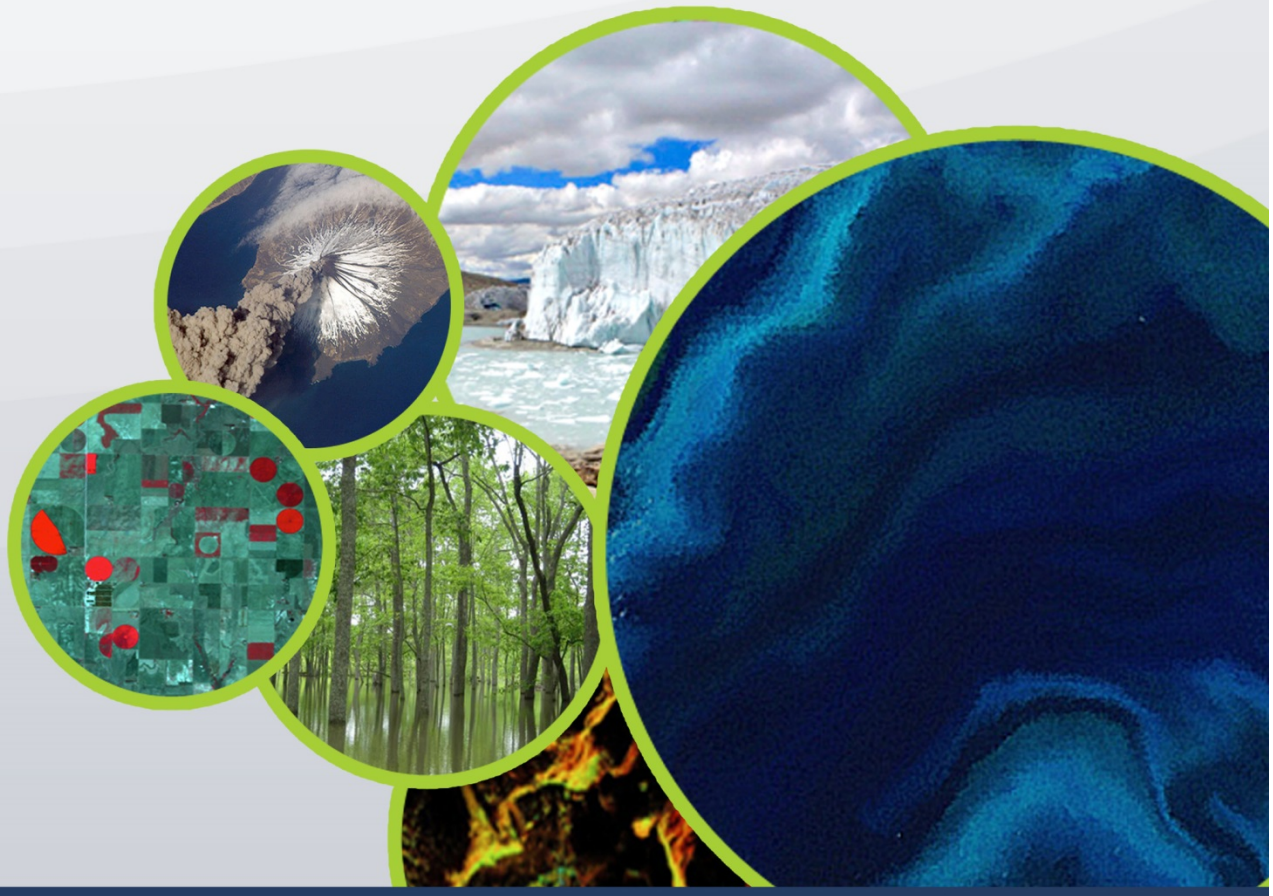
Committee on Earth Observation Satellites



The CEOS Governing Documents

Current as of August 01, 2017.

The CEOS Governing Documents

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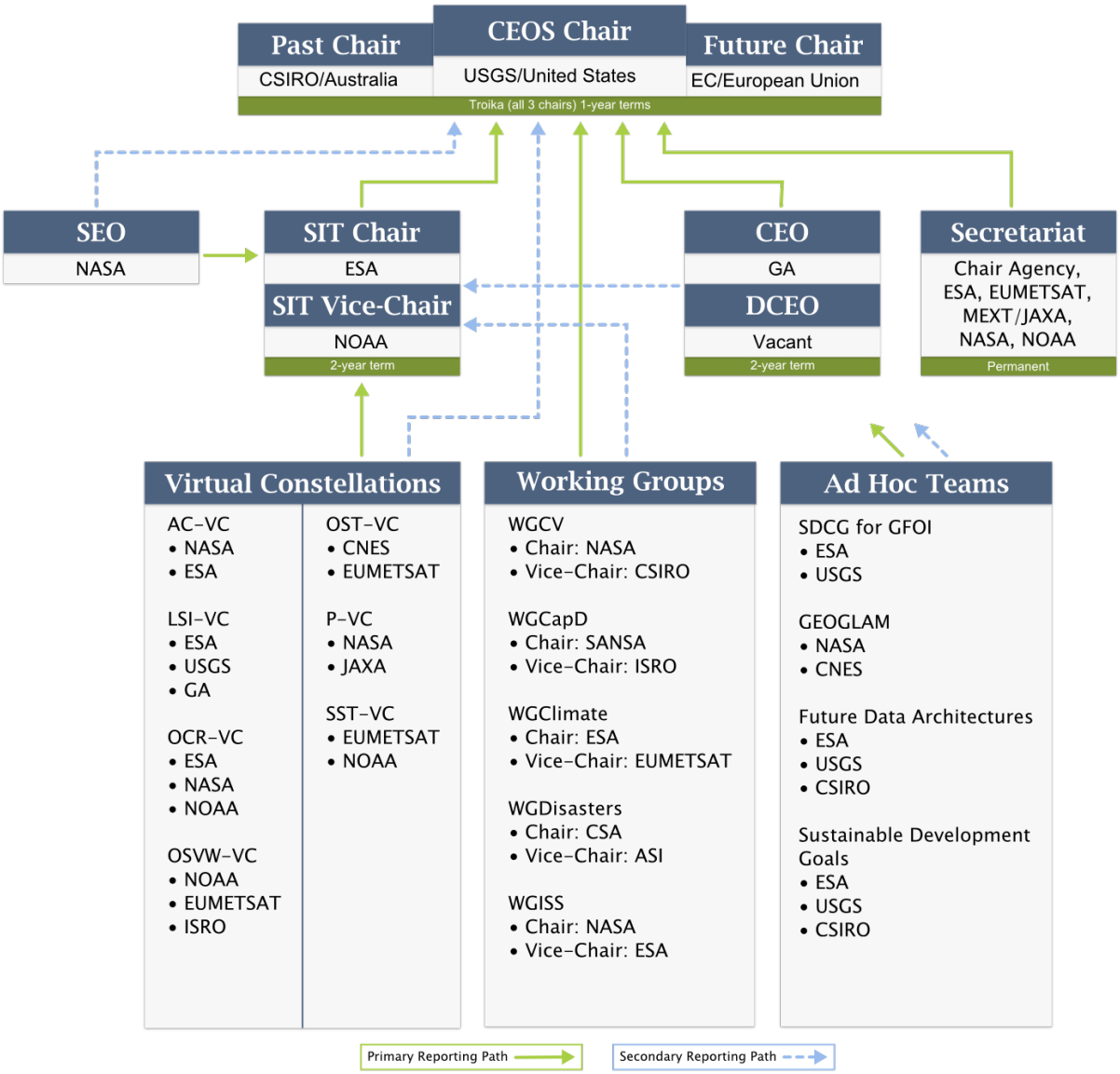
CEOS Organizational Chart

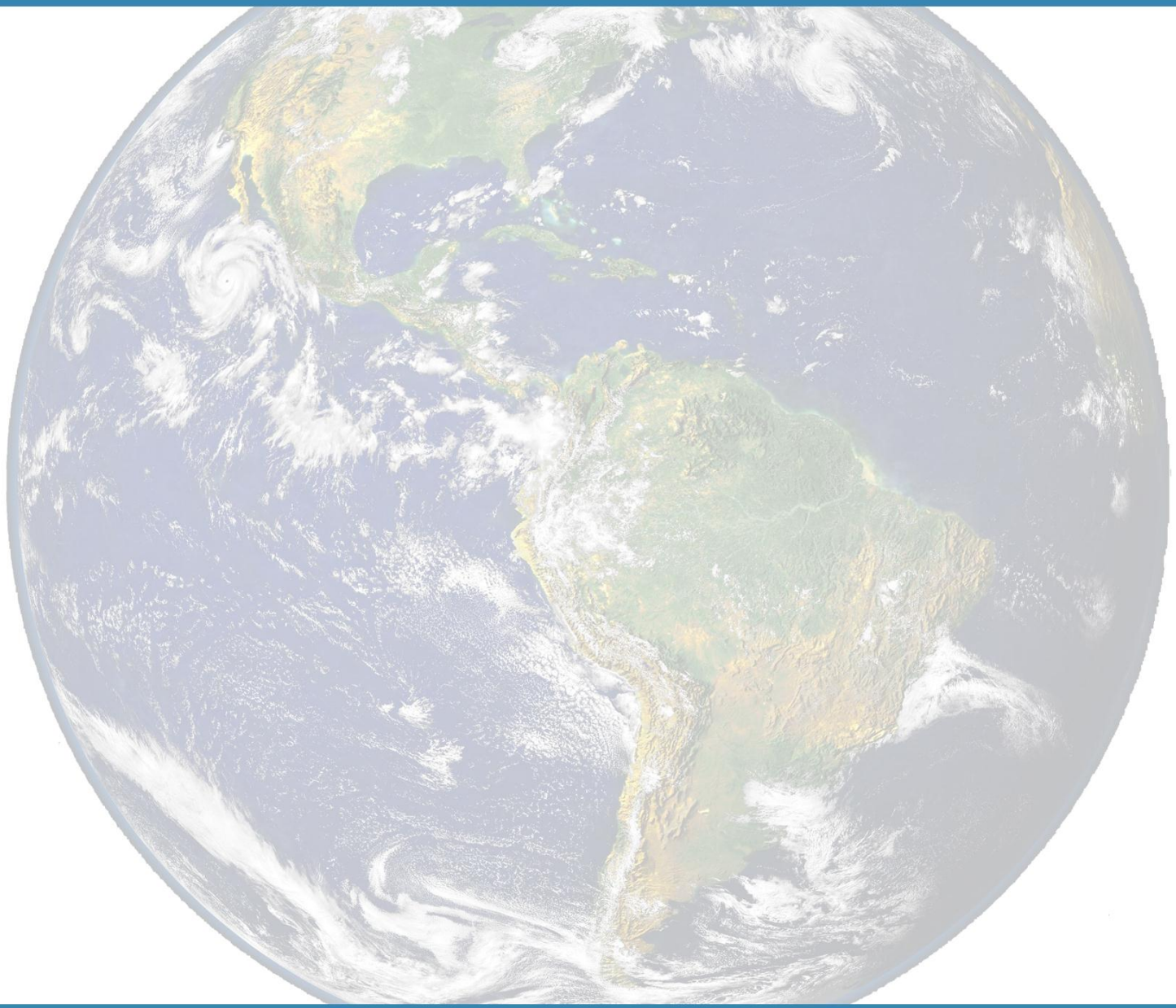


* The CEOS organizational chart is updated annually. Please refer to www.ceos.org for updates.

Committee on Earth Observation Satellites

CEOS

Strategic Guidance



Version: November 2013

Contents

1 Introduction and Background

The Committee on Earth Observation Satellites (CEOS) was established in September 1984 in response to a recommendation from a Panel of Experts on Remote Sensing from Space that was set up under the aegis of the G7 Economic Summit of Industrial Nations Working Group on Growth, Technology and Employment. This panel recognized the multidisciplinary nature of space-based Earth observations and the value of coordinating international Earth observation efforts to benefit society. Accordingly, the original function of CEOS was to coordinate and harmonize Earth observations to make it easier for the user community to access and utilize data. CEOS initially focused on interoperability, common data formats, the intercalibration of instruments, and common validation and intercomparison of products.

Since the inception of CEOS, the circumstances surrounding the collection and use of space-based Earth observations have changed. The number of Earth-observing satellites has vastly increased.[1] Onboard instruments are more complex, and are capable of collecting new types of data in ever-growing volumes. The user community has expanded and become more diverse, as different data types become available and new applications for Earth observations are developed. Users have become more organized, forming several international bodies that coordinate and levy Earth observation requirements. In response to this changing environment, CEOS has also evolved, becoming more complex, and expanding the number and scope of its activities. In addition to its original charge, CEOS now focuses on validated requirements levied by external organizations, works closely with other satellite coordinating bodies (e.g., the Coordination Group for Meteorological Satellites [CGMS]), and continues its role as the primary forum for international coordination of space-based Earth observations.

Over the past three decades, CEOS has significantly contributed to the advancement of space-based Earth observation community efforts. CEOS Plenary sessions provide a regular opportunity for CEOS Agencies to communicate, collaborate, and exchange information on Earth observation efforts. Such international coordination has spurred useful partnerships such as the Integrated Global Observing Strategy (IGOS), and CEOS played an influential role in the establishment and ongoing development of the Group on Earth Observations (GEO) and the Global Earth Observation System of Systems (GEOSS). Indeed, CEOS coordinates the GEOSS space segment. CEOS Agencies are working together to launch multi-agency collaborative missions, and such cooperative efforts have become the primary approach to Earth observation mission development. CEOS also provides an established means of communicating with external organizations, enabling CEOS to understand and then act upon these organizations' Earth observation needs and requirements.

To ensure it remains a vital and relevant organization, CEOS initiated a self-study in 2011 to revisit its mission and international role in light of the evolving nature of Earth observation initiatives and the changing needs of the Earth observation user community. As a result of this self-study, CEOS now employs three documents to guide and conduct its work: this *CEOS Strategic Guidance* document, which articulates the overarching long-term (7-10 years) purpose and goals of CEOS; a *CEOS Governance and Processes* document, which provides updated guidelines with regard to CEOS's structure and operations, and the processes CEOS employs to achieve its goals; and a

[1] As of November 2013, CEOS Agencies operate 107 space missions. For the latest count of missions and instruments sponsored by CEOS Agencies, visit the CEOS website (www.ceos.org).

three-year rolling *CEOS Work Plan*, which sets forth near-term actions to achieve the goals outlined in the *CEOS Strategic Guidance* document. The following *CEOS Strategic Guidance* document describes the overarching purpose of the organization and the value CEOS provides to its stakeholders and the global community. It defines broad goals for the organization, and outlines a general approach to achieve those goals, as well as methods to maximize success. The guidance herein addresses the path forward for CEOS, including various strategies CEOS can employ both to respond to anticipated challenges and capitalize on upcoming opportunities.

2 CEOS Mission and Objectives

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.

