

# WGClimate Coordinated Action Plan



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# 1 Introduction

## 1.1 Context

The space-based architecture for climate monitoring [RD-1] forms the major international reference for the contribution of space agencies to meeting the requirements of the Global Climate Observing System (GCOS). The implementation of the architecture is coordinated by the joint CEOS/CGMS Working Group Climate (WGClimate) that was established in 2013. The objectives of the WGClimate are:

- Provision of a structured, comprehensive and accessible view as to what Climate Data Records are currently available from satellite missions of CEOS and CGMS members or their combination;
- Creation of the conditions for delivering further Climate Data Records, including multi-mission Climate Data Records, through best use of available data to fulfil GCOS requirements (e.g. by identifying and targeting cross-calibration or re-processing gaps/shortfalls);
- Optimisation of the planning of future satellite missions and constellations to expand existing and planned Climate Data Records, both in terms of coverage and record length, and to address possible gaps with respect to GCOS requirements.

The first objective is primarily fulfilled by the creation and maintenance of the ECV Inventory, which is a database holding detailed information about GCOS ECV Climate Data Records (CDRs), together with appropriate viewing and navigation tools.

The second and third objectives require, amongst other things, the application of a gap analysis process to the ECV Inventory to identify gaps, shortfalls and improvement possibilities for both current and future climate data records.

The objectives associated with ECV Inventory development are intrinsic to the fulfilment of the core objectives assigned to WGClimate in its Terms of Reference, and form a pivotal asset in the implementation of the Climate Monitoring Architecture.

The development of the Inventory and the gap analysis also address the GCOS Actions 11 (Review of availability of climate data records) and 12 (Gap-analysis of climate data records) as stated in [RD-2].

The gap analysis, including specific recommendations to CEOS and CGMS, is provided in [RD-3].

## 1.2 Purpose and Scope of this Document

The basis for the actions contained in this document is the Inventory Development Cycle #2, resulting from ECV Inventory Version 2.0 and the associated gap analysis report [RD-3]. To successfully complete an Inventory Development Cycle, it is necessary to:

- Collect updated information from data providers on CDR holdings and planned/committed new CDRs;
- Incorporate updated information in the ECV inventory and perform a quality control to verify as much as possible, the completeness and consistency of the ECV inventory contents, as well as a critical analysis of the relevance of the various CDRs provided;

- Publish the ECV Inventory via the WGClimate web page;
- Perform a gap analysis on the ECV inventory to identify missing or endangered elements in the future;
- Use the results of the gap analysis to generate a coordinated action plan to address such gaps/missed opportunities.

The purpose of this document is to provide the results for the last element in this cycle which is the definition of the coordinated actions for the CEOS and CGMS coordination bodies, as well as associated bodies such as GCOS that need to be performed to implement the recommendations contained in the gap analysis report.

### 1.3 Document Structure

This document comprises the following chapters:

- Chapter 1:** Introduction describes the context of the coordinated action plan, provides document overview and document references;
- Chapter 2:** Describes the implementation, tracking and update of the coordinated actions;
- Chapter 3:** Restates the recommendations from the gap analysis report and provides one or several actions per recommendation;
- Annex A:** Glossary of acronyms.

### 1.4 References

- [RD-1] Dowell, M., P. Lecomte, R. Husband, J. Schulz, T. Mohr, Y. Tahara, R. Eckman, E. Lindstrom, C. Wooldridge, S. Hilding, J. Bates, B. Ryan, J. Lafeuille, and S. Bojinski, 2013: Strategy Towards an Architecture for Climate Monitoring from Space. Pp. 39, available at: [www.ceos.org](http://www.ceos.org); [www.wmo.int/sat](http://www.wmo.int/sat); <http://www.cgms-info.org/> GCOS, 2015: Status of the Global Observing System for Climate, GCOS-195, WMO, Geneva.
- [RD-2] GCOS, 2016: The Global Observing System for Climate: Implementation Needs, GCOS-200 (GOOS-214), WMO, Geneva, 2016.
- [RD-3] WGClimate ECV-Inventory Gap Analysis Report – V1.0 April 2018

### 1.5 Terminology

For the terminology used in this document please consult the Introduction of [RD-3].

## 2 Recommendations and Actions

In the following subsection, the recommendations from the gap analysis report are quoted and specific actions are prescribed.

