELLITE SYSTEMS AND OPERATIONS – WGI

The CGMS-51 WGI meeting took place on 22 April 2024. All Task Groups presented the progress of their respective activities since CGMS-51.

The following key WGI recommendations to CGMS plenary were highlighted:

The WGI Terms of Reference have been updated to reflect the evolved scope of the group over the recent years (including topics such as Low Latency Data Access, Space Environment Sustainability, and Radio-Frequency Interference (RFI) detection, monitoring and mapping). WGI recommended and plenary endorsed the updated CGMS WGI Terms of Reference (**CGMS-52-WGI-WP-16** - WGI Terms of Reference Update).

A proposal for an Enhanced DCP transmitter (EDCP) standard, prepared by the WGI Task Group on DCS, was presented. The benefits of the standard, proposed funding approach and timeline, as well as operational usage and transition, were detailed. WGI recommended and plenary endorsed the EDCP standard, as well as the proposed plan for activities leading up to declaring the EDCP standard as operational, and related timeline and funding approach (**CGMS-52-WGI-WP-17** - EDCP Transmitter Standard Proposal).

WGI recommended to capture the process used for the analysis of Hybrid Space Observation Architectures and subsequently re-apply it for specific cases identified by WGIII's Gap Analyses and plenary concurred.

WGI recommended and CGMS Plenary endorsed James Donnellon (NOAA) as new WGI Co-Chair, replacing Sean Burns (EUMETSAT). CGMS members are requested to nominate a representative for the co-rapporteuring of WGI.

CGMS-52 plenary actions					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	5	A52.02	**WG reports to plenary:** Members to provide nominations for the WGI co-rapporteur, WGII co-chair position, and WGIV co-chair in particular, as well as other open positions as per https://www.cgms-info.org/Agendas/WP/CGMS-52-CGMS-WP-11p	30 Jun 2024	**OPEN**

WGI also invited nominations to all WGI Task Groups by all agencies, noting especially the more recently formed Task Group on Space Environment Sustainability and Task Group on RFI, as well as the benefits of membership from all agencies in the Task Group on DCS.

All the above WGI recommendations were endorsed by CGMS-52 Plenary.

Additionally, the following informational items were highlighted:

The WGI Task Group on Low Latency Data Access (LLDA) has completed the SWOT analysis of current LEO weather satellites systems, identifying how low latency data access solutions could help in improving timeliness globally. In the lead up to CGMS-53, the Task Group will work on identifying concrete CGMS actions based on the LLDA SWOT, including priority areas and demonstration cases in agencies. E.g. cloud, TT&C, relation with private sector.

The WGI Task Group on RFI has progressed on developing Best Practices for frequency spectrum protection, along with methods for monitoring and tracking interference issues. Draft set of best practices based on common aspects of already existing or planned for adoption approaches are to be presented for endorsement by CGMS-53. The Group will also explore potential and existing uses of AI/ML and pattern recognition in RFI detection.

The WGI Task Group on Space Environment Sustainability has been established and foundations laid with Terms of Reference. This will cover all aspects of operations in the space environment, with CGMS member coordination to support improvements in safety and sustainability of space operations for all space actors. Objectives include best practices for space traffic coordination, lifetime extensions, end-of-life disposal and mitigations of risk and effects of space weather.

NOAA Small Satellite project, which aims to determine if DCS can support satellites equipped with Data Collection Platforms (DCPs), has progressed and the initial concept for satellite use of DCS has been successfully validated through TES-10. Concept is valid and DCS can be utilised by satellites to some definable degree. In the lead up to CGMS-53, the Task Group on DCS will collect inputs from the DCS Satellite Operators on how their policies affect the usage of Smallsat.

The WGI Task Group on Satellite Data and Codes work is ongoing with successful development of new BUFR encoding sequences and Common Code Table entries.

The SFCG-CGMS liaison Markus Dreis presented the frequency management outcomes of the World Radiocommunication Conference 2023 (WRC-23). All WRC-23 agenda items of relevance for CGMS were positively concluded, with the views expressed in the corresponding HLPP and also in-line with the WMO positions as presented to WRC-23. Markus also presented the WRC-27 agenda items of relevance to CGMS, which have been included in the HLPP. (**CGMS-52-WGI-WP-10** - WGI key recommendations to CGMS plenary (Sean Burns, co-chair/Markus Dreis, remotely).

The WGIV proposed a number of changes to the CGMS High-Level Priority Plan, that were endorsed by the CGMS-52 plenary (CGMS-52-CGMS-WP-13wgi - HLPP associated with WGI).

5.5 DATA ACCESS AND END USER SUPPORT - WGIV

CGMS-52-WGIV-WP-01p - WGIV key recommendations to CGMS plenary (Kotaro Bessho, co-chair)

The CGMS WGIV Cloud Services Expert Group has compiled a set of Best Practices. These have been reviewed by WGIV.

WGIV recalled its commitment to review CGMS members' adherence levels to the CEOS Data Preservation Guidelines and will follow up on this at its forthcoming meetings.

CGMS agencies were asked to consider nominating additional members for the Task Group on Data Access/Exchange. This key Group will have within its scope the global data exchange mechanisms used to ensure availability of key satellite data.

WGIV confirmed the continued availability of Kotaro Bessho (JMA) and as co-chair, and Simon Elliott (EUMETSAT) and Natalia Donoho (WMO) as WGIV rapporteurs. WGIV co-chair Prof. Asmus (ROSHYDROMET) has stepped down and CGMS members are requested to provide nominations for a new WGIV co-chair.

Plenary took note of the WGIV report, endorsed the Best Practices proposed by the CGMS WGIV Cloud Services Expert Group, and encouraged members to nominate a new co-chair for WGIV.

CGMS-52 plenary actions					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	5	A52.02	**WG reports to plenary:** Members to provide nominations for the WGI co-rapporteur, WGII co-chair position, and WGIV co-chair in particular, as well as other open positions as per https://www.cgms-info.org/Agendas/WP/CGMS-52-CGMS-WP-11p	30 Jun 2024	**OPEN**

5.6 SPACE WEATHER COORDINATION GROUP – SWCG

CGMS-52-SWCG-WP-01 - SWCG key recommendations to CGMS plenary (Tsutomu Nagatsuma, co-chair)

The SWCG informed plenary on:

- Significant progress made in coordination of operational space weather data provision and improving data access and quality to an increasingly mature user community;
- The need for CGMS members to continue to operate and plan new space weather missions to meet the user needs;
- Operational thermospheric density measurements are crucial to effective space traffic coordination are proposed to be included in the CGMS Baseline /HLPP for the first time;
- The CGMS satellite anomalies compiled since 2015, and proposed to be published on the CGMS website, to provide better insight into the resilience of satellite missions against space

weather effects. However, only a few CGMS members are currently providing data and the objectives of the database cannot be achieved without more data from CGMS members and other operators; and

- Improving data access outreach events in Asia, Europe and USA are an important activity of the SWCG Task Group and are now being extended to encompass both space-based and ground-based observations covering operations and research users as compatibility in the approach to coordination needs to be maintained.

Plenary took note of the SWCG report, approved the nomination of Jesse Andries (WMO) as co-rapporteur to the SWCG and agreed that a dedicated CGMS-53 plenary agenda point on space weather issues should be considered.

6. FUTURE DIRECTION OF CGMS 2022+

CGMS-52-CGMS-WP-04 - CGMS future direction 2022+ project - High level statement (Mikael Rattenborg)

The 51st CGMS plenary endorsed the CGMS future direction 2022+ project in June 2023 (Ref. CGMS-51-CGMS-WP-04). CGMS-51 further agreed to create a statement on the optimum composition of hybrid architectures (combining reference platforms, small satellites and procurement of commercial data) for fulfilling the operational observation requirements of CGMS members in the future, recognising the rapidly changing environment in small satellites and the commercial sector. In particular, identification of complementarity and associated merits between the three different aspects of a hybrid system, the provision of recommendations on an optimal mix to obtain essential observations, provided with very high reliability, and on how to fulfil the "backbone" observing requirements.

A writing team was composed by CGMSSEC and nominated members: YANG Lei/CMA, Sid Boukabara/NASA, and Heikki Pohjola/WMO.

The draft high-level statement was circulated to members prior to the plenary session, and the CGMSSEC presented the final draft version and subject to a few smaller adjustments the CGMS-52 plenary endorsed the statement.

Information on the various themes and progress by the various working groups is provided here: **CGMS-52-CGMS-WP-03**: CGMS future direction 2022+ themes - status (future information technologies; future observing (hybrid) space infrastructure - passive microwave observations; private sector relations; research to operations; socio-economic benefits; space situational awareness; climate and Earth system monitoring; support to developing countries). They will continue to be addressed within the framework of the CGMS working groups.

7. REVIEW OF CGMS PLENARY ACTIONS AND RECOMMENDATIONS

7.1 REVIEW OF ACTIONS FROM CGMS-51 AND NEW ACTIONS FROM CGMS-52

CGMS-52-CGMS-WP-11p - CGMS representatives and nominations (CGMS WGs, ISWGs, GSICS, VLab, WMO and other initiatives) (Anne Taube)

The CGMS Secretariat presented the current status of CGMS representatives in the various CGMS working groups, international science working groups and other teams and initiatives.

The CGMS members were asked to provide nominations to cgmssec@eumetsat.int for the following activities as follows:

CGMS-52 plenary actions					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	5, 8	A52.02	**WG reports to plenary:** Members to provide nominations for the WGI co-rapporteur, WGII co-chair position, and WGIV co-chair in particular, as well as other open positions as per https://www.cgms-info.org/Agendas/WP/CGMS-52-CGMS-WP-11p	30 Jun 2024	**OPEN**

Items CGMS-52-EUMETSAT-WP-13p - Proposed CGMS-52 summary conclusions on support to operational climate and greenhouse gas monitoring (Joerg Schulz) and CGMS-52-WGII-WP-04 - AI-ML next steps: proposed use cases for CGMS (Paolo Ruti) are addressed under sections 4 and 5 above).

CGMS-52-CGMS-WP-15 - Status of CGMS-51 plenary actions (Anne Taube)

The actions were circulated to participants for review and feedback by 30 June 2024.

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
CGMS members	8.2	A47.11	Climate session: CGMS members to endorse (through a written procedure) the ECV inventory gap analysis report and updated coordinated action plan	06 Jun 2024 Report and action plan expected for distribution July 2024 **14 May 2024** The report and action plan is almost finished and can be distributed to delegations most likely next week. Plenary will be requested to endorse both documents at the CGMS-52 plenary session. In case more time is needed for the review, written endorsement may be provided by end June 2024. **2023 27 Jun:** Status and way forward was presented to plenary CGMS-51-JWGCLIM-WP-02 EXT. The draft Gap Analysis Report is under preparation, the previous two gap analyses exercises v3 + v4 will be merged) expected to be ready in the latter half of 2023. The HLPP will also be updated to reflect the targets. **2023 6 Jun:** Status and way forward will be presented to CGMS-51 plenary (CGMS-51-JWGCLIM-WP-02). The draft Gap Analysis Report is under preparation, the previous two gap analyses exercises v3 + v4 will be merged) expected to be ready in the latter half of 2023. **(2023 2 Jun:** CGMSSEC/WMO Considerations to link this to the outcome/next steps of the CGMS future direction project. TBD/TBC.)	July 2024 (CGMS-52, Nov 2023, Dec 2022, Oct 2019)	**ONGOING**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				2023 Apr: WGClimate presented the status of affairs incl. that of the GHG TT and requests to the CGMS members CGMS-51-JWGCLIM-WP-01 EXT **2023 3 Feb:** CGMSSEC has contacted Jeff Privette, Chair WGClimate, for a status update. **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). **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		

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				endorsement is planned for Dec/Jan timeframe depending on review results.		
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.	**25 Apr 2024**DIscussed in WGIII, the CGMS baseline document will be updated accordingly and be presented to plenary 52. **2023 22 Nov:** (Monitored in the framework of WGIII). **2023 2 Jun:** Included in the HLPP. To be reviewed anew at the 6th risk assessment workshop in 2024. **2023 23 Feb:** Addressed at the 5th CGMS risk assessment workshop (21-23 Feb 2023) to be reviewed at the 6th CGMS WGIII risk assessment workshop 2024.	CGMS-52 (CGMS-51)	**CLOSED**
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.	**02 Jun 2024** With the formal establishment of the CEOS COAST initiative (Apr 2024) is expected to be completed as one of the initial tasks of this new CEOS initiative. **2023 22 Nov:** CEOS Plenary approved an initial proposal to establish at COAST Virtual Constellation last week. Final approval will be at CEOS SIT in April (9-11 April 2024) where the TOR and implementation plan will be finalised. **2023 23 March:** Following discussions between CGMS members this action has been transferred to the CEOS COAST initiative (The Coastal Observations Applications Services and Tools (COAST) Ad Hoc Team [EXT]). To be reported upon to CGMS-52. **2023 12 Feb:** A first analysis of the latest CGMS WGIII tables by the CEOS VC co-Chairs has not	CGMS-52 (Sep 2022)	**CLOSED**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				identified any gaps for the core space-one marine measurements. Two issues to be followed have been flagged: a) the delay in JAXA's AMSR-3 and the impact on high-latitude SST; and b) the potential change in technology (TBC) for the Sentinel-3NG altimeters that could lead to some disruptions in the SSH time series in the mid-2030s. A second iteration is ongoing with the appropriate CEOS VC and consolidated findings will be reported to WGIII in April.		
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).	02 Jun 2024 Expected to be undertaken by the CEOS COAST initiative (as per ref. action A50.02). **2023 23 March:** Following discussions between CGMS members this action has been transferred to the CEOS COAST initiative (The Coastal Observations Applications Services and Tools (COAST) Ad Hoc Team [EXT]). To be reported upon to CGMS-52. **2023 22 Feb:** CGMSSEC (through EUMETSAT) proposes to address this action/topic on occasion of OSOS-3, 12-15 June, and to provide an ocean community response to/on the state of operational oceanography satellite missions. **2023 12 Feb:** Delay expected. Currently anticipated for CGMS-52 in 2024.	CGMS-52 (June 2023)	**CLOSED**
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.	**2023 Jul:** Closed following the GSICS-EP meeting. GSICS-EP Chair: EUMETSAT Bojan.Bojkov@eumetsat.int	July 2023 (Dec 2022)	**CLOSED**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
			Please provide nominations to cgmssec@eumetsat.int and ~~mitch.goldberg@noaa.gov~~ (left NOAA)	GRWG Chair: EUMETSAT Mounir.Lekouara@eumetsat.int **2023 2 Jun:** Expected to be addressed on the occasion of the upcoming GSICS EP (after CGMS-51 plenary) and as far as is possible closed.		
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~~ (left NOAA)	**24 Apr 2024**Group established and confirmed in the framework of the CGMS-52 SWCG, April 2024 **2023 2 Jun:** Expected to be addressed on the occasion of the upcoming GSICS EP (after CGMS-51 plenary) and closed. **2023 8 Feb:** Current list of members of the task group on intercalibration of high energy electron sensor: • **CMA** Jianguang Guo • **ESA** Piers Jiggens, Hugh Evans, Melanie Heil, Juha-Pekka Luntama (from ET-SWx, WMO) • **EUMETSAT** Andrew Monham, Tim Hewison • **KMA** Dohyeong Kim, JaeYoung Byon (jybyon@korea.kr), Daehyeon Oh (update 17 Jan '24) • **NASA** Jim Spann • **NICT** Tsutomu Nagatsuma • **NOAA** Elsayed Talaat, Terry Onsager, Brian Kress, Juan Rodriguez	July 2023 (Dec 2022)	**CLOSED**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				• **ROSHYDROMET** Konstantin Ts. Litovchenko (TBC)		
CGMS space agency members	WGI report	A51.01	CGMS agencies to nominate additional members for all the WGI Task Groups, in particular those where no representatives of the agencies are currently participating in the Task Group(s). • **New WGI TG: WGI TG on Radio Frequency Interference Issues** • **WGI TG on Satellite Data and Codes** • **Recent merge of two WGI TGs: WGI TG on Low Latency Data Access** • **WGI TG on Space Environment Sustainability** • **WGI TG on Data Collection Services**	06 Jun 2024 Status provided in CGMS-52 WGI report https://www.cgms-info.org/Agendas/PPT/CGMS-52-WGI-WP-10. Action expected to transition from plenary to WGI from CGMS-53 as necessary. • **WGI TG on Radio Frequency Interference Issues** *TG Chair: NOAA Beau Backus* CMA NIE Jing, niejing@cma.gov.cn CMA WU Shengli, wusl@cma.gov.cn ECCC Casey Alec, alec.casey@ec.gc.ca ESA Soldo Yan, yan.soldo@esa.int EUMETSAT Elliott Simon, simon.elliott@eumetsat.int EUMETSAT Dreis Markus, markus.dreis@eumetsat.int EUMETSAT Nikolova Karolina, karolina.nikolova@eumetsat.int KMA Kim Dohyeong, dolong@korea.kr KMA JungHun CHOI, jhchoi75@korea.kr (Jan '24) NOAA Backus Beau, Beau.Backus@noaa.gov NOAA Dronen Skip, william.dronen@noaa.gov WMO Jesse Andries, jandries@wmo.int	CGMS-52 (Sep 2023)	**ONGOING**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				• **WGI TG on Satellite Data and Codes** *TG Chair: EUM Simon Elliott* CMA XU Zhe xuzhe@cma.gov.cn EUMETSAT Daniel Lee daniel.lee@eumetsat.int JMA Kazuki Shimoji kazuki.shimoji@met.kishou.go.jp JMA Kazutaka Yamada kyamada@met.kishou.go.jp KMA Jang Jae-Dong jaedongjang@kma.go.kr KMA Kim Junho jique0807@korea.kr NOAA AK Sharma awdhesh.sharma@noaa.gov NOAA Maurice McHugh maurice.mchugh@noaa.gov ROSHYDROMET Nikita Ekimov nikitaekimov@planet.iitp.ru WMO Heikki Pohjola hpohjola@wmo.int WMO Enrico Fucile efucile@wmo.int CGMSSEC Mikael Rattenborg mikael@rattenborg.eu • **WGI TG on Low Latency Data Access** *TG Chairs: EUMETSAT Antoine Jeanjean, Andrew Monham* *LWGI_LLDA@LISTSERV.EUMETSAT.INT* CMA Siwei Tian, Shuze Jia, Chengli Qi, Lei Yang		

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				EUMETSAT Sean Burns, Remy Chalex, Pier Luigi Righetti, Jose Maria de Juano Gamo, Karolina Nikolova ESA Juha-Pekka Luntama, Frank Zeppenfeldt ISRO - vacant JAXA Toshiyuki Kurino KMA Dohyeong Kim, Sung-Rae Chung NASA Jack Lauderdale, Otto W. Bruegman, Jerry Visalsawat, Kelvin Brentzel, Jake Simmons, Stephen Holt NOAA Beau Backus, Bruce Thomas, Changyong Cao, Elsayed Taalat, Fred Mistichelli, Jordan Gerth, Justin Gronert, Mark Turner, Nancy Ritchey, Otto Bruegman, William Skip Dronen, Satya Kalluri, Toby Hutchings • **WGI TG on Space Environment Sustainability** *TG Chairs: EUMETSAT Andrew Monham, ESA Juha-Pekka Luntama* CMA Cong HUANG, huangc@cma.gov.cn KASI Dr. Eun-Jung Choi, eunjung@kasi.re.kr KMA Jaeyoung Byon, jybyon@korea.kr NICT Tsutomu Nagatsuma, tnagatsu@nict.go.jp NOAA Scott Leonard, scott.leonard@noaa.gov WMO Heikki Pohjola, hpohjola@wmo.int • **WGI TG on Data Collection Services**		

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				TG Chair: EUMETSAT Nicholas Coyne WGI_DCS@LISTSERV.EUMETSAT.INT ISRO - invited to nominate a member		
CGMS members	WGI report	A51.02	CGMS Members are invited to nominate candidates for WGI Co-Rapporteur and Co-Chair.	06 Jun 2024 CGMS-52 plenary endorsed James Donnellon, NOAA, as new co-chair of WGI (replacing Sean Burns). Co-rapporteur nominations are still outstanding. 25 Apr 2024 James Donnellon, NOAA, was nominated as WGI co-chair pending plenary recommendation and starting following CGMS-52 (replacing Sean Burns, EUMETSAT) Members are requested to provide nominations for the co-rapporteur	Dec 2024 (Sep 2023)	**ONGOING**
IESWG CGMS rappor-teur	WGII report	A51.03	The IESWG to report on progress to plenary CGMS-53		CGMS-53	**OPEN**
CGMS-SEC	WGII, WGClimate reports	A51.04	The CGMS Secretariat to secure the inclusion of an agenda item on the GEO-ring observations reprocessing for climate project at CGMS-52 plenary (plus GeoRing sounding capabilities for NWP)	05 Jun 2024 https://www.cgms-info.org/Agendas/PPT/CGMS-52-EUMETSAT-WP-01p 11 Mar 2024 Included on the CGMS-52 WGII and plenary agendas	spring 2024	**CLOSED**
	GHG TT, CGMS WGI-WGIV co-chairs and	A51.05	The WGClimate GHG TT chairperson (Yasjka.meijer@esa.int) and the CGMS WGI - WGIV co-chairs and rapporteurs to meet (virtual sessions) to develop an initial path forward toward a future operational GHG monitoring system, and to define priorities, and to identify the roles of each	05 Jun 2024 Addressed in CGMS-52 plenary https://www.cgms-info.org/Agendas/PPT/CGMS-52-JWGCLIM-WP-04p. New actions will be raised for the way forward. 03 Jun 2024 A first meeting between the WGClimate, GHG TT and the leading entities of the	CGMS-52 (Autumn 2023)	**CLOSED**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
	rapport-eurs		CGMS WG for the implementation that becomes part of the roadmap's work plan. (Reference is also made to the CGMS-50 WGII actions related to the GHG TT).	CGMS WGI, WGII and WGIII is scheduled for 3 June 2024 on the occasion of CGMS-52 plenary.		
CGMS members TBD	WGIV report	A51.06	CGMS agencies to nominate additional members for all the WGIV Task Groups, in particular those where no representatives of the agencies are currently participating in the Task Group(s). WGIV Task Group on Data Access/Exchange WGIV Task Group on Metadata - CGMS members to nominate a chairperson for this TG. WGIV Task Group on User Readiness	06 Jun 2024 Report provided by WGIV https://www.cgms-info.org/Agendas/PPT/CGMS-52-WGIV-WP-01p Action expected to transition from plenary to WGIV from CGMS-53 as necessary. WGIV Task Group on Data Access/Exchange WGII 25 Apr 2024 Members are requested to nominate members and a Chairperson to this TG TG Chair: TBD EUMETSAT Simon Elliott, Daniel Lee CMA Li Xiaoru NOAA AK Sharma WMO Natalia Donoho WGIV Task Group on Metadata Information (TFMI) TG Chair: WMO Anna Milan CMA Xiangang Zhao ESA Alexi Glover EUMETSAT Nadeschda Nikitina, Simon Elliott ISRO Ruchi Modi JMA Yasutaka HOKASE KMA Taekyu Jang NOAA Paul Lemieux WGIV Task Group on User Readiness	CGMS-53 (Sept 2023)	**ONGOING**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				25 Apr 2024 The TG to review the RGB recommendations TG Chair: Sreerekha Thonipparambil (EUM) CMA Li Xiaoru EUMETSAT Stephan Bojinski, Sreerekha Thonipparambil ISRO Nitant Dube JMA Takuya SAKASHITA NASA Brock Blevins NOAA Satya Kalluri, Jason Taylor, Vanessa Escobar		
CGMS members	SWCG report	A51.07	CGMS members to nominate candidates for a co-rapporteur for SWCG	06 Jun 2024 CGMS-52 plenary endorsed Jesse Andries, WMO, as new co-rapporteur of SWCG. 25 Apr 2024 CGMS-52 SWCG nominated Jesse Andries as SWCG co-rapporteur, pending plenary endorsement. 11 Mar 2024 WMO has nominated Jesse Andries as co-rapporteur of the SWCG (Q1 2024)	CGMS-52 (Sept 2023)	**CLOSED**
CGMS member principals	FUTURE DIREC-TION	A51.08	CGMS principals are invited to nominate a representative to participate in a drafting group tasked to develop, by CGMS-52, a CGMS statement on the optimum composition of hybrid architectures (combining reference platforms, small satellites and procurement of commercial data) for fulfilling the operational observation requirements of CGMS members in the future, recognizing the rapidly changing environment in small satellites and the commercial sector.	06 Jun 2024 CGMS-52 plenary endorsed the high level statement on the understanding that the CGMS Secretariat will take the comments by plenary into account in the final version. 03 Jun 2024 Members are requested to provide feedback on the draft HL statement presented for endorsement at the CGMS-52 plenary https://www.cgms-info.org/Agendas/WP/CGMS-52-CGMS-WP-04	15 May 2024, CGMS-52 plenary (31 July 2023)	**CLOSED**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
			In particular, the group will identify complementarity and associated merits between the three different aspects of a hybrid system, and will provide recommendations on an optimal mix to obtain essential observations, provided with very high reliability, or on how to fulfil the "backbone" observing requirements.	02 Apr 2024 CGMSSEC has circulated the draft high level statement to CGMS member focal points of contact to provide feedback and comments by 15 May 2024. The Secretariat will then provide it to plenary for endorsement. 2023 8 Nov: CGMSSEC letter (EUM/CGMS/LET/23/1381413) circulated to members noting that the Secretariat together with the WMO will draft an initial statement. On the basis of the first draft statement, the CGMS Secretariat will arrange for online discussions with CGMS members. Members to nominate a representative *by end November 2023* for supporting the discussion and to share initial considerations for the preparation of the draft, please submit your input by email to cgmssec@eumetsat.int by *mid-December 2023*. CMA: Lei YANG yangl@cma.gov.cn NASA: sid.a.boukabara@nasa.gov WMO: Heikki Pohjola hpohjola@wmo.int		
CGMS members	FUTURE DIREC-TION	A51.09	CGMS members to nominate and/or confirm representatives for the "champion" to secure the continuity of the six pilot activities and within the respective working groups (as per CGMS-51-CGMS-WP-04) **FUTURE DIRECTION** **1 Socio Economic Benefits** WGIII / Yasushi Sumida JMA **2 Hybrid Space Observations Architectures**	05 Jun 2024 Activities will continue in the framework of the five CGMS working groups. Proposal to close the plenary action and address these directly in the working groups. All themes are generally embedded within the standing agendas of the working groups. Closed on the occasion of plenary. **SEB:** JMA / Y Sumida y_sumida@met.kishou.go.jp *addressed in CGMS-52 WGIII* 26 Apr 2024 JMA: https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=a716a4a9-	31 July 2023	**CLOSED**

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
			WGI / Simon Elliott EUMETSAT **3 Private Sector** WGIII / Mara Browne NOAA **4 Research to operations** WGIV (support WGII) / • NOAA, NASA to confirm by end July '23 • Other agencies to provide feedback by end July '23 **5 Future Information technology** IOT: WGI / Antoine Jeanjean EUM AI/ML: WGII *and WGIV* / CMA XU Na Cloud: WGIV / VACANT **6 Space situational awareness** SWCG, WGI / Juha-Pekka Luntama ESA - confirmed **7 Earth system monitoring** WMO, Albert Fischer - confirmed **8 Support to developing countries** CMA (name TBD by end July '23) - confirmed	97d8-42ed-81fd-9d468a3fd193&aid=48903fee-f4a0-4d51-b15d-c6a4b8a447c3 EUM: https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=c4ba4ff8-05de-4685-96ab-986ffaca1c74&aid=693f7f2b-d78b-4377-a71b-b0ab593812dc **Hybrid architectures:** EUM / Simon Elliott Simon.Elliott@eumetsat.int *addressed in CGMS-52 cross-cutting session on 24 April* **Private sector:** NOAA / Mara Browne mara.browne@noaa.gov Support: WMO, hpohjola@wmo.int *addressed in CGMS-52 cross-cutting session on 24 April* 24 Apr 2024 Overview: https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=85761766-294f-4f69-b2c0-9fd93ac2044a&aid=18399fe1-c26f-4c06-b4e7-b621db08cc90 Draft best practice: https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=86341dfb-c144-4fe8-940d-784a88cd7493&aid=981f3671-a7a4-418f-a86a-4bb00b23742e **20 Nov 2023:** Call for inputs made to members for best practices pertaining to end user license agreements and/or procurements with the private sector - to develop best practices - and participation in task team requested.		

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				EUM: Daniel.Lee@eumetsat.int **R2O:** Jordan.Gerth@noaa.gov, (joint NASA/NOAA effort) • NASA Will McCarty, will.mccarty@nasa.gov • NOAA Laurie Rokke, Laurie.Rokke@noaa.gov and Jordan Gerth, Jordan.Gerth@noaa.gov • NOAA support: Matt Zandbergen, Matthew.Zandbergen@noaa.gov *addressed in CGMS-52 cross-cutting session on 23 April* 24 Apr 2024 Proposal: https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=41cf8be0-bd0d-4517-b31a-c6fad887226d&aid=01e9e5f6-f7ff-4b24-b80b-1a79c7b03832 **Future IT: IOT** / EUM / Antoine Jeanjean Antoine.Jeanjean@eumetsat.int *addressed in CGMS-52 WGI* 22 Apr 2024 https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=8c829f84-331c-4f8b-a419-8efd41207599&aid=cf9487ab-349f-41d5-b73a-c62363f75f0b https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=b8d48722-68d9-49eb-9eba-d57362fe3ab4&aid=7ec1c419-9101-44a2-918e-6b14c6fc76dd **AI/ML** / CMA / Dr XU Na xuna@cma.gov.cn		

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				addressed in CGMS-52 cross-cutting session on 23 April 23 Apr 2024 Proposal: https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=3668af33-4607-4505-bcf2-b9b1ce6d9619&aid=1c8dc3d8-535e-48b7-9929-77861e14d9c5 Survey outcome: https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=6a5edffc-548c-4025-8cd9-9fca4337c1ba&aid=2c4e1b9d-fb7b-4da0-b38d-5ca3f773508b **CLOUD** 24 Apr 2024 NOAA kathryn.schontz@noaa.gov (elected at CGMS-52 WGI meeting) **SSA:** ESA / Juha-Pekka Luntamaa Juha-Pekka.Luntama@esa.int Proposed (Terms of Reference for) CGMS WGI Space Environment Sustainability Task Group *addressed in CGMS-52 SWCG* 25 Apr 2024 https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=85faa2b9-5f1a-4dfb-8ab1-c26f1965de69&aid=4677b70e-23f7-4743-b84a-a56c49d22e3b **ESM:** WMO / Albert Fischer afischer@wmo.int **SDC:** CMA / XIAN Di xiandi@cma.gov.cn		

Status of CGMS-51 plenary actions following CGMS-52 plenary discussions on 4-6 June 2024						
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**
				25 Apr 2024 Proposal by CMA: CGMS-52-CMA-WP-06 for further discussion in WGIV intersessionals.		
CGMS members, CGMS WGs	AI/ML session	A51.10	AI/ML theme to be included on the plenary agenda at CGMS-52, with the CGMS WGs (WGII, WGIV, ...) to address AI/ML in their respective intersessional meetings in preparation. Focal point of contact/Coordinator: Champion of future direction AI/ML theme to be nominated (link to action above)	06 Jun 2024 Proposed to close this plenary action on this basis and with the WGs to incorporate AI/ML on their respective agendas as necessary. References is also made to CGMS-52 plenary discussion and proposal on 'AI-ML next steps: proposed use cases for CGMS' https://www.cgms-info.org/Agendas/PPT/CGMS-52-WGII-WP-04 on way forward. 05 Jun 2024 https://www.cgms-info.org/Agendas/PPT/CGMS-52-WGII-WP-02 Proposed to address AI/ML matters directly in the framework of the CGMS working groups. WGs I–IV to identify what aspects of AI/ML to address. 14 May 2024 Will be addressed on the occasion of the WGII report to CGMS-52 plenary, and members are requested to provide guidance on the next steps. 22 Apr 2024 Addressed during the CGMS-52 WGII session on 22-26 April 2025.	CGMS-52	**CLOSED**

Leading entities	**AGN item**	**Rec #**	**Description**	**Recommendation feedback/reference document**
CGMS members	WMO MATTERS FOR COORDINATION WITH CGMS SPACE AGENCIES	R51.01	Plenary recommended that CGMS members actively support and respond to the WMO strategic initiatives and resolutions, such as EW4ALL, G3W, and Unified Data Policy implementation; and asks CGMS space agency members to participate in the upcoming Core Satellite Data Workshop (4-7 December 2023) and WMO Consultative Meetings on High-level Policy on Satellite Matters (Feb 2024).	04 Jun 2024 https://www.cgms-info.org/Agendas/PPT/CGMS-52-WMO-WP-03p, https://www.cgms-info.org/Agendas/PPT/CGMS-52-WMO-WP-02p. Recommendation carried over to CGMS-52 actions and recommendations 09 Apr 2024 Most CGMS members participated in the NWP core satellite data workshop, and CM-15 and provided their inputs to WMO.
CGMS members	(WGIV/6)	R51.02 (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.	04 Jun 2024 https://www.cgms-info.org/Agendas/PPT/CGMS-52-VLab-WP-01p, https://www.cgms-info.org/Agendas/PPT/CGMS-52-GUEST-WP-03 Recommendation carried over to CGMS-52 actions and recommendations 23 Apr 2024 Addressed at CGMS-52 WGIV meeting. WMO expected to address this in detail at CGMS-52 plenary, **2023 11 July:** Noted as a recommendation by the CGMS Secretariat **2023 28 June:** Plenary endorsed the recommendation in the report by the VLab to plenary. The "action" still remains valid. **2023 19 June**: CGMS members are kindly requested to contribute to the VLab to secure the continuity of this valuable activity. 2023 2 June: Topic to be raised in the report of the WGIV CGMS-51-WGIV-WP-01 EXT and VLab CGMS-51-VLab-WP-02 EXT to plenary.

CGMS-52-CGMS-WP-08 - Summary of new actions from CGMS-52 plenary (Anne Taube)

The actions were circulated to participants for review and feedback by 30 June 2024.

