Update from the Joint CEOS-CGMS Working Group on Climate and the GHG Task Team

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Wenying Su, NASA
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Presented to CGMS-52 Working Group II session, agenda item 4.1

Coordination Group for Meteorological Satellites

CEOS CGMS

Executive summary of the WP

In 2024, the Joint CEOS-CGMS Working Group on Climate (WGClimate) is actively updating three of its key lifecycle documents: 1) Space Agency Response to the GCOS Implementation Plan (2022), 2) ECV Inventory Gap Analysis Report, and 3) Coordinated Action Plan. The latter describes Agency and organization steps needed to meet climate science and monitoring needs expressed by GCOS. This overlapping work will effectively align and make WGClimate's core documents current following delays resulting from the COVID-19 pandemic. WGClimate is also restructuring its ECV Inventory database and processes to reduce maintenance costs and burdens on providers and reviewers. WGClimate will also be seeking CGMS and CEOS endorsement of its new Vice-Chair nominee: Dr. Vincent-Henri Peuch of ECMWF.

Pursuant to the Greenhouse Gas Roadmap, WGClimate and its GHG Task Team seeks urgent resumption of coordination with CGMS Working Groups to facilitate sustainment and operationalization of GHG space observations and product generation. Besides the clear urgency for reliable GHG monitoring, this evolution is needed to meet operational requirements, including those of UNEP's International Methane Emissions Observatory, WMO's Global Greenhouse Gas Watch, and UNEP's recurring Global Stocktake processes.

Key issues of relevance to CGMS:

- WGClimate and the GHG TT seek immediate resumption of coordination discussions and activities with CGMS Working Groups toward sustainment and operationalization of GHG observation and product generation to meet needs of stakeholder organizations. The GHG Roadmap, previously endorsed by CGMS Plenary, is under active revision and will identify required activities.

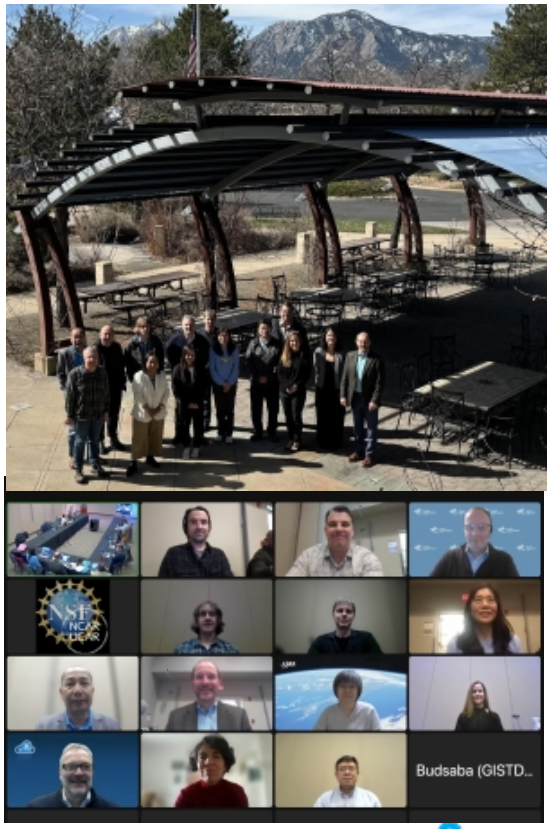
To be considered by CGMS:

- Action: WG Chairs to resume engagement and activities in the GHG Roadmap towards operationalization of GHG monitoring from space

Recent Major Events and Activities

- Delivered CEOS-CGMS Statement for SBSTA at COP-28 to CSA
- WGClimate-20 hosted by NOAA-Boulder (March)

- Top 2024 Priorities
  1. Conduct remaining work on Space Agency Response to GCOS Implementation Plan (IP)
  2. Complete Gap Analysis Report (v3/4.1)
  3. Update Greenhouse Gas Roadmap
  4. Update Coordinated Action Plan
  5. Update, restructure and rename ECV Inventory
  6. Submit journal manuscript on CDR definitions
  7. Nominate Vice-Chair: Vincent-Henri Peuch (ECMWF)

