CGMS-50 Joint WGI-WGIV-SWCG

SCIR International Cooperation

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Co-chairs: Tsutomu Nagatsuma, NICT / Vanessa Griffin, NOAA
Rapporteurs: Karolina Nikolova, Andrew Monham, EUMETSAT

# Notes from meeting:

## 1. Objectives

## 2. Review of interactions and activities between WGI, WGIV and the SWCG (incl. any action review)

Action review made at end of meeting, based on proposals in the WPs

## 3. Benefits of space weather data usage for satellite operators and role of anomaly report database

### Report on progress of the Space Weather Spacecraft Anomaly Database Task Group (A. Monham)

The Space Weather Spacecraft Anomaly Database objective is to be the data source for space weather actors to analyse the impact of space weather on satellite systems, in order to improve tools modelling space weather effects, spacecraft design robustness and support the spacecraft operations community with space weather warnings and improved post‐event anomaly analysis.

The blocking issue concerning the lack of input data highlighted at CGMS‐49 has continued to be problematic and it has been discussed whether or not it makes sense to continue with this effort at CGMS level. As a result, some potential courses of action relating to confidentiality concerns and workload have been identified which may help improve the situation, overcoming the perceived issues which are preventing the supply of data.

Further engagement with the spacecraft operations community is also proposed through an updated survey (following the last one performed in 2018) and consideration of whether Best Practices in usage of space weather data for post‐event anomaly analysis and risk mitigation based on forecasts can be formulated.
It is therefore recommended to continue with the TG effort with these actions and decide prior to CGMS‐51 whether sufficient progress has been made to justify the continuation of this TG effort.

It was agreed encouraging further CGMS members involvement - in particular more spacecraft operations representatives. The possibility to propose another paper to the SpaceOps23 conference will be looked at following the paper already presented to the virtual 2021 conference.

SWCG/A48.13 to be closed based on NOAA input to lead DB prototyping (once requirements defined)

SWCG/A49.05 to be kept open until CGMS-50 Plenary to see if any feedback can be made to the poll issued.

SWCG/A49.06 proposed to withdraw the action to poll commercial suppliers, due to lack of responses on internal poll (SWCG/A49.06). However, it was noted this action should be considered for reopening in the future, once internal CGMS efforts mature further.

Edmund Henley raised a question regarding ingest methods of anomaly information from different providers and recommended a phone survey.

Tsutomu Nagatsuma enquired about the consideration of historical best practices and information from periods in the past with higher amount of solar activity.

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| **CGMS-50 ACTIONS** |
| **Actionee** | **AGN item** | **Action****#** | **Description** | **Deadline** | **Status** |
| SWCG |  |  | TG to Review Terms of Reference to:Agree additional activities related to Best Practices on spacecraft operators usage of space weather data Agree on updates to required anomaly input data content and formats Recommend to CGMS-51 whether to continue TG activities based on progress made. | CGMS-51 | **OPEN** |

### CGMS agency spacecraft space weather anomaly reports compilation (A. Monham)

This Paper contains a compilation of all suspected Space Weather related anomalies on all operational missions operated by CGMS Agencies reported to CGMS-50.

The content includes reported space weather events on:
- GEO satellites
- LEO satellites
- Satellites in other Earth orbiting domains

CGMS members are invited to provide their input in the table in the CGMS spacecraft space weather anomaly report template (in the CGMS Guides & Templates document). there are certain details that are essential and others that are nice-to-haves.

Note that to maintain anonymity, vehicle identities and reporting Agency information are not provided.

Elsayed Talaat noted that using magnetic local time may help in achieving further anonymity of data sources.

Tom Renkevens noted that operators may not be reporting because there is either no anomaly or not considered significant by the operator.

Tsutomu Nagatsuma noted that there is a need to define a common threshold for reporting a spacecraft anomaly.

Andrew Monham considered that any anomaly that may have been caused by a radiation event should be reported and it is less important as to what impact it had on the mission availability (sometimes mission software is updated to mitigate the effect of radiation events, but the event itself is still recorded and its significance to the Database statistics does not change).

Juha-Pekka Luntama noted that it should be made clear that this is an effort in progress

### Analysis of Spacecraft Anomalies Reported in Logs of Service Outages (T. Nagatsuma)

Space-based meteorological observations are an indispensable part of our social infrastructure, but they are always face the risk of malfunction due to space radiation enhancement. To assess the impacts of space radiation on meteorological imagery observation services, an investigation was carried out on energetic particle variation during meteorological imagery service alerts, particularly on Himawari-8, MET-7, and MET-8 between 2015 and 2017.

It was found that about forty percent of the geostationary meteorological satellite anomalies occurred when 24-hr fluence of energetic electrons increased. The occurrence probability of spacecraft anomaly markedly increases when the energetic electron fluence exceeds a threshold value. About half of the geostationary meteorological satellite anomalies occurred during energetic electron fluence or proton flux enhancements. The occurrence probability of spacecraft anomaly markedly increases when the energetic electron fluence exceeds a threshold value (10^4  [/cm2 sr eV]). However, this analysis is limited because there is no detailed information about “spacecraft anomaly”. The results are important for planning safety operation of and developing robust next-generation spacecraft. The results also suggest that recording spacecraft anomaly report as database is very important.