CEOS is an international body uniquely capable of coordinating the broad spectrum of space-based Earth observation activities. CEOS participants include government organizations that develop and operate civil Earth observation satellites (Members) and other coordinating groups and scientific or governmental organizations that support CEOS's mission (Associates). Since CEOS's inception, the number of Members and Associates, collectively referred to as CEOS "Agencies," has grown to include nearly all civil space-based Earth observation agencies, together with associated key user organizations. CEOS operates on a best-effort basis using consensus-based decision-making processes, and its Agencies possess varying capabilities, areas of expertise, and resource levels. CEOS Agencies are mindful of the CEOS scope and desire to provide and share high-quality data, as well as information tools, to an expanding global user community on a full and open basis, and in accordance with the principles of Data Democracy as enunciated by CEOS at its 2010 Plenary in Rio de Janeiro. Satellite data requirements relating to societal benefits, global climate change, and sustainable development are collected and conveyed in connection with relationships established with CEOS by key user groups including, but not limited to: GEO, the Global Climate Observing System (GCOS), the United Nations Framework Convention on Climate Change (UNFCCC), and the United Nations International Strategy for Disaster Reduction (UNISDR). CEOS, through its internal mechanisms including Working Groups and Virtual Constellations, works to achieve compatibility and complementarity of data products, services, applications and policies.

CEOS has three primary objectives:

1. 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
2. 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
3. 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

3 Goals

To ensure that CEOS fulfills its mission and purpose and remains sustainable, viable, and relevant, CEOS will work to:

- **Close important observational gaps**. CEOS must identify key future observational gaps by gathering validated observational requirements from stakeholders and comparing them against the capabilities and capacity to be provided by upcoming Earth observation systems. Having targeted specific observational challenges, CEOS will promote solutions to reduce gaps and duplication through partnerships, membership growth and coordination, new launches, and leverage of existing member assets.
- **Achieve better integration across the full range of Earth observations**. CEOS must reach out to form working partnerships with organizations responsible for space-based, airborne, ground-based, and *in situ* data. For example, CEOS must continue to coordinate with GEO to accomplish the successful development of a GEOSS that integrates this full range of Earth observations.
- **Promote Data Democracy by improving access to and use of CEOS Agency data**. To facilitate open and easy access to Agency data, CEOS must improve discovery, provide interoperability arrangements, coordinate data access portals in specific topical areas, and promote the use of open-source tools for data handling. Not only will CEOS Agencies need to coordinate and incorporate standard data discovery and access mechanisms, they will also need to adapt these mechanisms to the tools employed by the user community. CEOS must also work to stimulate capacity-building initiatives—both human and technological—to maximize the societal benefits derived from CEOS Agency data.
- **Remain responsive to Earth observation users' needs globally**. CEOS must continue to forge partnerships with the increasingly diverse Earth observation user community. To aid this dialogue, CEOS must demonstrate that the Earth observation systems coordinated, developed, and operated by CEOS Agencies have provided real societal and/or scientific benefits with clear identification of the end users. This work needs to be implemented in full partnership with the CEOS Associates and stakeholders such as GEO's Communities of Practice (CoP). CEOS must understand and manage internal and external constraints to optimize its outputs and must remain flexible and forward-thinking to respond to the emerging needs of its stakeholders and the global community.

The work documented in the *CEOS Work Plan* shall be consistent with these goals and in consideration of the capacity and resources of CEOS Agencies. These goals will serve to reinforce CEOS's role as the unique forum for international coordination of space-based Earth observations to meet societal and scientific needs.

4 Value to Stakeholders

An improved understanding of the Earth system—weather, climate, oceans, land, geology, natural resources, ecosystems, and natural and human-induced hazards—is essential to better predict, adapt to, and mitigate the expected global changes and their impacts on society. Understanding a planet as complex as Earth, however, clearly requires a global effort since no single country can monitor Earth by itself. CEOS endeavors to provide the Earth observation data and derived information required to further our understanding of Earth and inform the decisions made by government and other leaders.

Bringing space-based sensors, ground-based data analysis systems, and skilled experts together requires a well-coordinated international effort and a strong commitment from space agencies. CEOS is dedicated to international collaboration among space systems and Earth observation missions, and provides the multilateral coordination that enables achievement of CEOS Agency goals and addresses the needs of the global community. CEOS Agencies strive to address critical scientific questions and to develop national satellite programs with common standards and systems that can provide data to the international community, while not unnecessarily overlapping satellite missions of other Agencies. CEOS ensures technical coordination among Agencies on issues concerning the usability of Earth observation data acquired by diverse systems, including coordinated access to data, intercalibration of multiple sensors, and coordination of multi-mission blended products.

CEOS also provides a forum where Agencies can identify partnership opportunities through which they can share development and operational costs and gain government support through CEOS endorsement of targeted initiatives.

The value of CEOS is also highly dependent upon strong external stakeholder engagement. The external stakeholders of Earth observations are a broad range of users including: national, regional and local decision makers; organizations responsible for the implementation of international conventions and treaties; business, industry, and service sectors; scientists, researchers, and educators; and ultimately, every inhabitant of Earth.

The sustained investment by CEOS Agencies will ensure the provision of information of unique value in both public and commercial spheres, derived from the measurements of a diverse range of geophysical parameters and phenomena.

5 Approach

To achieve its purpose, CEOS predominantly relies on coordination of the capabilities and assets of individual CEOS Agencies. The guiding principle behind all such coordination activities is the demonstration of the feasibility and added value of sustained space-based Earth observations, particularly in the context of responding to stakeholder requirements. More specifically, the scope of the coordination encompasses both current and future satellite observation systems, with the aim of ensuring their complementarity and completeness with respect to the stakeholder requirements.

Internal coordination is implemented through a variety of CEOS mechanisms. At the working level, this coordination is generally achieved using a combination of Working Groups (for the

coordination of infrastructure and cross-cutting issues) and Virtual Constellations (for the coordination of thematic/topical-based areas). In addition, and depending on the context, these permanent, working-level CEOS mechanisms may be augmented by ad hoc arrangements for specific, shorter-term activities, as deemed appropriate by the CEOS Plenary. Internal coordination at a higher level, often based on inputs from the working level, is generally carried out via a combination of the CEOS Secretariat, the Strategic Implementation Team (SIT) and the CEOS Plenary—the ultimate CEOS decision-making forum.

External coordination (e.g., with CEOS stakeholders such as GEO, GCOS, UNFCCC, and UNISDR) generally mirrors the internal coordination approach, with the nature of the issue determining the coordination mechanism to be applied. However, formal coordination with external entities is always undertaken by the CEOS Chair, except for areas which have been specifically delegated to the SIT Chair.

6 Definition and Measures of Success

CEOS defines success as the achievement of its goals (see section 3) as indicated by measurable results for its stakeholders, or, in cases where results cannot be measured directly, CEOS success may be attained when the stakeholders involved perceive that desired results are obtained. For instance, an example of directly measurable results would be the elimination of observational gaps for key parameters requested by Earth observation users. A less quantifiable, but still important result would be a successful effort to motivate a group of agencies to contribute to a specific CEOS project. Such cooperation might not be directly measurable, but could be perceived as a valued success by the parties involved.

To be successful, CEOS must also be sustainable. It is essential that CEOS build and maintain a strong organization where the majority of CEOS Agencies are significantly engaged in CEOS activities. For many of its goals and associated projects, CEOS directly evaluates success with respect to a list of milestones and deliverables or compared to a set of pre-defined criteria. Indicators of this type of organizational success, however, might be less tangible. For example, participation by a broad set of diverse agencies in CEOS leadership positions is evidence of the organization's perceived value and usefulness.

CEOS should evaluate its activities regularly during the entire life cycle of each project, including an analysis at the end of the project. Projects that are productive, result in important outcomes, and for which CEOS Agencies have committed sufficient financial and human resources are potential candidates for continuation. Activities that have accomplished their objectives should be discontinued, but follow-on activities might be defined if deemed necessary. Projects that do not demonstrate progress against milestones, do not provide valuable outcomes, or that lack Agency interest or committed resources should be refocused or discontinued. CEOS should not evaluate the success of its activities in isolation, however, but rather as part of the overall CEOS portfolio.

The CEOS lead(s) for each activity should report project status to the proper forum such as the CEOS Plenary or the CEOS Secretariat meetings. Plenary sessions also allow the organization to gather feedback from CEOS Agencies regarding the effectiveness of CEOS efforts. CEOS should make sure that external stakeholders understand that CEOS desires their regular feedback, and should invite them to report at CEOS events such as SIT meetings and CEOS Plenary meetings. Such

external feedback may facilitate a subjective evaluation of CEOS success not based on directly measured results.

To measure success for a given project or activity, CEOS should identify the following elements:

- Initial project needs and requirements at a sufficient level of detail, so that the participating agencies can better define the tasks to be undertaken and assess the level of resources to be allocated
- Milestones, schedule (including activity end date), deliverables, and success criteria specific to each individual project (e.g., long-term, ongoing activities will require different criteria than short-term projects), and key participating agencies and resources required for the duration of the project
- The appropriate level of project management and the channels by which to communicate project status, so that CEOS can adequately monitor progress against the list of project milestones, deliverables, and criteria

7 Challenges, Opportunities, and Strategic Direction

Knowledge of CEOS contributions to the international community and an understanding of the resources needed to accomplish its mission are integrally tied to the CEOS identity as the unique forum for international coordination of the broad spectrum of space-based Earth observation activities and products. As such, CEOS will be presented with a number of challenges and opportunities while it continues to maintain its strategic focus.

Challenge: Engage Stakeholders to Optimize Relevance – Sustainability and success for CEOS require that it engage stakeholders, both internal and external, to continuously optimize the relevance and delivery of its products and societal benefit contributions. To this end, CEOS leadership will actively promote the participation of all CEOS Agencies, partners, and new stakeholders in its mission and functions. CEOS will build and maintain partnerships to expand and complement its capacity and resources to deliver Earth observation measurement products, datasets, and a high standard of satellite and Earth observation mission coordination. To ensure efficiency, CEOS will examine the prioritization of its activities and commitments annually, informed by its strategic guidance documents, leadership, and governance mechanisms.

Challenge: Maintain Leadership Continuity and Participation – CEOS recognizes that continuity of leadership and maintaining broad participation in its work are important to its efficacy and sustainability. CEOS Agencies, which have varying capabilities, expertise, and resources, will be empowered to identify existing and future activities that can benefit from and be improved by their technical and other contributions. Addressing both of these critical success factors in the near and long term must be a strategic objective for CEOS leadership.

Challenge: Manage Cyclic and Scarce Resources – CEOS also recognizes that the resources available to CEOS Agencies can be cyclical, resulting in interruptions and diminished progress for the implementation of near-term and long-term endeavors. As a best-effort organization, CEOS remains vulnerable to underutilizing some Agencies and overburdening others. Successfully tying awareness of this reality to expectations of decision makers worldwide is important for CEOS, its

stakeholders, and the global community. Future CEOS leaders and Plenaries must continue to focus attention and efforts in this area.

Opportunity: Build Capacity for Earth Observation Products – With urgency for CEOS Earth observation data products increasing more quickly than the capacity for use, CEOS will actively promote availability of civil Earth observation data and endeavor to build capacity to use the resulting products. Broader geographic representation will remain a strategic and capacity-building priority for CEOS with respect to both the end user community and the Earth observation data providers.

Opportunity: Identify Gaps and Promote Complementarity – CEOS will remain a leader in the Earth observation community through the guidance and complementarity it achieves with others to accomplish its mission. CEOS will continue to fill a critical need in the global community to reduce unnecessary duplication and to identify gaps to be bridged so that resources can be put to best use.

Strategic Direction: Optimize the Societal Benefit of Space-based Earth Observation – CEOS will actively identify specific avenues through which its contributions for global societal benefit are showcased and communicated at Ministerial and other global forums. Guided by its founding principles and mission, CEOS will remain a forward-thinking and adaptive participant in the Earth observing community and intergovernmental forums. To further facilitate the accomplishment of its mission and maximize the societal benefits it delivers, CEOS will explore avenues for engagement with Earth observation communities of practice and other contributors to space-based activities.

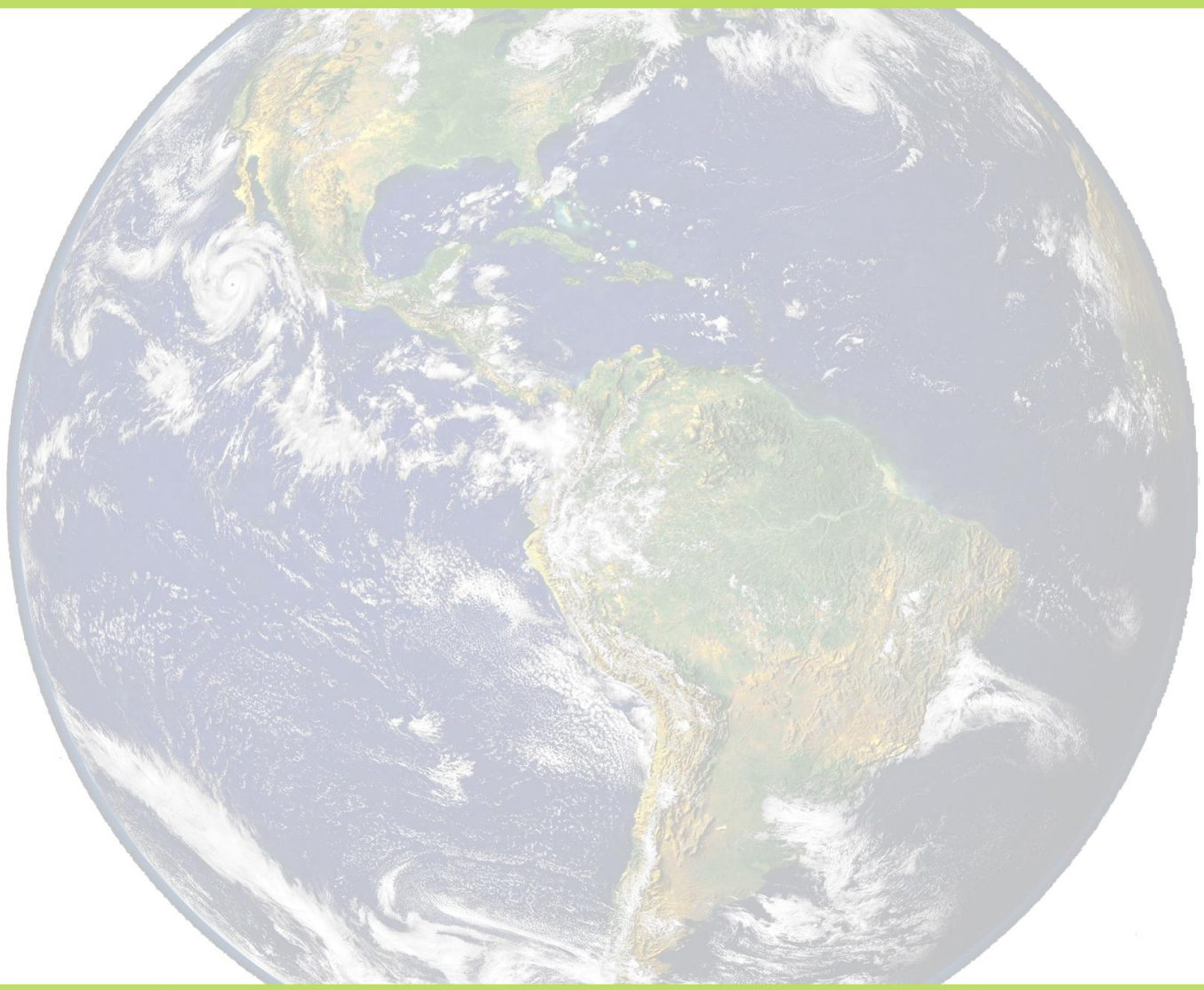
Strategic Direction: Remain the Focal Point for International Coordination of Space-based Earth Observations – Now and in the future, the global community will continue to study the Earth system using space-based and *in situ* observations for the benefit of the planet. As the unique international forum coordinating the full spectrum of civil space-based Earth observing systems, CEOS reaffirms its commitment to lead as a catalyst for change by fostering new technologies, measurement capabilities, improved data access strategies, innovative and integrated approaches to satellite data, and mission coordination for the global community.