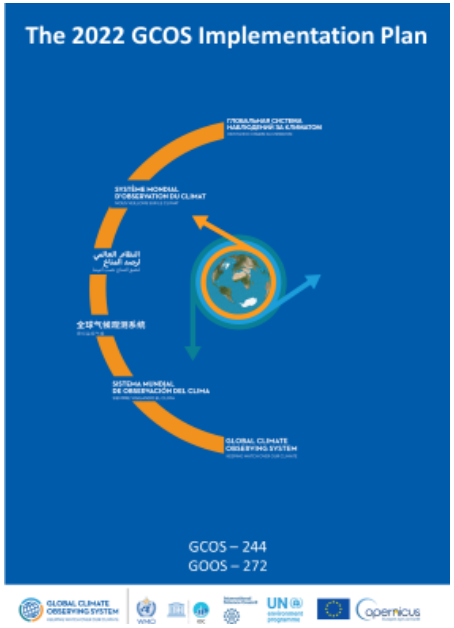


Warm Welcome to New Members

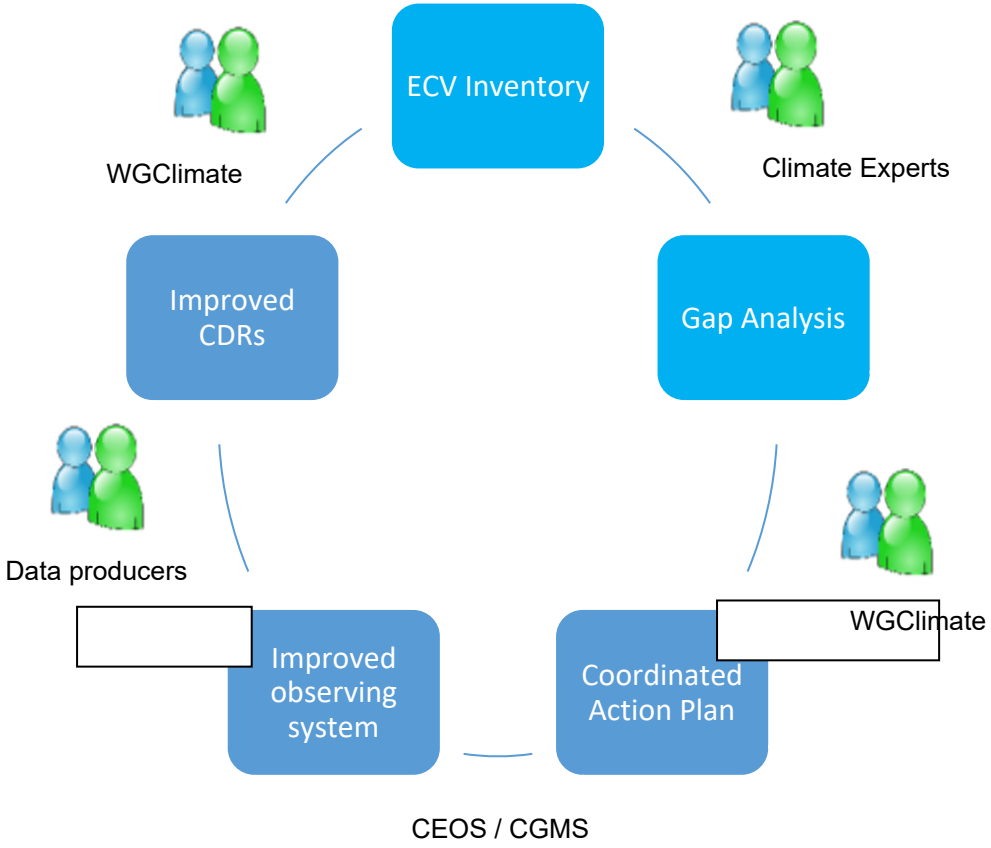
- GISTA (Geo-Informatics & Space Technology Development Agency), Thailand
  - Pakorn Petchprayoon
  - Budsaba Uamkasem
  - Kanjana Koedkurang
- SANSA (South African National Space Agency), South Africa
  - Lerato Shikwambana
  - Nale Mudau
- USGS (U.S. Geological Survey), United States
  - Kimberly Casey
  - Kelly Bruno
  - George Xian
- UKSA (U.K. Space Agency), Britain
  - Gareth Thomas

