

2024-2026 Work Plan

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# **Acronyms**

|  |  |
| --- | --- |
| AC-VC | CEOS Atmospheric Composition Virtual Constellation |
| CEO | CEOS Executive Officer |
| CEOS | Committee on Earth Observation Satellites |
| CEOS-ARD OG | CEOS Analysis Ready Data Oversight Group |
| CGMS | Coordination Group for Meteorological Satellites |
| COAST AHT | CEOS Coastal Observations Applications Services and Tools a*d hoc* Team |
| COVERAGE | CEOS Ocean Variables Enabling Research and Applications for GEO |
| EETT | CEOS Ecosystem Extent Task Team |
| GEO | Group on Earth Observations |
| LSI-VC | CEOS Land Surface Imaging Virtual Constellation |
| NSTT | CEOS New Space Task Team |
| OCR-VC | CEOS Ocean Colour Radiometry Virtual Constellation |
| OST-VC | CEOS Ocean Surface Topography Virtual Constellation |
| OSVW-VC | CEOS Ocean Surface Vector Winds Virtual Constellation |
| P-VC | CEOS Precipitation Virtual Constellation |
| SDG CG | CEOS Sustainable Development Goals Coordination Group |
| SEC | CEOS Secretariat |
| SEO | CEOS Systems Engineering Office |
| SIT | CEOS Strategic Implementation Team |
| SST-VC | CEOS Sea-Surface Temperature Virtual Constellation |
| UN | United Nations |
| VC | CEOS Virtual Constellation |
| WG | CEOS Working Group |
| WGCapD | CEOS Working Group on Capacity Building and Data Democracy |
| WGClimate | Joint CEOS – CGMS Working Group on Climate |
| WGCV | CEOS Working Group on Calibration and Validation |
| WGDisasters | CEOS Working Group on Disasters |
| WGISS | CEOS Working Group on Information Systems and Services |

# **1.Introduction and Overview**

The *2024-2026 CEOS Work Plan* has been developed by the CEOS Executive Officer (CEO) under the direction of the Canadian Space Agency (CSA) as the CEOS Chair for 2024, in consultation with the Japanese Aerospace and Exploration Agency (JAXA) as the CEOS Strategic Implementation Team (SIT) Chair, the CEOS Secretariat (SEC), CEOS Working Groups (WGs), CEOS Virtual Constellations (VCs), CEOS Ad Hoc Teams, the CEOS Systems Engineering Office (SEO), CEOS Agencies at large and external stakeholders.

The purpose of this document is to present near-term objectives and deliverables identified by CEOS in support of the mission and goals outlined in the *CEOS Strategic Guidance* document. It includes a description of CEOS activities to be executed in the current calendar year (2024) and summarises anticipated activities for the subsequent two years (2025-2026). Additional documents contributing information to this plan are located on the CEOS website (<https://ceos.org/>) and include: the *2023-2025 CEOS Work Plan*; the terms of reference for the CEOS Virtual Constellations and Working Groups; and several thematic observation strategies adopted by the CEOS Plenary. This Work Plan is revised annually as current activities are completed, planned activities are executed, and new initiatives are projected. However, many of the priorities and activities outlined herein are expected to remain consistent from year to year.

**CEOS Mission Statement**

**CEOS ensures international coordination of civil space-based Earth observation programs and promotes exchange of data to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind.**

The primary objectives of CEOS are:

* To optimise the benefits of space-based Earth observation through cooperation of CEOS Agencies in mission planning and in the development of compatible data products, formats, services, applications, and policies.
* To aid both CEOS Agencies and the international user community by, among other things, serving as the focal point for international coordination of space-based Earth observation activities, including the Group on Earth Observations (GEO) and entities related to global activities that have an environmental or socioeconomic impact.
* To exchange policy and technical information to encourage complementarity and compatibility among space-based Earth observation systems currently in service or development, and the data received from them, as well as address issues of common interest across the spectrum of Earth observation satellite missions.

Achievement of these three objectives requires significant internal and interagency coordination, and external consultation and coordination of outputs to respond to the needs of key stakeholders. These stakeholders consist of national governments, including the Group of Seven (G7) and the Group of 20 (G20), GEO, and organisations participating in treaties and global programmes affiliated with the United Nations (UN)[[1]](#footnote-1).

# **2.CEOS Priorities: Review from Plenary 2023 and outlook for the upcoming years**

This Work Plan has been developed in the context of long-term CEOS priorities as described in the CEOS Governing Documents, and specific priorities identified in the *Kyoto Statement* issued at the 29th CEOS Plenary Meeting held in Kyoto, Japan in 2015. In this Statement, CEOS Agencies affirmed their intent to work together to:

* Ensure that climate observation requirements identified by the Global Climate Observing System (GCOS) – and implications of the *Paris Climate Agreement* – are addressed.
* Ensure, in the context of the *Sendai Framework for Disaster Risk Reduction 2015-2030*, that CEOS Agency data are made available in support of disaster risk reduction and that CEOS continues engagement with UN agencies and authorities.
* Ensure that space-based Earth observations support the success of the next decade of the *Group on Earth Observations (GEO)*, and that CEOS engagement in GEO governance and leadership is enhanced.
* Proactively engage in global discussions on the critical challenges that face society, including attaining the *2030 Agenda for Sustainable Development.*

The 37th CEOS Plenary meeting took place in Chiang Rai, Thailand, from November 14th to 16th, 2023. The meeting reviewed the progress made against the priority areas of the outgoing CEOS Chair, the Geo-Informatics and Space Technology Development Agency (GISTDA), as well as the overall progress of the different CEOS activities. The 37th CEOS Plenary continued to underscore the vital role of Earth observation in addressing global challenges and advancing collaboration, roadmap updates, and effective decision making.

Thus, in the context of CEOS contribution to Global Stocktake – the first priority of GISTDA, the 2023 EO Handbook "Space Data for the Global Stocktake" was released, providing a valuable resource for the global community interested in Earth observations and climate. Closely linked to that, the Agriculture, Forestry, and Other Land Use (AFOLU) Roadmap received endorsement, whilst an Action Supplement to track its implementation was presented at the SIT-39 Meeting in Tokyo. In 2023, CEOS also engaged in the development of the WMO Global Greenhouse Gas Watch (G3W) and has been actively contributing to its Implementation Plan. Collaboration between CEOS and the UNFCCC Secretariat was emphasized, with calls for regular meetings and consistent messaging among key observation bodies. The CEOS Plenary also endorsed the joint CEOS-CGMS Space Agency Statement to the UNFCCC for COP28 in the United Arab Emirates.

With regards to GISTDA’s second priority, related to New Space, the CEOS Plenary endorsed the New Space Task Team white paper and recommendations, both of which inform the current Work Plan. It also gave its approval to disband the CEOS New Space Task Team, which was established as a temporary team two years ago.

Another important milestone of 2023 was the update of the CEOS Greenhouse Gas (GHG) Roadmap and the development of the dedicated GHG Satellite Mission Portal. Likewise, CEOS endorsed the Interoperability Framework and Roadmap. Moreover, CEOS approved the development of an Aquatic Carbon Roadmap, complementing the existing AFOLU and GHG roadmaps. The Ecosystem Extent Task Team's white paper and recommendations were approved, with a focus on ecosystem mapping and monitoring. Demonstrators for Ecosystem Extent will be developed in 2024. The Ocean Coordination Group was disbanded, and the 2023 CEOS Plenary accepted the CEOS Coastal Observations Applications Services and Tools (COAST) *Ad Hoc* Team’s Initial Proposal to transition to a COAST Virtual Constellation. It was agreed to extend the *Ad Hoc* Team through to SIT-39 to prepare the necessary documentation to support a SIT-39 decision regarding the proposed transition.

In 2023, a comprehensive review by the CEOS Executive Officer highlighted CEOS engagement in multiple facets of the GEO Work Programme, with CEOS providing crucial open data that forms the backbone of many GEO activities. Moreover, CEOS held Observer status on the 2023 GEO Executive Committee and has been elected to the GEO Programme Board for the 2023-2025 term. This demonstrates the depth of its integration and the significance of its contributions to GEO's overarching mission. As both entities move forward, the synergy between CEOS and GEO remains important in the global effort to leverage Earth observations for the benefit of people and our planet.

Furthermore, recognizing the significance of the United Nations Office for Outer Space Affairs (UNOOSA) "Space2030 Agenda" adopted in 2021 as a forward-looking blueprint for bolstering the role of space activities and tools in advancing global objectives, CEOS reaffirmed in 2023 its commitment to enhancing societal decision making across a spectrum of critical domains. Thus, CEOS will continue its support of a wide range of Space2030 topics.

At Plenary, CEOS Principals adopted the 2023 Communication Strategy, outlining campaigns for 2024-25. Leadership appointments included the endorsement of the United Kingdom Space Agency (UKSA) as the 2025 CEOS Chair and NASA as SIT Vice Chair for 2024-2025 and SIT Chair for 2026-2027. As the incoming 2024-2025 SIT Chair, JAXA highlighted priorities related to climate policy impact and Greenhouse Gas observations from space. The Canadian Space Agency (CSA) assumed the role of the 2024 CEOS Chair, focusing on biodiversity from space and associated external stakeholder engagement. Finally, the CEOS Plenary endorsed and welcomed Environment and Climate Change Canada (ECCC) as a CEOS Associate.

To serve these priorities and achieve its objectives, CEOS will reinforce satellite mission coordination, particularly through the CEOS Virtual Constellation activities, whilst also supporting technical and scientific collaboration through the Working Groups. This will improve the interoperability and compatibility of EO and data management systems among CEOS member agencies, thus maximizing societal benefits. In this way, CEOS remains dedicated to advancing the frontiers of space-based Earth observation to benefit society and address global challenges.

Looking ahead to the years 2024-2026, the current Work Plan provides a high-level summary of planned CEOS activities. In that regard it guides the upcoming activities of CEOS in this timeframe, whereas more detailed plans are developed at the level of CEOS Virtual Constellations, Working Groups, and Ad Hoc Teams.

# **3.Expected Outcomes for 2024-2026**

The expected outcomes for 2024-2026 reflect the ongoing and emerging priorities of CEOS, as characterised by its internal decision making and external commitments. They are intended to focus on improved Earth observation systems coordination and enhanced data access for key global programmes and initiatives.  The main outcomes are described for the following areas:

3.1. Climate Monitoring, Research, and Services

3.2. Carbon Observations in Support of Climate Science and Policy

3.3. Observations in Support of the Global Stocktake of the UNFCCC

3.4. Observations for Agriculture

3.5. Observations for Disasters

3.6. Observations for Water

3.7. Data Quality

3.8. Capacity Building and Data Democracy

3.9. Data Discovery, Access, Preservation, Usability and Exploitation:
approaches, systems, tools and technologies

3.10. Advancement of the CEOS Virtual Constellations

3.11. Support to Other Key Stakeholder Initiatives

3.12. CEOS Services

The projected outcomes for each thematic area are summarised in short introductory paragraphs that list the objectives / deliverables to be pursued in the three-year period of the Work Plan. A table indicating Objective / Deliverable Number, Title, Projected Completion Date (indicated by quarter of the calendar year) and Responsible CEOS Entities concludes each section.

This Work Plan is expected to be a companion document to the CEOS Deliverables Online Tracking Tool, which captures the most current information available for each Objective / Deliverable, including detailed descriptions of the Objective / Deliverable, background information, status, projected outcomes, connections to other CEOS external partners and entities, and other important information.

CEOS operates on a best-efforts basis. Responsible CEOS Entities are expected to accomplish the Objectives / Deliverables identified in this document and the Online Tracking Tool to the best of their abilities. The CEOS Deliverables Online Tracking Tool (accessible via <https://ceos.org/tracking/>), captures significantly more information than presented in this Work Plan. It is particularly important for CEOS Deliverables to have an identified external link, i.e., to a particular GEO Work Programme Flagship / Initiative / Community Activity[[2]](#footnote-2) or an activity connected to UNFCCC / UNCBD / UNCCD etc.

## **3.1 Climate Monitoring, Research, and Services**

CEOS and the Coordination Group for Meteorological Satellites (CGMS) work together, through the Joint CEOS/CGMS Working Group on Climate (WGClimate), to facilitate climate measurements, science and monitoring from space through the coordinated planning, tracking, production, improvement, sustainment and availability of space-based climate data records. This work is focused on implementation of the *Strategy Towards an Architecture for Climate Monitoring from Space* (hereafter referred to as the *Architecture*) developed and endorsed by CEOS, CGMS and the World Meteorological Organization (WMO). Further, in 2018 WGClimate chartered a Greenhouse Gas (GHG) Task Team focused on supporting the Global Stocktakes required by the *UNFCCC Paris Agreement*, signed in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC).