This CEOS Strategic Guidance document can be amended or modified only after review and careful consideration by the CEOS Agencies. This review should also examine other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting. The specific amendments or modifications must be reviewed at a CEOS SIT Meeting and approved at the subsequent CEOS Plenary.

Committee on Earth Observation Satellites

CEOS

Terms of Reference



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Terms of Reference

Committee on Earth Observation Satellites (CEOS)

Preamble: Remote sensing from space has evolved to a point where distinctions among existing missions result from the technology employed, rather than from the disciplines served in system operations. A number of international and national space-based Earth observation systems currently operate simultaneously and support both interdisciplinary and international activities.

The organization of international cooperation in space-based Earth observation systems has also evolved, from mission-specific reviews to the interdisciplinary coordination of multi-mission programs. The Earth observation user community has also expanded to become more complex and diverse, and delivers requirements through numerous coordinating bodies.

International discussion and cooperation have enhanced the utility of space-based Earth observation data to users worldwide, encouraged the coordination of program planning among operators of space-based Earth observation systems, and fostered international receptivity to and acceptance of space-based Earth observation system activities and applications. Cooperation in the development and management of remote sensing and associated data management programs benefits operators of space-based Earth observation systems and users of Earth observation data. Redundancy among systems and the utility of data can be optimized through the appropriate coordination of complementary and compatible space and ground segments, data management practices and products, and Earth observation systems research and development.

CEOS Members and Associates (as defined below, and collectively referred to as CEOS "Agencies") have affirmed the value of the activities described above. CEOS Members have agreed to continue to informally coordinate their current and planned systems for Earth observation from space through the organization of a Committee on Earth Observation Satellites (CEOS).

Mission: 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.

CEOS has three primary objectives:

- 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

Individual Members of CEOS will use their best efforts to implement CEOS recommendations in their respective Earth observation programs. CEOS will not supersede current or potential

agreements by Members. Participation in the activities of CEOS will not be construed as being binding upon space-based Earth observation system operators, or as restricting their right to develop and manage Earth observation systems according to their needs and policies.

Organization: CEOS meetings will be organized and chaired by a designated host organization.

Participants (Members and Associates)

MEMBERS

Governmental organizations that are international or national in nature and are responsible for a civil space-based Earth observation program currently operating, or at least in Phase B (detailed design phase) or equivalent of system development, are eligible for membership in CEOS. Members must have a continuing activity in space-based Earth observation intended to operate and provide nondiscriminatory and full access to data that will be made available to the international community. The addition of Members will be with the consensus of current Members of CEOS. Request for membership should be addressed to the Chair of the next scheduled CEOS Plenary session. The Members at that meeting will consider such requests.

ASSOCIATES

The following may be invited to participate in CEOS as Associates:

1. Governmental organizations that are international or national in nature and currently have a civil space-segment activity in Phase A/pre-Phase A (concept feasibility and definition phase) or equivalent of system development, or a significant ground-segment activity that supports CEOS objectives
2. Other existing satellite coordination groups and scientific or governmental bodies that are international in nature and currently have a significant programmatic activity that supports CEOS objectives

Addition of Associates will be by consensus of existing Members. Associates may participate fully in CEOS Plenary and Working Group discussions, and have their views included in reports; however, approval by Associates will not be required to establish consensus. The autonomy of both the associated organizations and the respective national and international Earth observation programs will remain intact. Membership in CEOS does not automatically assume membership in the respective associated organizations.

It is the responsibility of each Member and Associate to inform the CEOS Chair of a change in its status with regard to CEOS participant eligibility as outlined in these Terms of Reference. In the event that an organization's status changes, CEOS Members will review the change. Following the review, a change in status will be by consensus of the CEOS Members at a Plenary meeting.

Cooperative Activities

- CEOS Agencies will exchange technical information on and pursue the potential for coordination of space and ground segments. Such coordination could include discussions on current and future mission parameters, sensor capabilities and intercalibration, and data and telemetry downlink characteristics. In addition, Earth observation systems coordination within CEOS could address issues of ground station technical compatibility for backup satellite tracking, command and control, and sensor and telemetry data reception.

- CEOS Agencies will investigate the means for increasing data utility and cost effectiveness for both operators and users. CEOS activity could include the coordination of data acquisition, sampling, and preprocessing methodologies; the standardization of data formats where appropriate; the increase in compatibility of data archives; and the enhancement of user access to CEOS Agency data bases, information products, and services.
- CEOS Agencies will present their plans for emerging satellite remote-sensing technologies and programs, and they will discuss appropriate approaches for the coordination of future systems.
- CEOS Agencies will address current developments and future direction/opportunities regarding Earth observation from space, including free-flying spacecraft, mission-specific instruments flown on space transportation systems, and the placement of instruments on space platforms.
- CEOS Agencies will seek to ensure that the user community is made aware of the satellite programs of Members and will encourage discussions between the users and relevant satellite system operators, as necessary.

CEOS will consider and may make recommendations and agree on actions to promote appropriate coordination across satellite coordination groups, and national and international satellite programs. Furthermore, CEOS encourages its Members to maintain communication as appropriate with other external groups and organizations involved in space-based Earth observation activities and applications through the relevant channels within their respective governments. These external groups may include, but are not limited to, the Group on Earth Observations (GEO) and Global Earth Observation System of Systems (GEOSS); the United Nations Framework Convention on Climate Change (UNFCCC); the UN International Strategy for Disaster Reduction; the UN Convention on Biological Diversity; the Global Climate, Ocean, and Terrestrial Observing Systems; and the Group of Eight/Group of Twenty (G20) industrialized nations.

Planning, Implementation, and Reporting: CEOS will convene once each year in Plenary session. CEOS Plenary meetings will be hosted, organized and chaired by the CEOS Chair. Each Member and Associate will designate a Principal and a Contact for coordination between meetings. Each agency should inform the CEOS Chair and CEOS Executive Officer (CEO) of Principal and Contact changes. At the Plenary meeting of CEOS, the time, place, and host (CEOS Chair) for the next two meetings will be confirmed. Every effort should be made to rotate the CEOS Chair responsibility among major geographic regions (Americas, Europe/Africa, Asia/Pacific) to promote leadership diversity.

The incoming CEOS Chair will assume chair responsibilities at the conclusion of the Plenary meeting. Allocation of Plenary actions will be coordinated between the incoming and outgoing Chairs. Additional information regarding the roles and responsibilities of the CEOS Chair can be found in the CEOS Chair Terms of Reference.

CEOS includes the following permanent organizational mechanisms, as detailed in the CEOS *Governance and Processes* document: the Secretariat (SEC), the Strategic Implementation Team (SIT), the CEOS Executive Officer (CEO), the CEOS Systems Engineering Office (SEO), the Working Groups and the Virtual Constellations. Additional information regarding the objectives, roles, and responsibilities of these entities can be found in their respective Terms of Reference. In addition, CEOS utilizes the Troika (prior year, current year, future year CEOS Chairs) to allow CEOS leaders to

exchange ideas and discuss important issues regarding current year achievements, and direction, strategy, plans, and expectations for the following year. The Troika is chaired by the CEOS Chair. The CEO and SIT Chair are regularly invited to attend and others may be invited at the discretion of the CEOS Chair.

In addition to the permanent mechanisms noted above, CEOS may establish, as mutually agreed and on an ad hoc basis, temporary mechanisms (hereafter known as Ad Hoc Teams) to investigate specific areas of interest, cooperation and coordination and to report at subsequent Plenary meetings. Continuation of each Ad Hoc Team requires confirmation at each Plenary session. Conclusions resulting from CEOS Plenary sessions or the findings and recommendations of Ad Hoc Teams will be acted upon at the discretion of each CEOS Member.

Amendment History

Adopted 9/25/1984:	1st CEOS Plenary, Washington, D.C., USA (Host: NOAA)
Amended 11/11/1986:	2nd CEOS Plenary, Frascati, Italy (Host: ESA)
Amended 4/5/1989:	3rd CEOS Plenary, Ottawa, Canada (Host: CSA)
Amended 11/14/1990:	4th CEOS Plenary, São José dos Campos, Brazil (Host: INPE)
Reconfirmed 12/10/1991:	5th CEOS Plenary, Washington, D.C., USA (Host: NASA/NOAA)
Amended 12/11/1992:	6th CEOS Plenary, London, United Kingdom (Host: BNSC)
Amended 11/18/1993:	7th CEOS Plenary, Tsukuba, Japan (Host: MEXT/NASDA)
Amended 10/10/1996:	10th CEOS Plenary, Canberra, Australia (Host: CSIRO)
Amended 11/12/1998:	12th CEOS Plenary, Bangalore, India (Host: ISRO)
Amended 11/09/2000:	14th CEOS Plenary, Rio de Janeiro, Brazil (Host: INPE)
Amended 11/15/2005:	19th CEOS Plenary, London, United Kingdom (Host: BNSC)
Amended 11/6/2013:	27th CEOS Plenary, Montreal, Canada (Host: CSA)

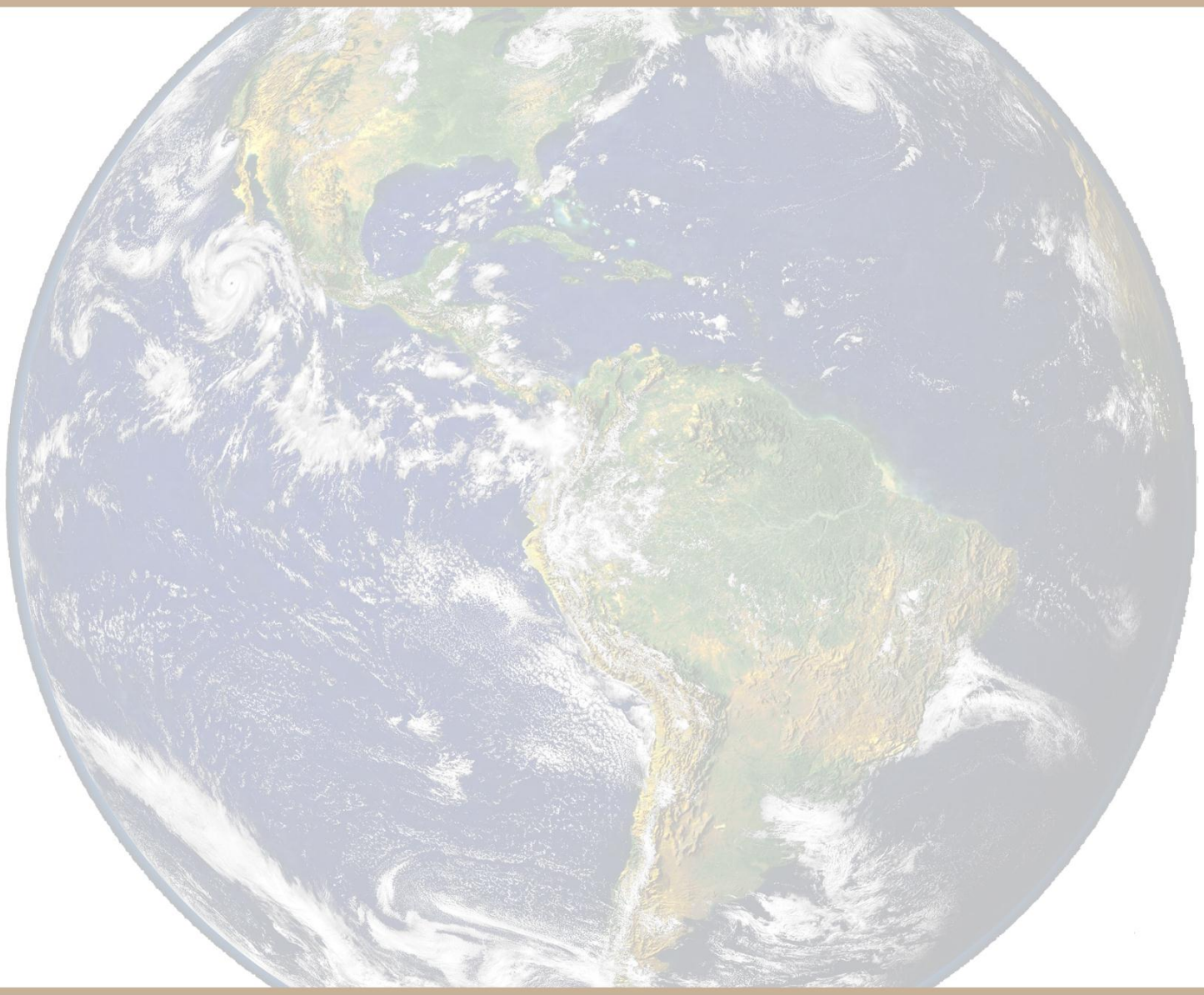
NOTE: A detailed description of the amendments can be found in the *CEOS_Historical_Record* document on the CEOS website (www.ceos.org) under the "Governing Documents" menu link.

These CEOS Terms of Reference can be amended or modified only after review and careful consideration by the CEOS Agencies. This review should also examine other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting. The specific amendments or modifications must be reviewed at a CEOS SIT Meeting and approved at the subsequent CEOS Plenary.

Committee on Earth Observation Satellites

CEOS

Governance and Processes



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Contents

1 Introduction and Background

To ensure it remains a vital and relevant organization, the Committee on Earth Observation Satellites (CEOS) initiated a self-study in 2011 to revisit its mission and international role in light of the evolving nature of Earth observation initiatives and the changing needs of the Earth observation user community. As a result of this self-study, CEOS now employs three documents to guide and conduct its work: a *CEOS Strategic Guidance* document, which articulates the overarching long-term (7-10 years) purpose and goals of CEOS; this *CEOS Governance and Processes* document, which provides updated guidelines with regard to CEOS's structure and operations, and the processes CEOS employs to achieve its goals; and a three-year rolling *CEOS Work Plan*, which sets forth near-term actions to achieve the goals outlined in the *CEOS Strategic Guidance* document. Included in this *CEOS Governance and Processes* document are a schematic diagram with accompanying explanation of the current CEOS organizational structure, as well as sections addressing CEOS roles and responsibilities, the CEOS decision-making process, CEOS major meetings, and CEOS membership and participation.

2 Organizational Roles and Responsibilities

Figure 2-1 depicts the CEOS organizational structure, including the paths by which each CEOS entity reports to leadership. Secondary reporting paths reflect augmented leadership arrangements that are normally put in place at the discretion of the entity charged with primary leadership responsibility. A summary of the key roles and responsibilities of each CEOS organizational mechanism follows. The CEOS website (http://www.ceos.org) includes Terms of Reference for the CEOS organizational mechanisms (under the "Governing Documents" menu link). Annex 1 lists the Working Groups, Virtual Constellations, and Ad Hoc Teams.