### 2.1 Actions related to the ECV Inventory

*Recommendation #1: WG Climate to elaborate on the differences between CDR and ICDR considering existing definitions and to estimate impacts of implementation of ICDR as a specific category in the ECV Inventory.*

**Action #1: WGClimate to develop a technical document to characterize the differences between CDR and Interim CDR, and to advice on the necessity and feasibility to separate the ECV inventory into CDR and ICDR.**

*Recommendation #2: WGClimate to include a more relaxed commitment level in the “Future CDRs” component of the ECV Inventory that does not require firm programmatic arrangements at the present time. This new level allows the capture of more contributions from future sensors.*

**Action #2: WGClimate will consider implementation of an update to the ECV Inventory Questionnaire in preparation of the next update of the ECV Inventory. This should allow an easier accommodation of agencies anticipating the generation of CDRs, but where no firm programmatic commitment is currently in place.**

*Recommendation #5: CEOS and WMO to discuss the possibility to better align or facilitate interoperability of the MIM and OSCAR/Space databases to ensure a more accurate, unified view of past, current and planned capabilities.*

**Action #3: WGClimate will forward the issues detected in the MIM and OSCAR databases during ECV Inventory Cycle 2 to CEOS and WMO (e.g. individual instrument lifetimes are largely missing from both databases).**

**Action #4: WGClimate will initiate a discussion with the CEOS MIM and WMO OSCAR representatives to assess options for and impacts of harmonizing these databases. This likely would have distinct advantages on maintenance, consistency and information transfer by agencies.**

*Recommendation #7: WGClimate to establish a specific inventory for FCDRs to signal their importance and to promote their usage for the production of ECV climate data records.*

**Action #5: WGClimate to establish an FCDR Inventory.**

## 2.2 General actions towards improved Climate Data Records

*Recommendation #3: Space agencies should adopt the nomenclature for climate data records as defined in [RD-2] and should encourage their personnel to apply it.*

**Action #6: CEOS and CGMS Agencies with interests in and/or mandates for developing climate data records will distribute the documentation on nomenclature within their agencies and foster usage. If needed WGClimate can assist this action with summarising the nomenclature in one document issued by the WGClimate.**

*Recommendation #4: GCOS to work with the WGClimate towards a clearer linkage between user requirements for the ECV products and climate applications.*

**Action #7: GCOS will in the process of updating its Implementation Plan strive to better link ECV user requirements to climate applications to ensure a more complete understanding of the intended usage, information chain, and potential impacts on decision-making. WGClimate will support GCOS by formulating its needs and participating in related discussions.**

*Recommendation #6: WGClimate to develop a white paper on what is needed for the validation of climate data records including uncertainty information and stability aspects.*

**Action #8: CEOS and CGMS agencies with interest in the development of climate data records will sponsor or co-sponsor one or more workshops (and require a written report) to define the needs for validation of climate data records. This shall include consideration of fiducial reference measurements. The workshops will be conducted in collaboration of CEOS WGClimate with WGCV and relevant CGMS Working Groups.**

*Recommendation #8: CEOS and CGMS agencies to add the delivery of FCDRs for each individual satellite instrument (linked to relevant precursor instrument series) to their agency remit.*

**Action #9: CEOS and CGMS agencies with interest in and/or mandate for the development of climate data records are requested to include FCDR generation into their agency remit to ensure future availability of consistent Level-1 data for climate data records.**

*Recommendation #9: CEOS and CGMS agencies to require the application of metadata standards with the production of climate data records.*

**Action #10: WGClimate will recommend appropriate international metadata standards to CEOS and CGMS agencies for consideration. CEOS and CGMS agencies will distribute this documentation within their agencies and foster usage.**

## 2.3 Actions for specific ECVs

### 2.3.1 CO<sub>2</sub>

*Recommendation #10: To ensure continuity in CO<sub>2</sub> CDRs, agencies or partner entities are requested to commit to the generation of CDRs in all relevant spectral domains including SWIR from existing or approved missions measuring tropospheric and total column CO<sub>2</sub>.*

**Action #11: CEOS and CGMS Agencies with interests in and/or mandates for developing CO<sub>2</sub> climate data records to strive for ensuring consistent, well-calibrated, bias-free time-series that can be continued into the future. They will coordinate their efforts in consultation with the AC-VC, WGClimate and WGCV to ensure appropriate use of data from multiple sensors. Agencies shall register resulting plans for new CO<sub>2</sub> CDRs with the ECV Inventory.**

*Recommendation #11: Agencies or related entities are encouraged to systematically link their satellite-based derivation of CO<sub>2</sub> sources and sinks with data from in-situ/ground-based infrastructure and modelling framework(s) in order to estimate Earth-surface CO<sub>2</sub> fluxes (see GCOS IP 2016 Action T71) and provide feedback on their plans/progress.*

**Action #12: WGClimate and GCOS Secretariat to monitor the status of the GCOS Action T71 and to report back to CEOS and CGMS.**