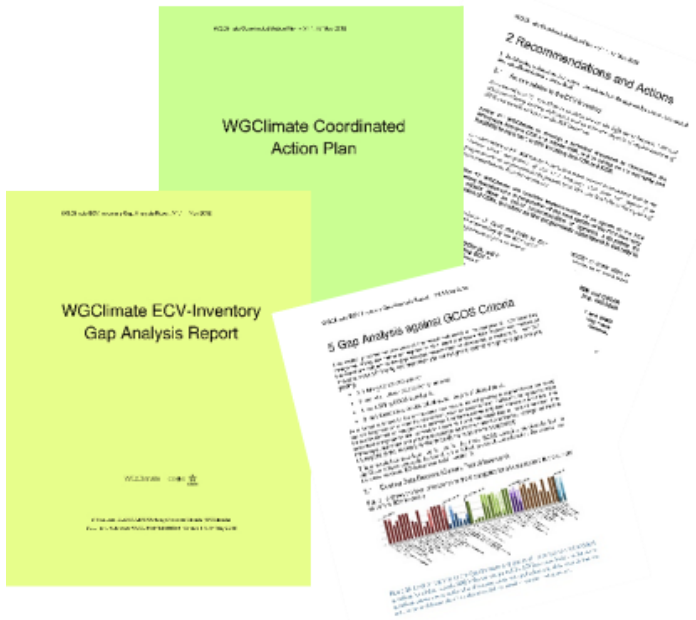
1. Agency Response to GCOS IP (2022)

- Purpose
  - Describes needs/gaps in Global Climate Observing System
  - Produced every 5-6 years
  - 2022: GCOS provided 16 Actions, each with multiple Activities
- WGClimate addressing with a two-phase response
  - Completed 21 Activities in 2023 (more straightforward)
  - Addressing similar number in 2024 (more complex)
  - Submission to CEOS and CGMS Principals: mid-2025



2-3. Core Documents Update: Context





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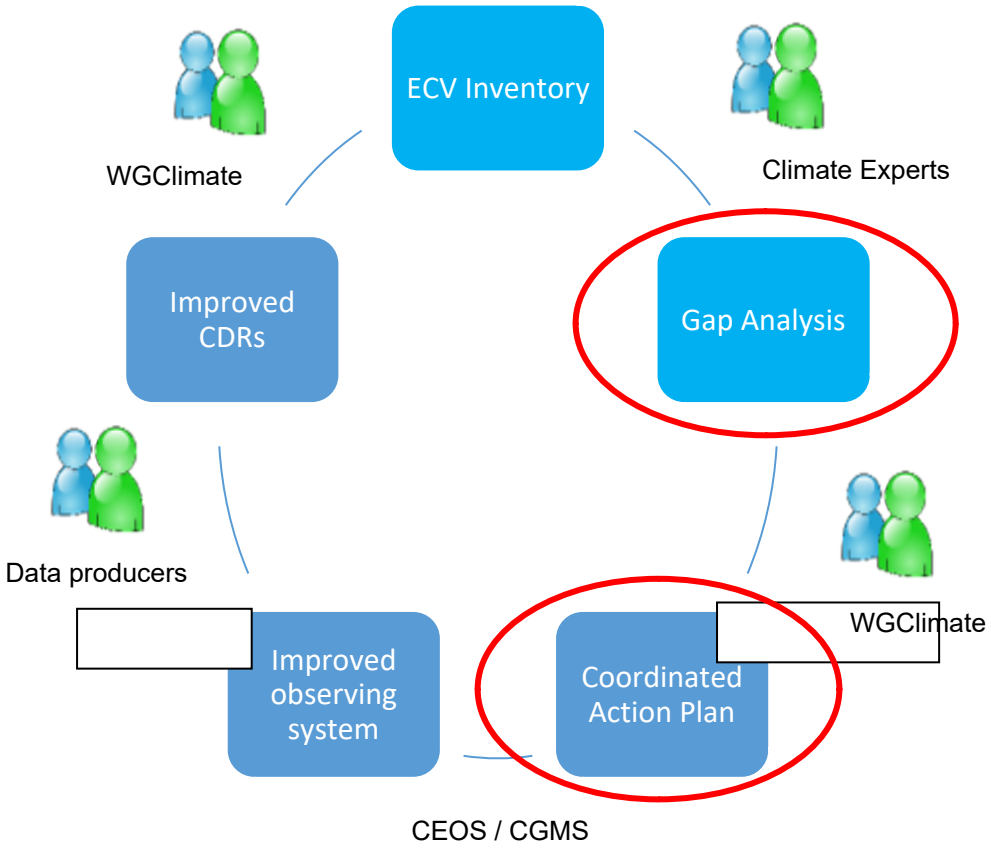
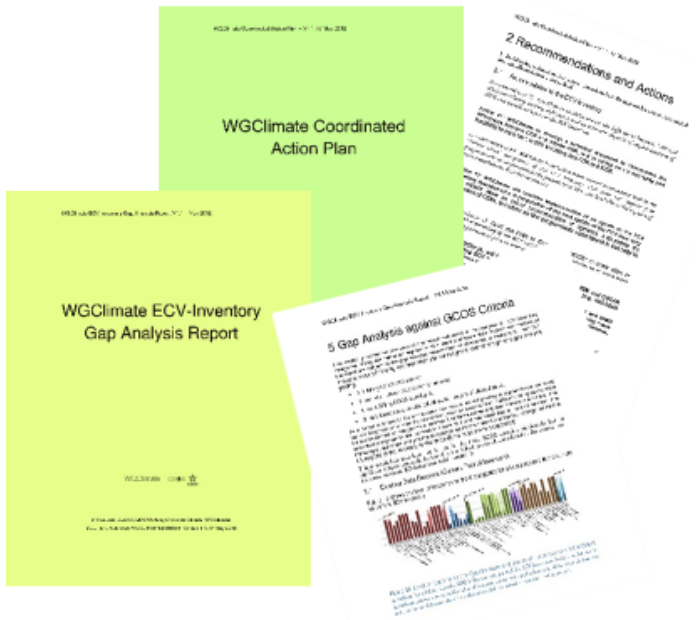




