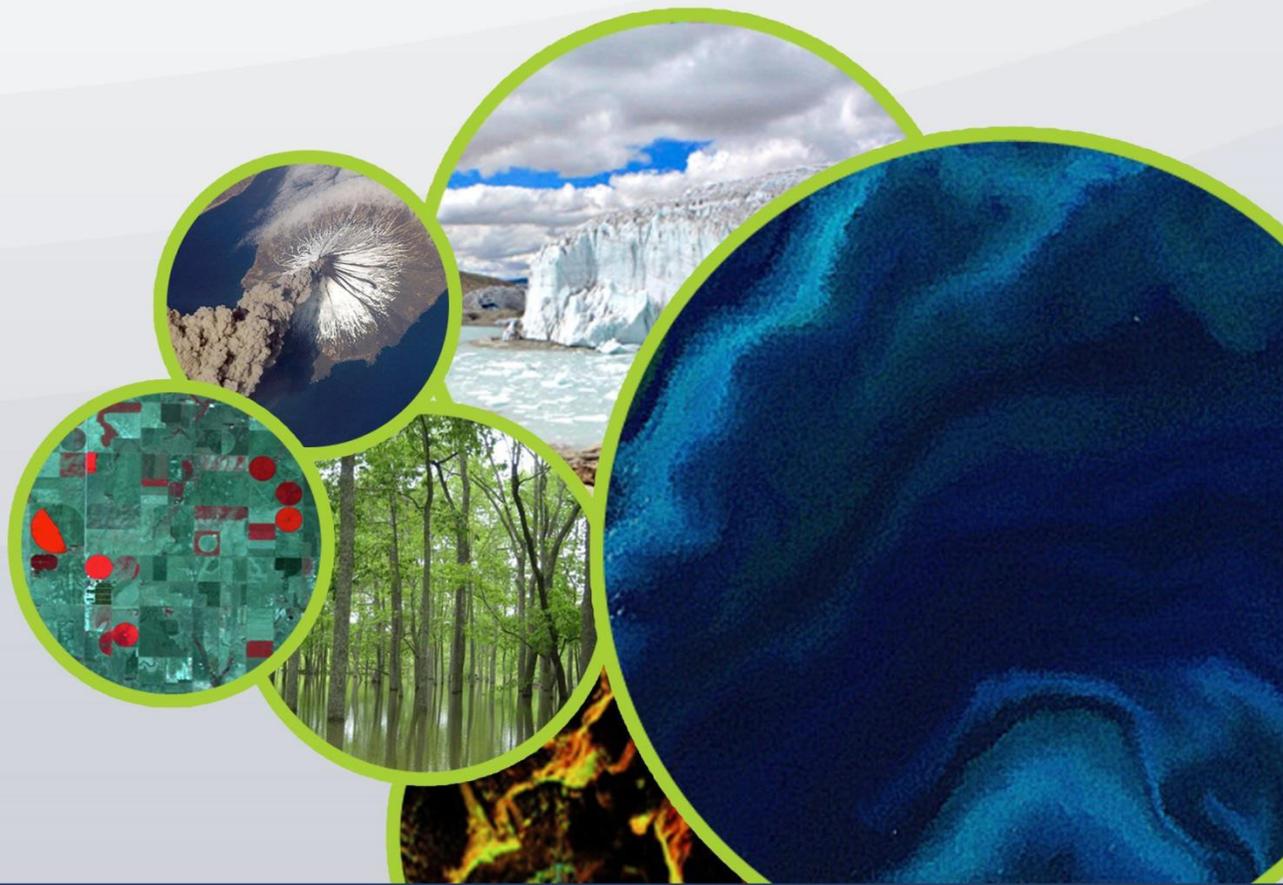




Committee on Earth Observation Satellites



# 2018-2020 Work Plan

March 2018 (Version 1)

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## 1. Introduction and Overview

The *2018-2020 CEOS Work Plan* has been developed by the CEOS Executive Officer (CEO) under direction of the CEOS Chair (European Commission [COM]), in consultation with the CEOS Strategic Implementation Team (SIT) Chair (National Oceanic and Atmospheric Administration [NOAA]), CEOS Secretariat (SEC), CEOS Working Groups (WG), CEOS Virtual Constellations (VC), CEOS Ad Hoc Teams, the CEOS Systems Engineering Office (SEO), CEOS Agencies at large, and CEOS's external stakeholders. The purpose of this document is to set forth near-term objectives and deliverables designed to achieve the goals outlined in the *CEOS Strategic Guidance* document. It includes a description of CEOS activities to be executed in the current calendar year, and summarizes anticipated activities for the subsequent two years (2019-2020). Additional documents contributing information to this plan are located on the CEOS website (<http://ceos.org/>) and include: *The Kyoto Statement*, issued at the 29<sup>th</sup> CEOS Plenary Meeting held in 2015; the *2017-2019 CEOS Work Plan*; the terms of reference for the CEOS Virtual Constellations and Working Groups; and a number of thematic observation strategies adopted by the CEOS Plenary. This Work Plan will be revised annually; however, the priorities and activities outlined herein are expected to remain fairly consistent from year to year. CEOS will revise this Work Plan each year, as current activities are completed, planned activities are executed, and new initiatives are projected.

### 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.**

To this end, the primary objectives of CEOS are:

- To optimize 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 and entities related to global change
- 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 Eight (G8) and the Group of 20 (G20), the intergovernmental Group on Earth Observations (GEO), and organizations participating in treaties and global programs affiliated with the United Nations (UN)<sup>1</sup>.

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<sup>1</sup> These treaties, international organizations, and international programs include the UN Framework Convention on Climate Change (UNFCCC), the 2030 Agenda for Sustainable Development (the SDGs), the UN Office for Disaster Risk Reduction (UNISDR), the United Nations Convention to Combat Desertification, and the Convention on Biodiversity (CBD), among others.

## 2. CEOS Priorities

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 29<sup>th</sup> 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 the achievement of the *2030 Agenda for Sustainable Development*.

At the 30<sup>th</sup> CEOS Plenary Meeting held in Brisbane, Australia in 2016, CEOS Agencies also agreed on the need for a cross-cutting effort to engage with the strategic implications of new approaches to exploitation of satellite Earth observation data: “Future Data Architectures”. CEOS will build on exploratory work completed in 2016. Additionally, 2017 CEOS Chair, USGS, introduced a related initiative on “Moderate Resolution Sensor Interoperability”. At the 2017 plenary, the incoming CEOS Chair, the European Commission, confirmed this data exploitation theme as an ongoing Chair priority and identified a priority in coordination of work on Carbon observations from space.

CEOS Agencies also affirmed their intention to continue to enhance their cooperation to respond effectively to Earth observation user needs by achieving integration across the full range of Earth observations, by closing important observational gaps, by promoting the sharing of CEOS Agency data, and by improving access to and use of such data. CEOS will continue to support more effective societal decision making in the areas of climate monitoring and research; carbon observations, including observations to support the effective monitoring and management of the world’s forested regions; water, including observations to support the effective monitoring and management of the world’s water resources; food security; disaster risk management; oceans; biodiversity; capacity building; and data availability and access. Satellite mission coordination will be strengthened, particularly through the CEOS Virtual Constellation activities. CEOS Working Groups and Virtual Constellations will expand their technical and scientific coordination to support these priorities, and improve the overall level of complementarity and compatibility of CEOS Agency Earth observation and data management systems for societal benefit.

CEOS will consider other requests from external stakeholders and determine what, if any, support is possible and appropriate. CEOS will also continue its outreach and communications efforts. As it executes these activities, CEOS will operate in accordance with the guidance provided in the *CEOS Governance and Processes* document regarding the organization’s structure, processes, and stakeholder relations.

CEOS’s internal and external coordination involves a considerable number of tasks supported by the full range of CEOS members and associate members. This document is intended to provide overall guidance for CEOS on expected outcomes for CEOS and its stakeholders for the 2018-2020 period.

*CEOS 2018-2020 Work Plan – V1 – March 2018*

For 2018, the plan addresses CEOS initiatives at a general level. Specific details regarding support required to achieve these outcomes will be maintained by the respective responsible CEOS Entities (e.g. CEOS Agencies, Working Groups, Virtual Constellations, Ad Hoc Teams), and reported as appropriate via updates to the online CEOS Deliverable Tracking Tool.

For subsequent years (2019-2020) this document summarizes planned CEOS activities more broadly; details regarding these future activities will be established in forthcoming updates of this document, as the activities near implementation. Virtual Constellations, Working Groups, and Ad Hoc Teams may prepare separate, more detailed Work Plans that complement this overall guiding Work Plan.

### 3. Expected Outcomes for 2018-2020

The expected outcomes for 2018-2020 reflect the ongoing and emerging priorities of CEOS, as characterized by its internal decision-making and external commitments. They are intended to focus on improved Earth observation (EO) systems coordination and enhanced data access for key global programs and initiatives.

The main outcomes are described for the following thematic areas for the period 2018-2020:

- 3.1. Climate Monitoring, Research, and Services
- 3.2. Carbon Observations, Including Forested Regions
- 3.3. Observations for Agriculture
- 3.4. Observations for Disasters
- 3.5. Observations for Water
- 3.6. Future Data Architectures
- 3.7. Capacity Building, Data Access, Availability and Quality
- 3.8. Advancement of the CEOS Virtual Constellations
- 3.9. Support to Other Key Stakeholder Initiatives
- 3.10. Outreach to Key Stakeholders
- 3.11. Organizational Issues

The outcomes for each thematic area are summarized in tables that list the objectives/deliverables to be pursued in that area, projected completion dates (typically indicated by quarter of the calendar year), background information, and responsible CEOS Entities.

CEOS operates on a best-efforts basis. Responsible CEOS entities are expected to accomplish the objectives and deliverables identified in this document to the best of their abilities, but there is no formal commitment to achieve the projected completion date.

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

CEOS and the Coordination Group for Meteorological Satellites (CGMS) have committed to work together, through the Joint CEOS/CGMS Working Group on Climate (WGClimate), to monitor climate from space through the coordinated planning, production, improvement, and availability of space-based climate data records on a global scale. This work is focused towards implementation of the *Strategy Towards an Architecture for Climate Monitoring from Space* developed and endorsed by CEOS, CGMS and the World Meteorological Organization (WMO). The following sections summarize activity from the perspective of CEOS contributions to the joint effort, as well as CEOS-specific activities in the climate domain.

A key focus of work during the 2018-2020 period will be the exploitation of the comprehensive ECV Inventory of climate data records including a broadening of the user base. The Inventory is the prime asset of the WGClimate that is used to identify data gaps and opportunities for improvement along the climate information value chain. It also supports efforts to communicate progress of the satellite coordination community within the United Nations system and more broadly.

In addition, work needs to be done to support the Global Climate Observing System (GCOS) in assuring a reliable requirements framework for future releases of the GCOS Implementation Plan.

#### I. Continue cooperation with GEO, GCOS, WMO, and CGMS in the development of a space-based system to support climate change information and adaptation.