It is recommended that the meteorological satellite operating organizations keep recording and publishing the event log (including service outages) for comparison and calibration of the data between the satellites. On the basis of logs of service outages recorded by individual organization, “spacecraft anomaly” should be reported.

Andrew Monham commented that the Meteosat anomalies should be analysed to see which ones were possibly radiation related, to remove "bad data" from the analysis.

Edmund Healy suggested that the analysis of local time dependence could be made to effects of shadow / background plasma

## 4. Requirements and feasibility of low latency RO data dissemination for space weather data users through direct broadcast

### Update on efforts to define requirements and feasibility of low latency RO Data Dissemination (A. Monham)

Following recommendation of CGMS-49 for a task group on the provision of low latency ionospheric radio occultation data to users, progress has been made with an exploratory meeting of SWCG, IROWG and ROM SAF participants. It has been agreed to expand the remit of the Task Group to cover the full scope of HLPP (6.4) “In coordination with IROWG establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring.”

This would address the aspects of Data Latency, Number of ionospheric measurement counts for the whole system, Observational Simulation Experiments to address sensitivity of operational applications to changes in latency / counts for establishment of requirements, Potential improvements in CGMS Member RO measurement capabilities and / or data access in support of such requirements.

The participants of the exploratory meeting to be included as regular TG representatives. Nominations are welcome for additional TG members.

It is proposed to rename the Task Group to “Ionospheric Radio Occultation System Optimisation Task Group”

It is recommended to absorb (i.e. close) the current actions SWCG/A48.15, 16, 17,18 into the TG Terms of Reference.

Terms of Reference draft to be refined / endorsed.

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| **CGMS-50 ACTIONS** |
| **Actionee** | **AGN item** | **Action****#** | **Description** | **Deadline** | **Status** |
| Ionospheric Radio Occultation System Optimisation Task Group |  |  | Establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring | CGMS-51 | **OPEN** |

Melanie Heil from ESA Space Weather office is looking into the use of nanosatellites for this purpose and should be added.

Vanessa noted that NOAA is looking at purchasing commercial Ionospheric Radio Occultation data and will suggest an additional member from NOAA. NOAA would need the help of other agencies to assess the impact of the data and see how much data it enough.

### COSMIC-2 RO latency (E. Talaat)

COSMIC-2 is delivering all products with latency well below requirements to the benefit of operational users. Future improvements to latency may be possible in near-term.

## 5. Space Weather Data Access (outcome of User Survey)

### Status of Space Weather Data Access including data formats – formation of Task Group (A. Monham)

The SWCG has undertaken a number of outreach activities with the operational space weather user community since 2018 in order to identify potential improvements which could be implemented by CGMS members to better service the user needs. This has included a number of surveys and dedicated discussion forums held in the context of annual space weather workshop events in Europe and the US.

In order to help glue this feedback together and focus on the priorities, a Task Group is now proposed with the objective of identifying and acting on the needs of the operational Space Weather Service community (referred to here as “Users”) including consideration of both in-orbit needs as well as improvements to data formats and ground segment dataflow. Due to the wide scope of aspects under consideration, the TG will firstly prioritise the main areas to address until CGMS-51 with the aim of providing some short-term returns as well as ensuring the basis for improvements in the longer-term.

Proposed TG members are drawn from CGMS members as well as representatives of the user community in order to improve the level of interactions and mutual understanding.

CGMS is invited to consider TG Draft Terms of Reference on Improving User Data Access to Space Weather Data from Orbital Sensors and plan for its refinement in June/July, timeframe is presented for approval.

Existing related actions A47.07 / A48.07 and A48.08 are proposed to be closed.

Andrew Monham proposed that in support of ISES inputs, Mamoru Ishii should also be invited.

Juha-Pekka Luntama noted that we should ensure existing research heliophysics community and experience and knowledge is taken into account. E.g. NASA, inclusing the use of the SPASE format.

It was noted that the overall scope of the TG is very large and that the first meeting is set to define priorities.

It was also noted that data "assimilation" is not performed in the same sense as for meteorological data and there is a strong human-in-the-loop component which should be considered.

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| **CGMS-50 ACTIONS** |
| **Actionee** | **AGN item** | **Action****#** | **Description** | **Deadline** | **Status** |
| Task Group on Improving User Data Access to Space Weather Data from Orbital Sensors |  |  | Task Group on Improving User Data Access to Space Weather Data from Orbital Sensors to identify work priorities and report on achievements | CGMS-51 | **OPEN** |

## 6. Frequency-related topics in support to space weather

### SFGC Frequency-related topics in support to space weather (M. Dreis)

## 7. AOB

## 8. Next steps, conclusions and reporting to plenary