2-3. Core Documents Update: Schedule

- Merged Gap Analysis Report
  - Out for review on April 30
  - Seek endorsement by June
- Coordinated Action Plan
  - Out for review on April 30
  - Seek endorsement by June
- Aligning with inputs to Space Agency Response to GCOS IP
- 2024 effectively a COVID-era clean-up and catch-up

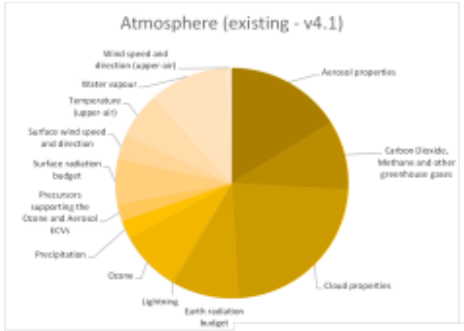
4. Evolution of ECV Inventory

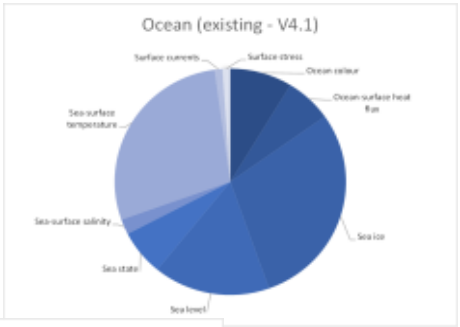
Purpose

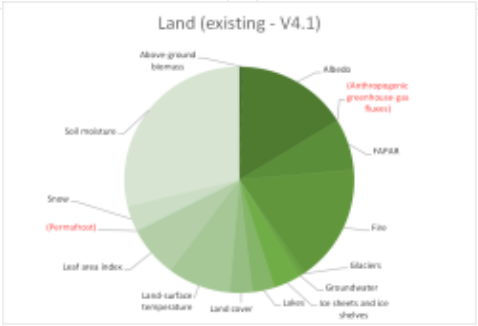
- One-of-a-kind international compendium of metadata for known CDRs
- Tool developed to ensure future space observation architecture will be adequate for CDR generation requirements
- Growing use as authoritative CDR library for end-users, researchers, developers

History

- V2.0: October 2017
- V3.0: August 2020
- V4.0: October 2021
- V4.1: November 2022