The following sections summarise activity from the perspective of CEOS contributions to the joint effort, as well as CEOS-specific activities in the climate domain.

As part of its sustained annual activities, WGClimate will:

* Deliver the annual Space Agency Statement to the UNFCCC Subsidiary Body of Scientific and Technological Advice (UNFCCC/SBSTA). The Statement is provided to the CEOS Chair Team for submission to the SBSTA meeting at the COP. WGClimate will also provide a summary version for oral presentation to SBSTA.
* Leverage its comprehensive Essential Climate Variable (ECV) Inventory of Climate Data Records (CDRs) and implement coordinated actions arising from Inventory gap analyses. The gap analyses identify opportunities for improvement of data records and their usage along the climate information value chain outlined by the *Architecture*.
* Examine the ECV Inventory to identify issues in the future availability of measurements for the Global Climate Observing System (GCOS) ECVs as described in GCOS Implementation Plans. As issues are found, WGClimate will initiate mitigation actions by improving coordination on long-term mission planning. Additionally, WGClimate will leverage the ECV Inventory to communicate progress of the satellite coordination community within the United Nations system and more broadly.
* Coordinate CEOS and CGMS activities towards the definition and implementation of an integrated operational global carbon observing system, including a system for monitoring the column concentrations of CO2, CH4 and other greenhouse gases from space. In 2020, CEOS and CGMS endorsed the Greenhouse Gas Roadmap. Together with the GHG Task Team, WGClimate will coordinate progress on and provide updates to tasks stated in its Annex. This involves collaborative work with the UNFCCC Subsidiary Body of Scientific and Technological Advice (SBSTA) and GCOS in support of the Paris Agreement.
* Continue to publish online use cases for climate data records to encourage wider application of the use of satellite observations. This activity effectively validates the *Architecture* and fosters usage of satellite-derived CDRs.
* Provide oversight to the continuing implementation of GHG monitoring activities.

During **2024**, WGClimate additionally will:

* **Continue development of the Space Agency Response** to the 2022 GCOS Implementation Plan. Per the plan and 2023 schedule, WGClimate has already responded to nearly half of the GCOS IP recommendations to the GCOS Secretariat. The Space Agency Response provides status and plans on IP recommendations for space observations and climate products.
* **Update the ECV Inventory** with ~50 previously submitted CDR records. This update will bring the Inventory further up to present.
* Continue **restructuring of the ECV Inventory** architecture and processes, including population, review and gap analyses protocols. This overhaul will reduce the complexity, maintenance costs and the submission and reviewing burdens on the providers and the community.
* Submit an updated **Gap Analysis Report** to CEOS and CGMS Principals. This Report will encapsulate information gleaned from the prior two Gap Analyses as well as update information gathered through the current development of the Space Agency Response to the 2022 GCOP IP.
* Submit an updated **Coordinated Action Plan** to CEOS and CGMS Principals. This Plan will leverage information in the 2024 Gap Analyses Report and the current development of the Space Agency Response to the 2022 GCOP IP.
* Submit a **CDR Definitions manuscript** for publication in a peer-reviewed journal. Providing a common and coherent set of definitions will help improve communications among Agencies, organisations and technical teams.

For **2025-2026**, significant outputs beyond the annual activities listed above will include:

* Submit the completed **Space Agency Response to the 2022 GCOS IP** to the CEOS and CGMS Principals.
* Release the **restructured ECV Inventory** and complete the first Inventory record update with the new structures.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| CMRS-19-06 | Implement Coordinated Actions 5 on FCDR Inventory, 6 on nomenclature document for CDRs, 10 on meta data standards | 2024 Q2 | WGClimate |
| CMRS-23-04 | Provide Agency Response to GCOP IP | 2024 Q4 | WGClimate |
| CMRS-24-01 | Update and align WGClimate website instances (CEOS, CGMS, climatemonitoring.info) | 2024 Q4 | WGClimate |
| CMRS-24-02 | Update ECV Inventory content with previously-submitted records (~50) | 2024 Q4 | WGClimate |
| CMRS-24-03 | Restructure ECV Inventory architecture and processes for population, review, gap analysis | 2025 Q3 | WGClimate |
| CMRS-24-04 | Submit manuscript with updated definitions of FCDR; CDR; ICDR | 2024 Q4 | WGClimate |
| CMRS-24-05 | Submit Merged Gap Analysis Report to CGMS and CEOS Principals for approval | 2024 Q3 | WGClimate |
| CMRS-24-06 | Submit 2024 Coordinated Action Plan to CGMS and CEOS Principals for approval | 2024 Q3 | WGClimate |
| CMRS-24-07 | Document GST1 lessons learned and GST2 recommendations (Lead for this activity is pending SIT-39 discussion and decisions) | 2025 Q4 | WGClimate |

## **3.2.** **Carbon Observations in support of Climate Science and Policy**

1. **Coordinate space-based observations to support the effective monitoring and management of the world’s forested regions in support of international climate agreements and the Data Component of the GEO Global Forest Observations Initiative (GFOI).**

Through the LSI-VC Forests and Biomass (LSI F&B) Team, CEOS is coordinating the implementation of the CEOS Strategy for Space Data for GFOI (endorsed by CEOS Plenary in 2011) for the provision of satellite observations in support of the development of national forest monitoring and measurement, reporting and verification (MRV) systems. This strategy will evolve to reflect changes in relevant CEOS Agency mission plans and to include coordination of the missions contributing to estimations of above-ground biomass (AGB). This new generation of missions, amounting to an investment of more than $US4bn by CEOS Agencies, is of significant interest to countries and institutions seeking to estimate avoided carbon emissions through incentive schemes such as REDD+. The LSI F&B Team proposes to support the accelerated policy relevance of the data from these missions by facilitating interaction between the GFOI community and technical CEOS communities, such as those pioneering the CEOS Biomass Protocol in the Working Group on Calibration and Validation (WGCV) Land Product Validation (LPV) subgroup, as well as the outreach and engagement defined and implemented through the CEOS AFOLU Roadmap.

**2024-2025:**

The LSI F&B Team will develop an action plan under the CEOS AFOLU Roadmap (endorsed at the 2023 CEOS Plenary in Chaing Rai) to support the 2nd UNFCCC Global Stock Take process in 2028. The team will also ensure our products support the AFOLU sector in a harmonized way through four thematic product teams, such as Above Ground Biomass (AGB), Land Cover, Wetlands and Mangroves. It will continue to steward the updated GFOI Data Strategy and to progress the priority initiatives identified concerning the policy relevance of AGB estimation missions.

The LSI F&B Team will seek to ensure that the work of CEOS in support of GFOI is consistent with and supportive of, the broader CEOS Carbon Strategy activities, including the *CEOS Strategy to Support the Global Stocktake of the UNFCCC Paris Agreement*.

1. **Implementation progress of the CEOS Strategy for Carbon Observations from Space**

In 2014, CEOS endorsed the *CEOS Strategy for Carbon Observations from Space* in response to the *GEO Carbon Strategy* (CARB). The CEOS strategy addresses three domains — atmospheric, oceanic and terrestrial — and their interfaces, and identifies a number of recommended actions to be completed by space agencies.

At the 30th CEOS Plenary Meeting, CEOS determined several targeted initiatives to advance the implementation of the *CEOS Strategy for Carbon Observations from Space*. These initiatives are crosscutting in nature and address numerous actions in the strategy. The initiatives cover a broad range of CEOS WGs and VCs and are addressed by the CARB objectives/deliverables.

In 2018, an expert CEOS team published a White Paper on a GHG monitoring constellation, which provided a blueprint for CEOS and CGMS Agencies to address the needs for GHG observations, driven by the Paris Agreement, over the next decade. Based on the GHG Constellation White Paper, WGClimate provided a roadmap and planning document, as approved by the CEOS and CGMS plenaries in 2020, to help coordinate the implementation of the GHG Constellation, including delivery of prototype GHG inventory products in late 2021 in support of the first Global Stocktake (GST). In parallel, the LSI F&B team delivered a number of Agriculture, Forestry and Other Land Use (AFOLU) products, in support of the GST, in time for promotion at COP-26 in November 2021. Both the GHG and AFOLU products were provided through the CEOS GST Portal (<https://ceos.org/gst>) along with technical explanations and user guidance. In 2023, the GHG Task Team has revisited the Annex C with actions of the GHG Roadmap. This Annex has been updated.

**2024-2025:** The GHG and AFOLU roadmaps foresee a long-term commitment to the further refinement of CEOS Agency data products in support of the GST process. Given emerging new stakeholders and an evolving community, the GHG Roadmap will be fully updated and issue 2 will be generated in 2024. This update will highlight the role of CEOS and other stakeholders and how this is expected to evolve during the implementation phase of new entities like WMO’s Global Greenhouse Gas Watch (G3W) and UNEP’s International Methane Observatory (IMEO) with its related Methane Alert Response System (MARS). Further implementation actions can be expected, including efforts to promote, educate and build capacity as we learn from the first GST and move toward supporting the second GST. While the initial GHG Roadmap focus was to support the Global Stocktake, the next issue of the GHG Roadmap will widen its view seeking new stakeholders, to better understand their needs and support them with required GHG data. Concretely for CO2 to reach out to policymakers at smaller spatial and temporal scales (covenant of mayors, finance sectors), and for CH4 to also reach policymakers, and stakeholders of non-oil and gas related emissions, e.g. landfills, wetlands.

The GHG task team will also work with space agencies and private partners to ensure GHG product continuity from future satellite missions. A set of standards for uncertainty reporting of flux estimation will also be developed to facilitate future product intercomparison. Calibrated and validated harmonised products from multiple sensors and multiple agencies can provide seamless long-term, frequent and intense global data for GHG monitoring. The WGCV hopes to work in the coming years with the GHG community to perform intercomparison of both radiance and retrieved GHG density levels, undertake calibration and validation (cal/val) campaigns, and provide common standard cal/val datasets. The GHG task team, together with the WGCV, will continue to secure and support sustainability, quality of, and timely access to HGH ground networks in support of the CO2 MVS, such as TCCON, COCCON and ICOS.

Depending on the outcomes of the CEOS GST Strategy discussion, further thematic coordination plans might be expected to emerge including those related to ocean carbon.

1. **Pursue an integrated carbon cycle interface between CEOS and the UNFCCC**

CEOS made significant efforts to the UNFCCC Global Stocktake (GST) process to demonstrate the policy relevance of EO satellite data and to plan for dataset inputs to the first and second global stocktakes (in 2023 and 2028 respectively) that will support the policy process. CEOS needs to move forward to the 2nd GST process but also consider how to engage appropriate climate stakeholders. In doing so, the SIT Chair set two priorities in 2024-2025:

1. Climate Policy Impact – addressing obstacles and opportunities for CEOS agency data, particularly AFOLU/Biomass map datasets, to have maximum impact in the key climate policy processes such as the Global Stocktake of the Paris Agreement.
2. GHG observations from space - addressing coordination for data continuity challenges ahead and developing good practice so that different operators may contribute to societal needs

**2024:** A number of measures can be expected regarding the planning and provision of space-based datasets for use in the GST process, including results from the work of the GHG and AFOLU Roadmap activities, related measures recommended by the GST Strategy paper, and GFOI support from the LSI F&B team. Specific GST recommendations and deliverables are set out in Section 3.3.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| CARB-17-05 | Cal/Val and production of biomass products from CEOS Agency missions | 2023 Q4 | WGCV |
| CARB-19-02 | Phase II R&D Program for GFOI | 2024 Q1 | LSI-VC F&B TeamCEOS GFOI Lead |
| CARB-19-03 | Early Warning Module for GFOI | 2023 Q2 | LSI-VC F&B TeamCEOS GFOI Lead |
| CARB-19-04 | Forest Biomass measurements for GFOI countries | 2023 Q4 | WGCVLSI-VC F&B TeamCEOS GFOI Lead |
| CARB-20-01 | Develop a CEOS AFOLU roadmap | 2023 Q2 | LSI-VC F&B TeamSIT ChairLSI-VC GEOGLAM TeamWGClimate GHG Task Team |
| CARB-20-02 | Integrated Carbon Cycle interface between CEOS and the UNFCCC | 2023 Q1 | WGClimateWGClimate GHG Task TeamSIT ChairCEOS GFOI LeadLSI-VC GEOGLAM Team |
| CARB-20-05 | Support and encourage space data uptake in GFOI countries | 2023 Q4 | LSI-VC F&B Team |
| CARB-21-01 | GST1 Prototype Products and Guidance | 2023 Q4 | LSI-VC F&B TeamWGClimate GHG Task TeamSIT Chair |
| CARB-22-01 | Production of harmonised biomass products from CEOS Agency missions | 2024 Q4 | WGCV LPV |
| CARB-23-05 | New Space and GHG product development and standards setting | 2024 Q1 | WGClimate GHG Task Team |
| CARB-24-01 | Generate issue 2 of GHG Roadmap | 2024 Q4 | WGClimate GHG Task Team |
| CARB-24-02 | Define interface between CEOS & G3W during its implementation phase | 2025 Q2 | WGClimate GHG Task Team |
| CARB-24-03 | Implement interfaces between CEOS & IMEO | 2025 Q2 | WGClimate GHG Task Team |
| CARB-24-04 | Facilitate new stakeholders with GHG data | 2025 Q4 | WGClimate GHG Task TeamSIT ChairWGClimate |
| CARB-24-05 | Create a governance to collaborate across GHG, AFOLU and aquatic carbon roadmap activities | 2024 Q4 | WGClimate GHG Task TeamLSI-VC Forests TeamOCR-VCSIT ChairWGClimate |

## **3.3 Observations in support of the Global Stocktake of the UNFCCC**

Article 14 of the 2015 Paris Agreement among Parties to theUNFCCCsets out the concept of the Global Stocktake (GST) to evaluate global progress towards the goals of the Agreement. The outcome of the GST will inform the preparation of subsequent Nationally Determined Contributions (NDCs) to allow for increased ambition and climate action to achieve the purpose of the Paris Agreement and its long-term goals. CEOS Agencies have coordinated their efforts to support the first GST (in 2023) and CEOS needs to consider the outcomes of the first GST towards subsequent GSTs (due every five years thereafter).

