

Review of the status of actions and recommendations from ITSC-23

Evolution of the global observing system

Milestone launches in 2021:

- **FY-4B, FY-3E** by CMA
 - See update by Peng Zhang during this meeting
- **Arktika-M N1** by Roshydromet (highly elliptic orbit with IR/VIS imager):
 - A list of products is being defined by Roshydromet during the commissioning phase, and this will be of high interest to relevant users.
 - **Recommendation IIFS23-R1 to Roshydromet: To share information on products from Arktika-M N1 with ITWG when available.**
 - Sample data of imagery has been shared with EUMETSAT with a view towards establishing a data service.
 - There are plans from Roshydromet to derive AMVs.

CGMS baseline and risk assessment:

- See update by Peng Zhang during this meeting.

Evolution of the global observing system:

Evolution of the CGMS baseline

The WG considered the current CGMS baseline in the context of potential future moves towards disaggregated systems and the use of smaller satellites. For the back-bone 3-orbit constellation, high-end, high quality observations tend to be assumed by users (“reference” system), though this is not explicit in the CGMS baseline.

Recommendation IIFS23-R2 to CGMS: To explicitly consider instrument capabilities and data quality as well as data provision in future updates of the CGMS baseline, particularly for the 3-orbit backbone system of LEO passive sounders which plays an important role as a reference-style system.

Supported by WG-III (Operational Continuity and Contingency Planning) of CGMS; they would like to factor-in instrument capabilities and product quality in risk assessments in the future.

The WG noted that benefit has been demonstrated in NWP from passive sounding data beyond the 3-orbit CGMS baseline system.

Recommendation IIFS23-R3 to CGMS and the NWP community: To advance the implementation of the WIGOS Vision 2040 for passive sounding with agency commitments beyond the established 3-orbit baseline in future updates of the CGMS baseline, and to gather requirements and perform trade-offs for such additional systems.

- Feedback from WG3: only agency commitments are considered in the baseline so far, but members are encouraged to work towards WIGOS Vision 2040 in general
- OSSE/information content-type studies under way in the US and Europe

Evolution of the global observing system: Small satellites/cubesats (I)

Recommendation IIFS23-R4 to NWP centres and other organisations involved in the evaluation of existing data from smaller satellites: To report on experiences with passive sounding instruments from smaller satellites at future ITSCs, including evaluations of data quality and stability, with a view towards potential future operationalization of such systems.

- Several ITWG members involved in evaluation of TROPICS data – looking forward to reports at ITSC-24.
- Evaluations have been done with TEMPEST-D data – reports at ITSC-24 encouraged.

Action IIFS23-A1 on Niels Bormann: To compile a list of existing and planned small-satellite/cubesat initiatives with passive sounding instruments and circulate among IIFS members.

- See next slide

Small satellites/cubesats with passive IR or MW sounders

Launched or confirmed non-commercial missions, excluding very short-duration missions:

- TEMPEST-D: Reising et al (2020), <https://doi.org/10.1117/12.2570371>
 - MW humidity-sounder, compatible with 6U CubeSat
 - Launched 21 May 2018 to ISS
- COWVR/TEMPEST: Brown et al (2017), <https://doi.org/10.1109/AERO.2017.7943884>
 - Full polarimetric MW radiometer, conically scanning + MW humidity sounder
 - Launched 21 Dec 2021 to ISS
- TROPICS: Blackwell et al (2018), <https://doi.org/10.1002/qj.3290>
 - MW humidity-sounder + 118 & 204 GHz for 3U Cubesat
 - Pathfinder launched 30 June 2021; 6-sat constellation to follow this year
 - Predecessors: MicroMAS-2, MiRaTA
- Arctic Weather Satellite: <https://www.esa.int/aws>
 - MW temperature & humidity sounder for a small satellite
 - Launch \geq 2024

Concepts are also being worked on for IR, though not yet confirmed:

- E.g., MISTIC Winds: Maschhoff et al (2016), <https://doi.org/10.1117/12.2239272>
 - Midwave Infrared Sounder for 27U CubeSat
- Presentation by Hank Revercomb at the Advanced Sounders WG Interim-meeting.