CGMS-52 plenary actions (as per 6 June 2024)					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	2	A52.01	**WIGOS Vision 2040 update:** CGMS members invited to nominate a CGMS representative to the WMO Task Team for the updating of the WIGOS Vision 2040. CGMS members are requested to send nominations to CGMSSEC@eumetsat.int by end June.	30 Jun 2024	**OPEN**
CGMS members	5	A52.02	**WG reports to plenary:** Members to provide nominations for the WGI co-rapporteur, WGII co-chair position, and WGIV co-chair in particular, as well as other open positions as per https://www.cgms-info.org/Agendas/WP/CGMS-52-CGMS-WP-11p	30 Jun 2024	**OPEN**
CGMS members	4, 8	A52.03	*Superseded by events. CGMS-52 plenary endorsed Simon Elliott, EUMETSAT, as CGMS focal poc. WGClimate will report on progress to CGMS-53.* **WGClimate/G3W:** CGMS members to nominate a representative to take the proposals in https://www.cgms-info.org/Agendas/PPT/CGMS-52-EUMETSAT-WP-13p forward. Following feedback, CGMSSEC will address next steps with WGClimate. (+ need for dedicated intersessional meeting between the CGMS WGs and WGClimate).	30 Jun 2024	**CLOSED**
GEO-Ring project members	4, 8	A52.03 (new)	**GEO-Ring:** CGMS asked the GEO-Ring project members to analyse the data policy situation for their historic and current geostationary imager data (inclusive of levels containing count data and calibration coefficients) for usage within cloud infrastructures and redistribution freely and without restrictions from cloud infrastructures and data stores to the benefit of users of and with agencies participating in the GEO-Ring project and to define a way forward.	CGMS-53	**OPEN**

CGMS-52 plenary actions (as per 6 June 2024)					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
CGMS members	8	A52.04	**AI-ML next steps: proposed use cases for CGMS** CGMS members to provide comments and feedback on the proposals in https://www.cgms-info.org/Agendas/PPT/CGMS-52-WGII-WP-04 CGMS members to nominate two focal points of contact as leading entity to pursue this activity. Following feedback, CGMSSEC will address next steps with WGI, WGII and WGIV leading entities.	30 Jun 2024	**OPEN**

CGMS recommendations (as per CGMS-52 plenary, 6 June 2024)				
Leading entities	**AGN item**	**Rec #**	**Description**	**Recommendation feedback**
CGMS members	WMO MATTERS FOR COORDINATION WITH CGMS SPACE AGENCIES	**R**51.01	Plenary recommended that CGMS members actively support and respond to the WMO strategic initiatives and resolutions, such as EW4ALL, G3W, and Unified Data Policy implementation; and asks CGMS space agency members to participate in the upcoming Core Satellite Data Workshop (4-7 December 2023) and WMO Consultative Meetings on High-level Policy on Satellite Matters (Feb 2024).	04 Jun 2024 https://www.cgms-info.org/Agendas/PPT/CGMS-52-WMO-WP-03p, https://www.cgms-info.org/Agendas/PPT/CGMS-52-WMO-WP-02p Recommendation carried over to CGMS-52 actions and recommendations 09 Apr 2024 Most CGMS members participated in the NWP core satellite data workshop, and CM-15 and provided their inputs to WMO.
CGMS members	WMO MATTERS FOR COORDINATION WITH CGMS SPACE AGENCIES (WGIV/6)	**R**51.02 (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.	04 Jun 2024 https://www.cgms-info.org/Agendas/PPT/CGMS-52-VLab-WP-01p, https://www.cgms-info.org/Agendas/PPT/CGMS-52-GUEST-WP-03 Recommendation carried over to CGMS-52 actions and recommendations 23 Apr 2024 Addressed at CGMS-52 WGIV meeting. WMO expected to address this in detail at CGMS-52 plenary, **2023 11 July:** Noted as a recommendation by the CGMS Secretariat **2023 28 June:** Plenary endorsed the recommendation in the report by the VLab to plenary. The "action" still remains valid. **2023 19 June**: CGMS members are kindly requested to contribute to the VLab to secure the continuity of this valuable activity. 2023 2 June: Topic to be raised in the report of the WGIV CGMS-51-WGIV-WP-01 EXT and VLab CGMS-51-VLab-WP-02 EXT to plenary.

8. CONFERENCE ANNOUNCEMENTS

CGMS-52-EUMETSAT-WP-11 - EUMETSAT Meteorological Satellite Conference, Sep-Oct 2024 (Paolo Ruti)

The EUMETSAT meteorological Satellite Conference will take place in Würzburg, Germany, 30 September - 4 October 2024. The session topics include:

1. Introductory session on international EO programmes;
2. Meteosat third generation: from products evaluation to Operational value;
3. Towards new operational programmes and preparedness studies;
4. How will AI/ML and cloud-based systems accelerate the use of Satellite data;
5. Assessing climate variability and change using satellite Observations;
6. Towards a full earth system approach;
7. Data and products for emerging services; and
8. Data access and cloud technologies.

More information on the conference can be found here https://www.eumetsat.int/eumetsat-meteorological-satellite-conference-2024.

CGMS-52-IMD-WP-05 - AOMSUC 2-8 December 2024, New Delhi (R K Giri)

The Fourteenth Asia-Oceania Meteorological Satellite Users' Conference (AOMSUC-14) hosted by IMD will be held from 2-7th December 2024 in New Delhi, India.

AOMSUC-14 is planning to be held as three events:

1) 2-3 December 2024: Comprehensive training event on satellite data and product utilisation in New Delhi;
2) 4-6 December 2024: The AOMSUC-14 plenary and scientific sessions in New Delhi; and
3) 7 December 2024: Joint Meeting of RA II WIGOS Project and RA V TT-SU for RA II and RA V NMHSs (by invitation) in New Delhi.

The sessions of the AOMSUC conferences are:

- The space programme and data access updates
- SmallSat/Cubesat for meteorology, climate, and environmental monitoring
- Application for:
    - numerical weather prediction
    - weather analysis and nowcasting
    - land surface and sea surface derived from satellite observations
- Space weather
- Performance and calibration of satellite instruments
- Use of AI/ML in weather forecasting
- Geoinformatics

Notice that there is neither a fee for conference registration and presentations for nor attendance.

Further information is available at http://nmsc.imd.gov.in/aomsuc/index.html. Participants wishing to present at the conference are invited to register online (same link as above). Deadline for abstract submission is on 27 September 2024.

CGMS-52-NOAA-WP-01 - NOAA Satellite Conference, August 2025 (James Donnellon)

The NOAA Satellite Conference, 2025 will take place in San Diego, USA, on 16-22 August 2025. It will be co-hosted with the American Meteorological Society (AMS) Committee on Satellite Meteorology, Oceanography and Climatology (SatMOC).

9. ANY OTHER BUSINESS – AOB

CGMS-52-CGMS-WP-14 - CGMS statement to WMO EC-78 (Paul Counet)

The CGMS Secretariat regularly makes statements to WMO high level meetings. Prior to the CGMS-52 plenary session, the CGMS Secretariat circulated a draft CGMS statement foreseen for the upcoming WMO EC-78 meeting. In the very recent past, CEOS also contributes with statements to the WMO high level meetings.

CGMS-52 plenary endorsed the CGMS statement to be made by the Head of the CGMS Secretariat to the WMO EC-78.

10. FUTURE CGMS PLENARY SESSIONS

CGMS-52-CGMS-WP-09 - Tentative schedule of future CGMS plenary sessions and announcement of CGMS-53 plenary and working groups meetings (Anne Taube)

The CGMS Secretariat presented the tentative plan for future plenary sessions. EUMETSAT will host the CGMS-53 plenary session in Europe on 3-5 June 2025 and with KMA preliminary confirming the hosting of CGMS-54 in 2026.

Further CMA kindly confirmed that they would host the CGMS-53 working group session on 24-28 March 2025 in China, in parallel with the next GSICS WG and EP for the sake of carbon savings and several participants will attend both GSICS and CGMS WGII meetings.

CGMS plenary #	Year	Location
CGMS-53	2025 (3-5 June)	Europe Confirmed!
CGMS-54	2026	South Korea Confirmed!
CGMS-55	2027	India
CGMS-56	2028	Russian Federation
CGMS-57	2029	China
CGMS-58	2030	WMO
CGMS-59	2031	Japan
CGMS-60	2032	North America
CGMS-61	2033	Europe
CGMS-62	2034	South Korea

11. CLOSING SESSION

Handover of CGMS flag

As per the long-standing CGMS tradition, as the current plenary host, NOAA handed over the CGMS flag to the next and 53rd plenary host, EUMETSAT.

Closing remarks

Dr. Volz, NOAA, reiterated his statements from his opening remarks, noting it was NOAA's pleasure to welcome the CGMS participants to Washington DC. Dr. Volz noted his pleasure that the week was very productive and full of discussions, as well through bilateral meetings and conversations. Dr. Volz thanked Aerospace for sponsoring the Tuesday lunch, and thanked L3Harris for sponsoring the plenary dinner and facilitating the associated and excellent panel. He further recognised the hard work of NOAA's Mary Ann Kutny of NOAA and EUMETSAT's Anne Taube and Joana Betencourt, for taking the lead on planning a CGMS plenary that turned out to be very smooth and productive. Dr. Volz closed the plenary session by stating he was looking forward to attending the CGMS-53 plenary in 2025 in Europe.

Mr. Evans, EUMETSAT/Head of the CGMS Secretariat, quoted Charles Dickens's 'A tale of two cities': "It was the best of times, it was the worst of times, it was an age of wisdom, it was an age of foolishness".

The best of times because one only needs to look at the CGMS community, with its expertise, initiatives and wealth of observing systems. The capacity to exploit the data, the opportunity offered by AI/ML, the good will and cooperation in the CGMS framework.

The worst of times in view of the impact on our society from climate change and severe weather.

Mr. Evans noted that CGMS is a very privileged community to be able to join those things up and to use its multilateral capabilities and expertise to address the huge challenge the world is currently facing. Recalling Dr Volz's earlier statement - the CGMS are the champions of hope, and which requires action and progress. A huge part of that is supported by international collaboration and cooperation which took place throughout plenary. Mr. Evans concluded by thanking everyone for their contributions, enthusiasm, and engagement, and wished everyone a good journey back home.

Working groups

WG I:	Satellite systems and operations
WG II:	Satellite data and products
WG III:	Operational continuity and contingency planning
WG IV:	Data access and end user support
SWCG:	Space weather coordination group

CGMS

Satellite systems and operations

WG I REPORT

Co-Chairs: *Dohyeong Kim, KMA / Sean Burns, EUMETSAT*
Rapporteur: *Karolina Nikolova, EUMETSAT*

1. WGI meeting introduction and expected outcomes

CGMS-52-WGI-WP-01 - 1.1 WGI Meeting Introduction by Co-Chairs/Co-Rapporteurs

The WGI Co-Chairs and Rapporteur opened the meeting with a welcome address, re-calling the role of WGI within CGMS, the objectives of WGI, its current structure, and status on WGI Co-Chairs / Co-Rapporteurs.

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

WGI invited nominations to all Task Groups by all agencies.

WGI agreed to nominate James Donnellon (NOAA) as WGI Co-Chair, replacing Sean Burns (EUMETSAT), to CGMS-52 Plenary for endorsement.

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

The WGI meeting was hybrid, with in-person participation at EUMETSAT and also virtual attendance via MS Teams.

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 also in the joint WGI-WGIV-SWCG Meeting.

CGMS-52-WGI-WP-02 - 1.2 WGI expected outcomes (Co-Chairs / Rapporteur)

The WGI Co-Chairs and Rapporteur summarised the expected outcomes and key objectives for the CGMS-52 WGI meeting.

It was recalled that, in line with the recommendation from CGMS-51 WGI, all Task Group should present their:

- Status on current and planned activities
- Up-to-date list of members
- Latest Terms of Reference
- Up-to-date Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis
- Latest version of Best Practices and proposed updates (if any)
- Status of implementation of Best Practices for each agency

Beyond the above reoccurring agenda items, the Task Group present dedicated papers, as required.

The CGMS-52 WGI agenda and expected outcomes have been structured accordingly.

CGMS-52-CGMS-WP-28wgi - 1.3 CGMS future direction project 2022+ (Anne Taube)

An overview of the CGMS future direction project activities was presented.

Members were requested to participate in relevant discussions during the week of the CGMS-52 WGs, including the cross-cutting sessions for all WGs on 23 and 24 April 2024.

Members were invited to nominate candidates for leading the sub-theme on Cloud Technologies. Kathryn Shontz (NOAA) was nominated to lead the sub-theme on Cloud Technologies.

2. Frequency Management

CGMS-52-CGMS-WP-01 - 2.1 Report on Frequency Management related topics (incl. SFCG, WMO, ITU, etc., M. Dreis)

The 42nd annual meeting of the Space Frequency Coordination Group (SFCG) took place on 30 May – 7 June 2023.

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

- SFCG aligned its Resolution 24-1R1 (Interference mitigation techniques for future systems planning to operate in the 2200-2290 MHz band) with the newly established ITU-R Recommendation SA.2155-0 (Attachment 1 of the report) on the optimisation of the use of the band 2200-2290 MHz.
- SFCG action item 42/9 on updating SFCG Resolution 27-1 for the companion uplink frequency band 2025-2110 MHz to align Recommendation ITU-R SA.2156 (Attachment 2 of the report) which has the purpose to limit interference within the frequency band 2025-2110 MHz through band limitation, in particular reducing the operational bandwidth.
- SFCG revised its report on SFCG Remote Sensing Information (SFCG 40-1R2) and responded to WMO on three aspects:
    - Updates to the OSCAR/Space database;
    - Inconsistent information at different levels of the database;
    - Frequency information other than for active and passive microwave sensors (to be further discussed).
- RFI reporting section on SFCG website (https://www.sfcgonline.org/RFI%20to%20EESS%20Sensors/default.aspx)

The World Radiocommunication Conference 2023 (WRC-23) took place on 20 November – 15 December 2023. All WRC-23 agenda items of relevance for CGMS were positively concluded with the views expressed in the corresponding HLPP, also in-line with the WMO positions as presented to WRC-23, in summary:

- New frequency allocations for the Earth Exploration Satellite Service (passive) in the frequency bands 239.2-242.2 and 244.2-247.2 GHz in order to provide protection for the operation of passive microwave sensors for Ice cloud imaging (WRC-23 Agenda Items 1.14);
- Protection of passive microwave sensor measurements in the frequency bands 18.6-18.8 GHz and 36-37 GHz from potential RFI through the establishment of appropriate power flux-density

respectively e.i.r.p density limits for new non-geostationary satellite services and applications around those frequency bands (WRC-23 agenda items 1.16, 1.17, 9.1 Topic D);

- Strengthening of the status of passive microwave sensing in frequency bands covered by the special provision of RR footnote 5.340 (all emissions are prohibited) by means of corrections to RR Resolution 731, relevant for all passive microwave sensors (WRC-23 Agenda Item 4);
- No new frequency spectrum and regulations in and around the MetSat downlink band 1695-1710 MHz which could negatively impact on MetSat data downlink and broadcast (WRC-23 Agenda Items 1.4 and 1.18);
- First level of recognition of Space Weather in the RR due to a definition of space weather and its service designation under MetAids (space weather) and a new Resolution outlining the importance of space weather applications (WRC-23 Agenda Items 9.1 Topic A).

The outlook to WRC-27 on agenda items of potential interest/concern to CGMS was presented, along with a first version of the WMO position for WRC-27 agenda items provided in Attachment 1 of the report.

The fifth meeting of the Expert Team on Radio Frequency Coordination (ET-RFC) was held at the Caribbean Telecommunications Union (CTU) Headquarters in Port of Spain, from 20 to 22 February 2024. One essential task and outcome of this meeting was the development of the first version of the WMO positions for WRC-27. During the process of development of this first version of the WMO positions to WRC-27 the following action item was identified, which was also sent to CGMS members for feedback:

- RFC2024.17: WMO SEC to submit the first version of WMO Position on the WRC-27 agenda to WMO Members (incl. through the network of NFPs), adding in the cover letter the call for input to verify any current and planned use of: (1) the EESS (active) allocation in the frequency band 17.2-17.3 GHz and (2) the EESS (passive) allocation in the frequency band 15.35–15.4 GHz to ensure that additional technical and operational characteristics, if any, are submitted to the ITU-R WP 7C. Also, to ask if radiosondes in 1.7 GHz are still in use.

Responses so far indicate that:

- No planned use of these bands from JAXA, CMA, NSOAS, ISRO, ROSHYDROMET and EUMETSAT;
- Canada reported their plans to utilize the 17.2-17.3 EESS (active) allocation, along with the 13.25-13.75 GHz EESS (active) allocation, for the Terrestrial Snow Mass Mission (TSMM), a dual-frequency synthetic aperture radar.

CGMS was invited to note this report and to provide feedback and information on its activities via the CGMS/SFCG Liaison Officer to SFCG-43 (June 2024) on any frequency related matter as appropriate.

The group discussion clarified the differences and links between the Oscar/Space database and SFCG database. The SFCG database allows for frequency coordination between space agencies, serving as a unified database for frequency pre-coordination of systems before entering them into ITU coordination. The SFCG Report 40-1R2 on remote sensor frequency information is updated on a yearly basis and crosschecked with the OSCAR/Space database and necessary alignments are provided to the OSCAR/Space Support Team (O/SST).

WGI agreed the following action:

CGMS-52 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
SFCG Rep	**2.1**	WGI/A52.01	Identify mechanisms to ensure long term continuity in information/knowledge transfer/exchange between SFCG and CGMS, including WMO, on frequency management topics of common interest.	CGMS-53	**OPEN**

3. RFI detection, monitoring and mapping

CGMS-52-WGI-WP-03 - 3.1 Report from the CGMS WGI Task Group on RFI detection, monitoring and mapping (incl. latest ToR, status on current & proposed/planned activities, B. Backus)

The Task Group on RFI Detection, Monitoring and Mapping (TGRFI) was established in response to CGMS-49 request to establish the initial ideas about mechanisms regarding the detection, monitoring, and mapping of RFI, including passive bands. The group began meeting in May 2022 and has continued meeting regularly since that original kick off.

The status of TGRFI, its activities to date, and its planned upcoming activities were presented. The Task Group currently has 13 members from CMA, ECCC, ESA, EUMETSAT, KMA, NOAA and WMO.

The tasks over the previous year included:

- Analysis of the inputs provided by CMA, EUMETSAT, KMA, and NOAA on spectrum concerns and activities on RFI detection, monitoring, and mapping;
- Continuing to pursue the establishment of a proposed set of best practices by CGMS-52 based on the common aspects of the approaches already adopted by members;
- Exploring the potential / existing uses of AI/ML and pattern recognition in RFI detection.

Four intersessional meetings were held since CGMS-51, with a primary focus on best practices with emphasis on passive band RFI. TGRFI has identified common ways of using collected input information as a basis for a set of best practices. This information can help members implement a standard approach for assessing, processing, and potentially mitigating RFI. The current best practices being developed are primarily focused on the most challenging of RFI, that of passive band corruption.

The next tasks, included in the updated Terms of Reference (ToR), are:

- To complete a draft proposed set of best practices by CGMS-53 based on the common aspects of the approaches already or planned for adoption by members, for endorsement by CGMS-53;
- To continue to explore the potential / existing uses of AI/ML and pattern recognition in RFI detection.

Once established, the best practices can be used to:

- Assist members in implementing a standard approach for assessing RFI;
- Develop more robust systems and processes for minimising remote passive band sensor corruption.

CGMS was invited to take note of the development status of the 'best practices' being developed for RFI handling, and consider and approve the Task Group's next tasks, as an updated ToR.

The WGI Co-Chair, Sean Burns, encouraged the Task Group to place more focus on the action for exploring potential / existing uses of AI/ML in RFI detection, specifically in terms of any pragmatic applications. Markus Dreis highlighted that uses of AI/ML may be relevant for RFI management in view of large constellations.

CGMS-52-WGI-WP-12 - 3.2 Proposed Best Practice on RFI detection, monitoring and mapping – for review/consideration (B. Backus)

The Task Group noted that it can be assumed that the global level of RFI is gradually increasing over time with the aggregation of single low level interfering signals up to a point when RFI becomes obvious. Thus, RFI can be expected to move from undetectable levels, then to levels of "insidious" data corruption, and then to levels of blatant data contamination, such that the data can only be discarded. Insidious data corruption means there could be RFI (data corruption) induced into the measurements unnoticed for a significant period as the measurements are erroneously taken as correct measurements without any interference component.

Therefore, monitoring of the development of mass market RF intensive applications is a factor for consideration in the characterisation process and as part of a best practice. This also requires building up monitoring records on measurements of already operational instruments to have reference data that can be later consulted and compared once the deployment of these RF intensive applications sufficiently increases. This allows for long term RFI trend observations.

The Task Group will work on completing a draft proposed set of best practices by CGMS-53 based on the common aspects of already existing or planned for adoption approaches, for endorsement by CGMS-53.

WGI agreed to update the status of the existing action WGI/A51.04 with the progress of the development of the best practices, with a deadline of CGMS-53 for the completion of the best practices.

The WGI Co-Chair, Sean Burns, highlighted the importance of these best practices and noted the significant progress made since CGMS-51. WGI agreed that once these practices are published they would also be presented to SFCG.

5. Low Latency Data Access

CGMS-52-WGI-WP-06 - *5.1 Report from the CGMS WGI Task Group on Low Latency Data Access (incl. latest ToR, status on current & proposed/planned activities, A. Jeanjean/A. Monham)*

The Low Latency Data Access (LLDA) Task Group was formed from the merger of the former Direct Broadcast Task Group and the Coordination of LEO Orbits Task Group.

The LLDA Task Group provides a forum for CGMS agencies to address improving LEO satellite systems low latency data access from both a global and regional perspective, harnessing common emerging

technologies and taking account of the evolution of the commercial and agency space systems. It is foreseen that historical boundaries between global and regional mission requirements and architectures may be substantially eliminated.

The status of the Task Group, its activities to date, and its planned upcoming activities were presented. The Task Group currently has over 30 members from CMA, ESA, EUMETSAT, KMA, NASA – GSFC, NOAA.

A dedicated Terms of Reference has been produced and is presented in the Task Group report in response to action WGI/A51.06. WGI endorsed the Low Latency Data Access Task Group Terms of Reference.

The document "Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis of Low Latency Data Access from LEO Meteorological Satellites" [CGMS-52-EUMETSAT-WP-13] was produced in response to WGI/A51.07.

The SWOT analysis also contains an analysis on the potential role of satellite platform as a service (SPaaS), in response to WGI/A51.08 where SPaaS are identified as an opportunity.

A merged Best Practices from the formerly separate Task Groups has been drafted and is presented separately [CGMS-52-CGMS-WP-03].

CGMS-52-CMA-WP-01 - 5.2 Low Latency Data Access status report + status of implementation of best practices (CMA, Siwei Tian)

This paper presented the status of Low Latency Data Access and status of implementation of best practices at CMA. All FY3 satellites are either compliant/partially compliant or planned to be compliant with the best practices. Some best practices are not applicable depending on the type of instrument. WGI thanked CMA for the addition of FY3F and FY3G.

CGMS-52-EUMETSAT-WP-01 - 5.3 Low Latency Data Access status report + status of implementation of best practices (EUMETSAT) (A. Jeanjean/A. Monham)

This paper presented the status of Low Latency Data Access and status of implementation of best practices at EUMETSAT. The Metop mission is compliant or partially compliant with all of the best practices. The EPS-SG mission is compliant or will be compliant with all of the best practices. The EPS-Sterna mission is compliant or will be compliant with most of the best practices, and some of the aspects of the best practices are still in preparation or under assessment. Updated links to EUMETSAT user information were provided.

CGMS-52-NOAA-WP-02 - 5.4 Low Latency Data Access status report + status of implementation of best practices at NOAA (William Dronen presented on behalf of Toby Hutchings)

This paper presented the status of Low Latency Data Access and status of implementation of best practices at NOAA. The POES and JPSS missions are compliant with all of the best practices.

CGMS-52-NOAA-WP-03 - 5.5 Merge of LEO Direct Broadcast and Coordination of LEO Orbits Best Practices draft proposal (Toby Hutchings)

A draft merged best practices of LEO Direct Broadcast and Coordination of LEO Orbits has been prepared. The Task Group will continue its work on the merged best practices in the lead up to CGMS-53 and present them for endorsement in CGMS-53. Once endorsed, the agencies can begin to present on their status

against the updated best practices in CGMS-54. In CGMS-53, EUMETSAT would already present against the proposed merged best practices, to serve as a template for all agencies ahead of CGMS-54. WGI agreed to update WGI/A51.09 accordingly.

CGMS-52-EUMETSAT-WP-13 - 5.6 Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis of Low Latency Data Access from LEO Meteorological Satellites (A. Jeanjean/A. Monham)

The paper analysed the Strengths, Weaknesses, Opportunities, and Threats (SWOT) of current LEO weather satellites systems to identify how low latency data access solutions could help in improving timeliness globally.

The study highlights the rapidness at which the "new space" sector is evolving. Although only a conceptual idea a couple of years ago, internet connectivity to LEO satellites is now a reality with lightweight transponders available as COTS providing 200 kbps link. The LEO IoT market has been disrupted within the last 5 years with the appearance of providers such as SpaceX, offering internet connectivity for ground-based users with up to 100 Mbps at competitive price.

Today, IoT solutions should be seen as opportunities for CGMS agencies. Two IoT applications of importance to CGMS were highlighted:

- IoT applications for LEO satellites:
    - Internet on LEO satellite is now a reality with the availability of GEO IoT solutions. The inter-satellite links between a LEO and GEO using beams are RF based signal. NASA is working on laser inter-satellite communication for the next GOES generation. For example, IQ spacecom offers a lightweight transponder (200 grams) that provides internet connectivity to the Inmarsat GEO fleet. This capability provides bi-directional connectivity to the spacecraft at 200 kbps. Some SPaaS companies (e.g. Loft Orbital), offers this transponder as pre-built COTS on the Longbow platform (e.g. Airbus OneWeb platform).
    - The current price of the GEO relay service for a LEO satellite is approximately 1k/euros/month per GB transferred.
    - NOAA/NESDIS initiated the Satellite DCS Use Concept Validation project, which demonstrated that LEO satellites can successfully interface with the Data Collection System (DCS) receivers (DCPR) and provide a low-rate data (100, 300, or greater bps) service to satellite users. The project also successfully demonstrated LEO commanding capability via GOES.
    - The DBNET network is a dedicated infrastructure for acquisition of direct broadcast that has been growing during the last decades. Although allowing connectivity from LEO satellites, this network is passive (no uplink possibility to LEO satellites). Today, direct broadcast reception allows for almost full coverage of the globe for the reception of sounding services. The cost of a pass acquisition from a subsidised DBNET station is around ~$10 per pass.
    - Commercial network of ground stations can offer either passive or active (i.e. downlink with possibility of uplink). The cost of a pass acquisition from a private ground station is around ~$100 per pass.

- IoT applications for ground-based devices:
    - GEO IoT commercial providers is a well matured market. Internet is provided via parabolic antenna, usually provided alongside a modem by the GEO IoT providers.
    - LEO IoT commercial providers: number of providers exploding (new space). Revisit time can be an issue, especially for new constellations with limited number of satellites, ranging to several hours. The number of relay satellites for a LEO constellation can range from a small number to several thousand (12000 satellites for SpaceX Starlink V1 system with up to 42000 for Starlink V2 system).

An analysis of Satellite Platform as a Service (SPaaS) was presented. As an example, Airbus platforms manufactured each day from Toulouse and US lines, with 200 kbps internet built-in as COTS. SpaceX launch within 6 months after receiving payload. The study noted their competitive cost covering payload integration, launch, operations, as well as their high relevance for proto-flight model, considering CGMS agencies usually keep control on operations.

With regards to sustained innovations, the study encourages either enhancing existing system such as DCS (e.g. LEO IoT for DCS) or enabling new mode operations regarding the use GEO IoT connectivity to LEO meteorological satellites. However, in comparison to GEO IoT cost and commercial DB stations, subsidised direct broadcast stations (e.g. DBNET type) offer the best value for money per Gb transmitted for acquiring LEO satellites that have a payload data rate greater than 10 kbps. This study therefore finds that direct broadcast remains a better value for money solution to GEO IoT for instrument payload downlink. With regards to disruptive innovations (e.g. satellite platform as a service), an option would be to explore some level of coordination performed at CGMS level regarding innovation. More generally, this study also raises the question of the CGMS position to follow regarding the emergence of the “new space” sector.

The study concludes that:

- LEO IoT could complement DCS in polar locations;
- GEO IoT internet may open new mode of operations for LEO meteorological satellites.

WGI noted the significant amount of useful information provided by the Task Group and noted that the more discussions need to take place to develop concrete outcomes.

Kathryn Shontz, as Future Directions Champion on cloud technologies, will work closely with the Antoine Jeanjean, as Future Directions Champion on IoT.

WGI agreed the following action.

CGMS-52 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
LLDA TG	**5.6**	WGI/A52.02	Identify concrete CGMS actions based on the LLDA SWOT, including priority areas and demonstration cases in agencies. E.g. cloud, TT&C, relation with private sector, etc.	CGMS-53	**OPEN**

6. Space Environment Sustainability

CGMS-52-WGI-WP-05 - 6.1 Report from CGMS WGI Task Group on Space Environment Sustainability (A. Monham)

The members of the Coordinated Group for Meteorological Satellites (CGMS) rely on the sustainability of the space environment to ensure their satellite missions remain able to deliver meteorological and space weather data to global forecasting services. In this regard, safety on Earth is very much intertwined with safety in space. CGMS has therefore established a Task Group on Space Environment Sustainability which shall address all aspects of operations in the space environment where CGMS member coordination can help improve the safety and sustainability of space operations for all space actors. The objectives include establishing best practices covering Space traffic coordination, lifetime extensions, end-of-life disposal and space weather mitigation of risks and effects. It is foreseen that a proposal on acceptable space traffic coordination practices can be submitted for consideration by UN COPUOS.

This Task Group builds upon the preliminary work initiated by its predecessor, the Space Debris and Collision Avoidance Task Group established in 2019, but having lapsed activities since 2022. The name of this revived Task Group has been changed in recognition of the broader scope of activities, dealing not only with debris but also with safe operations in increasingly congested orbits and additionally taking into account potential impacts from space weather. Furthermore, the objectives and actions from the CGMS Future Directions Project SSA theme are to be considered.

The report provided the background and content of the Terms of Reference for the newly formed CGMS WGI Task Group on Space Environment Sustainability, relevant to CGMS member current and planned missions.

The Terms of Reference is addressed to all CGMS participants and is relevant for all management, engineering and legal functions responsible for ensuring the definition, implementation and operation of CGMS agency space-based systems is compatible with the space environment and its sustainability. The Task Group objectives and activities defined by the ToR are therefore applicable across all satellite-based programmes in all mission phases. The ToR intends to cover all space sustainability issues of relevance to CGMS missions without exclusion. In particular, the ToR includes all SSA aspects associated with the Short-, Medium- and Long-term Goals for CGMS and split into the following categories:

- Space Traffic Coordination;
- Space Weather;
- Space Sustainability.

The main objectives of the Task Group, as per the ToR, are:

- Stay abreast on the status, current events and foreseen evolutions of the space environment, together with related regulations, guidelines, approaches, tools and services with the potential to constrain or inform in-orbit and planned CGMS mission services;

- Establish a Best Practice on Space Environment Sustainability aspects for CGMS member's missions;
- Identify and act upon risks to sustained operations.

The Task Group has submitted the following description via WMO to UNOOSA for inclusion in UN-Space Special Report on Space Debris to be presented at UN-COPUOS in June 2024:

"The members of the Coordination Group for Meteorological Satellites (CGMS), of which WMO is one, rely on the sustainability of the space environment to ensure their satellite missions remain able to deliver meteorological and space weather data to global forecasting services. In this regard, safety on Earth is very much intertwined with safety in space. CGMS has therefore established a Task Group on Space Environment Sustainability which shall address all aspects of operations in the space environment where CGMS member coordination can help improve the safety and sustainability of space operations for all space actors. The objectives include establishing best practices covering Space traffic coordination, lifetime extensions, end-of-life disposal and mitigation of space weather risks and effects. It is foreseen that a proposal on acceptable space traffic coordination practices can be submitted for consideration by UN COPUOS."

All CGMS members actively involved in space operations or supporting SSA / Space Weather data provision to spacecraft operators were invited to join the Task Group. A call for members was sent to the CGMS List Server and WGI members on 19 February 2024. Due to the scope of the Task Group, a secretarial function supporting the Co-Chairs would be welcomed. ISES Membership is also invited in order to support the objectives on space weather service utilisation by spacecraft operators and a presentation to ISES on this Task Group (and the Spacecraft Anomaly Task Group of SWCG) was made on 22 February 2024. Identification of experts to enable deeper understanding of issues between agencies is also foreseen.

The first Task Group meeting open to all interested CGMS members was held on 6 March 2024 with attendance of CGMS Secretariat, CMA, ESA, EUMETSAT, KASI, KMA, NICT, NOAA and WMO.

The Task Group currently has over 8 members from ESA, EUMETSAT, KASI, KMA, NICT, NOAA and WMO.

WGI endorsed the Terms of Reference of the Task Group.

WGI agreed to update the status of WGI/A50.07 with the progress of the development of the best practices, with a deadline of CGMS-53 for the completion of the best practices.

WGI supported the call for membership from each CGMS member organisation to help ensure the objectives can be met.

CGMS-52-ESA-WP-09 - 6.3 Zero Debris Charter (Q. Verspieren)

ESA has been encouraged by Member States to implement "a Zero Debris approach for its missions; and to encourage partners and other actors to pursue similar paths, thereby collectively putting Europe at the forefront of sustainability on Earth and in space, while preserving the competitiveness of its industry".

An overview of the Charter Targets was presented.

1. The probability of space debris generation through collisions and break-ups should remain below 1 in 1000 per object during the entire orbital lifetime. A suitable aggregate probability threshold for constellations of satellites in the low Earth orbit region should be identified.

2. Timely clearance of low Earth orbit and geostationary Earth orbit regions should be achieved with a probability of success of at least 99% after end of mission, including through external means when necessary.

3. The casualty risk from re-entering objects should remain significantly lower than 1 in 10 000, striving towards zero casualty. A suitable aggregate risk threshold for constellations of satellites in the low Earth orbit region should be identified.

4. Routine and transparent information sharing should be facilitated and active participation in strengthening global space traffic coordination mechanisms should be encouraged.

5. Access to timely and accurate data on space objects down to a size of 5 cm or smaller in low Earth orbit and 20 cm or smaller in geostationary Earth orbit should be improved to enhance decision making capabilities for collision avoidance.

The Zero Debris Charter aims to engage like-minded actors of the space sector in a collective effort towards space safety and sustainability. A Zero Debris Technical Booklet is being developed to list needs, technical solutions and contributions gathered through the Zero Debris community to achieve the jointly defined sustainability targets by 2030.

WGI took note of the Zero Debris Charter and encouraged members to familiarise themselves with it.

4. Satellite Data and Codes

CGMS-52-WGI-WP-04 - 4.1 Report from the CGMS WGI Task Group on Satellite Data and Codes (incl. latest ToR, status on current & proposed/planned activities, S. Elliott)

The CGMS 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.

The Task Group currently has 13 members from CMA, EUMETSAT, SRC Planeta, JMA, KMA, NOAA, WMO.

The Task Group has worked with the WMO Secretariat and the WMO Expert Team on Data Standards (ET-Data) and its Task Team on Table Driven Code Forms (TTTDCF) on the development of a number of new BUFR encoding sequences and Common Code Table entries. In each case, the Task Group acts as a reference group of experts who are invited to consider and endorse relevant proposals going through WMO's approval process.

During the period since CGMS-51, several entries have been defined in Common Code Table C-5 for satellite identifiers and in Common Code Table C-8 for instrument identifiers.

EUMETSAT has developed BUFR encoding sequences for products to be generated from Metop-SG. These sequences have been extensively reviewed by the various groups involved and came in to force with WMO's Fast Track-II process, in November 2023.

The Group continued to encourage WMO to ensure that OSCAR/Space includes references to the Common Code Table entries used for satellite identifiers (table C-5) and instruments (C-8). WMO has made significant progress in this area and will soon make available an update to OSCAR including the satellite identifiers form C-5, and the associated WIGOS station identifiers. The Group will continue to encourage the inclusion of instrument identifiers from C-8.

Between CGMS-52 and CGMS-53, 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. An important task for this period will be working together with the WGI Task Group on Metadata on supporting WMO with the transition to WIS 2.0, and the input to this from the satellite community.

WGI encouraged active participation in the work of the Task Group from all satellite operators.

7. Data Collection Services

CGMS-52-WGI-WP-08 - 7.1 Report from the CGMS WGI Task Group on Data Collection Services (incl. latest ToR, status on current & proposed/planned activities, N. Coyne)

The primary task of the Task Group on DCS has been to address the need for and make proposals for a new international DCP (IDCS) 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.

The discussions of the Enhanced DCP (E-DCP) standard have continued and is a major topic for the group. The group has developed a proposal for the way forward in developing a new Enhanced DCP (EDCP) standard, covered by a separate paper [CGMS-52-WGI-WP-14].

CGMS-52-WGI-WP-15 - 7.2 Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis of DCS (N. Coyne)

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 following five proposals for further work are based on the SWOT:

- 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.

Progress on these proposals is expected in the lead up to CGMS-53.

WGI agreed the following actions.