- V5.0: ~December 2024
  - 45 previously-submitted records
- V6.0: ~December 2025
  - Simpler structure, processes, new name

- EUMETSAT initiated new 5-year support contract (started April 2024)

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5. Climate Data Record Definitions

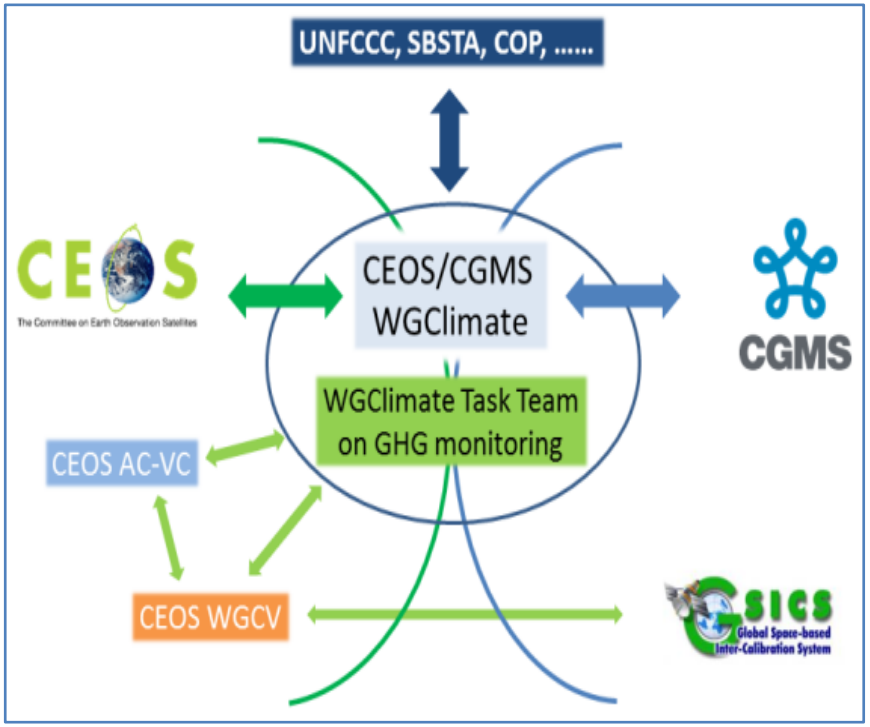
- Goal: General, robust, anticipatory of evolving technologies
  - e.g., indices, reanalysis-derived CDRs, GPSRO, gravimetry, ML/AI, *in situ*
- Near-final definitions briefed to CEOS Plenary in November 2023
- Manuscript in development for peer-reviewed journal article in late 2024

6. Vice-Chair Candidate: Vincent-Henri Peuch (ECMWF)

- Joined ECMWF in 2011. Led initiation and implementation of Copernicus Services at ECMWF. Founding Director of the Copernicus Atmosphere Monitoring Service for 10 years.
- Current member of ECMWF Directorate as Director for engagement with the European Union and Head of ECMWF Bonn (190 staff) -- the centre of gravity for ECMWF EU activities including Copernicus and Destination Earth.
- 30-years experience in atmospheric composition modelling, composition-climate interactions and data assimilation of observations of atmospheric constituents (>105 publications, h-index: 48).
- Active in international scientific and steering bodies including WMO's Global Atmospheric Watch and Global Greenhouse Gas Watch Study Group (co-chair) and ESA's Advisory Committee for Earth Observation and Climate Science Advisory Board.
- **ECMWF representative to Joint CEOS-CGMS Working Group on Climate and ECMWF's CEOS contact since 2022.** Contributes to Greenhouse Gas aspects, Space Agencies response to GCOS IP and provides liaison with relevant ECMWF/C3S/CAMS/DestinE activities: reanalyses, link to policy stakeholders, data stores, use cases…

GHG Task Team

- **Implemens and maintains** the **GHG Roadmap**
- **Interfaces with, stimulates and monitors GHG-related activities with CGMS & CEOS** WGs:
  - WG-Climate, WGCV, AC-VC, GSICS, WGCapD, etc
- **Ensures representation** of CEOS & CGMS bodies by identifying **Points of Contact (PoCs) for tasks** to be executed by these bodies