If anyone is aware of other missions not listed here, please let N.Bormann@ecmwf.int know.

Evolution of the global observing system: Small satellites/cubesats (II)

Recommendation IIFS23-R5 to providers of data from constellations of smaller satellites: To work towards a standardisation of downlink equipment and data protocols to ease provision of NRT capabilities.

Recommendation IIFS23-R6 to providers of data from constellations of smaller satellites: To work towards a common data outlay in a WMO-recognised data format to ease swift ingestion into NWP systems.

- **Definition of BUFR format for TROPICS data on-going.**

Timeliness aspects

To support timeliness activities, dedicated impact studies are very useful. Such studies have been conducted in the past by JMA (reported at ITSC-23), but it was felt more would be useful.

Recommendation IIFS23-R7 to NWP centres: To conduct impact studies highlighting the benefit of good timeliness of observations, and to report on these at future meetings.

HLPP – items assigned to ITWG

Item 4.4.2 (on NEdT estimates for MW sounders):

Tiger Yang: A TGRS paper that compares different NEdT algorithms is available (“A New Algorithm for Determining the Noise Equivalent Delta Temperature of In-orbit Microwave Radiometers”;
<https://ieeexplore.ieee.org/document/9494725>).

Further clarification/discussion on this item in last meeting of the NWP WG.

Recommendation IIFS23-R8 to CGMS members: To provide ICVS-style instrument performance monitoring for operational instruments.

The latest version of the CGMS HLPP is available here:

https://www.cgms-info.org/documents/CGMS_HIGH_LEVEL_PRIORITY_PLAN.pdf

Action IIFS23-A2 on IIFS members: To provide further feedback on the latest version of the HLPP to IIFS co-chairs.

- No further comments were received.

HLPP – other selected aspects

Regarding the section “Advance the response to the Vision for WIGOS in 2040, by the implementation of new capabilities beyond the CGMS baseline”, the absence of advancing MW sounding capabilities for NWP beyond the CGMS baseline was noted (see also link to recommendation IIFS23-R3).

Recommendation IIFS23-R9 to CGMS: To include an item on establishing requirements for MW sounding capabilities beyond the CGMS baseline for NWP in the relevant section of the HLPP.

Similar recommendation made following the WMO Gap Analysis; to be discussed at CGMS Risk Assessment workshop and CGMS WG-III.

Regarding the section “Stimulate trade-off analyses for the development of future passive sounding instruments”: A previous item on trade-off studies that includes FOV-sizes for IR sounders has been closed. The group noted that such trade-off activities are still important.

Recommendation IIFS23-R10 to CGMS: To reinstate an item in the HLPP on conducting trade-off studies regarding the benefits of spectral, radiometric, and spatial resolution of infrared sounders, taking into account aspects such as scene inhomogeneity and uncertainties in spectroscopy.

Should be brought to the attention of CGMS-50 for further discussion in WG-II (Satellite Data and Products).

Calibration

A workshop 'An SI-Traceable Space-based Climate Observing System' was held by CEOS WGCV and WMO-CGMS GSICS at NPL, UK on Sept, 2019. As a consequence, a special issue in Remote Sensing "The Needs and Path Toward an SI-Traceable Space-based Climate Observing System" has been published:

https://www.mdpi.com/journal/remotesensing/special_issues/Space-based_COS

The whitepaper 'SI-Traceable Space-based Climate Observing System' is being drafted, led by Hewison, Fox, Wielicki and Kopp.

Action IIFS23-A3 on Peng Zhang: To circulate the workshop report to IIFS members once available.

- Workshop report is now available under: <http://calvalportal.ceos.org/report-and-actions> (action closed)
 - Underlines again the importance of a space-based reference system.