**2018-2020:** CEOS Agencies will continue to cooperate with CGMS, GEO, GCOS, and WMO, by implementing Agency actions to achieve the socio-economic benefits described in the CEOS-CGMS-WMO *Strategy Towards an Architecture for Climate Monitoring from Space*, with emphasis on the strategy's Applications and Decision-Making pillars. CEOS will consider how to address and contribute to WMO's Global Framework for Climate Services (GFCS). In addition, connections to the World Climate Research Programme (WCRP) are planned to be established that are needed for efficient support to major activities on global reanalysis and climate model evaluation where climate data records play an essential role.

This coordination will be supported by the development and promotion of further case studies, and the development and maintenance of a Joint CEOS/CGMS WGClimate presence on the CEOS website that provides the single authoritative location for information about the Working Group's activities.

#### II. Continued implementation of the Architecture for Climate Monitoring from Space

**2018:** WGClimate will present the first version of a gap analysis and action plan based on the second version of the ECV Inventory for endorsement. In addition, the first annual update of the ECV Inventory will be performed taking the new GCOS-IP, including new ECV products, fully into account.

**2019-2020:** Following on from successful delivery of the second version of the inventory of Climate Data Records for Essential Climate Variables published in 2017, the Joint CEOS/CGMS WGClimate plans to update the ECV Inventory continuously by providing a new version every year. This will be accompanied by an annual version of an incremental gap analysis report and updated action plan.

The update of the Inventory is based on collating updated information from data providers on Climate Data Record holdings and plans, including a comprehensive quality control to verify completeness and consistency of the ECV Inventory contents. The incremental gap analysis will address delta improvements with respect to the compliance of satellite missions and products with the GCOS Climate Monitoring Principles and with the *Guideline for the Generation of*

*Datasets and Products meeting GCOS Requirements.* In addition, specific ECV products will be analyzed in more depth according to the needs of CEOS and CGMS. This includes an analysis of the relevance of the various data records for climate services and research, as well as an assessment of missed opportunities to use instrument data and on potentially missing measurements in the future.

Building on lessons learnt from the second version of the ECV Inventory an attempt will be made to promote the existence and usage of Fundamental Data Records for the delivery of ECV Climate Data Records. In addition, a new class of emerging so-called Interim Climate Data Records that represent a consistent continuation of climate data records with much higher timeliness. Such data records very much support climate service applications.

The ECV Inventory will be continued to be located on the Joint CEOS/CGMS WGClimate web presence at [www.climatemonitoring.info](http://www.climatemonitoring.info) to ensure accessibility.

### III. Continued strong engagement with UNFCCC/SBSTA and GCOS processes

**2018-2020:** The Joint CEOS/CGMS WGClimate ensures to be the focal point for a coordinated space agency response to climate information needs through its relations with GCOS and the Subsidiary Body for Scientific and Technological Advice (SBSTA). The group will continue these strong linkages during 2018-2020, including:

- providing, on request, updates on progress in implementation of the Architecture for Climate Monitoring from Space to both GCOS and SBSTA;
- supporting GCOS at Steering Group at Panel Level, and Secretariat level, in the preparation of the next version of the GCOS-IP, in particular in the formulation of requirements

Climate Monitoring, Research, and Services Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>Information dissemination and communication</b>			
<b>CMRS-13:</b> Development and Promotion of Case Studies	Q3 2019	Previous work, supervised by the EC JRC and WMO, has already produced WMO 1192 <i>Case Studies for Establishing an Architecture for Climate Monitoring from Space</i> . WGClimate #6 An updated version containing additional case studies is targeted for the WMO congress in 2019. The output of previous and potential future work is to be supported by the dedicated Joint CEOS/CGMS WGClimate website.	WGClimate
<b>Delivery of a second iteration of the Essential Climate Variable Inventory</b>			
<b>CMRS-15:</b> Cycle 2 Gap analysis	Q2 2018	Several teams will perform the cycle 2 gap analysis in parallel, with the work organized by thematic area. To ensure consistency of approach across the full inventory, the gap analysis work of the individual teams will be overseen/coordinated by the WGClimate Chair team.	WGClimate

Climate Monitoring, Research, and Services Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>CMRS-16:</b> Action plan	Q2 2018	The action plan will identify agreed actions that CEOS and CGMS Members and Associates intend to take to address priority gaps. The action plan will be endorsed and released to the CEOS community at the 31 <sup>st</sup> CEOS Plenary Meeting.	WGClimate
<b>Annual delivery of the Essential Climate Variable inventory</b>			
<b>CMRS-17:</b> Collection, incorporation, and quality control of new & updated information from data providers	Q4 every year from 2019 onwards	Based on a stable questionnaire, with potential updates of the inventory structure, to accommodate, for example, requirements stemming from C3S and WCRP; and experiences from applicable projects.	WGClimate
<b>CMRS-20:</b> Gap analysis	Q4 every year from 2019 onwards	WG chairs will initiate 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 WG Chair team and support by several expert teams that will perform the gap analysis in parallel.	WGClimate
<b>CMRS-21:</b> Action plan	Q4 every year from 2019 onwards	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.	WGClimate
<b>Engagement with GCOS</b>			
<b>CMRS-19:</b> Joint CEOS/CGMS response to the new GCOS IP	Q2 2018	Complement the response to the GCOS IP 2016 with the technical supplement addressing individual ECVs. Reflecting the partnership, this document will be developed jointly by CEOS and CGMS.	WGClimate

### 3.2. Carbon Observations, Including Forested Regions

- I. **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 Space Data Component of the GEO Global Forest Observations Initiative (GFOI).**

**2018:** Through its Ad Hoc Space Data Coordination Group (SDCG) for GFOI, CEOS is developing and 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.

In 2018, the SDCG will build on previous activity by continuing to implement the first element of the CEOS Space Data Strategy for GFOI — the *Global Baseline Data Acquisition Strategy for GFOI*, endorsed in 2013 and updated in 2015.

The SDCG will also work to implement the *Space Data Services Strategy for GFOI*, endorsed in 2014. Through this strategy, SDCG seeks to provide a coordinated strategy for national data acquisition that will accommodate countries that have specific technical requirements or heritage and experience with working with a particular EO data source or type. An update of this strategy is planned for 2018 to reflect the changes within GFOI moving into its Phase 2. The SDCG, with support from the CEOS Systems Engineering Office (SEO), will continue to work with several countries to develop pilot data services based on a new Data Cube architecture, in coordination with FDA, Moderate Resolution Interoperability and LSI, with regular reports to be provided.

The SDCG will also continue work in cooperation with GOF-C-GOLD to implement the *Strategy for Satellite Data in support of GFOI R&D* endorsed at the 29<sup>th</sup> CEOS Plenary.

The discussion and efforts at *SDCG-12* towards a *GFOI Near-Real-Time Monitoring* system will continue in 2018 with a dedicated User Needs Assessment and pilot demonstrations.

**2019-2020:** The SDCG will deliver annual implementation updates to the *Global Baseline Data Acquisition Strategy for GFOI* and the *Space Data Services Strategy for GFOI* at the annual SIT meetings.

**II. Progress implementation 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*. The CEOS strategy addresses the three domains— atmospheric, oceanic and terrestrial — and their interfaces, and identified a number of recommended actions to be completed by space agencies.

At the 30<sup>th</sup> CEOS Plenary Meeting, CEOS determined a number of targeted initiatives to advance to implementation of the *CEOS Strategy for Carbon Observations from Space*. These initiatives are cross-cutting in nature and address numerous Actions in the strategy. The first set of initiatives cover a broad range of CEOS WGs and VCs, and are addressed by the CARB objectives/deliverables proposed over the 2018-2020 period.

Carbon Observations, Including Forested Regions Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>CARB-4:</b> CEOS delivery of coordinated land surface observations for GFOI countries	Q2 2018	CEOS will acquire coordinated land surface observations for GFOI countries in accordance with the endorsed strategies.	SDCG for GFOI

Carbon Observations, Including Forested Regions Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>CARB-5:</b> Updated <i>Global Baseline Data Acquisition Strategy for GFOI, Space Data Services Strategy for GFOI, and Strategy for Satellite Data in support of GFOI R&amp;D</i>	Q2 2018	With the end of the commissioning phase of Sentinel-2B GFOI has reach full operational capability in 2017. Element-1 (baseline data acquisition strategy), Element-2 (data services) and Element-3 (R&D) will require updates to reflect changes in space data assets, national implementation plans and GFOI’s move into Phase 2.	SDCG for GFOI
<b>CARB-12:</b> White paper on a carbon observation constellation	Q3 2018	White paper on coordinated detailed planning/preparation of a constellation of instruments to measure CO2 and CH4 from space.	AC-VC
<b>CARB-15:</b> Carbon data Portal prototype	Q3 2018	Implement a carbon data portal to facilitate the discoverability and accessibility of ECV products and space-borne CDRs. The portal is designed with a service-oriented architecture and follows the principles outlined by the GEOSS Community Portal white paper. The portal will seamlessly access data both in CWIC and FedEO to provide necessary data, tools and services to the carbon science community of both CEOS and GEOSS. The reference implementation can be shared with the broader CEOS carbon community.	WGISS
<b>CARB-16:</b> Cal/Val and production of biomass products from CEOS missions	Q4 2019	Development of a coordinated cal/val strategy across NASA and ESA biomass missions that rationalizes protocols, data sharing, and the establishment of ground-based carbon super-sites.	NASA and ESA
<b>CARB-17:</b> Engaging with IPCC inventories and promoting satellite EO	Q4 2019	<p>The <i>2006 IPCC Guidelines for National GHG Inventories</i> currently indicates that satellite data has limitations in spatial, vertical and temporal resolution. However, the IPCC Guidelines will be updated and released in 2019, and update of verification guidance with respect to atmospheric measurement and new datasets is expected. This creates the possibility that the update will include use of GHG observation data from satellites.</p> <p>CEOS has accumulated GHG scientific data by satellites such as GOSAT and OCO-2, and more satellites will follow. Thus, CEOS engagement with IPCC and efforts to support this update are important for EO data uptake in Climate actions.</p>	JAXA
<b>CARB-18:</b> Colombia Data Cube Prototype for Forest Mapping and Carbon Stock Assessments	Q4 2018	The SEO initiated a Data Cube prototype in Colombia in 2016. This project will demonstrate an end-to-end approach for Carbon stock assessments of forests to support UNFCCC reporting. Coordination with FAO and the GFOI Office will be essential.	SEO (with support from SDCG for GFOI)

### 3.3. Observations for Agriculture

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

**2018:** GEOGLAM aims to enhance agricultural production estimates through the use of Earth observations in order to address concerns raised by the G20 Agricultural Ministers about market volatility for the world’s major crops, as well as to provide early warnings of crop shortages and failures in countries most at risk of food insecurity. GEOGLAM has also expanded its work to include monitoring of global rangelands through the Rangeland and Pasture Productivity (RAPP) initiative. Through the CEOS Ad Hoc Working Group on GEOGLAM, CEOS has worked with GEOGLAM to address challenges and opportunities related to acquisition of and access to satellite observations of cropped land and rangeland surfaces. GEOGLAM is a system of systems, and components of it are already in the operational phase, including both contributing activities of its partners and the GEOGLAM Crop Monitor activities. GEOGLAM’s implementation is continuous and responsive to the needs of GEOGLAM’s growing list of national, regional, and global monitoring partners. These operational systems, as well as emerging national and regional monitoring activities, can be further enhanced by CEOS efforts to support the provision of timely and appropriate satellite observations at “analysis-ready” levels (consistent with LSI-VC efforts).