CGMS-52 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
DCS TG	**7.2**	WGI/A52.03	Work on the five proposals for DCS improvements based on the SWOT analysis, including work with RFI Task Group and DCS RFI register, DCS promotional materials presenting global view of DCS, improved DCS outreach via DCS introduction video, further work on EDCP standard, improvements to DCS user information across agencies.	CGMS-53	**OPEN**
DCS TG	**7.2**	WGI/A52.04	Propose an interagency approach for DCS data access via WIS 2.0. Review also related changes to the Data Access Best Practice document.	CGMS-53	**OPEN**
DCS TG	**7.2**	WGI/A52.05	Present an overview of the various applications of DCS known across CGMS Operators.	CGMS-53	**OPEN**

CGMS-52-WGI-WP-14 - 7.3 EDCP Transmitter Standard Proposal (incl. implementation plan 2024 – 2027 and funding requirements) – for endorsement (N. Coyne)

This paper outlines the proposal for an Enhanced DCP transmitter (EDCP) standard that the WGI Task Group on DCS has been developing over the last 3 years. The standard is now mature enough to move to building and testing a prototype. This will allow the standard to be tested and the expectations on the performance of the standard to be verified. The standard itself is contained in a standalone document [EUM/CGMS/STD/23/1380795] and is also included as an annex to the paper proposal.

The Task Group presented an overview of the proposed EDCP standard. The proposed EDCP standard can be realised with only firmware updates to the existing DCP transmitter hardware. It foresees using 1500Hz for each channel, with the ability to operate at 400 or 800 baud depended on modulation type. The 400-baud setting would provide a platform, which would be more robust to movement and interference at the cost of speed. The 800-baud would provide better speed at the cost of robustness. The best mode could be chosen for the environmental conditions. This operational mode would be automatically detected on the receiver side making it very flexible. There is a new header defined that would allow the GPS co-ordinates, battery voltage etc. to be included in each transmission. The receivers would also need to be modified to allow the reception of this new standard. It is expected this would be realised with firmware updates.

If endorsed by CMS-52 Plenary, the Task Group would proceed with producing and testing a prototype transmitter in 2025. The proposal is to achieve this with funding from NOAA (working with the manufacturer Microcom) and EUMETSAT (working with the manufacturer OTT-Sutron). The Task Group presented a timeline, which foresees declaring the EDCP standard operational by 2027.

CGMS WGI was invited to propose to CGMS Plenary the endorsement of the EDCP standard, as well as the proposed plan for activities leading up to declaring the EDCP standard as operational, and related schedule and funding approach.

The group discussed the EDCP standard proposal.

JMA approved proceeding with EDCP prototype and its presentation to CGMS-52 Plenary, noting that no funding would be provided by JMA, since:

- JMA plans to continue DCS on Himawari-10 with the same specifications as the current DCS. On the other hand, it is not clear whether JMA will continue DCS on Himawari-11 yet;
- Since the number of JMA's DCS users is not very large and there are other solutions that can replace DCS, the Japanese government does not intend to continue DCS for that long;
- Therefore, JMA has no incentive or reason to extend its functionality and fund the new EDCP standard.

WGI agreed to present the draft EDCP Standard, prototype development plan, and related funding requirements for endorsement by CGMS-52 Plenary, noting that:

- The report would need further work to further detail the use cases for the new EDCP, apart from those related to international use;
- The report would need to further detail how this new standard would be introduced into operations (e.g. alongside or in addition to existing standards, as well as any transition).

If the EDCP Standard and related plans for development and rollout into operations are endorsed by CGMS-52 Plenary, WGI/A49.03 will be closed and a new action will be opened to track the development of the EDCP prototype and rollout into operations.

CGMS-52-EUMETSAT-WP-10 - 7.4 Operational DCS status report + status of implementation of best practices (EUMETSAT, N. Coyne)

This paper presented the status of the EUMETSAT Data Collection Services (DCS), currently supported by Meteosat-10 at 0° and Meteosat-9 at 45.5°E IODC (Indian Ocean Data Coverage). Meteosat-9 took over from Meteosat-8 as the prime IODC satellite 1 July 2022. Meteosat-10 took over from Meteosat-11 as the prime 0° satellite on 21 March 2023.

The paper includes details of channel utilisation, DCP allocation, geographical distribution and DCP data dissemination mechanisms. The DCS is one of the core services operated by EUMETSAT in support of meteorology and weather prediction. Noting that the EUMETSAT DCS is also embarked on the Meteosat Third Generation (MTG).

The EUMETSAT DCS currently supports both standard-rate (100bps) and high-rate (1200bps) DCPs. The prime IODC application is for the Indian Ocean Tsunami Warning Network (IOTWS). As of 31 March 2024, there are 143 DCP operators located in 76 countries (Europe, Africa, Asia). There are a total of 1672 DCPs allocated, with 498 actively transmitting. Out of those DCPs allocated, 457 are HRDCPs transmitting at 1200 bps (359 supported by Meteosat-10 at 0° and 27 by Meteosat-9 at 45.5°E). The remaining 1215 are Standard Rate DCPs (1080 supported by Meteosat-10 at 0° and 135 by Meteosat-9 at 45.5°E). Since March 2023, 66 new DCPs have been assigned (69 HRDCP and 0 SRDCP). The EUMETSAT DCS has a typical reliability greater than 99%.

The paper included the EUMETSAT status of implementation of the CGMS Best Practices in support to DCP Transmitter Certification Process (EUM/CGMS/DOC/21/1252912). EUMETSAT is compliant with all of the best practices, apart from having an interactive online registration process for manufacturer certification.

The paper included the EUMETSAT status of implementation of the CGMS Best Practices in support to DCP Data Access (EUM/CGMS/DOC/21/1252911). EUMETSAT is compliant with all of the best practices, apart from offering tailoring features via the web service, making all DCS data available to users of the web service, and making DCS documentation easily accessible via the web service.

CGMS-52-ISRO-WP-01 - 7.5 Operational DCS status report + status of implementation of best practices (ISRO) (K. Mohan PV)

This paper presented the status of the ISRO Data Collection Services (DCS), currently supported by The Geostationary Satellites INSAT-3DR, INSAT-3D and GSAT-17, carrying Data Relay Transponder (DRT) in UHF x C band. ISRO/India has launched INSAT-3DS satellite as a replacement of INSAT-3D on February 17, 2024. The payloads are operating in the 402 MHz band for uplink and 4.5 GHz band for down link. These help in collecting realtime data for meteorological, hydrological and oceanographic applications, from automatic data collection platforms (DCP).

DRTs are supporting about 3800 Automatic Weather Stations and 64 Automatic Tide Gauges, ~600 terminals for Water recourses, ~100 terminals of Snow and Avalanche Study, 50 terminals for environment radiation monitoring, 375 terminals for Moored Buoy data collection, 15 terminals for Tsunameter. About 20000 terminals are for Distress Alert Transmitter.

350 more AWS terminals are planned for Snow & Avalanche study. 50 more terminals are also planned for radiation monitoring.

ISRO was invited to take part in the activities and meetings of the Task Group on DCS.

CGMS-52-JMA-WP-02 - 7.6 Operational DCS status report + status of implementation of best practices (JMA) (A. Shimizu)

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 Himawari-9 took over the DCS service in 2022 and will continue in this role until 2029.

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

The paper included the JMA status of implementation of the CGMS Best Practices in support to DCP Transmitter Certification Process (EUM/CGMS/DOC/21/1252912). JMA is compliant with all of the best practices.

JMA does not require certification for DCP transmitter manufacturers, so the CGMS Best Practices in support to DCP Data Access (EUM/CGMS/DOC/21/1252911) is not relevant.

CGMS-52-NOAA-WP-04 - 7.7 Operational DCS status report + status of implementation of best practices (NOAA) (W. Dronen)

The GOES DCS is an environmental data relay system that supports the collection of over 978,000 message per day from over 32,000 active Data Collection Platforms (DCPs) located throughout the Western

Hemisphere. The GOES DCS Program has 672 different user agency agreements representing 42 countries. DCP platforms collect environmental data and transmit this information to a GOES East or West satellite. The satellites then rebroadcast this data to terrestrial receive facilities maintained by NOAA or users' own facility. NOAA collects the complete range of DCS data, distributes it using the DCS Administrative and Data Distribution System (DADDS) or to other distribution interfaces. The DADDS is the central management for GOES DCS and provides user, DCP, and spectrum management tools.

The NOAA GOES DCS continues to be highly reliable and highly utilised. The system continues to grow and fulfils many critical roles for many users, including use of environmental data to act to protect life, property, and the environment. The growth of system usage, advance of technology, IT security requirements and external radio frequency interference provide both opportunities and challenges. NOAA GOES DCS is replacing DADDS, modernizing DCP communication technologies, and restoring a DCP Command link in order to make GOES DCS a more modern, efficient, and flexible system.

The paper included the NOAA status of implementation of the CGMS Best Practices in support to DCP Transmitter Certification Process (EUM/CGMS/DOC/21/1252912). NOAA is compliant with all of the best practices, noting that the NOAA National Weather Service Telecommunication Gateway (NWSTG) has capability to distribute on the Global Telecommunication System (GTS) with one international user, NOAA stores user data for 30 days with scaling storage and long-term storage up to the user and NOAA uses web notices and all-user e-mails to communicate outages, which are rare. Replacement DADDS may have improved issue tracking and user communication.

The paper included the NOAA status of implementation of the CGMS Best Practices in support to DCP Data Access (EUM/CGMS/DOC/21/1252911). NOAA is compliant with all of the best practices, noting that DCP certifications are very rare and government representative conducts personal visit to the manufacturer. Manufacturers contact the NOAA Radio Frequency Engineer directly. All procedures, standards, and approved manufacturers are published on a public webpage. There is currently no timeline requirement for the certification process.

CGMS-52-ROSHYDROMET-WP-01 - 7.8 Operational DCS status report + status of implementation of best practices (ROSHYDROMET, O. Ryzhkova)

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 Electro-L N2, N3 and N4 (14.5W, 76E, 165.8E) with a backup option via Luch series communication satellite and highly elliptical orbit satellites Arctica-M N1 and N2. There are 696 DCPs currently deployed. DCPs are distributed all over the Russian territory, including 141 DCPs in hard-to-reach areas. The Russian DCS will be further complemented with the launch of geostationary Electro-L N5 satellite.

CGMS-52-CGMS-WP-04a – 7.9 Best practices in support to DCP TX certification process - latest version and new proposals (N. Coyne)

The paper covers the status of the "CGMS agency best practice in support to DCP TX certification process" [EUM/CGMS/DOC/21/1252912 v1, 5 November 2021]. The document is fit for purpose and no updates are currently needed.

CGMS-52-CGMS-WP-05 – 7.10 Best Practices in support to DCP data access - latest version and new proposals (N. Coyne)

The paper covers the status of the "CGMS agency best practice in support to DCP data access" [EUM/CGMS/DOC/21/1252911 v1, 5 November 2021]. The document is fit for purpose and no updates are currently needed.

CGMS-52-NOAA-WP-05 – 7.11 Proposal on the agreed permitted Smallsat use of DCS by satellite systems and under what conditions - for endorsement (B. Backus)

In this paper, NOAA proposes the development of a process for updating the CGMS DCS Handbook over the CGMS-53 intersessional period to provide best practices for satellite use of DCS, including the permitted uses of DCS by satellites, conditions of use, criteria to support Members' assessments of applications for use of DCS by satellites, identification of consistent agreement practices to be applied by DCS administrations/agencies, and a process for notification and coordination with the CGMS Task Group on Data Collection Services of applications for satellite use of DCS.

The paper notes DCS systems have come under pressure from small satellite constellation companies that seek additional usable RF spectrum and wish to increase use of this band for their space operations. The paper also suggests it is expected that satellite use of the DCS system will alleviate some of this risk and may further strengthen the value of protecting the system. Satellite use of the DCS also fosters a new means for collecting and distributing meteorological and climatology data. This can be done using DCS-equipped smallsats in polar orbits. Additionally, should a commanding capability be implemented in GOES, this DCS equipped smallsat could also relay these commands from other DCS systems.

The initial concept for Satellite use of DCS was successfully validated through TES-10. The paper notes that the concept is valid and that DCS can be utilised to some definable degree by satellites. The launch and operation of TES-11 and 16 will provide a more significant validation of the operational challenges of this concept. NOAA recommends CGMS consider endorsing satellite use of DCS and asking WGI TGDCS to develop and include best practices in the DCS Handbook.

WGI agreed the following actions:

CGMS-52 ACTIONS - WGI					
Actionee	**AGN item**	**Action #**	**Description**	**Deadline**	**Status**
DCS TG	**7.11**	WGI/A52.06	The Task Group on DCS Satellite Operators to report on how their policies affect the usage of Smallsat.	CGMS-53	**OPEN**
DCS TG	**7.11**	WGI/A52.07	The Task Group on DCS to work on DCS Handbook updates related to Smallsat.	CGMS-53	**OPEN**

8. WGI Coordination Items

WGI Terms of Reference

CGMS-52-WGI-WP-18 - WGI Terms of Reference Update – for review and recommendation to Plenary (Co-Chairs/Rapporteur)

The paper presents the updated WGI Terms of Reference. The WGI Terms of Reference were last updated in CGMS-46 [CGMS-46- CGMS-WP-18].

In recent years, the scope of Working Group I has gradually evolved to cover additional important systems operations topics, such as Low Latency Data Access, Space Environment Sustainability, Radio-Frequency Interference (RFI) detection, monitoring and mapping. Additionally, the coordination of satellite data formats within the CGMS community was transferred from CGMS WGIV on "Data access and end user support" to WGI.

CGMS WGI invited to recommend for endorsement to CGMS Plenary the revised Terms of Reference for WGI.

The group reviewed the updated WGI Terms of Reference and agreed to present them for endorsement to CGMS-52 Plenary.

CGMS Global Contingency Plan, as proposed by WGIII (incl. CGMS Baseline, Risk Assessment Workshop outcomes & Implementation of WGI aspects)

CGMS-52-WGIIIWP-02WGI - Status and outcome of the 6th CGMS risk assessment - WG I: Satellite Systems and Operations (Melissa Johnson)

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 workshop from 21-22 February 2024, hosted by EUMETSAT.

WGI reviewed the draft update of the CGMS Risk Assessment.

CGMS High Level Priority Plan (incl. Review, Status of implementation, Proposed Updates)

CGMS-52-CGMS-WP-07WGI - Status of implementation of CGMS High Level Priority Plan (2023-2027) (M. Rattenborg)

This working paper provided the status of implementation of CGMS High Level Priority Plan (2023-2027). It also listed proposals for changes to the HLPP targets. WGI reviewed and provided inputs to the current status of the HLPP.

CGMS-52-CGMS-WP-08WGI - Revised HLPP 2024-2028 for recommendation to plenary (M. Rattenborg)

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

WGI action items & recommendations (incl. review/updates of existing and proposed new action items & recommendations)

CGMS-52-WGI-WP-09 - WGI action items & recommendations (incl. review/updates of existing and proposed new action items & recommendations, co-chairs/rapporteur)

WGI discussed the actions and recommendations from previous CGMS plenary sessions (CGMS-51 and earlier). The status of the open actions on and recommendations for WGI were reviewed and updated.

Future WGI sessions (incl. dates for future plenary and intersessional meetings, proposals for new agenda items)

CGMS-52-WGI-WP-19 - Decision on dates on WGI activities in 2024-2025 (CGMS-52 to CGMS-53) (for discussion, co-chairs/rapporteur)

The paper guided the discussion on planning the dates and formats of the WGI activities between CGMS-52 and up to and including CGMS-53.

WGI agreed on the WGI and Task Group intersessional meeting dates up to CGMS-53.

9. Any other business

There were no other business discussed.

10. Meeting Conclusions

CGMS-52-WGI-WP-11 - Agreement on Outcomes, Conclusions & Preparations of WGI Report for Plenary (Co-Chairs / Rapporteurs)

The WGI Co-Chairs and Co-Rapporteur thanked the WGI meeting participants for their valuable contributions to a successful meeting.

The outcomes and conclusions of the meeting were reviewed against the expected outcomes presented in the beginning of the meeting. The expected WGI outcomes were achieved.

LIST OF WORKING GROUP PARTICIPANTS

CGMS-52 - WGI List of Participants		
First name	Last name	Organisation
Anne	Taube	CGMS Secretariat
Siwei	Tian	CMA
Alec	Casey	ECCC
Juha-Pekka	Luntama	ESA
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Sean	Burns	EUMETSAT
Markus	Dreis	EUMETSAT
Simon	Elliott	EUMETSAT
Antoine	Jeanjean	EUMETSAT
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CGMS-52 - WGI List of Participants		
First name	**Last name**	**Organisation**
Zoya	Andreeva	WMO
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Working Group II

CGMS

Satellite data and products

WGII REPORT

Co-chairs: *XU Na CMA / J. V. Thomas ISRO*
Rapporteurs: *P. Ruti, EUMETSAT / A. Heidinger, NOAA*

1. Opening

The co-chairs began by expressing gratitude and welcoming everyone to the meeting, conveying a warm and inclusive atmosphere. They shared their honor and excitement about being elected as co-chair, committing to support the group effectively. Regrettably, the co-chairs mentioned they would only be able to join the meeting online. Throughout the introduction, the co-chairs thanked the attendees and extended a heartfelt welcome to everyone present.

1.1 Meeting objectives and expected outcomes, status of WGII co-chairs and rapporteurs, WGII ToR

CGMS-52-WGII-WP-06 - Meeting objectives and expected outcomes, status of WGII co-chairs and rapporteurs, WGII ToR

The main objectives discussed include reviewing the activities related to the goals of Working Group 2, fostering international coordination among different working groups, and focusing on advancing climate and greenhouse gas international scientific coordination.

A special session has been planned to discuss the utilization of AI, with a particular focus on how these tools and approaches impact operational models and the remote sensing community.

The chair outlines expectations for the meeting, which include generating substantive discussions to feed into a plenary session scheduled in Washington. There is also a mention of synthesizing recommendations and identifying priorities for further discussion.

1.2 Status of WGII co-chairs and rapporteurs

See final summary – CGMS-52-CGMS-WP-11.

1.3 Tour de table

1. **Greenhouse Gas Coordination Activity Approval**

    - The World Meteorological Organization (WMO) formally approved the global greenhouse gas watch, moving it to the executive council for further implementation. This is significant for the Climate Monitoring and Surveillance (CMS) and Continuous Environmental Observation (CEOS) groups as it marks the beginning of the implementation phase.

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

2.1 CGMS agency reports on highlights and issues in dataset and product generation

CGMS-52-CMA-WP-04 - CMA agency report on highlights and issues in dataset and products (Na Xu)

1. **New Satellite Launches**:
    - **FY-3G**: Launched in April 2023, this satellite focuses on rainfall measurement and is currently in trial operation. It provides detailed precipitation data and three-dimensional structures of various meteorological phenomena.
    - **FY-3F**: Launched in August 2023, this satellite is designed to replace FY-3C, focusing on comprehensive earth-atmosphere system exploration with 10 onboard instruments.
2. **Satellite Status Updates**:
    - Adjustments in the service schemes for FY-4 satellites, with FY-4B taking operational duties and FY-4A moving to a different position and suspending service.
3. **Technological Advances**:
    - FY-3G features high-accuracy instruments for Earth and Moon imaging, while FY-3F includes newly developed and improved instruments for enhanced data collection.
4. **GNOS-II Products**:
    - Enhanced wind, soil moisture, and sea ice products, demonstrating accuracy and positive impacts on numerical weather prediction models.
5. **Future Plans**:
    - Upcoming launches of FY-4C and FY-3H satellites in 2025, aimed at continuing and expanding geostationary and polar orbit meteorological observations.

CGMS-52-EUMETSAT-WP-04 – EUMETSAT report on highlights and issues in dataset and products (Paolo Ruti)

1. **Current Architecture**:
    - **Meteosat Third Generation (MTG)**: Includes rapid scanning, full disc sounding, and imaging services.
    - **EUMETSAT Polar System – Second Generation (EPS-SG)**: Provides sounding and imagery, and microwave imagery.
    - **Ocean Altimetry**: Through Sentinel-6 and Jason-3 missions.
    - Additional data integration from international partners.

2. **Future Evolution (2030 timeframe)**:
    - Expansion of LEO components with new satellites (EPS-Aeolus, EPS-Sterna).
    - Enhanced data collection through commercial and international partnerships.

3. **Key Product Developments - highlights**:
    - **Sentinel-3 Atmospheric Motion Vectors**: Improved AMVs for high latitudes.
    - **Cloud and Aerosol Properties**: In preparation for new missions like EPS-SG and CO2M.
    - **Forest Fires and Air Quality**: Monitoring trace gases from IASI.
    - **Land Correction in ASCAT Products**: New developments for better accuracy.
    - **CO2 Monitoring**: Development of the CO2M greenhouse-gas monitoring constellation.

4. **EUMETNET Initiative**:
    - Focused on data curation, analysis, modeling, postprocessing, and developing new products and services to foster AI and ML applications.

CGMS-52-IMD-WP-01 - IMD report on highlights and issues in dataset and product generation (AK Mitra, Shibin Balakrishna)

1. **INSAT Satellite Operations**:
    - The Indian Meteorological Department (IMD) operates three dedicated antennas for receiving signals from INSAT-3D, 3DR, and the upcoming 3DS satellites.
    - Calibration and validation (Cal/Val) campaigns were conducted in collaboration with ISRO to ensure the accuracy of sensor data from these satellites.

2. **Cyclonic Event Monitoring**:
    - Rapid scans were conducted during major cyclonic events in 2023, providing detailed observations and data for analysis.

3. **Validation and Indexes**:
    - INSAT-3D/3DR Sounder data was validated against radiosonde data for parameters like Lifting Index (LI) and Dry Microburst Index (DMI).
    - Snow cover change maps were generated for the Himalayan region, with comparisons to MODIS data indicating significant warming in recent winters.

4. **Rainfall and Temperature Products**:
    - Improved rainfall estimation techniques for the southwest monsoon using INSAT-3D/3DR brightness temperatures showed better accuracy compared to traditional methods.
    - Land surface temperature data for urban areas like Delhi was generated and validated with in-situ observations.

5. **Ocean and Wind Products**:
    - Real-time scatterometer wind products from Oceansat-3 are operational, aiding in monitoring cyclonic activities.
    - Climatology of wind-derived products, including low-level convergence and upper-level divergence, is being developed.

6. **Data Transfer and Inter-calibration**:
    - Seamless data transfer for SIGMET Coordination with the Hong Kong Observatory has been established.
    - Inter-calibration of historical satellite data is ongoing to ensure consistency and accuracy in long-term climate monitoring.

Ongoing and Future Work:

- Efforts are underway to establish an independent processing chain for INSAT data.
- Development of a GUI-based tool for better visualization of satellite products and compliance exercises for existing data archives.
- Enhancements in translational speed detection and tracking of convective clouds are planned.

CGMS-52-ISRO-WP-03 - ISRO report on highlights and issues in dataset and product generation (Rashmi Sharma)

1. **Current Satellites**:
   - **INSAT-3D and INSAT-3DR**: Operational in GEO, with INSAT-3D's sounder non-functional since September 2020.
   - **INSAT-3DS**: Launched on February 17, 2024, addressing previous calibration and sun intrusion issues.
   - **EOS-06 (Oceansat-3)**: Operational with Ku-band scatterometer and 13-band Ocean Color Monitor; data released via the BHUVAN web-portal.
   - **EOS-07 (Microsat-2B)**: Launched in February 2023, carrying a 6-channel Microwave Humidity Sounder, with data available on the MOSDAC portal.

2. **Joint Missions**:
   - **SARAL/AltiKa**: Extended till December 2024, pending satellite health.

3. **Future Launches**:
   - **GISAT-2**: Scheduled for launch in 2024.
   - **Oceansat-3A**: Set for 2025, with enhanced atmospheric temperature and humidity sensing capabilities.

4. **Technological Developments**:
   - **Inter-Calibration of IR Channels**: Under GSICS, using IASI-B/C, with plans to extend to CrIS.
   - **Ray-Matching Method**: Developed for inter-calibration of Vis/SWIR channels, utilizing MODIS data.

5. **Future Missions**:
   - Proposals for advanced GEO satellites with capabilities such as faster scanning, higher resolution imaging, and improved sensors for environmental monitoring and climate change assessment.

CGMS-52-JAXA-WP-01 – JAXA Earth Observation Program and Data Product (Takuji Kubota)

1. **GCOM-C Mission**: Focus on global climate change observation with high-resolution imagery.
2. **GOSAT Series**: Long-term greenhouse gas monitoring, including CO2, CH4, and CO observations.
3. **AMSR Series**: Advanced microwave scanning radiometers for continuous water-related geophysical parameter observations.
4. **GPM Core Observatory**: Recent altitude adjustments to extend the mission's lifespan.
5. **Upcoming Missions**:
    - **EarthCARE**: Joint mission with ESA for cloud profiling and climate studies, launching in May 2024.
    - **ALOS-4**: Advanced L-band SAR mission for land and disaster monitoring, launching in JFY2024.
    - **GOSAT-GW**: Will enhance greenhouse gas and water cycle observations with new instruments AMSR3 and TANSO-3, launching in JFY2024.
    - **PMM**: Next-generation precipitation radar mission planned for JFY2028.
6. **Global Satellite Mapping of Precipitation (GSMaP)**: Enhanced precipitation monitoring and real-time data distribution.
7. **Collaborations**: Engagement with international groups like SWCEM and IPWG, and development of the Earth Digital Twin for integrated environmental predictions.

CGMS-52-JMA-WP-03 - JMA report on highlights and issues in dataset and product generation (Takuya Sakashita)

1. **Himawari-9**: Started operations in December 2022 with stable data quality comparable to Himawari-8, validated by landmark and GSICS inter-calibration analyses.
2. **Product Development**: Enhancements in convective cloud information and fog detection products using AI/ML, resulting in reduced false alarms and improved accuracy.
3. **New Cloud Product**: Developing a new fundamental cloud product using advanced algorithms, scheduled for introduction in JFY 2026.
4. **Himawari-10**: Manufacturing contracted in March 2023, with planned operation by JFY 2029. The new satellite will include the Geostationary HiMawari Sounder (GHMS) to capture 3-D atmospheric variables for improved NWP, incorporating PCA for data volume and noise reduction.

CGMS-52-KMA-WP-06 - KMA report on highlights and issues in dataset and product generation (Byung-il Lee)

1. **Monitoring and Warning of Extreme Weather**: Utilizing model-simulated satellite images and AI-based detection algorithms to improve forecasting accuracy for events like typhoons and convective initiation.

2. **Filling Observation Gaps**: Employing AI technology to supplement ground observation data with satellite-derived products, such as proxy radar and UV index estimations.

3. **Climate Mission Support**: Monitoring greenhouse gases and other environmental variables using satellite data to better understand and respond to climate change.

4. **Satellite Data Assimilation**: Developing a geostationary hyperspectral infrared sounder planned for 2033 to enhance numerical weather prediction models, particularly for severe weather events.

CGMS-52-NASA-WP-04 - NASA report on highlights and issues in dataset and product generation (Maudood Khan)

1. **Calibration and Validation Activities**: NASA has engaged in various surface-based networks and field campaigns to ensure accurate data from its satellite instruments. Notable efforts include the Tropospheric Ozone Lidar Network (TOLNet) and the Pandora spectrometer system, which are vital for monitoring air quality.

2. **Research Highlights**: Significant findings include the doubling of Earth's heating rate since 2005, driven by decreased cloud cover, reduced sea ice, and increased trace gases and water vapor. This research underscores the importance of satellite and in situ data in understanding climate changes.

3. **Data Products**: NASA has developed several advanced data products, such as the Integrated Multi-satellite Retrievals for GPM (IMERG) and the Soil Moisture Active Passive (SMAP) mission. These products enhance our understanding of precipitation and soil moisture dynamics.

4. **Field Campaigns**: The FireSense project exemplifies NASA's efforts to develop technologies for wildland fire management through airborne campaigns. These campaigns provide critical data for improving fire behavior models and air quality forecasts.

CGMS-52-NOAA-WP-06 - NOAA report on highlights and issues in dataset and product generation (Andrew Heidinger)

1. NOAA is preparing to launch GOES-U, the final satellite in the GOES-R series, on June 25, 2024. This satellite, to be renamed GOES-19, will replace GOES-16 as GOES East.

2. The NOAA-21 satellite became the primary satellite in the Joint Polar Satellite System (JPSS) in March 2024, with NOAA-20 and Suomi-NPP serving as backup and tertiary satellites, respectively.

3. NOAA is collaborating with NASA on the next-generation geostationary mission, Geostationary Extended Orbit (GeoXO), with contracts awarded for the development of the GeoXO Imager and Sounder.

4. The Space Weather Follow-On Lagrange-1 (SWFO L1) Mission, scheduled for launch in 2025, aims to maintain real-time solar imagery and solar-wind measurements.

5. NOAA is transitioning all product generation to the Cloud, enhancing capabilities in flood mapping, fire weather detection, and greenhouse gas monitoring.

6. The presentation also discusses advancements in fire weather detection, flood mapping, water quality products, and methane detection using satellite technology.

CGMS-52-ROSHYDROMET-WP-02 - ROSHYDROMET report on highlights and issues in dataset and product generation (Alexander Uspensky)

- The presentation from ROSHYDROMET provides an overview of their meteorological satellite-based products and activities. The Russian orbital constellation for hydrometeorological monitoring includes several LEO, GEO, and HEO satellites, such as Meteor-M, Electro-L, and Arktika-M series. Key highlights include the generation of various satellite-based weather products, such as cloud parameters, precipitation zones, and atmospheric motion vectors, derived from these satellites. The presentation also discusses the ground segment infrastructure for data reception and processing, as well as the application of satellite data in monitoring forest fires and volcanic activity. The effectiveness of atmospheric motion vectors from the Arktika-M No.1 satellite was validated against radiosonde and GFS NCEP winds, showing good correlation.

CGMS-52-WMO-WP-01 - WMO report (Natalia Donoho)

- WMO presentation highlights several key updates and initiatives from the World Meteorological Organization (WMO). It includes the introduction of new leadership, with Professor Celeste Saulo as Secretary-General and Mr. Thomas Asare as Assistant Secretary-General. The WMO Space Programme emphasizes the critical role of Earth observation satellite data in weather prediction and the importance of satellite data availability and utilization.
- The 15th Session of the Consultative Meetings on High-Level Policy on Satellite Matters (CM-15) addressed increasing benefits of satellite data for developing countries, managing high data volumes, involving the private sector, and coordinating greenhouse gas monitoring.
- The presentation also outlines the "WIS2 in a box" project aimed at improving data management and dissemination, and the Global Greenhouse Gas Watch (G3W) initiative for monitoring atmospheric CO2 and CH4. Coordination efforts in space weather and radio frequency spectrum management are highlighted, along with the challenges faced by countries lacking sufficient meteorological infrastructure for early warning systems.

3. CGMS International Science Working Groups

3.1 GSICS EP Specific topics for the attention of CGMS

CGMS-52-GSICS-WP-01 - GSICS Report (Mounir Lekouara)

The GSICS presentation summarizes the outcomes of the 2024 annual GSICS meeting. Key points include the establishment of a new lunar calibration sub-group and a focus on inter-calibration of polarimeters within the VIS-NIR sub-group. The harmonization of GSICS coefficient reporting across agencies is under discussion, with recommendations to be presented at the CGMS-52 plenary session in June 2024. The year was marked by productive collaborations, with new inter-calibration products and ongoing cooperative efforts in lunar models, infrared, and VIS-NIR inter-calibration. The GSICS community continues to grow, with new sub-groups and a focus on enhancing product deliverables through various calibration activities.

3.2 ICWG Specific topics for the attention of CGMS

CGMS-52-ICWG-WP-01 - ICWG activity updates and recommendations (Andrew Heidinger)

1. Updates on High-Level Priority Plan (HLPP) actions and ICWG-3 meeting held in February 2024, with over 100 attendees discussing cloud property intercomparisons and new algorithms.

2. Preparation for future cloud property intercomparison activities using the ISCCP-NG L1G dataset.

3. Discussions on AI/ML approaches for cloud property retrievals, suggesting a new topical group for AI/ML in ICWG-4.

4. Challenges in validating cloud retrievals without direct ground truth, highlighting ongoing efforts to improve validation methodologies.

5. Encouragement for collaboration between ICWG and IWWG, especially in evaluating cloud height retrievals for the AMV community.

3.3 IROWG Specific topics for the attention of CGMS

CGMS-52-IROWG-WP-01 - IROWG update on recommendations and activities (Hui Shao)

1. **Upcoming Workshop**: IROWG-10 is scheduled for September 2024 in Boulder, Colorado, focusing on GNSS (Global Navigation Satellite System) radio occultation (RO) and its applications.

2. **RO Impact on NWP**: Recent studies confirm the significant impact of RO data on numerical weather prediction (NWP), ranking highly among various observation types for reducing forecast errors.

3. **Best Practices Document**: A draft document outlining best practices for RO observations for long-term climate studies is proposed for adoption by the CGMS.

4. **Data Archiving Concerns**: Emphasis on the need for government-owned archives for long-term preservation of RO data.

5. **Technological Developments**: Recommendations for advancing RO technology for improved planetary boundary layer profiling and enhanced weather prediction.

6. **New RO BUFR Template**: Proposal for updating the BUFR template to accommodate new data types and improve quality control.

7. **Community Engagement**: Highlights from recent workshops, such as the second GNSS Polarimetric RO User Workshop, and ongoing projects aimed at enhancing the RO infrastructure and its applications in meteorology and climate studies.

8. The IROWG ROMEX Workshop, held in April 2024 in Darmstadt, Germany, focused on the Radio Occultation Modeling Experiment (ROMEX). The workshop highlighted the progress in collecting and processing radio occultation (RO) data, with EUMETSAT handling around 30,000-40,000 profiles per day during September-November 2022. Initial evaluations indicate high-quality data beneficial for Numerical Weather Prediction (NWP) experiments. Preliminary results suggest a positive impact of ROMEX data on weather forecasts, though conclusive findings are expected by September 2024. The workshop also identified areas for further research. The need for uniform spatial and local time coverage in RO observations was emphasised, which is not necessarily met even for the large quantities of profiles obtained within ROMEX.

3.4 IPWG Specific topics for the attention of CGMS

CGMS-52-IPWG-WP-02 – IPWG activity updates and recommendations (Chris Kummerow)

1. **Positive Developments**:
    - The Global Precipitation Measurement (GPM) mission's orbit boost extends its operations into the early 2030s.
    - New radiometers with advanced capabilities are being launched by agencies such as JAXA, NASA, and NOAA.
    - Growing use of AI/ML techniques is improving precipitation products, particularly in estimating frozen precipitation.

2. **Challenges**:
    - The increasing use of AI/ML has led to unverified global products.
    - CubeSat/SmallSat missions often lack quality control, affecting data consistency.
    - There is a need for better uncertainty prediction in regions without validation data.

3. **Organizational Efforts**:
    - The IPWG has established several working groups (WGs) and focus groups (FGs) to address specific challenges, including surface precipitation networks, multi-satellite products, machine learning, and CubeSat/SmallSat constellations.
    - The IPWG is developing a benchmarking activity to assess the quality of precipitation products.

4. **Key Issues for CGMS**:
    - The need for standards in quality control and intercalibration of radiometers.
    - Commitment from CGMS members to support and implement these standards is crucial for maintaining high-quality global precipitation products.

3.5 ITWG Specific topics for the attention of CGMS

CGMS-52-ITWG-WP-02 - ITWG activity updates and recommendations (*Reima Eresmaa*)

1. The ITSC-24 conference held in Tromsø, Norway, in March 2023, reported its outcomes and recommendations to CGMS-51, with presentation materials available online.
2. Preparations are ongoing for ITSC-25, scheduled for the second quarter of 2025, with exact dates and location to be announced.
3. New ITWG co-chairs, Fiona Smith (Australia) and Reima Eresmaa (Finland), were elected in May 2023.
4. Mitch Goldberg (NASA) retired as rapporteur to CGMS, succeeded by Lihang Zhou (NOAA).
5. Intersessional virtual meetings for various working groups (Advanced Sounders, Climate, Numerical Weather Prediction, etc.) are scheduled for June-July 2024.
6. ITWG contributes to discussions on future hybrid space infrastructure and documents the performance and impact of current and future microwave-sounding satellite constellations.

