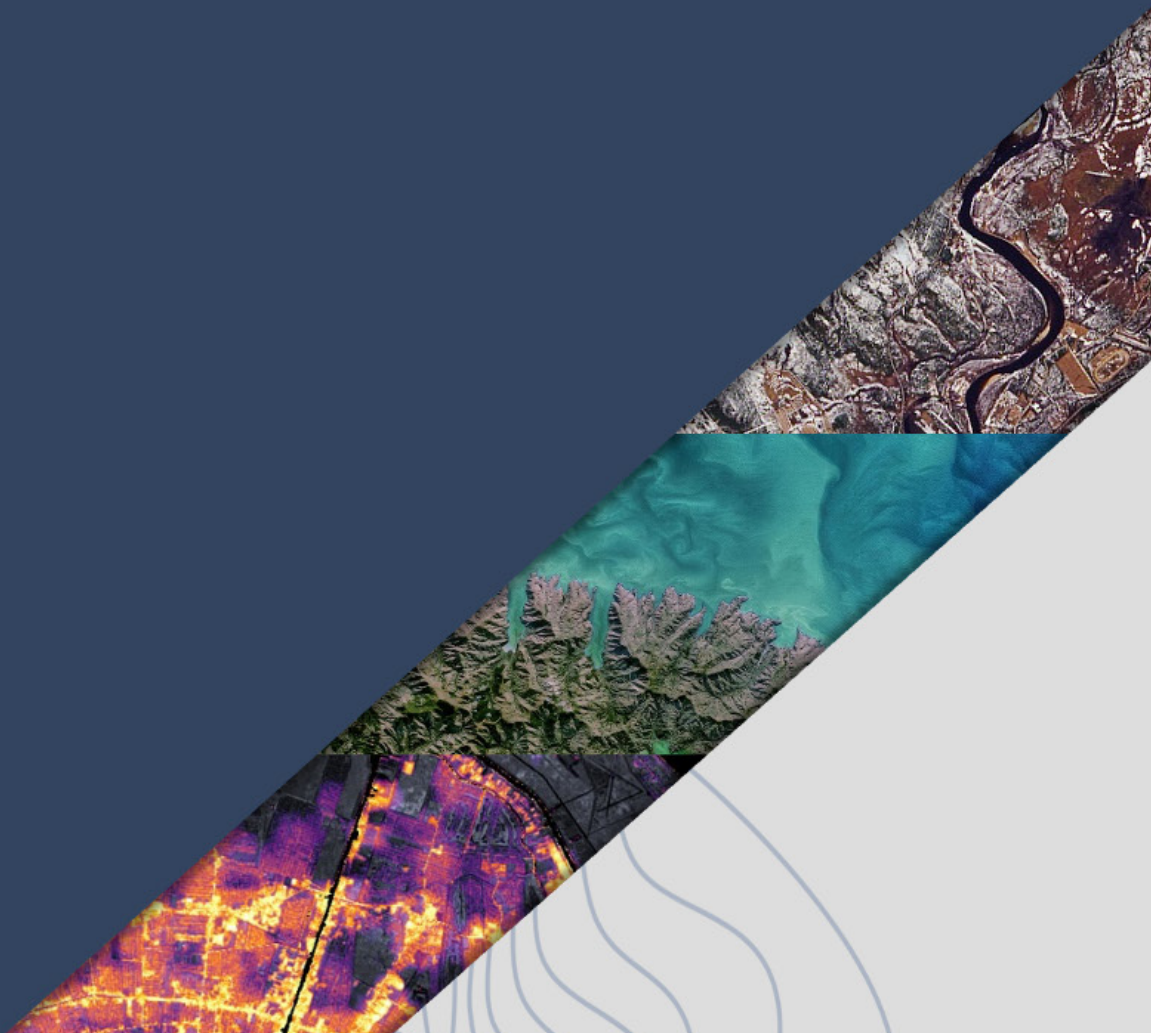
WGClimate Coordinated Action Plan 2024



Joint CEOS-CGMS Working Group on Climate

Version 2.0, March 2025

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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).

