2022

Status and way forward of the CGMS future direction 2022+ project

Presented to CGMS-51 Working Groups I-IV and SWCG

Coordination Group for Meteorological Satellites

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Executive summary of the WP

This working paper gives an overview of the activities undertaken on the CGMS future direction 2022+ project since CGMS-50 plenary for consideration and feedback by the CGMS-51 working groups (WGs I-IV and the SWCG). The 2nd high-level meeting on 29 March 2023 endorsed the way forward proposed, noting the need for the identification of concrete implementation measures in the next year (up to CGMS-52) and a stronger link as concerns the potential interfaces.

The basis for discussion are the agreed seven strategic themes (and as illustrated by the following slides):

- Socio-economic benefits
- Research to operations
- Future observing (hybrid) space infrastructure
- Future information technologies
- Relationship with the private sector
- Climate and Earth system monitoring
- Space situational awareness

+ A topic for all: supporting developing countries

ACTION: 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.

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To be considered by CGMS working groups:

ACTION: 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**

SOCIO-ECONOMIC BENEFITS

Overarching goals

Phase 1, in the near-term (1-2 years):
To collect and make available to CGMS members, SEB case studies of relevant satellite systems for the purpose of identifying common practices in next phase.

Presentations of these studies to CGMS members would be encouraged, i.e. in the form of on-line workshops.

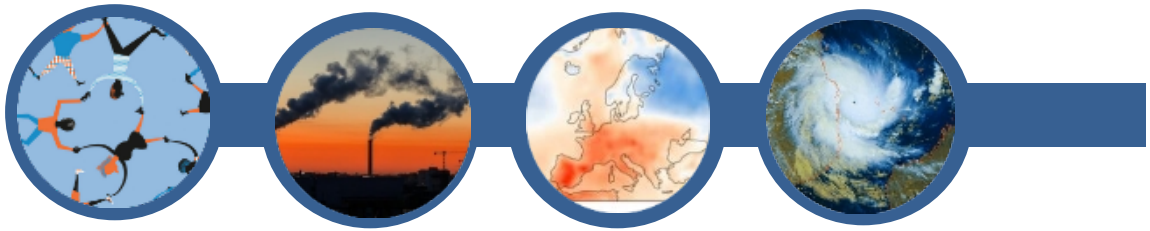
Phase 2, in the medium-term (3-4 years to completion):
To explore with WMO and other agencies the possibility to develop a study on the SEB value of the space-based observing system responding to WIGOS 2040 in cooperation with CGMS, and to trigger collaboration with CGMS members

Additional questions/proposals

Update phase 1 to narrow the questions and after that to think who can run such an analysis (OECD, WB, WMO ….)

Providing WMO with well defined questions (maybe looking to specific sectors globally) and exploring the link to the WMO Impact workshop

Figuring out how to document and share the benefits of satellite observations for climate seems especially challenging



To be lead by WGIII

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RESEARCH TO OPERATIONS

Overarching goals

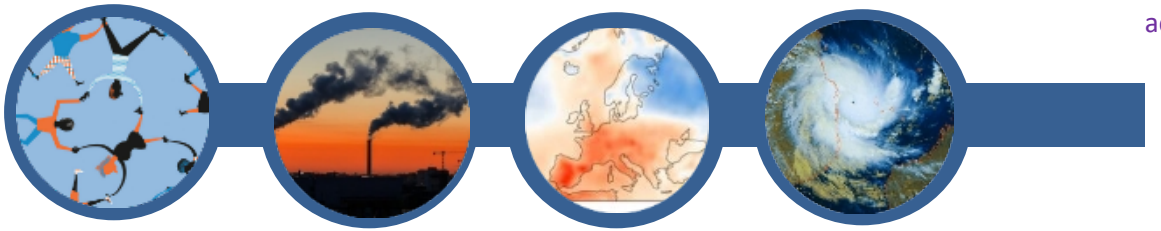
Medium-term goals (1-2 years):
Collect the experience of each agency by carrying out a Research-to-Operations method survey with each agency;

Based on the results of the method survey, propose a consistent Research-to-Operations baseline process that includes flexibility and adaptability

Identification of research missions with a potential transfer to operations

Long-term goals:
Encourage both CGMS agencies and R&D operations to incorporate the Research to Operations baseline process in the planning stage of the new satellite system and to report on their experiences with the application of the process;

Facilitate the participation of R&D agencies in operations projects



Additional questions/proposals

Research-2-Operations-2-Research; Research-2-Operations-2-Users

R2O issues (a) getting quasi-operational use of research data as soon as possible after a mission launches, and (b) figuring out how to continue observations pioneered with research satellites in a sustainable way

O2R - what specific limitations in the current operational systems are limiting our ability to provide the products and services that are desired, including forecasts, and how can research help create the pathway that could get us past those limitations.