3.6 IWWG Specific topics for the attention of CGMS

CGMS-52-IWWG-WP-01 - IWWG Status Report of the International Wind Working Group (IWWG) Activities (Iliana Genkova)

The presentation "CGMS-52-IWWG-WP-01" reports the activities and discussions of the International Winds Working Group (IWWG) since the CGMS-51 meeting. It includes updates on the 16th International Winds Workshop held in May 2023, covering various topics such as the status of operational winds, satellite-derived winds in numerical weather prediction (NWP), ocean surface winds, and future missions. Key highlights include the progress in 3D Atmospheric Motion Vectors (AMVs) from hyperspectral IR sounders, recommendations for AMV producers and users, and the potential impacts of these winds on weather forecasting. The presentation also addresses the group's efforts in standardizing wind product derivation, reprocessing historical data for climate applications, and preparing for future workshops and collaborative projects.

3.7 IESWG The International Earth Surface Working Group

CGMS-52-IESWG-WP-01 - IESWG activity updates including updated ToRs for an IESWG CGMS International Science Working Group for WGII review (Ruston)

1. **Approval and Focus**: The IESWG was approved as a probationary working group within CGMS, emphasizing its unique expertise in data assimilation and Earth surface modeling aimed at optimizing the use of current and future observations.
2. **Main Topics**: The group's primary areas of focus are snow, ice, and cryosphere-atmosphere interactions; vegetation and land-atmosphere fluxes; and soil moisture, river discharge, and the water cycle.

3. **Recent Updates**: The 5th IESWG meeting in September 2023 identified gaps in snow observations and modeling, particularly the need for measuring Snow Water Equivalent (SWE). This is being addressed through missions such as the Canadian TSMM and the CIMR Copernicus Expansion mission.

4. **Challenges and Progress**: The group is working on improving Land Data Assimilation Systems (LDAS), addressing model error specifications, and enhancing the accuracy of Land Surface Temperature (LST) characterization. Direct satellite radiances assimilation for snow is a key goal, necessitating better observation operators.

5. **Future Directions**: The IESWG continues to support the development of microwave radiative transfer models for complex surfaces and identifies SWE measurements as a critical gap. The group endorses the continuity of water missions and emphasizes the development of SWE products in collaboration with the user community.

4. Climate and greenhouse gas observations

4.1 Working papers on climate and greenhouse gas, including CEOS-CGMS climate report (mitigation, adaptation, long-term monitoring)

CGMS-52-JWGCLIM-WP-01 - Update from the Joint CEOS-CGMS Working Group on Climate and the GHG Task Team (Jeff Privette)

1. **Updating Documents**: The Space Agency Response to the GCOS Implementation Plan, the ECV Inventory Gap Analysis Report, and the Coordinated Action Plan are being revised to align with current climate science needs.

2. **Greenhouse Gas Monitoring**: The GHG Task Team is pushing for resumed coordination with CGMS Working Groups to operationalize GHG space observations and ensure reliable monitoring to meet various international requirements.

3. **Recent Achievements**: These include delivering a statement for SBSTA at COP-28, hosting WGClimate-20, and prioritizing tasks such as updating the Greenhouse Gas Roadmap and restructuring the ECV Inventory.

4. **Leadership Changes**: The nomination of Dr. Vincent-Henri Peuch as the new Vice-Chair for WGClimate.

5. **Future Plans**: Submitting revised core documents for endorsement, supporting CEOS SIT Chair priorities, and updating the GHG Roadmap.

CGMS-52-WMO-WP-02 – Global Greenhous Gas Watch (G3W) Implementation Plan – Updates (Gianpaolo Balsamo (online))

1. **G3W Initiative**: Approved by INFCOM-3 in April 2024, the G3W aims to provide a comprehensive monitoring system for greenhouse gases (GHGs) by integrating Earth observations with advanced data assimilation and AI techniques.

2. **Implementation Phases**:
    - **2024-2027**: Implementation and Pre-Operational Phase (IPP)
    - **2028-2031**: Initial Operational Phase (IOP)
    - **2032-2050**: Enhanced Operational Phase (EOP)
3. **Funding and Collaboration**: The project has a budget of $1 billion, focusing on observations, integration, and coordination. It calls for collaboration with national, regional, and international efforts, and seeks engagement from the private sector.
4. **Objectives and Impact**: G3W aims to fill critical gaps in GHG monitoring, support climate action, and provide policy-relevant information. It seeks to harmonize efforts globally, leveraging existing standards and ensuring sustainability and data accessibility.
5. **Workshop Recommendations**: Addressing gaps in spatial and temporal data, ensuring sustainable satellite operations, and promoting integration and standardization across domains.

5. High Level Topics – New horizons

5.1 Use of satellite observations

CGMS-52-EUMETSAT-WP-15 - GEORing – Updates and perspectives (Joerg Schulz/Andrew Heidiger)

The presentation by EUMETSAT for CGMS-52 WG-II discusses the GEO-Ring project, which aims to create a Fundamental Climate Data Record (FCDR) from historical radiance measurements from geostationary satellites. This effort, in collaboration with NOAA and supported by JMA, seeks to reconstruct data spanning from the mid-1970s to present, providing 30-minute temporal and approximately 0.05° spatial resolution. The project involves data rescue, quality control, sensor recalibration, and validation, and plans to use cloud environments for data distribution. The presentation also highlights workshops, the roadmap for FCDR production, and applications such as cloud, aerosol, and storm tracking. Additionally, it addresses the need for data policy harmonization and potential future extensions, including integrating data from polar orbiting satellites.

CGMS-52-IMD-WP-02 – GEORing updates (Shibin Balakrishnan, AK Mitra and KC Sai Krishnan)

The presentation from the India Meteorological Department (IMD) for CGMS-52 focuses on the GEO-Ring initiative, which aims to develop Climate Data Records (CDRs) through consistent long-term satellite observations. These records help in enhancing the accuracy of climate and environmental change predictions. The presentation highlights the utilization of INSAT series satellites for continuous meteorological observations, detailing the instruments and data quality. Key efforts include inter-calibration activities, quality control, and recalibration to ensure consistent and accurate satellite data. The initiative also addresses the challenges of anomalies, calibration errors, and the need for improved geo-location. The presentation underscores the collaboration between global satellite agencies to produce fundamental climate data records and the importance of filling data coverage gaps over the Indian Ocean.

CGMS-52-EUMETSAT-WP-17 - Hyperspectral infrared sounding for weather prediction (Dorothee Coppens)

The presentation "Hyperspectral IR soundings across the Geo Ring" by EUMETSAT highlights the advancements and future plans for hyperspectral infrared soundings from geostationary and low-Earth orbit satellites. Key missions discussed include IASI on Metop satellites, providing detailed atmospheric data twice daily, and the upcoming IRS on MTG-S, which will offer high-resolution soundings every 30 minutes over Europe starting in 2025. These missions aim to enhance weather forecasting, nowcasting, and atmospheric composition analysis. The presentation also explores the potential for combining data from various satellite sounders to improve extreme weather event predictions and discusses the need for optimal combinations of satellite missions to address existing gaps in atmospheric observations.

5.2 Perspectives and updates from interaction with the EO commercial sector

CGMS-52-CMA-WP-08 - CMA and the commercial sector (Min Guan)

1. **Yunyao Aerospace Constellation**: This will consist of multiple satellites in sun-synchronous and low-inclination orbits to enhance meteorological observations. It aims to provide extensive atmospheric and ionospheric data by 2025.

2. **TianMu-1 Meteorological Constellation**: Comprising 23 satellites already in orbit as of 2023, this constellation will offer comprehensive atmospheric profiling and is expected to expand further by 2025, providing global 3D atmospheric data.

3. **FengYun+ Constellation**: This involves an expanded constellation of FengYun satellites, contributing to improved meteorological data collection and services.

4. Chinese Small Satellite Commercialization: Featuring satellites like Yunyao, Tianmu-1, Jilin-1, Zhuhai-1, and Catcher-1, this initiative aims to bolster the commercialization of meteorological satellites, enhancing data availability and utility.

CGMS-52-ESA-WP-10 - ESA and the commercial sector (Josep Rosello Guasch)

1. **GNSS-Radio Occultation**: EUMETSAT has successfully procured Spire commercial RO data since 2021, demonstrating significant added value. ESA promotes the inclusion of a second data source and explores future activities in polarimetric RO.

2. **Future Missions and Architecture**: The ESA department responsible for defining and preparing future EO systems and technologies emphasizes preparatory activities for future missions and the development of new domains in EO.

3. **Commercial Applications and Collaboration**: ESA's collaboration with commercial entities focuses on quality assessment, impact studies, and integrating commercial data into institutional frameworks. This includes the GNSS-RO model and its potential applicability to other applications.

4. **Greenhouse Gases (GHG) Monitoring**: ESA highlights active commercial sector participation in GHG monitoring, with several institutional and NewSpace missions targeting CO2, CH4, and NO2 emissions. Challenges include balancing detection and monitoring capabilities at a global scale.

5. **Hybrid Architectures**: Combining traditional satellites with SmallSat complements for applications such as GHG monitoring, ocean observation, and soil moisture assessment.

6. **Challenges and Opportunities**: The presentation outlines the challenges and opportunities of linking commercial data with institutional frameworks, emphasizing the importance of collaborative efforts through working groups like IROWG and IPWG.

CGMS-52-ISRO-WP-06 - ISRO update on the commercial sector (J V Thomas)

1. **ISRO and Commercial Sector Engagement**: ISRO promotes, regulates, and supports the private space industry, comprising over 450 SMEs, 50 large industries, and 100 startups, through initiatives like IN-SPACe.

2. **Industry and Academic Partnerships**: Collaborations with industries, startups, academia, and government ministries are crucial for space research, technology development, and the production of launch vehicles and satellites.

3. **Emerging Private Space Sector**: India's private space sector is growing, with significant developments in small satellite production, launch vehicles, and geospatial solutions. Companies like Skyroot Aerospace and Agnikul Cosmos are notable contributors.

4. **Startups in Satellite Operations**: New startups focus on deploying satellites for environmental monitoring, crop health, climate change, and other applications, with several planned and recently launched missions.

5. **Data Utilization and Applications**: Emphasis on remote sensing, machine learning, and big data analytics for various sectors, including agriculture, urban planning, and disaster management.

CGMS-52-NOAA-WP-08 - NOAA and the commercial sector (Martin McHugh)

1. **Operational GNSS-RO Contracts**: NOAA has established contracts to acquire unique, non-duplicate data for atmospheric and ionospheric products, with a preference for unrestricted data distribution rights.

2. **Pilot Projects**: NOAA has undertaken several pilot projects, such as the Space Weather Pilot and Ocean Surface Wind Pilot, to evaluate the quality and impact of commercial data on weather forecast models.

3. **Challenges and Lessons Learned**: NOAA identified issues with configuration control, transparency, vendor reliability, and volatile pricing. These insights are crucial for other members considering commercial data purchases.

4. **Benefits of RO Data**: Assimilating radio occultation (RO) data into numerical weather prediction models has led to significant forecast error reductions and improvements in tropical cyclone forecasts.

5. **Future Plans**: The presentation outlines NOAA's planned activities for 2024-2025, including further data buys and potential new pilot contracts for space weather and data-as-a-service.

6. CGMS risk assessment and baseline

6.1 CGMS WGIII 6th risk assessment

CGMS-52-WGIII-WP-02WGII - Status and outcome of the 6th CGMS WGIII risk assessment - WGII: Satellite Data and Products (Melissa Johnson)

1. **CGMS Baseline Commitment**: Ensuring sustained, free, and operational observations from member satellites, aligned with WMO's requirements and the WIGOS 2040 vision.

2. **Risk Assessment Process**: Annual evaluations categorize risks into low (green), moderate (yellow), and high (red), based on potential gaps in data availability and mission continuity.

3. **Earth Observations Risks**:

    - High risk of gaps in low-inclination radio occultation observations post-COSMIC-2.
    - Long-term risks for Synthetic Aperture Radar and High-Resolution Optical Imager observations.
    - Moderate risks for precipitation radar, microwave imager, and SWIR imaging spectrometer.

4. **Space Observations Risks**:

    - Long-term continuity risks for observations at L1 (interplanetary magnetic field and plasma analyzer).
    - Slight near-term risk for coronagraph observations mitigated by backup plans.

5. **Mitigation Actions**: Includes recommendations for expanding the hyperspectral sounding in geostationary orbits, ensuring data provision from commercial sources, and coordinating long-term CO2 monitoring through the Joint Working Group on Climate.

6. **Updates and Launch Schedules**: Adjustments to mission timelines and end-of-life dates, with significant updates on missions like MetOp, Sentinel, and GOES series.

7. Review of internal WGII survey

7.1 Review of WGII survey on AI/ML

CGMS-52-EUMETSAT-WP-11 - Short presentation on AI/ML survey outcomes (Justin Shenolikar)

1. **Background**: CGMS members are exploring the future direction of AI/ML, with Dr. Xu Na of CMA leading one of the pilot activities. AI/ML systems like ChatGPT and data-driven weather forecasting models are of significant interest.

2. **Survey Participation**: The survey had 20 participants from various geographic regions and organizational types, ensuring a broad representation of views.

3. **AI/ML State Among Members**: Almost all members have ongoing AI/ML projects, with most in conceptual or developmental stages. Organizations prioritize in-house expertise and model development, focusing on areas such as satellite data applications and observational retrieval.

4. **Data Curation**: Data selection, annotation, generation, refinement, and designing are key activities in preparing data for ML training. High-quality, representative datasets are crucial, with many agencies seeking cooperation on these tasks.

5. **Cooperation Priorities**: Members expressed a desire for inter-agency cooperation, particularly in data curation, ML model development, AI product development, and the creation of benchmarking tools.

6. **Conclusions**: While nearly all agencies are engaged in AI/ML, the extent and maturity of their projects vary. There's a need for improved data curation and shared best practices to advance AI/ML applications.

8. Selected topics of high priority to members

8.1 Selected topics of high priority to members 5min/presentation + 5 min discussion

CGMS-52-ISRO-WP-07 - Update on the Microwave Humidity Sounder performance and products (Pradeep Thapliyal)

This presentation by ISRO provides an update on the performance and products of the Microsat-2B Millimeter-wave Humidity Sounder (MHS). Launched on February 10, 2023, the MHS operates in a 37-degree inclined orbit at 450 km altitude. It features a 6-channel cross-track scanning radiometer operating at 183.31±15.75 GHz with a spatial resolution of 10 km at nadir, offering a swath of approximately 1000 km. The data, available on the MOSDAC website, show consistent results with simulated brightness temperatures and improvements in moisture and temperature analyses. Inter-calibration with JPSS/ATMS observations indicates negligible bias and standard deviations of less than 2.0 K across channels. The assimilation of MHS data into operational systems has demonstrated improvements in model initial conditions and forecast accuracy.

CGMS-52-JAXA-WP-25 - Joint ESA/JAXA presentation: Pre-launch activities of the EarthCARE mission (Takuji Kubota, Dirk Bernaerts)

The presentation covers the pre-launch activities of the EarthCARE mission, a joint effort between ESA and JAXA. EarthCARE, the sixth Earth Explorer Mission, is the largest and most complex to date, designed

to provide vertical profiles of aerosols and clouds, cloud profiling, and 3D cloud-aerosol scenes using various instruments like ATLID, CPR, MSI, and BBR. Key infrastructure includes ground stations in Sweden and Canada, and operational centers in Germany, Italy, and Japan. The mission's science and validation workshop highlighted its potential for machine learning applications, numerical weather modeling, and 4D-Var data assimilation. The launch is scheduled for May 2024 from Vandenberg Space Force Base.

CGMS-52-NOAA-WP-09 - Status update on the progress on the NEON missions (Satya Kalluri (online))

The NOAA presentation at the CGMS-52 focuses on the progress and plans for the Near Earth Orbit Network (NEON) program, which aims to develop the next generation of low-Earth orbit (LEO) environmental satellites. NEON will employ a disaggregated architecture to enhance flexibility and resilience in satellite operations. Key initiatives include the QuickSounder mission, targeting a launch in March 2026, to demonstrate commercial operations using the Advanced Technology Microwave Sounder (ATMS). The programme emphasizes partnerships, leveraging commercial capabilities, and aims to ensure continuity and advancement in microwave and infrared sounding, weather imaging, and other critical observational needs through a series of planned missions extending into the 2030s.

CGMS-52-NASA-WP-07 - Updates on applications of COWVR/TEMPEST Data and Mission Status (Tong Lee (online))

1. **COWVR/TEMPEST Measurements**: These instruments provide comprehensive and unique data on air-sea interactions and atmospheric conditions over the diurnal cycle, improving storm monitoring and forecasting.

2. **Operational Use**: The data from COWVR/TEMPEST is used operationally by the U.S. Navy for tropical cyclone forecasting, enhancing the capabilities of the National Hurricane Center and Joint Typhoon Warning Center.

3. **Benefits of Mission Extension**: Extending the mission would further advance understanding of diurnal convection, improve observations of the El Niño-Southern Oscillation cycle, and aid in developing coupled data assimilation techniques for better weather and climate predictions.

CGMS-52-WMO-WP-14 - Potential new Direct Broadcast Network (DBNet) services (Mikael Rattenborg)

The WMO-CGMS Direct Broadcast Network (DBNet) Coordination Group seeks input from CGMS Science Working Groups on potential new DBNet services of interest. DBNet provides real-time acquisition and delivery of Low Earth Orbit (LEO) satellite data through a global network of direct broadcast receiving stations. This data, pre-processed and formatted according to agreed standards, is delivered to the global user community within 30 minutes. The network aims to enhance global consistency by using common software and standardized protocols. Feedback is requested on which new DBNet services should be introduced and their potential applications. The transition from the Global Telecommunication System (GTS) to WIS 2.0, a new data-sharing infrastructure, presents opportunities for better handling high volume datasets with strict timeliness requirements.

CGMS-52-IPWG-WP-03 - Sustaining a core satellite reference capability with radar and radiometer for precipitation measurements (Joe Turk (online))

The power point presentation from the International Precipitation Working Group (IPWG) at CGMS-52 discusses the long-term strategy for replacing the Global Precipitation Measurement (GPM) system. It highlights the need for continuity in passive microwave (MW) imager and precipitation radar observations, emphasizing the coordination between these systems. The presentation acknowledges the era of TRMM and GPM, which has provided over 25 years of consistent precipitation data, and outlines plans for future coordination of new precipitation radars and MW sounders in the post-GPM era. The IPWG stresses the importance of maintaining high-quality precipitation datasets and encourages CGMS agencies to continue their support beyond the lifespan of any single satellite mission.

CGMS-52-CMA-WP-05 - The progress on FY-3 precipitation observation missions (Jian Shang (remotely))

1. **FY-3 Precipitation Measurement Missions**: China developed the FY-3 satellite programme to enhance precipitation measurement capabilities, launching the FY-3G satellite on April 16, 2023. This satellite is one of the few in the world capable of measuring precipitation with spaceborne radar.

2. **FY-3G Status**: The FY-3G satellite monitors the 3D structure of precipitation systems and aims to improve weather forecast accuracy. It operates at an orbital height of 407 km and includes six instruments, combining active remote sensing with passive microwave imaging and other experimental tools.

3. **FY-3G Instruments**: The satellite is equipped with a Precipitation Measurement Radar, Microwave Radiation Imager, Medium Resolution Spectral Imager, GNSS Radio Occultation Sounder, Short-wave Infrared Polarized Multi-Angle Imager, and a High Accuracy On-board Calibrator.

4. **Data and Products**: The FY-3G provides various data products, including calibrated radar reflectivity, precipitation type, phase, rate, and 3D raindrop spectrum with high resolution. These data have been available to users worldwide since late 2023 and early 2024.

5. **Future Plans**: To ensure continuity, the FY-3I satellite is planned for launch around 2026, aiming to complement FY-3G and maximize global coverage.

11. Review of WGII organisational matters

11.1 WGII actions, status of WGII chairpersons/rapporteurs, ToRs, ISWGs, Dates of WGII activities 2023-2024, preparing for plenary

CGMS-52-WGII-WP-10 - Status on WGII Chairs and rapporteurs; and CGMS rapporteurs for the CGMS International Science Working Groups

- JV Thomas explained that he can continue to contribute to WGII, but a replacement needs to be found before CGMS-53.

ISWG	Co-chairs	Rapporteur	Status
ICWG	Martin Stengel, DWD Kerry Meyer, NASA/Goddard	Andrew Heidinger/ NOAA	OK
IPWG	Takuji Kubota (JAXA), Chris Kummerow (Colorado State Univ., US)	Joseph Turk, NASA	OK
IROWG	Ulrich Foelsche/Univ. Graz Hui Shao/ JCSDA/UCAR	Tony Mannucci/NASA	OK
ITWG	Fiona Smith, BoM Reima Eresmaa, FMI	Ms Lihang Zhou/NOAA	New rapporteur recommended by WGII to CGMS-52 plenary
IWWG	Iliana Genkova, NOAA Feng Lu, CMA	Jaime Daniels/NOAA	OK
IESWG	Samantha Pullen UK Met Office Clara Draper - NOAA Federal Benjamin Ruston UCAR	Clara Draper - NOAA Federal	OK
WGClimate	Jeff Privette/NOAA (Chair) Dr Wenying Su/NASA (Vice Chair) Handover from Chair to Vice Chair will take place in November 2024.	Reporting done by Chair	WGII recommended Vincent-Henri Peuch, ECMWF, as new Vice-Chair pending endorsement by CGMS and CEOS plenaries
GSICS EP	Bojan Bojkov, EUMETSAT, (Chair)		GSICS EP to address the need for a CGMS rapporteur

CGMS-52-WGII-WP-05 - WGII recommendations to plenary (Paolo Ruti)

Report on CGMS-52 Recommendations and Acknowledgments

GSICS

WG II acknowledges the significant work carried out by the Global Space-based Inter-Calibration System (GSICS) and fully supports its ongoing activities and newly proposed teams.

Encourage GSICS and IPWG to interact on Cubesat intercalibration aspects.

IROWG

The International Radio Occultation Working Group (IROWG) strongly advocates for an open data policy towards purchasing commercial radio occultation (RO) data and recommends all agencies adopt this model. It emphasizes the importance of free and unrestricted access to essential RO data, including archived low-level data, with a preference for archiving raw (level 0) data.
IROWG acknowledges the substantial capacity increase in commercial RO data providers. For instance, Chinese companies like Yunyao and Tianmu may soon produce over 100,000 profiles per day. The risk of losing this capacity underscores the need for agencies to consider acquiring this data while available.
Based on current results from the ROMEX studies, IROWG stresses the necessity of maintaining uniform spatial and local time coverage for satellite mission planning. It proposes a modification to the current HLPP 1.2.9 statement to include providing 20,000 occultations per day with uniform spatial and local time coverage on a sustained basis.

ICWG and IWWG

CGMS recommends that each space agency participate in the ICWG cloud product intercomparison using ISCCP-NG L1g data. It also encourages collaboration between the IWWG and ICWG to identify ISCCP-NG golden days that can make cloud height retrievals available for evaluation by the AMV community.

WG II

WG II recognizes the substantial effort put forth by the international working groups and supports the sharing of best practices. Contributions have been provided by IROWG and IPWG. WG II endorses the following individuals:

- Clara Draper (NOAA) as the new co-chair and rapporteur of IESWG.
- Lihang Zhou (NOAA) as the new rapporteur of ITWG.
- Vincent-Henri Peuch (ECMWF) as the new vice-chair of the Joint WG on Climate.

WG II acknowledges the significant societal impacts of G3W and the need for operational satellite information. It encourages G3W to prepare a short document for plenary to identify the added value and specific contributions from CGMS to G3W.

IESWG

IESWG has identified Snow Water Equivalent (SWE) as a critical observational gap. We recommend ongoing support for the Canadian Terrestrial Snow Mass Mission, which will deliver high resolution space-borne SWE measurements for the first time. The value of these data could be further enhanced for NWP and short-range hydrological applications with dedicated support for higher temporal frequency data dissemination.

GEORing

CGMS requests that all relevant space agencies grant permission for their historic and current geostationary imager L1b data to be redistributed freely and without restrictions within the L1g data of the GEORing.

Key questions for discussion include:

- What constitutes the optimal combination of different satellite sounding missions?
- What additional analyses are needed for future architectural designs?
- What are the existing gaps that need addressing?
- What are the requirements for risk assessment from the GeoRing perspective?

AI/ML

Topics and actions to be discussed at the plenary include:

- Data curation activities to build best practices for AI readiness.
- Cooperation across international working groups on ML applications.
- Specific collaborative projects, such as lightning prediction from geo-imagers.

Three areas warrant further discussion:

1. Data quality considerations for satellite-based datasets for ML training.
2. Sharing information on ML retrieval algorithms.
3. Ensuring the quality of AI/ML blended products and labeling them appropriately.

Internal Recommendations, Best Practices, and Actions

CGMS recommends each space agency participate in the ICWG cloud product intercomparison using ISCCP-NG L1g data. Continued support from CGMS agencies for their algorithm teams' involvement in the cloud property intercomparison is crucial.

IROWG best practices should support radio occultation observations for long-term climate studies, and IPWG is positioned to synthesize best practices and reach consensus on standards.

IWWG

Inter-agency collaboration is encouraged to better comprehend wind products and their accuracy in extreme conditions. CGMS also encourages the exploration of broader use of ML/AI in satellite winds-related products/applications.

Specific Project Recommendations

1. Establishing a coherent development of snow water equivalent (SWE) products with close user community coordination.
2. Continued support for SWE-related missions, including TSMM and Copernicus CIMR.
3. Considering soil moisture products from GNSS-R.

CGMS-52-WGII-WP-01 - Decision on dates on WGII activities in 2024-2025 (CGMS-52 to CGMS-53) (WGII co-chairs)

Intersessional Meetings

Future WGII intersessional meetings are planned for:

- 17 September 2024

- 19 November 2024
- 21 January 2025
- 25 February 2025 (final preparation for CGMS)
- 24-28 March 2025 (CGMS 53 WG meetings)

LIST OF WORKING GROUP PARTICIPANTS

CGMS-52 - WGII List of Participants		
First name	Last name	Organisation
Mikael	Rattenborg	CGMS Secretariat
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Heikki	Pohjola	WMO

CGMS-51 WGII high level actions and recommendations						
Actionee	**AGN item**	**Action #**	**Description**	**Status, as of Plenary 2023**	**Deadline**	**Status following CGMS-52 plenary**
IESWG CGMS rapporteur	WGII report	A51.03	The IESWG to report on progress to plenary CGMS-53	**Oct 23:** General update requested	CGMS-53	**CLOSED** following CGMS-52 plenary session
CGMSSEC	WGII, WGClimate reports	A51.04	The CGMS Secretariat to secure the inclusion of an agenda item on the GEO-ring observations reprocessing for climate project at CGMS-52 plenary (plus GeoRing sounding capabilities for NWP)	**Oct 23:** General update requested	CGMS-53	**CLOSED**
CGMS members	FUTURE DIRECTION	A51.09	CGMS members to nominate and/or confirm representatives for the "champion" to secure the continuity of the six pilot activities and within the respective working groups (as per CGMS-51-CGMS-WP-04 EXT EXT)	2023 Oct: 1 (SEB) - **JMA to nominate**; 2 (Hybrid Space) - Simon Elliott EUMETSAT confirmed; 3 (Private Sector) - Mara Browne NOAA confirmed; **4 (R2O) WGIV to nominate**; 6 (SSA) - Juha-Pekka Luntama ESA confirmed; 5a (Info Tech IoT) - Antoine Jeanjean		**CLOSED** for WGII (NOAA has in the meantime nominated and CGMS approved a champion for cloud technology)

CGMS-51 WGII high level actions and recommendations						
Actionee	**AGN item**	**Action #**	**Description**	**Status, as of Plenary 2023**	**Deadline**	**Status following CGMS-52 plenary**
			FUTURE DIRECTION **1 Socio Economic Benefits** WGIII / JMA to confirm by end July '23	EUMETSAT confirmed; **5b (AI/ML) - CMA to nominate**; **5c (Cloud) - WGIV to nominate**; 7 (Earth System Monitoring) - Albert Fischer WMO confirmed; **8 (Support to dev. countries) - CMA to nominate**		
			2 Hybrid Space Observations Architectures WGIV / Simon Elliott EUMETSAT - confirmed **3 Private Sector** WGIII / Mara Browne NOAA - confirmed **4 Research to operations** WGIV (support WGII) / NOAA, NASA to confirm by end July '23 Other agencies to provide feedback by end July '23			

CGMS-51 WGII high level actions and recommendations						
Actionee	**AGN item**	**Action #**	**Description**	**Status, as of Plenary 2023**	**Deadline**	**Status following CGMS-52 plenary**
			5 Future Information technology IOT: WGI / Antoine Jeanjean EUM **AI/ML:** WGII *and WGIV* / TBD KMA? Cloud: WGIV / TBD **6 Space situational awareness** SWCG, WGI / Juha-Pekka Luntama ESA - confirmed			
			7 Earth system monitoring WMO, Albert Fischer - confirmed **8 Support to developing countries** CMA (name TBD by end July '23) - confirmed			
CGMSSEC & WMO		WGIIA50.01	CGMSSEC and WMO to consider if night-time light capabilities should be covered in HLPP, the CGMS Baseline,	**Update Oct 2023:** Will be Discussed at risk assessment in Feb '24; has been added to the HLPP. **April 2023:** Ongoing (to	CGMS-51	**CLOSED** this has been taken into account in the updated CGMS Baseline document as endorsed by CGMS-52 plenary

CGMS-51 WGII high level actions and recommendations						
Actionee	**AGN item**	**Action #**	**Description**	**Status, as of Plenary 2023**	**Deadline**	**Status following CGMS-52 plenary**
			and should be reflected in the WMO Gap Analysis	organize a meeting online maybe) - still ongoing		
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 unrestricted access shall be provided to archived raw data (including auxiliary data)	**2023**: IROWG is preparing a best-practice document Acknowledge the new data buy approach implemented by NOAA (for Jan2023 to Jun2023) - towards free data access - continue to be IROWG recommendation - risk of losing data for climate monitoring (data that are not freely provided) - objective to maintain a consistent record in collaboration with private sector (23 Nov 2022)		**CLOSED** (see CGMS best practices on commercial data buys https://cgms-info.org/wp-content/uploads/2024/06/CGMS-best-practice-document-Relationship-with-the-private-sector-for-commercial-data-purchases.pdf
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	**October 2023: ROMEX to provide new advance by 2024. 2023**: IROWG continues to recommend 20,000. However, ROMEX will maybe update this number.		**CLOSED** Regular reporting is provided to CGMS and WGII from IROWG on the progress and outcomes of the ROMEX project.

CGMS-51 WGII high level actions and recommendations						
Actionee	**AGN item**	**Action #**	**Description**	**Status, as of Plenary 2023**	**Deadline**	**Status following CGMS-52 plenary**
			daily target identified in HLPP is met with global and full local time coverage	WMO action - IROWG will send an email to WMO Cross organizational collaboration - providers and global centers to re-evaluate this limit of 20000 through an international collaboration - NWP centers working with data providers (steering meeting in Nov-Dec 2022) (23 Nov 2022)		

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
GSICS, WGClim, SCOPE-CM	WGII/8	A47.21	GSICS, WGClimate ~~and SCOPE-CM~~ to organise a workshop on calibration supporting reprocessing.	**2023 - to be analyzed at EP meeting if still needed** **2022 19 May:** WGII discussions (initial request coming from CMA). Delayed due to COVID. 2021 10 Dec: It will not happen before GCMS-50 - so it would be good to present at the Plenary in order to get support from agencies ang gathering involvement from other WGs 2021 27 Sep: No update, pending. CGMS-49 WGII Apr 2021: Workshop to be planned (delayed due to the pandemic). 2121 11 Mar: JWGC to discuss in March and GSICS at Annual meeting 2021 Jan: WGClimate to meet in February 2020 May CGMS-48 WGII session: Postponed due to Covid-19 situation. 2020 Mar 12 WGII IS #2: To be discussed on 17 March within GSICS community. 2020 Jan 9 WGII IS #1: -	**CGMS-50 (Mar 2020, CGMS-48)**	**OPEN** To be addressed at WGII IS#1 on 17 Sep 2024 (NB action related to SCOPE-CM is closed)

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
				(First review to take place at GSICS meeting in March 2020, Korea - meeting cancelled).		
GSICS			Establish a common reference solar spectrum with appropriate spectral coverage and spectral resolution and develop common methods and tools for on-ground calibration and characterisation and inter-calibration of UV-Vis- NIR SWIR spectrometers			**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: GSICS to nominate new 'rapporteur' to discussion on-going actions. Comment from ITWG: "This is something that's done by: (i) operational NWP centres as part of pre-operational testing of new instruments (esp. the RTM part) as well as; (ii) groups that produce reprocessed datasets for climate reanalysis applications. In the context of (ii), EUMETSAT (and Spascia) are producing reprocessed datasets for MW O2 sounding instruments (e.g. SSM/T-1) and they have used RTM techniques (based on ERA5 fields) to assess data quality. Regarding documentation: Stuart Newman produced a paper on this approach as an output of GAIA-CLIM (https://www.gruan.org/documentation/articles/newman-et-al-2020-rs) and, more recently Paul Poli has published something on this approach for rescued & reprocessed data (https://journals.ametsoc.org/view/journals/bams/98/7/bams-d-15-00194.1.xml). "

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
GSICS			Establish a methodology to characterise microwave instruments for O2 absorption channels through the SNO and RTM modelling. The implementation will be done successively by the individual satellite operators;			**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: GSICS to nominate new 'rapporteur' to discussion on-going actions
GSICS			Establish mechanisms for cross-calibrating scatterometers across the constellation.			**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: GSICS to nominate new 'rapporteur' to discussion on-going actions
IWWG	WGII /5	A46.06	IWWG to look at improving quality indicators for high resolution wind derivation	2023 remains open following CGMS-51 discussions.	CGMS-49 (CGMS-48/47)	**OPEN** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: Remains open. Updates requested

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
			for mesoscale and regional applications. (Ref. CGMS-46-IWWG-WP-01)	2022 no updates - to produce a short document to be presented to IWWG and then having a best practices doc (IWWG)		
				2021 27 Sep: Ongoing, preliminary results provided by UKMO and CIMSS. 2021 May 16: CGMS-49-IWWG-WP-02 CGMS-49 WGII Apr 2021 2121 11 Mar/2020 Mar 6: IWW15 postponed until 14-18 Sept 2020 Jan 9 WGII IS #1: To be reviewed at the IWWG meeting in April 2020. (Régis Borde, Steve Wanzong) CGMS-47: Research activities continue that aim to identify additional quality information from the AMV derivation that could be used to filter out poor quality AMVs and/or set observation errors for the AMV height assignment. • Quality measure associated with the correlation surface (addresses feature tracking) • Optimal estimation cost associated with cloud top temperature retrieval (addresses AMV height assignment)		

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
				• Cloud top pressure error estimates (addresses AMV height assignment) • No results to report at this time.		
				• We expect that some useful information relevant to this action may be extracted from work associated with A46.04. • This topic will be re-visited at IWW15. WGII IS#2 2019: no update		
CMA, EUM, NOAA (Space agencies)	WGII /3	WGII/A48.02	Data providers to document data processing QC processes (including a month of QC statistics, e.g. rejection percentage at each QC step) and space sampling information and provide to IROWG.	**2023 to become a best practice document** 2022 - prepare a short doc as best practices, from IROWG - updates 2022 - final report of the workshop will provide best practices input 2021 10 Dec: No progress.	Apr-21	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 Aug: IROWG believes this should simply be closed. A BP document is most likely not forthcoming at this time, because each NWP center implements their own QC approach, and have adapted to do this for both government-led and commercial data.

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
				2021 27 Sep. No progress to date. Action on NOAA and EUMETSAT to request information on QC information on procured data and report back. Further discussions foreseen for IROWG September 2022, Addressed in CGMS-49 WGII Apr 2021. For further discussion. 2021 11 Mar: Waiting for IROWG meeting.		
				2021 Jan: CMA, EUM, NOAA to consider and implement as far as is possible. IROWG noted that RO data from KOMPSAT-5 are also of interest. 2020 Dec from IROWG: Reference is made to previous WGII action A46.08: IROWG to develop process and principles for RO data quality control to ease intercomparison of data from different providers.		