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.

1.2 Purpose and Scope of this Document

The actions contained in this document are resulting from the gap analysis reports published in 2018 [RD-2] and 2024 [RD-3], respectively. The gap analyses were based on version 2.0 of the ECV Inventory in 2018 and versions 3.0 – 4.1 of the ECV Inventory in 2024.

The purpose of this document is to provide the status and way forward for the coordinated actions agreed in v1.0 of this document and to define new coordinated actions from the recommendations made in the most recent gap analysis report issued in 2024. Coordinated actions are to be executed by the CEOS and CGMS coordination bodies and should become part of the annual CEOS work plan [RD-2] and the CGMS High Level Priority Plan [RD-3]. Actions are also added for associated bodies such as GCOS after being accepted by GCOS as viable way forward to improve the delivery of climate data records for GCOS ECVs.

1.3 Document Structure

This document comprises the following chapters:

Chapter 1:	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 agreed in 2018.
Chapter 3:	Restates the recommendations from the gap analysis report 2024 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 and http://www.cgms-info.org/ GCOS, 2015: Status of the Global Observing System for Climate, GCOS-195, WMO, Geneva.
[RD-2]	CEOS 2024-2026 Work Plan - May 2024 v3.1. Available at https://ceos.org/document_management/Publications/CEOS_Work-Plans/CEOS%202024-2026%20Work%20Plan%20-%20May%202024%20v3.1.pdf
[RD-3]	CGMS High Level Priority Plan (HLPP) 2024: Available at https://cgms-info.org/publication-category/4_all-publications/3_general-publications/
[RD-4]	Schulz, J. et al, 2018: WGClimate ECV-Inventory Gap Analysis Report – V1.0 April 2018. Available at https://ceos.org/publications-key-documents/
[RD-5]	Schulz, J. et al:, 2024: WGClimate ECV-Inventory Gap Analysis Report – V2.0 October 2024. Available at https://ceos.org/publications-key-documents/
[RD-6]	Eaton, B. et al, 2023: NetCDF Climate and Forecast (CF) Metadata Conventions, V1.11 December 2023. Available at https://cfconventions.org
[RD-7]	Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* The FAIR Guiding Principles for scientific data management and stewardship. *Sci Data* **3**, 160018 (2016). https://doi.org/10.1038/sdata.2016.18. Updates see https://www.go-fair.org/fair-principles/
[RD-8]	Meijer, Y. et al., 2024: Roadmap for a Coordinated Implementation of Carbon Dioxide and Methane Monitoring from Space – Issue 2, Version 1.0, October 2024. Available at https://ceos.org/publications-key-documents/
[RD-9]	The Global Climate Observing System 2021: The GCOS Status Report, GCOS-240, 384pp.

[RD-10]	Jacob, D. J., Varon, D. J., Cusworth, D. H., Dennison, P. E., Frankenberg, C., Gautam, R., Guanter, L., Kelley, J., McKeever, J., Ott, L. E., Poulter, B., Qu, Z., Thorpe, A. K., Worden, J. R., and Duren, R. M.: Quantifying methane emissions from the global scale down to point sources using satellite observations of atmospheric methane, Atmos. Chem. Phys., 22, 9617–9646, https://doi.org/10.5194/acp-22-9617-2022, 2022.

1.5 Terminology

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

2 Status of Recommendations and Actions from 2018

In the following subsection, the recommendations from the gap analysis report 2018 [RD-4] are quoted and the status and way forward for the agreed coordinated 28 actions are described. Over the past years 17 actions have been completed, 2 abandoned, and 9 remain open.

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 #2018-01: WGClimate to develop a technical document to characterise the differences between CDR and Interim CDR, and to advise on the necessity and feasibility to separate the ECV inventory into CDR and ICDR.