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GHG TT: Recent Achievements

Soft update GHG Roadmap

- **Action list** has been updated through a thorough review **per A**
- **Product standardization** → several meetings; work in progre
- GHG observations from space is one of JAXA's headline prioritites new CEOS SIT chair for 2024–2025

CEOS GHG Missions Portal; centralized overview of GHG Missions in one Portal ceos.org/ghg

New Space; Significant steps have been taken and progress followed by J. Worden

International Engagement

- WMO's Global GHG Watch. CEOS representatives in Study Group supporting the implementation plan
- IMEO (members participating in WGs) & collaboration to intensify further.
- International Methane Standards Workshop by NPL in Teddington, UK. Report will be generated with Recommendations & timeline summary

GHG TT: Operationalizing GHG Monitoring

GHG Roadmap (v1; 2020, endorsed by CEOS & CGMS plenaries)

- Identified respective roles and responsibilities
  - Key developer: GHG Task Team
  - Assumed one operational system and a phased implementation approach
  - Lacked operational users and requirements
- Update required due to evolving realities

GHG Roadmap (v2; expected 2024), to be endorsed at CEOS and CGMS plenaries

- New: Independently address gas species (CH_4, CO_2) and scales (local, regional)
- New: Address new and (any) emerging operational users and stakeholders
  - Provides a generic description on how to proceed with (new) stakeholders
  - UNEP's International Methane Emissions Observatory (IMEO, incl. MARS-required tip & cue)
  - WMO's Global Greenhouse Gas Watch (G3W)
- New: Position CEOS-CGMS
  - as trusted entity for L2 GHG products
  - as facilitating & enabling stakeholders to gradually operationalize L2+ aspects
- New: Approach toward NewSpace and commercial satellites and data

GHG at similar stage to meteorology 50 years ago → **We need CGMS!**

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Review of Near-term Activities

- Submission to Merged Gap Analysis Report to Principals (June)
- Submission to Coordinated Action Plan to Principals (June)
- CGMS Plenary (June)
- Support CEOS SIT Chair priorities on GSTs & Climate Policy Impact (April-Sept.)
- Update GHG Roadmap (Ongoing till complete)
- Draft Statement for SBSTA/COP-29 (July-August)

- Other miscellaneous activities
  - Exploring process and options for a COP Side Event
  - Dialog with SCO on gathering satellite needs for local/regional scale climate adaption projects

Thank you

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Backups

WGClimate Vice-Chair Ground Rules

- Issued Call for Nominations on 16 January 2024
- New Vice-Chair assumes duties at the CEOS 2024 Plenary
  - Current Vice Chair rotates to Chair for 2-year term, then next rotation
- For WGClimate's Terms of Reference
  - Chair alternately drawn from meteorological and non-meteorological agencies
    - Wenying Su, the current Vice Chair, is from a non-meteorological agency (NASA)
    - Next Vice-Chair must be from a meteorological agency
- One nomination received: Vincent-Henri Peuch (ECMWF)
- Next steps: Submit to CGMS and CEOS Plenaries for approval

16 Actions in GCOS IP Space Agency Supplement

A: ENSURING SUSTAINABILITY	A2. Address gaps in satellite observations likely to occur in the near future
	A3. Prepare follow-on plans for critical satellite missions
B: FILLING DATA GAPS	B1. Development of reference networks (in situ and satellite Fiducial Reference Measurement (FRM) programs)
	B3. New Earth observing satellite missions to fill gaps in the observing systems
	B5. Implementing global hydrological networks
	B6. Expand and build a fully integrated global ocean observing system
	B9. Improve estimates of latent and sensible heat fluxes and wind stress
C: IMPROVING DATA QUALITY, AVAILABILITY AND UTILITY, INCLUDING REPROCESSING	C1. Develop monitoring standards, guidance and best practices for each ECV
	C2. General improvements to satellite data processing methods
	C4. New and improved reanalysis products
	C5. ECV-specific satellite data processing method improvements
D: MANAGING DATA	D4. Create a facility to access co-located in situ cal/val observations and satellite data for quality assurance of satellite products
F: OTHER EMERGING NEEDS	F1. Responding to user needs for higher resolution, real time data
	F2. Improved ECV satellite observations in polar regions
	F3. Improve monitoring of coastal and Exclusive Economic Zones
	F5. Develop an Integrated Operational Global GHG Monitoring System