Could we really build a baseline of R2O and O2R? Would it be better to collect R2O and O2R critical questions across the organizations and discuss them specifically what it means to CGMS? Would it be possible to select a benchmark to explore the different components?

Open Source Science - how will it impact? The push for open source science means that there is interest in going beyond the sharing of “end results” to give people earlier access to the process

To be lead by WGIV

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FUTURE OBSERVING (HYBRID) SPACE INFRASTRUCTURES

Overarching goals

Identifying all hybrid space infrastructures for the different observation types – CGMS baseline

Demonstrating that the impact of CGMS contributions, as part of the integrated system, explicitly considering data buy

Addressing such aspects as orbit coordination and harmonized data access to ensure the different components of the hybrid space infrastructures provide a seamless operational service to the users (sharing the cal/val infrastructure)

A critical review of WIGOS 2040 with respect to hybrid systems in preparation of the next revision of the vision.

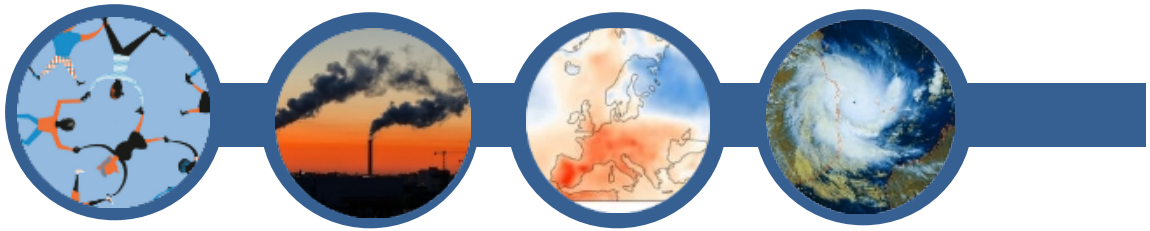
Additional questions/proposals

We should be thinking about how the collective cal/val infrastructure can be mutually supportive so that we can all "help validate each other"

It is proposed to choose a specific case to examine the various facets of the hybrid space infrastructure. Microwave is good initial case, as it involves all the elements defining a hybrid space infrastructure (platform, instrument, orbit) and also management

Complementarity between this paper and the technological development – ensuring the alignment

To be lead by WGI



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FUTURE INFORMATION TECHNOLOGIES

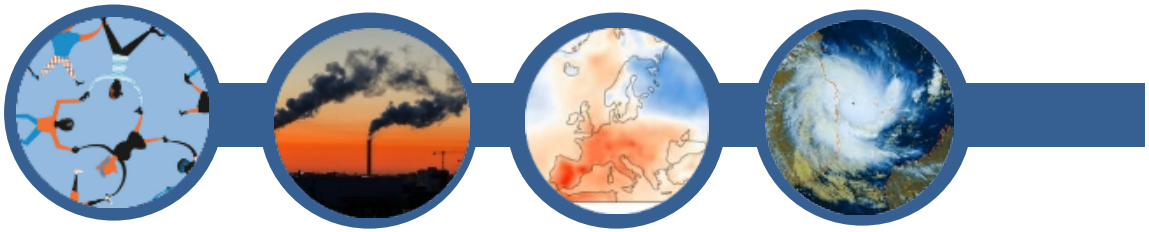
Overarching goals

Mid-term Goal

- Identify the actual and potential cloud and AI/ML technologies for applying to the data management infrastructure, and develop best practices
- One or more CGMS members to Prepare demonstration to collaborate with private sector regarding the satellite data distribution
- Assess the IOT technology for inter- and intra-connections between satellite and ground network

Long-term goals:

- Consider to establish more interoperable data sharing and exchange system architecture in common for new small satellite constellations
- Consider to build space-ground networked testbeds for data distribution and collection including transmission rates of various data and their latency impacts
- Suggest the guideline of the space-based information network according to the outcome of the expert team of WG I



Additional questions/proposals

CGMS could scout the technological developments and debate the question about the impacts into the satellite value chain (ex. AI/ML or cloud technology) - what the impact of future technology

- Space2ground
- Data collection systems
- Data processing
- Data access
- IOT observations, e.g. crowdsourcing

Open Source Science - how it will impact? the push for open source science means that there is interest in going beyond the sharing of “end results” to give people earlier access to the process

WIS 2.0 architecture and technical considerations (moving to goals).