Status: Open

The action is part of the CEOS work plan [RD-2] for closure by end of 2024. Several proposals for the definitions of the various data record terms have been discussed and the WGClimate plans to publish a peer reviewed paper to make those definitions available to the community of data record producers as an accepted non-binding standard.

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 #2018-02: 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.

Status: Completed

This action was completed on 28 February 2019 with an update of the questionnaire that guides the population of the ECV Inventory. It was used the first time for Inventory v3.0 published in 2020.

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 #2018-03: 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).

Status: Completed

The action was completed on 30 June 2018 and resulted in several corrections of errors and other improvements in CEOS MIM and OSCAR databases.

Action #2018-04: WGClimate will initiate a discussion with the CEOS MIM and WMO OSCAR representatives to assess options for and impacts of harmonising these databases. This likely would have distinct advantages on maintenance, consistency and information transfer by agencies.

Status: Completed

WGClimate #20 decided the Action is completed with limitations. A bigger discussion was conducted at the CEOS TW2018 with the outcome that apart from corrections of errors and other improvements in CEOS MIM and OSCAR Space such as adding information for uncovered instruments a standardisation of geophysical variable naming would need to be agreed to harmonise CEOS MIM, OSCAR Space, and GCOS ECV naming. As one of the standards the CF conventions were identified but not agreed upon and not applied.

The action may be revitalised at a later stage after GCOS has finalised its ongoing rationalisation exercise of the ECVs naming and organisation that may result in a harmonisation with OSCAR within the WMO system. This would have high relevance for WGClimate to be used in the ECV Inventory as well. How far the CEOS MIM will adapt to such an agreement is currently unknown but might be discussed at some point at a CEOS Technical Workshop.

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 #2018-05: WGClimate to establish an FCDR Inventory.

Status: Open

WGClimate #20 decided to keep this action open as it can only be implemented after the definitions under Action #2018-01 have been completed. The definitions cover additional elements such as individual sensor Fundamental Data Records as well as interim versions of it, which are of value for timely provision of climate information by operational climate services as well as global and regional reanalyses.

It is planned that the data record Inventory 6.0 or 7.0 planned for 2025/26 should entail such data records. A new system for the ECV Inventory will be first released in 2025 and it will be able to support an inventory of FCDRs in later releases.

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-4] and should encourage their personnel to apply it.

Action #2018-06: 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.

Status: Completed

WGClimate #20 decided to close this action with reference to the planned publication of data record definitions and their expected promotion of their use within the agencies producing climate data records.

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

Action #2018-07: 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.

Status: Open

WGClimate #20 decided to keep this action open to achieve an improvement of the GCOS requirements for following GCOS Implementation Plans. GCOS has started an ECV rationalisation effort in 2024 that may address the issue of requirements for applications in terms of usage of data or requirements at application-relevant time and space scales.

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 #2018-08: 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-CGMS WGClimate with CEOS WGCV and relevant CGMS Working Groups.

Status: Abandoned

WGClimate#20 decided to abandon this action because it could not be achieved in the last 6 years. Several discussions were held with CEOS WGCV and within several agencies but no workshop or similar emerged, while the science has proceeded. WGClimate will rethink what is really required in terms of consistency of data records, uncertainty estimates etc. with respect to the user's needs and then reconsider plans in this direction.

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 #2018-09: 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.

Status: Open

WGClimate #20 decided to keep this action open with the understanding it describes a long-term goal for the community. Recent years saw some progress on this item, but it is still a long way to a sustained production of FCDRs for every mission. Before this can be successfully addressed the FCDR definition needs to be acknowledged and largely followed by agencies. In addition, the inventory of FCDR and FDR production by agencies (see Action #2018-05) may help to foster generation of FCDRs also in international collaborations such as the recent EUMETSAT and NOAA project on FCDR for observations from the geostationary ring of satellites that is also supported by JMA and IMD.

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

Action #2018-10: 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.

