



# Report for the Climate Working Group Meeting at ITSC-23, 8 June 2021

*Co-chairs: Nathalie Selbach (DWD), Cheng-Zhi Zou (NOAA)*

## Climate WG meeting at ITSC-23

- *Meeting on 8 June 2021, 12 – 15:30 UTC with 36 Participants:*

*Nathalie Selbach (DWD, Co-chair), Cheng-Zhi Zou (NOAA, Co-chair), Awdhesh Sharma (NOAA), Younousse Biaye (Université Gaston Berger, UFR SAT), Bill Bell (ECMWF), Chun-Hsu Su (BOM), Domenico Cimini (CNR-IMAA), Erica Lynn McGrath-Spangler (NASA), Evan Fishbein (NASA), Graeme Martin (UW-Madison SSEC), Hank Revercomb (UW-Madison SSEC), Hu (Tiger) Yang (Univ. of Maryland), Indira Rani S (NCMRWF, MoES), James Jung (NOAA), Joe Predina (Logistikos Engineering), Jeon-Ho Kang (KIAPS), Masahiro Kazumori (JMA/), Kozo Okamoto (JMA/MRI), Laura Le Barbier (CNES), Larry Flynn (NOAA), Leanne Avila (UW-Madison SSEC), Liam Gumley (UW-Madison CIMSS), Lihang Zhou (NOAA), Rohit Mangla (Meteo-France), Peter Steinle (BOM), Robert Knuteson (UW-Madison SSEC), Salvatore Larosa (CNR-IMAA), Silke May (DWD), Scott Mindock (UW-Madison SSEC), Sylvain Heilliette (ECCC), Timo Hanschmann (EUMETSAT), Yong Chen (NOAA), Viju John (EUMETSAT), Vincent Guidard (CNRM/MeteoFrance), Wei Han (UW-Madison SSEC), Zhiyu Yang (SITP/CAS)*

## Status of actions since last meeting (ITSC-21)

### Action Climate 1 from ITSC-21 on WG co-chairs:

Establish how requirements from climate community are collected as input for development of new satellite sensors and provide the information to the group. Establish whether there is a clear role for ITWG-Climate group on definition of climate requirements for new satellite sounding sensors

### Status: **closed**

Input received from Jörg Schulz (EUMETSAT) for ITSC-22: *“Requirements are usually collected for ECVs or Level-2/3/4. The responsibility for this process lies with GCOS. For sensor data at Level-1 this is normally done at each individual agency during its mission planning”*

This topic was discussed at ITSC-22 and a recommendation (Climate-4) to satellite agencies has been formulated and was included in the report to CGMS.

# Status of actions since last meeting (ITSC-22)

## Global Observing System design

**Action Climate-1 on Heikki Pohjola:** Provide information on the status of information about FCDRs in OSCAR to the Climate WG. This information will also be added to the Climate WG webpage.

**Status: ongoing**

Development work related to OSCAR/Space is ongoing: WMO is currently implementing a restful API to deliver WIGOS and JSON OSCAR/Space records; idea is to make OSCAR/Space WIGOS metadata record compatible allowing users to export information from the OSCAR/Space database based on the XML template, for example regarding the relationship between instruments and variables. The Joint Working Group Climate has been involved.

A first version of OSCAR/Space with this functionality will be released in August/September 2021. Once the new functionality is available, the respective information will be added to the Climate WG webpage.

## Status of actions since last meeting (ITSC-22)

### Global Observing System design

**Action Climate-2 on Co-Chairs:** Provide information on the CEOS/CGMS Joint Working Group on Climate on the Climate WG webpage (e.g. link to report, etc.)

**Status: closed**

Information has been added to Climate WG webpage  
(<http://cimss.ssec.wisc.edu/itwg/cwsg/>)

**Action Climate-3 on Co-Chairs:** Provide information on the GCOS and AOPC gap analysis report to the Climate WG webpage (e.g. link to report, etc.)