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
				○ IROWG acknowledges there are about 10-30% observations rejected during the data processing and retrieval procedures for current missions. However, the quality control (QC) procedures are not consistent among different data providers and processing centers. They are very likely to differ between the current and future missions as well. Providers should document their QC procedures (e.g., QC pertains to orbits, space sampling/ inhomogeneity, neutral atmosphere or space weather products, etc.) and share with IROWG.		
				○ IROWG recommends an action to data providers to document data processing QC processes (including a month of QC statistics, e.g. rejection percentage at each QC step) and space sampling information and provide to IROWG.		
CGMS members - WMO oscar	WGII /8	WGII/A48.15	CGMS Members shall make available their validated instrument SRFs together with uncertainty	**2023 - each agency providing a link to the related web pages** 2022 Request WMO to report the status - so we can have an update at WG2 - 2021 10 Dec: ?to be part of OSCAR 2022 - SRF ongoing	CGMS -49	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: Comment from ITWG: many SRF's are available at the NWP SAF website for IR/VIS instruments and only a few MW ones. Under a few instruments it says "SRFs cannot be published

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
			information through their instrument calibration landing pages. In addition, a document summarising the currently available SRFs and their status (accurate/inaccurate) as well as identifying any missing information shall be provided through the landing pages.	2021 27 Sep: Ongoing. CGMS-49 WGII Apr 2021: ISRO & IMD have held a coordination meeting and implementation is ongoing. 2021 Feb: Some space-agencies may already provide SRFs on separate websites, but do not link this webpage to their landing pages. In order to complete the action would, thus, be to add links to your SRF subpages on your space agency instrument landing pages.		due to licence restrictions". JCSDA holds a repository of SRFs within github, which cannot be made publicly available, for example it contains DoD sensors which are typically designated "sensitive". There are also several SRFs available at https://cimss.ssec.wisc.edu/goes/calibration/. SRFs are not currently available on OSCAR/Space.
				2021 Jan: EUM, JMA, have included such information. A reminder will be sent (by Rob Roebling, EUMETSAT) CMA information is included on the GSICS web page. http://gsics.nsmc.org.cn/portal/en/fycv/srf.html EXT	-	
WMO	2	WGII/A49.12	WMO conduct a survey on baseline Level-2 product requirements for LEO satellites.	**2023 Oct - Remains open following CGMS-51 Plenary. 2023** - when will the survey be reported ? **2022 19 May:** Open. No progress. 2022 21 Mar: WMO to report to WGII CGMS-50 2021 10 Dec: ?	CGMS-50	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: Actions taken: WMO opinion that action is too broad in scope (too many LEO programmes to effectively evaluate). Recommend a focus on certain instrument types instead. To be discussed at WG-II during working group meetings in April

CGMS-51 WGII internal actions						
Action ee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
WMO	2	WGII/A49.09	SST – review specification involving key users	2023 no update 2021 10 Dec: CEOS plenary there was a proposal to support oceanography - SST GEO baseline, what time and spatial coverage = WG2 to contact Virtual Constellation Initiative	Dec-21	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: Actions taken, to be discussed at WG-II during working group meetings in April
WMO	2	WGII/A49.10	Review the baseline dissemination strategy for volcanic ash product	2023 no update 2021 10 Dec: Need for WGII and WGIV to set up a dedicated meeting?	Dec-21	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: Actions taken, to be discussed at WG-II during working group meetings in April

CGMS-51 WGII second level internal actions						
Actionee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
SCOPE-CM	WGII/4	A47.08	SCOPE-CM to report back on the conclusion of the 9 pilot projects	**October 2023: Recommend to close following plenary actions regarding SCOPE-CM** 2023: No Updates 2022 Oct: updated only one use case (from EUMETSAT) the rest was outdated. Partly addressed. 2021 10 Dec: WMO to finalise -no need for WGII to review as an outcome of a presentation so already assessed 2021 27 Sep: Report to be published CGMS-49 WGII Apr 2021: WMO Secretariat to publish the related report. 2121 11 Mar: Still open, WMO to finalize 2021 Jan: Draft report under preparation.	Dec 2021 (CMGS-48)	**CLOSED** Following CGMS-52 plenary discussions

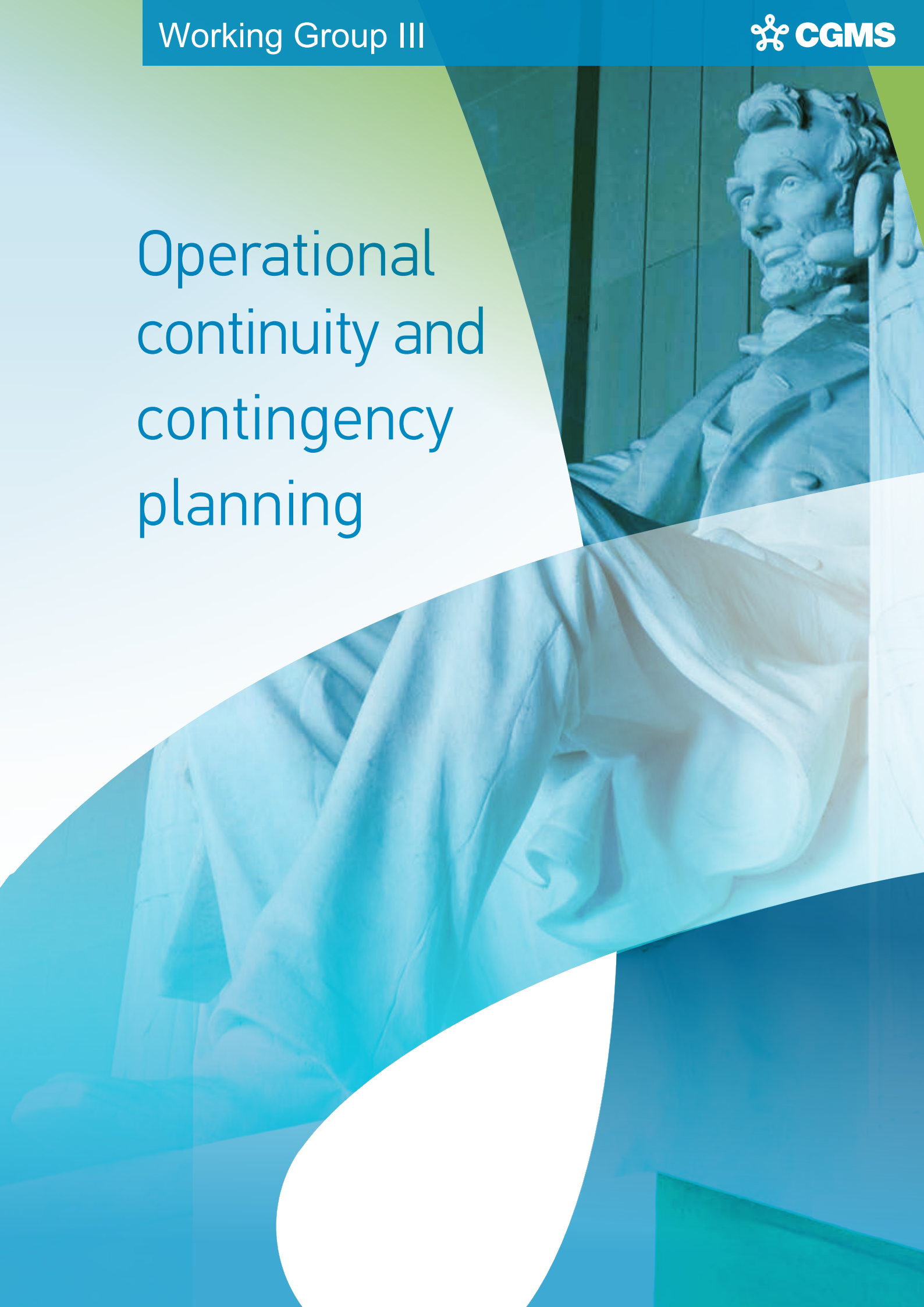
CGMS-51 WGII second level internal actions						
Actionee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
				2020 May CGMS-48 WGII: SCOPE-CM leads have been contacted by WMO on 22 May 2020 to provide feedback on outcome of projects before 30 June 2020. Plan to publish results in WMO Bulletin. New deadline. 2020 Mar 12 WGII IS #2: WMO to report in May 2020 2020 Mar 6: Changes with SCOPE-CM ongoing? Chair stepping down? 2020 Jan 9 WGII IS #1: No further information available		
ITWG	WGII/3	WGII/A48.03	ITWG to send a report demonstrating the value of temperature sounding of the upper stratosphere and mesosphere (as for the SSMIS UAS channels).	2023 Oct: Remains open following CGMS-51 plenary 2022:requesting a report on 2021 10 Dec: No clear way forward. To be addressed at the next	CGMS-50 (CGMS-48)	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: In 2024 the Copernicus Climate Change Service (C3S) will issue an ITT on the topic of 'Improved

CGMS-51 WGII second level internal actions						
Actionee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
				WGII intersessional meeting.		Representation of the Stratosphere in Future Reanalyses' . Part of this work programme will be testing the impact of SSMIS temperature sounding channels in the upper stratosphere and mesosphere – an area where ERA5 had particularly visible deficiencies (large biases in temperature and discontinuities at major changes in the observing system). The expectation is that this work will commence Q3/Q4 2024 and run for 3 years, and be delivered by a team external to ECMWF, but with familiarity with the IFS or capacity to spin-up this capability efficiently. At this stage, the benefits to medium range NWP are probably small, but for climate reanalyses are more significant
				2021 27 Sep. Work completed, report to be provided to WG II for review, CGMS-49 WGII Apr 2021: To be addressed at the upcoming ITWG meeting in June 2021. 2021 11 Mar/2021 Jan: ITWG meeting to be held in June 2021. Mitch to provide progress information. Some reports expected at ITWG.		

CGMS-51 WGII second level internal actions						
Actionee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
GSICS, OSVW	WGII/4	WGII/A48.10	OSVW to present at next GSICS meeting the potential and potential benefits and issues of crosscalibration of scatterometer data (at the GSICS annual meeting).	2023 Oct: No Update 2021 10 Dec: No progress - Depending on GSICS outcome it could find a solution or to be discussed and be considered as a green category (colour scheme)	Mar-21	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: GSICS to nominate new 'rapporteur' to discussion on-going actions
				2021 27 Sep: No progress 2021 11 Mar: OSVW have been invited? 2021 Jan: OSVW group to be invited to the next GSICS meeting.		
IWWG	3	WGII/A49.13	To clarify approach for 3D wind profile measuring constellation in recommendation	2023 Oct: No update 2022: EUMETSAT 3D wind profiling. other than EUMETSAT at the moment not much going on 2021 27 Sep: IWWG to follow up at their next meeting	Mid-May 2021	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January: Remains open. Updates requested
WGClimate, GCOS	5	WGII/A49.19	GCOS and JWGClimate to develop a proposal for a	2023 Oct: WMO to clarify	CGMS-50	**ONGOING**

CGMS-51 WGII second level internal actions						
Actionee		**Action #**	**Description**	**Status, as of Plenary 2023**		**Status following CGMS-52 plenary**
			formal approach for the translation of GCOS technology free requirements to requirements for space-based observations.	2022: Ken checking with GCOSsec 2022 21 Mar: Who is taking the lead to move this activity forward?		To be addressed at WGII IS#1 on 17 Sep 2024 2024 - Remains open. Updates requested
JWGClimate	6	WGII/A49.23	JWGClimate GHG task team to provide a report on the progress of the evolution of ground-based/in-situ GHG observations to CGMS.	2023 Oct: No progress reported 2022: Ken asking to GHG team meeting 2021 10 Dec: No progress reported. 2021 27 Sep: Work is ongoing. GHG TT, and others, preparing a synthesis report on requirements for observations, including ground-based/insitu observations.	CGMS-50	**ONGOING** To be addressed at WGII IS#1 on 17 Sep 2024 2024 January - Remains open. Updates requested

CGMS



Operational continuity and contingency planning

WGIII REPORT

Co-Chairs: *Irene Parker, NOAA / TANG Shihao, CMA (acting)*
Rapporteur: *Heikki Pohjola, WMO*

1. Opening and introduction

Co-chair Irene Parker (IP) (NOAA) opened the meeting and welcomed all participants to the WGIII session of CGMS-52 working groups. She presented the meeting agenda and the objectives of the meeting related to the role of WGIII with regards to the CGMS baseline and the CGMS risk assessment. The meeting participants were introducing themselves with a roundtable onsite and online. The list of the participants can be found in Annex 1.

Nomination and election of CGMS WGIII co-chair

After grateful services as the WGIII co-chair Peng Zhang (CMA) stepped down from his position. CMA nominated Tang Shihao (TS) (CMA/NMSC) as a candidate for WGIII co-chair. IP opened the floor for other nominations by members. There were none, and WGIII meeting approved the nomination of Tang Shihao to be submitted to CGMS-52 Plenary for final approval.

2. CGMS future direction 2022+ project

CGMS-52-CGMS-WP-20wgiii - CGMS future direction 2022+ project - Process proposal (ref. Hybrid space observations architectures paper)

Sean Burns (SB) (EUMETSAT) presented the Hybrid Space Observations Architectures theme in the framework of the CGMS future direction 2022+ project. Hybrid space infrastructure comprised of various size platforms from large to nano and instrument classes from reference measurements to lower performance including different orbits (SSO/LEO, GEO, HEO, drifting) and ownership models from intergovernmental or governmental to commercial providers. The CGMS intends to provide answers to questions on how to keep the hybrid infrastructure contemporary and maintain the balance between public and private sectors, how to maximize the impact of CGMS satellites as part of an overall system and ensure uniform access to all types of data from the hybrid system. SB highlighted that this is addressed in the WMO Vision for WIGOS 2040 with subcomponents of a backbone and complementary constellations. Medium-term goals of CGMS include taking into account the identification of hybrid space infrastructure, demonstrations of the impact of CGMS's contributions, explicitly considering data buy and addressing i.a. orbit coordination and harmonized data access to ensure uniform user access to services, and a critical review of WIGOS 2040 with respect to hybrid systems using passive microwave (MW) data as an example, which involves all elements of hybrid space infrastructure. Lessons learnt can be considered for other domains such as radio occultation and hyperspectral measurements.

Further, SB summarized the contributing input from all relevant CGMS working groups. WGI Task Group on low latency data access is well positioned to consider the coordination of orbits and direct broadcast systems. The main challenge faced will be finding a way to include commercial providers in the coordination of, inter alia, orbits, data access systems, and data formats, full filling the interests of both CGMS members and the commercial operators. WGII IPWG and ITSG provided extensive and valuable

assessments of the performance and impact of the identified MW constellations. In general, they concluded: more data is generally a good thing, but the quality of the data needs to be carefully taken into account. The analysis provided by Working Group III makes clear that, in the case of passive microwave sounders, there is currently no gap in data availability. Working Group IV concluded that CGMS will need to ensure that its members can capitalize on the emerging data distribution technologies (such as cloud access and WIS 2.0) in a consistent and effective way, to deliver data to users.

CGMS-52-CGMS-WP-21wgiii - CGMS future direction 2022+ project - Relationship with the private sector

Mary Ann Kutny (MK) (NOAA) presented under the Relationship with the Private Sector theme a Best Practices document for commercial data buys on behalf of Mara Browne (theme champion). The goal of the theme is to develop recommendations intended to harness and/or leverage the opportunities of a rapidly growing commercial space sector while maintaining operational standards and open data sharing. During the intersessional period a formal data call for inputs from Members was issued, WGIII conducted a CGMS survey to establish best practices for commercial data purchases to gain an overview of the current status of Members' operational use of commercial data purchases, gather information about Members' plans to purchase commercial data and identify potential areas suitable for a best practice recommendation for all Members. The best practices document was reviewed and recommended by Working Group III and it will be submitted to Plenary-52 for endorsement.

The Best Practices for consideration are:

- BP.01 Ensure that international data policies are upheld, especially pertaining to the free and unrestricted sharing of government earth observations data.
- BP.02 Include language to purchase unique data sets when purchasing commercial data.
- BP.03 Ensure service standards.
- BP.04 Facilitate interoperability between private and public sector data.
- BP.05 When procuring commercial data, consider using standard open data licenses to define any restrictions on use.
- BP.06 CGMS Members should communicate their commercial space policy to other CGMS Members.
- BP.07 Ensure the best value when deciding whether to enter into a contract.
- BP.08 Ensure a vibrant research enterprise.

MK proposed a recommendation for WGIII to adopt a standing agenda item on Relationship with the Private Sector covering reports on potential or future commercial Earth Observation (EO) technologies, Information on Member pilots and/or testbeds to evaluate new commercial EO technologies and recommendations of potential or future commercial EO technologies to be referred to WGII or appropriate science working groups for assessment of operational maturity. This was supported by the meeting. The next intersessional period leading up to Plenary-53 will engage with the private sector through the WMO Open Consultative Platform (OCP) under the Geneva declaration, through WMO technical and scientific working groups. Pending the outcome of the OCP in June 2024, the Champion will

share outcomes at the first WGIII intersessional meeting with recommendations for future activities to be agreed upon.

3. WMO core satellite data (WMO Res 1)

Establishment of core satellite data

CGMS-52-WMO-WP-03 – Update on WMO efforts to establish core data

Heikki Pohjola (WMO) (HP) presented the outcomes of the WMO Core Data Workshop and High-Level Consultative Meeting on Satellite Matters related to the WMO efforts to establish Core and Recommended satellite data. The WMO Core Satellite Data Workshop held in Dec 2023 was attended by 46 participants in-person as well as 25 online participants, representing satellite operators and NWP centres around the globe. The workshop objectives and outcomes were to identify and review an initial list of WMO Core and Recommended satellite data for global NWP for adoption in the WIGOS Manual and to understand and address the main obstacles to increased exchange of satellite data, and identify specific opportunities to overcome those challenges. The workshop noted that the current data policies of satellite operators are not entirely aligned with the proposed list of Core satellite Data, and more work is needed to achieve that goal.

The 15th Session of the Consultative Meetings on High-level Policy on Satellite Matters (CM-15) was held in Geneva, Switzerland on 6-7 February 2024. Approximately 70 participants from space agencies and WMO elected officials and Secretariat (both in person and online) attended the meeting. The role of the Consultative Meetings on High-level Policy on Satellite Matters is to facilitate a formal and substantive exchange between leadership of space agencies and representatives of the World Meteorological Organization (WMO), which includes Presidents of the Commission for Observation, Infrastructure and Information Systems (INFCOM) and the Commission for Weather, Climate, Hydrological, Marine and Related Environmental Services and Applications (SERCOM), as well as the Secretary-General and Directors. In summary, the meeting delved into numerous critical topics, including collaborative efforts to support Members with the least capacity,

- particularly in advancing the UN Early Warnings for All initiative;
- dealing with new paradigms of bringing data and users together in the face of growing data volumes and capabilities;
- exploring best practices and emerging opportunities in collaboration with the commercial satellite sector;
- pioneering the transformation of the Global Greenhouse Gas Watch (G3W) from concept to reality in the years ahead;
- anticipating the impact of the impending but still nebulous AI revolution on weather and climate enterprise, particularly concerning satellite data, and
- examining the evolution of WMO, its space program, and WIGOS processes, including the co-design of the WIGOS 2040 Vision update, to better serve the framing of user requirements for weather, climate, water and related environmental applications, and the satellite agencies' responses.

HP concluded that INFCOM-3 decided on Core and Recommended satellite data as drafted in the WIGOS Manual on the WMO Integrated Global Observing System (WMO-No. 1160) and presented in INFCOM-3/Doc 8.1(1). WMO will work to establish Core and Recommended satellite data for other applications like nowcasting, hydrology and climate monitoring.

Stephan Bojinski (EUMETSAT) asked about the Core satellite data defined for other application areas and how they would be recorded in the WIGOS manual. HP responded that the requirements are embedded in the same data tables, and not in separate data tables for each application area. MK commented that NOAA appreciated the process WMO has taken to engage with users and satellite operators to define Core and Recommended satellite data. CMA was asking about the attributes defined in the data tables and if there will be more details defined in the future. HP responded that attributes will evolve with defined datasets for other application areas, and currently they are intentionally left open.

4. Updates on significant observational missions (in response to/from a CGMS baseline/risk assessment point of view)

4.1 Operational missions

CGMS-52-ISRO-WP-08 - INSAT-3DS and Oceansat-3 data products and dissemination

Minal Rohit (MRo) (ISRO) presented INSAT-3DS and Oceansat-3 status. INSAT-3DS was launched on 17 Feb 2024 using GSLV-F14 rocket, from Satish Dhawan Space Centre (SDSC/ISRO). It has improvements from the INSAT-3D satellite to mitigate the issues related to the blackbody calibration and mid-night sun-intrusion. The satellite is now in IOT phase at 83E. After IOT it will replace INSAT-3D at 82 E. Details of the INSAT-3DS payloads and products were presented. Oceansat-3 (EOS-06) with Ku-band scatterometer, 13-band radiometer and ARGOS DCP provides data for ocean, atmosphere and land applications. MRo reported that plans for the missions beyond Oceansat-3A were initiated and details are expected to be available in 2025. Oceansat-3A will be launched in 2025 having equatorial crossing time at noon and having global coverage for ocean color and sea-surface monitoring. ARGOS in Oceansat-3 will be replaced by Millimeter-wave Atmospheric Temperature and Humidity Sounder (MATHS) payload. It is 20-channel cross-track scanning radiometer operating at 50-60GHz and 183.31± 16.25GHz bands providing atmospheric vertical temperature and humidity profiles with nadir spatial resolution of 25 km and 15 km, respectively. IP congratulated ISRO for their recent launch of INSAT-3DS.

CGMS-52-EUMETSAT-WP-09 - MTG operationalization and products

Stephan Bojinski (SB) (EUMETSAT) presented an overview of the MTG programme, the transition plan for MSG to MTG-I1 operations in the period 2024-2026, and the approach to transitioning products by the Central Facility and Satellite Application Facilities (SAFs). SB presented the launch dates of MTG and EPS programmes. He explained the main objectives of the MTG mission as a continuation and improvement over MSG, with enhanced and new missions,focusing on short range forecasting and nowcasting of high impact weather. A secondary objective is air quality monitoring over Europe with synergies between the Sentinel-4, infrared sounder and imager payloads. Initial data from the MTG-I FCI was published earlier in 2024. Commissioning is currently expected to continue until at least June 2024. Following the commissioning, the MTG-I 1 will become the primary satellite in parallel with Meteosat-11.

The EUMETSAT SAFs have assigned responsibilities for product continuity as from the first day of operations ("Day-1") including integrated development and validation processes for SAF products. They have target for Day-1 services and full exploitation of novel sensors capabilities.

The approach for the MSG-based legacy of MTG-I1 Day-1 products is to continue MSG-based processing chains and product generation for EUMETSAT Central Facility until the end of 0-degree services, and for SAFs to be decided by each SAF on a case-by-case basis. The standard User Notification Service (UNS) is starting with MTG-I1 (Meteosat-12) operations with full monitoring of services.

4.2 Research missions

CGMS-52-NASA-WP-06 - Overview and status of NASA PACE mission

Eric McVay (NASA) gave a presentation on Plankton, Aerosols, Clouds, and ocean Ecosystem (PACE) mission related to NASA Earth Science Fleet. NASA launched PACE from Kennedy Space Center (FL) on February 8th. The PACE observatory completed commissioning activities and is now conducting nominal science operations. Next launches are PREFIRE satellites in May and June 2024 and NISAR later in 2024. PACE will make new global measurements of ocean color, improving our understanding of the carbon cycle and ocean ecosystem responses to a changing climate. Also, PACE will help us to understand long-term changes in aerosol and cloud properties and their relation to climate and will provide key information on aerosols such as airborne dust, pollen, smoke, and haze. These particles can significantly reduce air quality which can lead to asthma and respiratory distress among vulnerable people.

PACE's ocean color science applications require a robust System Vicarious Calibration (SVC) programme achieved through the collection of many high-quality with paired satellite-to-in situ observations. It is using HyperNAV, which is profiling system equipped with highly accurate, well characterized, hyperspectral resolution radiometric sensors and MarONet, which builds on the heritage of the MOBY mooring but improving the spectral radiometric uncertainty. PACE's required data products extend heritage capabilities (e.g., from the Sea viewing Wide Field-of-view Sensor (SeaWiFS); Moderate Resolution Imaging Spectroradiometer (MODIS); and Visible Infrared Imaging Radiometer Suite (VIIRS)). In 2023, NASA selected 23 teams of scientists that will be collecting, over 4 years, suites of above and in-water measurements that will be utilized to validate required and advanced data products.

The PACE mission data products will be made publicly available via NASA's Ocean Biology Distributed Active Archive Center (OB.DAAC). PACE's OCI, HARP2, and SPEXone have over 100 data products that are either available, coming soon, or are currently being evaluated. Expected data latency is 3-24 hours from collection to distribution.

IP asked if there are plans to improve the data latency of the products. Eric responded that improvements to the data latency is under discussion.

5. WIGOS Vision

Albert Fischer (WMO) presented WMO's plans for updating the WIGOS Vision 2040. The WIGOS requirements are coming from the Rolling Review of Requirements, which are technology free and application area driven. Gap analyses are maintained against OSCAR/Space and OSCAR/Surface to

monitor the implementation status. The 8th WMO Workshop on Impact of Various Observation Systems on NWP will be held late May 2024. This will provide the way forward for the WIGOS strategic directions including the WIGOS Vision 2040 update. The WIGOS Vision 2040 update cycle will be kicked-off in 2024 with consultation and revision processes. The goal is to have an updated WIGOS Vision adopted by the INFCOM-4 and WMO Cg-20 in 2027. The space-based architecture will encompass commercial data and SmallSat developments.

The WIGOS Vision 2040 update work is related to the hybrid space observation architectures and the CGMS future direction project, and WMO will set up a task team for the entire WIGOS Vision update. It is important to involve working groups and other stake holders of the WIGOS Vision in the update process. Natalia Donoho (WMO) pointed out that at the time the WIGOS Vision update work was performed by the WMO expert teams. Even if the expert teams' composition is no longer the same, it is necessary to involve existing expert teams in this work. Elsayed Talaat (ET) (NOAA) pointed out that also the WMO expert team on space weather (ET-SWX) is important. He recalled that it should be based on the Rolling Review of Requirements process. MK mentioned that currently the WIGOS Vision is focused on weather and water and not the Earth system approach, and this aspect shall be included. SB proposed a CGMS WGIII task group to contribute to the scope of the WIGOS Vision update. Anne Taube (AT) confirmed that CGMS is interested in being involved. IP concluded that the task team is a good idea, and the scope and composition will be discussed in the intersessional meetings.

CGMS-52 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WMO (CGMSSEC, WGIII)	5	WGIII/52.01	WMO to write an invitation letter via CGMSSEC for CGMS WGIII to nominate representatives to the WMO task team on the WIGOS Vision 2040 update.	Q3/2024	**OPEN**

6. WMO OSCAR/Space database status update

CGMS-52-WMO-WP-05 - Status and plans of WMO OSCAR/Space database

HP gave a presentation on OSCAR/Space status and recent development. It is an essential tool and information source to support the WMO Rolling Review of Requirements (RRR) process and WMO Gap Analysis, which are used to monitor the compliance of satellite programmes in the implementation of the CGMS Baseline and the space-based component of the Vision for WIGOS in 2040 (WMO-No. 1243). The WMO Space Programme Office continues a successful development framework with a contractor for the OSCAR/Space technical maintenance. The recent development plan in 2023 resulted in a software release including implementation of WIGOS Station Identifiers for satellites linked to Common Code Tables C-5 information, sub-categories for the energy ranges of the space weather instruments, major redesign for OSCAR/Requirements, and several other new features. The major milestones in 2024 are to migrate the development to Microsoft Azure Platform, to implement Single Sign on login using WMO identity providers, automatic update of EOL and launch dates at year end, Essential Climate Variable filter in gap analysis and Earth–Sun line approach for space weather. In addition, WMO wants to kick off the work

towards OSCAR/Analysis including the first step to combine variable requirements with OSCAR/Space capabilities. The main mechanism for the WMO Space Programme Office to collect the relevant information for the database content updating is through online templates submitted to the OSCAR/Space Support Team (O/SST) members, usually two to three times per year. In addition, similar requests were sent to some non-CGMS members having their satellites in OSCAR/Space.

HP pointed out that the main challenge in updating the database is the low response rate by O/SST members to the WMO update requests. Only 10 out of 17 agencies responded to the last update request in August 2023 with several reminders sent. To improve the situation, online workshops are going to be organized including an OSCAR/Space tutorial for O/SST. Also, updating of the satellite status is challenging for non-CGMS satellites and commercial satellites. Currently there are 12 such companies operating satellites recorded in the OSCAR/Space. The commercial sector is expected to grow in the future leading to possible challenges in securing adequate updates to the database.

KMA pointed out that their focal point is not up to date, and they will provide the new focal point of contact supporting O/SST to WMO. Andrew Monham (AM) asked a question on space weather data access links in OSCAR/Space and if they are maintained. HP confirmed that the links are maintained. However, data access links are not the main information content in OSCAR/Space and they are of a limited number.

7. CGMS baseline and risk assessment

7.1 CGMS baseline and risk assessment

CGMS-52-WMO-WP-06 - WMO Gap Analysis

01	*Hyperspectral IR sounders (GEO)*	*10*	*GNSS constellation for radio occultation (LEO)*
02	*UV/VIS/NIR sounders (GEO)*	*11*	*GNSS Reflectometry (LEO/Drift)*
03	*Day-night visible imagers (LEO)*	*12*	*Doppler Wind Lidar (LEO/Drift)*
04	*Microwave Imagers (LEO)*	*13*	*Backscatter Dial Lidar (LEO/Drift)*
05	*Scatterometers (LEO)*	*14*	*Lidar and wide swath radar for Altimetry (LEO/Drift)*
06	*Low frequency microwave imager (LEO)*	*15*	*Limb sounder in IR and MW (LEO/Drift)*
07	*UV/VIS Nadir and Limb Sounders (LEO)*	*16*	*UV/VIS/NIR spectrometer (LEO/Drift)*
08	*Precipitation radar and cloud radar (LEO)*	*17*	*High Temporal MW Sounders (LEO/Drift)*
09	*Total and spectral solar irradiance (LEO)*		

Table 1. Missions encompassed by the WMO gap analysis for Earth observation.

01	*Solar wind, coronograph and magnetic field observations from L1 beyond 2033.*	*05*	*Solar heliospheric imagers from L1*
02	*Solar X-ray spectrograph observations from LEO.*	*06*	*Observations of electric, magnetic and radio wave fields from polar orbits (LEO, HEO)*
03	*Solar X-ray/UV/EUV spectrometers and imagers at L1.*	*07*	*Radio wave measurements from polar orbits (LEO, HEO)*
04	*Observations of magnetic fields from L1 and solar orbits*		

Table 2. Missions encompassed by the WMO gap analysis for space weather.

HP presented the WMO Gap Analysis covering Earth observation and space weather observation gaps against the WMO WIGOS Vision 2040. The basic inputs for this analysis were from the WMO OSCAR/Space database, which is continuously updated with the latest satellite status provided by the space agencies. The results are dependent on the lifetime of the satellites being accurate which is often not the case as dates can be extended subject to the payload's technical functionality and funding being available. The summary charts were presented together with the more detailed analysis of the recognized gaps related to the instrument types in the WIGOS sub-components 1 and 2 for the next decade. The gap analysis summarises 17 gaps for Earth observation and 7 gaps for space weather.

CGMS-52-WGIII-WP-02WGIII – Status and outcome of the 6th CGMS Risk Assessment

Melissa Johnson (MJ), NOAA, introduced the risk assessment preparation and explained the process how data for flyout charts were collected. NOAA is requesting the updates from space agencies just before the risk assessment workshop to ensure that data reflects the most up-to-date situation related to the missions of the space agencies. MJ presented the lates version of the risk assessment slide set, which was coordinated between NOAA, satellite operators and WMO. AT (EUMETSAT) thanked the extensive preparation work and coordination of the work.

After the work of the risk assessment workshop earlier in 2024, the top-level risk assessment reflects the following high-risk areas:

- Continuity risk from RO observations in low inclination orbits in the later part of the decade as there is no commitment for a follow-on to COSMIC-2.
    - The CGMS Baseline commitment for RO observations is now being met in the short-term with the inclusion of data from commercial providers.
- Long-term continuity risk to Synthetic Aperture Radar and High Resolution Optical Imager observations.
- Long-term continuity risk to Energetic Particle Sensor observations at L1.
- Long-term continuity risk to L1 Magnetometer and Plasma Analyzer observations.
    - Vigil at L5 is now included in the assessments but is considered complementary and does not mitigate the risk.

In addition, the top-level risk assessment reflects the following moderate risk areas:

- Slight long-term continuity risk for the SWIR Imaging Spectrometer.
    - The Joint Working Group on Climate is working to coordinate long-term CO2 monitoring.

- Slight long-term continuity risk for the Precipitation Radar.
  - NASA and JAXA presented plans beyond the GPM Core at the 6th RAW, with the goal to add to assessment during the 7th RAW.
- Slight long-term continuity risk for the Microwave Imager.
  - ESA has reported on plans for the CIMR and CRISTAL missions with the goal to add to assessment during the 7th RAW.
- Slight continuity risk for Scatterometry.
  - ISRO continues to provide updates on plans beyond OceanSat-3A.
- Risk of near-term gap in Coronagraphy in the early part of the decade has been mitigated as NOAA is prepared to provide STEREO-A coronagraphy from Wallops and Fairbanks in the event of loss of SOHO/LASCO before 2025, but long-term continuity at L1 is still at risk.

Misako Kachi (JAXA) pointed out that the risk assessment shall more clearly make sure that MW instruments are covering the entire MW spectrum range for all MW applications, for example SST. IP commented that WGIII will take an action on how to tackle proper representation of MW spectrum coverage in the risk assessment. Tang Shihao recommended that the risk assessment should also include the risk related to ground segments of the satellite system. IP commented that it will be discussed in the intersessional meetings to see if and how this might be addressed and if it can be embedded within the framework of the current risk assessment activity.

CGMS-52 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WGIII	7.1	WGIII/52.02	WGIII to discuss the potential inclusion of ground segment status in the framework of the CGMS risk assessment.	Next intersessional mtg (9 Sept 2024)	**OPEN**
WGIII & WGII	7.1	WGIII/52.03	WGIII to recommend to WGII the need for articulating MW missions with different frequencies in the CGMS baseline and risk assessment in the future and how to visualise it in the flyout charts	Q4/2024	**OPEN**

CGMS-52-WGIII-WP-01WGIII - CGMS Baseline - Discussion on how to best articulate attributes versus commitments versus requirements in the CGMS baseline document

AT (EUMETSAT) presented CGMS baseline updates on behalf of CGMSSEC. She pointed out the following edits:

Reference documents (1.2):

- Reference document list was updated.

Observations and orbits (2):

- L5 position will be added

- GEO position in attributes for hyperspectral sounder was updated
- Day-night band added under multi-purpose meteorological imagers (multispectral, visible, and IR): Added day-night visible channel for LEO early morning and afternoon orbits.
- Related to SWIR imaging spectrometer, more clarity is needed related to the missions that are contributing to which GHG measurements. CGMSSEC will reach out members with regards to participation in the GHG TT addressing SWIR observations and how to specify them in baseline.
- For coronagraph L5 will be added and the range definition will be removed.
- For EUV imager the range definition will be removed.
- For X-ray spectrometer 5 slots are not needed. The definition is originating from the WIGOS Vision 2040, and the requirements should be updated (existing action on SWCG).
- It was proposed to have four ranges for all energetic particles on GEO as follows 30W-60E, 60E-150E, 150E-120W, 120W-30W. SWCG to confirm the approach later.

CGMS-52 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WGIII for WGII/GHG TT	7.1	WGIII/52.04	WGIII for WGII: GHG TT to indicate if SWIR missions for CH4, and CO2 missions should be added to the CGMS baseline and the risk assessment review in the future	Q1/2025	**OPEN**

7.2 7th Risk Assessment

CGMS-52-WGIII-WP-09 – Proposal for showing spares in the risk assessment fly out charts

MJ presented a proposal how to show spare satellites in CGMS Risk Assessment. Spares are on-orbit satellites that are functioning and can be brought down from storage in the event of an anomaly or failure of operational satellite. Spares to be included in the flyouts are at the discretion of each CGMS member. Missions to be included as spares will be solicited in January 2025 (with regular updates in the future). It raises awareness of total CGMS member capabilities in orbit to enable a more robust representation of the risk. It will not affect the overall operational risk assessment for each observation but will allow better visualization of mission resiliency and risk posture. The approach visualizing the spares in the fly out charts was supported, and they will be included in the 7th risk assessment 2025.