Status: Completed

WGClimate #20 decided to close the action. Some international quasi standards such as for CF [RD-6] are widely used with an increased fraction of data record producers applying FAIR principles [RD-7] as well. WGClimate will continue to promote and encourage usage of CF standards and FAIR principles. This will be done in the context of the ECV Inventory by labelling the data records for which CF standards and FAIR principles were applied. WGClimate is aware that new or adapted metadata standards may appear for AI/ML applications in cloud computing environments and may decide to promote the most suitable for climate data records.

2.3 Actions for specific ECVs

2.3.1 CO_2

Recommendation #10: T*o ensure continuity in CO_2 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_2.*

Action #2018-11: CEOS and CGMS Agencies with interests in and/or mandates for developing CO_2 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_2 CDRs with the ECV Inventory.

Status: Completed

The action is completed, the production of CO2 data records is part of the GHG monitoring roadmap [RD-8]. Successful combination of instrument records will probably only be possible in the long run with a more sustained space segment, e.g. starting with the Copernicus CO2M mission.

Recommendation #11: Agencies or related entities are encouraged to systematically link their satellite-based derivation of CO_2 sources and sinks with data from in-situ/ground-based infrastructure and modelling framework(s) in order to estimate Earth-surface CO_2 fluxes (see GCOS IP 2016 Action T71) and provide feedback on their plans/progress.

Action #2018-12: WGClimate and GCOS Secretariat to monitor the status of the GCOS Action T71 and to report back to CEOS and CGMS.

Status: Completed

Action was completed in 2021 with the contribution of WGClimate to the GCOS Status Report 2021 [RD-9]. The GCOS Status Report [RD-9] considers the GOCS Action T71 completed with reference to preparations are well developed as described in the CEOS GHG roadmap [RD-8] and with the EU with ESA, ECMWF and EUMETSAT setting up a CO2 Monitoring and Verification Support (MVS) Capacity.

2.3.2 CH_4

Recommendation #12: The AC-VC to develop a plan to address the measurement of stratospheric CH_4 profiles in order to fill the gap for the related FCDR/CDRs.

Action #2018-13: The AC-VC, in collaboration with WGClimate, to develop a plan to address the measurement gap for stratospheric CH_4 profiles in order to provide FCDR/CDR in the future. This plan shall be subject to endorsement by WGClimate.

Status: Open

WGClimate #20 decided to keep the action open as no specific consideration of CH_4 profiling has been undertaken. This is because the focus was on surface emissions to which such measurements are not contributing. Nonetheless several measurement systems exist that could deliver parts of the CH_4 profile [RD-10] but no plan how this could be turned into a long-term data record has been considered yet.

Recommendation #13: Agencies to plan for the generation of tropospheric column CH_4 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 #2018-14: CEOS and CGMS Agencies with interests in and/or mandates for developing CH_4 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_2 CDRs with the ECV Inventory.

Status: Completed

The action is completed, the production of CH_4 data records is part of the GHG monitoring roadmap [RD-8]. Successful combination of instrument records will probably only be possible in the long run with a more sustained space segment, e.g. starting with the Copernicus CO2M mission.

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 #2018-15: 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.

Status: Abandoned

WGClimate #20 decided to abandon the action after several conversations with the CEOS P-VC and members of the CGMS IPWG. As for other ECVs several agencies are producing climate data records for precipitation from several sets of sensor data and in combination with ground-based in situ and radar data depending on the targeted application. The CEOS P-VC supported further analysis of the sustainability of the space segment for precipitation. The SCOPE-CM initiative does not exist anymore, thus a plan across the coordination bodies seems unrealistic today.

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 #2018-16: The CEOS SST-VC to work with GHRSST 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.

Status: Completed

WGClimate #20 decided to declare this action as completed. Space agencies invest into improving FDRs and FCDRs useful for SST climate data records. Particularly C-band radiometer data from SMMR will be reconsidered after original count data have been found at NASA. In addition, the joint EUMETSAT and NOAA project on geostationary radiances will help to optimise the quality of input data for SST retrieval. GHRSST has already stated the potential usefulness of historical data such as from HIRS that already has been recalibrated by EUMETSAT. Further resources are needed to make further analysis of the usage of the historical radiances and the potential production of extended SST climate data records.