The substantive elements of the GST of particular interest to CEOS are:

* Mitigation, i.e., reporting, measurement, and tracking the progressive decrease in national GHG emissions,
* Adaptation to ongoing climate change and its consequences and impacts,
* Finance of mechanisms to support the Paris Agreement, and
* Equity among Parties for implementation (this last being implicit in the process).

The GST strategy paper sets out a series of recommendations for action, taking into account CEOS capabilities and interests, and building on existing efforts where appropriate. The recommendations are as follows:

1. WGClimate and WGClimate GHG Task Team should consult with the relevant elements of CEOS, including Associates such as ISC, WCRP and GCOS, together with modelers, to check the GHG Implementation roadmap on completeness concerning requirements for terrestrial observation (SIF, NPP, land cover, biomass, etc.) for supporting mitigation actions through the development of Monitoring and Verification System (MVS). The actions in Annex C of the roadmap shall be complemented as needed.
2. The need for parallel inputs to ocean models deemed necessary for the support of MVS and for a wider validation of carbon flux estimates globally should be considered and appropriately combined into the actions in Annex C of the GHG roadmap.
3. The results of the actions from the above recommendations should inform (a) the report of CEOS to UNFCCC (e.g., SBSTA/RSO (Research and Systematic Observation) discussion on observation to support the implementation of the Paris Agreement) and should pro-actively flow (b) into the consultation process of the *ad hoc* group for the Synthesis Report on Observations for the GST.
4. CEOS should consider, in conjunction with modelers, setting up one or more focused observational campaigns in the areas suggested above, or others, as a major contribution to the understanding of the trends of GHG emissions from natural sources in key areas.
5. The AFOLU roadmap team should continue the work it has started for CEOS, reflecting the decisions taken at CEOS Plenary 2020. The AFOLU roadmap team and WGClimate GHG Task Team should work together to ensure consistency between data for emissions reported via AFOLU and for prior biogenic terrestrial emissions, and those due to changing land use, in implementing monitoring and verification systems. These need to be consistent on both temporal and spatial scales. The WGClimate GHG Task Team should ensure that their Roadmap is consistent with the outcomes of this discussion.
6. It is recommended that, to help in ensuring the take-up of satellite-based methods for AFOLU (and indeed in the context of MVS), CEOS should work with a few selected demonstrator countries to assist them in their national reporting under AFOLU (the model of GFOI can be compared). USGS through its SilvaCarbon programme would be well placed to lead this.
7. CEOS should work with the various partners set out above to identify data requirements and actions for CEOS in relation to adaptation, including participation of relevant CEOS groups such as WGClimate and WGDisasters. Case studies might be of value to demonstrate competence and relevance. Partnership with specific countries in implementing their National Adaptation Plans (NAPs) could be of value, as in the case of AFOLU above, both to demonstrate worked examples and to strengthen support for this approach at UNFCCC, including at COPs.
8. CEOS should maintain a watch over the implementation of projects funded through climate fund mechanisms to ensure that all appropriate assistance is given by agencies in their implementation and governance.
9. CEOS must continue all efforts to provide the necessary climate data records that support the assessment of the actual status of the climate and the prediction and projection of future climate change, its response to changing GHG emissions and other drivers, and the impacts of climate change.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| GST-22-02 | Ensure that the products from terrestrial observations needed to derive biogenic emissions as priors for Monitoring and Verification System (MVS) such as CO2MVS are considered in the GHG TT Roadmap Annex C. | 2023 Q2 | WGClimate GHG Task TeamLSI-VC |
| GST-22-03 | Ensure that the products from oceanic observations needed to derive biogenic emissions as priors for Monitoring and Verification System (MVS) such as CoMVS are considered in the GHG TT Roadmap Annex C. | 2023 Q4 | COAST AHTOCR-VCSST-VCWGClimate |
| GST-22-04 | Deliver results of GST Strategy actions to key meetings in the UNFCCC Calendar, including SBSTA and COP, and meetings of the GST Ad hoc group for the Synthesis Report on Observations for the GST. | 2023 Q4 | WGClimateWGClimate GHG Task Team |
| GST-22-06 | GHG TT and AFOLU Roadmap Team to ensure their plans are consistent with each other in treatment of relevant areas. | 2023 Q4 | LSI-VC F&B TeamWGClimate GHG Task team |
| GST-22-07 | Establish National Inventory Test User Group and channels for country feedback on CEOS products and their application. | 2024 Q3 | LSI-VC F&B Team |

## **3.4 Observations for Agriculture**

The GEO Global Agricultural Monitoring Initiative (GEOGLAM) aims to enhance agricultural production estimates using Earth observations to address concerns raised by the G20 Agricultural Ministers about market volatility for the world’s major crops, as well as to provide early warning of crop shortages and failures in countries most at risk of food insecurity.

1. **Respond to the Group on Earth Observations Global Agricultural Monitoring (GEOGLAM) community’s articulation of satellite data requirements for monitoring agriculture.**

GEOGLAM has thrice published its Earth observation requirements, with each subsequent revision adding complexity and precision:

1. **2012**: First version, simplified
2. **2016**: Second version, better representation of variables and new mission capabilities
3. **2019**: A more holistic view of needs beyond acquisition and into accessibility and utilisation. An important component of this is GEOGLAM’s Essential Agricultural Variables (EAVs), which are Earth observation-based “building blocks” that in combination with one another or with other non-EO information support actionable, policy-required information on the state, change, and forecast of agricultural land use and productivity. GEOGLAM has learned from the ECVs and also leverages existing ECVs in meeting its G20+ mandate.

CEOS deliverable AGRI-19-04 reflects the 3rd update, although thesecond half of the action was not completed (“Production of these EAVs for GEOGLAM will require a long-term coordinated effort between GEOGLAM and the CEOS Working Group Calibration/Validation’s Land Product Validation (LPV) sub-group. It is proposed that in 2020 the mechanisms for such a collaboration are characterized.”)

GEOGLAM is recommending a “fresh start” and closing out AGRI-19-04 and AGRI-22-04, (“CEOS Response to GEOGLAM Requirements”) and better defining the areas of work moving forward. In that vein, GEOGLAM has drafted a White Paper in advance of SIT-39 that aims to spark awareness of a discussion among members of LSI-VC and the CEOS Principals, other Working Groups, and individual agencies to identify a strategic path forward to support GEOGLAM by aligning the conditions for the production of the EAVs as products or by supporting the production of the EAVs themselves (Figure 01).



**Figure 01: Possible realms of engagement between GEOGLAM and CEOS.** There is additional support toward EAV production supported by multiple space agencies individually, already. CEOS involvement in these “realms” would support GEOGLAM success directly and indirectly by ensuring GEOGLAM and individual CEOS agencies are aligned (Figure source: GEOGLAM Programme Scientist Alyssa Whitcraft)

Therefore, the proposed new actions for CEOS related to GEOGLAM are:

1. Identify agency contacts for the LSI-VC Subgroup on GEOGLAM. At present, there is minimal agency representation and engagement on agriculture.
2. Discuss and characterize the role of CEOS Working Groups to support GEOGLAM’s implementation of the EAVs. Example areas include, but are not limited to:
3. Assess gaps in satellite Earth observation capabilities in collaboration with CEOS, e.g. **SEO, MIM Database, USGS-RCA**
4. Identify gaps and opportunities for easing access to and utilization of satellite data in the production of EAVs. e.g. **WGISS**
5. Assess method status with respect to its quality and scalability/transferability.
6. Assess method quality, develop validation good practices via the GEOGLAM Initiative on Product Quality, e.g. through Community Workshops with **WG Cal-Val Land Product Validation Group**, one of which occurred in September 2023 around Good Practices for Cropland and Crop Type Mapping Validation, with support from ESA and NASA.
7. Identify the best mechanisms, timelines, and points of contact to increase harmonization between ECVs, EBVs, EAVs, and any other Essential Variables to optimize the value of space agency investments toward coordinated land monitoring.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| AGRI-19-04 | Iteratively respond to GEOGLAM EO Data Coordination team’s definitions of “Applications Ready Data” (ARD+) and “Essential Agricultural Variables for GEOGLAM” | 2024 Q4 | LSI-VC GEOGLAM Team |
| AGRI-22-02 | CEOS Response to GEOGLAM Requirements | 2024 Q4 | LSI-VC GEOGLAM Team |

## **3.5 Observations for Disasters**

The CEOS Working Group on Disasters (WG Disasters) ensures the sustained coordination of disaster-related activities undertaken by the CEOS Agencies and acts as an interface between CEOS and the community of stakeholders and users involved in risk management and disaster risk reduction.

Increased impacts of global climate change bring more frequent and extreme hydro-meteorological events, often leading to consequences such as landslides, flooding, drought, wildfires, or rising sea levels. These hazards and other traditional non-climate hazards such as volcanoes present enhanced opportunities for the EO community to demonstrate the unique scope and reach of satellites in support of the full cycle of risk management.

The primary objectives of the WG Disasters are:

* To promote new scientific advancements in disaster and risk sciences
* To support the efforts of Disaster Risk Management authorities in protecting lives and safeguarding property through satellite-based EO and science-based analyses
* To foster increased use of EO in support of Disaster Risk Management
* To support the implementation of the *United Nations Sendai Framework for Disaster Risk Reduction* (focusing on its Priority 1 “Understanding Risk”)
* To raise the awareness of politicians, decision makers, and major stakeholders (e.g., GEO, UN Agencies, donor institutions like the Asian Development Bank, World Bank/Global Fund for Disaster Risk Reduction, scientific communities, national resource management agencies, civil protection agencies, local decision makers, and others) of the benefits of using satellite EO in all phases of Disaster Risk Management.

In 2024, the WG Disasters will support the ongoing work of international initiatives, including GEO, to strive to increase the awareness of decision makers of the critical role of satellite EO, and reinforce the need for enhanced satellite EO programmes to better address Disaster Risk Management (DRM) needs. The WG Disasters has highlighted the importance of moving from technical demonstrations to sustained application of EO for improved risk management. This is demonstrated by the approval by the CEOS Plenary in 2023 of two activities born of CEOS WG Disasters demonstrators: G-VEWERS (Global Volcano Early Warning and Eruption Response System) and the pre-operational Recovery Observatory. The move toward a more permanent effort with regard to volcano monitoring and value-added information provision for disaster recovery is a significant step forward.

* Recovery Observatory. Beginning with a transition from a CEOS-led RO to a DRM stakeholder-led RO in 2024, the RO aims to establish 2-4 Recovery Observatories (ROs) globally per year. The Recovery Observatory was recently recognised by the UN General Assembly in the framework of the Space 2030 Agenda as “a means to increase the contribution of satellite data to recovery from natural disasters” and to contribute to Sendai Framework priority 4: Build Back Better. The WG Disasters intends to build on this recognition by engaging new partners to support this critical phase of risk management.
* G-VEWERS. An incremental approach for global monitoring with scalable options for implementation will be presented. As a result, monitoring for volcanoes globally could accelerate, ensuring risk reduction and improved volcano response.

In 2024, final reports are expected from the Wildfire Pilot, the Flood Pilot and the Landslide Demonstrator. In addition, the WG Disasters has kicked off a preparedness pilot in Tonga.