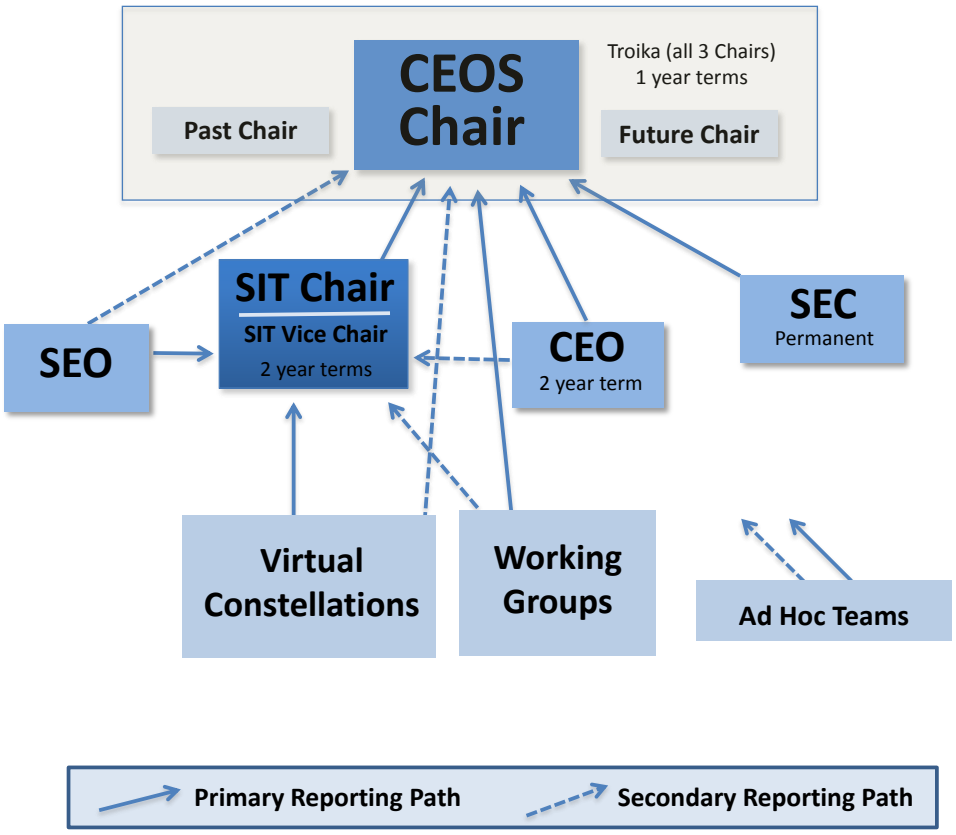


Figure 2-1. CEOS Organizational Structure (see last paragraph in section 2 for explanation of reporting paths for Ad Hoc Teams)

The **CEOS Chair** has the overarching responsibility for ensuring that the guidance and direction from the annual CEOS Plenary are appropriately reflected in CEOS's activities and collective strategic priorities. To assist the CEOS Chair in the execution of this responsibility, some major tasks, such as primary coordination of Virtual Constellation activities, are assigned to the Strategic Implementation Team (SIT) Chair, as reflected in the reporting paths shown in Figure 2-1. The CEOS Chair will be a senior space agency official who serves a one-year term and receives guidance from, and reports to, the CEOS Plenary. The term of the previously confirmed incoming CEOS Chair nominee begins at the conclusion of the CEOS Plenary.

In addition to organizing and chairing the CEOS Plenary, the CEOS Chair presides over the CEOS Secretariat (SEC) and the Troika, the latter consisting of the CEOS Chair, the immediate past CEOS Chair, and the incoming CEOS Chair. In addition, the CEOS Chair oversees the activities of the CEOS Executive Officer (CEO); the Deputy CEOS Executive Officer (DCEO), if one exists; and the Working Groups. The CEOS Chair is the primary interface for all external coordination. To promote leadership diversity, CEOS makes every effort to rotate the Chair responsibility amongst major geographic regions (the Americas, Europe/Africa, Asia/Pacific). The composition of the CEOS Chair team is at the discretion of that Agency's CEOS Principal and will include expertise and resources to fulfill the range of activities and detailed responsibilities outlined in the CEOS Chair Terms of Reference.

The **SIT Chair** serves a two-year term and formally reports to the CEOS Chair. Biennially, the terms for previously confirmed SIT Chair and SIT Vice Chair nominees begin at the conclusion of the CEOS Plenary. In consultation with the CEOS Chair, the SIT Chair is responsible for the development and implementation of a harmonized planning process for CEOS activities in relation to CEOS strategic priorities, commitments to stakeholders, and the international user community.

The CEOS Chair typically delegates to the SIT Chair the technical implementation of the CEOS contributions to the Group on Earth Observations (GEO) Work Plan and leadership of the resultant interactions with the GEO Secretariat. From the perspective of internal technical coordination, the SIT Chair is responsible for the primary coordination of Virtual Constellation activities, and supports the CEOS Chair in the coordination of Working Group activities. Also, through the chairing and organization of meetings of the Strategic Implementation Team, the SIT Chair is responsible for ensuring a structured debate on issues of strategic significance to CEOS.

The **CEOS Secretariat (SEC**), chaired by the CEOS Chair, provides a forum for coordination between Plenary sessions and is maintained by: the European Space Agency (ESA); the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT); the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) of the United States; Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT); and the Japan Aerospace Exploration Agency (JAXA). To ensure the expeditious and smooth conduct of business, the immediate past and future CEOS Chairs are also included in the CEOS Secretariat. In addition, the Strategic Implementation Team (SIT) Chair, SIT Vice Chair, Working Group Chairs, CEOS Executive Officer (CEO), and CEOS Systems Engineering Office (SEO) are invited to participate in the SEC. Representatives from additional CEOS Agencies or other relevant organizations may participate in the Secretariat on a temporary basis at the invitation of the CEOS Chair, for a period not to exceed the term of the CEOS Chair.

The SEC meets on a monthly basis to review SEC and Plenary action items and assist in coordination of CEOS activities, both internally and externally. The SEC fulfills a key policy role by assisting the CEOS Chair and the SIT Chair in the formulation of CEOS position statements, coordinating external meeting attendance, and reviewing major meeting agendas, actions and minutes. In addition, SEC agencies maintain the *CEOS Earth Observation Handbook*, and publish the *CEOS Newsletter* and other outreach publications. Those in attendance are also given the

opportunity to report on other relevant topics relating to the SIT, Working Groups, GEO, and other topics of interest. Meetings are typically conducted by teleconference, but may be combined with major CEOS meetings to take advantage of face-to-face participation.

The **CEOS Executive Officer (CEO)** is detailed on a full-time basis by a CEOS Agency, and appointed by the CEOS Chair for a two-year term. Additionally, with the consent of the CEOS Chair and CEO, a CEOS Agency may also detail a Deputy CEO (DCEO) for the same term. The CEO reports to the CEOS Chair and to the CEOS SIT Chair, in areas where the CEOS Chair has delegated authority to the CEOS SIT. The CEO works closely with the CEOS Secretariat and leadership of CEOS Agencies, Working Groups, and Virtual Constellations. The activities of the CEO include development of the *CEOS Work Plan*, supporting discussions with the GEO Secretariat on CEOS contributions to the GEO Work Plan, advising CEOS leadership on prospects for continued/expanded internal and external cooperation, and action tracking.

The **CEOS Systems Engineering Office (SEO)** formally reports to the SIT Chair (its annual work plan is coordinated with the SIT Chair) but the SEO may also consider requests for work from the CEOS Chair. The focus of the SEO is on the provision of systems engineering leadership, typically through the provision of advice and support to the Virtual Constellations, Working Groups, and ad hoc mechanisms regarding system engineering methodologies and associated tools, thereby helping to ensure consistent approaches that strengthen plans and improve coordination and collaboration. This support includes the conduct of systems engineering assessments and special studies (e.g., gap analyses), as well as the provision of technical assistance to CEOS space data acquisition planning initiatives. The SEO also provides non-technical support to the CEOS organization for the CEOS website, mailing lists, and actions database (with inputs from the CEO); develops outreach materials; and maintains the historical records and archives of CEOS.

CEOS **Working Groups** are one of the two permanent working-level mechanisms for coordinating the assets of the CEOS Agencies (see Annex 1 for a list of the Working Groups). Working Groups typically address topics such as calibration/validation, data portals, capacity building, and common data processing standards that are shared across a wide range of Earth observation domains. As a consequence, their activities are intimately connected with, and complementary to, the work of the Virtual Constellations (see below). In this context, Working Groups are often viewed as "cross-cutting" mechanisms within CEOS. Furthermore, the activities of Working Groups are usually structured so as to respond to requirements from GEO and other internal and external organizations. The establishment of a new Working Group must be decided by CEOS Principals at the CEOS Plenary. Each CEOS Working Group's primary reporting path is to the CEOS Chair, with a secondary reporting path to the SIT Chair, if so delegated by the CEOS Chair.

The CEOS **Virtual Constellations** are the other permanent working-level mechanism for coordinating CEOS Agency assets. A CEOS Virtual Constellation typically consists of multiple space- and ground-based systems (potentially including related data delivery systems) that operate together in a coordinated manner to meet a common set of requirements in a well-defined thematic Earth observation domain. Although the Virtual Constellations mechanism, itself, is permanent, CEOS will establish, evaluate, and if necessary, disband individual Virtual Constellations (see Annex 1 for a list of the Virtual Constellations). The individual space and ground segments in a Virtual Constellation can belong to one owner or multiple owners. To achieve their objectives, Virtual Constellations make use of collaborative partnerships to address both current and emerging observational gaps and sustain the routine collection of critical observations, while maintaining the independence of individual Agency contributions and minimizing unnecessary duplication/overlaps. The establishment of a new Virtual Constellation must be decided by CEOS Principals at the CEOS SIT Meeting, according to the process outlined in the *CEOS Virtual Constellation Process Paper*. Each CEOS Virtual Constellation's primary reporting path is to the SIT Chair, with a secondary reporting path to the CEOS Chair, if so delegated by the SIT Chair.

In the event that the permanent mechanisms described in the preceding paragraphs are judged to be insufficient for CEOS to undertake a particular activity, the capability exists for the Plenary to create Ad Hoc Teams. The Plenary assigns short-term objectives to each Ad Hoc Team and defines the team lifetime when the team is created. The primary reporting path for an Ad Hoc Team is either to the CEOS Chair or to the SIT Chair, as designated by the Plenary according to the purpose and function of the Ad Hoc Team. Annually, the Plenary reviews all Ad Hoc Teams for continuation, termination, or transition to a permanent mechanism.

3 Decision-Making Process

Consistency, effectiveness, and efficiency are the conditions for long-term organizational well-being. To assure a successful organization, CEOS must select the appropriate set of new activities to pursue and consistently meet its current commitments. CEOS requires a consistent and reliable mechanism to assist the organization in determining which new initiatives and projects to pursue, and to evaluate the course of its ongoing activities.

Technical decisions are usually driven by bottom-up criteria, but strategic and organizational matters, such as the assessment of new activities, typically require a top-down approach based on the long-term vision that CEOS captures in its *CEOS Strategic Guidance* document. The decision-making process described here reflects these different approaches and identifies the appropriate decision makers according to the nature of the decisions to be made.

Clearly delineated procedures for working together—well defined roles and responsibilities, and effective communication processes—are fundamental for the smooth functioning of the organization, and help to minimize confusion and conflict during the decision-making process. It is important that each CEOS entity, such as the Plenary, SIT, Working Group (WG) or Virtual Constellation (VC), uses a reliable mechanism to make decisions.

To ensure proper consideration of the various issues of interest to internal and external CEOS stakeholders, CEOS has identified three categories of strategic and organizational activities. These categories are shown in Table 3-1 and represent activities concerning external interfaces, internal CEOS operations, and actions at the working level (e.g., WG and VC activities). For each activity category, Table 3-1 also shows example decisions, relevant reference documents, the decision maker, and the appropriate meeting where each decision is made. Principals are required to make decisions regarding activities that impact an external interface or internal CEOS operations. Decisions regarding activities that interface with external organizations require consideration by Principals at the CEOS Plenary meeting. Most other decisions requiring input from Principals can be made at either the Plenary or the SIT Meeting, depending on the topic. WG and VC leadership (WG Chairs and VC Co-leads) will make decisions regarding working-level WG or VC activities in consultation with the CEOS Chair (WGs) or SIT Chair (VCs). Working-level decisions will be made at WG and VC meetings. Additional details concerning decision criteria, the consideration of new activities, consideration of current activities, and a process for consensus decision making are described below.

Table 3-1. Summary of CEOS Decision Process

ACTIVITY CATEGORY		EXAMPLE DECISIONS	REFERENCE DOCUMENTS	DECISION MAKERS	DECISION MEETING
External Interface or "Outward facing"	**Current:**	– Evaluate need for GEO Societal Benefit Area Coordinators in CEOS	*CEOS Strategic Guidance* document	Principals	Plenary
	New:	– CEOS responses to GEO, Global Climate Observing System (GCOS), and United Nations Framework Convention on Climate Change (UNFCCC) – New CEOS-CGMS (Coordination Group for Meteorological Satellites) Working Group on Climate		Principals	Plenary
Internal	**Current:**	– Continue support to an ad hoc activity for another year	*CEOS Strategic Guidance* document, CEOS ToRs, and *CEOS Work Plan*	Principals	Plenary or SIT Meeting
	New:	– Establishment of a new Ad Hoc Team – Establishment of a new VC			
Working Level	**Current:**	– Termination of an activity in the current WG/VC Work Plan due to insufficient Agency support	WG and VC ToRs, VC Process Paper, and WG/VC Work Plans	WG/VC leadership (after appropriate consultation with CEOS Chair [WGs] or SIT Chair [VCs])	WG/VC meetings
	New:	– New data operability activity – New combined data product from two VC missions			

Decision Criteria

CEOS decisions regarding current or proposed activities shall be made on the basis of specific criteria including:

(a) Alignment with CEOS strategic goals – Activities must align to the goals defined in the reference documents pertaining to each activity category. Internal CEOS general, WG, VC, and ad hoc activities must also align with their respective organizational terms of reference, or other reference documents listed in Table 3-1. New activities, once approved, may be added to the relevant work plan, as needed.

(b) Benefit to internal and/or external stakeholders - Intended outcomes of the activity must have specific value to internal and/or external stakeholders (e.g., responding to stakeholder requirements). This value may not be monetary, but may be in the form of societal benefit. In the case of current activities, CEOS must evaluate the expected future benefit to stakeholders.

(c) Feasibility and Affordability – CEOS Agencies must possess the necessary personnel and fiscal resources to support an activity so it can fulfill its intended outcomes. Commitments of key supporting Agencies are required to ensure success. In the case of new activities, CEOS must consider its current priorities and commitments. In the case of current activities, CEOS must evaluate future feasibility and affordability in order to continue commitments for the activity.

