CGMS future direction 2022+ project:

CGMS high level statement on the global hybrid architecture coordination: to meet operational evolving user needs and respond to the WIGOS 2040 Vision

Endorsed by CGMS-52 Plenary on 6 June 2024

1. CGMS HIGH-LEVEL STATEMENT

The value of satellite observations for monitoring the weather, the climate, and the Earth system in general, and the impact on societies and economies have never been so high. Adapting and optimising global observation architectures in view of responding to operational requirements and dealing with evolving environment is therefore a must for space agencies. We are entering an era where hybrid satellite architectures[1] can become increasingly important for providing such fundamental observations.

Key examples are atmospheric variables such as temperature, moisture, wind, greenhouse gases, aerosols, etc., measured by a combination of radio-occultation, microwave, infrared and lidar measurements.

In the rapidly changing environment, there is a need to find the right balance between the different components of a hybrid satellite observing architecture, which should continue to deliver cost-effective and high-quality data to operational meteorological users and respond to their evolving operational and possible demand for more R&D-focused observations. The cooperation between satellite operators gathered within the framework of CGMS will be essential to achieve this.

The move towards a hybrid satellite architecture has several drivers:

- Availability of different classes of satellites: large (>1 ton), mini/small (100 kg-1t) and nano/micro (< 100kg), including increased diversity of launch options;
- Miniaturisation of instrumentation technologies, in terms of size, mass and power;
- Demand for higher performance data (accuracy, resolution, temporal refresh, etc.) with its associated socio-economic benefits;
- Demand for more observations to further support Earth system science and modelling;
- Cost-effectiveness and increasing reliability of smallsats and other non-large payloads;
- Rapid development of “New Space” commercial capabilities and the challenges presented for satellite integration and testing; and
- Opportunities to provide additional data from constellations of smaller satellites with less accurate sensors, complementing the large satellite constellations.

[1] We define a hybrid satellite architecture as one that combines reference platforms, small and other non-large satellites with different classes of instruments and procurement of commercial data.

The key elements of the hybrid satellite architecture as envisioned by CGMS in response to WIGOS 2040, are:

- Long-term committed reference operational missions reliably producing high-quality measurements of critical parameters required by major global applications and deployed upon agreed reference orbits;
- Additional capabilities with sufficient reliability and continuity, in supplemental orbits, providing complementary temporal and spatial sampling and potential continuity and/or new capabilities;
- Ground-processing capabilities for the generation of harmonised data, for product validation and for instrument cross-sensor calibration based on reference missions; and
- Provisions for on-ground and in-orbit capabilities to assess instrument performance, to facilitate early critical data assimilation to users.

CGMS will strive to ensure that the contributions of its members are coordinated to form a coherent and complementary hybrid architecture that will serve the needs of the operational weather and climate community, as well as many users and applications as possible. Pathfinder constellations relying on "Newspace" approaches, with a related level of reliability to demonstrate emerging capabilities and/or can provide more cost-effective ways to provide critical data record continuity. CGMS members will work with all relevant public and private partners to achieve this. CGMS will leverage coordination with other initiatives such as the CEOS Virtual Constellations, with the goal of optimising the overall value of the hybrid architecture and minimising gaps.

To demonstrate the practical implementation of the approach for hybrid space architectures, a process has been developed based on passive microwave observations. The activity involved all CGMS Working Groups, and the outcome proved the value of the approach. Initially this can be embedded in the CGMS contingency plan used when an observation gap is identified. The process can be used for other observations in future.

Role of the commercial sector

The contributions of commercial providers might become a vital component of the future hybrid architecture to ensure wide availability for high-impact observations. Coordination between CGMS members will be important to increase the collective value of the hybrid architecture outcome. As part of this coordination, we foresee that CGMS members will aim at continuing enhancing the coordination of the data procurement mechanisms needed to acquire satellite data from the commercial sector, consistent with the CGMS Best Practices for Commercial Data Buys. This includes the provision of non-redundant data, data sharing, harmonisation of data processing and quality control, improved change management, and cross-calibration with reference missions. Further, CGMS members will be encouraged to continue to share best practices for end user license agreements and commercial procurements aimed at balancing the needs of this coordination while complying with national regulations and policies.

2. DATA SHARING AND GLOBAL COORDINATION WITH THE GOAL TO OPTIMIZE THE HYBRID ARCHITECTURE VALUE

In accordance with the policy principles of the WMO Unified Data Policy Resolution (Res. 1), CGMS members will continue to encourage sharing the data obtained from the different components of the hybrid architecture openly and freely, for the benefit of all and to maximise the value of Earth observations to humanity.

To the extent possible, CGMS members will strive to openly share tools, codes, and algorithms as well as harmonise ground processing systems to make the data as consistent as possible, which in turn is expected to reduce costs and barriers to interoperability.

CGMS members will aim at coordinating planning, designing, and procuring the individual components of the hybrid architecture as much as feasible, to achieve synergistic capabilities, save costs, and for the goal of optimising the value of the observations to a maximum number of users, applications and models.

BACKGROUND INFORMATION AND REFERENCE DOCUMENTS

The 51st CGMS plenary endorsed the CGMS future direction 2022+ project in June 2023 (*Status, activities, report on the outcome and proposed way forward of the CGMS future direction 2022+ project* CGMS-51-CGMS-WP-04). CGMS-51 further agreed to create a statement on the optimum composition of hybrid architectures for fulfilling the operational observation requirements of CGMS members in the future.

The 51st plenary agreed on the following actions:

- CGMS principals 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, recognising the rapidly changing environment in small satellites and the commercial sector. 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.

Writing team composition (16 Jan 2024)

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Title
Status, activities, report on the outcome and proposed way forward of the CGMS future direction 2022+ project (CGMS-51-CGMS-WP-04)
CGMS-51 report
CGMS High-Level Priority Plan (HLPP)