A further new initiative concerning Seismic Risk, including Hazard and Exposure mapping and the generation of products for immediate use by decision makers, will be started in 2024. Sustainable application of EO is achievable with increased visibility within donor communities and a strong appeal for support from committed end users. This effort is well underway with the three demonstrators listed above.

The WG Disasters will continue to support the GEO Geohazard Supersites and Natural Laboratories initiative (GSNL) with data and/or resources data hosting or processing (e.g., via the Network of Resources of ESA). GSNL aims at improving the monitoring and management of seismic and volcanic hazards, providing access to new EO data and capacities, especially in developing countries e.g., Africa and the Latin America and Caribbean (LAC) region.

Other GEO activity is described in the EO4DRM initiative. The demonstrators previously mentioned fall under this scope. EO4DRM has several key thematic demonstrators reaching maturity; each demonstrator presents specific sustainability challenges and requires a dedicated approach.

* Operational Landslide Monitoring and Next-generation Landslide Science. Targeted local applications at commercial maturity with private partners but that have a global approach requires renewed science commitment.
* The GEO/LEO/SAR Flood Pilot will report on effective best practices and value of data and methodologies shared by pilot team members to CEOS Member Agencies. It will also explore how to effectively improve flood risk management with the use of Earth observation from satellites.
* The Wildfire Pilot will complete its study of user needs and the definition of the final pilot deliverables geared towards integrating satellite-based EO observations in support of global fire monitoring. All demonstrator activities will produce reports in accordance with specified WG Disasters Deliverables.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| DIS-15-04 | Implementation of data coordination for the GEO GSNL initiative | 2030 Q4 | WG Disasters |
| DIS-20-01 | CEOS Contribution to GEO GSNL Initiative for DRR | 2024 Q4 | WG Disasters |
| DIS-20-02 | GNSL evolution feasibility study | 2024 Q4 | WG Disasters |
| DIS-20-04 | Landslide demonstrator showing value of combining optical and radar data for multi and cascading hazard disaster risk prediction and assessment products (maps and models in areas of high known risk due to activity, exposure and vulnerability), with report on effective practices, key data and practices. | 2024 Q4 | WG Disasters |
| DIS-22-01 | Flood Pilot with GEO-LEO-SAR “Understanding Flood Risk from Space” | 2024 Q4 | WG Disasters |
| DIS-22-04 | Wildfire Pilot Final Report | 2024 Q4 | WG Disasters |
| DIS-24-01 | G-VEWERS – Global Volcano Early Warning and Eruption Response System | 2030 Q4 | WG Disasters |
| DIS-24-02 | Pre-operational RO | 2026 Q4 | WG Disasters |
| DIS-24-03 | Tonga Preparedness Pilot | 2024 Q4 | WG Disasters |
| DIS-24-04 | Data provision to the GEO GSNL initiative | 2030 Q4 | WG Disasters |
| DIS-24-05 | GEO-GSNL contribution to the WGDisasters | 2030 Q4 | WG Disasters |

## **3.6 Observations for Water**

The CEOS Working Group for Information Systems and Services (WGISS) and Land Surface Imaging Virtual Constellation (LSI-VC) have been working with GEO AquaWatch to develop a suspended sediment regional Aquatic Analysis Ready Data (ARD) product. An ARD product is generated from raw data and processed so that it can be used without the need for further processing to be applied by users. In the context of water quality, ARD is defined as the systematic radiometric, atmospherically, geometrically, and spatially corrected full archive EO datasets of normalised water leaving radiance or reflectance.  Through participation in the COAST ad hoc Team, GEO AquaWatch will leverage and benefit from the CEOS Earth Analytics Interoperability Lab (EAIL) to compare the ARD implementation approaches.  This comparison will be about developing an aquatic ARD like the existing CEOS ARD for Land (CARD4L) approach in which 1) definitions are established for all criteria, operations, functions that are applied to top of the atmosphere (TOA) EO data, and 2) the various ARD approaches will then be compared in every step they perform to produce ARD data over inland and coastal waters. WGISS and LSI-VC will collaborate with GEO AquaWatch to:

* Define the Product Family Specifications (PFS) for aquatic ARD through discussions with the aquatic community,
* Ensure the interoperability of multi-sensor ARD data and data cubes through communication of good practices to the global water quality community,  and
* Assist in scoping of a potential cloud-based processing of ARD which could be versioned so that downstream users can select alternatives and versioning of Analysis Ready Data.

Deliverables related to the above activities are detailed in sections 3.10 and 3.11.

## **3.7 Data Quality**

The CEOS Working Group on Calibration and Validation (WGCV) continues to evaluate and recommend best practices for the characterisation/calibration of satellite-based sensors, and the validation of satellite-based EO data products. The results of this work are the calibration and validation building blocks for data and tools that underpin the work of the Virtual Constellations and other Working Groups. For these underpinning activities, different tasks are focused within subgroups focused on specific areas of interest.

* The WGCV supports six Subgroups that operate as individual entities and focus on specific technical areas related to calibration and validation as follows:
* [Atmospheric Composition (ACSG)](https://ceos.org/ourwork/workinggroups/wgcv/subgroups/acsg/)
* [Infrared Visible Optical Sensors (IVOS)](https://ceos.org/ourwork/workinggroups/wgcv/subgroups/ivos/)
* [Land Product Validation (LPV)](https://ceos.org/ourwork/workinggroups/wgcv/subgroups/lpv/)
* [Microwave Sensors (MSSG)](https://ceos.org/ourwork/workinggroups/wgcv/subgroups/mssg/)
* [Synthetic Aperture Radar (SAR)](https://ceos.org/ourwork/workinggroups/wgcv/subgroups/sar/)
* [Terrain Mapping (TMSG)](https://ceos.org/ourwork/workinggroups/wgcv/subgroups/tmsg/)

I. Coordinate and contribute to the development of suitable methodologies for the on-ground characterisation of satellite-based EO sensors, the on-orbit calibration of EO missions, and the validation of satellite-based Level 1 and Level 2 products.

2024-2026: The calibration of missions in the thermal infrared domain is becoming increasingly important, with several CEOS agencies working on future missions in this area. This includes SBG (Surface Biology and Geology) (NASA), Copernicus LSTM (Land Surface Temperature Monitoring) (ESA/COM) and Trishna (CNES/ISRO). A team of experts from the IVOS and LPV subgroups is conducting a study to determine the necessary characteristics of sites and their instrumentation to produce a derived brightness temperature signal at top of atmosphere with the highest possible accuracy while minimising any associated uncertainties. The team has also identified an inventory of potential sites that fulfil or could fulfil these criteria and provide a roadmap toward the establishment of what is being called TIRCalNet, following the past example of RADCalNet. The first progress meeting was held in January 2024 with CNES and JPL, the partnering agencies. They have committed to providing input data to the study from La Crau and Lake Tahoe sites respectively. There will be several deliverables during the study that will take ~18 to 24 months depending on progress and data availability. The most relevant deliverable would be the final report, constituting the roadmap towards an operational TIRCalNet, expected in 2026.

In the context of Synthetic Aperture Radar (SAR), the SARCalNet initiative aims to promote standardised SAR calibration and facilitate the harmonised implementation of cal/val tasks by a broad SAR community. It is crucial to have a network of curated calibration sites for SAR and well-established cal/val procedures. A team representing many SAR mission agencies has been working on documents to establish the requirements for SARCalNet. These documents include guidelines for artificial and natural targets; recommended minimum analysis of the imagery; as well as a handbook describing SARCalNet submission protocols and procedures. A subcommittee of users will actively curate the reference target submissions and produce an annual summary report. Calibration sites and targets might receive different levels of endorsement (and associated labels) depending on the completeness of provided information. Access to the SARCalNet website is currently restricted to the SARCalNet community for the testing phase and the calibration sites and targets database is evolving and populating.

There is a growing number of public and commercial providers offering high-resolution space-borne Earth observation data. To effectively utilise this data, it is important to understand its characteristics, calibration methods, and quality and technical capabilities. Interoperability between satellites and products will expand opportunities for global applications including agriculture, assessment of the water cycle, forest and vegetation monitoring, pollution monitoring, and climate. Data can be used together only if it is sufficiently characterised, therefore, harmonisation of calibration and validation approaches is fundamental. The WGCV will continue supporting New Space through its active participation in VH-RODA and JACIE workshops, as well as direct involvement through its various subgroup initiatives.

In 2024, WGCV will conduct pilot assessments for assessing cal/val measurements as Fiducial Reference Measurements (FRMs) based on the FRM assessment framework that has been developed and is made available on the [CEOS Cal/Val Portal](https://calvalportal.ceos.org/web/guest/frms-assessment-framework). FRM measurements should ideally have documented SI traceability (e.g., via round-robin characterisation and regular pre-and post-deployment calibration of instruments) using metrology standards or community recognised best practices. The uncertainty budget for all FRM instruments, and derived measurements, must be available and maintained. FRM measurement protocols, procedures and community-wide management practices like measurement, processing, archive, documents, etc. are defined, published and adhered to by FRM instrument deployments. The results of the pilot assessment will be discussed at the 2024 WGCV Plenary and will be published on the [CEOS Cal/Val Portal](https://calvalportal.ceos.org/).

The WGCV will continue to provide a framework for performing intercomparison exercises. The intercomparison frameworks have demonstrated to be successful and useful. ACIX – intercomparison of atmospheric correction scheme – is evolving towards hyperspectral using PRISMA and EnMap data. CMIX - Cloud Masking scheme intercomparison – is progressing with improvement in the validation approach using the SkyCam – ground-based sky camera network for validation on satellite-derived cloud masks. DEMIX - DEM intercomparison and impact on orthorectification process - is close to finalisation, a peer-reviewed publication has been submitted and the final report is expected in 2024. DEMIX will evolve toward GCPix aiming at providing and comparing GCP (Ground Control Point) for high resolution sensors. SRIX4VEG - Intercomparison of Surface reflectance for vegetation – the results have been presented at the 2023 November Workshop. SRIX4VEG II campaign was held in Australia in March 2024. Supported by the ACTRIS-CREGARS Research Infrastructure and under the auspices of the Network for the Detection of Atmospheric Composition Change (NDACC) the Third Cabauw Intercomparison of DOAS-like Instruments (Differential Optical Absorption Spectroscopy) with external referee (CINDI-3) will take place in the Netherlands in May-June 2024 with community-wide field intercomparison and certification of MAX-DOAS instruments, complemented by mobile-DOAS and airborne data (variability and tomography), PGN/Pandora, and a range of aerosols, ozone and other trace gases measurements. Finally, a match-up database for radiometric quality assessment is being developed that will support the quality assessment from New Space.

**II.** **Continue cooperation with Group on Earth Observations (GEO), Global Space-based Inter-calibration System (GSICS), and WMO and ground-based networks in the provision of high quality EO data products.**

2024-2026: The WGCV will continue to strengthen its cooperation with GSICS on the topic of sensor calibration. A joint workshop on pre-flight calibration and characterisation will be held on 19-22 November 2024. This workshop aims to review and assess requirements against current and future application needs as well as consider innovations in state-of-the-art calibration and characterisation methods and facilities. The conclusions drawn from the workshop will lead to the publication of a CEOS WGCV and CGMS-GSICS guidance document, proposing minimal/desirable characterisation requirements and the means (methods/facilities) to achieve them for various application and instrument types. The guidance will extend to consider optimum ways to document and report calibration and characterisation information, including the associated uncertainties and traceability to International System of Units (SI)[[3]](#footnote-3), in a manner that facilitates transparency to all stakeholders in a standardised manner. The guidance document, expected to be published within a year of the workshop, will primarily focus on the solar reflective domain and may include an appendix section related to the thermal infrared (TIR) domain.

Furthermore, a joint task team between WGCV and GSICS has been established to coordinate and ensure interoperability of the forthcoming SI-Traceable Satellites (SITSats). SITSats are envisioned to be the foundation for a future ‘international climate and calibration observatory’ and this new generation of explicitly designed satellites will help enable a new epoch in climate quality observations of the Earth. The joint task team will build on the workshop “SI-Traceable Space-based Climate Observing System: a CEOS and GSICS Workshop” held in London in September 2019, which assessed the benefits and requirements of a space-based climate observing system, summarising current measurement capabilities, climate-based needs, and future implementation plans. The SITSat Task team will develop a dedicated webpage on the CEOS Cal/Val Portal for SITSats. A prototype of this webpage is planned to be ready by 2024 to enhance collaboration and information dissemination within the community.