To be lead by WGI, WGIV (Cloud), WGII (AI/ML)

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RELATIONSHIP WITH THE PRIVATE SECTOR

Overarching goals

Identify/Evaluate potential or future commercial EO technologies – and share info on pilots/testbeds/etc. to evaluate new commercial EO technologies

Assessing the operational maturity of commercial observation technology

Develop best practices/templates*:*

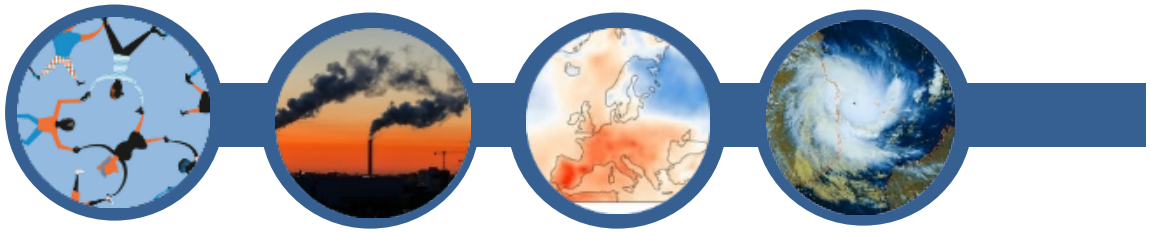
- for End User License Agreements/Procurements;
- for considering the value of public access and the additional costs of data sharing rights
- Incl. quality control considerations

Additional questions/proposals

How CGMS members will interact with the private sector? → with the objective to comply with the new WMO Res.1, i.e. to continue to promote global and free exchange of data

A possible solution through the consultative mechanism under Geneva declaration, WMO. Incorporate the selected engagement mechanism in the other papers

How do we deal with commercial Research data to support cal/val and operational development?



To be lead by WGIII

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CLIMATE AND EARTH SYSTEM MONITORING

Overarching goals

Strengthen and deepen the dialogue with the NWP community, to achieve a consolidated definition of current and future NWP requirements (put in context of res 1)

Creating synergies and improve coordination across initiatives for cryosphere, hydrology and ocean by capturing the trend in modelling developments for better observations at the interface between climate components.

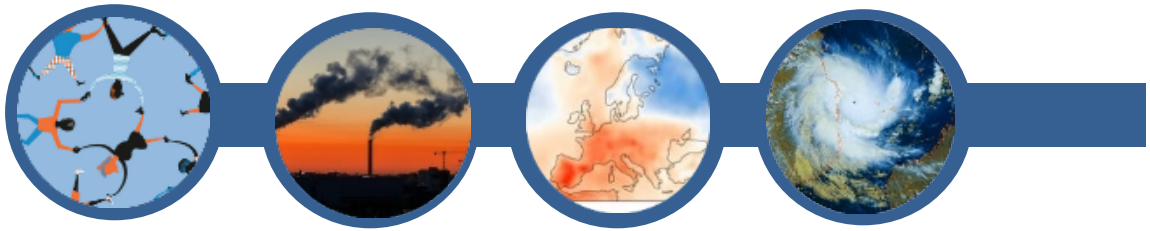
Coordination role with WMO to ensure the support to the WMO GHG Monitoring Infrastructure Initiative - from a satellite observations perspective

Additional questions/proposals

For climate monitoring many/most of the data sets that will be used to address multi-decadal time scales will be multi-instrument/multi-platform/multi-program, and we need to be sure that the agencies have mechanisms in place to support the integration across all of those dimensions

The space agencies should advocate and, where possible, maintain the quality (or improve it) for complementary data sets that underpin the satellite observations (e.g., terrestrial reference frame for surface altimetry and gravimetry).

Quite important but broad goals - so how do we translate for CGMS?



To be lead by WGII

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SPACE SITUATIONAL AWARENESS

Overarching goals

Space Traffic Coordination

- Review of CGMS Member Agencies' satellite operations for collision avoidance and re-entry
- Perform a gap analysis between the needs and the available/used STC services
- Carry out an assessment of service development prospects
- Prepare a proposal for the best practises to support improvement

Space Weather

- Potential new goal within the SSA Theme: Produce a report of space weather observation requirements by improved STC services and space sustainability; Identification of synergies with other CGMS Themes