Consideration of New Activities

The external or internal entity proposing a new activity should provide a written description of the activity to the CEOS Secretariat (SEC), which will act as a "clearinghouse" for proposals to CEOS. This written description should include a brief discussion of the activity and address in detail the elements needed to measure success, as defined in section 6 of the *CEOS Strategic Guidance* document. After analysis of the written description, the CEOS Secretariat will determine whether and how the activity should be further considered. All proposed CEOS activities must be sponsored by a CEOS entity. If the entity proposing the activity is external to CEOS, the Secretariat will suggest a CEOS internal entity to sponsor the activity. If the activity is proposed by an internal CEOS entity (e.g., a WG or VC), then it is the responsibility of that CEOS internal entity to sponsor the proposed activity. It is expected that new activities proposed to the SEC are significant in nature and require discussion and strategic evaluation by CEOS Principals. Decisions regarding new activities at the working level are made in forums such as WGs and VCs. If approved, such new activities would become part of the *CEOS Work Plan* (updated annually) and/or become part of a WG or VC Work Plan.

The CEOS sponsor of the new activity will prepare a presentation, in addition to the written activity description provided to the Secretariat, which will be sent to decision makers at least two weeks prior to the appropriate decision meeting. The CEOS sponsor will make a brief presentation on the proposed activity during the appropriate decision meeting. If the entity that proposed the new activity is external to CEOS, that entity is not required to make a presentation, but their presence at the decision meeting should be encouraged, so they can answer any direct questions, thus facilitating a full and clear understanding of the proposed activity. Decisions should be made at appropriate meetings by the decision makers identified in Table 3-1 above. Additional decision

meetings (perhaps teleconferences) may also be arranged to introduce additional flexibility, as long as all decision makers have the opportunity to participate.

Sufficient time should be reserved on the agenda of the meeting at which the decision will be made to discuss the proposed activity. This discussion should be led by the chair of the decision meeting and the CEOS sponsor and, if applicable, the external entity proposing the new activity. To ensure that sufficient emphasis is placed on decision making, meeting agendas should include a "decision-making session" to discuss all pending decisions, or clearly highlight the agenda items that are "for decision" rather than "for information."

Consideration of Current Activities

CEOS must consistently monitor its current activities to assure they meet the decision criteria described above. Based on internal or external inputs, any CEOS entity may propose to terminate a current CEOS activity in cases where that activity no longer meets the criteria or the activity is completed. In addition, CEOS shall address its current activities as it prepares the *CEOS Work Plan*, which is updated annually at the start of the calendar year. Those activities no longer aligned with CEOS strategic goals and objectives, no longer of benefit to stakeholders, or no longer feasible or affordable, may be considered for termination at the appropriate meeting, as indicated in Table 3-1. In addition, WGs and VCs may decide to continue or terminate activities within their own work plans based on similar criteria. Ad Hoc Teams have a defined lifetime, and the Plenary reviews these groups annually, and approves them for continuation, termination, or transition to a permanent mechanism (see Annex 1 for list of Ad Hoc Teams).

Process for Consensus Decision Making

In an international, culturally diverse organization that is based on a best-effort principle, consensus decision making optimizes agreement and "buy-in" of Agencies, maximizing their commitment to deliver their best effort. CEOS decision making at all levels is based on this consensus principle. The primary elements of this decision process are a full discussion of the activity with a movement toward a decision that reflects a clear majority among those present. Such decisions do not require a formal vote, but rather recognition by the leader of the meeting (typically the CEOS Chair or SIT Chair) that a significant number of Agencies support the decision. The CEOS Chair or SIT Chair shall clarify and summarize the position of the group and attempt to resolve any strong objections before a decision is reached. In some cases, specific Agencies may choose not to support an activity due to their internal constraints, but the decision to support activities as a CEOS organization should not be constrained if sufficient support is available.

4 Major Meetings

CEOS major meetings are those that are not specific to a CEOS Working Group, CEOS Virtual Constellation or project supported by CEOS resources, and that are attended by the representatives of the various CEOS entities, including CEOS Principals and CEOS Contacts. These major meetings include: the CEOS Plenary, the SIT Meeting, the SIT Workshop, the CEOS-GEO Actions Workshop, the monthly CEOS Secretariat teleconference, and the Troika Meeting. Table 4-1 provides additional information for each major meeting regarding timing/frequency, attendance, objectives, and format.

This section contains a series of recommendations aimed at maximizing the efficiency of the major meetings. The recommendations address several aspects such as the meeting objectives, attendance, agendas, and format, and the frequency/timing of the meetings.

Table 4-1. CEOS Major Meetings Summary

MEETING AND CHAIR	TIME-FRAME	ATTENDANCE	MEETING OBJECTIVES AND FORMATS
CEOS-GEO Actions Workshop **Chaired by: CEO**	January-February	Attendance by • Mostly technical experts and scientists • Members of SIT Chair and/or CEOS Chair teams • CEO, SEO, WG Chairs, VC Leads	• Define yearly cooperation activities by CEOS Agencies to support several GEO Work Plan Tasks and Components. Synchronized with the updated annual GEO Work Plan
CEOS Strategic Implemen-tation Team (SIT) Meeting **Chaired by: SIT Chair**	March-April	Attendance by • Mostly CEOS Principals, staffed by CEOS Contacts • SIT Chair and SIT Chair Team, CEOS Chair and CEOS Chair Team, CEO, SEO, WG Chairs, VC Leads • Supported by a few technical experts & scientists Preceded by optional side meetings	• Focus on strategic guidance with regard to governance, stakeholders, and the accomplishment of deliverables and societal benefit contributions of the VCs and WGs Emphasis may vary depending on the CEOS SIT Chair leadership, but will be consistent with the overarching goals of the three-year *CEOS Work Plan*.
CEOS SIT Technical Workshop **Chaired by: SIT Chair**	September	Attendance by • Mostly technical experts and scientists • Few CEOS Principals (not required, depending on agenda/issues) • SIT Chair and SIT Chair Team, CEOS Chair and CEOS Chair Team, CEO, SEO, WG Chairs, VC Leads Preceded by optional side meetings	• Status of the *CEOS Work Plan* (Actions to be implemented) • Prepare CEOS participation and outreach at ministerial-level and other major events at the end of the calendar year (e.g., GEO Plenary, UNFCCC Subsidiary Body for Scientific and Technological Advice COP). • Prepare the necessary Information to make appropriate decisions at the CEOS Plenary
CEOS Plenary **Chaired by: CEOS Chair**	October-November (before GEO Plenary)	Attendance by • Mostly CEOS Principals, staffed by CEOS Contacts. • CEOS Chair and CEOS Chair Team, SIT Chair and SIT Chair Team, CEO, SEO, WG Chairs, VC Leads • Few technical experts/scientists (depending on agenda/issues for which their support is needed) Preceded by optional side meetings	• Focus on decisions to be made by Principals Emphasis may vary depending on the CEOS Chair leadership. Overlaps with the SIT Technical Workshop, especially for usual technical groups (VCs, WGs, and Ad Hoc Teams), should be avoided.
CEOS Secretariat Chaired by: CEOS Chair	Monthly	Mostly teleconferences, attendance by • CEOS Secretariat participants, as defined in Section 2 • Other participants, at the invitation of the CEOS Chair	• Status of CEOS Work Plan activities, stakeholder related business, and outreach
CEOS Troika Meeting **Chaired by: CEOS Chair**	As needed (often at SIT or Plenary Meetings)	Attendance by • Current, prior year and future year CEOS Chairs • CEO and SIT Chair are regularly invited to attend • Others invited at the discretion of the CEOS Chair	• To allow CEOS leaders to exchange ideas and discuss important issues regarding current year achievements, and the direction, strategy, plans, and expectations for the following year.

Meeting Purpose, Goals and Objectives

While most CEOS major meetings have clearly defined goals and objectives that remain constant, those of both the CEOS Plenary and the SIT Meeting may vary from one year to the next. These two meetings are organized and led by two different teams: the CEOS Chair Team and SIT Chair Team. Past experience has demonstrated that the resources, fields of interest, competencies, and strengths of the CEOS Chair and SIT Chair Teams vary, and that, thanks to the dialog between the CEOS Chair and the SIT Chair, both teams may complement each other and ensure proper leadership of CEOS. Flexibility in the definition of the objectives for the Plenary and SIT Meetings allows both teams to adjust the objectives of their respective meetings to target CEOS needs and best benefit the organization. Imposing fixed and repetitive objectives independently of the teams in place might be counterproductive.

Some flexibility in fixing the SIT and Plenary meeting objectives is also necessary, as the status of some CEOS activities and CEOS entities may vary from one year to the next. In particular, before these two major meetings take place, both the CEOS Chair and the SIT Chair should reach out (e.g., through periodic meetings with Working Group Chairs and Virtual Constellation Co-Leads) and work carefully to understand the pressing issues so that they can effectively establish meeting objectives, design meeting agendas, and frame issues that require decisions.

Meeting Attendance

The profiles of the participants in the major meetings vary as depicted in Table 4-1. Meeting participation can be achieved by physically attending a meeting or by virtually attending via videoconference, teleconference, etc. The CEOS Principals are expected to participate in two meetings each year: the SIT meeting and the CEOS Plenary meeting. The main difficulties in ensuring the expected level of attendance at CEOS major meetings are mainly related to the meeting agenda and to the travel required to attend such meetings in person.

Many agencies face travel budget restrictions that prevent their representatives from physically attending the various CEOS major meetings. This issue is becoming even more critical with the increase in the number of CEOS entities holding meetings (e.g., Working Groups, Virtual Constellations, and Ad Hoc Teams) and the growing number of major initiatives supported by CEOS. In cases where the Principal is not able to attend, Agencies are encouraged to delegate attendance to CEOS Contacts.

The following two subsections (“Meeting Agendas” and “Meeting Format”) also suggest recommendations that may influence meeting attendance.

Meeting Agendas

The agenda of each meeting should be designed to reflect the meeting objectives, but also needs to take into account the profile and interests of the majority of the expected attendees. For example, to take advantage of the presence of CEOS Principals at the Plenary, the agenda should include discussion of issues that are more programmatic than technical and focus on decisions to be made instead of reporting. CEOS should take advantage of SIT and Plenary meetings as opportunities to make progress on issues of strategic relevance.

Careful development of the CEOS Plenary agenda should ensure that:

- The Plenary meeting shall focus on major matters that either require a decision or that, by their importance, need to be brought to the attention of the CEOS Principals (e.g., activities that require the commitment of CEOS Agency resources).
- The Plenary meeting shall not be used for technical reporting purposes; rather, it should focus on issues requiring decisions or guidance from CEOS Agencies, and the agenda should guarantee sufficient time for discussion.
- Technical topics might still be discussed in the presence of interested CEOS Principals during side meetings conducted in conjunction with the Plenary meetings. In particular, Plenary meetings may be preceded by a day of technical side meetings dedicated to the CEOS Working Groups, Virtual Constellations, and other key CEOS initiatives.
- There shall be as little redundancy as possible between the SIT Technical Workshop and the CEOS Plenary Meeting.

The CEOS Chair and SIT Chair should coordinate to ensure that either the CEOS Plenary or the SIT Meeting (not both) serves as an appropriate forum to invite external stakeholders to discuss a topic of interest for CEOS, while the other meeting should focus on issues and matters internal to CEOS.

Meeting Format

Physically attending all major meetings (except CEOS Secretariat teleconferences) may cause financial difficulties for some agencies. Each meeting should be organized to include the appropriate technological infrastructure (videoconference, teleconference, etc.) to allow remote participation (virtual meeting access), in addition to physical participation. Remote participation shall be compatible with the meeting objectives and goals.

The reporting at the various major meetings shall be minimized and targeted to the meeting objectives, avoiding out-of-scope reporting and allowing sufficient time for discussion. Whenever possible, the meeting organizer shall prepare a report template. The use of a template shall help limit the length of the reporting and guide the content of the presentations. If needed, reporters can supplement oral reports with detailed written reports, posters, or backup slides, which will not be examined during the meeting, but will be provided to participants for external review.

To reach consensus before the end of each major meeting, the respective meeting chair shall take care to avoid lengthy and unproductive discussions. If discussion time is exceeded and meeting participants are not reaching consensus, the Chair should adequately moderate the debate and control the time needed for each discussion, and ask the respective Agency representatives to work on the issue outside the meeting.

Meeting Frequency and Timing

The frequency and timing of the major meetings are designed to reflect the current CEOS objectives; in particular, the major meetings are synchronized with the GEO Plenary meetings and the major meetings of other CEOS stakeholders, such as the United Nations Framework Convention on Climate Change (UNFCCC)/Conference of the Parties (COP). As the CEOS objectives evolve, the objectives, frequency and timing of the major CEOS meetings shall be re-assessed.

Occasionally, the period between the CEOS Plenary and the SIT meeting may introduce counterproductive delays for specific matters that cannot wait for a decision to be taken at a major meeting. For those specific matters, it shall be possible to organize ad hoc meetings with the participation of the relevant decision makers. Such meetings could be held either as virtual meetings or side meetings in conjunction with other scheduled meetings (which may not necessarily be CEOS meetings) to reduce participants' travel costs.

5 Membership and Participation

Active Members and Associates (see Annex 2 for a chronological record of CEOS membership) shape CEOS: they take turns providing leadership for the Plenary, SIT, Working Groups, and Virtual Constellations and they serve as the engine that powers and sustains CEOS activities and as a source for ideas for new initiatives. In the context of CEOS, people, energy, and ideas matter. The challenge for CEOS is to maximize the engagement and participation of its Members and Associates by demonstrating the benefits of involvement. Such benefit may be in the form of collaborative missions and data systems and participation in global initiatives for societal benefit.

A best-effort organization like CEOS needs a mass of consistently active Members and Associates to ensure that key activities have sufficient human resources and that there is a seamless transition of leadership at all levels. Given the dynamic nature of membership and participation, routine contact with and among CEOS Agencies will always be a challenge. This challenge can be addressed through maintaining active primary and secondary contacts wherever possible, and by ensuring that contacts exist within the working levels, as well, so that there are always multiple routes for correspondence with any given Member or Associate. To address this issue, the CEO and SEO will work under direction of the CEOS Chair and SIT Chair to periodically confirm contact information with Members and Associates. In addition, participant lists for key meetings should be obtained by the meeting organizer and provided to the CEO and SEO.

CEOS should be viewed as a place where organizations can gather to accomplish specific goals that are relevant to them, with no pressure to participate in activities that are of less interest or for which they do not have resources. As CEOS initiates and further implements activities, Members and Associates may choose to participate or not participate, depending on their interest in particular activities. In choosing new activities to undertake, CEOS should consider whether its portfolio of activities includes not only those that are of interest to the most active CEOS Members, but also includes activities of value and interest to a wide range of CEOS Agencies.

Some Members and Associates are active in Working Groups and other working-level interactions and activities, but are not active at the Plenary level. It is important that CEOS recognize and value the contributions of Members and Associates that participate at the working level, but that may not participate as extensively in Plenary or SIT Meetings. The status of Members and Associates can also change over time. Associates may determine that they qualify to become Members or conversely Members may determine that they wish to become Associates. In cases where a Member or Associate is truly inactive, CEOS leadership will contact such Agencies on an individual, one-on-one basis to encourage them to re-engage with CEOS. CEOS leadership shall maintain awareness of emerging international groups capable of qualifying for CEOS membership, and make an effort to engage them in CEOS activities.

Lack of resources to attend meetings and participate in activities is a known challenge for some Members and Associates. Travel funds are chronically limited, and smaller organizations also have limited human resources to devote to the business of an organization like CEOS. CEOS conducts monthly Secretariat meetings via teleconference; leverages its in-person major meetings through the inclusion of Virtual Constellation, Working Group and other side meetings; and works to ensure the possibility of virtual, internet-based participation in its Plenary and SIT Meetings. CEOS will continue to examine ways to increase the use of telecommunications technology and leverage other internal and external meetings to maximize the efficient use of resources.