### 2.3.2 CH<sub>4</sub>

*Recommendation #12: The AC-VC to develop a plan to address the measurement of stratospheric CH<sub>4</sub> profiles in order to fill the gap for the related FCDR/CDRs.*

**Action #13: The AC-VC, in collaboration with WGClimate, to develop a plan to address the measurement gap for stratospheric CH<sub>4</sub> profiles in order to provide FCDR/CDR in the future. This plan shall be subject to endorsement by WGClimate.**

*Recommendation #13: Agencies to plan for the generation of tropospheric column CH<sub>4</sub> ECV data records based on the data collected by instruments on missions such as Sentinel-5P, MERLIN, GeoCarb, Sentinel-5, FY-3D, GOSAT-2.*

**Action #14: CEOS and CGMS Agencies with interests in and/or mandates for developing CH<sub>4</sub> climate data records to strive for ensuring consistent, well-calibrated, bias-free time-series continued into the future. They will coordinate their efforts in consultation with the AC-VC, WGClimate and WGCV to ensure appropriate use of data from multiple sensors. Agencies shall register resulting plans for new CO<sub>2</sub> CDRs with the ECV Inventory.**

### 2.3.3 Precipitation

*Recommendation #14: The CEOS Precipitation Virtual Constellation (P-VC) to further study the situation on precipitation climate data records taking into account the findings of WGClimate gap analysis report and to identify a way forward to stimulate the production of an improved precipitation CDR based upon the experiences gained*

*with existing datasets. The P-VC should also consult with the CGMS-IPWG and WMO SCOPE-CM activity for the establishment of international collaboration for the development and production of such a CDR.*

**Action #15: WGClimate will initiate a joint discussion with CEOS P-VC, CGMS-IPWG and WMO SCOPE-CM to develop a plan for providing an optimal set of precipitation CDRs.**

#### 2.3.4 Sea Surface Temperature

*Recommendation #15: The SST-VC should foster further work on SST ECV products in regards to the improvements that may be possible by better exploiting/integrating geostationary, historic IR sounders and C-band radiometers.*

**Action #16: The CEOS SST-VC to work with GHRSSST on future utilisation of the mentioned data sources and regularly inform WGClimate on the progress which shall become measurable in the ECV Inventory as well.**

*Recommendation #16: C-band microwave radiometer measurements for all-weather SST:*

- *(Short term) All efforts to maximise the life time of AMSR-2 on JAXA's GCOM-W1 should be supported.*
- *(Mid-term) The possibility of an AMRS-2 on GCOM-W2 should be prioritised, full data sharing in regards to MWI instruments of the FY-3 series and HY-2B.*
- *(Longer term) Agencies with operational mandates should develop and fund a sustainable plan, with redundancy, for observations from C-band microwave conical scanning radiometers.*

**Action #17: CEOS and CGMS Agencies with experience in microwave radiometry to help maximise the lifetime of the AMSR-2 instrument on GCOM-W1.**

**Action #18: CEOS and CGMS Agencies to strive to ensure that the needed C-band microwave data are made publicly available and can be used for the generation of climate data records.**

**Action #19: CEOS and CGMS Agencies with interests in and/or mandates for developing C-band microwave radiometers to coordinate their efforts to arrive at an operational capability, and coordinate their efforts with WGClimate and the SST-VC.**

#### 2.3.5 Sea Surface Salinity

*Recommendation #17: CEOS and CGMS Agencies with interests in and/or mandates for Sea Surface Salinity are encouraged to support independent multi-sensor SSS CDR activities from the available L-Band observations.*

**Action # 20: CEOS and CGMS Agencies with interests in and/or mandates for developing Sea Surface Salinity climate data records to strive to ensure consistent, well-calibrated, bias-free time-series from existing measurements and to coordinate their efforts with the WGClimate to ensure appropriate use of data**



**from multiple sensors. The resulting agency plans shall be registered with the ECV Inventory.**

*Recommendation #18: Space agencies should give priority to sea surface salinity measurements in their future missions to ensure continuity of SSS CDRs. Following this recommendation agencies should consider including L-band instrumentation on future passive microwave missions.*

**Action #21: CEOS and CGMS Agencies with interests in and/or mandates for developing L-band microwave radiometers to coordinate their efforts to arrive at an operational capability. Progress on sustaining the SSS CDRs will be reported to the WGClimate through agency representatives.**

### 2.3.6 Land Surface Temperature

*Recommendation #19: The CEOS Land Surface Imaging-Virtual Constellation (LSI-VC) to coordinate on the formulation of future high resolution missions and seamless continuity of sustained Land Surface Temperature CDRs.*

**Action #22: LSI-VC to formulate future high resolution missions for Land Surface Temperature climate data records aiming at seamless continuity of CDRs.**