**Status: closed**

*Information has been added to WG webpage*

## Status of actions since last meeting (ITSC-22)

### Reanalysis, Data Rescue and Data Quality Assessment

**Action Climate-4 on WG Co-chairs:** Co-chairs to ask GSICS for guidance on stewardship of data, documentation and metadata related to the recovery and assessment of early satellite data sets

**Status:** **closed**

Since **GSICS** is primarily a ***forward looking organization***, it would be difficult to provide guidance on data stewardship of early satellite datasets. The GSICS Research Working Group progress is mainly attained by the activities of the subgroup members. If the Climate WG could ***focus on specific instruments, the request may be taken to the GSICS subgroups or satellite climate data record programs*** (e.g. NOAA/NCEI maintains a set of temperature profile observations from the Vertical Temperature Profile Radiometer (VTPR) during 1972-1979 and MSU and SSU observations during 1978 to 2006).

## Status of actions since last meeting (ITSC-22)

### Hyperspectral IR sounder uncertainties

**Action Climate-5 on Climate WG members:** To determine the requirements for uncertainty information from all operational hyperspectral IR instruments and document.

**Status: ongoing** – has been further discussed at ITSC-23 meeting

**Action Climate-6 on Climate WG co-chairs:** To ask GSICS to forward the request to the instrument teams at agencies to provide the uncertainty information from all operational hyperspectral IR instruments.

**Status: closed**

Discussions with the GSICS group suggested that this request could be reviewed and discussed at the next GSICS Panel Meeting. In addition, Manik Bali (NOAA, GSICS Coordination Centre) provided lots of inputs that have been added to the Climate WG webpage

## *Mitigation of the impact of identified degradation or loss of capabilities*

### **End of life of sensors and impact in climate time series:**

- EUMETSAT Metop-A will be de-orbited in November 2021
- NOAA legacy satellites in orbit for long time (N15 > 20yrs, N18>15yrs), N16 and N17 decommissioned on 6/2014 and 4/2013, respectively
- potential impact of the loss of capabilities on climate applications is the termination of CDRs developed from these satellites

**Recommendation Climate-1 to satellite agencies:** The separation of instrument variability from the often subtle, long-term variations in climate related processes requires careful calibration and validation of the sensor and its derived data products. The Climate WG encourages satellite agencies to intercalibrate time series from overlapping satellites in order to allow a continuation of climate time series (including trend analysis) when transitioning from older to newer satellites.

**Recommendation Climate-2 to satellite agencies:** Satellite agencies should ensure a frequency continuity for all instruments in future sensor designs for developing credible climate data records.



## **Small satellites:**

- Small satellites are becoming more important in the context of Earth observation and have potential for climate applications
- allow for an affordable future constellation that can offer measurements with a temporal-spatial resolution that is not accessible to traditional remote-sensing satellites, helping to fill the gaps in climate monitoring
- typically have a shorter lifetime than the traditional larger satellites -> complement to the larger satellites, but not as a replacement for them

**Recommendation Climate-3 to space agencies:** Consider climate requirements in terms of stability and length of life cycle when designing small satellite sensors

## **Impact on reanalysis**

- Observations from many different satellites are assimilated in reanalysis
- Observation system changes over period of reanalysis
- Studies needed to understand the impact of losing different sensors and assess on the possible loss of performance
- ECMWF is currently planning to perform such studies in preparation of the next generation of their reanalysis (ERA-6)

**Action Climate-1 on Bill Bell:** Bill Bell to report at the next meeting (Climate WG meeting at ITSC-24) about the plans at ECMWF and progress to-date concerning impact studies on losing different satellite sensors for assimilation in a reanalysis

## ***Long-term continuity of OSCAR/Space***

- long-term continuity of OSCAR/Space as a primary tool to support the CGMS Risk assessment and the WMO Rolling Review of Requirements including gap analysis against observing system requirements for satellite data
- making OSCAR/Space the primary repository for WIGOS satellite metadata records generated by CGMS operators
- Updated OSCAR/Space planned to be released in Aug/Sep 2021 (making OSCAR/Space and WIGOS metadata compatible)

**Recommendation Climate-4 to WMO:** WMO to collect information on available FCDRs from data providers and include it in OSCAR.