The WGCV will continue working with the GEO Secretariat, including work to support relevant GEO activities, mainly by encouraging the widespread adoption of quality assurance principles. The development of calibration and validation infrastructure and comparison campaigns within the frame of the WGCV will be used to promote these principles and best practices. The WGCV will continue to foster cooperation with WMO, ground-based networks, and CEOS WGs and VCs through dedicated presence during WGCV meetings and by reaching out to science users and data product providers in the atmosphere, terrestrial, and ocean communities.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| CV-14-03 | Workshop on state of the art for pre-flight calibration techniques | 2025 Q4 | WGCV |
| CV-17-01 | L1 top-of-atmosphere interoperability | 2025 Q4 | WGCV |
| CV-20-01 | Surface Reflectance measurements Intercomparison exercise for vegetation (SRIX 4Veg) | 2024 Q4 | WGCV |
| CV-20-03 | DEMIX | 2024 Q1 | ECESA |
| CV-22-01 | Validation protocols for atmospheric aerosol and cloud profiles | 2024 Q1 | WGCV ACSG |
| CV-22-02 | CEOS Terms and Definitions Wiki | 2024 Q4 | WGCV |
| CV-23-01 | Develop an FRM Assessment Framework | 2024 Q4 | WGCV |
| CV-23-02 | SARCalNet: Establishment of initial SARCalNet processesand network initiation | 2024 Q1 | WGCV SARSubgroup |
| CV-23-03 | TIRCALNET: Establishment of initial TIRCalNet processesand network initiation | 2026 Q4 | WGCV IVOSSubgroupWGCV LPVSubgroup |
| CV-23-04 | Launch of a GCP Intercomparison Exercise | 2024 Q4 | WGCV TMSG |
| CV-23-05 | Retrieval and validation of high winds with combinedactive-passive microwave measurements | 2025 Q2 | WGCV MSSG |
| CV-23-06 | Retrieval and validation of sea surface atmosphericpressure with microwave remote sensing | 2025 Q2 | WGCV MSSG |
| CV-24-01 | Third Cabauw Intercomparison of DAOS-like Instruments (CINDI-3) | 2025 Q1 | WGCV ACSG |
| CV-24-02 | Good Practices Protocol on Land Cover | 2025 Q3 | WGCV LPV |
| CV-24-03 | Good Practices Protocol on Vegetation Indices | 2024 Q3 | WGCV LPV |
| CV-24-04 | CEOS-ARD STAC Extension (SAR) | 2025 Q1 | WGCV LSI-VC |

## **3.8 Capacity Building and Data Democracy**

The CEOS Working Group for Capacity Building and Data Democracy focuses and unifies CEOS efforts towards providing intensive Earth observation awareness raising, capacity building, education and training in multiple formats; promoting wider and easier access to EO data; increasing the sharing of software tools such as the use of open source software and open systems interface; and increasing data dissemination capabilities, aiming at transferring relevant technologies to end users.

In 2024 the WGCapD will continue to increase its efforts at the global, regional and national level by building upon activities carried out in 2023. This will be done by delivering training in different formats (e.g., in-person, virtual), collaborating with other CEOS working groups, and developing new activities in support of GEO and the global disaster, environmental and sustainability agendas. New resources will be made available on the WGCapD webpages. The WGCapD annual meeting will be held online. In addition, the Earth Observation Training, Education, and Capacity Development Network (EOTEC DevNet), which aims to improve coordination among different space-based asset providers and training providers, will continue pursuing greater engagement of its regional communities of practice and will continue developing the network of networks; this work includes expanding on the flood tools tracker and the work done in the EOTEC DevNet Floods working group.

2024-2026: WGCapD will continue to address a global need for the identification and coordination of the world’s diverse and often disparate capacity building and training resources related to satellite Earth observations.

WGCapD divides its work into support to global, regional, national and infrastructure activities:

1. For **global work**:
* Focus on online learning through e-learning, MOOCs, webinars, challenges and blended learning approaches.
* EOTEC DevNet will continue connecting CEOS WGCapD with other global networks and will seek to achieve self-sustainability.
* Development of a curriculum using WGCapD produced resources is under preparation.
1. For **regional work**:
* Focus on support to regional GEOs: AfriGEO and AmeriGEO.
* Support trainings in conjunction with regional societies and other meetings.
* Leverage single-agency regional activities as possible.
1. For **national work**:
* Support national training where fitting.
* Strengthen our understanding of national needs in other thematic areas.
* Strengthening inclusiveness and support to underrepresented communities.
1. For **infrastructure**:
* Enablers, with a focus on sharing of best practices and resources, convening key stakeholders, and addressing user needs.
* Joint work with WGISS.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| ***Global Deliverables*** GEO to strengthen AmeriGEO and AfriGEO through training contributions at their respective meetings/workshops. |
| CB-22-07 | Open Source Science Outreach Plan and Training | 2023 Q4 | WGCapD |
| CB-23-03 | Guidance Document for Conducting Needs Assessments for Capacity-Building | 2024 Q1 | WGCapD |
| CB-23-04 | Open-Source Science Outreach Plan and Training in support of NASA's Transform to Open Science (TOPS) Initiative | 2024 Q2 | WGCapD |
| CB-23-06 | Recovery observatory for decision makers | 2023 Q4 | WGCapD a self-sustaining phase. |
| CB-23-08 | Recommendations on learning objects joint repositories and metadata standards for learning objects | 2024 Q2 | WGCapD |
| CB-24-01 | ESA/NASA Trans-Atlantic Training 11 | 2024 Q2 | WGCapD |
| CB-24-02 | ESA/ISRO PolSAR Training | 2024 Q4 | WGCapD |
| ***Regional Deliverables*** |
| CB-20-21 | Copernicus User Uptake in Africa | 2023 Q4 | WGCapD |
| CB-22-08 | Copernicus training of trainers in Africa | 2024 Q4 | WGCapD |
| CB-23-05 | Digital Earth Africa online courses: Water resources (English and French), Agriculture (English, French) | 2023 Q4 | WGCapD |
| CB-24-03 | Engage & empower South African youth to use EO for Economic Empowerment | 2025 Q1 | WGCapD |

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| ***National Deliverable*** |
| ***Infrastructure Deliverables*** |
| CB-20-07 | Best Practice Guide to E-Learning | 2024 Q2 | WGCapD |
| CB-22-10 | Sentinel Selected Applications: practical training with Jupyter Notebooks on the ESA EO Platform | 2023 Q4 | WGCapD |
| CB-22-12 | EOTEC DevNet Multi-Stakeholder Network Analysis | 2023 Q4 | WGCapD |
| CB-22-14 | EO Capacity Building Curriculum  | 2024 Q2 | WGCapD |
| CB-22-15 | Third Vietnam School of Earth Observation (VSoEO 3) | 2023 Q4 | WGCapD |

## **3.9 Data Discovery, Access, Preservation, Usability and Exploitation: approaches, systems, tools and technologies**

Through the CEOS Working Group on Information Systems and Services (WGISS), CEOS Agencies will continue to foster the enhancement of the WGISS Connected Data Assets Infrastructure to support not only the CEOS entities, but also external entities such as GEO, UN, WMO, etc., by enabling discovery and access capabilities to mature data services provided by CEOS Agencies.

The WGISS Data Discovery and Access Interest Group will support the adoption of supported WGISS standards e.g., Open Geospatial Consortium (OGC), Catalogue Service for the Web and CEOS OpenSearch Best Practices, and definition of new ones, with the aim of connecting as many CEOS agencies as possible into the federated system. The Interest Group is concerned with ensuring data users have easy and efficient ways of discovering and accessing data and associated services through the exploitation of standard protocols and the harmonizing of search and data retrieval processes.

The Interest Group will evaluate the possibility of defining a guideline/best practice for the Spatio Temporal Asset Catalog (STAC) at CEOS level and facilitate discussions on STAC integration with other CEOS groups including LSI-VC and the ARD-OG, as well as participate with external groups discussing STAC including OGC. With increased requests for federated collaborative environment to access data and services, the Interest Group intends to explore scenarios for a federated authentication and authorization mechanism.

Earth observation data represent a unique, valuable, independent, and strategic resource that needs to be preserved, managed and curated throughout its lifecycle to make sure it continues to provide essential information on our planet and the changes which are affecting it. The WGISS Data Preservation and Stewardship Interest Group continues to accomplish its data preservation and curation efforts through addressing space data and associated information archiving, preservation, consolidation, and valorisation aspects, including efforts to recover heritage data currently not accessible or at preservation risk.

The Interest Group will begin developing a white paper on EO data collections management and governance that will address topics including management of data collections in the cloud, preservation of collections, reproducibility of previous collections versions (algorithm availability), cross-collection validation, and general interoperability and governance approaches. The Interest Group will also begin development of a white paper to address and recommend techniques to ensure preservation and reusability of software tools related to EO missions.

The WGISS Technology Exploration Interest Group will survey cutting-edge technologies related to EO. Survey results will be summarised and issued as guidelines and best practices. The “Jupyter Notebook Best Practices” will be issued in 2024 by collaborating with WGCapD, UN, GEO, etc. Use cases of Artificial Intelligence / Machine Learning (AI/ML) focusing on EO research and applications will be investigated and summarised in a white paper also in 2024.

An interoperability framework for the CEOS community is essential due to the importance of EO data in a wide range of applications, including agriculture, climate change monitoring, disaster management, and urban planning, as well as the increasing cooperation of public and commercial space actors worldwide to meet this demand. As a result, the need for interoperability of EO, and more broadly geospatial, data and related information systems has become more critical than ever before.

The WGISS Data Interoperability and Use Interest Group was re-initiated in 2023 and developed a CEOS Interoperability Framework and initial Roadmap. In collaboration with various CEOS entities, the Interest Group will continue to evolve the roadmap and develop an Interoperability Handbook 2.0, which will lead to increased interoperability maturity for EO data.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| DATA-22-01 | Jupyter Notebook Best Practice | 2024 Q2 | WGISS |
| DATA-22-05 | Feasibility Study for Common Guidelines for the STAC Implementations | 2024 Q3 | WGISS |
| DATA-23-01 | AI/ML White Paper | 2024 Q4 | WGISS |
| DATA-24-01 | White Paper on EO Data collections management and governance | 2025 Q1 | WGISS |
| DATA-24-02 | White paper on Software preservation | 2025 Q2 | WGISS |
| DATA-24-03 | CEOS Interoperability Handbook 2.0 | 2025 Q1 | WGISS |

## **3.10 Advancement of the CEOS Virtual Constellations**

CEOS seeks to characterise the Virtual Constellations in the context of both the development of the space segment for GEOSS and of the multitude of outcomes and deliverables that CEOS seeks to provide for GEO and other users and frameworks.

**2024-2026:** Ensure that the Virtual Constellations (VCs) — Atmospheric Composition (AC- VC), Land Surface Imaging (LSI-VC), Ocean Colour Radiometry (OCR-VC), Ocean Surface Topography (OST-VC), Ocean Surface Vector Wind (OSVW-VC), Precipitation (P-VC), Sea Surface Temperature (SST-VC) — are accomplishing the outcomes and deliverables associated with the activities documented in the *CEOS Virtual Constellations Process Paper* and their respective terms of reference and implementation plans.

1. **AC-VC**

The CEOS Atmospheric Composition Virtual Constellation (AC-VC) exists to sustain a systematic capability to provide essential observations of atmospheric composition from space. Key objectives include coordination of the collection and delivery of data to improve predictive capabilities for changes in ozone layer, monitor air quality, and monitor climate forcing associated with changes in atmospheric composition.

The harmonization of tropospheric ozone datasets (VC-20-01) is progressing well. The achievements of the ongoing community effort Tropospheric Ozone Assessment Report, Phase II (TOAR-II, 2020-2024) were presented at a workshop in Q4 2023 and are being published in the TOAR-II Community Special Issue (ACP/AMT/BG/GMD inter-journal). The validation and harmonization of products from the air quality missions in orbit in particular TEMPO, GEMS and S5P/TROPOMI is progressing well. A joint Announcement of Opportunity Call for the validation of products from the future Sentinel-4 and Sentinel-5 will be released in spring 2024. While the validation efforts will continue, the parent Action VC-20-02 (validation coordination) and its children VC-20-03 (validation plans) and VC-20-04 (announcements of opportunity) can be closed. A review of the recommendations from the whitepaper on validation needs of the geostationary air quality constellation (Geo-AQ) has been initiated. The PM2.5 whitepaper is being followed up (VC-20-05). A roadmap is in the making with a roadmap pursuing the whitepaper recommendations and a presentation of use cases. AC-VC climate activities focus on the development and delivery of atmospheric Greenhouse Gas (GHG) Inventories and Observing System Simulation Experiments (OSSEs) to support the GHG Task Team within the Working Group on Climate. The next AC-VC meeting will be held in the second half of 2024. In 2024, AC-VC would also like to initiate a new white paper related to the remaining gaps in the geostationary ring of air quality satellites, in particular the lack of hourly satellite air quality observations over Africa and South America.

1. **LSI-VC**

The CEOS Land Surface Imaging Virtual Constellation (LSI-VC) is guided by a vision of sensor-agnostic land surface data from all missions, achieving observations that enable users to characterise change on the Earth’s surface through time.