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 #2018-17: CEOS and CGMS Agencies with experience in microwave radiometry to help maximise the lifetime of the AMSR-2 instrument on GCOM-W1.

Status: Completed

This action was completed in 2019 and JAXA kept AMSR-2 alive until today with prospects to create overlap with AMSR-3 foreseen for launch on GOSAT-GW in 2024.

Action #2018-18: 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.

Status: Completed

WGClimate #20 decided to close this action based on information from EUMETSAT that the SMMR raw data have been found at NASA and made available to EUMETSAT. With support of the Copernicus Climate Change Service EUMETSAT will perform quality control and will attempt a recalibration of all channels including C-band in 2026/27. Resulting data with all metadata including information on quality and recalibration will be publicly available. Data from newer instruments such as the AMSR series and future radiometers such as the Copernicus CIMR are and will continue to be publicly available.

Action #2018-19: 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.

Status: Completed

WGClimate #20 decided to close this action based on the information from JAXA that the AMSR-3 satellite is planned for launch in 2024. In addition, plans of the European Commission to realise the Copernicus CIMR mission have progressed to Phase C/D with two satellites in preparation (CIMR-A and CIMR-B) to be launched sequentially separated by ~7 years starting in 2028/29. This shall secure the availability of C-band microwave measurements for more than a decade.

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 # 2018-20: 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.

Status: Completed

This action was completed in 2021. Datasets from NASA and production plans from an ESA CCI project have been registered in the ECV Inventory version 3.0.

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 #2018-21: 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.

Status: Completed

WGClimate #20 decided that this action has been completed. The European planning of the Copernicus CIMR mission has advanced to MRD with high probability of realisation. However, it still needs to be retained in the next phase of the Copernicus programme with the next EU budget cycle. In addition, NASA's Soil Moisture Active Passive (SMAP) mission began collecting sea surface salinity data in April 2015, overlapping with Aquarius observations for approximately three months. Using the same frequency as Aquarius L-band, SMAP's global salinity measurements continue the time series that began with Aquarius in August 2011. CIMR and SMAP are in the same orbit with an ECT of 06:00 UTC with descending orbit, possibly enabling a continuation of the salinity time series after SMAP reaches its end of life.

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 #2018-22: LSI-VC to formulate future high-resolution missions for Land Surface *Temperature climate data records aiming at seamless continuity of CDRs.*

Status: Open

After discussion at LSI-VC #15 in 2024 WGClimate decided to keep the action open. LSI-VC proposed to update the surface temperature PFS with a new stability metric to bring it in line with GCOS requirements metrics. For USGS and ESA missions LSI-VC members will coordinate on this formulation.

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 #2018-23: 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.

Status: Open

After discussion at LSI-VC #15 WGClimate decided to keep the action open until planned high resolution CDR products have been added to the ECV Inventory. LSI-VC agreed to provide the necessary information.

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 #2018-24: 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.

Status: Open

After discussion at LSI-VC #15 WGClimate decided to keep the action open and await a discussion of LSI-VC and GCOS TOPC that will consider what is required by the agencies to deliver this action.

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 #2018-25: 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.

Status: Completed

Action is completed, WMO OSCAR and CEOS MIM databases contain biomass with some linkage to sensors. However, information in the data bases needs to be kept up to date which is considered normal work.

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 #2018-26: 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.

Status: Open

WGClimate #20 decided to keep this action open and tasked the ECV Inventory Support Team at EUMETSAT to take stock on the level of availability of C-band and L-band Level 1 measurements.

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

Action #2018-27: 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.

