CGMS Contingency Plan

Sustained contributions to the Global Observing System

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1. INTRODUCTION

The Coordination Group for Meteorological Satellites (CGMS) provides a forum for the exchange of technical information on meteorological and environmental satellite systems as well as research and development missions in support of the World Meteorological Organization's (WMO) Rolling Review of Requirements (RRR). The primary goal of the coordination activities is to support operational weather monitoring and forecasting as well as climate monitoring. CGMS coordinates satellite systems of its members in an end-to-end perspective including, but not limited to protection of on-orbit assets, support to users, and facilitation of shared access to satellite data and products.

The 11th WMO Congress, in 1995, recognised the need to ensure the continuing operation of the environmental satellite systems. The Congress appealed to satellite operators to ensure continuity, quality and coverage of their satellite programmes in furthering WMO Members operational and research programmes. In its Resolution 5 (CgXI), Congress urged its concerned Members to maintain the polar-orbiting and geostationary satellite systems to ensure the continuity of operation and to "develop contingency plans to ensure the continued use and utility of satellite data and products."

The plan was initially established by CGMS in response to CGMS-31 in 2002 and CGMS-32 in 2003 (actions 31.39 and 32.20 respectively) in order to consolidate the conclusions of numerous contingency related discussions, guidance received from WMO bodies, and the lessons of experience.

The 'Contingency Plan' addresses one of the major objectives of the CGMS as stated in its charter:

"CGMS encourages complementarity, compatibility, and possible mutual backup in the event of a system failure through cooperative mission planning, compatible meteorological data products and services, and the coordination of space and data related activities, thus complementing the work of other international satellite coordinating mechanisms."

1.1 DOCUMENT PURPOSE

The purpose of the Contingency Plan is, to the extent possible, to develop guidance and a process for identifying, mitigating, and coping with risks to the continuity of the CGMS Baseline. The CGMS Baseline documents the commitments and plans of CGMS Members to provide observations and measurements in support of the WMO Global Observing System. This plan aims to serve two purposes. First, serve as a reference for CGMS satellite operators in the planning and implementation of satellite missions. Second, outline a process for risk assessment against the CGMS Baseline, and a process for mitigating risk to and coping capability degradation or loss against the baseline. This plan also serves to inform the user community such as WMO and Intergovernmental Oceanographic Commission (IOC) of these processes.

1.2 REFERENCE DOCUMENTS

Title	Purpose and Revision cycle	Link to current version
CGMS Baseline	Revised every four years	CGMS Baseline

CGMS Contingency Plan	Defines guidance and the process for identifying, mitigating, and coping with risks to the continuity of the CGMS Baseline.	(this document)
CGMS High-Level Priority Plan (HLPP)	4-year rolling plan containing high-level priorities for CGMS activities. Aspirational targets for enhancing the CGMS response to the WIGOS Vision are included in the HLPP. Revised annually.	CGMS HLPP
WMO Gap Analysis	The latest WMO gap analysis of CGMS Baseline against the WIGOS 2040 Vision. Document provided to CGMS on an annual basis.	CGMS-51-WMO-WP-13
WIGOS Vision	Contains the overall vision for the complete observing system, based on WMO requirements. WMO document No. 1243 https://community.wmo.int/vision2040	Vision for the WMO Integrated Global Observing System in 2040

1.3 SCOPE

The scope of this CGMS Contingency Plan includes the observations, measurements, and services included in the CGMS Baseline. All risk assessments as well as capability loss mitigation and coping actions will be in reference to the CGMS Baseline. Further, this document will establish:

1. Guidelines to Members on ensuring continuity;
2. Guidelines for developing inter-member cooperation to ensure continuity;
3. The CGMS risk management process to help ensure continuity; and
4. Possible approaches to responding to capability loss.

1.4 DEFINITIONS

Contingency: Within the context of the CGMS, a contingency arises when a CGMS is no longer in a position to provide satellite-based observations, measurements, and services corresponding to the CGMS Baseline or when the CGMS Member anticipates such a situation in the near future.

Contingency planning: The development of strategy, analysis, planning, development of capabilities, and processes necessary to assure continuity of established baseline observations, measurements, and services in the event of unforeseen circumstances.

Mitigation: Proactive attempt by a Member or CGMS to ensure continuity of observations, measurements, and services in support of the CGMS Baseline; an effort to anticipate and thereby reduce or eliminate the probability of a risk materialising or risk avoidance.

Coping: Steps taken by a Member or CGMS to reduce the impact of a materialised risk or capability loss against the CGMS Baseline. For the remainder of this document, these will generally be referred to as “capability losses” or simply “losses”.

2. GUIDELINES TO CGMS MEMBER ORGANISATIONS

In order to ensure continuity of observations and services in support of the CGMS Baseline, CGMS Members should adopt the following guidelines in the management of their satellite and ground systems.

2.1 RISK ANALYSIS

In order to ensure continuity of observations and services in support of the CGMS Baseline, CGMS Members should adopt the following guidelines in the management of their satellite and ground systems.