At the 29<sup>th</sup> CEOS Plenary Meeting, CEOS endorsed the *CEOS Strategic Response to GEOGLAM Requirements*, describing how CEOS Agencies will coordinate to support information requirements arising from GEOGLAM. At that time, GEOGLAM Data Requirements reflected a first effort carried out between 2012 and 2014. In 2016, the GEOGLAM Secretariat initiated an effort to “refresh” its information and EO data requirements characterization based on a compendium on “best-practices” arising from GEOGLAM’s R&D activities (particularly, JECAM, Asia-RiCE, and Sentinel-2 for Agriculture). In 2016 and 2017, surveys were sent to various R&D partners seeking input on 13 variables related to agriculture. At the SIT Technical Workshop in September 2017, initial results of these R&D requirements were presented, and a fruitful group discussion followed, resulting in a recommendation that this set of R&D requirements be complemented by a “holistic” assessment of *operational* GEOGLAM user (e.g. EC JRC MARS, USDA FAS, China CropWatch, national monitoring activities, etc.) requirements.

This holistic assessment would not just address questions related to acquisition (when, where, how often, and with which sensor classes), as with the initial “GEOGLAM Requirements 1.0,” but additionally address questions of access and utilization. This is in line with the considerable growth of satellite data acquired by CEOS agencies between 2012 (GEOGLAM’s Requirements 1.0 effort) and present (GEOGLAM’s Requirements 2.0 effort): we are moving from a period of data scarcity to data surplus, and GEOGLAM is working to capitalize on these new opportunities.

In this vein, an operational user workshop – to which CEOS Ad Hoc WG on GEOGLAM personnel are invited – will be hosted by EC JRC in Ispra, Italy during the week of 16 April 2018. After this meeting, the ensuing 6 months leading up to CEOS Plenary will be utilized by the CEOS Ad Hoc WG on GEOGLAM (in particular, a focused sub-WG of GEOGLAM leadership, the CEOS SEO, and other interested personnel) to evaluate the requirements and draft a CEOS Strategic Response to GEOGLAM Requirements for endorsement at Plenary.

From that point forward, the CEOS Ad Hoc WG on GEOGLAM will work to implement the endorsed strategy. Additionally, the CEOS Ad Hoc Working Group on GEOGLAM will continue working with GEOGLAM to identify potential CEOS inputs and track/report on the application of data provided by CEOS Agencies. The CEOS Ad Hoc Working Group on GEOGLAM will also continue to monitor updates to the overarching GEOGLAM implementation plan, including emerging requirements from GEOGLAM's regional networks: Asia-RiCE, GEOGLAM Latinoamérica and its sister initiative AmeriGEOSS Food Security & Sustainable Agriculture Working Group (each launched in 2015), AfriGAM (launched in 2016), and EuroGEOSS (launched in 2017). The CEOS Ad Hoc WG for GEOGLAM will gather and review these needs and advise the broader CEOS community on appropriate responses. A key focus will be potential practical (sustainable) operational use of CEOS data, especially SAR, for rice crop monitoring in Asia, Latin America, Africa, and other areas (particularly those impacted by cloud cover). The CEOS Ad Hoc Working Group on GEOGLAM will consult with the Asia-RiCE team to continue upscaling monitoring activities to more major rice crop areas (wall-to-wall country-wide) in selected countries.

Through the CEOS Systems Engineering Office (SEO), CEOS will continue to work with GEOGLAM to deliver data services prototype projects and investigate common data sharing policies. In addition, the SEO will continue to support the Asia-RiCE team to undertake bench mark tests to improve data and information accessibility.

Lastly, CEOS will consider GEOGLAM's requests for guidance on engagement of the commercial space sector. GEOGLAM has been regularly contacted by commercial data providers and believes CEOS can provide valuable insight on this matter.

**2019 and beyond:** GEOGLAM will continue to expand its efforts by increasing the number of supported countries, expanding its use of mission data by utilizing new mission datasets (i.e. optical and radar), continuing development of regional networks and gathering associated requirements, and continuing to investigate methods for data management and distribution. The CEOS Ad Hoc Working Group on GEOGLAM will update *CEOS Ad Hoc WG for GEOGLAM Scope of Work Document* (last version presented at CEOS Plenary 2017) to reflect the expansion of effort and changes to data supply arrangements. Subsequent updates to the *CEOS Strategic Response to GEOGLAM Requirements* will be on an "as needed" basis.

## II. **Continue support to the Joint Experiments on Crop Assessment and Monitoring (JECAM) initiative**

**2018:** JECAM was initiated in 2009 by the GEO Agriculture Monitoring Community of Practice (CoP) to enhance collaborative international research on agriculture through use of remotely-sensed EO. In 2011, CEOS initiated efforts to supply JECAM users with relevant remote sensing data through a coordinated Earth observations from space data acquisition program involving CEOS Agencies and commercial data providers. In recent years, other activities have received significant funding to carry out operational research and development in support of GEOGLAM, for example the European Commission's FP7 supported Stimulating Innovation for the Global Monitoring of Agriculture (SIGMA) project and the European Space Agency funded Sentinel-2 for Agriculture and GEORICE activities. These activities contribute to GEOGLAM's broader operational R&D efforts, collaborating with and often having complementary test site locations with JECAM sites.

CEOS Agencies will continue data acquisitions for support to JECAM and GEOGLAM R&D

activities at selected sites for both Northern Hemisphere and Southern Hemisphere growing seasons. It is expected that these acquisitions will continue at least through the end of 2018, and be described in an annual report. CEOS Agencies will continue to liaise with the GEOGLAM R&D Co-Leads and the GEOGLAM EO Data Coordination Lead on data requirements related to this matter.

Observations for Agriculture Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>AGRI-4:</b> CEOS Strategic Response to GEOGLAM Requirements	Next update Q4 2018	The <i>CEOS Strategic Response to GEOGLAM Requirements</i> identifies how CEOS Agencies will coordinate their relevant Earth observing satellite systems to acquire data to support information requirements arising from GEOGLAM. Updates to this document may include the addition of new mission datasets, updates to primary and contributing datasets, updates to sampling approaches, adjustments to the strategy that improve GEOGLAM coverage, and updates to country coverage. In addition, this task will include updates to the Scope Document, which reflects the high-level plans for the Ad Hoc GEOGLAM team and addresses new requirements evolving from regional networks and RAPP.	CEOS Ad Hoc Working Group on GEOGLAM
<b>AGRI-8:</b> Vietnam Data Services Prototype	Q2 2018	Complete initial deployment of a Vietnam Data Cube with a particular emphasis on data interoperability (optical and radar) and agriculture applications including rice crop monitoring.	SEO
<b>AGRI-9:</b> RAPP (Rangelands) Data Cube Demonstrations and Application Testing	Q4 2018	Complete a Data Cube demonstration for one or more test sites to support RAPP (rangelands). This demo will explore steps for data cube creation at local test sites and explore applications targeted toward rangelands agriculture (fractional cover, custom cloud-free mosaics, NDVI anomaly).	SEO

### 3.4. Observations for Disasters

CEOS is committed to supporting disaster risk management in the context of the *2030 Agenda for Sustainable Development* and the *Sendai Framework for Disaster Risk Reduction 2015-2030*, and enhancing the contribution of space-based Earth observations in support of disaster risk reduction. CEOS representatives will work closely with key stakeholders (e.g. GEO, UN agencies, donor institutions like the Asian Development Bank, World Bank Global Fund for Disaster Risk Reduction, scientific community, national resource management agencies, civil protection agencies, local decision makers and others) to foster the use of satellite EO data. The overarching goal of the WG Disasters are to increase and strengthen the contributions of satellite EO to the various DRM phases and to inform politicians, decision-makers and major stakeholders of benefits of using satellite EO in each of those phases.

The disaster-related activities described below serve that goal.

**I. Strengthen support to the disaster management community through the sustained coordination of disaster-related activities undertaken by CEOS Agencies.**

**DRM Pilots:** Beginning in 2013 CEOS Agencies started a series of pilots to support DRM more efficiently with a focus on risk reduction, by optimizing and better coordinating satellite EO and access to data by users and practitioners. The three pilots on floods, seismic risk and volcanoes concluded their activities in 2017, and are currently developing implementation plans for demonstrator activities that build on pilot success. The Landslides Pilot, started in 2016, is continuing with the aim: 1) to demonstrate the effective exploitation of Earth observations (EO) data and technologies to detect, map and monitor landslides and landslide prone hillsides, in different physiographic and climatic regions; 2) to apply satellite EO across the cycle of landslide disaster risk management, including preparedness, situational awareness, response and recovery with a distinct multi-hazard focus on cascading impacts and risks.

2018-2019: WG Disasters will continue to implement the Landslides Pilot, as endorsed at the 29<sup>th</sup> CEOS Plenary Meeting. Final report from the Landslide pilot and follow-on actions will be presented at 33<sup>rd</sup> CEOS Plenary. WG Disasters will present Implementation Plans for three demonstrator activities (Floods, Seismic Hazards and Volcanoes) at the spring 2018 SIT meeting.

**Recovery Observatory:** The main objective of the Recovery Observatory (RO) is to work with reconstruction professionals to develop the use of Earth Observation in the reconstruction phase after a major disaster.

The CEOS Recovery Observatory was triggered on 22nd December 2016 covering the area devastated by Hurricane Matthew in Southwest Haiti. CEOS Agencies engaged in the project team and their partners will implement the Recovery Observatory as a one-time full-scale demonstration over a four-year period, aiming at defining a generic and replicable RO concept.

Several CEOS agencies are actively involved into the post Matthew RO, including CNES, ASI and CSA as Steering Committee Members, DLR as an active data contributor, and provider of a change detection product, NOAA as future provider of coastal monitoring and health related products, and both CNES, ASI as providers of data and value-added product support through contracts with industry and academia. It can be mentioned that Charter members such as Roscosmos, Kari, CNES made crisis images available for the post Matthew RO.

Following triggering, the project team was constituted, composed of local and international stakeholders and space agencies, led by Global Facility for Disaster Reduction and Recovery (GFDRR) and CNES.

The information system infrastructure (“Dotcloud”) that has been implemented through a joint WGISS and WG Disasters activity is used for the post Matthew RO.

The post Matthew RO activity has seen rapid progress in 2017, with several missions in Haiti and the creation of a Steering Committee made up of three local champions, three space agencies, the World Bank and the UNDP. Further to a demo phase at mid-2017, value-added products targeting six thematic priorities for recovery are being developed and a User Workshop will review the success of these products in May 2018.