Status: Completed

WGClimate #20 decided to close this action with reference to the Above Ground Biomass activities under JAXA SIT leadership and the formulation of the CEOS AFOLU roadmap. This roadmap contains an action accepted by the LSI Virtual Constellation to track the CEOS agency data continuity for key AFOLU measurement groups and to provide guidance as needed to new missions, and report to the CEOS SIT. This will contribute to mission continuity for sustained long-term AGB measurements. WGClimate will work with LSI VC on aspects such as research to operation processes involving CGMS and WMO to integrate this into a long-term operational observing system.

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

Action #2018-28: 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.

Status: Completed

WGClimate #20 decided to close this action with reference to Action #2018-27.

3 New Recommendations and Actions

Recommendation #1: GCOS to continue the consolidation of the GCOS ECV Products into physical quantities that match WMO OSCAR physical quantities to allow a seamless use of OSCAR and the ECV Inventory.

Action #2024-01: WGClimate leadership to closely follow the GCOS ECV consolidation process and to organise discussion at WGClimate meetings about outcomes and further development.

Recommendation #2: It is noted that in the ECV rationalization discussion within GCOS, the GCOS task team proposed to remove anthropogenic GHG flux ECVs. However, it is recommended to keep GHG fluxes between Earth's surface and atmosphere containing both natural and anthropogenic sources in a similar way as other matter and energy fluxes.

Action #2024-02: WGClimate leadership to address this recommendation with the relevant GCOS panels and/or GCOS SC. It might be achieved as part of the ECV consolidation under Action #2024-01.

Recommendation #3: Agencies with interest in the AGB ECV shall operationalise the production of this ECV inclusive of comprehensive validation of resulting data records.

Action #2024-03: WGClimate to assess via the ECV gap analysis if transitions to more operational production of globally consistent AGB data records appear in agency or climate service planning and if such data records appear in the ECV Inventory.

Recommendation #4: GCOS to improve interactions with specialist groups when creating new GCOS Implementation Plans or updates of requirements.

Action #2024-04: WGClimate leadership to forward this recommendation to relevant GCOS panels and/or GCOS SC prior to the preparation cycle of the next GCOS Implementation Plan. GCOS and WGClimate could think of a joint strategy to leverage community expertise for future GCOS Implementation Plans and WGClimate gap analysis on the GCOS ECVs.

Recommendation #5: Agencies with interest in soil moisture to support L-band passive microwave and SAR missions and to plan for the generation of L-band based ECV soil moisture data records based on the data collected by instruments on missions such as SMOS, SMAP, CIMR, SAR-L, and ROSE-L utilising an ensemble of algorithms.

Action #2024-05: WGClimate to assess the situation in a future gap analysis involving the GCOS TOPC panel and community expertise. A first step should be part of Action #2018-05 on the establishment of an F(C)DR inventory that would show the availability of suitable Level 1 data records.

Recommendation #6: Agencies operating altimeters suitable for sea level estimates shall consider operational climate data record production including past sensors.

Action #2024-06: WGClimate to assess via the ECV gap analysis if transitions to more operational production of sea-level data records appear in agency or climate service planning and if such data records appear in the ECV Inventory.

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, GCOS and WMO. The status of actions is assessed by the WGClimate at their regular sessions. Updates to existing actions as well as new recommendations and actions may originate from future analysis of the ECV Inventory and will be presented for endorsement by CEOS and CGMS.

Annex A. Action status

Table 1: Table of coordinated action status, O denoting Open actions, C denoting completion, and A denoting abandoned actions.

Action #	Description	Status
Action #2018-01	WGClimate to develop a technical document to characterise the differences between CDR and Interim CDR, and to advise on the necessity and feasibility to separate the ECV inventory into CDR and ICDR.	O
Action #2018-02	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.	C
Action #2018-03	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).	C
Action #2018-04	WGClimate will initiate a discussion with the CEOS MIM and WMO OSCAR representatives to assess options for and impacts of harmonising these databases. This likely would have distinct advantages on maintenance, consistency and information transfer by agencies.	C
Action #2018-05	WGClimate to establish an FCDR Inventory.	O
Action #2018-06	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.	C
Action #2018-07	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.	O
Action #2018-08	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-CGMS WGClimate with CEOS WGCV and relevant CGMS Working Groups.	A