2.2 MISSION PLANNING

When planning the development of missions, CGMS Members should take steps to ensure continuity when planning their missions. These steps include:

- Long-term planning of satellite missions allowing on-orbit redundancy and launch schedule flexibility to quickly recover from a launch or on-orbit failure.
- Designing a resilient space segment architecture, including disaggregation as appropriate.
- Securing financial resources to implement these plans.
- Securing the availability of the required expertise for the whole lifecycle.
- Monitoring the implementation of the plans through project management practices.
- Addressing technological risk through adequate feasibility studies, tests, and demonstrations.
- Identifying the risk areas in: the overall system design; the space segment; space ground interfaces and ground systems, including telecommunications, network and computer security; and mitigating these risks through adequate measures such as redundancy or alternative means.
- Monitoring the risk over the whole life cycle, including maintenance aspects and subsystems becoming obsolete.

2.3 OPERATIONAL MANAGEMENT

CGMS members should take steps during operations to ensure continuity of observations, measurements, and services.

For the space segment, this can involve:

- Ensuring the availability of in-orbit backup satellites to assume primary responsibilities as required.
- Considering the relocation of a satellite, which could include the possibility of merging two missions with reduced coverage.
- Splitting a mission over two satellites (e.g., primary and secondary) in case of partial payload failure.

For the ground segment or the space-ground interface this can include:

- Development and use of backup satellite data acquisition, command and control, and processing facilities.
- Development and use of alternative, lower bandwidth telecommunications to broadcast and disseminate data.
- Production of a reduced set of prioritised products.

3. INTER-MEMBER COORDINATION

In the event of an extended satellite outage where the satellite operator has no standby satellite available, cooperative contingency plans jointly developed by the operators are essential. Cooperative contingency strategies may involve satellite as well as ground facilities or alternative derived product processes.

The CGMS joint contingency strategy is primarily based on the possible use, through bilateral arrangements, of any spare capacity available to other CGMS Members. Part of the strategy is to act preventively, e.g. via:

- Agreeing on Member responsibilities in the implementation of the CGMS Baseline, including temporal and geographical (coverage) overlap;
- Regularly reviewing its status of implementation and assess the potential risk;
- Improving commonalities among the systems, facilitating mutual support;
- Considering jointly establishing in orbit capability serving as a backup for another Member.

Members should also consider establishing backup arrangements for the ground system to allow other Members to provide data acquisition and routing capabilities.

4. CGMS COORDINATION IN ENSURING CONTINUITY

4.1 ESTABLISHING THE BASELINE

The CGMS Baseline constitutes the commitments and plans of CGMS Members to provide specific observations, measurements, and services. The CGMS Baseline thus defines the scope of the Contingency Plan.

CGMS members may elect to host their sensors on platforms not owned by the member (hosted payloads). Hosted payloads will be reflected in the CGMS baseline and risk assessment when the CGMS member commits to provide the sensor data consistent with the Baseline principles.

CGMS members may provide commercially sourced data to meet commitments to the CGMS Baseline [under licenses]. The CGMS members commit to the provision of such data consistent with the Baseline principles.

4.2 RISK ASSESSMENT

CGMS will monitor Members' implementation of the CGMS Baseline through an annual risk assessment. CGMS Members will provide the information necessary to compare current capabilities against the CGMS Baseline including CGMS Members providing the output of the risk analyses of their own satellite systems.

Working Group III, with dedicated support from the CGMS Secretariat, will analyse the current and planned missions supporting the Baseline to identify losses and potential losses relative to the baseline. The Observing Systems Capability Analysis and Review (OSCAR)/Space database is the primary source of information for this risk assessment as a reference for CGMS. The process for this risk assessment is outlined in Appendix A.

4.3 MITIGATING RISKS

Working Group III will assess the impact of potential losses, in consultation with the other working groups or CEOS as necessary. Working Group III will recommend mitigation actions to CGMS plenary for endorsement.

4.4 COPING WITH A SUDDEN LOSS IN CONTINUITY OF THE CGMS BASELINE

In the event of a sudden loss of capability, Members should inform Working Group III about any actions they will take to cope with the loss after they complete their internal decision making process. If a Member does not have an internal solution, Members can request assistance from Working Group III to identify methods to cope with the loss. Working Group III, in coordination with the other working groups, will then recommend actions to cope and send this recommendation to the CGMS Plenary for endorsement.

5. POSSIBLE APPROACHES TO RESPOND TO CAPABILITY LOSSES

Each loss is unique, ranging from capability degradation to complete capability loss, and will require unique solutions. Working Group III and Members should consider the following possible alternatives when determining solutions and acknowledge that these solutions will likely only partially mitigate the loss.

For the Geostationary orbit a particular approach has been successfully used by CGMS, based on the possible use of spare capacity available from other CGMS GEO satellite operators through bilateral arrangements, on a "Help your neighbour" principle. A satellite operator having a spare capacity in orbit beyond its priority needs can move a spare satellite east or west to cover at least part of the area of his neighbour facing a contingency situation. The operator providing a satellite should have the capability to control two satellites from its ground station. The baseline is that the provider of the satellite will continue to operate it, to avoid duplication of expensive control facilities, while the host operator will make necessary provision for the regional utilization of the satellite. Where possible, direct control of the satellite will be implemented.