2018: WG Disasters will continue implementing the “Hurricane Matthew Recovery Observatory Operations Plan” approved at the 31<sup>st</sup> CEOS Plenary. During RO commissioning the first products

will be incorporated ensuring easy access. These products will be showcased at the May 2018 2<sup>nd</sup> User Workshop, a user forum promoting RO use and validating the first RO products. This activity will include the first “early evaluation”, with a report to the Steering Committee on issues and recommendations going forward. A feedback mission to UNDP and WB headquarters is planned for mid to late 2018, with a view to exploiting the lessons learned in the RO to develop a generic RO concept for more systematic use of satellite observations by these agencies during the early recovery process.

2019-2020: WG Disaster will continue the post Matthew RO operations ensuring product and Dotcloud updates, engage in capacity building activities, generate annual reports to stakeholders and partners, as well as developing a legacy strategy to ensure capacity developed in the project is not lost but applied to other risk management activities in Haiti. In parallel, work has begun on a Generic RO Proposal, that will be worked on with WB and UNDP in 2018 and will be put forward in 2019.

**Demonstrators:** The three Disaster Risk Management (DRM) pilots defined in the 2013 CEOS Disaster Risk Management Observation Strategy on floods, seismic hazards, and volcanoes recently concluded and their activity reports were approved during the 31st Plenary Meeting.

Follow-on actions foresee the definition of demonstrators aiming to consider the successful elements of the pilots and broaden their application to new users in wider geographic areas, or to consolidate applications with existing users and seek long-term sustainability through new funding relationships.

Each thematic demonstrator is preparing an Implementation Plan for review by SIT-33; when possible, demonstrators will be linked to existing activities such as GEO-GSNL and GEO-DARMA.

**2018:** Define demonstrators project and Implementation Plans

**2019-2020:** Gradually deliver demonstrator results and report to CEOS about demonstrator activity and about the longer term vision for sustained use of satellite observations in the associated communities.

**Geohazards Lab:** The Geohazards Lab is a new initiative in the CEOS WG Disasters approved at the 31<sup>st</sup> CEOS Plenary. The Geohazards Lab is a group of interoperable platforms with federated resources which shall provide data access (with appropriate authorization and accounting functions), EO processing to exploit EO data to support geohazard risk assessment and e-collaboration capabilities to animate the user community (including promoting, sharing and providing persistent access to results generated by users). The platform is able to access data collections provided through CEOS WG Disaster activities alongside with open and free EO data sources such as Landsat and the Sentinels. The users of the Geohazards Lab are the WG Disasters pilots and demonstrators, the RO, the GSNL and GEO-DARMA who are able to execute processing chains on the platform as well as other EO experts/geoscience centers already contributing to precursors activities (such as the users of the Geohazards-TEP named GEP).

**2018:** Completion of the concept phase and start of the implementation phase.

**2019-2020:** Exploitation of the Geohazards Lab functionalities by the Seismic Hazards Demonstrator, the Recovery Observatory, the Landslide Pilot, the Geohazard Supersites and Natural Laboratories (GSNL) and possibly, the Volcano Demonstrator and GEO-DARMA.

Generation and distribution of advanced science products from the wider geohazards community.

**II. Support implementation of a coordinated approach, convened through the Group on Earth Observations, to implementation of priority recommendations in the Sendai Framework for Disaster Risk Reduction 2015-2030 (GEO-DARMA)**

GEO-DARMA, a CEOS-led and supported initiative in the frame of the intergovernmental Group on Earth Observations (GEO), aims to address priorities of the *Sendai Framework for Disaster Risk Reduction 2015-2030* using Earth observations (EO).

GEO-DARMA (Data Access for Risk Management) will facilitate the sustained provision of accurate EO-based risk information products and services to national and local decision-makers in political and socio-economic sectors, to implement disaster risk reduction and resilience measures, during all disaster risk management phases, whenever those products and services require satellite EO combined with other sources of data (in-situ ground observations, socio-economic, model outputs).

The broad goal is to define and implement end-to-end solutions that respond to the real needs of the user community. Space EO technology presents new opportunities in this area of work; the challenge is matching such capabilities to those end users most in need. The goal is to establish an inclusive, comprehensive process to address local disaster risk reduction requirements by using EO technologies efficiently. Long-term outcomes of GEO-DARMA are to foster the use of EO data and EO-based risk information by end-users (e.g. civil protection agencies and other agencies and ministries at the national level) and to increase awareness within donor agencies of the value of space solutions.

A GEO-DARMA Kick-off workshop was held in March 2017 and a Concept Workshop was held in May 2017 during the Global Platform Meeting, as well as the 1<sup>st</sup> Steering Committee meeting in May, and the 2<sup>nd</sup> Steering Committee meeting in November. The 3<sup>rd</sup> Steering Committee was held in January 2018, and the next Steering Committee is planned for May in Mexico. The Concept Phase identified regional priorities through reports by regional institutions in Asia and Africa.

**2018-2019:** The Concept Phase will continue for Latin America/Caribbean. In other regions, project ideas developed in 2017 will be reviewed. The role of space agencies will be to assess whether satellite EO could contribute to these proposed projects, and realistically address the priorities within the frame of available resources and for which external stakeholders are willing to contribute. The WGDisasters Data Coordination Team will play a key role in identifying the satellite resources that could be made available without affecting the on-going activities of WGDisasters. The Prototyping ('pilot') Phase will be implemented beginning in 2018, based on the results of the Concept phase. The Pilot projects to be implemented are currently under definition and are expected to begin by mid 2018 in some regions. To ensure alignment with CEOS Agency capacity, detailed proposals will be developed for each potential Pilot project, with each proposal identifying the CEOS and external resources necessary for the implementation. The proposals will be presented to CEOS Plenary and/or SIT as appropriate for endorsement in order to secure approval to proceed to implementation.

**III. Continue support to the GEO Geohazard Supersites and Natural Laboratories Initiative.**

The concept for the Geohazard Supersites and Natural Laboratory was conceived during the 3<sup>rd</sup>

International Geohazards workshop held in November 2007 at ESA-ESRIN. In 2010 it was established as an initiative within the Group on Earth Observation (GEO), and is organised as a voluntary international partnership of scientists and satellite (SAR and optical) and in situ (seismic, geologic, geodetic, etc.) data providers aiming to improve geophysical scientific and geohazard assessment, ensuring rapid and effective uptake of scientific information in DRR, complying with Priority 1 of the Sendai Framework. The initiative is established as a network of communities generating scientific information products and supporting users with services focused on areas with important hazard and risk levels: the Supersites and the Natural Laboratories.

The GEO Geohazards Supersites and Natural Laboratories (GSNL) Initiative aims to:

- to enable the global scientific community with open, full and easy access to a variety of space- and ground-based data over the Supersites and the Natural Laboratories;
- to promote advancements in geohazard science over the selected sites;
- to provide scientific information services to local DRR stakeholders and decision makers;
- to innovate technologies, processes, and communication models, enhancing data sharing and Open Science.

The CEOS WG Disasters is involved through the Data Coordination Team; the latter receives the request for satellite data support from the Supersites, then collects the various space agencies' commitments to fulfill the Supersite image requests (with archive data and/or new acquisitions).. The space agencies then independently provide open access to their satellite imagery for the Supersite scientific community. The in situ data providers (which in most cases are the Supersite Coordinators) commit to provide open access to ground-based data. The Supersite data and resources are open for the international scientific community (licensing may apply), and this stimulates collaboration, knowledge transfer, capacity building, and generation of new scientific results, which are shared within the community.

The scientific results which are relevant to geohazard assessment are then communicated by the Supersite Coordinator to the end-users and decision makers, using the national institutional channels already in place with them.

CEOS has officially endorsed 11 Permanent Supersites and a set of Event Supersites.

**2018-2020:** A key priority for 2018 will be fulfilling the data needs for the two recently approved supersites in D.R. of the Congo (Virunga volcanoes) and Chile (Southern Andes volcanoes). The CEOS will continue to provide data for the approved Permanent Supersites and Natural Laboratories as agreed for each of them.

Further biennial reports from the Etna, Campi Flegrei, Marmara and Hawaii supersites will be received and reviewed, and presented to the CEOS Plenary for endorsement.

The CEOS WG Disasters (through the Data Coordination Team), will continue to assess incoming requests from the scientific community to increase the number of both permanent and event Supersites and, in case of positive evaluation, will provide the relative satellite data to the Supersites scientific teams.

The CEOS WG Disasters will continue to review results from the Supersites initiative through the supersite periodic review process and present its assessment to the CEOS Plenary.

Observations for Disasters Objectives/Deliverables: 2018-2019			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>DIS-10:</b> Implementation of data coordination for the GEO-GNSL initiative	Q4 2020	<p>Potential proposals for new GSNL activities (i.e. new permanent &amp; event Supersites) aiming at expanding the objectives of the current pilots will be assessed by the Data Coordination Team and the various pilot teams in due time. The assessment will be done by WG Disasters following the procedures endorsed by CEOS.</p> <p>The status of implementation of the plan, of the pilots and supersites being supported, and the coordination relating to the GSNL initiative will be reported at CEOS SIT and Plenary meetings.</p>	WGDisasters
<b>DIS-12:</b> Report on survey of donors for post-2017 operation of a Recovery Observatory	Q4 2018	<p>WGDisasters will develop a survey of initial results of the Recovery Observatory from the perspective of institutional donors, and include outlooks on possible inclusion of additional hazards and the sustainability of Recovery Observatory activities for 2018 onwards.</p> <p>The findings of this survey will be presented in a lessons learned report in 2018 to enable timely consideration by CEOS Agencies.</p>	WGDisasters
<b>DIS-15:</b> Support for GEO-DARMA identification of major hazards and DRR issues for each selected region	Q2 2018	<p>GEO-DARMA will seek independent identification of disaster risk management priorities at regional level by authoritative regional institutions in line with the priorities from the <i>Sendai Framework for Disaster Risk Reduction 2015-2030</i>.</p> <p>This task will require the active support of major stakeholders in the field of disaster risk management at global, regional and national levels in order to implement a series of pilot projects.</p>	WGDisasters
<b>DIS-16:</b> Report on Landslide Pilot and follow-on actions.	Q4 2019	<p>A report will be prepared to summarize the learnings from the landslide pilot, and to recommend pathways forward.</p>	WGDisasters
<b>DIS-17:</b> Demonstrators Implementation Plan	Q2 2018	<p>Follow on actions from seismic hazards, volcanoes and flood pilots</p>	WGDisasters

### 3.5. Observations for Water

#### I. Implement the CEOS Strategy for Water Observations from Space

**2018-2020:** Planning and coordination of space agency support to global initiatives for monitoring of water resources will be a focus for CEOS over coming years.

At the 29<sup>th</sup> CEOS Plenary Meeting, CEOS adopted the *CEOS Strategy for Water Observations from Space*. This strategy describes what CEOS will do in support of water observations

generally, and GEO-identified water observation requirements specifically.