Annex 1: Working Groups, Virtual Constellations, and Ad Hoc Teams

The CEOS Working Groups, Virtual Constellations, and Ad Hoc Teams, as of November 2013, are listed below. A current list of such activities resides on the CEOS website (http://www.ceos.org) under the "Organization" menu link.

Working Groups:

Calibration and Validation

Capacity Building and Data Democracy

Climate (joint with CGMS)

Disasters

Information Systems and Services

Virtual Constellations:

Atmospheric Composition

Land Surface Imaging

Ocean Colour Radiometry

Ocean Surface Topography

Ocean Surface Vector Wind

Precipitation

Sea Surface Temperature

Ad Hoc Teams (year of team initiation in parentheses):

CEOS Carbon Task Force (2008)

Ad Hoc Space Data Coordination Group for the Global Forest Observation Initiative (2011)

Ad Hoc Working Group on GEOGLAM (2011)

Land Surface Imaging Study Group (2013)

Annex 2: CEOS Membership

A chronological record of CEOS membership, as of November 2013, is shown below. For an alphabetical list of current CEOS Agencies, including their Principals and Contacts, see the CEOS website (http://www.ceos.org) under the "Members and Associates" menu link.

AGENCY NAME	AGENCY ACRONYM	HEADQUARTERS LOCATION	MEMBERSHIP TYPE	YEAR OF ACCEPT-ANCE
Centre National d'Etudes Spatiales	CNES	France	Member	1984
Canadian Space Agency	CSA	Canada	Member	1984
European Space Agency	ESA	France	Member	1984
Instituto Nacional de Pesquisas Espaciais	INPE	Brazil	Member	1984
India Space Research Organisation	ISRO	India	Member	1984
Japan Aerospace Exploration Agency	JAXA	Japan	Member	1984
National Aeronautics and Space Administration	NASA	USA	Member	1984
National Oceanic and Atmospheric Administration	NOAA	USA	Member	1984
Agenzia Spaziale Italiana	ASI	Italy	Member	1986
Deutsches Zentrum für Luft- und Raumfahrt	DLR	Germany	Member	1986
United Kingdom Space Agency	UKSA	United Kingdom	Member	1986
Commonwealth Scientific and Industrial Research Organisation	CSIRO	Australia	Member	1989
European Organisation for the Exploitation of Meteorological Satellites	EUMETSAT	Germany	Member	1989

AGENCY NAME	AGENCY ACRONYM	HEADQUARTERS LOCATION	MEMBERSHIP TYPE	YEAR OF ACCEPT-ANCE
Canada Centre for Mapping and Earth Observation (CCMEO), previously Canada Centre for Remote Sensing (CCRS)	CCMEO	Canada	Associate	1990
Crown Research Institutes	CRI	New Zealand	Associate	1990
Norwegian Space Centre	NSC	Norway	Associate	1990
International Council of Scientific Unions	ICSU	France	Associate	1991
International Geosphere-Biosphere Program	IGBP	Sweden	Associate	1991
Intergovernmental Oceanographic Commission	IOC	France	Associate	1991
Swedish National Space Board	SNSB	Sweden	Associate	1991
World Climate Research Program	WCRP	Switzerland	Associate	1991
World Meteorological Organization	WMO	Switzerland	Associate	1991
Belgian Science Policy Office	BELSPO	Belgium	Associate	1992
Global Climate Observing System	GCOS	Switzerland	Associate	1992
Global Ocean Observing System	GOOS	France	Associate	1992
Russian Federal Service for Hydrometeorology and Environmental Monitoring	Roshydromet	Russia	Member	1992
Federal Russian Space Agency	Roscosmos	Russia	Member	1992
United Nations Environment Program	UNEP	Kenya	Associate	1992
Chinese Academy of Space Technology	CAST	China	Member	1993

AGENCY NAME	AGENCY ACRONYM	HEADQUARTERS LOCATION	MEMBERSHIP TYPE	YEAR OF ACCEPT-ANCE
National Remote Sensing Center of China	NRSCC	China	Member	1993
National Space Agency of Ukraine	NSAU	Ukraine	Member	1993
European Commission	EC	Belgium	Member	1994
United Nations Food and Agriculture Organization	FAO	Italy	Associate	1994
United Nations Office for Outer Space Affairs	UNOOSA	Austria	Associate	1994
United Nations Economic and Social Commission for Asia and the Pacific	ESCAP	Thailand	Associate	1997
Global Terrestrial Observing System	GTOS	Italy	Associate	1997
International Society for Photogrammetry and Remote Sensing	ISPRS	United Kingdom	Associate	1998
South African Council for Scientific and Industrial Research/Satellite Applications Centre	CSIR/SAC	South Africa	Associate	1998
Comision Nacional de Actividades Espaciales	CONAE	Argentina	Member	1999
International Ocean Colour Coordinating Group	IOCCG	Nova Scotia	Associate	2000
United States Geological Survey	USGS	USA	Member	2000
Geo-Informatics and Space Technology Development Agency	GISTDA	Thailand	Member	2001
Korea Aerospace Research Institute	KARI	South Korea	Member	2001

AGENCY NAME	AGENCY ACRONYM	HEADQUARTERS LOCATION	MEMBERSHIP TYPE	YEAR OF ACCEPT-ANCE
United Nations Educational, Scientific and Cultural Organization	UNESCO	France	Associate	2002
National Space Research and Development Agency	NASRDA	Nigeria	Member	2004
Space Technologies Research Institute of Turkey	Tubitak-Uzay	Turkey	Member	2006
Center for the Development of Industrial Technology	CDTI	Spain	Member	2007
China Center for Resources Satellite Data and Application	CRESDA	China	Member	2007
National Satellite Meteorological Center/Chinese Meteorological Administration	NSMC/CMA	China	Member	2010
South African National Space Agency	SANSA	South Africa	Member	2010
Global Geodetic Observing System	GGOS	Italy	Associate	2011
Netherlands Space Office	NSO	Netherlands	Member	2011
Earth System Science Organisation	ESSO	India	Associate	2012
Vietnam Academy of Science and Technology	VAST	Vietnam	Member	2013
Geoscience Australia	GA	Australia	Associate	2013

This CEOS Governance and Processes document can be amended or modified only after review and careful consideration by the CEOS Agencies. This review should also examine other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting. The specific amendments or modifications must be reviewed at a CEOS SIT Meeting and approved at the subsequent CEOS Plenary.

Terms of Reference: CEOS Chair

Purpose: The Committee on Earth Observation Satellites (CEOS) Chair leads the Committee on Earth Observation Satellites in its mission to ensure international coordination of civil space-based Earth observation programs and promote exchange of data to optimize societal benefit and enable decisions for securing a prosperous and sustainable future for humankind. The CEOS Chair leads the organization's governance and is also its principal representative in the international community.

Organization: The CEOS Chair presides over the Secretariat and the Troika, the latter consisting of the CEOS Chair, the immediate past CEOS Chair, and the incoming CEOS Chair. For purposes of succession planning and continuity of major Earth observation endeavors in relation to stakeholders, CEOS Agencies wishing to be considered for the role of Chair are asked to inform the Agency in the CEOS Chair role at least two years in advance. Every effort should be made to rotate the CEOS Chair responsibility among major geographic regions (the Americas, Europe/Africa, Asia/Pacific) to promote leadership diversity. The composition of the CEOS Chair Team, itself, is at the discretion of that Agency's CEOS Principal and will include expertise and resources to fulfill the range of activities outlined in these Terms of Reference and the *CEOS Strategic Guidance* document and *CEOS Governance and Processes* document. It is also suggested the composition of the CEOS Chair Team include appropriate international relations and technical expertise to effectively interact internally with the CEOS Working Groups and Virtual Constellations , and externally, with Ministerial-level organizations and other external stakeholders.

The CEOS Chair will be selected by the CEOS Plenary for a one-year term. The term of a previously confirmed incoming CEOS Chair nominee begins at the conclusion of the CEOS Plenary. The CEOS Chair will be a senior space agency official, from a different agency than the CEOS Strategic Implementation Team (SIT) Chair.

Objectives: The CEOS Chair's objectives and intended outcomes, listed below, consist of overall leadership and guidance of the organization and its activities with regard to governance, stakeholder relationships, and mission objectives and priorities as implemented by the CEOS Working Groups, Virtual Constellations, and Ad Hoc Teams.

<u>Strategic Guidance</u>

- Play a central role in the strategic coordination of existing and future missions of CEOS Agencies, continuing to support the Group on Earth Observations (GEO) in the realization of the space segment of the Global Earth Observation System of Systems (GEOSS).
- Work with the SIT Chair and the Secretariat to build capacity and complementarity among CEOS Agencies, stakeholders, and partner organizations by broadening the participation in and contributions to CEOS Earth observation activities.
- Lead and coordinate, with the support of the CEOS Executive Officer (CEO), activities in support of external stakeholders. These external stakeholders may include, but are not

limited to: GEO; the United Nations Framework Convention on Climate Change (UNFCCC); the United Nations International Strategy for Disaster Reduction; the United Nations Convention on Biological Diversity; the Global Climate, Ocean, and Terrestrial Observing Systems; and the Group of Eight/Group of Twenty (G20) industrialized nations.

Executive Management

- Organize and chair the following meetings that inform, review, and advance the implementation of CEOS activities and deliverables each year: the annual CEOS Plenary, monthly meetings of the Secretariat, and meetings of the Troika at intervals deemed appropriate. The Chair may request other meetings as needed to discuss priorities, objectives, or issues. The CEOS Chair may also invite observers or CEOS entities, as appropriate, to any meeting.
- Lead the Secretariat as the coordinating body of CEOS and the central point for executive leadership discussions and reporting on activities. The CEOS Chair will develop the Secretariat meeting agenda, provide it in advance to all participants for comment, and distribute meeting minutes in a timely manner. The CEOS Chair is also responsible for inviting representatives from additional CEOS Agencies or other relevant organizations to participate in the Secretariat meetings, as required.
- To ensure leadership continuity, work with the Secretariat to identify and actively recruit Agencies qualified to serve as future CEOS Chair candidates, at least two years in advance.
- Oversee the activities of the CEOS Executive Officer (CEO) and, if one exists, the Deputy CEOS Executive Officer (DCEO), and make best efforts among CEOS Members and Associates to ensure continuity through succession planning.
- Oversee the activities of the CEOS Working Groups. This may include, but is not limited to: regular telecons with Working Group Chairs to understand progress and issues, and support for resolving issues that require Agency interaction. The CEOS Chair may delegate this responsibility to the SIT Chair, and/or utilize the support of the SIT Chair for this activity.
- Propose Ad Hoc Teams to the CEOS Plenary for discussion and consensus decision.

Planning, Implementation, and Reporting:

- Be the principal interface for all external reporting, except when delegated to the SIT Chair or CEOS Executive Officer.
- Report to the CEOS Plenary on matters requiring discussion or decision by CEOS Plenary, and arrange for appropriate action to be taken, except when delegated to the SIT Chair or CEO.
- Report to external stakeholders on the progress of CEOS actions/commitments.
- Work with the CEO and the CEOS Secretariat to ensure well-prepared and coordinated CEOS representation at key stakeholder meetings.

These Terms of Reference can be amended or modified only after consultation and agreement by the CEOS Chair and the SIT Chair. The amendment process should include a review of other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting. Such amendment or modification shall require review and approval by the CEOS Plenary.

Terms of Reference: CEOS Strategic Implementation Team (SIT) Chair

Purpose: The Strategic Implementation Team (SIT) of the Committee on Earth Observation Satellites (CEOS) provides strategic guidance on the direction, progress, and status of implementation activities in relation to the established priorities, commitments, and partnerships of the CEOS organization.

Organization: The CEOS SIT Chair formally reports to the CEOS Chair, and participates in the meetings of the CEOS Secretariat and Troika. The SIT Chair is supported by the SIT Chair Team, whose composition is at the discretion of the SIT Chair. The SIT Chair Team includes expertise and resources to fulfill the range of activities outlined in these Terms of Reference, the *CEOS Strategic Guidance* document, and the *CEOS Governance and Processes* document. It is recommended that the SIT Chair Team members possess adequate international relations and technical expertise to effectively interact with and support the Virtual Constellations (VCs) and Working Groups (WGs).

Biennially, CEOS confirms and endorses an Agency as SIT Chair and a second Agency as SIT Vice Chair at the CEOS Plenary meeting. Both SIT Chair and SIT Vice Chair Agencies serve a two-year term, with the SIT Vice Chair taking on the role of SIT Chair at the end of the SIT Vice Chair term. The terms for the previously nominated and confirmed SIT Chair and SIT Vice Chair begin at the conclusion of the CEOS Plenary. The SIT Vice Chair role is intended to provide active support to the SIT Chair. Both the SIT Chair and SIT Vice Chair are invited to participate in the CEOS Secretariat. For purposes of succession planning and continuity of the implementation of major Earth observation deliverables in relation to stakeholders, CEOS Agencies seeking consideration to chair the SIT are asked to offer their candidacy to the CEOS Chair at least two years in advance so that they may be first considered for the SIT Vice Chair role, which precedes the role of SIT Chair.

Participation in SIT meetings is open to any CEOS Agency willing and ready to contribute to one or more of the activities being discussed by the SIT. The SIT Chair may, at his/her discretion, arrange dedicated sessions for those Agencies discussing coordination of implementation plans. The SIT Chair may also invite observers, as appropriate, to any meeting.

Objectives: The objectives and intended outcomes of the SIT Chair, listed below, center on strategic guidance with regard to governance, stakeholders, and the accomplishment of deliverables and societal benefit contributions of the VCs and WGs.

<u>Strategic Guidance</u>

- In consultation with the CEOS Chair, play a central role in technical coordination of existing and future missions of CEOS Agencies, continuing to support the Group on Earth Observations (GEO) in the realization of the space segment of the Global Earth Observation System of System (GEOSS).

- Work to accomplish greater synergy between the research satellite and operational satellite communities in building upon proven research instrumentation to develop future-generation operational monitoring capabilities
- Work with the CEOS Chair and Secretariat to build capacity and complementarity among CEOS Agencies, stakeholders, and partner organizations by broadening the participation in and contributions to CEOS Earth observation activities
- Oversee the activities of the CEOS VCs and, as delegated by the CEOS Chair, assist in overseeing the WGs. The SIT Chair may also oversee certain Ad Hoc Teams, as designated by the Plenary. Oversight of these entities may include, but is not limited to, regular telecons with VC Co-Leads and WG Chairs to provide strategic guidance, understand progress and issues, and support the resolution of issues that require agency coordination.
- Seek and monitor implementation of commitments by the membership in support of the *CEOS Strategic Guidance* and *CEOS Work Plan* documents.

Executive Management

- Working with the CEOS Chair and the CEOS Executive Officer (CEO), chair the following major meetings that inform, review, and advance the implementation of CEOS activities and deliverables each year: the CEOS SIT Meeting in the March to April timeframe, and the CEOS SIT Technical Workshop in the August to September timeframe (not required, but often desired to prepare for the CEOS Plenary, GEO Plenary, United Nations Framework Convention on Climate Change (UNFCCC), and other key external stakeholder meetings).
- Working with the CEOS Chair and the CEO, organize and coordinate the CEOS-GEO Actions Meeting in the January to February timeframe. This meeting will be chaired by the CEO.
- Evaluate initial proposals, full proposals, and implementation plans for new VCs according to the *VC Process Paper* and facilitate the discussion and decision process with CEOS Principals at the SIT Meeting.
- Take on such other tasks as the CEOS Chair considers appropriate.