## ***Coordination of data access and end-user support***

- Clear references to data records are important for transparency and citation
- Adequate metadata are important to allow using full potential of data; internationally accepted standards and best practices should be applied to improve interoperability and compatibility

**Recommendation Climate-5 to data record providers:** CDRs should be citable by e.g. having Digital Object Identifier (DOI) reference and being accessible to users. All data records should be accompanied by metadata that follows WIGOS standards

**Recommendation Climate-6 to data developers:** CDR development and stewardship shall follow guidance similar to [NCEI Data stewardship maturity matrix](#) or the [Copernicus Climate Change \(C3S\) convention](#) (including recommendations for metadata)

**Action Climate-2 to Climate WG co-chairs:** Add information on NCEI Data stewardship maturity matrix and C3S convention to Climate WG webpage

## *Calibration*

### **Bias Monitoring**

The NOAA Product Validation System (NPROVS) currently store collocated radiosonde (high-density) and hyper-infrared/advanced microwave instrument measurements for every GRUAN radiosonde that falls within 2 hrs of a MetOp or NOAA (SNPP, N20) overpass. These include radiosondes from the JPSS dedicated radiosonde program targeting NOAA satellites. The Climate WG supports these activities

**Recommendation Climate-7 to EUMETSAT:** The Climate WG recommends that EUMETSAT consider funding its own dedicated radiosonde program targeting MetOp satellites

# Calibration

## Hyperspectral instruments

- extensive calibration and validation programs before and after satellite launches to determine uncertainty information of operational hyperspectral IR instruments (AIRS, IASI, CrIS, etc.): information available via satellite agencies and [GSICS](#)
- WG emphasized importance of improving the accuracy and information content of spaceborne observations for detecting climate trends and quantifying feedback mechanisms using on-orbit SI standards for the absolute calibration of spectrally resolved radiances and adequate global sampling
- Significant progress is expected for the solar part of the spectrum via the US CLARREO Reflected Solar Pathfinder (2023), ESA TRUTHS mission (2026-28), and Chinese LIBRA mission (2025-2032); and future plans for new Earth emission observations by the ESA FORUM mission (2026) and the Chinese LIBRA mission

**Recommendation Climate-8 to satellite agencies:** Satellite agencies shall establish programs to conduct absolute calibration or inter-calibration for hyperspectral IR sounders during their life cycles and document and publish the results.

**Recommendation Climate-9 to CGMS:** WG recommends that CGMS emphasize the need to establish an improved global climate benchmark with multiple standards as soon as possible for verifying international progress toward dealing with the threat of climate change.

**Recommendation Climate-10 to US satellite agencies:** WG recommends that the US satellite agencies proceed with the Infrared Pathfinder defined by the CLARREO program

## ***Error characteristics of satellite data and products***

- Common vocabulary and methodology with appropriate error propagation to include the errors associated with validation data is important in order to better understand and trace uncertainties when interpreting long time series of e.g. ECVs.

**Recommendation Climate-11 to satellite data product developers:** Report statistical uncertainties of the CDR trends together with the calibration uncertainties.

## ***Advancing architecture for space-based monitoring of climate***

- CEOS/CGMS [ECV Inventory Questionnaire Guide](#) identified about 30 ECVs, consisting of nearly 100 individual physical variables
- Current CEOS/CGMS [ECV inventory](#) includes nearly 800 CDRs
- [Gap analysis](#) of the existing ECV Inventory: some key ECVs, particularly GHG, are still under-represented in the current ECV inventory

**Recommendation Climate-12 to space agencies:** Support the further development of ECVs and GHG CDRs to enrich the ECV inventory for climate change monitoring.