At the end of 2015, GEO entered its second decade under a new Strategic Plan with new organizational arrangements. In 2016, GEO endorsed a new Work Programme which highlights that water-related activities within GEO are evolving rapidly, potentially creating a need for CEOS to clarify the ‘reference point’ for its water-focused actions over coming years. Noting this, CEOS will:

- Continue to implement the *CEOS Strategy for Water Observations from Space*, through activities of existing CEOS Entities;
- Monitor developments within GEO to determine the most appropriate reference points for water observation requirements, and CEOS responses, in the future.

Observations for Water Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>WAT-4:</b> Updates on implementation of the CEOS Strategy for Water Observations from Space, including consideration of required adjustments based on activity in GEO	Q4 2019	CEOS, through the SIT Chair, will continue to monitor progress on GEO water-related activities.  The SIT Chair will also engage with GEO to determine when, and if, the strategy should be revisited. Regular updates will be provided at SIT meetings.	SIT Chair
<b>WAT-6:</b> Response to satellite-related aspects of the GEO AquaWatch Initiative Implementation Plan	Q4 2018	CEOS support for the implementation of the GEO AquaWatch (monitoring and forecasting of water quality of inland and coastal waters) community activity is crucial, as satellite observations are an integral component. AquaWatch will be submitted as a formal GEO Initiative in 2017.	NOAA and CSIRO (with OCR-VC)

### 3.6. Future Data Architectures

Since CEOS plenary 2015, led by the then CEOS Chair CSIRO, CEOS has been examining how so-called “future data architectures” (FDA) will alter the way that agencies provide access to their EO data. Following on from an interim FDA document submitted at the 2016 plenary, in 2017, CEOS engaged with this theme in more detail across a number of threads, through an extended and more strategically focused Ad Hoc Team on Future Data Architectures (FDA-AHT). The team developed a discussion document entitled “Future Data Access and Analysis Architecture Strategy for CEOS” for Plenary 2017 identifying a set of activities which should be implemented by CEOS agencies to capitalize on the opportunities presented by future data architectures. CEOS Principals took the decision to focus in 2018 on the five core areas identified in the discussion document (and listed below) within the Future Data Architecture Ad-hoc team and the relevant CEOS groups. This “data” focus was reinforced by the incoming CEOS Chair, the European Commission, who identified the area of “data” as one of the two focus areas for its chairmanship.

#### I. CEOS Analysis Ready Data (ARD)

- Implementation of CARD4L, noting the critical need for progress in the land domain, which is less advanced than marine and atmosphere domains;

- Definition of a comprehensive CEOS strategy for ARD, incorporating coastal, marine, and atmospheric domains in a manner complementary to Coordination Group for Meteorological Satellites (CGMS) and World Meteorological Organization (WMO) activities.

## **II. Interoperable Free and Open Tools**

- Provision of interoperable free and open tools to exploit advances in technology and meet user demand, including increasing contributions to the CEOS Data Cube (CDC) initiative and utilizing data platform infrastructures;
- Continuation of ongoing programme of ‘pilot projects’ for new technologies, undertaken at low-risk/low-cost, to ensure feedback to CEOS agencies on real users’ requirements, providing Principals with real-world evidence as to what suitable future projects might be.

## **III. Data, Processing, and Architecture Interface Standards**

- Identification of standards for portability of ‘algorithms’ that exploit satellite EO data between different exploitation platforms, whatever technologies, whether proprietary or open, that they are based on.

## **IV. Analytical Processing Capabilities**

- Facilitate implementation of modular and easy-to-use analytical processing capabilities in full computing environments for time series and other analysis

## **V. User Metrics**

- Definition of a data use metrics framework through which agencies can contribute to a ‘sector wide’ view of how EO data is actually being used, not just how much is being downloaded

The outcome of these initiatives should be a more coordinated and coherent EO data offering, against which organisations can confidently invest their resources and leverage their distribution channels to users in an effort to realise benefits that go far beyond the traditional mono-mission approach. Coordination across the above core initiatives will be managed by the FDA Ad-Hoc team co-chaired by CSIRO, ESA and USGS, with responsibility for specific activities being identified in the following actions paragraphs. In addition, in order to facilitate the core activities on this theme, the FDA Ad-hoc team will also seek to establish a common understanding of the functional blocks of a generic Future Data Architecture. To do this, agencies will contribute to identifying the current public and private offerings in FDA for EO and characterize them. An analysis of public vs. private roles in these FDAs will also be necessary and is expected to facilitate the analysis of the principal interfaces within an FDA and help to identify where interoperability arrangements need to be established.

Future Data Architectures Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>Framing the discussion on FDAs</b>			
<b>FDA-2:</b> Collaborative development of CEOS Data Cube technology	2019-Q4	CEOS Agencies will develop the CEOS Data Cube as a piece of re-usable and customizable open source technology that lowers the barriers to use of satellite Earth observation data. Activity will be undertaken in accordance with the CEOS Data Cube Work Plan.	<b>CSIRO, GA, SEO, UKSA, USGS</b>
<b>FDA-5:</b> Promote awareness of FDAs	Q2 2019 (Interim reports)	With growing interest in Future Data Architectures, WGCapD will identify ways of promoting the use of Future Data Architectures and possible outreach capacity building activities for end users and decision makers (e.g. webinars, workshops, etc).	<b>WGCapD supported by WGISS and SEO</b>
<b>FDA-8:</b> Establish a common description of Future Data Architecture functional blocks and identify interfaces and interoperability approaches.	Q3 2018	Based on the outputs of the inventory and review of existing standards and approaches at CEOS agencies, on the pilot projects and using the various workshops (listed below) where FDA activities are discussed, FDA-AHT will establish a common understanding and develop a white paper describing the functional blocks and typical interoperability approaches for a generic FDA.	FDA AHT supported by WGISS
<b>FDA-9:</b> Inventory and characterise existing FDAs operated by both public and private entities including the standards and approaches they use (e.g. Data Cubes, Exploitation Platforms, Copernicus DIAS, etc).	Q3 2018	As CEOS agencies are defining their processing and data dissemination standards, they seek to apply and follow international standards and best practices, including those generated by WGISS.  This does not only concern common standards in terms of catalogs, metadata, terminology, and semantics, but it also involves interoperability standards for data discovery and download and for EO data analysis Application Programming Interfaces (APIs), as well as common interface standards such as INSPIRE, OGC, and W3C, and interoperability with other data access services (e.g., European Data Portal, international, GEOSS).  WGISS will inventory and characterise existing FDAs operated by both public and private entities including the standards and approaches they use (e.g. Data Cubes, Exploitation Platforms, Copernicus DIAS, etc).	WGISS

Future Data Architectures Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>CEOS Analysis Ready Data (ARD)</b>			
<b>FDA-7:</b> Product Specifications in accordance with the CARD4L Framework	Q1 2018	CEOS Analysis Ready Data for Land (CARD4L) will be satellite data that have been processed to a minimum set of requirements and organized into a form that allows immediate analysis with a minimum of additional user effort, and interoperability both through time and with other datasets.  LSI-VC will complete the development of the first concrete specifications for CARD4L-branded products.	LSI-VC (with WGCV)
<b>Interoperable Free and Open Tools</b>			
<b>FDA-10:</b> Finalise inventory of Software and Tools available or used at CEOS agencies for EO data exploitation and use focusing on Open Source but remaining as broad and inclusive as possible and implement a mechanism for discovery and access.	Q3 2018	Each CEOS agency will continue to develop its data and computational infrastructures consistent with its capacity and user service mandates. CEOS has a role in identifying tools to support complementarity and interoperability across CEOS agencies in support of the FDA strategy objectives.  WGISS will finalise the ongoing work of inventorying the software and tools available or used at CEOS agencies for EO data exploitation and use (e.g. EO data visualization, analysis, processing, readers/writers, etc), and implement a mechanism for discovery and access. Focus will be on Open Source but remaining as broad and inclusive as possible.	WGISS
<b>Data, Processing, and Architecture Interface Standards</b>			
<b>FDA-11:</b> Organise several sessions/workshops to share lessons learned and outcomes from FDA systems and platform pilots and Interoperability Projects.	Q4 2018	Several CEOS agencies have already carried out initial pilot projects and CEOS seeks to share the experience gained from these to ensure the discussions on the strategic dimensions of FDA are informed by practical evidence. Sessions (including but not limited to those detailed below) should focus on several issues ranging from technical to programmatic lessons learned will be shared and considered as input for the definition of technical FDA recommendations. <ul style="list-style-type: none"> <li>• WGISS-45, FDA workshop, 11/04</li> <li>• SIT-33, 24-25/04</li> <li>• FDA Big Data Workshop, 26/04 Boulder</li> <li>• SIT Technical Workshop, 12-13/09</li> </ul>	FDA AHT and WGISS
<b>FDA-12:</b> Inventory of space data product formats used by CEOS agencies.	Q4 2019	Develop an inventory of current product format used in CEOS agencies and identify recommendations to facilitate interoperability.	WGCV

Future Data Architectures Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>User Metrics</b>			
<b>FDA-13:</b> Develop a User Metrics Best Practice.	Q4 2018	The proposed User Metrics initiative seeks to ensure planning and responsibilities are put in place for CEOS to leverage the experience being gained by individual agencies and GEO to collate available user metrics and to adapt the FDA strategy as these metrics are analysed beyond what is simply being downloaded. WGISS will perform a survey on existing user metrics in Earth Observation and other domains (e.g. social media) and develop a best practice for User Metrics recommended for application by CEOS agencies; these will include a user questionnaire to allow classifying the final user in terms of use of the data products and allowing generation of summary statistics on how EO data is being used and for what.	WGISS

### 3.7. Capacity Building, Data Access, Availability and Quality

#### I. Advance CEOS Data Democracy activities.

Through the Working Group for Capacity Building and Data Democracy (WGCapD), CEOS Agencies raise awareness of the value of EO data products and services to user communities, including support to locate and access data, products, and tools, and targeted training workshops. WGCapD also supports CEOS initiatives and helps WGs and VCs undertake their own capacity building initiatives, by providing guidance on best practices.

WGCapD has offered a variety of training and capacity building activities, including in-person training workshops, webinars, and efforts to better collect, coordinate, synergize and make available existing capacity-building resources for satellite Earth observation users in developing countries. In 2017, this working group held five Synthetic Aperture Radar (SAR) Data Workshops: two in South Africa (January and May), one in Gabon (February), one in Costa Rica during AmeriGEOSS Week (August), and one in Zambia (October). WGCapD also developed and delivered a SAR Data Processing & Applications Webinar Series, which took place from April 17th – June 9th, which helped 252 participants from 53 countries learn how to better use and apply SAR data.

In support of broader capacity building and training activities led/organized by the other CEOS Working Groups and Virtual Constellations, WGCapD has drawn upon its collective training and capacity building experiences to develop a “best practices” resource that may help guide their future in-person and online capacity building and/or training decisions and plans.