Action #	Description	Status
Action #2018-09	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.	O
Action #2018-10	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	C
Action #2018-11	CEOS and CGMS Agencies with interests in and/or mandates for developing CO_2 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_2 CDRs with the ECV Inventory.	C
Action #2018-12	WGClimate and GCOS Secretariat to monitor the status of the GCOS Action T71 and to report back to CEOS and CGMS.	C
Action #2018-13	The AC-VC, in collaboration with WGClimate, to develop a plan to address the measurement gap for stratospheric CH_4 profiles in order to provide FCDR/CDR in the future. This plan shall be subject to endorsement by WGClimate	O
Action #2018-14	CEOS and CGMS Agencies with interests in and/or mandates for developing CH_4 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_2 CDRs with the ECV Inventory	C
Action #2018-15	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.	A
Action #2018-16	The CEOS SST-VC to work with GHRSST 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.	C
Action #2018-17	CEOS and CGMS Agencies with experience in microwave radiometry to help maximise the lifetime of the AMSR-2 instrument on GCOM-W1.	C
Action #2018-18	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.	C
Action #2018-19	CEOS and CGMS Agencies with interests in and/or mandates for developing C-band microwave radiometers to coordinate their efforts	C

Action #	Description	Status
	to arrive at an operational capability, and coordinate their efforts with WGClimate and the SST-VC.	
Action #2018-20	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.	C
Action #2018-21	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.	C
Action #2018-22	LSI-VC to formulate future high resolution missions for Land Surface *Temperature climate data records aiming at seamless continuity of CDRs.*	O
Action #2018-23	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.	O
Action #2018-24	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.	O
Action #2018-25	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.	C
Action #2018-26	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.	O
Action #2018-27	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.	C
Action #2018-28	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.	C

Action #	Description	Status
Action #2024-01	WGClimate leadership to closely follow the GCOS ECV consolidation process and to organise discussion at WGClimate meetings about outcomes and further development.	O
Action #2024-02	WGClimate leadership to address this recommendation with the relevant GCOS panels and/or GCOS SC. It might be achieved as part of the ECV consolidation under Action #2024-01.	O
Action #2024-03	WGClimate to assess via the ECV gap analysis if transitions to more operational production of globally consistent AGB data records appear in agency or climate service planning and if such data records appear in the ECV Inventory.	O
Action #2024-04	WGClimate leadership to forward this recommendation to relevant GCOS panels and/or GCOS SC prior to the preparation cycle of the next GCOS Implementation Plan. GCOS and WGClimate could think of a joint strategy to leverage community expertise for future GCOS Implementation Plans and WGClimate gap analysis on the GCOS ECVs.	O
Action #2024-05	WGClimate to assess the situation in a future gap analysis involving the GCOS TOPC panel and community expertise. A first step should be part of Action #2018-05 on the establishment of an F(C)DR inventory that would show the availability of suitable Level 1 data records.	O
Action #2024-06	WGClimate to assess via the ECV gap analysis if transitions to more operational production of sea-level data records appear in agency or climate service planning and if such data records appear in the ECV Inventory.	O

Annex B. Acronyms

3D	Three Dimensional
CDR	Climate Data Record
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CH_4	Methane
CO_2	Carbon Dioxide
ECV	Essential Climate Variable
FCDR	Fundamental Climate Data Record
GCOS	Global Climate Observing System
GHRSST	Global High Resolution Sea Surface Temperature Project
ICDR	Interim Climate Data Record
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
SSS	Sea-surface Salinity
SST	Sea Surface Temperature
SWIR	Short Wave Infrared

WGClimate	The Joint CEOS/CGMS Working Group on Climate
WGCV	CEOS Working Group on Calibration & Validation
WMO	World Meteorological Organization

For more information contact: wgclimate@climatemonitoring.info

www.climatemonitoring.info