7.3 Any outstanding items on the baseline and risk assessment

The WG discussed and agreed on the need for the inclusion of the reference to day-night visible channel to the baseline (see agenda item 7.1).

8. Socio Economic Benefit Studies

Reports on performed or ongoing SEB studies

CGMS-52-ESA-WP-07 - Status of study on Socio-Economic Impact Assessment of European Space Weather Service - scope and objectives

Juha-Pekka Luntama (JL) (ESA) presented the status of the SEB study for the "Impact Assessment of European Space Weather Service (SWE)". The European Commission (EC) has entrusted ESA to execute tasks to reach the objectives by the EU Space Programme in the Space Weather domain. In the framework of the first task, ESA is managing a Socio-economic Impact Analysis (SeIA) of European Space Weather Service, which will assess benefits using two scenarios: 1) Initial operational EU space weather service (2025 scenario); and 2) Full space weather service for all user domains identified in ESA Space Weather Customer Requirements Document (CRD). The study started in November 2023 and will be completed in April/May 2025.

The SEB study consists of work packages which include characterisation of:

- SWE operational scenarios for 2025 and 2040 and all user domains vulnerable to SWE effects
- Cost estimates of operational SWE services in 2025 and 2040
- Identification of pathways from SWE events to societal impacts
- Socio-economic Impact Assessment (SeIA) associated to the implementation of an EU SWE operational system in 2025 and 2040
- In-depth Case Studies for each identified user domain
- Presentation of standalone national Success Stories for relevant user domains in specific European countries.

Results from this study will complement results from similar studies in other regions, and it supports the CGMS strategic theme of SEBs in space weather domain. Study results can be presented to CGMS WGIII, subject to permission by the EC.

IP was asking if NOAA and ESA have been in contact, because NOAA is also preparing similar studies. ET confirmed that NOAA chief economist is leading the work and they have been in contact. JL confirmed that ESA is managing the study on behalf of EC, but they have generally no problem in sharing the study results (there may be some confidential information). IP asked if the study also focuses on the orbits and not only instrument capabilities. JL responded that the study on an optimal constellation is included as far as is possible. ET explained that specific infrastructure might be hard to link to the space weather forecast. For example, by adding L5 you could expect a better forecast and the benefit could be estimated. Jl confirmed that this SEB study assumes that Vigil is available at L5.

CGMS-52-CSA-WP-01 - Arctic Observing Mission (AOM) Socio-Economic Benefit Study Report

Ray Nassar (RN) (ECCC) presented the Arctic Observing Mission (AOM), which is a proposed Canadian-led international satellite mission concept that will provide valuable data on weather, greenhouse gases, air quality and space weather over the Arctic and latitudes north of ~40°N. AOM, if implemented, will take advantage of the unique vantage point of a highly elliptical orbit to address climate change and other key challenges of our time for northern high latitude regions. AOM is completing a pre-formulation study to refine the options for mission architecture and inform what is required for the design, implementation and operational phases of the mission. The pre-formulation activities are scheduled for completion in late 2024. A key aspect of these activities was a socio-economic benefits study that defined potential quantitative and qualitative benefits for each of AOM's four proposed payloads. Through extensive interviews with Canadian and international stakeholders, the study found that each of AOM's payloads

have the potential to realize significant socio-economic benefits to Canadians, including Arctic and northern communities. The benefits of the operational meteorological and space weather sensors are more easily quantifiable, while the strong research component of the greenhouse gas and air quality sensors results in benefits that will become clearer in the long-term. The outputs from the socio-economic benefits study will be incorporated into AOM's business case obtaining high density and high frequency observations of weather, climate, air quality and space weather over northern latitudes that will benefit Canadians, including Arctic and northern communities, in many profound ways.

ET asked how the study is going to be shared. RN answered that it will not be posted publicly, but he promised to share the document with interested parties (such as ET or others) by email directly. MK was asking about the proposal or lessons learnt from the SEB study to which RN responded that one challenge was that the different instruments contribute to very different application areas, and although multiple experts were interviewed by the contractor, not all application areas could be covered so a more complete analysis would need more interviews to cover these additional areas of expertise.

CGMS-52-WGIII-WP-09WGIII - CGMS future direction 2022+ project - Socio economic benefits

Kazuki Yasui (JMA) gave a presentation on the socio-economic benefits (SEB) topic under CGMS Future Direction 2022+ project. The SEB analysis for satellite programmes is provided to policymakers/decision makers to promote understanding of the implementation of satellite activities, including future satellite programmes and sustainability of current satellite systems, because satellite missions are expensive and needs long term planning. A short-term goal is to collect and make SEB case studies relevant to satellite systems available to CGMS members and to organize an online workshop. A medium-term goal is to explore with WMO and other organizations the possibility to develop an SEB study responding to the WIGOS 2040 in cooperation with CGMS. A related meeting with WMO staff was organized in Jan 2024. AT thanked JMA for their work and contributions to the CGMS Future Direction 2022+ project.

CGMS-52-EUMETSAT-WP-18 - EUMETSAT EPS-Sterna and EPS-Aeolus socio economic benefits study

Paul Counet (PC) (EUMETSAT) presented the EUMETSAT EPS Sterna and Aeolus SEB studies. The methodology is the same as was used for the SEB study made on EPS/Metop in 2011. Observations of the Aeolus precursor have had a substantial positive impact, it is so far the most impactful source of wind observations over the ocean outperforming 3 scatterometers and 4 geostationary satellites. At mid--latitudes the positive impact persists for up to Day 6 in NWP. Extrapolation shows that the same quantity of observations as Aeolus, but with the higher measurement accuracy of EPS -Aeolus would have higher impact, reducing forecast error by 2-3.5% out to Day 4 in NWP. Also, ECMWF EDA experiments confirm that the same quantity of observations as Aeolus but with the higher measurement accuracy of EPS -Aeolus would have higher impacts on 12-hr forecasts with 2-2.5% in Northern Hemisphere, 3-4% in the Arctic region. In addition, EPS -Aeolus would provide observations with overall impact of 3% for assessing SEBs.

EPS -Sterna would more than compensate the loss of MW sounders on satellites reaching end of life and maintain contributions to SEBs. The baseline EPS -Sterna constellation (6 sat/3 orbits) would have a positive impact above 4% on short to medium range forecasts in the mid latitudes of Europe and 7% in the Arctic. It has an Additional impact of 2% on very short-range regional forecasts through data

assimilation in regional NWP. Therefore, it has a total impact of 6% in the mid-latitudes of Europe and 9% in the Arctic. It will improve the cumulative precipitation forecasts at regional and global scale. 6 satellite with 3 orbit constellation is recommended as optimal from an impact perspective. However, the overall impact of 6% for assessing SEBs for EUMETSAT Member States ignores the impacts of new channels (325 GHz) not available on legacy sounders and underestimates the SEBs for Nordic Countries (above 60°N).

This SEB study concludes the economic value for weather and climate services of 53 BEUR in total. This study is publicly available on the EUMETSAT website, and will be presented to EUMETSAT's Council in June 2024.

AM asked if there was a SEB study for the MTG GEO programme. PC responded that such a study had not been undertaken.

9. Review of WGIII list of actions

CGMS-52-WGIII-WP-03 - Status of CGMS-51 WGIII list of actions

Please see the status in Annex B.

10. CGMS High Level Priority Plan (HLPP)

Review and updating of the HLPP

CGMS-52-CGMS-WP-07WGIII - Status of implementation of CGMS High Level Priority Plan (2023-2027)

CGMS-52-CGMS-WP-08WGIII - Revised HLPP 2024-2028 – for recommendation to plenary

MR (CGMSSEC) presented the implementation status of the CGMS High Level Priority Plan for 2023-2027 and proposed revisions for the updated version for 2024-2028. Following edits were noted:

- 1.1.2 Ensure continuity of precipitation radar observations will be closed.
- 1.1.5 Ensure continuity of coronagraph, plasma analyser and magnetometer observations from L-1 through exploitation of scientific space weather missions for operational gap filling will be closed
- 1.2.2 Advance the new generation of GEO satellites, including advanced imaging, lightning mapping and hyperspectral IR sounding for the whole geostationary ring is kept open, and waiting input related to ISRO's plans. AT pointed out that GEMS is not in CGMS and reference should be removed.
- 1.2.5 Work towards optimising the distribution of planned scatterometer missions across different polar and inclined non-synchronous orbits to achieve the 6-hour sampling requirement of the WIGOS and resolve diurnal variations will be removed.
- 1.2.6 Work towards ensuring low frequency microwave imagery for all-weather SST and ice monitoring from at least 2 sun-synchronous orbits is waiting for ESA to confirm CIMR.
- 1.2.7 Establish observational requirements for microwave observations (sounder and imager) for NWP and precipitation and perform gap analysis against CGMS baseline.
  For precipitation, develop a benchmark to conduct comprehensive assessments of current and future scenarios for the CGMS baseline has progress and indicator is changed to be green.

- 1.2.8 Work towards increasing geographical resolution and coverage for altimetry measurements, including very high latitudes is waiting for ISRO's plans for altimetry mission status.
- 1.2.15 Work towards auroral monitoring capabilities will be closed and should be moved to CGMS baseline.
- 1.4.1 Support satellite impact studies, including in particular impact of data latency and the impact of the early morning orbit could have input from WMO impact workshop organized in May 2024.
- 1.4.2 Develop capacity to assess socio-economic benefits of CGMS satellite missions to be removed.

11. Future CGMS WGIII meetings

CGMS-52-CGMS-WP-14WGIII - Status of co-chairs/rapporteurs of the CGMS working groups, CGMS International Science Working Groups, VLab, and other groups

AT presented situation of the co-chairs and rapporteurs of the working groups.

- WGI: James Donnellon, NOAA, is proposed to replace Sean Burns, EUMETSAT, pending plenary endorsement.
- WGII: Members are requested to nominate candidates for a WGII co-chair to replace J V Thomas, ISRO,.
- WGIII: TANG Shihao, CMA, is recommended to plenary as the new WGIII co-chair following ZHANG Pengs''.departure.WGIV: Members are requested to nominate candidates for a WGIV co-chair.
- SWCG: Jesse Andries (WMO) recommended to plenary as a new SWCG co-rapporteur.
- WGClimate: Reporting done by chair. Coordination may need improving.
- GSICS: Additional rapporteur for GSICS may be needed. The GSICS ToR needs reviewing and updating if so.
- GHG task team: Lead by Yasjka Meier (ESA). WGI-WGIV have nominated representatives to support the GHG TT.
- VLab: No change.
- SATCOM: Nicolas Coyne, EUMETSAT, replaces Sean Burns, EUMETSAT.

CGMS-52-WGIII-WP-02 - Decision on dates of inter-sessional activities/meetings in 2024-2025 (CGMS-52 to CGMS-53) and dates of the CGMS-53 WGIII plenary session

AT presented future WGIII related meeting dates. Intersessional meetings will take place on 9 Sep, 6 Nov in 2024, 22 Jan and 10 Mar in 2025. Additional intersessional meetings will be decided if needed and in due course. The risk assessment workshop will be organized 25-27 Feb 2025 fully virtual. CGMS-53 WG meetings are taking place 24-28 Mar 2025 with the CGMS-53 plenary session on 3-5 June 2025.

12. Any other business

HP presented the WMO INFCOM-3 decision 6.2/2 (INFCOM-3), where a new INFCOM MG composition includes C/SC-GCOS, C/SC-GOOS and CGMS representatives. The meeting concluded that CGMS would need an invitation letter requesting a CGMS representative to be part of the INFCOM MG.

CGMS-52 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WMO	11	WGIII/52.05	WMO to send an invitation letter to CGMSSEC with ToR and expectations of INFCOM MG for CGMS members to nominate candidates to participate in the INFCOM MG group	Q3/2024	**OPEN**

13. Conclusions, preparation of the WGIII report for plenary

Co-chair Irene Parker concluded the outcomes of the meeting and thanked active participation on site and virtually. She appreciated the importance of the feedback received related to the CGMS Risk Assessment. Also, she pointed out the active participation on the SEB studies, which is an important part of the WGIII contributions. The incoming co-chair, Tang Shihao, thanked Irene Parker for chairing the meeting as well as all participants.

LIST OF WORKING GROUP PARTICIPANTS

CGMS-52 - WGIII List of Participants		
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STATUS OF CGMS-52 WGIII actions FOLLOWING CGMS-52 WGIII, APRIL 2024

CGMS-52 actions - WGIII					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
WMO (CGMSSEC, WGIII)	5	WGIII/52.01	WMO to write an invitation letter via CGMSSEC for CGMS WGIII to nominate representatives to the WMO task team on the WIGOS Vision 2040 update.	Q3/2024	**OPEN**
WGIII	7.1	WGIII/52.03	WGIII to discuss the potential inclusion of ground segment status in the framework of the CGMS risk assessment.	Next intersessional mtg	**OPEN**
WGIII & WGII	7.1	WGIII/52.03	WGIII to recommend to WGII the need for articulating MW missions with different frequencies in the CGMS baseline and risk assessment in the future and how to visualise it in the flyout charts	Q4/2024	**OPEN**
WGIII for WGII/GHG TT	7.1	WGIII/52.04	WGIII for WGII: GHG TT to indicate if SWIR missions for CH_4, and CO_2 missions should be added to the CGMS baseline and the risk assessment review in the future	Q1/2025	**OPEN**
WMO	11	WGIII/52.05	WMO to send an invitation letter to CGMSSEC with ToR and expectations of INFCOM MG for CGMS members to nominate candidates to participate in the INFCOM MG group	Q3/2024	**OPEN**

STATUS OF CGMS-51 WGIII ACTIONS FOLLOWING CGMS-52 WGIII, APRIL 2024

WGIII Actions							
Actionee	**AGN item**	**Action #**	**Description**	**Action feedback/closing document**	**Deadline**	**Status**	**HLPP ref**
ISRO		WGIII/A49.02	ISRO to update CGMS-50 on their plans for a geostationary hyperspectral infrared sounder.	**2024 21 Feb:** ISRO provided a status report to the 6th risk assessment WS. GEO HSIR under discussion with Ministry of Earth Sciences, Govt of India. Follow-on Oceansats (beyond Oceansat-3). Oceansat-3A already ongoing and launch planned in 2025. ISRO will present to plenary in June status on HSIR. **2023 22 Nov:** Discussion ongoing with IMD. ISRO will report at the CGMS-52 plenary on the timeline of the mission **2023 21 Feb:** The action will be maintained and ISRO is requested to report to upcoming CGMS sessions. **2022 20 Dec, 28 Sep**: INSAT 4th generation consideration, TBC if an HSIR will be included. ISRO will provide the latest status to the 5th CGMS risk assessment workshop. **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-52	**CLOSED**	1.2.2
• JAXA NASA	4	WGIII/A49.06	NASA and JAXA to confirm plans to fly a precipitation radar beyond the GPM Core.	**2024 21 Feb:** JAXA provided a status report to the 6th risk assessment. **2023 21 Feb**: Status provided at the 5th CGMS WGIII risk assessment by JAXA. JAXA (and/or NASA) to provide updates at the 6th risk assessment. **2022 May:** NASA and JAXA confirmed that this is ongoing. JAXA and NASA are kindly requested to	CGMS-52 (Feb-24)	**CLOSED**	1.1.2

				provide the latest status to the 5th CGMS risk assessment workshop **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			
• ESA	4	WGIII/A49.07	ESA to report on plans for the CIMR (Copernicus Imaging Microwave Radiometer) and CRISTAL (Copernicus Polar Ice and Snow Topography Altimeter) missions	**2024 21 Feb:** ESA provided a status report to the 6th risk assessment. Once fully approved, the missions are expected to be incorporated in the CGMS risk assessment. Tentative launches in 2028. **2023 26 Apr:** ESA to report to the 6th risk assessment WS in Feb 2024. **2022 17 Feb**: The programme is not yet approved. ESA expects to be in a position to report at the 5th risk assessment workshop in 2023. **2021 Sep 27**: To be addressed within the framework of the 4th risk assessment WS	Feb 2024, CGMS-52	**CLOSED**	1.1.1 1.2.8
• *WMO + WGIII*	*WGIII IS #1 28 Sep 2022*	n/a	Following the update of the WIGOS Manual, update the CGMS baseline accordingly.	25 Apr 2024 closed on occasion of CGMS-52 WGIII meeting, replaced by an updated action. **2024 21 Mar:** WMO WIGOS Manual (1160) updates will be taken forward by INFCOM-3 in April 2024, and recommended to the WMO Executive Council (EC-76) in June 2024. **2023 5 Oct:** WIGOS manual update related to CGMS baseline is not taking place before 2024. Thus, it is more likely the topic will be addressed at the 7th risk assessment workshop (2025). **2023 23 Feb:** The update of the WIGOS Manual has been postponed. A major update is expected in the 2023/2024 timeframe. Potentially to be addressed at the 6th CGMS WGIII risk assessment workshop in 2024. ***2022 28 Sep:*** *CGMS to update the baseline following WMO's regulatory update of the WIGOS manual (raised on the occasion of the CGMS WGIII inter-sessional meeting)*	Feb 2025 (Feb 2024)	**CLOSED**	1.2

• WMO	6	WGIII/A49.17	Continue preparing and submitting to O/SST templates on OSCAR/Space data that needs to be updated, approximately 2-3 times a year.	**2024 22 Feb:** WMO calling for focal points of contact to be actively engaged in OSCAR / space. WMO considers holding a WS. *Action closed and a new action will be raised on space agency members.* **2023 26 April:** CGMS-51 WGIII meeting (action updated from 3-4 times/year to 2-3 times/year **2023 23 Feb:** Currently taking place approx. twice/year. **2022 17 May**, 24 Feb: Ongoing	CGMS-52 (CGMS-50)	**CLOSED**	1.3
• 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.	**2024 21 Feb:** NOAA provided a status report to the 6th risk assessment WS. **2023 22 Nov:** NOAA is prepared to provide STEREO-A coronagraphy from the Wallops and Fairbanks stations in the event of loss of SOHO/LASCO. Another status update will be provided at the 6th Risk Assessment Workshop and with the action expected to be closed at that stage. NOAA reported on STEREO-A coronagraph gap mitigation and referred to the earlier report by Elsayed Talaat (NOAA). NOAA initiated a QuickPUNCH project as a gap mitigation in case of unavailability of coronagraph imagery of GOES-U (scheduled launch in 2024) and SWFO-L1 (scheduled launch in 2025)). Status report will be given to the 6th risk assessment workshop. **2023 21 Feb:** Presentation made to the 5th risk assessment. Update on STEREO-A to be made at the 6th CGMS WGIII risk assessment workshop in 2024. (On PUNCH - concluded). **2022 28 Sep:** Ongoing. NOAA will include status in its input to the 5th risk assessment.	CGMS-52 (CGMS-51)	**CLOSED**	1.1.5
• KMA	WGIII/4.1	WGIII/A50.02	KMA to report on plans beyond GK-2B for visible/UV spectrometer and Narrow Band imager.	**2024 21 Feb:** KMA provided a status report to the 6th risk assessment. Launch 2032, 10-year design lifetime. **2023 22 Nov:** No further updates at this point in time.	CGMS-52 (CGMS-51)	**CLOSED**	1.2.3

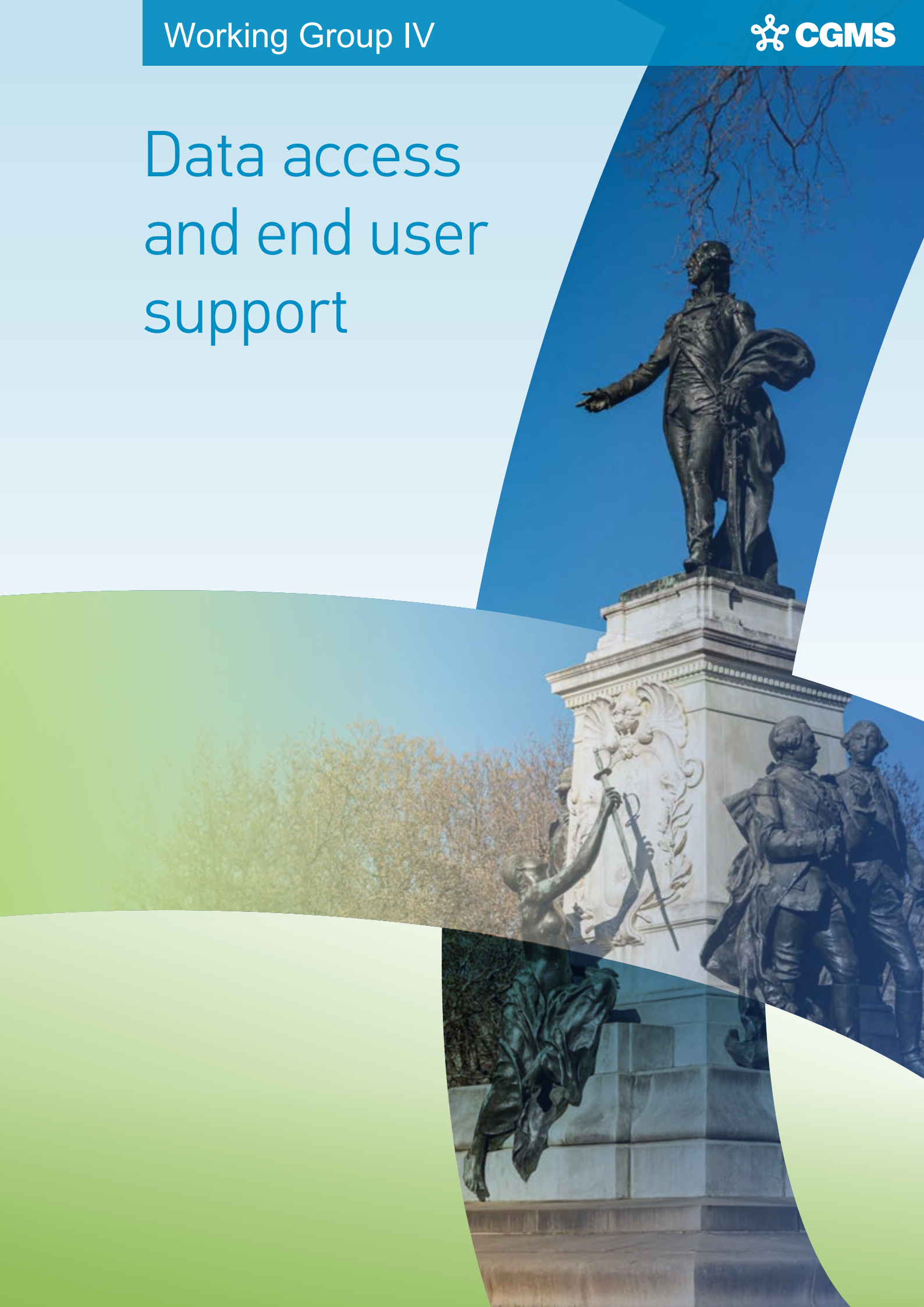
				2023 23 Feb: KMA to confirm: KMA to report on any progress at the 6th CGMS WGIII risk assessment workshop in 2024 **2022 28 Sep:** Feasibility studies ongoing (results together with special feasibility test expected to take +/-2 years overall)			
• WMO	WGIII/4.2	WGIII/A50.04	To implement energy ranges for high energy particle classification to OSCAR/Space as defined in the CGMS Baseline.	**2023 22 Nov:** Implemented (SWCG also informed). Closed on the occasion of the WGIII inter-sessional. **2023 26 April:** Presented to CGMS-51 WGIII. CGMS-51-WMO-WP-14 EXT **2023 23 Feb:** Development ongoing. Likely delivery around June 2023. WMO to report on status in April 2023 at the CGMS-51 WGIII meeting	6th RA WS, Feb 2024 (CGMS-51 WGIII, RA workshop 2023)	**CLOSED**	
• EUM • NOAA • CMA	WGIII/6	WGIII/A50.07	To present outcomes of the undertakings on socio-economic benefits and impact studies.	**9 Sep 2024** Closed following CGMS-52 plenary. Closure reconfirmed at WGIII IS#1 on 9 Sep 2024. **26 Apr 2024**WGIII presentations on SEB studies **JMA** https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=a716a4a9-97d8-42ed-81fd-9d468a3fd193&aid=48903fee-f4a0-4d51-b15d-c6a4b8a447c3 **EUM** https://www.eumetsat.int/media/51705 **ESA** https://www.cgms-info.org/Agendas/GetWpFile.ashx?wid=984c157c-aa09-41a2-b25a-a1d372cdf172&aid=25cd5680-82d3-40a3-b126-85bd59e0968a **2024 21 Mar:** Updates will be presented in CGMS-52 **2024 16 Feb:** EUMETSAT study: Socio-economic bnefits of EPS-Aeolus and EPS-Sterna (summary): https://www.eumetsat.int/media/51705 and full report: https://www.eumetsat.int/media/51704 EUMETSAT plans to make a presentation to the CGMS-52 WGIII meeting in April.	CGMS-52, (CGMS-51)	**CLOSED**	1.4.3

				2023 26 Apr: CGMS-51-NOAA-WP-12 PPT EXT, CGMS-51-CMA-WP-02 EXT **2023 18 Jan:** CMA will provide SEB report at WGIII session in April 2023. EUMETSAT expects to be able to share the outcome of a currently ongoing SEB study in 2024. **2022 28 Sep:** NOAA expect to have a study available for the GEO XO mission (ongoing). (SEB studies to be addressed in the CGMS WGIII CGMS-51 plenary session in April 2023)			
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.	**25 Apr 2024 CGMS-52 WGIII** WMO gap analysis **2024 16 Feb:** To be addressed on the occasion of the CGMS-52 working group meetings in April. Further inputs required for WGII. *Action to be closed, and a new action to be placed on WGII - no longer applicable?* **2023 22 Nov:** Implemented. Night-time light capabilities can be analysed with OSCAR/Space and that will be included in the WMO Gap Analysis 2024. Guidance needed from WGII wrt to the gap analysis. **2023 5 Oct:** Night-time light capabilities are now available in OSCAR/Space Gap Analysis. Will be reflected in the next WMO Gap Analysis. **2023 23 Feb:** Addressed at the 5th CGMS risk assessment workshop (21-23 Feb 2023) to be reviewed at the 6th CGMS WGIII risk assessment workshop 2024.	CGMS-52 (CGMS-51)	**CLOSED**	1.2
CMA	6.1		CMA to look into the potential of the operational use of Chinese commercial RO data.	**2024 21 Feb:** CMA provided a presentation on the commercial Yunyao and Tianmu (RO) satellite constellations at the risk assessment. The associated data policy is currently under elaboration. **2023 27 Sept:** WGIII IS: CMA hopes to report to the 6th risk assessment.	CGMS-52	**CLOSED**	1.1.4

CGMS WGs	8		The CGMS working groups are requested to consider and identify the implications/impact/activities in each working group and to give feedback as necessary. This includes implementation measures and interface considerations. - Do you agree on lead designation to Working Groups. (Note: no new WGs are proposed). - Additional questions and proposals to be discussed? - Support to developing countries - Interface considerations, other to be considered? - Implementation measures (short and long term) - For recommendation to plenary	**2023 27 Sept:** WGIII IS: Closed following CGMS-51 plenary session and endorsement of the CGMS future direction themes and proposed way forward.	CGMS-51 plenary	**CLOSED**	

CGMS

Data access and end user support



WGIV REPORT

Co-Chairs: *Kotaro Bessho, JMA / Vasily Asmus, ROSHYDROMET*
Rapporteurs: *Natalia Donoho, WMO / Simon Elliott, EUMETSAT*

1. Opening, objectives and expected outcomes / WGIV co-chairs and rapporteur status

Working Group IV Co-Chair Kotaro Bessho (JMA) welcomed the participants to the meeting. He recalled that WGIV is dedicated to the coordination of satellite data access and user support. This is achieved by considering, i.a. the mechanisms of data exchange and user focussed issues.

The group endorsed the proposed agenda for the meeting and proceeded with a round of introductions of the participants.

3. User-provider dialogue on regional/global scales

3.1 User-provider dialogue on regional/global scales

CGMS-52-KMA-WP-07 - RAII and RAV (KMA, JMA, CMA, and BoM) progress report on the RAII WIGOS Project to develop support for NMHSs in satellite data, products, and training in 2024

KMA presented the RA II and RA V Progress Report on the RA II WIGOS Project to Develop Support for NMHSs in Satellite Data, Products, and Training in 2023 and the 5th Joint Meeting of RA II WIGOS Project and RA V TT-SU for RA II and RA V NMHSs.

KMA, JMA, CMA, and BoM have strengthened cooperation in 2023 to develop support for meteorological satellite users in RA II and RA V. In 2023, AOMSUC-13 was held in South Korea hosted by KMA, and cooperation activities were carried out through a Training Event and a Joint RA II and RA V Coordination Meeting held in conjunction with conference.

The 5th Joint RA II and RA V Coordination Meeting on 10th November 2023 included about 45 participants and 19 Country Reports from 12 members of RA II and 7 members of RA V. The meeting consisted of 7 presentation sessions including Updates on Working Structure and Operating Plans of RA II ET-SOA and RA V ET-SAT, Members' reports, Reports from RA I and RA III/IV, WMO-CGMS VLab updates and plans and so on. The member report included Utilization of GEO/LEO satellite data, Capacity building and training needs, and technical infrastructure challenges.

Additionally, the Work Plan of RA II ET-SOA and RA V ET-SAT in 2024 were shared. There are Joint Meetings between RA II ET-SOA and RA V ET-SAT in May, a Training Event & Joint RA II and a RA V Coordination Meeting during AOMSUC-14, and a training course on satellite meteorology such as RTC-Beijing and RTC-Seoul. RA II ET-SOA has also an ongoing plan of RA II WIGOS Cooperative activities of RA II ET-SOA with ET-SSU for WMO Early Warning for All (EW4ALL).

CGMS-52 RECOMMENDATIONS – WGIV		
item	**Recommendation#**	**Description**
3.1	WGIV/1	Other regional associations (ie. Other than RA II and RA V) and organizations with an area of responsibility are recommended to provide corresponding inputs in the future.

3.2 Implementation and evolution of sustained and coordinated communication satellite broadcast systems

CGMS-52-CMA-WP-07 - The update of FENGYUN satellite data and application services

CMA provided an update and plans of FengYun satellite data and application services. They described the data policy of FENGYUN satellite data, the status, and future plans of the FENGYUN satellite data distribution and services. FY-3G and FY-4B data distribution information was updated. FENGYUN satellite data are open to NMSs and other international organizations and users for free via many ways. For real-time users, FENGYUN satellite data can be accessed via direct broadcasting station, CMA data broadcasting system (CMACast), the GTS, and WIS-2. For non-real-time users, FENGYUN satellite data can be accessed from the FENGYUN satellite data center website, downloading toolkits and offline data services. For emergency users, FENGYUN satellite emergency support mechanism (FY_ESM) is useful to National Meteorological Services (NMSs). The software platform of FENGYUN Earth provides the international user community the facility to enhancing FENGYUN satellite data application.

CGMS-52-EUMETSAT-WP-14 - Updates and plans on EUMETCast services

EUMETSAT shared updates and plans on EUMETCast services. EUMETCast is EUMETSAT's real-time data access system, delivering several terabytes of satellite data daily to thousands of users for weather forecasting and safety-critical operations, it encompasses comprehensive coverage through Telecommunication Satellites and Terrestrial Networks, the system handles over 6 TB/day of data, translating to nearly 500 TB/day delivered to users when considering the volume disseminated per user subscription.

EUMETSAT gave an update on EUMETCast. This covered recent advancements in the uplink service, highlighting features such as the usage of backup capacity to provide additional services, seamless protection switching (SMPTE-2022-7) and robust business continuity measures. Additionally, it explored the advantages of transitioning to a new telecommunication satellite, discussing how this move will enhance the system capabilities.

EUMETSAT also explained enhancements in EUMETCast Terrestrial, including the integration of Automatic Multicast Tunnelling (AMT) and software-based authentication.

CGMS-52-JMA-WP-07 - Update and plans on usage of cloud services, data dissemination and distribution of Himawari-8/9

JMA provided an update and plans on usage of cloud services, data dissemination and distribution of Himawari-8/9, including HimawariCloud and HimawariCast. They also talked about JMA Data Dissemination System (JDDS) and variety of meteorological data (e.g. satellite imagery and High-resolution Cloud Analysis Information) to NMHSs.

JMA noted that the core data from Himawari-10 will be huge and may require new infrastructure to be built to support data distribution. JMA will endeavor to follow the newly established guidelines for user preparedness.

3.3 Global or inter-regional data circulation and access, WIS

CGMS-52-ISRO-WP-09 - ISRO web portal to support ocean and meteorological user community

ISRO share updates on their web portal to support ocean and meteorological user community. This is provided by their Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC).

CGMS-52-NOAA-WP-11 - Update and plans on GEONETCast Americas (GNC-A)

NOAA provided update and plans on GEONETCast Americas (GNC-A). They also provided an introduction to and status report on GNC-Americas, recent and future efforts to upgrade system capabilities, and contribution and application for regional early warning initiatives.

CGMS-52-WMO-WP-07 - Strengthening Meteorological Satellite Data Exchange with WIS 2.0

In the next years WMO will perform a phased introduction of its next generation information system (WIS 2.0). This brings with it a change of paradigm for both data providers and consumers; it also presents a number of opportunities for CGMS Members.

WMO (Chair SC-IMT) has shared slides on the Strengthening Meteorological Satellite Data Exchange with WIS 2.0. WMO Secretariat and the WIS2 team will be happy to support CGMS with the transition to WIS 2.0, ensuring an easy and consistent delivery of data to users.

CGMS-52-EUMETSAT-WP-08 - Update on EUMETSAT's preparations for the migration from GTS to the WIS 2.0

EUMETSAT gave a summary of the WIS 2.0 architecture and provided an update on how EUMETSAT is preparing for its migration to WIS 2.0. WGIV was reminded that the Manual on the GTS and the current WIS catalogue will be frozen at the end of 2024, meaning that no new bulletin headers could be added to the GTS.

CGMS-52-JMA-WP-04 - JMA's Update on the status and plans of WIS 2.0

JMA provided an update on the status and plans of WIS 2.0, the challenges on the current system (WIS1.0/GTS), JMA’s contribution to the WIS2.0 pilot phase in 2023, and future plan of the WIS2.0 pre-

operational phase in 2024. The final decision about using a WIS 2.0 node and/or HimawariCloud for Himawari data distribution is still being made.

The Working Group noted the opportunity to join the WMO INFCOM Study Group on Future Data Infrastructure (SG-FIT).

3.4 Widening of data access, to new missions/providers as well as for other user communities

No documents were discussed under this agenda item.

3.5 Disaster support

CGMS-52-JMA-WP-08 - Update on JMA Himawari Request service

JMA provided an update on JMA Himawari Request service. JMA launched a new international service "HimawariRequest", allowing users to request Target Area observations covering a 1000 km x 1000 km area every 2.5 minutes, in January 2018. They provided current status and consideration of processing methods, continuous coordination with CMA and KMA, and the improvement of the portal page.

In response to an inquiry from IMD, JMA explained that if support is requested via email for cyclone monitoring over the Indian Ocean, this could potentially be addressed in as little as 30 minutes.

3.6 Support to the Ocean user community

CGMS-52-IMD-WP-03 - Utilization of Oceansat-3 scatterometer wind vector products in operational real time monitoring of extreme weather events

IMD provided an overview of the utilization of Oceansat-3 scatterometer wind vector products in operational real time monitoring of extreme weather events. For real time weather forecasting of extreme weather events, India Meteorological Department (IMD) utilizes information from diverse observational platform to issue a credible and higher lead time forecast. The oceanic region, being data sparse solely relies on satellite based products to track and monitor the genesis of weather systems in deep sea, away from the coast. The wind vectors data from these Scatterometers has been assimilated in NWP models by various national and international agencies. Case studies of OCEANSAT-3 data during Tropical Cyclones provide extraordinary information in identifying the cloud band and eye wall pattern associated with the tropical cyclone.