**2018-2020:** WGCapD plans to continue delivering SAR training workshops for users in developing countries on data access, awareness, processing, and applications.

In addition, the WGCapD recognizes a global need for the collection, coordination, and synergization of the world’s diverse and often disparate capacity building and training

resources related to satellite Earth observations. As such, the group plans to collaborate with UNOOSA, UNESCAP, and other UN Agencies to highlight the value and benefits of EO tools and services and explore existing methods and tools (and the resources required) to identify and implement a sustainable solution for these problems.

The WGCapD also plans to continue collaborating with GEO to strengthen AmeriGEOSS, AfriGEOSS, and Asia-Oceania GEOSS (AO GEOSS) through its training contributions at their respective meetings/workshops, as was done via the SAR Technology training offered at AmeriGEOSS Week and the Google Earth Engine and Sentinel Data Access and Processing training given in support of AfriGEOSS objectives, both in 2017. Training contributions in support of the AO GEOSS will also be explored.

WGCapD has adopted the approach of dividing the work the group supports into global and regional and national activities:

- 1) For **global work**:
  - Focus on on-line learning through e-learning, MOOCs, webinars, blended learning approaches.
- 2) For **regional work**:
  - Focus on support to the 3 GEOSS initiatives' annual meetings: AfriGEOSS, AmeriGEOSS, and AOGEOSS.
  - Support trainings in conjunction with regional society and other meetings.
  - Leverage single-agency regional activities as possible.
- 3) For **national work**:
  - Support UN-SPIDER mission needs.
  - Strengthen our understanding of national needs in other thematic areas.

## **II. Continue to support the development and operationalization of the GEOSS Common Infrastructure (GCI) and its CEOS-related elements.**

**2018:** Through the Working Group on Information Systems and Services (WGISS), CEOS Agencies will foster the implementation and enhancement of the GCI through continued development and coordination of tools that improve discovery, interoperability, and access to satellite data. Such tools include the CEOS WGISS Integrated Catalogue (CWIC), the International Directory Network (IDN) and the Federated Earth Observation (FedEO) gateway system which together constitute the WGISS Connected Data Assets Infrastructure. In order to be effective, WGISS work shall be supported by CEOS agencies through the adoption of the defined standards, the implementation of the required interfaces and metadata formats, and the identification of experts joining the group activities.

WGISS will also support adoption of supported WGISS standards (e.g. OGC CSW 2.0.2 and CEOS OpenSearch Best Practices) with the aim of connecting as many CEOS Agencies as possible into the federated system. WGISS will also work with the SEO to explore opportunities to integrate systems such as the CEOS Visualization Environment (COVE) and the EO Handbook Database to streamline data management processes and improve consistency.

In addition, WGISS will continue its core activity of promoting and exchanging technical information and lessons-learned experience about current and trending data system technologies/services and data stewardship impacting CEOS Agencies, with the aim of

preparing CEOS and CEOS Agencies for the future.

**2019-2020:** WGISS will support data access for the CEOS Virtual Constellations, Working Groups, and GCI through the use of the supported WGISS standards (e.g. OGC CSW 2.0.2 and *CEOS OpenSearch Best Practices*) and Connected Data Assets Infrastructure. WGISS will also ensure, with the cooperation of CEOS agencies, that the IDN will be used as a collection dataset registration system for CEOS Agencies.

**III. Coordinate the development of suitable methodologies for the on-ground characterization of satellite-based EO sensors, the on-orbit calibration of EO missions, and the validation of satellite-based Level 1 and Level 2 products.**

**2018-2020:** The Working Group on Calibration and Validation (WGCV) continue to evaluate and recommend best practices for the characterization/calibration of satellite-based sensors and the validation of satellite-based Earth observation data products. The results of this work are the building blocks for data and tools needed by the VCs and other WGs in terms of calibration and validation. For these broad applications, different tasks are focused in several sub-groups dealing with specific areas of interest. Three sub-groups serve, in particular, the calibration of sensors and their link to international acknowledged standards. Another three sub-groups are related to topical subjects concerning validation of data products.

As is evident throughout this document, the interoperability and utility of ARD products are an emphasis of CEOS. WGCV efforts to provide the tools needed to allow users to assess ARD quality will begin with defining and quantifying uncertainties for surface reflectance product validation at continental scales. A similar effort will take place related to GHGs by developing a set of standards for CO<sub>2</sub> and CH<sub>4</sub> products that are suitable for intercomparisons across multiple missions. WGCV activities will build upon the recent progress towards understanding global biomass by developing an initial set of guidance for biomass product validation using near-term missions such as NISAR, GEDI, and BIOMASS. Ensuring that the results of this work are readily available will take place through a significant update to the CEOS Cal/Val portal and the WGCV web site within the CEOS interface

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

**2018:** WGCV will strengthen its cooperation with GSICS in the topic of sensor calibration by continuing to identify opportunities for cooperation. The effort to develop a recommendation for a GSICS/CEOS solar spectrum that ensures interoperability is nearing completion. A similar project related to Level-1 top-of-atmosphere interoperability is underway making use of the lessons learned from the MRI activities and will be a link towards the quantification of the surface reflectance uncertainties discussed above.

**2019-2020:** WGCV will continue working with the GEO Secretariat, including work to support relevant GEO activities, mainly by encouraging widespread adoption of quality assurance principles. The development of calibration infrastructure and comparison campaigns within the frame of WGCV will be used to promote these principles and best practices. 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 the science users and data product providers in the Atmosphere, Terrestrial,

and Ocean communities.

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

**2018-2020:** The CEOS Database (a.k.a., the Missions, Instruments and Measurements Database, or MIM) is the only official consolidated statement of CEOS Agency programs 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 visualization 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’ capability 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, IDN) or to external information systems, such as WMO’s Observing Systems Capability Analysis and Review Tool (OSCAR) and the Global Change Information System (GCIS, <http://data.globalchange.gov/lexicon/ceos>).

In 2018, 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.

<b>Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2018-2020</b>			
<b>Objective/Deliverable</b>	<b>Projected Completion Date</b>	<b>Background Information</b>	<b>Responsible CEOS Entity</b>
<b>CB-10:</b> CEOS MIM Database Update Survey and Release of Online Version	Survey Q2, release Q4, each year	CEOS Agencies to provide resources to support their responses to the survey issued in the April-May timeframe to update the CEOS MIM database; release of the updated CEOS MIM Database will be online prior to the annual CEOS Plenary Meeting.	ESA, with support from CEOS Agencies
<b>CB-19:</b> Collaborate with the CEOS SDG-AHT to identify SDG-related training and capacity building opportunities related to space-based EO and meeting the challenges of the <i>2030 Agenda for Sustainable Development</i>	Q4 2018	WGCapD is participating in the CEOS SDG Ad Hoc Team which will support GEO in promoting use of EO to track progress towards, and achieve, the Global Sustainable Development Goals (SDGs).	WGCapD

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>CB-20</b> Provide CB support to the regional and thematic AmeriGEOSS initiative	Q4 2018	Provide training and capacity building support to AmeriGEOSS with training opportunities as part of their annual meetings/initiatives  Help with the development of methods and guidance documentation for best practices around <b>institutional capacity development for GEOGLAM project in the Americas</b> as well as with the Capacity Building Development plan.	WGCapD
<b>CB-21:</b> Explore future options for providing portal-based access to capacity building and training resources	Q4 2020	Conduct a study of existing and potential new approaches to collect, coordinate, and synergize available capacity building and training resources related to satellite Earth observations, e.g. GEOCAB, VLab training calendar and methods, and other alternate approaches.	WGCapD
<b>CB-26</b> Provide CB support to the regional and thematic AfriGEOSS initiative	Q4 2020	Provide training and capacity building support to the AfriGEOSS with training opportunities as part of their annual meetings/initiatives. For AfriGEOSS 2018 (June 25-29), investigate the possibility of offering a training on Flood Mapping or Forestry.	WGCapD
<b>CB-27</b> Provide CB support to regional and thematic AOGEOSS initiative	Q4 2020	Engage with AOGEOSS initiative and find out the needs of the region for possible training initiatives WGCapD could support	WGCapD
<b>CB-28</b> Conduct global capacity building courses through a multi-lingual MOOC (Massive Online Open Course) on radar backscatter	Q1 2019	DLR's SAREDU project by FSU Jena will provide a multi-lingual MOOC (German, English, French, Spanish, Portuguese-tbc) on radar backscatter through the EO-College portal in Q4 2018 or 2019	WGCapD
<b>CB-29</b> Conduct global capacity building courses through Webinar on Asia-GEOGLAM, SAR Missions – Present and future, Disaster Risk Reduction (UNOOSA) (global training-interactive)	Q3 2019	ISRO with support of NASA, DLR and other theme specialists will plan to conduct these webinar series on these specialised topics.	WGCapD

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>CB-30</b> Conduct global capacity building courses through a MOOC (Massive Online Open Course) on SAR	Q1 2019	ESA with support of DLR's SAREDU project by FSU Jena and CSA will provide a second run of an improved ECHOES IN SPACE SAR MOOC extended by additional application examples	WGCapD
<b>CB-31</b> Conduct global capacity building courses a MOOC (Massive Online Open Course) on Land Cover and Land Use Changes	Q4 2019	ESA with support of other WGCapD members will provide a MOOC (Massive Online Open Course) on Land Cover and Land Use Changes, if feasible through the EO-College portal in cooperation with DLR	WGCapD
<b>CB-32:</b> Provide regional hands-on training in land cover land use change topics in GEOSS regions in conjunction with related meetings.	Q4 2019	WGCapD will build on the successful NASA-ESA Trans-Atlantic Training program to provide hands on training in land cover land use change topics, starting in Asia to leverage existing NASA investments.	WGCapD
<b>DATA-2:</b> Full representation of CEOS Agency datasets in the IDN and accessibility via supported WGISS systems and standards	Q2 2019	As the IDN contains OpenSearch endpoints for data access and is also the CEOS Data Collections access point for the GEOSS Common Infrastructure (GCI) and GEO Portal, it is essential that all CEOS Agencies keep information on their data collections, including Analysis Ready Data, up-to-date in the IDN according to its metadata model (DIF-10)	WGISS and CEOS agencies / Working Groups
<b>DATA-8:</b> Maintain and evolve WGISS Connected Data Assets Infrastructure and Systems for CEOS Agencies data and services discovery and access	Q4 2018	Consolidation, operations, maintenance and evolution of current CWIC/FedEO/IDN overall Architecture.	WGISS
<b>DATA-9:</b> ECVs/CDRs Discovery and Access through WGISS Systems	Q3 2018	Facilitate discoverability and accessibility of ECV Products and space-born CDRs relevant for the CEOS Carbon Action via WGISS Connected Data Assets Systems & Standards (FedEO/CWIC/IDN, OpenSearch).	WGISS
<b>DATA-11:</b> Data and Technology Exploration webinars and workshops	Q4 2019	WGISS will host at least one workshop annually to serve as a forum for exchange of technical information and lessons-learned experience about current, trending and future data management approaches and technologies, services and other Internet-related technologies.	WGISS