CGMS Member-owned and -operated payloads hosted on commercial platforms are included in the risk assessment. Commercially sourced data may be considered for mitigation of critical capability losses, and CGMS members should commit to the provision of such data consistent with the Baseline principles.

5.1 EXTENDING OPERATIONS OF IN-ORBIT SATELLITES

Heritage satellites can continue to provide user benefits when operated beyond their design lifetime and can play a significant role in mitigation of loss of capabilities. Continued operations of previous generation satellites entail significant technical and financial challenges to operators, but CGMS operators will undertake regular reviews of in-orbit satellite lifetime, assessing the health of the satellite and its payload, the continued user benefits of the data and the technical and financial feasibility of continued operations of the satellite and its ground segment. Such a lifetime review in particular considers the requirement for continued capability for end-of-life operations in compliance with international space debris mitigation standards.

5.2 UTILISING ALTERNATIVE INFRASTRUCTURE TO RESPOND TO CAPABILITY LOSSES

CGMS Members should consider what is causing the loss and work among the members to determine if resources from other organisations can assist in mitigating or coping with the loss. Examples include additional ground station support to meet data latency needs or back-up missions that can be adjusted to fill losses in the observing system.

5.3 GUIDANCE TO SATELLITE OPERATORS ON USING RESEARCH MISSIONS TO RESPOND TO LOSSES

CGMS Members should also coordinate with research agencies to identify missions that, if necessary, can be utilised for operational services. When conducting risk analyses, WMO and CGMS members should consider these missions as loss mitigation. CGMS Members should consider the following factors when leveraging research missions for operational use:

- Partnering with research agencies early in the development life-cycle to: allow users to access data for operational use, lower latency to meet operational needs, and encourage use of common data formats to ease ingest into operational data processing centres
- Investing in ground infrastructure to acquire, relay and process data from research missions
- Partnering with research agencies to calibrate and validate research data products to accelerate their use in operational data processing centres.

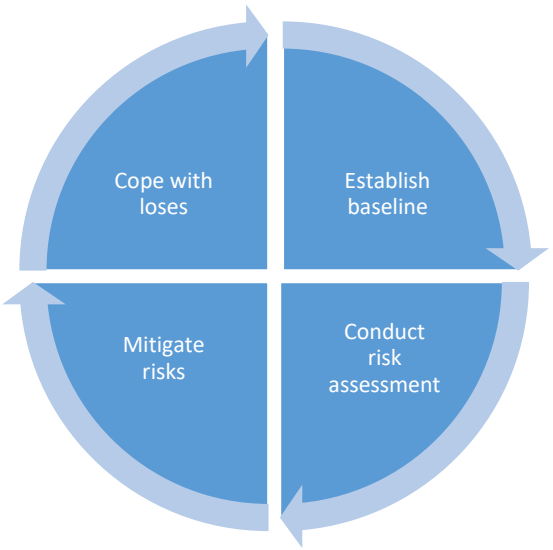
5.4 IDENTIFY SCIENTIFIC SOLUTIONS TO RESPOND TO CAPABILITY LOSS

Within CGMS, Working Group III will engage with Working Group II in order to identify approaches to mitigating or coping with the loss of observations and measurements. For example, radio occultation measurements can help to mitigate or cope with the loss of microwave or infrared sounders and infrared sounders can help mitigate the loss of long-wave infrared measurements necessary for climate monitoring and prediction.

6. CGMS RISK ASSESSMENT

The CGMS level contingency planning follows a traditional risk management framework in order to avoid degradation or loss of service, and to minimise the impacts of any potential losses.

The risk assessment process is visualised in the figure below:



The CGMS risk assessment is conducted annually against the CGMS Baseline to track how well CGMS is meeting its observational commitments and to ensure action is taken to mitigate risks if possible.

The process to develop the risk assessment begins by soliciting member updates to the data used for the prior year's assessment, which ensures the latest information is obtained directly from CGMS members and is reconciled with the OSCAR/Space database. Satellite flyout charts are produced for each sensor/observation to show coverage of baseline requirements for the next ten years by CGMS member missions, and may also include member owned and operated payloads hosted on commercial platforms if certain criteria is met. The detailed charts are reviewed by CGMS agency representatives at the risk assessment workshop and a qualitative assessment is performed to determine whether CGMS has met its baseline observational commitments and highlight areas of risk. For those areas at risk, actions may be identified to support mitigation efforts.

In the context of the risk assessment meetings, the CGMS Baseline and the CGMS High-Level Priority Plan (HLPP) are also reviewed against the WMO Gap Analysis to identify areas where CGMS should strive to expand its response to the user needs expressed in the WIGOS vision.

Revised versions of the risk assessment, CGMS baseline and HLPP documents are then finalized at the Operational Continuity and Contingency Planning Working Group (WGIII) meeting for recommendation to the CGMS plenary. After plenary endorsement, the Baseline and HLPP are published by CGMS.