- Most Actions have multiple Activities
- Space agencies play minor role in 3 additional Actions
- Space agencies collaborate with others on 2 additional Actions

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Near-final/Working CDR Definitions

- Near-final CDR definitions
  - A Climate Data Record (CDR) is a consistently-processed and uncertainty-quantified time series of earth system data or information, located in time and space, of sufficient length and quality to be useful in climate-related applications.
    - Subtype: A Fundamental CDR (FCDR) is a CDR of at-sensor observations.
  - An Interim CDR (ICDR) is a consistently-processed and uncertainty-quantified time series of earth system data or information, located in time and space, generated by a baselined CDR system modified to enable lower latency production.
  - Caveats and clarifications

• “Earth system data or information” is an observation or a derived/modeled earth-system variable (measurable or not, e.g., it could be synthesized like "potential temperature" or an index like LAI)

• “Consistently-processed” means generated with a processing system designed to minimize output discontinuities and changes in the algorithmic approach over the period of record.

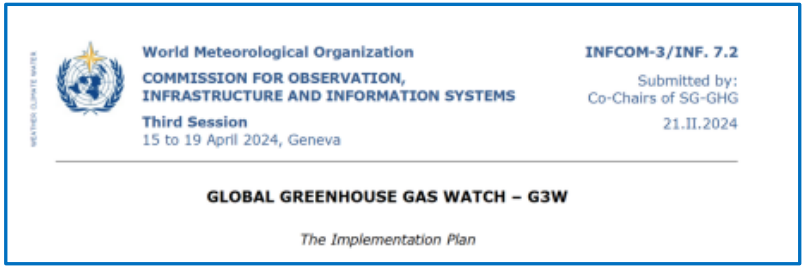
• “Sufficient” length and quality values vary with use and application. There are no fixed thresholds. A CDR must be fit-for-purpose.

• The definitions are not all mutually-exclusive, and more than one can apply to a given time series (e.g., an ICDR can become a CDR of typically lower quality than baselined CDR).

GHG User: WMO's Global GHG Watch

G3W Implementation Plan v1.0

- Aim has been to position CEOS as the trusted partner for space-based observations up to L2
- Expectation is that stakeholders, like G3W, will gradually operationalize L2+ aspects
- Section 3.5 → Theme: Space-based observations of GHGs and related variables
- Three specific **actions** were included:
  - O10: Liaise and prioritise with CEOS-CGMS for direct GHG observations from space
  - O11: Liaise and prioritise with CEOS-CGMS for indirect GHG observations from space (required to infer GHG fluxes)
  - O12: Liaise and prioritise with CEOS-CGMS for required space-based observations to monitor changes in the carbon cycle in a (future) changing climate
- Some of the activities listed in GHG Roadmap can be (gradually) taken over by G3W
- In implementation phase, there is a need to work on **CEOS ← → G3W** operational interfaces



World Meteorological Organization
COMMISSION FOR OBSERVATION, INFRASTRUCTURE AND INFORMATION SYSTEMS
Third Session
15 to 19 April 2024, Geneva

INFCOM-3/INF. 7.2
Submitted by:
Co-Chairs of SG-GHG
21.II.2024

GLOBAL GREENHOUSE GAS WATCH – G3W

The Implementation Plan

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GHG User: UNEP's IMEO

IMEO Working Groups

- Several working groups were established and met twice
- Clear need to continue this work of some of the working groups
- Aim has been to position CEOS as the trusted partner for space-based observations up to L2
- Expectation is that stakeholders, like IMEO, will gradually operationalize L2+ aspects
- Three specific **activities** were already identified:
  - **An automated tip-and-cue system**. This basically implies automated messages based global mappers (like S5p, S5 and CO2M) to indicate to IMEO areas of potential interest for plume mappers.
  - **An automated hyperspectral 'L2' processing request.** IMEO would like to investigate/follow-up on observed plumes by investigating for signs in S2, S3, prisma and similar missions. As this is not part of the standard processing of these missions, we would need to foresee an automated process vis-à-vis satellite agencies. We think ESA could lead the way on this topic.
- In its further evolution, there is a need to improve **CEOS ← → IMEO** operational interfaces