LSI-VC championed the concept of CEOS Analysis Ready Data (CEOS-ARD) and continues to develop specifications for land surface products. In 2024 we aim to improve the discoverability and accessibility of CEOS-ARD by publishing a new CEOS-ARD STAC extension and also increase community participation and transparency with a new CEOS-ARD GitHub repository.

LSI-VC is also a key contributor to the CEOS-ARD Oversight Group, the CEOS-ARD Strategy (being updated in 2024), and the OGC ARD Standards Working Group, which will use CEOS-ARD as a basis for broader geospatial ARD standards.

In 2024 the LSI-VC is aiming to host its first workshop to engage with the commercial sector on CEOS-ARD and other land surface imaging topics. This is planned to take place in Tokyo, Japan, alongside LSI-VC-15 and will focus on the Japanese commercial EO sector.

LSI-VC also continues its work on land surface imaging gap and requirement analyses, with a focus on agriculture and forests (noted below, led by the LSI-VC Subgroups) as well as new activities in collaboration with WGClimate on Land Surface Temperature Climate Data Records and the Space Agency Response to the GCOS Implementation Plan.

Following the endorsement of the CEOS AFOLU Roadmap in 2023, the LSI-VC Forests & Biomass Subgroup now turns its attention to defining specific actions to implement the Roadmap and achieve the 2035 observing system required to address the AFOLU information needs of society.

The LSI-VC GEOGLAM (agriculture) Subgroup will serve as the forum for a CEOS response to the updated GEOGLAM observation requirements that are driven by the Essential Agricultural Variables (EAVs). The subgroup will seek to explore how the operational products required to achieve the agricultural monitoring ambitions of GEOGLAM might be met with the support of CEOS agencies.

1. **P-VC**

The CEOS Precipitation Virtual Constellation (P-VC) exists to sustain and enhance a systematic capability to observe, measure and validate global precipitation. These observations are essential to understand the distribution and characteristics of precipitation, its role in the hydrological/water cycle, and its impact on the climate system. Importantly, accurate and timely knowledge of global precipitation is needed to improve the prediction of high-impact weather events such as hurricanes, floods, droughts and landslides, as well as the management of freshwater resources and the interconnectivity with the Earth System (for example, crop yields and fire susceptibility). The spatial and temporal variability of precipitation necessitates the utilisation of data from multiple sensors on multiple satellites to ensure sufficient observations are available to provide representative sampling across the range of scales (spatially and temporally) as required by the research, operational and application-driven user communities.

The P-VC has the following strategic objectives to address this aim:

1. Provide a coordination mechanism to harmonise precipitation-capable satellite systems, data collection, processing and delivery, retrieval algorithms, and calibration/validation infrastructures,
2. Serve as a programmatic point of contact for precipitation measurements, addressing issues which go beyond the individual mission programmes,
3. Coordinate activities to develop and improve the knowledge and understanding of precipitation (rain and snow) processes, the distribution of precipitation and the changes in precipitation over time on a global basis, and
4. Support and engage the scientific and operational user communities.
5. **SST-VC**

The CEOS Sea Surface Temperature Virtual Constellation (SST-VC) provides a forum for collaboration on the production and coordination of sea surface temperature products across the international spectrum of remote sensing instruments, including infrared and microwave sensors on polar orbiting and geostationary platforms working closely with science team members from the Group for High Resolution Sea Surface Temperature (GHRSST) Project.

The SST-VC will continue to participate in and support the CEOS ARD Oversight Group and its related activities, including the emerging Open Geospatial Consortium (OGC) ARD Standards Working Group, and CEOS Interoperability initiatives. This will include working with the SIT chair and other CEOS-ARD interests to continue to evolve and improve the CEOS ARD Framework and Product Family Specification. The SST-VC will also continue participation in the Ocean Coordination group to bring expertise from the GHRSST project in data formats and metadata for marine products, remote sensing requirements in high latitude regions and other related activities. The SST-VC will look for areas to collaborate with the newly proposed COAST-VC, ensuring no overlap in work. The SST-VC will intend to expand participation to the team from the CEOS members by seeking additional engagements.

1. **OST-VC**

The goal of the CEOS Ocean Surface Topography Virtual Constellation (OST-VC) is to implement a sustained, systematic capability to observe the surface topography of global oceans. OST-VC links CEOS Agencies, the Ocean Surface Topography Science Team (OSTST) and the altimetry user community. It is suited to discuss constellation-wide programmatic issues and high-level constellation user requirements.

**2024-2025**: In 2024-2025, the OST-VC will seek to strengthen multi-mission collaboration, continue its yearly community meetings (OSTST meetings) where information about current and future missions will be shared.

1. **OCR-VC**

The focus of the CEOS Ocean Colour Radiometry Virtual Constellation (OCR-VC) is the monitoring and forecasting of Earth’s living aquatic environments. OCR provides information in three major application areas: climate, carbon and water quality.

OCR-VC activities for 2024 will focus on continuing the development of the Aquatic Carbon roadmap. Carbon-related activities include the Blue Carbon Workshop taking place early in 2024, whose outputs will feed into the roadmap. The OCR-VC will continue to contribute to the Aquatic Reflectance Product Family Specification for CEOS-ARD to extend it to all water types including seas and open oceans. Finally, in 2024, capacity building will continue to provide new resources and training to users.

OCR-VC activities for 2025-2026 will include the continuation of developing a coordinated multi-mission basis for OCR cal/val, including System Vicarious Calibration (SVC) infrastructures and protocols for bio-optical in situ measurements, as well as collect and synthesize feedback from users through the International Ocean Colour Symposium (IOCS) being held in 2025.

All OCR-VC activities and deliverables support the implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Colour Radiometry (INSITU-OCR).

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| VC-14-09 | Implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Colour Radiometry (INSITU-OCR) | 2026 Q4 | OCR-VC |
| VC-19-06 | Update of CEOS OST-VC User Requirements Document | 2024 Q4 | OST-VC |
| VC-20-01 | Tropospheric ozone dataset validation and harmonization | 2023 Q4 | AC-VC |
| VC-20-02 | Air quality constellation validation coordination | 2024 Q4 | AC-VCWGCV |
| VC-20-03 | Air quality constellation validation coordination: validation plans | 2023 Q2 | AC-VCWGCV |
| VC-20-04 | Air quality constellation validation coordination: announcements of opportunity | 2023 Q4 | AC-VCWGCV |
| VC-20-10 | CEOS–Industry ARD Workshop | 2024 Q2 | CEOS-ARD OGLSI-VCSIT Chair |
| VC-20-26 | System Vicarious Calibration (SVC) infrastructures in support of Climate-quality OCR data records | 2026 Q4 | OCR-VC |
| VC-20-27 | Development of protocols for bio-optical in situ measurements | 2026 Q4 | OCR-VC |
| VC-22-04 | Mission continuity timelines for land domain CEOS-ARD PFS | 2024 Q4 | LSI-VC |
| VC-23-01 | Aquatic Carbon roadmap | 2025 Q4 | OCR-VC |
| VC-23-02 | Blue Carbon Workshop | 2024 Q2 | OCR-VC |
| VC-23-03 | Aquatic reflectance ARD | 2024 Q1 | OCR-VC |
| VC-23-05 | CEOS-ARD Impact Case Studies | 2025 Q4 | CEOS-ARD OGLSI-VC |
| VC-23-06 | CEOS-ARD in the Cloud | 2025 Q4 | CEOS-ARD OGLSI-VCWGISS |
| VC-23-08 | CEOS Representation to the Open Geospatial Consortium (OGC) Analysis Ready Data (ARD) Standards Working Group (SWG) | 2025 Q4 | CEOS-ARD OGSEOWGCVWGISSLSI-VC |
| VC-23-09 | CEOS-ARD Community Building | 2025 Q4 | CEOS-ARD OGLSI-VC |
| VC-23-10 | Expansion of the Aquatic Reflectance CEOS-ARD PFS to Cover Oceans | 2023 Q4 | CEOS-ARD OGOCR-VCLSI-VC |
| VC-23-11 | LSI-VC Response to the Observation Requirements of the CEOS AFOLU Roadmap | 2025 Q4 | LSI-VCLSI-VC GEOGLAM TeamLSI-VC F&B Team |
| VC-23-12 | CEOS-ARD Product Family Specifications (PFSs) | 2024 Q4 | CEOS-ARD OGAll VCs |
| VC-23-13 | CEOS-ARD Product Assessments | 2024 Q4 | CEOS-ARD OGWGCVAll VCs |
| VC-24-01 | CEOS-ARD Strategy 2024 Implementation | 2026 Q4 | AC-VC |
| VC-24-02 | CEOS-ARD Github Repository | 2024 Q4 | LSI-VC |
| VC-24-03 | CEOS-ARD STAC Extension (Optical) | 2025 Q4 | LSI-VC |

## **3.11 Observations in support of the United Nations Sustainable Development Goals**

At the 35th CEOS Plenary in 2021, after five years of successful activities, the CEOS SDG *ad hoc* Team transitioned to a new permanent and coordinated home for the management of all CEOS activities related to the U.N. Sustainable Development Goals (SDGs). The **CEOS SDG Coordination Group (CEOS SDG CG)**, which includes representatives from the CEOS Strategic Implementation Team (SIT) Chair, the CEOS Systems Engineering Office (SEO), the CEOS Executive Officer (CEO), and other key members from the former SDG *ad hoc* Team. The CEOS SIT Chair provides strategic oversight to the Coordination Group, while the CEOS Systems Engineering Office (SEO) provides coordination and implementation leadership. The SEO coordinates SDG deliverables and work plan activities by liaising with all lead experts responsible for each SDG deliverable. The lead experts organize their technical capacity and support using a pool of experts (internal and/or external) connected to each SDG topic (e.g., current SDG indicator sub team members), CEOS existing groups (WG, VC, AHT), and SDG-related GEO Work Programme activities.

The SDG Coordination Group continued to focus its activities on four SDG indicators: 6.6.1 on water extent, 11.3.1 on urbanization, 14.1.1 on coastal eutrophication/marine pollution, and 15.3.1 on land degradation. It continues to provide support to UN custodian agencies and other strategic partners, by analyzing satellite data requirements and supply for key indicators upon request, and liaising with other CEOS groups (capacity building, ARD strategy, EO-enabling infrastructure, etc.) to harness CEOS collective expertise and maximize benefits for the CEOS Agencies and for the SDG stakeholder community.

**2024-2025**:

At the CEOS 37th Plenary in Thailand, the SDG Coordination Group delivered a face-to-face side-meeting to review deliverables status (2023) and planned activities for 2024. During the Plenary, the SEO reported on SDG activities, status progress and informed the Principals about upcoming planned deliverables for 2024 which includes the engagement with the Pacific Islands Countries and Territories (PICTs) through SPC (Pacific Community).

At three face-to-face meetings held in 2023, the Coordination Group reviewed their progress and presented to CEOS members, confirming the need for a coordinating body to ensure CEOS provides satellite data expertise to stakeholders including UN custodian Agencies (e.g. UNEP on water extent, UNCCD on land degradation, etc.), and in particular the Group on Earth Observations (GEO) which is focused on transitioning to implementation of the GEO Post-2025 Strategy. Following last year’s feedback, the SDG Coordination Group further engaged with other CEOS bodies (WGCapD, Ecosystem Extent, WG Climate) to ensure it promotes SDG efforts and leverages existing expertise across the organization. In this context, the Group agreed to maintain proposed activities for end-users, while exploring other activities aligning with CEOS strategic priorities and responding to external requests. For 2024 and beyond, the Group will:

* Ensure continuity with:
	+ **EO Support Sheets Review**: as key CEOS technical resources useful for SDG stakeholders, the first versions of these four documents (4 Indicators) were published on the SDG website in 2022. Three out of 4 were reviewed late 2023, with the one on 15.3.1 granted an extension until 2024 to align with the UNCCD and GEO LDN reviewing processes. In 2024 again, the SDG CG will request another annual review to CEOS experts, so that users can refer to it and meet their needs. These updates will consider new missions, tools and resources relevant to SDGs.
	+ **Broad contributions to SDGs/Communications:** the SDG webpages and CEOS social media will be updated and rearranged to reflect the current activities undertaken by the group. The Group will continue its effort to call out for inputs to other CEOS bodies to promote CEOS work on SDG in CEOS communications.
* Improve outreach & coordination:
	+ Internal:
		- WGCapD: the Group has started to re-engage with new leadership including with WGCapD, and facilitated external connections (UNESCAP) to increase SDG capacity building support
		- Ecosystem Extent Task Team: the Group will continue to explore opportunities to address 2024 CEOS Chair priority (Biodiversity) with the Ecosystem Extent Task Team
		- The Group will assess which CEOS work activities support SDGs and identify them as part of the online tool. Propose identification of SDG indicator-level support of relevant CEOS work activities in the 2025 work plan.
		- The Group will continue to call for inputs and ideas from other CEOS bodies to maximize our impacts
	+ Communications: the Group will review and propose new communications material, as needed, to promote upcoming SDG work (e.g. EO support sheets)
	+ External:
		- United Nations Global Geospatial Information Management (UN-GGIM) ‘Rescuing the SDGs’ Paper: the Group has agreed to co-author and contribute to a UN-GGIM-led paper to highlight the value of using EO data and help accelerate the UN SDG delivery process. By doing this, the Group aims to better position CEOS and international satellite data providers to influence future policy frameworks beyond 2030.
* Respond to external requests and refine specific data needs:
	+ **GEO LDN Task**: the GEO Land Degradation Neutrality Flagship works closely with UNCCD (UN Convention to Combat Desertification), and requested CEOS help to address specific needs with regards to satellite data and decision tree documentation (see the Good Practice Guidance).
	+ Future work associated with other SDG indicators will be considered through normal CEOS governance processes: *CEOS External Requests Process Paper* and *CEOS New Initiatives Process Paper*.
	+ Continue our engagement with the **Small Island Developing States** (SIDS) including **PICTS**: following an Open Data Cube application for SDG deliverables which demonstrateshow CEOS tools and services can directly support the SDGs (not necessarily at the indicator level), as well as with refining their satellite data requirements through the Digital Earth Pacific project and GEO Pacific Islands Advisory Group PIAG, the CEOS SDG Coordination Group (through SEO and CEO) will continue to explore opportunities and support regional and country sustainability efforts to achieve their goals, beyond the indicators level (Global SDG Indicators Framework).