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>DATA-12:</b> CEOS data holdings reported in GEO	Q3 2018	Provide support to GEO in their efforts of reconciling metrics of CEOS data holdings provided through WGISS Connected Data Assets standards and systems.	WGISS
<b>DATA-13:</b> Develop a White Paper on Single Sign-On (SSO) authentication.	Q4 2018	<b>Single sign-on (SSO)</b> allows user login with a single ID and password to gain access to connected (federated) systems. This capability is crucial for interoperability between different FDA platforms and systems. WGISS will develop a white paper on single-sign-on (SSO) authentication best practices to support machine-to-machine authentication for EO analysis	WGISS
<b>CV-1:</b> Update of general WGCV website to enhance better communication across CEOS and users	Q3 2018	Re-organization of WGCV website concept which includes on one side the entry to the CEOS portal, the CEOS CalVal portal, and the different subgroup web-sites in order to achieve a better outreach and communication strategy.	WGCV
<b>CV-3:</b> Workshop on state of the art for pre-flight calibration techniques	Q4 2018	Hold an open-invitation workshop to discuss and promote best practices on pre-flight and onboard calibration of sensors, initially focusing on optical.	WGCV
<b>CV-9:</b> Radiometric Calibration Network (RADCALNET)	Q4 2018	Establish an automated network via a multi-agency project, including coordination infrastructure, and land-based test-sites for post-launch traceable calibration of sensor radiometric gain, initially for <50 m resolution sensors. Progress will follow the developed project plan.	WGCV
<b>CV-13:</b> Intercomparison of atmospheric correction models	Q4 2018	The WGCV task team “Atmospheric Correction” will carry out several comparison measures between models and report about their findings including recommendations with respect to EO applications.	WGCV
<b>CV-14:</b> Report on application of approaches for cloud masking	Q4 2018	The WGCV task team “Cloud Masking” will research different cloud masking approaches for different sensors and spectral areas in order to deliver a report about their findings including recommendations for the applications of cloud	WGCV
<b>CV-15:</b> L1 top-of-atmosphere interoperability	Q4 2018	Develop an initial recommendation of a community reference in collaboration with GSICS.	WGCV

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>CV-16:</b> Report on outcomes from GSICS/CEOS reference Solar Spectrum evaluation	Q2 2018	Cooperation through a series of virtual meetings to evaluate recent advances to recommend a solar spectra for GSICS and CEOS to ensure interoperability.	WGCV
<b>CV-17:</b> Continental scale surface reflectance validation	Q2 2019	Provide guidance for development of methodologies to validate the results of the recent ACIX work leading to protocols for determining uncertainties for interoperable reflectance products.	WGCV
<b>CV-18:</b> Greenhouse gas reference standards for interoperability	Q4 2019	Develop list of reference standards for CO <sub>2</sub> and CH <sub>4</sub> products that are suitable for use in intercomparison of multiple missions	WGCV
<b>CV-19:</b> Biomass validation protocols	Q2 2020	Development of an initial set of guidance for validation of biomass products using near-term missions such as NISAR, GEDI, and BIOMASS	WGCV

### 3.8. Advancement of the CEOS Virtual Constellations

- I. **Characterize 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.**

**2018-2020:** 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.

Advancement of the CEOS Virtual Constellations: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>VC-2:</b> Ozone dataset validation and harmonization	Q4 2020	Production of peer-reviewed papers on ozone profile intercomparisons of data sets and long term (1979-now) combined data sets.	AC-VC
<b>VC-3:</b> Air quality constellation coordination	Q4 2018	Prepare document on validation needs for the AQ Constellation.	AC-VC

Advancement of the CEOS Virtual Constellations: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>VC-9:</b> Implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Colour Radiometry (INSITU-OCR)	Ongoing	Implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Colour Radiometry (INSITU-OCR), including recommendations of the INSITU-OCR White Paper ( <a href="http://www.ioccg.org/groups/INSITU-OCR_White-Paper.pdf">www.ioccg.org/groups/INSITU-OCR_White-Paper.pdf</a> ) and establishment of the INSITU-OCR Secretariat (EUMETSAT, NASA and NOAA). Implementation is following a modular approach.	OCR-VC (with EUMETSAT, NASA and NOAA)
<b>VC-14:</b> Vision for an OSVW Constellation	Q2 2019	White Paper describing and justifying the oceanography and climate requirements for an OSVW constellation.  The International Ocean Vector Winds Science Team (IOVWST) meeting held in 2016 strongly recommended: at least three scatterometers in orbits designed to roughly meet the WMO requirements; and one instrument in a non-sun-synchronous orbit to help with the diurnal cycle, better sampling at mid-latitudes, and to improve inter-calibration. It has been proposed that a User Requirements Document be developed. An interim report will be presented to CEOS at SIT-31, and a more in-depth analysis will be prepared for the OceanObs meeting to be held in Q3 2019.	OSVW-VC
<b>VC-15:</b> OSVW Standards and Metrics	Q4 2018	Standards and metrics for OSVW services and products, including standard Cal/Val methods. Cal/Val methods will be addressed by the IOVWST Climate Working Group.	OSVW-VC
<b>VC-17:</b> Support to ECV precipitation parameters	Q4 2018	Precipitation ECV support: Provide the CEOS Response to GCOS Action A-8; ensure continuity of satellite precipitation products through five deliverables. Deliverables for 2018 are: reprocessing of all TRMM data to GPM standard (Version 8) (Q2), expansion of GPM DPR Ka band swath in routine operations (Q2), operational availability of JPSS-1/NOAA-20 MIRS precipitation products (Q2), completion of AMSR2 FO MDR and initiation of pre-project phase (Q3), launch of MetOp-C (Q4).	P-VC

Advancement of the CEOS Virtual Constellations: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>VC-18:</b> Programs for improvement of global precipitation products	Q4 2018	Precipitation products (with respect to algorithm development, outputs, and user requirements) using multi-satellite and multi-agency data through coordination between Precipitation Virtual Constellation (P-VC) partners. Deliverables for 2018 are: ICE-POP: International Collaborative Experiment – PyeongChang Olympics-Paralympics 2018 (Q2), GPM Disease Initiative Workshop (Q2), AMSR-E reprocessing to AMSR2 standard algorithms and formats (Q4), expansion of GSMAp_NOW NRT multisatellite product to Meteosat region (Q4).	P-VC
<b>VC-19:</b> Documented plan for the SST Virtual Constellation	Q3 2018	Building on Donlon, et al (2010) <i>Successes and Challenges for the Modern Sea Surface Temperature Observing System</i> , the SST-VC will describe and justify the requirements and design for the modern virtual constellation for SST. This description of an optimal SST constellation will prove useful to CEOS Agencies in planning and implementing a globally coordinated and cost- effective observing capability for SST.	SST-VC
<b>VC-30:</b> Interoperability case study for Landsat and Sentinel-2	Q4 2018	The framework for moderate land sensor interoperability – see now completed <b>VC-29</b> – will be applied to the Landsat and Sentinel-2 missions	LSI-VC (with WGCV)
<b>VC-31:</b> Evaluate CARD4L among target user communities and provide feedback on changes to CEOS information tools	Q4 2018	Conduct an evaluation of CARD4L with target user communities, starting with GEOGLAM and GFOI.	LSI-VC (with SDCG-GFOI, CEOS-GEOGLAM <i>ad-hoc</i> WG)
<b>VC-32:</b> CARD4L Product Assessment Framework	Q3 2018	Define how a formal process for the assessment of products as CARD4L will be completed including: how the CARD4L PFS are to be used, roles and responsibilities, how feedback on the CARD4L Framework generated through this process is handled, promotion of CARD4L datasets, etc.	LSI-VC
<b>VC-33:</b> Maintain the CARD4L Product Family Specifications (PFS)	Q4 2018	Ongoing task to maintain the CARD4L Product Family Specifications and integrate new Product Families when deemed appropriate.	LSI-VC

Advancement of the CEOS Virtual Constellations: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>VC-34:</b> CARD4L Engagement Strategy	Q3 2018	<p>A CARD4L Engagement Strategy will be defined to outline the approach for:</p> <ul style="list-style-type: none"> <li>• Estimation of the cost-benefits of CARD4L for providers and users.</li> <li>• Promotion of CARD4L, including through workshops, conferences and journals.</li> <li>• Encouraging the development of CARD4L compliant datasets.</li> <li>• Gathering feedback from users on the benefits of and potential improvements to CARD4L datasets.</li> </ul> <p>The Engagement Strategy will also include a target roadmap for CEOS agency CARD4L production. An online list of CARD4L datasets, including their level of maturity, will be maintained at: <a href="http://ceos.org/ard/">http://ceos.org/ard/</a></p>	LSI-VC
<b>VC-35:</b> Passive microwave radiometer continuity	Q4 2018	Coordinate inter-agency efforts to seek continuity and redundancy of Passive Microwave Radiometer observations for SST.	SST-VC
<b>VC-36:</b> Monitoring MRI implementation examples		<p>Monitor existing MRI – see now completed <b>VC-29</b> – implementation examples by agencies such as the MRI framework for moderate resolution land sensor interoperability applied to the Landsat and Sentinel-2 missions. Develop the long-term plans and actions for MRI, as well as identifying any expansion of MRI to other sensors. Specifically, the following actions are planned:</p> <ul style="list-style-type: none"> <li>• Furthering the framework under consideration of the agreed principles and expanding it to other sensors with a focus on moderate resolution SAR.</li> <li>• Analyzing various past/ongoing implementations (e.g. NASA HLS, ESA HSL) for MRI framework compliance.</li> <li>• Initiating detailed assessments of various implementation options (common grid, spectral &amp; temporal adjustments).</li> </ul>	LSI-VC
<b>VC-37:</b> CEOS Information Tool Improvements	Q4 2018	Identify potential modifications to existing CEOS information tools that can be made to help improve their value for gap analyses.	LSI-VC

### 3.9. Support to Other Key Stakeholder Initiatives

#### I. Promote the use of satellite data in the 2030 Agenda for Sustainable Development

**2018-19:** with continuation of the Ad Hoc Team, it will continue to:

- Support GEO in its SDG-related initiatives, mainly through the EO4SDG (“Earth Observation for Sustainable Development Goals” initiative): capacity building, training and communications materials, country engagement, forum to share best practices on EO data and SDG, and EO4SDG website content.

- Collect and centralize information from individual CEOS Agency work programmes relevant to SDGs: building on a Compendium database, with regular updates sent within CEOS contacts to collect more accurate information.
- Promote space-based EO data as a key source of data for use by national statistic offices (NSOs) to monitor specific SDG indicators and encourage CEOS space agencies to proactively contact their national governments in the Voluntary National Review process.
- Identify areas where SDG indicator development work has the potential to result in broader applicability (e.g. supporting the SDG / target, and sustainable development policies)
- Develop activities – including capacity building - with external stakeholders (GEO, NGOs, UN entities, development banks or financial institutions) to join the efforts in the space world to help monitor and achieve the SDGs.
- Develop communications material (brochure, website content) with SEO team's support to better inform CEOS space agencies and external stakeholders about the critical role of EO space data in the SDG process.