CGMS-52-KMA-WP-08 - Report on KMA's Marine Weather Broadcast Service via GK2A

KMA has been operating Marine Weather Broadcast Service (MWBS) by GK2A satellite since July 23, 2020 to provide high-quality digital marine weather information to vessels and to replace WeFax. GK2A MWBS uses the Low Rate Information Transmission (LRIT) to provide marine weather information such as sea surface analysis, weather charts, marine forecast, and satellite images observed by GK2A. It is available for vessels in the ocean and in Asia-Pacific islands, such like in situation where limited internet access, using Small-scale Data Utilization Station (SDUS) in connection with smartphone or tablet PC. The information provided by this service includes the emergency messages for severe weather and disaster information such as typhoon, storm, earthquake, and tsunami warnings.

3.7 Support for Arctic observations

CGMS-52-ROSHYDROMET-WP-04 - Updates and plans on the Arktika-M programme

ROSHYDROMET provided updates and plans on the Arktika-M programme. Since CGMS-51 the Russian hydrometeorological highly elliptical satellite constellation has been increased by Arctica-M N2 satellite and now consists of 2 satellites providing 24-hours coverage of the Arctic region.

CGMS-52-WMO-WP-08 - Cryosphere and Polar activities

WMO (Global Cryosphere Watch) provided updates on cryosphere and polar activities. WMO is planning a workshop in 2025: “space-based cryosphere and polar observation”.
The objectives will be:

– Review user needs based on the recommendations prepared by the Global Cryosphere Watch
– User consultancy for CGMS and CEOS space agencies engagement
– Research and operations requirements
– Evaluate cryosphere core and recommended satellite data and the roadmap for addressing gaps
– Evaluate cryosphere observations relative to CGMS baseline and WIGOS Vision 2040

CGMS WGIV was asked to consider participation in the review of gap analyses and the drafting of a roadmap for core cryosphere data, endorsement of the proposed approach to the planned workshop, and potential engagements. This was endorsed by WGIV.

CGMS-52 RECOMMENDATIONS – WGIV		
item	**Recommendation#**	**Description**
3.7	WGIV/2	Agencies to consider participation in the review of gap analyses and the drafting of a roadmap for core cryosphere data, endorsement of the proposed approach to the planned workshop, and potential engagements

3.8 Support for Hyperspectral infrared instruments

CGMS-52-EUMETSAT-WP-03 – Update on the availability of MTG IRS products via EUMETSAT data access services

EUMETSAT provided update on the availability of MTG IRS products via EUMETSAT data access services. EUMETSAT’s Meteosat Third Generation (MTG) mission will include both an imaging and a sounding satellite embarking different instrument suites. MTG-S, the sounder satellites, will fly with the InfraRed Sounder (IRS) on board. This instrument will provide substantial benefit to weather forecasting by tracking the three-dimensional structure of atmospheric water vapour and temperature operationally. EUMETSAT operates a portfolio of data access services that will provide users with MTG-S IRS data products.

CGMS-52-JMA-WP-05 - Update on JMA's hyperspectral infrared sounding mission

JMA provided an update on JMA's hyperspectral infrared sounding mission. JMA starts manufacturing the follow-on satellite “Himawari-10” in JFY 2022. Himawari-10 is scheduled to be launched in JFY 2028 and

begin operating in JFY 2029. Himawari-10 will carry the Imager (GHMI), the Sounder (GHMS) and the Radiation Monitors for Space weather (RMS). They expressed their gratitude for the opinions and requests they received from domestic and international researchers when considering the imager and sounder specifications. JMA has created simulated observation data of GHMS to support early application, product development and user readiness for the IR sounder. The simulated observation data of GHMS will be provided to researchers and satellite operators for contribution to the development of related technology and user readiness. Towards Himawari-10 operation in JFY 2029, they are planning to provide various information for Himawari-10 for the preparation of Himawari-10 observation data utilization.

4. Coordination of Metadata (incl. standards within ocean communities) - Metadata matters

CGMS-52-WMO-WP-09 - Report on the status and plans of the CGMS Task Group on Metadata

WMO provided report on the status and plans of the CGMS Task Group on Metadata. The Task Group on Metadata (formerly called Task Force on Metadata Implementation) was formed within the CGMS WGIV for data access and end-user support to continue discussions of a new approach on metadata in the context of WMO WIS 2.0.

The draft list of instruments and satellites prepared by the group includes all non-commercial and some commercial satellites with the status of operational, commissioning, or stand-by as defined in the WMO OSCAR/Space website. It is available for review and feedback until the end of May. The final draft will be submitted for approval through the WMO fast-track approval procedure during the 2nd half of 2024 and then it will be published at the WMO Codes registry in November or December 2024.

5. User readiness for new satellite systems

5.1 User readiness for new satellite systems

CGMS-52-WMO-WP-10 - Status of implementation of the agreed best practices on user readiness preparation

WMO presented the status of implementation of the agreed best practices on user readiness. The CGMS/WMO Best Practices for Achieving User Readiness for New Meteorological Systems was endorsed by CGMS-51 plenary, June 2023, and it is aimed to support and guide satellite operators and users in their respective preparation activities. The Best Practices provide a typical breakdown of user readiness activities and a timeline of deliverables from satellite operators to support user readiness. The Best Practices cover activities performed both by User Organizations and Satellite Operators. The Best Practices was also approved at the third session of the WMO Infrastructure.

Commission (INFCOM-3), 15-19 April 2024. WMO also summarized the outcomes of the discussion associated with the approval of the Best Practices by INFCOM-3 and the proposal made by China for the update of the Best Practices in the next intersessional period in collaboration with CGMS.

This presentation provides the information regarding the implementation status of Best Practices by WMO Members, exemplified by the preparation for GEO-XO by users in WMO RA-III-IV.

CGMS-52-VLab-WP-01 - Updates and plans on the VLab

VLab Co-Chair presented updates and plans on the VLab. The Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) Management Group (VLMG) coordinated efforts through quarterly online meetings. The Eleventh meeting of the VLMG will convene January 20-23, 2025, in Muscat, Oman. The Directorate General of Meteorology (DGMET) will host the meeting at the VLab Oman Centre of Excellence. Since CGMS-51, VLab members offered a variety of training opportunities, focusing on enhancing skills related to the utilization of various satellite systems, including the new generation of satellites. Additionally, specialized training efforts were dedicated to supporting the Early Warnings for All (EW4ALL) Initiative. The VLMG thanks NOAA/NWS, EUMETSAT, and KMA for their annual Trust Fund contributions. All 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 members are invited to review and sustain support to their own Satellite Programs that offer International Training.

CGMS-52 ACTIONS – WGIV		
item	**Action#**	**Description**
5.1	WGIV/1	CGMS members are to review and sustain support to their own Satellite Programs that offer International Training

5.2 Notification of changes (and alerts) in satellite data and/or products impacting users

No documents were discussed under this agenda item.

6. Cyber security towards end users

This agenda item was not addressed at this meeting.

7. Cloud Services interoperability

Outcome of the 2nd CGMS WGIV cloud expert workshop

CGMS-52-WGIV-WP-16 - Status and plans of the CGMS WGIV Cloud Service Expert Group (2023-2024)
CGMS-52-WGIV-WP-05 - Readout and approval of CGMS cloud expert best practices

The Chair of the CGMS WGIV Cloud Service Expert Group shared the Group's status and plans. The CGMS WGIV Cloud Expert Working Group was established in July 2020 across all CGMS members under WGIV. Over the past year, the Expert Group held the 2023 annual Cloud workshop, completed development of a Cloud Best Practices document, currently in works for CGMS publication, and collaborated with the Committee of Earth Observing Satellites (CEOS). Discussion focused on Background & Deliverables, 2023 Accomplishments, including 2023 Cloud Workshop, CGMS Cloud Best Practices Document, Coordination with CEOS and next steps (CGMS Cloud Champion and 2025 Cloud Workshop). The Expert Group Chair has also provided a readout of the CGMS cloud expert best practices. These have already been subject to review by WGIV and were fully endorsed at the meeting.

CGMS-52-WGIV-WP-06 - Cloud champion next steps to support CGMS

CGMS-51 Plenary identified several topic areas/themes of importance for the future of CGMS and defined areas of interest, charging each area to find a champion to increase awareness, collaboration and drive to pilot demonstrations. The Future Information Technologies "Theme" will maximize benefits to CGMS of emerging Information technologies, in particular AI/ML, Internet of Things and Cloud Technology. Three champions are identified in this theme:

- AI/ML: WGII & WGIV – XU Na/CMA
- Internet of Things (IoT): WGI – Antoine Jeanjean/EUMETSAT
- Cloud: WGIV – Kathryn Shontz/NOAA

Kathryn Shontz will build on her leadership role of the WG-IV Cloud Expert Group.

CGMS-52 RECOMMENDATIONS – WGIV		
item	**Recommendation#**	**Description**
7	WGIV/3	WGIV Cloud Expert to extend activities to all CGMS entities, broadening the use and value of the associated Best Practices Document and Workshop

8. Long term data preservation

At the CGMS-47 plenary in 2019, CGMS agreed to the recommendation of WG-IV to adopt the "CEOS EO Data Preservation guidelines". The following action was agreed:

> "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 2021-2022 timeframe."

WGIV noted that CGMS has not yet conducted this review, and agreed that it should be considered in the scope of forthcoming intersessional meetings. It was further agreed that the following points would be addressed in this context:

- The CEOS WGISS Data Stewardship Interest Group that is book captain for the DP Guidelines, have updated the guidelines document in 2023. The new guidelines can be found on Data Preservation and Stewardship | CEOS | Committee on Earth Observation Satellites <https://ceos.org/ourwork/workinggroups/wgiss/preservation/>
- The WMO Expert Team on Satellite Systems and Utilization (ET-SSU) has also discussed the issue of data stewardship and pointed to the need to ensure regular reprocessing of satellite data. ET-SSU agreed that the following requirement should be discussed with the satellite community (through WG-IV and the CEOS-CGMS Joint Working Group on Climate:

  > *Satellite operators to ensure long-term data preservation and scientific stewardship of data, including regular reprocessing (roughly every five years). These processing needs to be considered as part of data stewardship, without specifying frequency of re-processing as well as keeping criteria for reprocessing open.*

CGMS-52 ACTIONS – WGIV		
item	**Action#**	**Description**
8	WGIV/2	At its forthcoming intersessional meetings, WGIV to consider the requirement for long-term data preservation and scientific stewardship raised by ET-SSU and consider how the WG can support this.

9. Review of WGIV list of actions

CGMS-52-WGIV-WP-03a - Status of CGMS-51 WGIV list of actions

The WGIV actions were reviewed, and the status updates were made as needed. The current status is available here: https://eumetsat.atlassian.net/wiki/spaces/SCIRIC/pages/21826242/CGMS-51+WGIV+actions.

CGMS-52-WGIV-WP-04b – CGMS-51 plenary list of actions

CGMS-52-CGMS-WP-14WGIV - Status of co-chairs/rapporteurs of the CGMS working groups, CGMS

For WGIV co-chair Prof. Asmus (ROSHYDROMET) is retired but remains active. He will not be able to participate in the activities of the WG as required. WGIV needs a replacement co-chair, with nominations ideally in place in time for CGMS 52 Plenary.

A dedicated group has been meeting on a semi-formal basis to work on recipes for RGB images. This group is to some extent, part of the activities of WMO's ET-SSU. WGIV noted that there may be some overlap with the work of its Task Group on User Readiness. It might be appropriate for this RGB group to prepare a report for WGIV in the future under agenda item 3.9.

CGMS-52 ACTIONS – WGIV		
item	**Action#**	**Description**
9	WGIV/3	WGIV to decide how the activities of the informal RGB recipe group can be properly reflected in the work of WGIV

10. Report on CGMS future direction 2022+ project

CGMS-52-CMA-WP-06 – Support to developing countries – proposal

CMA presented a proposal for a survey to establish how CGMS Members could provide support to developing countries. WGIV would be able to help develop this concept through its intersessional meetings, noting the need to ensure no overlap with the work of WGII. The Group agreed that the questions should be made sufficiently general/overarching to ensure wide applicability. CMA agreed to update the proposed survey to increase the generality, and provide it for subsequent discussion at intersessional meetings.

The overall reporting of activities relating to the CGMS future direction 2022+ project was covered in the dedicated cross cutting Working Group sessions on 23 April (AI/ML and Research to Operations) and 24 April (Hybrid infrastructure and Private Sector Engagement).

The report on Hybrid Space Observation Architectures (CGMS-52-CGMS-WP-20wgiv) was summarised for WGIV. WGIV endorsed the concept of capturing the process used for this analysis and re-applying this process for specific cases identified by WGIII's Gap Analyses.

CGMS-52 RECOMMENDATIONS – WGIV		
item	**Recommendation#**	**Description**
10	WGIV/4	WGIV recommends to plenary that the process used for this analysis of Hybrid Space Observation Architectures is captured and subsequently re-applied for specific cases identified by WGIII's Gap Analyses.

The report on Relationship with the Private Sector (CGMS-52-CGMS-WP-21wgiv) was summarised for WGIV, together with the Best Practices for Commercial Data Buys (CGMS-52-CGMS-WP-22wgiv). It was noted that the Best Practices do not include the archival of level 0 data, and that this was intentionally excluded. WGIV endorsed the proposed Best Practices for commercial data buys.

11. CGMS High Level Priority Plan (HLPP)

Review and updating of the HLPP

The WG reviewed the aspect of the HLPP relevant to its activities, and concluded the following:

- under WMO's ET-SSU is a group focussed on support to nowcasting. This group could provide visibility of its activities to a wider audience by providing a report to future WGIV sessions;
- WMO's activities relating to Early Warnings for All (EW4ALL) may reveal gaps where CGMS Members could support. This, and members response to EW4ALL in general could be reported to WGIV under agenda item 3.5, Disaster Support, and
- the International Charter Space and Major Disasters could once again be approached and asked if it would consider providing a report, also under agenda item 3.5, Disaster Support.

12. Future CGMS WGIV meetings

CGMS-52-WGIV-WP-02 - Decision on dates on WGIV activities in 2024-2025 (CGMS-52 to CGMS-53)

WGIV	Proposed CGMSG-52 to CGMS-53 WGIV intersessional dates
WGIV Intersessional meeting #1	10 September 2024, 12:00 – 13:00 UTC
WGIV Intersessional meeting #2	21 November 2024, 12:00 – 13:00 UTC
WGIV Intersessional meeting #3	12 February 2025, 12:00 – 13:00 UTC

WGIV	Proposed CGMS-52 to CGMS-53 WGIV intersessional dates
CGMS-53 working group meetings	24 – 28 March 2025
CGMS-53 plenary session In-person	3 – 5 June 2025

13. Any other business

Nothing to report.

14. Conclusions, preparation of the WGIV report for plenary

CGMS-52 ACTIONS – WGIV		
item	**Action#**	**Description**
5.1	WGIV/1	CGMS members are to review and sustain support to their own Satellite Programs that offer International Training
8	WGIV/2	At its forthcoming intersessional meetings, WGIV to consider the requirement for long-term data preservation and scientific stewardship raised by ET-SSU and consider how the WG can support this
9	WGIV/3	WGIV to decide how the activities of the informal RGB recipe group can be properly reflected in the work of WGIV

CGMS-52 RECOMMENDATIONS – WGIV		
item	**Recommendation#**	**Description**
3.1	WGIV/1	Other regional associations and organizations with an area of responsibility are recommended to provide corresponding inputs in the future.
3.7	WGIV/2	Agencies to consider participation in the review of gap analyses and the drafting of a roadmap for core cryosphere data, endorsement of the proposed approach to the planned workshop, and potential engagements
7	WGIV/3	WGIV Cloud Expert to extend activities to all CGMS entities, broadening the use and value of the associated Best Practices Document and Workshop
10	WGIV/4	WGIV recommends to plenary that the process used for this analysis of Hybrid Space Observation Architectures is captured and subsequently re-applied for specific cases identified by WGIII's Gap Analyses.

LIST OF WORKING GROUP PARTICIPANTS

CGMS-52 - WGIV List of Participants		
First name	Last name	Organisation
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Ling	Gao	CMA
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Sean	Burns	EUMETSAT
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Karolina	Nikolova	EUMETSAT
Christian	Marquardt	EUMETSAT
Mark	Higgins	EUMETSAT
Simon	Elliott	EUMETSAT
Nicholas	Coyne	EUMETSAT
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CGMS-52 - WGIV List of Participants		
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Rémy	Giraud	WMO
Zoya	Andreeva	WMO
Jesse	Andries	WMO
Anna	Milan	WMO
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SWCG

CGMS

Space weather coordination group

SWCG report

Co-Chairs: *Tsutomu Nagatsuma, NICT/Elsayed Talaat, NOAA*
Rapporteur: *Andrew Monham, EUMETSAT*

1. Welcome, objectives and review of 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, ECCC, ESA, EUMETSAT, IMD, IPWG, IROWG, ISRO, JAXA, JMA, KMA, NASA, NICT, NOAA 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. CGMS risk assessment and baseline update

CGMS-52-WGIII-WP-02SWCG - Status and outcome of the 6th CGMS WGIII risk assessment - SWCG (Melissa Johnson)

The Risk Assessment highlights the following:

a. The short-term risks associated to measurements at L1 relying on ageing spacecraft DSCOVR, ACE and SOHO, prior to the entry into operations of the NOAA SWFO mission. Note that the ISRO Aditya L1 mission will not support real-time data flows. NOAA is prepared to provide STEREO-A Coronagraphy from WCDAS and FCDAS in the event of loss of SOHO/LASCO. The NASA PUNCH mission is scheduled for launch in 2025. To this end, NOAA initiated a QuickPUNCH project as a gap mitigation in case of unavailability of coronagraph imagery of GOES-U (scheduled for launch in 2024) and SWFO-L1 (scheduled for launch in 2025). NOAA NESDIS is actively planning a low data latency coronagraph data pipeline to deliver timely PUNCH coronagraph data to NOAA's space weather prediction centre for the coronal mass ejection forecast and modelling. Closes Action SWCG/A51.07.
b. Not presented to SWCG, but there is a continuity risk from ionospheric RO observations in low inclination orbits in the later part of the decade as there is no commitment for a follow-on to COSMIC-2. **It was pointed out that a dedicated Risk Assessment for ionospheric RO could be planned for in 2025.**
c. Longer-term risks associated to the end of programmes are identified for:
    i. L1 measurements (end of SWFO-L1)
    ii. Low and high energy particle measurements in the GEO 86.5°-123°E range (end of FY-4B). KMA confirmed GK-2B follow-on at the 6th RAW, with the goal to add to assessment during the 7th RAW.

    It is noted that in both cases above, plans for follow-on missions are being proposed in the respective agencies and awaiting approval.
d. Vigil at L5 is now included in the assessments but is considered complementary to L1 and does not mitigate the long-term risks associated with L1 measurements.

3. Updates on space-based observational capabilities

CGMS-52-CMA-WP-03 - FengYun Satellites as a Space Weather Constellation : The Current and Upcoming Capabilities (Weiguo ZONG)

The presentation highlighted the current and planned FengYun Space Weather Constellation:

a. The current satellites in orbits:
   i. GEO-FY-2H/G、FY-4A/B ;
   ii. LEO-FY-3C/D/E/F/G
b. The upcoming satellites:
   i. GEO-FY-4C(2025)、FY-4M(MircoWave Star)(2025or2026)
   ii. LEO-FY-3H(2025)/I(rainfall orbit, 2026)/J(2027)

and identified their planned usage in support of:

a. Sun observations
b. Magnetosphere – magnetic field
c. Ionosphere and neutral atmosphere.

In the field of space weather monitoring, the space-based integrated observation technology has been developed, and the comprehensive observation of the solar-terrestrial causal chain combining in-situ and remote sensing has been realized, and the space-based integrated observation network has been initially formed, with the preliminary independent monitoring capability of the whole process of the space weather causal chain.

In the future FengYun satellites development planning, the space weather monitoring capability will be further strengthened. So as to realize real-time and continuous monitoring of the solar-magnetosphere-ionosphere-thermosphere environment, to meet the needs of Chinese operational space-based space weather monitoring and protection.

Developing specific space weather operational monitoring satellites properly, to develop the Chinese space weather constellation, will vigorously promote space-based space weather observational capability and these observations will play an important supporting role in the space weather operational forecasts and service.

In discussion, the following points were made:

- CMA confirmed the data is available to global users in near-real-time. How to access the data will be informed by CMA.
- Updates to the High-Level Priority Plan and eventually the baseline maybe foreseen for measurements of thermospheric density from LEO satellites.
- It shall be assessed whether the existing CMA measurements should be added to the baseline, including also auroral measurements.
- It is recommended to discuss these points in the SWCG Intersessional meetings.

CGMS-52-ESA-WP-01 - ESA Vigil (L5) and D3S missions update (Juha-Pekka Luntama)

The presentation provides a summary of the implementation status of the space weather missions in the framework of the ESA Space Safety Programme. The presentation covers:

a. missions in development: Vigil, Aurora, space weather nanosatellites; and
b. new missions being proposed in the next ESA Ministerial Level Council: SWORD.

In the discussion, the following points were made:

- How is the cross-calibration of the instruments on the nanosatellite constellation made? This will be a data buy mission and ESA will specify the expected data quality. A vigorous ground calibration and validation of the measurement data from space will be required from the company.
- ESA are not implementing a dedicated science team for Vigil, but all data is made available for scientific observations. The Mission Advisory Group will give recommendations on both the operational and scientific use of the data.
- Can quality assessments be made between multiple companies? ESA have specific requirements for data quality and look to NOAA experiences etc. Radiation monitoring GSICS group also may help.

CGMS-52-KMA-WP-01 - KMA update on its space weather activities (JaeGwan Kim)

KMA presented the update for space weather activities. The update focuses on an enhanced analysis of the two-year cross-comparison between GK2A KSEM PD data and GOES-16 MPS-HI conducted last year. This involved incorporating an additional condition for conjunction, magnetic disturbance indicated by a Kp index of less than 2.

As a result, we could not discern a significant difference in correlation compared to the previous results. Additionally, the report introduces a correlation between Charging Monitor (CM)
data and electron flux measurements.

It also outlines KMA's strategy to design a new space weather payload, KSEM-II, for the upcoming GK2A Follow On satellite, contemplating the integration of new sensors.

In the discussion, the following point was made: In addition to the presented KSEM data access webpage, access from the indicated KSEM data is planned to be included in the EUMETCast data redistribution service later this year.

CGMS-52-NICT-WP-01 – NICT Space Weather Observation Update (Tsutomu Nagatsuma/Kaori Sakaguchi)

For space weather monitoring in GEO, NICT have been developing Radiation Monitors for Space weather (RMS) which measures high energy electrons and protons to be installed on Himawari-10. The engineering model development of RMS will be finished until the end of August 2024. RMS/Himawari-10 will be in operation since JFY 2029. RMS/Himawari-10 will contribute to the global network of operational space-based space weather observation in GEO.

CGMS-52-NOAA-WP-13- NOAA Space Weather Observations Update (Elsayed Talaat)

Updates were presented covering the following points:

- All instruments have been integrated to the GOES-U spacecraft and the launch on Falcon Heavy is planned for June 25, 2024.
- The NOAA-NASA Space Weather Observations Programs Division (SWO) continues to manage the Space Weather Follow-on (SWFO) and Space Weather Next (SW Next) programs.
- Ongoing development of SWFO-L1 Observatory, instruments, and ground segment.
- Continued progress in formulation of the Space Weather Next program; L1 Series project completed KDP-A in September 2023 and the GEO series project is in pre-formulation.
- Ongoing final data and vendor evaluation for Space Weather Data Pilot.

In discussion, the following points were made:

- Milestone 2 for the L1 series will allow CGMS to remove the risk associated to EOL SWFO (expected in Q4 2024).
- A question was raised as to whether there is a risk due to the decoupling of terrestrial and SWx missions? NOAA do recognise that SWx missions cannot just be add-ons to terrestrial. It has national recognition.
- Will need refresh of one of GOES by 2032.
- Are GTO observations planned? Is in the list of objectives for enhancing, but not a high priority.

4. Updates on space weather activities - Agency reports

CGMS-52-EUMETSAT-WP-07 - EUMETSAT space weather activity status and planning update (Andrew Monham)

EUMETSAT presented the progress in implementing the space weather roadmap for an increasing role in delivery of operational space weather data services in support of European and global operational space weather services. Specific highlights include:

- Steps to on the NOAA SEM-2 processor implementation at EUMETSAT continue as a joint EUMETSAT-NOAA-ONERA effort.
- Metop-GRAS lower ionospheric profile data (bending angles) up to 300 km
- altitude delivered operationally since April.
- Redistribution of space weather data over EUMETCast through the data hub increasing
- Operationalisation of topside TEC products from Metop, Metop-SG and multi-mission products, including commercial RO, is envisaged **if use case expressed by partners.**
- Potentially implement processing in EARS stations to reduce latency for limited data **sets if use case is confirmed.**

In discussion, the following point was made:

- One-stop-shop for access to space weather data is welcomed by representative of the UK Met Office Space Weather Operational Centre.

CGMS-52-ESA-WP-03 - ESA space weather service network: progress and next steps (Alexi Glover)

The presentation reports on the status of the ESA space weather service network, updates made to products and service pages and recommendations from the space weather service network review, with focus on:

- Strengthening the network's R2O(2R) Processes.
- SWE Portal Evolution.

In discussion, the following point was made:

- The SOSMAG data available through WIS 2.0 is the same data as found on the ESA Portal.

CGMS-52-ISRO-WP-10 - Aditya L1 performance update (K Sankarasubramanian)

The presentation introduces the scope and payloads of the Aditya L1 mission and the mission preliminary observations made from the various instruments along with a description of how the mission is unique.

In discussion, the following points were made:

- The mission has scientific objectives and data is not provided for operational purposes.
- Comparisons with data outputs from existing and planned operational L1 missions will be valuable.

CGMS-52-JAXA-WP-04 - Introduction of Space Environment & Effects System (SEES) in JAXA and contributions to future Space Weather activities (Yugo Kimoto)

The presentation introduces the Space Environment & Effects System (SEES), a database system for providing data and models concerned with space environments, in JAXA R&D section. Three near real time space environment data have been provided from SEES. Not all data are publicly available, now. For future work, research, including calibration will be performed and data will be published.

In discussion, the following points were made:

- This is a unique data set long-term record of the environment, it is intended and planned to continue, but no formal commitments are made.
- Also being planned is a space weather monitor to Mars mission.
- It should be considered whether this should go into baseline observations.
- Rideshare opportunities should also be considered for increasing observations.

CGMS-52-NASA-WP-01 - NASA space weather activities (Jamie Favors)

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.

A summary of NASA activities during the last twelve months that may be of interest to CGMS members is introduced. It includes highlights of NASA's ongoing work with partners, including its support for the expansion of the global in situ ground networks, recent airborne field campaigns, research results, tools, and datasets that allow the scientific community reliably track changes to the Earth system.

CGMS-52-NICT-WP-02 - NICT Space Weather Activities (Tsutomu Nagatsuma)

NICT Space Environment Laboratory routinely operate space weather services of Japan on 24/7 bases as a part of ICAO's global centers, ACFJ. Updated information about NICT's space weather activities is as follows:

- New space weather warning system was developed to meet new criteria of space weather forecasting and warning established in June 2022. The system is planned to open as a public service in 2024.
- According to space weather service applications, the Sun's high free energy regions (HiFERs) viewer is developed for supporting forecasters to predict large solar flares.
- For predicting thermospheric mass density, NICT operates real-time simulation using GAIA (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy). The data assimilation of GAIA using FORMOSAT7/COSMIC2 RO observations is currently being developed and will be merged into the real-time system in the near future.

CGMS-52-WMO-WP-11 - WMO report on the Space Weather Expert Team priorities and activities (Jesse Andries)

The presentation provides an overview of space weather activities in the WMO, together with its role in the Strategic Plan 2024-2027 and how it is being integrated into the core activities: WIGOS, WIS and WIPPS. Furthermore, WMO's role in building global space weather service capabilities is explained.

CGMS-52-NOAA-WP-16 - Update from the NOAA Space Weather Prediction Center (William Murtagh)

The presentation reported on the National Space Council Release of the Implementation Plan on 20 Dec 2023. This includes to:

- Implement and sustain a satellite-anomaly attribution information system including temporary upsets in function, loss of communications, or failure of the satellite, which can be used to better understand and model the effects of space weather on satellite operations.

PROSWIFT Act directs formation of a non-government Space Weather Advisory Group (SWAG). The SWAG shall conduct a comprehensive survey of the needs of users of space weather products to identify the space weather research, observations, forecasting, and modeling advances required to improve space weather products.

NOAA is also assessing an update to the Space Weather Scales at national and international level.

Existing and planned space weather service observational capabilities from space and ground that are critical to space weather services of SWPC, efforts to establish a communications plan for a significant

space weather event, support to the Artemis lunar mission and to commercial space weather observational activities are presented.

In discussion, the following points were made:

- **The SWAG report can be shared with CGMS**
- **The communications plan could also be addressed in the frame of CGMS SWCG intersessional meetings.**
- Question was raised on the long-term funding of ground-based observations needed for operational space weather services. NSF is focussed on research, rather than a body for operational service. SWPC is looking at what measurements are needed and where. Is all the existing network needed, or just some strategic locations?

5. International space weather data user activities

CGMS-52-ISRO-WP-11 - Space Weather impact monitoring using Indian ground network (Raj Kumar Choudhary)

The presentation highlights the importance of ionospheric Total Electron Content (TEC) on societal applications using GNSS signals and steps taken in the ISRO InSwim programme to observe and model the ionosphere.

The presentation also explains that during the time when the Earth and Mars/ Venus are on the opposite sides of The Sun, signals from the orbiting satellites can be used to track the inner coronal regions of the Sun, which is difficult to probe using any other means and where the acceleration of solar winds take place.

Also presented was the use of radio signals from the Akatsuki spacecraft orbiting Venus, to track the evolution of solar wind velocity during a CME event.

In discussion, the following points were made:

- In the scope of the conjunction study, ISRO explained they are making use of the Ooty radio telescope along with satellite observations.
- Question was raised on the geometry of the conjunction study. It was explained that measurements even closer that 10-7 Solar radii could be possible.
- ISRO explained they have also looked at the resulting solar wind at L1 and compared to the other observations. It can be seen how turbulence evolves as it moves way from sun through comparison of wind velocities.

CGMS-52-GUEST-WP-01 - Update of the International Space Environment Service (ISES) activities in 2023 (Mamoru Ishii)

The International Space Environment Service (ISES) has been the primary organization engaged in the coordination of space weather services since 1962. Space weather is not new, but space weather services are becoming increasingly important as our technologies and national/international infrastructures become more vulnerable to storms in space. The growing demand for space weather services to protect our space-based and ground-based assets requires the worldwide coordination of strong partners.

The ISES network of Members, Associate Warning Centers, and Collaborative Expert Centers provides space weather forecasts, warning, alerts, and environmental data to government and private-industry users around the globe.

Since 2023 ISES start with new office members and discuss with WMO and COSPAR for further cooperation in the framework of WICCT. ISES plays both roles of satellite data users and PoC of end users of space weather.

Sustainable Observations are essential for operational space weather nowcast/forecast. ISES acknowledge to give us opportunities to discuss future plans and requirements with CGMS/SWCG in SWW, ESWW and AOSWA as a data user community.

In discussion, the following points were made:

- Looking at what special efforts should be made to get the community ready, ISES requested more observations close to the sun.
- ISES are actively participating in the relevant CGMS Task Groups

CGMS-52-ESA-WP-02 - Space Traffic coordination needs for space weather inputs (J.-P. Luntama)

The presentation reports on the CGMS future direction 2022+ conclusions, which contained four short- and medium-term recommendations for Space Situational Awareness objectives:

- Review of CGMS Member Agencies' satellite operations for collision avoidance and reentry prediction, and establish best practices to support improvement.
- Establish space weather observation requirements for improved Space Traffic Coordination services and space sustainability.
- Establish CGMS best practises for long term space sustainability, considering a "Zero Debris Policy".
- Engage with UN-COPUOS to achieve global standardized approach for STC based on CGMS proposal.

The Terms of Reference for the new WGI Task Group on Space Environment Sustainability includes all aspects of SSA. It also includes a dedicated objective: Space weather forecast usage and mitigation of risks and effects so it is necessary to have close interaction between the new Task Group and SWCG.

The presentation also introduces the Space Traffic Coordination requirements in ESA SWE Customer Requirements Document.

In discussion, the following points were made:

- It is proposed to present the ESA STC requirements in the first TG meeting and discuss plan to implement them.
- Reiterated need for membership of the SESTG
- There is a need to link to WMO OSCAR requirements for observations on SWx services. This should be included in the baseline, risk assessment.

CGMS-52-WMO-WP-12 – International Space Weather Coordination Forum report (Jesse Andries online)

The presentation describes the genesis of the International Space Weather Coordination Forum (ISWCF) based on a 2022 report from the UNCOPUOS Expert Group on Space Weather: "Towards improved international coordination for space weather". Related to the first recommendation from this report: "Mechanisms to improve Global coordination services", UNCOPUOUS requested WMO, ISES and COSPAR to lead efforts to improve the global coordination of space weather activities in consultation and collaboration with other relevant actors and international organizations, including COPUOS and their constituent member states actively engage with these organisations to encourage such collaboration. As part of the response to COPUOUS, a decision was made to organise ISWCF to engage with other international organisations in the coordination efforts.

The first meeting of the ISWCF took place on November 17, 2023 at WMO in Geneva with delegates from International Organizations engaged in Space Weather, representing a mix of Research and Operational, Ground based and Space based backgrounds. The aim was:

- to explore pathways to increased coordination of their activities, and to identify areas where coordination is lacking
- to provide outline of the international Space Weather landscape identifying primary focus of each organization represented in the Forum
- develop plans for interfacing with international organizations representing major user groups
- develop approach to alignment with national/regional strategic planning activities and funding programs
- develop plans for pilot projects to demonstrate the value of collaboration and coordination

Regarding the coordination of Space-based Observations:

- Participants from major space agencies agreed that there is a need for an International Agency Space Weather Coordination Group (IASWCG). IASWCG could serve as a forum where agencies that fund space weather research missions can come together to share their plans and coordinate research missions relevant to space weather.
- Scientific missions and operational missions have a shared interest in effective research to operations process.

Regarding the coordination of Ground-based Observations:

- Several types of ground-based observing networks discussed. Several rely on a small number of personnel in different countries operating under the umbrella of different institutions. The importance of their regionally or world-wide coordinated work is not necessarily recognized by their home institutions. Proper (international) recognition could help in securing funding for operators of ground-based sensor infrastructure, and could facilitate expanding, maintaining, and sustaining these space weather assets.

ISWCF also discussed the pathway to a strategy for interfacing with international organizations representing major user groups:

- While recognizing the successful example with ICAO for aviation, it was also recognized that in contrast to ICAO having unified requirements for space weather providers, other users e.g., power

grid, have a different perspective and it can be questioned whether addressing all user groups with a uniform approach is sensible in these other user domains.
- A bottom-up approach could start from collecting the activities of user communication by ISES members and collecting best practices. As a top-down approach, the efforts to identify international representatives of space weather end users should be continued.

Regarding cross-cutting themes lacking coordination:

- Measurement Requirements (based on user needs, and sharpened requirements to be demonstrated scientifically).
- Standards and Interoperability (need to coordinate between different efforts, no one-size-fits all but need to strive for a level of consistency to serve common needs e.g. shared interest to facilitate R2O2R process).

A top level summary and Statement of Intent by the participants is available on the meeting website https://community.wmo.int/en/meetings/international-space-weather-coordination-forum

The meeting established a general consensus (and motivation) on the need to collaborate on concrete items based on the strengths and specificities of each of the organizations.

CGMS-52-CGMS-WP-02 – International efforts related to the needs of Space Traffic Coordination services (open discussion)

Members were asked to contribute to an open discussion with any plans for NRT, operational thermospheric density measurements, with consideration of observation requirements from atmospheric density models.