**2025- 2026:**

Additional ideas and activities are being discussed, but require further strategic and resources refinement. If CEOS aims to support GEO and its members to improve the use of EO satellite data in the SDG Framework, and continue to offer its expertise to UN Agencies (see the two engagement papers shared with GEO, 2022), CEOS Principals need to allocate appropriate resources.

This includes exploring ways to support and deliver a **Wetland inventory;** the creation of an **SDG Dashboard** (a visualization tool, similar to the NASA-ESA-JAXA EO dashboard, to help show how CEOS datasets can be used in the SDG context); and opportunities to collaborate with **New Space** (potential future demonstration project targeted on SDGs (links to specific data for end users requiring CEOS and/or GEO’s help to get access to data that only industry would provide, e.g. high-resolution data for islands, or Radar data in other regions, etc.).

Finally, the CEOS SDG Coordination Group will maintain awareness of evolving United Nations activities to develop a follow-on global policy framework that will address global sustainable development post-2030. The value and impact of Earth observations must be integrated early in this process as foundational information, rather than the ‘non-traditional data’ status it holds currently in the existing county-owned, country-led SDG reporting process.

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| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| SDG-24-01 | EO Support sheet for SDG Indicator 6.6.1 (Water) 2024 Review | 2024 Q4 | ESA |
| SDG-24-02 | EO Support sheet for SDG Indicator 11.3.1 (Urbanization) 2024 Review | 2024 Q4 | GEO Secretariat |
| SDG-24-03 | EO Support sheet for SDG Indicator 14.1.1 (Marine Pollution) 2024 Review | 2024 Q4 | NOAA |
| SDG-23-04 | EO Support sheet for SDG Indicator 15.3.1 (Land degradation) 2024 Review | 2024 Q4 | CSIRO |
| SDG-23-05 | GEO-LDN Land Degradation Neutrality (LDN) Task  | 2024 Q2 | SEO |
| SDG-24-04 | UN-GGIM IAEG-SDGs WGGI Paper: Rescuing the SDGs | 2024 Q3 | CSIRO, SEO, JAXA |
| SDG-24-05 | UNCCD Support: Land Cover Suitability for SIDS | 2024 Q4 | SEO, CSIRO |

## **3.12 Support to Other Key Stakeholder Initiatives**

 **I. Continue CEOS contributions to UN Ocean Decade and maintain leadership role in the GEO Blue Planet Initiative.**

**2024-2025:** CEOS Agencies will continue to develop and distribute experimental and operational data, products and services, undertaken within the CEOS COAST Virtual Constellation, including contribution to the UN Ocean Decade (IOC). Both activities include linkages with GEO Blue Planet, and likewise continue operational satellite oceanography activities (EUMETSAT, NOAA) to facilitate distributed access to collocated, synergistic datasets with fit-for-purpose latency, quality, coverage and content for applied, commercial and research use.

**II. Further develop CEOS contributions to meet biodiversity observation requirements.**

**2024-2025:** At the 2022 CEOS Plenary, the Ecosystem Extent Task Team (EETT) was formed for a two-year duration to assess the utility of mapping Ecosystem Extent using current and New Space EO available in the next 10 years. As a forum for national and international organizations focused on space-based EO, CEOS is uniquely positioned to explore how data products from these missions can support user needs for mapping ecosystem extent. CEOS assistance can include coordinating space agency activities on using mission capabilities to support and enhance the measurement, monitoring, and understanding of biodiversity from space.

At the 2023 CEOS Plenary, the EETT delivered a White Paper that provides an integrated international perspective on how space-based EO can be used to support ecosystem mapping and monitoring with a focus on ecosystem extent. In 2024, a science journal version of the white paper will be developed to present and publish some of the white paper concepts in more detail for a biodiversity science audience, Earth scientists, and other audiences that help to inform policy making and the public.

Further development of a demonstrator on the use of EO for ecosystem extent mapping and monitoring will continue in 2024 for delivery at the CEOS Plenary on 22-24 October 2024, in Montreal, Canada. The Hudson’s Bay Lowlands demonstrator being developed by Environment and Climate Change Canada will utilize the CEOS Analytics Lab and focus on Wapusk National Park. Work will continue on a recent CNES-funded project on the use of EO for ecosystem monitoring in Costa Rica, and a recently funded CSIRO project focused on Australia’s Great Western Woodlands will begin. All three of these projects will be developed around data cubes that, among other advantages, will simplify combining data from different types of sensors and data sources, including in situ data.

In December 2022, the Parties to the Convention on Biological Diversity (CBD) agreed to the Kunming-Montreal Global Biodiversity Framework (KMGBF), which identifies the CBD’s Goals and Targets for the next decade and beyond. A key component of the KMGBF is its Monitoring Framework which includes specific indicators, many of which are directly or indirectly dependent on space-based EO data products. Ecosystem extent is one such indicator; others include ecosystem condition, invasive species, and ecosystem services. While the KMGBF does not identify all of the information needed to assess and protect biodiversity, it does provide a policy context that CEOS can use as it evaluates approaches for a sustained and enduring CEOS contribution in the biodiversity area--a priority proposed by the incoming 2024 CEOS Chair that was endorsed by the 2023 CEOS Plenary in Chiang Rai, Thailand. Another key input to CEOS in this regard is the United Nations System of Environmental Economic Accounting (UNSEEA), which has identified Ecosystem Extent, Ecosystem Condition, and Ecosystem Services as three of its ecosystem accounts. The biodiversity area has a variety of ongoing activities in addition to the more specific ones outlined above for 2024. These are discussed next.

Essential Biodiversity Variables (EBVs) are a collection of 21 biological variables that capture key dimensions of biodiversity and how they are changing. They are of particular importance for monitoring biodiversity change and are intended to be the feedstock for a variety of important derived products, especially for indicators such as those identified in the KMGBF and other international conventions. Although space-based EO can play a primary role in many EBVs and a supportive role in most of them, the value of space-based EO for EBVs and many other important products is not yet fully exploited. Utilizing the full potential of space-based EO will take time and involve advancement in several areas including:

* More complete integration with in situ data
* Increased incorporation of space-based EO by the biodiversity community of practice, much of which has traditionally focused mainly or exclusively on in situ measurements
* More higher-level, value-added data products such as EBVs and indicators
* Easy-to-use tools so that greater numbers of data users in the biodiversity community can access and utilize space-based EO and derived products
* Outreach to and capacity building for the broader biodiversity community

Another relevant and important activity undertaken by GEO BON and partners is the continued enhancement of the “BON-in-a-Box” toolkit. By facilitating access to and utilization of products, as well as enabling a generation of value-added products, this toolkit addresses several of the above areas. Significantly, it also provides a sustainable, open source home for product algorithms that agencies might develop, either in-house or via third parties, such as universities. This approach would help address the very limited availability of EO-based higher-level products from Earth observing missions. International dialogue on an ambitious concept for a global observation system for biodiversity will continue. This concept is perhaps roughly analogous to the WMO Integrated Global Observing System (WIGOS) and space-based EO will play a key role in any such global system.

**III.     CEOS Coastal Observations, Applications, Services and Tools  Virtual Constellation**

The COAST (Coastal Observations, Applications, Services and Tools) virtual constellation (VC) is a dedicated coastal-focused ad hoc team helping bridge land and ocean observations within CEOS and, given its cross-cutting nature, helping to integrate across multiple CEOS entities and domains, both thematic (e.g., Disasters, SDGs, and Capacity Development) and technical (e.g., Ocean, Land and Atmosphere, Biodiversity, WGISS, cal/val, and COVERAGE).  The COAST VC is advancing two pilot projects that leverage the CEOS-ARD framework already demonstrated for terrestrial applications.  The COAST AHT is well-positioned to highlight the broader use of Earth observations for greater societal benefit within coastal zones (e.g., Blue Economy; SDG-14), and demonstrates a specific mechanism for CEOS to engage with external stakeholders such as GEO, IOC/GOOS, UN Environment Programme and high visibility activities such as the UN Decade of Ocean Science for Sustainable Development (2021-2030).

In 2023 the COAST AHT successfully released a public version of the Application Knowledge Hub (AKH), held a successful 90-minute Product Demonstration Side Event during the SIT Technical Workshop on October 17th 2023, and advanced several new products in pilot regions.  The end of the ad hoc team term arrived, and to continue progress permission was granted by CEOS during Plenary 2023 to begin the transition of COAST into a virtual constellation, requiring a final implementation plan and Terms of Reference documents to be approved during SIT-39.  In February 2024, CNES agreed to become the third co-lead for COAST, joining ISRO and NOAA who have committed to serve through 2025.

**2024-25**: the COAST AHT expects to complete product co-design and demonstration, training, validation of the initial products, and capacity development of pilot products in initial geographical regions. Efforts are underway to finalize a COAST-VC Implementation Plan draft, and recommence activities. New Products in the Blue Carbon thematic area and Arctic Pilot regions are expected. Potential collaborations with other VCs and WGs are planned, as well as external partners like COAST Predict (an endorsed programme) in support of our UN Ocean Decade activities. Demonstration Side Events during SIT TWs are planned to continue as a way to showcase CEOS COAST progress.

**V. CEOS and the ‘New Space’ Agenda**

Across CEOS Agencies, there is significant interest in how best to engage companies in ‘New Space’ that may bring an important added value to the public upstream and downstream sectors, for which the ultimate beneficiaries are data users. In several countries represented in CEOS, national public institutions are exploring avenues for facilitating this innovative and rapidly expanding industry (the New Space sector) and for fostering partnerships with next-generation non-governmental entities that are closely linked to EO from space, either in the procurement of satellites (upstream) or in the exploitation of EO data. There is growing consensus in CEOS that sharing experience acquired by the national space agency at the country level can be useful and beneficial to other CEOS Agencies (Members and Associates).

There is also robust interest among CEOS membership in exploring ideas for future initiatives between CEOS and the commercial sector. This potential new direction is consistent with the *CEOS Strategic Guidance* *Document* (Section 3 - Goals) in which the CEOS organisation recognises that it must remain flexible and forward-thinking to respond to the emerging needs of its stakeholders and the global community. Forging partnerships with the increasingly diverse Earth observation user community presents both opportunities and challenges for CEOS to remain true to its mission statement:

*“CEOS ensures international coordination of civil space-based Earth observation programs and promotes exchange of data to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind.”*

The topic of New Space was introduced by the 2022-2023 CEOS SIT Chair (ESA) as one of the strategic priorities of its two-year term as SIT Chair. At the 2022 CEOS Plenary, a New Space Task Team (NSTT) was established for one year to explore collaboration opportunities in New Space that could potentially bring mutual benefit to all parties, including the identification of concrete initiatives to drive the agenda forward. This one-year effort of the NSTT was open to representatives of all CEOS Members and Associates who were then free to consult within their respective communities to bring forward observations and ideas. Additionally, the leads of the various CEOS entities (Working Groups, Virtual Constellations, and Ad Hoc Teams) were consulted in order to assess the potential for existing CEOS initiatives to better address the potential of the New Space sector and to consider what else might be done in the context of their work.