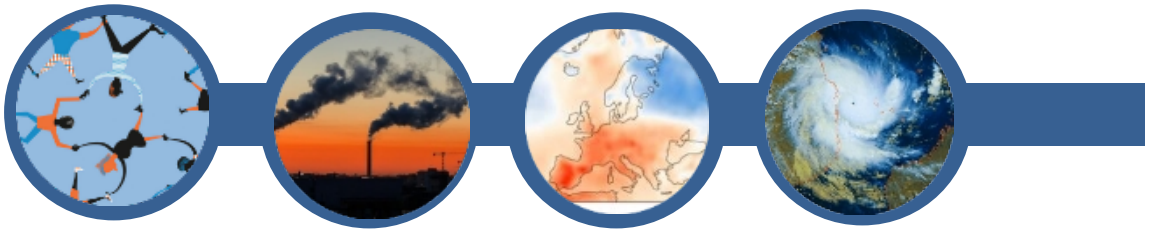
Space sustainability

- Share Space Sustainability Rating
- Carry out a pilot project where some operational missions planning are evaluated
- Share "zero debris policy" to all CGMS Member Agencies and carry out assessment of impacts of such policy on operational missions including private sector
- Prepare a CGMS best practises document for long term space sustainability

Additional questions/proposals

What the concrete impact on CGMS duties and functions?

How do we guarantee the proper data sharing question?



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To be lead by WGI and SWCG

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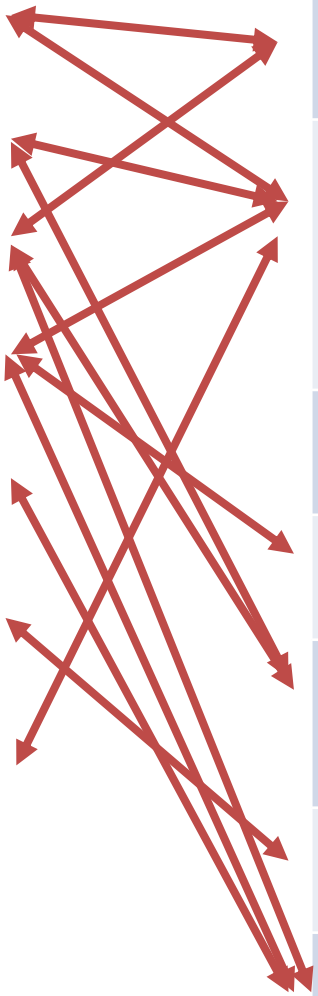
INTERFACE CONSIDERATIONS

Strategic Theme
Socio-economic benefits
Hybrid Space Infrastructure
Relationship to Private Sector
Climate and Earth system Monitoring
Research to operations
Space Situational Awareness
Future Information Technologies



Interface	Comment
OECD/Space	Support to understand /evaluate SE trade-offs and potential private sector engagement
WMO	Strengthen links to INFCOM and its Expert teams on Early Warning for all, NWP Requirements and Impact, WIS 2.0. Dialogue about GHG infrastructure needs, socio-economic benefits and dialogue with Private Sector.
GEO	Subject to new GEO strategy
GCOS	Strengthen dialogue through JWGClimate
Private Sector	CGMS inputs to WMO Private Sector dialogue. Encourage PS participation in technical and scientific groups under CGMS
UNOOSA	Strengthen dialogue through COPUOS on SSA and Best Practices on space sustainability.
CEOS	Stregthen dialogue with Virtual Constellations (Ocean) and NewSpace Task Group

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A TOPIC FOR ALL:
SUPPORTING DEVELOPING COUNTRIES

- We propose to prepare a note to plenary (2024?) in collaboration with WMO and WB

Key topics to be covered

- Contributions to Early Warning for all – it should be investigated what data CGMS can contribute (e.g. provision of timely access to polar orbiting data).
- Encourage feedback on requirements and applications for satellite products from users in developing countries and their inclusion in application demonstrations - Reference to Satellite data requirement group of WMO
- Promote multilingual versions of the satellite remote sensing application service platform;
- Assist accessing SSA services for satellite operations and ground systems especially for applications to civil aviation, electric grids and telecommunication infrastructure which are at risk.
- Assist future satellite operators in the launch of meteorological satellites.
- Continue to facilitating Data Access for Operational Applications – Provide satellite application data-sharing support (through the Internet, satellite receiving stations, etc.)
- Continue to provide training for developing countries on satellite applications and space weather forecasting techniques;
- Relationship between fully public and private services

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Next steps and way forward:

- 8 May 2023 7th Task Team meeting (virtual)
  - Consider feedback from WGs
- 14 June 2023 8th Task Team meeting (virtual)
  - Preparation of plenary

- 26-28 June 2023 CGMS-51 plenary (in-person at JMA)
  - Discussion and endorsement of recommendations

- Post CGMS-51 plenary
  - Wrap up meeting(s) by the Task Team
  - Implementation activities by the various working groups in their respective inter-sessional meetings