**II. Continue CEOS contributions and maintain leadership role in the GEO Blue Planet Initiative.**

**2018-2019:** CEOS Agencies will continue to develop and distribute experimental and operational data, products, and services, along with the further evolution of the proposed COVERAGE model to facilitate distributed access to collocated, synergistic datasets with fit-for-purpose latency, quality, coverage and content for applied, commercial, and research utilization.

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

**2018:** The CEOS Biodiversity activity will continue to work closely with the GEO Biodiversity Observation Network (GEO BON) to foster the development of remote sensing enabled Essential Biodiversity Variables (EBVs). During 2018, GEO BON affiliated groups will be publishing the results of workshops held in 2017 to refine a list of EBVs (including those for which satellite remote sensing will be a significant source of observations). They will also be drafting an EBV development and implementation plan.

**2019-2020:** The CEOS Biodiversity activity will continue to work with GEO BON and the broader biodiversity research and conservation applications remote sensing community. In addition to fostering community collaborations, the objective will be to create connectivity among the various remote sensing enabled EBV projects. These are gradual process that have both a technical as well as social components.

**IV. Continue dialogue on enhanced CEOS-level coordination to support improved research and monitoring of the Earth's Polar Regions.**

**2018-2019:** CEOS Agencies will continue to maintain a dialogue with GEO, CGMS, and the WMO on their respective interests and coordination initiatives relating to polar observations. CEOS, in conjunction with PSTG, will continue to facilitate acquisition and distribution of fundamental satellite datasets for the development of specific information products for polar research and applications (e.g. cryospheric, atmospheric, etc.). CEOS Agencies will support the development of key science products under their own respective science programs. The PSTG, charged with prioritizing requirements, engaging in a dialogue with polar science authorities, and supporting the development of satellite sensor derived

products for cryospheric research and applications, will encourage formal submission of science requirements documents from the cryosphere communities (permafrost, sea ice, snow cover, ice sheets, and glaciers). CEOS, in conjunction with PSTG, will develop observation strategies to avoid observational gaps over polar regions.

## V. CEOS Ocean Variables Enabling Research and Applications for GEO

**2017-18:** COVERAGE (CEOS Ocean Variables Enabling Research and Applications for GEO) is a new CEOS initiative, proposed by NASA and endorsed at the SIT32 meeting in Paris as a three-year, collaborative pilot project involving CEOS Agency and international stakeholder participation. It seeks to provide a coherent set of data products from the four Ocean VCs and implement a technology platform providing value-added services for improved, more integrated ocean data access in support of marine GEO initiatives, including MBON and Blue Planet. COVERAGE project development is comprised of four phases (A-D).

A phase A COVERAGE activity supported by NASA officially kicked off in November 2017. This first phase of COVERAGE, extending through summer 2017, focuses on important preliminary arrangements and involves a detailed technical scoping exercise to drive subsequent development. The primary task of assembling the execution team and advisory board has already been completed (COV-1), and the establishment of the collaborative framework for stakeholder participation is ongoing. Phase A also involves the compilation of use cases and functional requirements for the COVERAGE system, including development of an inventory of high value datasets for inclusion, derived through a process of ongoing stakeholder engagement and based on priority set of community driven applications (COV-2).

**2018-2020:** A detailed COVERAGE project implementation plan and schedule will be formulated by the second quarter of 2018 (COV-3). Associated technical work that has been initiated involves development of a system architectural design, which will include specifications of source data streams and interfaces.

COVERAGE Phase B (1 year duration, through Q2-2019) will involve technical implementation of a prototype system demonstrating core functionality for a limited range of data types, with an emphasis on collocated, multi-parameter satellite products from the 4 Ocean VCs (COV-4). Ongoing stakeholder engagement and the solicitation of feedback will be integral to this and subsequent phases of the project.

Phase C of the COVERAGE project will commence within the third quarter of 2019 and is also expected to be 1 year in duration. Technical work will address peer review comment and involve development of the fully featured COVERAGE system, demonstrating functionality for the suite of datasets in support of target GEO applications (COV-5).

The final phase of COVERAGE (D), is expected to last 6 months through the close of 2020 and will involve testing and evaluation of the assembled technical system (COV-6).

Support to Other Key Stakeholder Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>SDG-2:</b> Compile and maintain a compendium of CEOS Agencies engagement on SDGs	Q3 2018	Collect and centralize information across CEOS Agencies on their SDG engagement and related activities, through online surveys and other consultation channels, including direct phone calls with the SDG PoCs of the respective CEOS Agencies. The Compendium of CEOS engagement on SDGs is meant to be used for CEOS internal use only, to collect main points of contacts on SDGs in the various CEOS agencies, identify strengths and weaknesses in CEOS collective engagement, and better coordinate / align / optimize CEOS agencies' engagement on SDGs. The compendium will be made available to CEOS members and regularly updated as soon as new information is available from the CEOS Agencies.	AHT SDG
<b>SDG-3:</b> Review and assess the contribution of EO to the SDG Targets and Indicators. Produce a compendium and policy brief.	Q3 2018	Assess the current and potential contribution of EO to the SDG Targets and Indicators (through the lenses of space-based EO) and identify areas of better EO uptake, with the objective to increase the effective use of satellite observations and products in the overall SDGs processes (targets achievement and indicators? monitoring) and by all key players (global to local)	AHT SDG
<b>SDG-4:</b> CEOS engagement plan on SDGs	Q3 2018	Develop a coherent, flexible and adaptive CEOS engagement strategy on SDGs to maximize CEOS efforts and available resources on SDGs for a higher impact (on the use of EO in SDGs) and for more tangible benefits for CEOS agencies. A specific emphasis will be placed on the development of national use cases of EO methods and applications for target setting and SDG indicator monitoring and reporting.	AHT SDG
<b>BP-4:</b> CEOS Action Plan for GEO Blue Planet Initiative Components Implementation Plan	Q4 2018	Building upon the GEO Blue Planet Initiative Implementation Plan (September 2016) and the 3 <sup>rd</sup> Blue Planet Symposium (June 2017), coordinate efforts across the CEOS Ocean VCs and develop action plan for CEOS contributions to Blue Planet activities.	CEOS Blue Planet Expert (NOAA) (with Ocean VCs)
<b>BON-4:</b> Increase the visibility of remote sensing for biodiversity research and conservation applications	Ongoing	The remote sensing biodiversity research and conservation applications community has grown steadily over the past decade. The last few years has seen an increase in collaboration and activities. To further accelerate collaborations, the community will focus on developing joint symposia at professional society meetings, convening community workshops, and supporting additional venues for collaborations (eg online fora). The biodiversity group anticipates supporting at least three such activities per year.	CEOS Biodiversity Experts (DLR and NASA)

Support to Other Key Stakeholder Objectives/Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>BON-5:</b> Develop improved descriptions of candidate remotely sensing enabled EBVs and their sub-variables	Q4 2018	EBVs—both those for which remote sensing can play a role and those for which it cannot—are still under development. The GEO BON Ecosystem Structure and Ecosystem Function working groups in particular are focused largely on development of the remote sensing enabled EBVs and they will make recommendations to the broader biodiversity community.	CEOS Biodiversity Experts (DLR and NASA)
<b>POL-1:</b> Annual status report	Q4 2018	Facilitate communication between PSTG and CEOS through provision of an annual status report on polar activities and develop a formal collaboration approach with PSTG.	CEOS Polar Expert (CSA)
<b>COV-2:</b> COVERAGE use cases & focal pilot application	Q2 2018	Determine priority application for COVERAGE via stakeholders engagement and compile use cases/requirements	COVERAGE Lead (NASA)
<b>COV-3:</b> COVERAGE Project Implementation Plan	Q2 2018	Develop detailed project implementation plan and schedule	COVERAGE Lead (NASA)
<b>COV-4:</b> COVERAGE Phase B prototype system	Q2 2019	Development of prototype COVERAGE system demonstrating core functionality for limited datasets	COVERAGE Lead (NASA)
<b>COV-5:</b> COVERAGE Phase C system	Q2 2020	Implementation of fully featured COVERAGE system in support of designated GEO application	COVERAGE Lead (NASA)
<b>COV-6:</b> COVERAGE system evaluation (Phase D)	Q4 2020	Testing and evaluation of the COVERAGE system	COVERAGE Lead (NASA)

### 3.10. Outreach to Key Stakeholders

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

**2018-2020:** 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.

Key 2018 meetings will be identified as they are announced, and the CEOS SEC will develop strategic plans to ensure CEOS is positioned to participate as appropriate.

**II. Maintain the CEOS Website and enhance currency and relevance of content**

**2018-2020:** CEOS released a new website, with a modern user interface and updated appearance, in 2014. CEOS, with coordination through the SEO, will build on the “content management” approach underpinning this new 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.

**III. Publish the CEOS Newsletter**

**2018-2020:** CEOS, through contributions of JAXA, will continue the publication of this valuable, long-standing communication tool. It will be issued twice per year.

Outreach to Key Stakeholders: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>OUT-1:</b> CEOS awareness and promotional material delivered at key meetings	Ongoing	The CEOS calendar will be used to confirm CEOS representation at key international and stakeholder meetings, as updated throughout the three-year term.	CEOS Chair with support from CEO, SIT Chair and CEOS SEC
<b>OUT-2:</b> CEOS Newsletter	Q1 and Q3 of each year	Call for information input in December and June; newsletters released in February and August.	JAXA, with support from CEOS Agencies

**3.11. Organizational Matters**

**I. Updated and refreshed Terms of Reference for CEOS Working Groups**

**2018:** CEOS has completed the development of its complete set of Guiding Documents, which provide a comprehensive description of CEOS priorities and processes and will enhance consistency amongst the various CEOS entities in key areas, while retaining flexibility for those entities to organize themselves as appropriate.

One area where consistency is important, is in the structure and content of the Terms of Reference of Working Groups. In 2015, CEOS commenced work to translate the current Working Group Terms of Reference into the new format, taking the opportunity to refresh them where appropriate. In 2016, updated Terms of Reference started to be endorsed. In 2018, CEOS Working Groups will complete this task.

Organizational Issues Deliverables: 2018-2020			
Objective/Deliverable	Projected Completion Date	Background Information	Responsible CEOS Entity
<b>ORG-7:</b> Refreshed Terms of Reference for Working Groups	Q3 2018	As a result of the updated Governing Documents, work is required to reformat/translate existing Terms of Reference into the new structure to ensure consistency. A status update will be provided by each Working Group at SIT-33.	Working Groups with support from CEO

*This CEOS Work Plan will be updated annually by the CEO under the guidance of the CEOS Chair, and in consultation with the CEOS Strategic Implementation Team Chair, CEOS Secretariat, CEOS Working Groups, Virtual Constellations, Ad Hoc Teams, the CEOS membership at large, and CEOS' external stakeholders. This document shall be consistent with and mutually supporting of other CEOS guiding documents.*