The following recommendations were put forward to CEOS Principals:

1. In view of augmenting the scientific and operational potential of long-term, institutional programmes, CEOS Members and Associates should act collectively in using the CEOS mechanisms to identify and support potential complementary capabilities enabled by New Space and other commercial actors.
2. CEOS Members and Associates should strive to continue to share information on relevant events and activities related to New Space, including commercial data evaluation results when possible. CEOS Agencies should also investigate ways to work together on cooperation agreements with New Space actors possibly including common lines to take on end-user licence agreements and Intellectual Property Rights (IPR) issues.
3. Cooperation and collaboration opportunities should be sought to facilitate interoperability between private and public sector data and future CEOS SIT Chairs are encouraged to routinely provide the opportunity for CEOS Members and Associates to report on developments in the standards domain, be they from public or private sources, at future SIT Technical Workshops.

The NSTT reached the end of its mandate at the 2023 CEOS Plenary. Whilst there is now no dedicated team responsible for this, it was agreed by CEOS Principals that it would be important to keep the topic on the CEOS agenda and the specific actionable outcomes to be noted within this 2024-2026 CEOS Work Plan. These are referred to in the table below as “OUT-“ deliverables.

|  |  |  |  |
| --- | --- | --- | --- |
| **Number** | **Objective/Deliverable Title** | **Projected Completion** | **Responsible CEOS Entity(ies)** |
| OUT-24-01 | CEOS and the ‘New Space’ Agenda | 2026 Q4 | CEOS ChairSIT Chair |
| OUT-24-02 | Increase engagement with the commercial sector on CEOS-ARD | 2024 Q4 | CEOS-ARD OG |
| OUT-24-03 | Unify CEOS engagement with the commercial sector at at key meetings with respect to ARD and Cal/Val | 2026 Q4 | CEOS-ARD OG |
| OUT-24-04 | Revise the CEOS-ARD Industry Engagement Strategy | 2024 Q4 | CEOS-ARD OG |
| OUT-24-05 | Ensure that legacy and new public and commercial datasets can be used more interoperably | 2024 Q4 | WGISS |
| OUT-24-06 | Integrate New Space data into the CEOS Analytics Lab  | 2024 Q4 | SEO |

## **3.13** **CEOS Services**

This section describes services provided by CEOS to the international Earth observation community. These are ongoing functions, that serve space agency “core business” such as data discovery and calibration/validation, the CEOS Missions, Instruments and Measurements (MIM) database, the WGISS Connected Data Assets or Radiometric Calibration Network (RadCalNet). As ongoing functions, these services are presented in the Work Plan, but are not monitored in the same way as other Work Plan Deliverables.

1. **Accessibility of CEOS Agencies Datasets**

Full representation and accessibility of CEOS Agencies’ datasets through WGISS Standards and Connected Data Assets Infrastructure (i.e., International Directory Network [IDN], CEOS WGISS Integrated Catalogue [CWIC], Federated EO Gateway [FedEO]). As the IDN contains OpenSearch endpoints for data access and is also the CEOS Data Collections access point for the GEOSS Platform (formerly GEOSS Common Infrastructure-GCI) and GEOSS Portal, all CEOS Agencies must keep information on their data collections, including Analysis Ready Data, up-to-date in the IDN according to its metadata model (DIF-10). This requires interaction with CEOS Agencies and data providers.

**Responsible CEOS Entity**: WGISS

1. **Radiometric Calibration Network (RadCalNet)**

The CEOS WGCV RadCalNet service provides all satellite operators (agencies and commercial) with access to ‘free and open’ SI-traceable Top-of-Atmosphere (TOA) spectrally-resolved reflectances to aid in the post-launch radiometric calibration and validation of optical imaging sensor data ([www.radcalnet.org](http://www.radcalnet.org/)). This is an essential pre-requisite to achieving sensor-to-sensor harmonisation and subsequent data interoperability. RadCalNet provides the means to derive and correct for biases between sensors in a robust and consistent manner resulting in the information needed to assign the quality metrics increasingly required for many ARD products.

Following an initial developmental period with four sites, and an opening to the community in 2018, a fifth site was added (July 2020) following a peer review of the site against the membership criteria. Over the next few years, we anticipate small evolutions in documentation and procedures both at individual sites and at network level to account for improvements in technology, methodology and feedback from users. Whilst continuing to expand the range and number of users, we also anticipate and encourage membership of new sites. Additional sites will increase the geographical and temporal availability of data while providing different spectral radiometric properties. The continued improvements by WGCV’s RadCalNet Working Group to RadCalNet processing and distribution, evaluation of test site protocols and hardware, and new test sites will facilitate the evaluation of a range of new sensor characteristics expected in the coming years.

**Responsible CEOS Entity:** WGCV

1. **Collection, Incorporation, and Quality Control of New and Updated Climate Information from Data Providers**

Update and verify the content of the ECV Inventory based on contributions by data providers and publish the annual version on climatemonitoring.info.

Completion date is recurrent: Q4 every year from 2019 onward.

**Responsible CEOS Entity**: WGClimate

1. **Essential Climate Variable (ECV) Inventory Gap Analysis**

Perform gap analysis work that always provides incremental updates to the year before in terms of improvements on the compliance to GCOS requirements and a report in focus areas addressing needs of CEOS and CGMS. The gap analysis is coordinated by the WGClimate Chair with support from several expert teams that will perform the gap analysis in parallel. Completion date is recurrent: Q4 every year from 2019 onward.

**Responsible CEOS Entity**: WGClimate

1. **Coordinated Action Plan – Climate**

The action plan identifying agreed actions that CEOS and CGMS Members and Associates intend to take to address priority gaps will be updated once a year. The actual action plan will be endorsed and released to the CEOS community at a suitable meeting.
Completion date is recurrent: Q4 every year from 2019 onward.

**Responsible CEOS Entity**: WGClimate

1. **Space Agencies Statement to UNFCCC/SBSTA**

The WGClimate Chair drafts the annual "Space Agencies Statement" to the autumn season SBSTA/COP and presents this for endorsement to CEOS and CGMS Plenaries (mostly done in virtual endorsement mode). The statement is presented at SBSTA by the country chairing CEOS. Completion date is recurrent in Q3/Q4 every year from 2019 onward.

**Responsible CEOS Entity**: WGClimate

1. **Maintain the Missions, Instruments and Measurements (MIM) database as a key tool to enhance understanding of Earth observations from space missions and data.**

The CEOS Database (a.k.a., the Missions, Instruments and Measurements Database, or MIM) is the only official consolidated statement of CEOS Agency programmes and plans. Each year, the database will be updated based on survey inputs provided by all CEOS Agencies to reflect the current status of CEOS Agency missions and instruments. The European Space Agency (ESA) and the SEO have developed a number of analysis and visualisation tools to apply this information in support of gap assessments and the database is used by the SEO as the basis for missions, instruments and measurements references in the ECV Inventory.

Together, these resources represent the cornerstone of CEOS capabilities to undertake informed coordination decisions. CEOS will continue development of these resources each year, with a particular focus on engaging them for ECV development and observational gap analyses. New enhancements for advanced search capabilities will be added, as well as links to other CEOS resources (e.g. COVE, CWIC and IDN) or to external information systems, such as WMO’s Observing Systems Capability Analysis and Review Tool (OSCAR) and the Global Change Information System (GC[IS, http://data.globalchange.gov/lexicon/ceos).](http://data.globalchange.gov/lexicon/ceos%29)

Annually, the ESA CEOS MIM Database team will continue work on the development and promotion of new tools for, and in collaboration and coordination with, the community to discover and browse the information contained in the MIM, including content on GCOS, carbon, water, and other CEOS thematic activities.

**Responsible CEOS Entity**: ESA

1. **Publish the CEOS Newsletter**

CEOS, through contributions of JAXA, will continue the publication of this valuable, longstanding communication tool. The CEOS Newsletter articles are posted once a month in a timely manner on its webpage and the annual newsletter is issued once a year.

**Responsible CEOS Entity**: JAXA

1. **Maintain the CEOS Website and Enhance Currency and Relevance of Content**

CEOS, with coordination through the SEO, will build on the “content management” approach underpinning the CEOS website to promote more up-to-date and relevant information for users. For example, the website will be proactively used to promote CEOS Agency launches.

**Responsible CEOS Entity**: SEO

1. **Engage, attend, be strategically involved (where appropriate), report on CEOS achievements, and present at key meetings.**

CEOS desires to increase and improve the connections between CEOS and its stakeholders during deliverable development. CEOS leadership and the national delegations of CEOS Agencies will expand links with stakeholders to inform ministers of CEOS Earth observation products and coordination efforts and to enlist appropriate G20/G8 support for enhanced Earth observation coordination. CEOS should highlight CEOS achievements in global change monitoring and the significance of long-term satellite observation capabilities in statements at key high-level meetings.

**Responsible CEOS Entity**: CEOS Chair, SIT Chair, CEO, All CEOS Agencies and Entities

# **4. Conclusion**

The Work Plan now has a profound number of deliverables. Moreover, there several pilots and demonstrators in the current plan. There is also work ongoing around essential variables for agriculture, biodiversity, climate and other areas are under development.

This reflects the fact that for 40 years now, CEOS has steadily pursued its mission to coordinate civil space-based Earth observation programmes, promote data sharing and support the maximisation of economic, societal and environmental benefits.

By ensuring technical and scientific collaboration across a large community of practitioners representing the CEOS member agencies around the globe, CEOS remains at the forefront of the development of space-based EO capabilities.

In that regard, CEOS has achieved significant progress in relation to its four key priorities: (i) ensuring that climate observation requirements by GCOS and the Paris Climate Agreement are met, (ii) supporting the implementation of the Sendai Framework for DRR, (iii) contributing space-based EO to the various efforts undertaken by GEO, and (iv) engaging in global discussions on critical challenges facing society including in relation to the SDGs. This was made possible through the working groups, virtual constellations, and ad hoc teams.

Seen from a thematic perspective, CEOS has furthered its contributions to climate monitoring, research and services; has supported carbon observations in connection to GFOI and in close collaboration with UNFCCC; has supported the establishment of the first Global Stocktake (GST); has helped to address needs for satellite data in relation to agriculture, linked both to GEOGLAM and GST for AFOLU; has facilitated coordination for space data contributions to DRR; and has contributed to multiple initiatives promoting space-based observations for water.

In parallel, CEOS has supported numerous cross-cutting activities underpinning the work of practitioners across the many work plan themes. This entails the promotion of good practice in relation to calibration and validation; the execution of capacity building and data democratisation activities; the implementation of a wide range of efforts around data discovery, access, preservation, usability and exploitation; the undertaking of a diverse set of activities focussing on Analysis Ready Data; and – under its Virtual Constellations – the optimisation of observational capabilities for atmospheric composition, land surface monitoring, precipitation, sea surface monitoring, ocean surface topography, ocean colour radiometry, and ocean surface vector winds.

In addition, CEOS will continue to support many key stakeholder initiatives. This includes dedicated efforts to advance the uptake of EO data in the framework of SDGs; support provided to several topics linked to the UN Space 2030 Agenda, including but not limited to Climate Monitoring and Research, Carbon Observations, Biodiversity and DRR; the development of demonstrators in support of biodiversity monitoring requirements; and the execution of pilot projects linked to the monitoring of coastal zones. Moreover, CEOS has been exploring ideas for future initiatives between CEOS and the commercial sector. Finally, CEOS has been providing services to the EO community in the form of core ongoing functions, such as accessibility to CEOS Agencies Datasets, facilitation of radiometric calibration, gap analyses, but also a host of outreach activities (CEOS newsletter, CEOS website, representation in key events, etc.).

All these achievements are thanks to the leadership from and coordination among the many people committed to the positive impact of EO. Under the guidance of the CEOS Chair, SIT Chair, SEO and CEO, and thanks to the invaluable efforts of the working groups, virtual constellations, ad hoc teams and the CEOS Secretariat, CEOS continues to set the standard for civil space-based Earth observation.

1. These treaties, international organisations, and international programs include United Nations Framework Convention on Climate Change (UNFCCC), UN 2030 Agenda for Sustainable Development (the SDGs), UN Office for Disaster Risk Reduction (UNDRR), UN Convention to Combat Desertification, and UN Convention on Biological Diversity (CBD), among others. [↑](#footnote-ref-1)
2. https://www.earthobservations.org/documents/gwp23\_25/geo\_work\_programme\_2023\_2025\_summary\_document\_v3\_20221214.pdf [↑](#footnote-ref-2)
3. The International System of Units, internationally known by the abbreviation SI (from French Système international d'unités), is the modern form of the metric system and the world's most widely used system of measurement. [↑](#footnote-ref-3)