*Recommendation #20: The CEOS Land Surface Imaging-Virtual Constellation (LSI-VC) together with WGCV and WGClimate to devise a way forward for the combined use of past, current and future instruments to create sustained Land Surface Temperature CDRs.*

**Action #23: The LSI-VC to assess the usefulness of available data from multiple sensors for the generation of climate data records. Resulting plans at Agencies to generate climate data records shall be registered with the ECV Inventory.**

### 2.3.7 Leaf Area Index

*Recommendation #21: LSI-VC should assess the climate user community needs for LAI data records that are not currently being exploited from existing missions (e.g. Sentinel-2, Landsat), and inform WG Climate of their findings to enable further planning for needed LAI data records.*

**Action #24: The LSI-VC and GCOS TOPC to assess the climate user community needs for LAI that are not currently exploited from existing missions to enable planning for further Leaf Area Index data records as appropriate. Resulting plans at Agencies to generate climate data records shall be registered with the ECV Inventory.**

### 2.3.8 Above Ground Biomass

*Recommendation #22: Both the CEOS MIM and WMO OSCAR databases should be updated in a consistent fashion to reflect the Above-ground Biomass ECV and in doing so are co-aligned.*

**Action #25: CEOS and WMO to update the MIM and OSCAR databases with respect to Above-ground Biomass, based on information from the gap analysis report provided by WGClimate. This action shall be performed together with Actions #3 and #4.**

*Recommendation #23: All C-band and L-band SAR measurements of CEOS and CGMS agencies, should be made openly available by space agencies operating the instruments for the construction of CDRs for Above-ground Biomass. The combination of L-band and C-band measurements will help extend the sensitivity of existing estimates.*

**Action #26: CEOS and CGMS Agencies to strive to ensure that the needed C-band and L-band SAR data are publicly available and can be used for the generation of climate data records.**

*Recommendation #24: Space agencies to plan for continuity of measurements, such as to be provided by BIOMASS and GEDI.*

**Action #27: CEOS and CGMS Agencies, with interests in and/or mandates for developing instruments dedicated to the derivation of Above Ground Biomass, to coordinate their efforts to reach continuous measurement availability. They will coordinate their efforts with WGClimate to ensure future provision of adequate CDRs.**

*Recommendation #25: Space Agencies to plan for high-resolution data provision in support of REDD+ type applications leading to the Global Stocktake process.*

**Action #28: CEOS and CGMS Agencies, with interests in and/or mandates for developing instruments dedicated to the derivation of Above Ground Biomass, to coordinate their efforts to develop high resolution SAR/LIDAR measurements. They will coordinate their efforts with WGClimate to ensure future provision of adequate CDRs.**

## 2.4 Implementation, Tracking and Update of Actions

The actions provided in this document will be implemented in a coordinated manner with other CEOS and CGMS bodies.

It is planned that the actions and their status will be available on the CEOS website. Status updates are performed at each meeting of the WGClimate. New recommendations and actions may originate from the analysis of the current and future versions of the ECV Inventory and will be presented for endorsement by CEOS and CGMS.

# Annex A. Acronyms<sup>1</sup>

3D	Three Dimensional
CDR	Climate Data Record
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CH <sub>4</sub>	Methane
CO <sub>2</sub>	Carbon Dioxide
ECV	Essential Climate Variable
FCDR	Fundamental Climate Data Record
GCOS	Global Climate Observing System
GHR SST	Global High Resolution Sea Surface Temperature Project
ICDR	Interim Climate Data Record <sup>2</sup>
IPWG	International Precipitation Working Group
IR	Infrared
JAXA	Japan Aerospace Exploration Agency
LAI	Leaf Area Index
LIDAR	Light Detection and Ranging
MW	Microwave
REDD+	Reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries (UNFCCC)
SCOPE-CM	Sustained and Coordinated Processing of Environmental satellite data for Climate Monitoring
SSS	Sea-surface Salinity
SST	Sea Surface Temperature
SWIR	Short Wave Infrared
TCDR	Thematic Climate Data Record
TIR	Thermal infrared
UNFCCC	United Nations Framework Convention on Climate Change
WGClimate	The Joint CEOS/CGMS Working Group on Climate
WGCV	CEOS Working Group on Calibration & Validation
WMO	World Meteorological Organization

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<sup>1</sup> Specific acronyms of satellite missions and instruments can be found under <https://www.wmo-sat.info/oscar/spacecapabilities> and <http://database.eohandbook.com/> and <http://space.skyrocket.de/>.

<sup>2</sup> An Interim Climate Data Record (ICDR) regularly extends in time a Fundamental or Thematic Climate Data Record using a system having optimum consistency with and lower latency than the system used to generate the FCDR or TCDR.

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