The following points were made:

- It was pointed out that CMA have neutral density measurements and continuation – will help Space Traffic Coordination. Thermospheric density measurements are proposed to be added to the CGMS baseline, noting that the WIGS Vision does include thermospheric measurements.
- Consider adding additional thermospheric density measurement methods to the HLPP.
- It was pointed out that it is challenging to make continuous measurements and a campaign approach may need to be considered to help improve the thermospheric models.
- Currently agencies use empirical models driven by parameters which could be improved by observations on campaigns. But there is a need to move to a real-time forecast.
- Sensors such as accelerometers, and sensing of the O/N2 ratio. CMA have started to make measurements and NOAA have research instruments, such as GOLD. Other US efforts such as TRITON are being implemented. It is important to get new observations to retrain the models.
- Inclusion of thermospheric observations will be needed on the gap / risk analyses (which will occur once forming part of the baseline).

CGMS-52 actions - SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
SWCG	SWCG/5	SWCG/A52.XX	Consider HLPP / Baseline updates on the following: ▪ Thermospheric density observations to be added to baseline (CMA observations) ▪ Assessment of thermospheric measurement means in HLPP ▪ Auroral observations to be added to baseline (CMA observations)	CGMS-53	OPEN

6. OSCAR review for space weather - Completeness and suitability of space weather related content

CGMS-52-WMO-WP-13 - Updates on Space Weather information in OSCAR/Space and WMO Gap Analysis (Heikki Pohjola)

This working paper summarises the WMO gap analysis for Earth observation and space weather observation capabilities against the requirements presented in the WMO Vision for WIGOS 2040. It compares space-based observation capabilities recorded in OSCAR/Space to the WMO WIGOS Vision for 2040 requirements for the period 2024-2034. Descriptions of the missing observational capabilities related to the specific observation types in WIGOS subcomponents 1 and 2 are given. Several gaps or reduced coverage for satellite Earth observations and space weather observations are highlighted as main concerns which are non-compliant with the WIGOS Vision 2040 requirements. For space weather gaps are identified for the interplanetary solar wind and in-situ magnetic field at L1, solar coronagraph at L1 after 2033 and radio-waves in the ionosphere.

7. Briefings from GSICS GRWG Space Weather Subgroup on Intercalibration

CGMS-52-SWCG-WP-07 - GSICS GRWG report (Tsutomu NAGATSUMA)

Activities of GSICS GRWG Space Weather Sub-group have started since 2023, as an outcome of SWCG task group on inter-calibration of high energy electron sensor. The scope and work plan of the sub-group was established. In the breakout session of the sub-group in the GSICS Annual meeting 2024, activities of crosscalibration are reported from the member organizations. To standardize the cross-calibration procedure for high energy particle sensor, the document on COSPAR/PRBEM standard data procedure was also reviewed in the breakout session, and we have realized that several issues about applying the document to GEO high energy particle crosscalibratoin needs to be discussed with COSPAR/PRBEM members. The meeting at COSPAR 2024 will be arranged for discussion. We also accepted the GSICS quarterly newsletter in a special issue on the cross-calibration of space weather instruments. It is recommended that CGMS/SWCG continue to collaborate with the GSICS GRWG Space Weather Sub-group to share information and have discussions.

8. Review of SWCG list of actions

CGMS-52-SWCG-WP-10 - Status of CGMS-51 SWCG list of actions (Andrew Monham)

SWCG actions							
Actionee	AGN item	Action #	Description	Action feedback/closing document	Dead-line	Status	HLP P ref
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.	**KEEP OPEN** Some latency info added, but further inputs still required by WMO - proposed to keep OPEN SWCG IS#2: Inputs needed before the CGMS Risk Assessment in February SWCG IS#1: CGMS Members to provide inputs on SWCG/A50.01 by IS#3 (26 January 2023)	CGMS-52	**OPEN**	1.3
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	**KEEP OPEN** 5 TG meetings taken place. Next steps identified in TG report	CGMS-52	**OPEN**	6.4
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, i.e. identification of frequency bands requiring protection, with coordination with WMO-ET-SWx/WMO-ET-RFC	WRC-23 now in progress. RF standing agenda item Proposed to keep action OPEN SWCG IS#2: Markus Dreis invited to SWCG IS#3 26 Jan 2023. o Action: Heikki (WMO) to send input from WMO-ET-SWx RF subgroup. SWCG IS#1: - WRC takes place 20 Nov-15 Dec. 2023. - Markus Dreis (EUMETSAT) to be invited to report latest developments and needs	CGMS-51	**CLOSED**	6.1

SWCG actions							
				at SWCG IS#2, 30 November.			
GMS 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	HAVE ADEQUATE MEMBERSHIP Discussion on membership / Action status to take place under SWCG agenda point 7. 2023 3 Feb: CGMSSEC contacted M Goldberg for a status update.	CGMS-52	**CLOSED**	6.2
SWCG (Anomaly TG)	Joint WGI-WG-IV-SWCG/2	SWCG/A51.01	Expand extent of anomaly data feedback	**KEEP OPEN**	CGMS-52	**OPEN**	2.5.1
SWCG (Anomaly TG)	Joint WGI-WG-IV-SWCG/2	SWCG/A51.02	Review current usage of space weather data for spacecraft operations and goals for improvement.	**TRANSFERRED to SESTG of WG1**	CGMS-52	**CLOSED**	2.5.1
SWCG (Data Access TG)	Joint WGI-WG-IV-SWCG/4	SWCG/A51.03	Report Space Weather data gaps & discrepancies between providers and user surveys and OSCAR DB and related priorities for resolution.	**Existing surveys reviewed. Is normal work going forward**	CGMS-52	**CLOSED**	
SWCG (Data Access TG)	Joint WGI-WG-IV-SWCG/4	SWCG/A51.04	Propose standardised Space Weather operational formats and CF convention metadata examples.	**KEEP OPEN, noting further preliminary work required on discovery**	CGMS-52	**OPEN**	6.6
SWCG (Data	Joint WGI-WG-IV-	SWCG/A51.05	Implement improved data access through existing mechanism infrastructure	*Progress made **KEEP OPEN***	CGMS-52	**OPEN**	6.5

SWCG actions							
Access TG)	SWCG /4						
SWCG (Data Access TG)	Joint WGI-WG-IV-SWCG /4	SWCG/A5 1.06	Review future landscape of operational data delivery mechanisms and coordination taking into account WIS 2.0 and other cloud-based data access mechanisms.	**KEEP OPEN**	CGMS-52	**OPEN**	6.5
NOAA	SWCG /2	SWCG/A5 1.07	Report on the STEREO-A coverage implementation	Input to WGIII RA group made	RA Workshop 2024	**CLOSED**	1.1.5
NOAA	SWCG /4	SWCG/A5 1.08	Provide NOAA aviation and satellite industry testbed reports to SWCG when available	Presentation made **KEEP OPEN**	CGMS-52	**OPEN**	
SWCG	SWCG /5	SWCG/A5 1.09	Members to document any plans for NRT, operational thermospheric density measurements with consideration of observation requirements from atmospheric density models.	CMA Presentantations / discussion made.	CGMS-52	**CLOSED**	
WCG/data access + RO TGs	SWCG /5	SWCG/A5 1.10	Consider ICAO PECASUS requirements for improved LEO RO observation, energetic (tens of Kev) electron precipitation flux from LEO orbit , SEP flux spectra (100s MeV to GeV)	**KEEP OPEN** Invite PECASUS, other advisory groups to state requirements in a coming SWCG meeting. Coordinate with WMO on WIGOS revision.	CGMS-52	**OPEN**	
SWCG	SWCG /9	SWCG/A5 1.11	Produce a report of space weather observation requirements for improved STC services and space sustainability	**Transferred to WGI SESTG** Coordinate with WGI and include coordination service providers, US Office of Space Commerce, EU SST and space weather service providers (ISES)	CGMS-52	**CLOSED**	6.7

9. Status report on CGMS future direction 2022+ project

CGMS-52-CGMS-WP-09SWCG - CGMS future direction 2022+ project - Progress on space situational awareness (Juha-Pekka Luntama (ESA)

CGMS future direction 2022+ conclusions contained four short- and medium-term recommendations for SSA objectives:

- Review of CGMS Member Agencies' satellite operations for collision avoidance and re-entry prediction, and establish best practices to support improvement.
- Establish space weather observation requirements for improved Space Traffic Coordination services and space sustainability.
- Establish CGMS best practises for long term space sustainability, considering a "Zero Debris Policy".
- Engage with UN-COPUOS to achieve global standardized approach for STC based on CGMS proposal.

First steps to implement these recommendations are in progress:

- ToR for the new WGI Task Group on Space Environment Sustainability includes all aspects of SSA
- Close interaction with SWCG for space weather observation requirements, status of service developments and O2R.

10. Review and updating of the HLPP

CGMS-52-CGMS-WP-07SWCG - Status of implementation of CGMS High Level Priority Plan (2023-2027) (Mikael Rattenborg)

This working paper provides the status of implementation of CGMS High Level Priority Plan (2023-2027). It incorporates 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 - CEOS-CGMS Joint Working Group on Climate.

CGMS-52-CGMS-WP-08SWCG - Revised HLPP 2024-2028 – for recommendation to plenary (Mikael Rattenborg)

SWCG provided inputs which will lead to further refinement of the HLPP to be presented at Plenary.

CGMS-52 actions - SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
SWCG	SWCG/ 10	SWCG/A52.XX	Consider HLPP / Baseline updates on the following: - observation requirements in support of interplanetary human exploration	CGMS-53	OPEN

11. Future CGMS SWCG meetings

CGMS-52-CGMS-WP-02 - Decision on dates on SWCG activities in 2024-2025 (CGMS-52 to CGMS-53)

Decision on dates on SWCG activities in 2024-2025 (CGMS-52 to CGMS-53) (Anne Taube)

The following dates are proposed for the SWCG Intersessionals.

SWCG activity	Proposed dates
Intersessional #1	3 September 2024
Intersessional #2	3 December 2024
Intersessional #3	29 January 2025
Intersessional #4	18 February 2025

12. Any other business

None

13. Conclusions, preparation of the SWCG report for plenary

The SWCG Chairs and Rapporteur thanked the SWCG members and external presenters for their active participation in the meeting and efforts throughout the year.

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CGMS

Joint WG I-
WG IV-SWCG

JOINT WGI-WGIV-SWCG REPORT

Chair: *Tsutomu Nagatsuma, NICT*
Rapporteurs: *Karolina Nikolova, Andrew Monham, EUMETSAT*

1. Welcome, objectives and review of the agenda

The meeting Chair, Dr. Tsutomu Nagatsuma supported by Rapporteurs Mr. Andrew Monham and Karolina Nikolova, welcomed the participants, consisting of representatives from CMA, ESA, EUMETSAT, ISRO, JMA, JAXA, KARI, KMA, NICT, NOAA, ROSCOSMOS, ROSHYDROMET and WMO (see Annex 1 for full list of participants).

The draft agenda proposed by the CGMS Secretariat prior to the meeting was reviewed and adopted.

2. Establishing a space weather spacecraft anomaly report database

CGMS-52-SWCG-WP-03 - Report on progress of the Space Weather Spacecraft Anomaly Database Task Group (Andrew Monham)

The Space Weather Spacecraft Anomaly Database Task Group objective is to promote the collection of spacecraft anomaly data as the data source for space weather actors, to analyse the impact of space weather on satellite systems. Particularly to improve:

- spacecraft design robustness
- support the spacecraft operations community with space weather warnings and improved post-event anomaly analysis
- tools modelling space weather effects

The Task Group has been active in promoting the sharing of anomaly data in various for involving the spacecraft operations community and has established strong links to similar activities on-going in NASA. Outreach to commercial operators is also on-going.

Strong backing for this activity is received from representatives of UN COPUOUS with the Long-Term Sustainability Guidelines specifically encouraging support to this CGMS activity and CGMS/WMO have drafted a compliance matrix.

The data provision template and guidelines in the latest Excel format are available on the CGMS website and all data received since 2015 has been compiled into this format. It is proposed to publish this data on the CGMS website following SWCG report approval at Plenary. Study work under NASA/NOAA contract may result in a useful basis for an anomaly database structure allowing security and confidentiality concerns to be addressed and is being covered in a separate presentation.

The objective introduced at CGMS-51 to identify best practices in usage of space weather data by spacecraft operators and their goals for improvement, is moved to the WG1 Space Environment Sustainability Task Group.

The Task Group achievements since CGMS-51 were presented and include a call for latest anomaly input data made using new Excel Template, linking with UN COPUOS STSC LTS Guidelines and WMO ET-SWx, effort on compiling EDAC scrubbing data started in EUMETSAT, interactions with external entities (commercial operators) involved in compiling anomaly data, interactions taking place with US effort on establishing secure database technology and several outreach activities at the European Space Weather Week (End User Dialogue with Spacecraft Operators).

In the lead up to CGMS-53, the Task Group plans to work on expanding extent of anomaly data feedback.

CGMS-52-SWCG-WP-04 - CGMS agency spacecraft space weather anomaly reports compilation (Andrew Monham)

This paper introduced the compilation of all spacecraft anomalies reported by CGMS members since 2025. A CGMS Spacecraft Anomaly Database for the period 2015 to 2023 has been compiled and contains 270 LEO reports, 40 GEO reports and 124 reports from other orbits. It was proposed to publish this database on the CGMS Website following approval of the SWCG report at CGMS-52 Plenary.

The reporting of Error Detection and Correction (EDAC) scrubbing events from several EUMETSAT LEO satellites during 2023 was illustrated. Space Weather Analysts are invited to report on value of this EDAC data. If confirmed useful, this will be included in the published anomaly database and CGMS members invited to supply EDAC data including the provision of the historical archive where available.

CGMS-52 actions - J-WGI-WGIV-SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
SWCG	Joint WGI-WGIV-SWCG/2	SWCG/A52.XX	SWCG to seek feedback from space weather analysts on value of the collected EDAC 2023 data	CGMS-53	

CGMS-52-NASA-WP-08 - Spacecraft Anomaly Resolution Knowledgebase SPARK Creating a centralized anomaly database (Alec Engell)

Alec Engell presented efforts by a NASA contractor commercial company called NextGen to create a centralised and standardised satellite anomaly database (SPARK). An overview of technical implementation of SPARK and its notional architecture was presented. Statistics based on the anomaly catalogues in the database were presented (e.g. occurrences of anomalies per year and root cause).

In discussion, the following points were raised:

- The tool can extract statistics on relationship between space environment and space anomalies.
- It was proposed to look at incentives to provide data to the database, such as only allowing database usage if the user is also actively sharing data.
- It was enquired whether machine learning is being utilised for early detection of anomalies. The focus so far is on data collection, but user application of ML on that data would be beneficial.
- It was also suggested that providing reports of lessons learned could encourage sharing of data.

- It was proposed that a paper for publication in the Journal Space Weather could be considered in order to get feedback from the Space Weather Research community.

3. Space Weather data access

CGMS-52-SWCG-WP-05 - Report from the CGMS SWCG Task Group on Improving User Data Access to Space Weather Data from Orbital Sensors (Andrew Monham)

The Task Group on Improving User Data Access to Space Weather Data from Orbital Sensors helps glue together the feedback obtained from the various outreach activities of SWCG:

- Data Provider and User Surveys conducted 2017-2019
- CGMS-User meetings held in space weather workshops in Asia, Europe and USA

and identifies the priorities for improving the provision of CGMS Agency space weather sensor data to operational users.

The Task Group has been very active with wide participation of all representing relevant roles of data providers and users, holding 5 meetings and a number of outreach events to external parties in workshops in Asia, Europe and the USA. Furthermore the group is cooperating closely with the WMO Expert Team on Space Weather.

Based on identification of priorities, the group has made significant strides in:

- updating the baseline of data provision to user needs and gap identification and correlating this with the OSCAR DB;
- working on improving data access reliability through leveraging of existing cooperation agreements for meteorological data exchange;
- Initiating prototype format standardisation and metadata definition activities in coordination with the related WMO activity.

Progress has been made on all actions since CGMS-52, but further work will continue to CGMS-53:

- Action SWCG/A51.03: WMO are supporting the gap assessment between the provider / user surveys and OSCAR DB;
- Action SWCG/A51.04: Work is commencing on future CF type approach compatible with both Ops needs and SPASE, taking into account work of IHDEA https://ihdea.net/. Please refer to presentation from UK Met Office: Formats and metadata for operational space weather data from space: considerations for any future design;
- Action SWCG/A51.05: Work on-going to leverage EUMETSAT cooperation agreements for operational redistribution of space weather data through EUMETCast. Agreement reached in 2023 for redistribution of KSEM data (subject to EUMETSAT Council approval in June 2024). Discussions at an advanced stage with some other partners.

- Action SWCG/A51.06: EUMETSAT/ESA/WMO have cooperated on making SOSMAG data available (non-operational latency) as a trial. CGMS SWCG members support the WMO-ET SWx discussions on the role of WIS2.0 in supporting operational space weather dissemination.

CGMS-52-GUEST-WP-04 - Formats and metadata for operational space weather data from space: considerations for any future design (Edmund Henley, Met Office UK)

Edmund Henley presented on formats and metadata for operational space weather data from space. He noted the lack of standardised formats and metadata in operational space weather data from space, which incurs penalties on users, which may be hidden from providers.

As a discipline, space weather lacks some key standards on variable naming & coordinate reference frame identification which have helped terrestrial weather advance, and build tools to automatically handle data from many sources. It was highlighted that as more NMHSs are addressing space weather, CGMS providers should consider what can be done to make their data more comparable.

Compatibility represents a key challenge and continued CGMS activity was recommended to better understand any implications of relevant changes to terrestrial practices (e.g. WIS 2.0) and overlaps with existing space weather standards.

It was also highlighted the metadata is a particular issue, since it can be difficult to identify what a variable represents, its units, reference frames, etc., which creates various usability challenges.

The following points were raised in discussion:

- In response to a query from NOAA regarding the sufficiency of NOAA's space weather data documentation, it was clarified that the documentation is extremely useful for those that have built up experience, but some improvements could be made to make information easier to find for new users.
- It was suggested this can be worked within CGMS to identify concrete improvements and work towards centralisation where possible.
- In addition, it was proposed that it would be beneficial to work on defining levels of products, as well as related documentation. It was noted that there is inconsistency in the definitions of levels of products across space weather missions. It was agreed that there should be consistency, particularly when it comes to operational space weather data, and proposed that CGMS would prepare a recommendation / best practice. Coordination is required with WMO's efforts in this respect. (Action).
- In terms of a pragmatic approach for metadata and data formats, the relationship between metadata and WIS 2.0 requirements needs to be clarified and a wider CGMS action can be held off for the time being. As a pragmatic approach it was proposed that NOAA works with ESA on SWFO metadata and formats.
- More generally, the CGMS SWCG can assess what if being done for planned and current missions.

- It was also noted that there are already some data formats and metadata established by research community on space weather data, So there is also a need to discuss formats and metadata in the frame of space weather research for harmonization.

CGMS-52-NOAA-WP-15 – Report on NOAA test-bed exercises (Bill Murtagh)

NOAA's Space Weather Prediction Center (SWPC) organized two recent Space Weather Prediction Testbed Exercises.

The purpose is to:

- Bring together forecasters, customers, regulators, internal and external research and development staff, and federal partners to explore the current capabilities, needs, and gaps of current space weather products and services.
- Enable the testing of emerging concepts and new technologies for improving space weather prediction to accelerate R2O and inform O2R.

In discussion, the following point was raised:

- It was pointed out that the false alarm rate is crucial to users – intention is to provide error bars.

CGMS-52 actions - J-WGI-WGIV-SWCG					
Actionee	**AGN item**	**Action**	**Description**	**Deadline**	**Status**
CGMS Members	Joint WGI-WGIV-SWCG/3	SWCG/A52.XX	Report on the space weather product level decisions. Identify and differences and propose steps for alignment.	CGMS-53	OPEN

4. Ionospheric Radio Occultation system optimisation

CGMS-52-EUMETSAT-WP-05 - Report from the CGMS SWCG Task Group on Ionospheric Radio Occultation System Optimisation (Andrew Monham)

The Task Group on Ionospheric Radio Occultation System Optimisation was formed at CGMS-50 to address 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.

All documentation is available on the Google Drive along with the Data Access Task Group information.

The Task Group benefits from expert ionospheric RO experts along with representatives of the CGMS RO data providers and 5 meetings were actively supported.

Significant progress has been made in developing the capability table of ionospheric RO missions, reviewing methods to geolocate plasma bubble scintillation, initiating Observing System Simulation Experiments (OSSE) such that it can be expected significant further progress to meet the high-level aim of the group can be made prior to CGMS-53.

Since CGMS-51, the Task Group has worked on review of current implemented systems, initiating OSSEs to aid in requirement definition and latency issues.

Action SWCG/A50.03 (reflecting to the above mentioned HLPP objective remains open, but with significant progress made by the TG.

In the lead up to CGMS-53, the Task Group plans to work on maintenance of the RO capability table, including commercial providers and resolving discrepancies / gaps found with respect to the OSCAR DB comparison, preparing OSEs/OSSEs, further analysing the geolocation of scintillations taking advantage of above mentioned OSSEs and further studies, as well as considering readiness to propose potential improvements in CGMS Member RO measurement capabilities and / or data access in support of the requirements.

In response to the request from the TG leader, NOAA indicated that they will propose a name to take over the leadership and coordination of this TG.

CGMS-52-SWCG-WP-09 - Report on commercial ionospheric RO data assessment (Elsayed Talaat)

There is interest among the international community in understanding the requirements for radio occultation (RO) observations, often expressed as a count per day, particularly for ionospheric observations. The CGMS SWCG Task Group on Ionospheric Radio Occultation System is addressing the requirements for radio occultation observations for ionosphere monitoring. The IROWG is conducting the ROMEX experiment to understand RO count requirements for the lower atmosphere.

NOAA wants to understand the needs for ionospheric RO observations to set requirements for commercial data buys and assess the need for an RO government backbone. The paper presented a preliminary assessment of the number of ionospheric RO observations needed to support modeling as well as some future work to further refine this estimate.

The initial approach is to address the RO requirements for resolving the background ionosphere to support modeling through data assimilation.

As an objective requirement, a preliminary number of 30,000 RO profiles per day is proposed for global background ionosphere. The caveats are that:

- This study assumes that one RO profile per model grid cell is sufficient.
- Horizontal smearing and tangent point movement during the occultation track were not accounted for.

As part of future work, Observation System Simulation Experiment (OSSE) studies will examine the optimum number of daily RO occultations with regard to improvements in data assimilation. Architecture

studies are also needed to understand the coverage and refresh of TEC, electron density profiles, and scintillation.

5. Frequency-related topics in support to space weather

CGMS-52-EUMETSAT-WP-06 - Outcome of WRC23 related to space weather (Markus Dreis)

The international regulatory framework, the ITU Radio Regulations (RR), before WRC-23 did not contain any recognition or provisions related to space weather observations using radio frequencies.

The World Radiocommunication Conference 2023 (WRC-23) had to deal with space weather frequency related issues under agenda item 9.1 Topic A as a first step and when agreed by WRC-23, complemented by a second step for studying particular frequency bands for consideration of regulatory provisions for receive-only space weather sensors and their protection in the Radio Regulations.

In response to this two-step approach, WRC-23 established the following:

- Space Weather designation under a new sub-category of MetAids (space weather) in a new RR Article 29B;
- New ITU-R Resolution 675 outlining the importance of space weather applications;
- Definition of space weather embedded in this ITU-R Resolution 675;
- Follow-on WRC-27 agenda item 1.17 for possible frequency allocations to MetAids (space weather) in the following frequency bands: 27.5-28.0 MHz, 29.7-30.2 MHz, 32.2-32.6 MHz, 37.5-38.325 MHz, 73.0-74.6 MHz, 608-614 MHz.

A query was raised about the practical effect of where there already is a space radio astronomy allocation. Markus noted that if there is already radio astronomy allocation, then no action is necessary and focus is better placed on the areas where allocation is required.

WMO highlighted the importance of the progress made on space weather items in WRC-23 and expressed appreciation for the efforts made.

6. Space environment sustainability Space Weather aspects

CGMS-52-SWCG-WP-08 - Space Weather aspects of the Space Environment Sustainability Task Group Terms of Reference (Andrew Monham)

The proposed Terms of Reference for the WGI Task Group on Space Environment Sustainability were briefly presented. This Task Group builds on preliminary work initiated by its predecessor, the WGI Task Group on Space Debris and Collision Avoidance.

The Terms of Reference aims to cover all space sustainability issues of relevance to CGMS missions. In particular, all SSA aspects associated with the Short-, Medium-and Long-term Goals for CGMS* and split into the following categories:

- Space Traffic Coordination
- Space Weather
- Space Sustainability

All CGMS members actively involved in space operations or supporting SSA / Space Weather data provision to spacecraft operators invited to join this effort. Due to the scope of the Task Group, a secretarial function supporting the Co-Chairs would be welcomed. ISES Membership is also invited in order to support the objectives on space weather service utilisation by spacecraft operators and a presentation to ISES on this TG (and the spacecraft anomaly TG of SWCG) was made on 22 February 2024. Identification of experts to enable deeper understanding of issues between agencies is also foreseen.

The WGI Rapporteur, Karolina Nikolova, noted that the WGI Terms of Reference have been aligned with the new Task Group's Terms of Reference, and confirmed an editorial edit has been made to highlight that when it comes to space weather the objective of this TG within WGI is the usage of the space weather forecast information rather than the forecasting itself.

CGMS-52-ESA-WP-06 - Space Weather for spacecraft operators: End user interaction within ESA's Space Safety Programme (Alexi Glover)

This paper focused on the end user interaction within ESA's Space Safety Programme.

There is user engagement from the start of the development process through to testing of end results, which builds on continuous reliable provision with end user in the loop, recognises that users have different needs and levels of expertise and are looking for different types of information accordingly. In terms of R2O, there is development of tailored capabilities. In terms of O2R, there is feedback on needs, usability, user workflows and procedures.

An SWE Portal upgrade was completed in 2023 to include a section dedicated to guidance for end users, manuals, tutorials etc.

The Customer Requirements were updated in 2023 and all user domains were reviewed.

7. Review of actions

The full review of CGMS-51 actions related to the Joint Meeting is available in the SWCG Report.

8. AOB

None

9. Next steps, conclusions and reporting to plenary

The CGMS-52 reports from the working groups will be prepared ahead of CGMS-53 and sent out for review.

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CGMS

Annexes

ANNEXES

ANNEX I: OPENING ADDRESS

NOAA, Dr. Michael Morgan, Assistant Secretary for Earth Observations and Prediction

Introduction

Good morning and good afternoon to those joining us online.

On behalf of the National Oceanic and Atmospheric Administration, or NOAA, it is a pleasure to be here to welcome you to Washington, DC for the 52nd Plenary of the Coordination Group for Meteorological Satellites.

As Assistant Secretary of Commerce for Environmental Observation and Prediction, I am responsible for providing NOAA agency-wide direction with regard to weather, water, climate, and ocean observations, including in situ instruments and satellites, and the process of converting observations to predictions for environmental threats.

As you are aware, NOAA is an agency that enriches life through science. Our reach goes from the surface of the sun to the depths of the ocean floor as we work to keep the public informed of the changing environment around them. From daily weather forecasts, severe storm warnings, and climate monitoring to fisheries management, coastal restoration and supporting marine and space commerce, NOAA's products and services support economic vitality and affect more than one-third of America's gross domestic product.

Satellites provide critical information that help us better understand our Earth system and the impacts of the challenges of climate change. We are proud of NOAA's robust satellite programs and recognize we can only succeed in partnership with our international partners, including all of the CGMS members represented here today.

We know that humans are changing Earth's climate at a rate not previously seen in recorded history, and this causes significant problems for our planet's ecosystems and its people. While we often talk about climate change as something that will happen in the future communities and ecosystems around the world are feeling the impact **today**.

Stage Setting

Consider this:

- NOAA ranked 2023 as the warmest year in our global temperature record, which dates back to 1850;

- Upper ocean heat content—the amount of heat stored in the top 2000 meters of the ocean—was at a record high in 2023;
- In September 2023, sea ice in the Antarctic reached an annual maximum extent of 16.96 million square kilometers, setting a record low maximum in the satellite record that began in 1979; and
- The U.S. alone has sustained 383 weather and climate disasters since 1980 where overall damages/costs reached or exceeded $1 billion (including Consumer Price Index adjustment to 2024). The total cost of these 383 events exceeds $2.720 trillion.
- Last year there were 28 such events and this year as of May 7th there have already been 7.

These examples illustrate how things that we depend upon and value — water, energy, transportation, wildlife, agriculture, ecosystems, and human health — are experiencing the effects of a changing climate, including the increasing number of natural disasters.

NOAA shares a mission with many of those agencies represented here today to understand and predict changes in climate, weather, oceans, and coasts, and to share that knowledge and information with others.

I want to underscore the importance of sharing that knowledge with others. I know you will be talking this week about how you can contribute to the success of the WMO Early Warnings for All Initiative, ensuring everyone on Earth is protected from hazardous weather, water, or climate events.

Climate Ready Nation

At NOAA we are also helping to build a Climate-Ready Nation, where “the Nation’s prosperity, health, security, and continued growth benefit from and depend upon a shared understanding of, and collective action to reduce, the impacts of climate change.”
We know that many of you share the goal of ensuring that your Nations - and the global community - understand and prepare for the challenges of a changing climate.
One hallmark of NOAA’s efforts to build a Climate-Ready Nation is ensuring that communities and decision makers have equitable access to the climate information, products, and services they need, and a clear understanding of what this information means for their communities, economies, natural resources, and the built environment.

This is about relevant, timely, information being equitably delivered to communities for decision making.

Another hallmark is that the public and decision-makers are empowered to take a range of adaptation and mitigation actions at the scales needed to systematically prevent or reduce the negative impacts of climate change, by utilizing socioeconomic, ecological, and other relevant information to build resilience, while considering trade offs of different pathways.

NOAA is working to build a Climate Ready Nation by expanding our work with existing and new partners to equitably meet the needs of communities and businesses facing hazardous weather events and long-term climate impacts.

NOAA is doing a great deal to translate our long-term climate observations, research, and modelling projections into decision support services and to go that last mile to get useful information into the hands of users.

Future Satellite Observations

Fundamental to this effort are the satellite observations that underpin NOAA's science and services.
Of course, the rapid changes in the space sector will impact how we provide those satellite observations in the future. The increasing breadth of observations we will need to forecast weather and monitor climate necessitates reimagining our future satellite architecture. I am happy to see we, as CGMS members, are continuing to discuss how we can develop more advanced and agile systems by harnessing New Space to make technology, platform, and business model innovations operational on more rapid timescales. This will include expanding international and commercial partnerships and on-ramping new technologies for space systems and dissemination.

As you are aware - and I know Dr. Volz will discuss this in more detail in the NOAA Agency update - disaggregation is a key element of our Near Earth Orbit Network (NEON) Program, which is developing our future low-Earth orbit (LEO) environmental satellites.

We know the challenge of integrating disaggregated systems is significant for NOAA and that challenge grows ever more complicated when we seek to integrate disaggregated networks across multiple global agencies. I am pleased that CGMS has adopted a proactive approach to addressing these challenges and I look forward to hearing the outcomes of your discussions this week.

Closing

I cannot overstate the importance of the partnerships represented in this room. We are often asked why NOAA engages in international partnerships and the short answer - one you already know - is simply we cannot afford not to.

To those of you here in the room today, thank you for traveling to Washington. NOAA is delighted to host you here. For those of you online, thank you for joining at what is likely to be an inconvenient time for many of you.

I wish you a successful CGMS-52 Plenary Meeting, and I look forward to hearing the outcomes of this week's conversations.

Thank you.

ANNEX II: 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

Abbreviation	Meaning
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
GST	2024 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

Abbreviation	Meaning
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
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 III LIST OF PLENARY PARTICIPANTS

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Photographs

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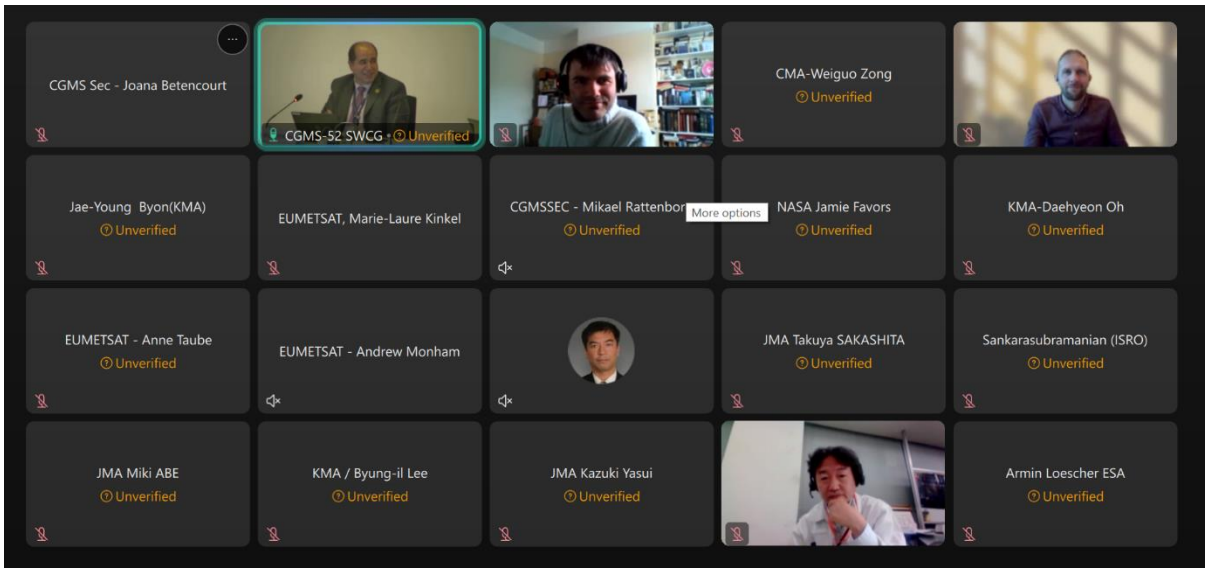
WGII

WGIII

WGIV

SWCG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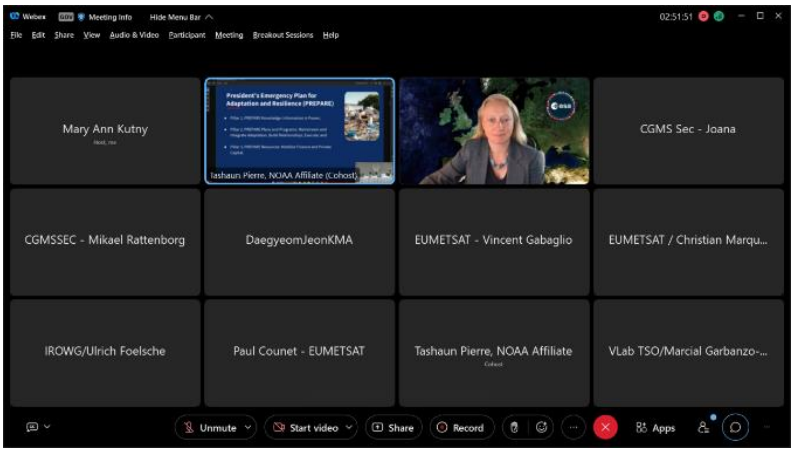
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GENERAL CGMS INFORMATION

CGMS Agenda and Working Papers

The agenda and Working Papers (WPs) are available at: CGMS Agenda and Working Paper Tool (cgms-info.org)

List of actions and recommendations

Status of CGMS-51 list of plenary actions and recommendations following CGMS-52 plenary discussions.

Status of CGMS-52 list of plenary actions and recommendations following CGMS-52 plenary discussions.

CGMS List Servers

There are currently nine CGMS list servers:

- Plenary, WGI, WGII, WGIII, WGIV, and SWCG; and
- WGI Task Group on direct broadcast systems, Task Group on data collection services and Task Group on data access.

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.

General enquiries

Please contact the CGMS Secretariat at CGMSSec [at] eumetsat.int in case of any enquiries related to CGMS.

CGMS

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