Planning, Implementation, and Reporting: The SIT Chair organizes and chairs meetings of the SIT to strategically address space agency commitments to the *CEOS Work Plan*. The SIT Chair convenes each meeting at a time and place to facilitate the participation of as many interested representatives as possible, and makes every effort to offer web conferencing for representatives who cannot attend in person. The SIT Chair provides an agenda and related documents at a reasonable time prior to each meeting. The SIT Chair develops the agenda in consultation with the CEOS Chair and the Secretariat, and identifies potential outcomes for the meeting in question, topics for decision or approval, topics for information, topics requiring CEOS Agency guidance, and actions. As needed, the SIT Chair pursues inter-sessional contacts with CEOS Member Principals and works together with the CEOS Chair, CEO, and Secretariat to keep all CEOS Agencies informed of the organization's activities and issues during the period between CEOS Plenaries.

The SIT Chair is also responsible for the following reporting and representation activities.

- In cooperation with the CEOS Chair, CEO and Systems Engineering Office (SEO), be the principal CEOS interface with GEO for the annual CEOS–GEO Coordination Meeting (in the

December to January timeframe) between CEOS executive leadership (CEOS Chair, SIT Chair, CEO, SEO) and the GEO Secretariat.

- The SIT Chair will keep the CEOS Chair and CEO regularly informed and briefed, particularly in connection with external stakeholder meetings, where the CEOS Chair or designee will be the formal CEOS representative.
- In cooperation with the CEO, report to the CEOS Plenary on technical implementation matters requiring discussion or decision by CEOS Plenary, and arrange for appropriate action to be taken.
- Develop, maintain, and report (to CEOS Plenary annually) progress on CEOS contributions to the GEO Work Plan.
- Ensure appropriate 'space component' representation in any implementation initiatives undertaken by CEOS in support of various stakeholder initiatives. Representatives will report regularly to the SIT Chair, and will look to him/her for support in carrying out CEOS commitments.

These Terms of Reference can be amended or modified only after consultation and agreement by the CEOS Chair and the SIT Chair. The amendment process should include a review of other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting. Such amendment or modification shall require review and approval by the CEOS Plenary.

Terms of Reference: CEOS Secretariat (SEC)

Purpose: Led by the Committee on Earth Observation Satellites (CEOS) Chair, the permanent CEOS Secretariat (SEC) ensures progress on and implementation of Plenary and SEC actions; drafts and approves CEOS position statements, major meeting agendas, and minutes; and provides ongoing coordination of CEOS activities through monthly meetings between Plenary sessions.

Organization: The permanent Secretariat is maintained by the

- European Space Agency (ESA),
- European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT),
- National Aeronautics and Space Administration (NASA) of the United States,
- National Oceanic and Atmospheric Administration (NOAA) of the United States,
- Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan, and
- Japan Aerospace Exploration Agency (JAXA).

The SEC is chaired by the current CEOS Chair Agency, which is responsible for developing the SEC meeting agenda and topics for discussion. In addition, to ensure the expeditious conduct of business, the immediate past CEOS Chair and the incoming CEOS Chair are included in the SEC. The Strategic Implementation Team (SIT) Chair, SIT Vice Chair, CEOS Executive Officer (CEO) and CEOS Systems Engineering Office (SEO) are invited to participate in the SEC. The CEOS Working Group Chairs are also invited to all SEC Meetings so that they may report on the status of Plenary-related action items under their responsibility, and they are copied on all relevant correspondence. Representatives from additional CEOS Agencies or other relevant organizations may participate in the Secretariat on a temporary basis at the invitation of the CEOS Chair, for a period not to exceed the term of the CEOS Chair. Agencies or other organizations wishing to participate in the Secretariat on a temporary basis will apply in writing to the CEOS Chair, who will specify the length of the Agency's participation, not to exceed the term of the CEOS Chair.

Objectives:

- Facilitate communication relating to CEOS activities between major CEOS meetings
- Play a key policy role in drafting and approving CEOS position statements and major meeting agendas and minutes in support of the CEOS Chair and SIT Chair
- Facilitate communication with external stakeholders
- Facilitate communication among internal stakeholders, such as the SIT and Working Groups
- Facilitate progress and address issues relating to select *CEOS Work Plan* initiatives
- Along with the CEO, coordinate CEOS representation at external meetings
- Report on the status of SEC actions and actions from previous Plenary meetings
- Maintain and update the *CEOS Earth Observation Handbook* and the corresponding online Mission, Instrument and Measurement (MIM) database

- Produce the *CEOS Newsletter* and other periodic outreach publications
- Other tasks as assigned by the CEOS Chair

Planning, Implementation, and Reporting:

The SEC meets on a monthly basis to review SEC and Plenary action items and assist in coordination of CEOS activities. Those in attendance are given the opportunity to report on other relevant topics to include the activities of CEOS, Group on Earth Observations (GEO), SIT, Working Groups, external meeting attendance, and other topics of interest. Meetings are typically conducted by teleconference, but may be combined with major CEOS meetings to take advantage of face-to-face participation.

These Terms of Reference can be amended or modified only after consultation and agreement by the CEOS Chair. The amendment process should include a review of other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting. Such amendment or modification shall require review and approval by the CEOS Plenary.

Terms of Reference: CEOS Executive Officer (CEO)

Purpose: The Committee on Earth Observation Satellites (CEOS) Executive Officer (CEO) supports CEOS objectives to coordinate Earth observation (EO) satellite missions on a global basis, and to enhance the use and sharing of their data for societal benefit. The role of the CEO is to ensure the efficient conduct of CEOS activities in support of internal and external stakeholders. These external stakeholders may include, but are not limited to: the Group on Earth Observations (GEO); the United Nations Framework Convention on Climate Change (UNFCCC); the United Nations International Strategy for Disaster Reduction; the United Nations Convention on Biological Diversity; the Global Climate, Ocean, and Terrestrial Observing Systems; and the Group of Eight/Group of Twenty (G20) industrialized nations.

Organization: The CEO is detailed on a full-time basis by a CEOS Agency, and appointed by the CEOS Chair for a two-year term. This term may be extended or renewed if jointly agreed by the CEO, incoming CEOS Chair, and CEO's host Agency. Additionally, with the consent of the CEOS Chair and CEO, a CEOS Agency may also detail a Deputy CEOS Executive Officer (DCEO), on at least a half-time basis, for a two-year time period. In this event, the CEO and DCEO will agree upon their respective duties to fulfill the objectives and requirements specified in this document, and communicate this arrangement to the CEOS community. The CEO position was first agreed to at the 2006 CEOS Plenary in Buenos Aires, with the initial focus of facilitating CEOS coordination with the GEO, Global Climate Observing System (GCOS), and other stakeholders and providing support and guidance to CEOS leadership and membership at large. The CEO participates in the meetings of the CEOS Secretariat and Troika.

Objectives: Through the following objectives, the CEO advises CEOS leadership on CEOS priorities, objectives, new initiatives, and timetables for action.

- Under direction of the CEOS Chair and in consultation with CEOS leadership, the CEO develops the *CEOS Work Plan* (three-year longevity, updated annually). The CEO also supports the CEOS Chair and Strategic Implementation Team (SIT) Chair in development, coordination and approval of the *CEOS Strategic Guidance* (10-12 year longevity) document and the *CEOS Governance and Processes* (5-7 year longevity) document.
- Consults and coordinates with the GEO Secretariat on: CEOS contributions to GEO Work Plan Tasks and Components, CEOS participation in GEO Work Plan Task/Component leadership, development of CEOS Actions in support of GEO Work Plan Tasks, and CEOS participation in GEO Working Groups and Implementation Boards.
- Routinely liaises with CEOS Working Groups, Virtual Constellations, the CEOS Systems Engineering Office (SEO), and the GEO Secretariat.
- Works closely with CEOS Contacts and external stakeholders to facilitate execution of CEOS Actions; provides overall guidance and reports to external stakeholders regarding CEOS Actions.
- Advises and provides guidance on major CEOS initiatives; participates in the many CEOS entity (*e.g.,* Working Groups, Virtual Constellations) meetings to ensure cross-flow of information at working levels within CEOS.

- Advises CEOS leadership on prospects for continued/expanded internal and external cooperation.
- At the request of the CEOS Chair, represents CEOS at meetings of CEOS partners and stakeholders.
- In cooperation with the SIT Chair, CEOS Chair, and SEO, supports the annual CEOS–GEO Coordination Meeting (in the December to January timeframe) between CEOS executive leadership (CEOS Chair, SIT Chair, CEO, SEO) and the GEO Secretariat.
- Leads the annual CEOS-GEO Actions Workshop (in the January to February timeframe).
- Edits major CEOS publications and advises/assists with CEOS outreach efforts.
- Tracks and reports on upcoming internal and external meetings and events where CEOS representation/participation is required/invited; reports on status of CEOS representation at relevant meetings during monthly Secretariat telecons.
- Reviews and manages the CEOS mailing and contact lists, and consults with the SEO in updating CEOS mailing list servers. These lists will also be coordinated with the CEOS Chair and the SIT Chair to maintain accuracy and efficiency in CEOS communications.

Planning, Implementation, and Reporting:

- The CEO reports to the CEOS Chair and to the CEOS SIT Chair, in areas where the CEOS Chair has delegated authority to the CEOS SIT. The CEO works closely with the CEOS Secretariat and leadership of CEOS Agencies, Working Groups, and Virtual Constellations.
- The CEO, in consultation with the SIT Chair, reports at the annual SIT, SIT Technical Workshop, and Plenary meetings on the CEOS contributions to the GEO Work Plan, as well as CEOS contributions to other initiatives.
- The CEO shall lead the development of reports and position statements (interventions) on CEOS annual accomplishments.

These Terms of Reference can be amended or modified only after consultation and agreement by the CEOS Chair and the SIT Chair. The amendment process should include a review of other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting. Such amendment or modification shall require review and approval by the CEOS Plenary.

Terms of Reference: CEOS Systems Engineering Office (SEO)

Purpose: The Committee on Earth Observation Satellites (CEOS) Systems Engineering Office (SEO) provides systems engineering leadership and support to CEOS through technical and management services and the development of tools and products that facilitate systems engineering solutions for societal benefit.

Organization: The SEO was conceived by NASA in 2007, as a contribution to CEOS, and is currently funded and led by NASA. Continued leadership and funding for the SEO will be addressed annually by the sponsoring organization. The SEO formally reports to the Strategic Implementation Team (SIT) Chair and its annual work plan is coordinated with the SIT Chair, but the SEO may also consider requests for work from the CEOS Chair. NASA currently utilizes a mix of NASA employees and contractors representing various CEOS agencies to meet SEO objectives. Participation from other Agencies is desired to meet the expanding efforts of the SEO.

Objectives: The SEO's objectives and intended outcomes are focused on management and technical services to CEOS.

Management

- The SEO will manage the CEOS website, including hosting and content. Website visits will be tracked and reported annually at the CEOS Plenary to optimize outreach potential.
- The SEO will update the CEOS mailing list servers with inputs provided by the CEOS Executive Officer (CEO), who will review and manage the CEOS contact list. These lists will be coordinated with the CEOS Chair and SIT Chair to maintain accuracy and efficiency in CEOS communications.
- The SEO will manage the CEOS-GEO Actions database. This includes hosting and coordination of content with the CEO to maintain accuracy and effectiveness.
- The SEO will work with the CEO to support the development of the *CEOS Work Plan*.
- The SEO will support CEOS-external stakeholder interfaces by working with CEOS leadership (Chair, SIT, CEO), Virtual Constellations (VCs), and Working Groups (WGs) on priority initiatives supporting those stakeholders.
- The SEO will support CEOS outreach and training activities, pending availability of funding. This support may include development of outreach materials, hosting of exhibition booths (e.g., GEO, International Geoscience and Remote Sensing Symposium [IGARSS], American Geophysical Union [AGU]) and training.

Technical

- The SEO will develop systems analysis tools to support the CEOS SIT, VCs and WGs. Examples of such tools include the CEOS Visualization Environment (COVE), the Essential Climate Variable (ECV) database, and the Data Policy Portal.
- The SEO will conduct systems engineering gap assessments (missions and measurements) and special studies to support the CEOS SIT, VCs, WGs, and Ad Hoc Teams.

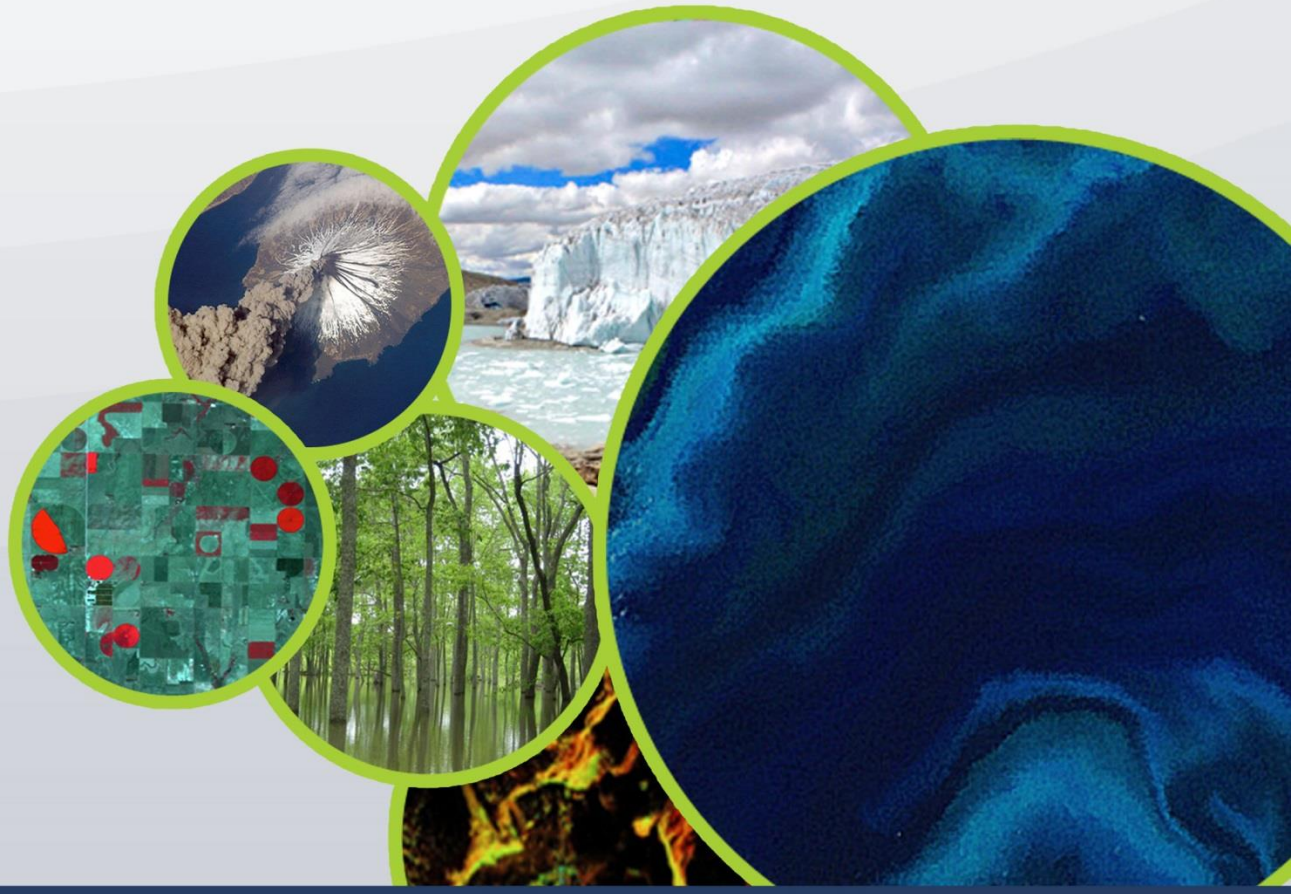
- The SEO will support CEOS data acquisition planning initiatives. This support may include the development of measurement requirements, mission coverage and gap assessments, data volume assessments, cloud cover analyses, data policy assessments, and the coordination of mission data to optimize the use of Agency resources.
- The SEO will support the development and annual updates to the *Earth Observation (EO) Handbook* and the corresponding online database. This support includes prototyping new technical functions and reviewing development plans. The partnership between the SEO and Mission, Instrument and Measurement (MIM) team will improve the content and effectiveness of the MIM.

Planning and Reporting:

- The SEO will develop an annual SEO Work Plan and present the results at the CEOS Plenary meeting. The elements of this SEO Work Plan depend on available resources, SIT priorities, CEOS Chair priorities and SEO priorities.
- The SEO will present an annual report at the CEOS Plenary meeting. This report will summarize the key accomplishments of the SEO from the current year and the proposed SEO Work Plan for the following year.
- The SEO will present status reports, as needed, at CEOS meetings (i.e., Secretariat, SIT, Working Groups, Constellations) on topics related to their systems analysis tools, systems engineering assessments, and data acquisition planning assessments.

These Terms of Reference can be amended or modified only after consultation and agreement by the CEOS Chair and the SIT Chair. The amendment process should include a review of other CEOS guiding documents that will be affected by the amendment or modification to ensure that all of the guiding documents are consistent and mutually supporting.

Committee on Earth Observation Satellites



2017-2019 Work Plan

May 2017 (Version 1.1.1)

Contents

1 Introduction and Overview

The *2017-2019 CEOS Work Plan* has been developed by the CEOS Executive Officer (CEO) under direction of the CEOS Chair (United States Geological Survey [USGS]), in consultation with the CEOS Strategic Implementation Team (SIT) Chair (European Space Agency [ESA]), 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 (2017), and summarizes anticipated activities for the subsequent two years (2018-2019). Additional documents contributing information to this plan are located on the CEOS website (http://ceos.org/) and include: *The Kyoto Statement*, issued at the 29th CEOS Plenary Meeting held in 2015; the *2016-2018 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)[1].

[1] 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 29th CEOS Plenary Meeting held in Kyoto, Japan in 2015.

In this Statement, CEOS Agencies affirmed their intent to work together to:

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

At the 30th 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".

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' internal and external coordination involves a considerable number of tasks supported by the full range of CEOS participants. This document is intended to provide overall guidance for CEOS on expected outcomes for CEOS and its stakeholders for 2017-2019.

For 2017, 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 (2018-2019) 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 2017-2019

The expected outcomes for 2017-2019 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 2017-2019:

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 2017-2019 period will be to contribute to development of a comprehensive and integrated space response to the Global Climate Observing System (GCOS) Implementation Plan 2016, adopted at the 22nd Conference of the Parties to the UN Framework Convention on Climate Change, held in Marrakech, Morocco in November, 2016.

This work will be underpinned by ongoing efforts to create an up-to-date and comprehensive Essential Climate Variable Inventory that identifies data gaps and opportunities for improvement along the climate information value chain, as well as efforts to communicate progress of the satellite coordination community within the United Nations system and more broadly.

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

2016-2018: CEOS Agencies will continue to cooperate with GEO, GCOS, WMO, and CGMS 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).

This coordination will be supported by the development and promotion of 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

2017: Following on from successful delivery of the first inventory of Essential Climate Variables completed in 2015, the Joint CEOS/CGMS WGClimate will complete a second iteration during 2017.

This will involve: collating updated information from data providers on Climate Data Record holdings; incorporating updated information in the ECV Inventory; quality control to verify completeness and consistency of the ECV Inventory contents, as well as to critically analyze the relevance of the various records; generating a coordinated action plan to address gaps/opportunities; and communicating the results on completion of the cycle. A key element of the work will be reviewing 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*.

Building on lessons learnt from the first iteration, this iteration will focus on achieving buy-in from Climate Data Record programme managers and will employ a strictly limited time window for updates by record providers.

This activity will be complemented by hosting of a computerised ECV inventory and development of further ECV inventory capabilities. The ECV Inventory will be located on the Joint CEOS/CGMS WGClimate web presence to ensure accessibility.

2018-2019: Following completion of a full update cycle during 2016-2017, another update cycle will commence, aimed at further improving the currency, quality and completeness of available information. This cycle will build on lessons learned from the 2016-2017 cycle, and is expected to take into consideration the new GCOS-IP.

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

2017-2019: The Joint CEOS/CGMS WGClimate ensures the planning and development of 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 2017-2019, including:

- developing a comprehensive space agency response to the GCOS Implementation Plan 2016 for report at UNFCCC COP-23 in November 2017.
- providing, on request, updates on progress in implementation of the Architecture for Climate Monitoring from Space to both GCOS and SBSTA.

Climate Monitoring, Research, and Services Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
Information dissemination and communication			
CMRS-12: Establishment of a WGClimate website	Q3 2017	The website will provide the single authoritative location for Joint CEOS/CGMS WGClimate-related information including the Climate Monitoring Architecture definition and the ECV Inventory, and will be used as the working area for members from both CGMS and CEOS. This will include development of enhanced tools to increase the efficiency and utility of the ECV Inventory.	WGClimate

Climate Monitoring, Research, and Services Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
CMRS-13: Development and Promotion of Case Studies	Q3 2017	Previous work, supervised by the EC JRC and WMO, has already produced WMO 1192 *Case Studies for Establishing an Architecture for Climate Monitoring from Space*. The possibility exists for further involvement by an expanded team. The output of previous and potential future work is to be supported by the dedicated Joint CEOS/CGMS WGClimate website.	WGClimate
Delivery of a second iteration of the Essential Climate Variable Inventory			
CMRS-14: Collection, incorporation, and quality control of new & updated information from data providers	Q1 2017	For the purposes of this iteration, the set of questionnaires using for data collection during the first iteration will be re-used. The announcement of the process to request updates to the inventory records was made at the 29th CEOS Plenary Meeting.	WGClimate
CMRS-15: Gap analysis	Q2 2017	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 ESA and USGS.	WGClimate
CMRS-16: Action plan	Q4 2017	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 31st CEOS Plenary Meeting.	WGClimate
Delivery of a third iteration of the Essential Climate Variable inventory			
CMRS-17: Collection, incorporation, and quality control of new & updated information from data providers	Q3 2018	It is expected that the third iteration will enhance the questionnaire, and potentially the inventory structure, to accommodate for example: The 2016 GCOS IP; any requirements stemming from C3S; and experiences from applicable projects.	WGClimate
CMRS-20: Gap analysis	Q1 2019	Several teams will perform the cycle 3 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 undertaken in a coordinated manner.	WGClimate
CMRS-21: Action plan	Q4 2019	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 a suitable meeting.	WGClimate

Climate Monitoring, Research, and Services Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
Engagement with GCOS			
CMRS-19: Joint CEOS/CGMS response to the new GCOS IP	Q4 2017	The GCOS IP 2016 includes information on observation requirements that requires a response from space agencies. Reflecting the partnership, this document will be developed jointly by CEOS and CGMS. UNFCCC SBSTA encouraged CEOS to submit its comprehensive space agency response to the GCOS IP 2016 at SBSTA 47 during COP-23 in November 2017.	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).

2017: 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 2017, 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 continue to work to update the strategy to reflect new data stream availability.

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. 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 and Moderate Resolution Interoperability, with regular reports to be provided.

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

2018-2019: 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

2017: 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 30th 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 2017-2018 period.

2018-2019: CEOS will approach implementation of the strategy opportunistically: identifying opportunities to leverage CEOS Agency priorities and interests to establish concrete activities that progress the identified actions.

Carbon Observations, Including Forested Regions Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
CARB-4: CEOS delivery of coordinated land surface observations for GFOI countries	Q2 2017	CEOS will acquire coordinated land surface observations for GFOI countries in accordance with the endorsed strategies.	SDCG for GFOI
CARB-5: Updated *Global Baseline Data Acquisition Strategy for GFOI*, *Space Data Services Strategy for GFOI*, and *Strategy for Satellite Data in support of GFOI R&D*	Q4 2017	Element-1 (baseline data acquisition strategy), Element-2 (data services) and Element-3 (R&D) will require annual updates to reflect changes in space data assets and national implementation plans. It is expected that GFOI will reach full operational capability after 2017.	SDCG for GFOI
CARB-12: 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
CARB-13: Assessment of Terrestrial Carbon Strategy variables	Q4 2017	In support of the CEOS Carbon Strategy, LSI-VC will analyze validated land carbon observation requirements and identify the gaps in and opportunities for optimization across CEOS Agency missions. This work will leverage GEOGLAM requirements 'matrix' as a framework. A status report will be provided at the 2017 SIT Technical Workshop.	LSI-VC

Carbon Observations, Including Forested Regions Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
CARB-14: Extraction of ECV gap-analysis outcomes for carbon-relevant ECVs	Q4 2017	Analyze the output of the WGClimate ECV Gap Analysis for those variables where there is overlap with those identified is the CEOS Carbon Strategy, i.e. a meta gap analysis for carbon relevant ECVs	WGClimate
CARB-15: Carbon data portal	Q4 2017	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 and services to the carbon science community of both CEOS and GEOSS.	WGISS
CARB-16: 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
CARB-17: Engaging with IPCC inventories and promoting satellite EO	Q4 2019	The *2006 IPCC Guidelines for National GHG Inventories* 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. 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.	JAXA
CARB-18: 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)
CARB-19: Land products validation listing and framework	Q4 2017	Summarize current list of validated land data products relevant to Carbon Strategy, documenting validation framework and protocols and providing guidance for online platform for intercomparison of terrestrial carbon products.	WGCV

3.3 Observations for Agriculture

I. Develop and implement a data acquisition strategy to provide satellite observations that will facilitate the monitoring of agricultural production in support of the GEO Global Agricultural Monitoring (GEOGLAM) initiative.

2017: 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. Through the CEOS Ad Hoc Working Group on GEOGLAM, CEOS has developed, and continues to coordinate the implementation of, strategies for the provision of satellite observations to GEOGLAM. GEOGLAM is a system of systems, and components of it are already in the operational phase, including both contributing activities/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 29th 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. This strategy, together with the CEOS Ad Hoc Working Group's Scope of Work document, will continue to guide the work of the CEOS Ad Hoc Working Group on GEOGLAM in 2017 and will be updated as necessary.

In 2017, the GEOGLAM Secretariat is leading 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. Accordingly, in 2017, a more significant update of the Strategic Response is expected.

In addition to its work implementing the endorsed strategy, the CEOS Ad Hoc Working Group on GEOGLAM will continue working with GEOGLAM to define their space data requirements, 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 activities: Asia-RiCE, GEOGLAM Latinoamérica (launched in 2015), and AfriGAM (launched in 2016). While the latter two regional networks are still in foundational stages for 2017, Asia-RiCE is in a mature state and as such its team's requirements as well as those of the Rangelands and Pasture Productivity initiative (RAPP) will be updated. 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 upscale target area from one province to 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.

2018-2019: 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 sampling strategies, and continuing to investigate methods for data management and distribution. The CEOS Ad Hoc Working Group on GEOGLAM will further update the *CEOS Strategic Response to GEOGLAM Requirements* as well as the *CEOS Ad Hoc WG for GEOGLAM Scope of Work Document* to reflect the expansion of effort and changes to data supply arrangements.

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

2017: 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 2017, 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: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
AGRI-4: *CEOS Strategic Response to GEOGLAM Requirements*	Annually Q4	The *CEOS Strategic Response to GEOGLAM Requirements* identifies how CEOS Agencies will coordinate their relevant Earth observing satellite systems to acquire data to support information requirements arising from GEOGLAM. Annual updates to this document 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 the Rangelands (RAPP) project and upscaling of SAR coverage in support of Asia-RiCE (eventual goal: national coverage). An interim report of the updated strategy will be presented at the annual SIT meeting. The final updated strategy will be presented for endorsement at the annual CEOS Plenary Meeting.	CEOS Ad Hoc Working Group on GEOGLAM
AGRI-8: Vietnam Data Services Prototype	Q3 2017	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
AGRI-9: RAPP (Rangelands) Data Cube Demonstrations and Application Testing	Q4 2017	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 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.

2017: Thematic Pilots: CEOS Agencies, through the Working Group on Disasters (WGDisasters), will continue to respond to the three Disaster Risk Management (DRM) pilots defined in the 2013 *CEOS Disaster Risk Management Observation Strategy*: floods, seismic hazards, and volcanoes. WGDisasters will also continue to implement a fourth pilot, on Landslides, as endorsed at the 29th CEOS Plenary Meeting.

Specific Earth Observation (EO) requirements have been identified for each pilot, in close cooperation with representatives from the user communities (stakeholders, scientists, civil protection organizations, local authorities, resources management national authorities, etc.). Through WGDisasters, CEOS Agencies will provide data for other entities to develop new end products and services to better deliver flood-related information (floods), map active faults at global scale (seismic hazards), operationally monitor potentially active volcanoes (volcanoes), and detect, map and monitor landslides in different physiographic and climatic regions (landslides).

WGDisasters will also finalize reports describing follow-on actions recommended once the initial term of the thematic pilots concludes in 2017 for consideration by Plenary. The multi-hazard landslide pilot will have only begun in 2016 and will have only preliminary follow-on actions recommended in the report.

Both the seismic hazard and volcanoes pilots also have regional and local objectives that are directly related to the ongoing Geohazard Supersites and Natural Laboratories GEO initiative (see 3.4, section III).

Recovery Observatory: 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 demonstration over a three to four-year period. The main objective of the Recovery Observatory is to work with reconstruction professionals to develop the use of Earth Observation in the reconstruction phase after a major disaster. This will involve: working closely with the reconstruction community consisting of both local and international stakeholders to determine where EO data can make a difference; making data available; and developing required information products.

An information system infrastructure that will support the Recovery Observatory has been implemented through a joint WGISS and WGDisasters activity. Following triggering, the project team was constituted, composed of local and international stakeholders and space agencies lead by Global Facility for Disaster Reduction and Recovery (GFDRR) and CNES.

2018-2019: CEOS will implement the follow-on actions agreed in relation to the Pilots at the 31st CEOS Plenary Meeting.

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.

2017: A Concept Phase will focus on the identification of regional priorities. This phase will select the regions to start with and the regional Institutions (ideally 2 or 3 per region) with whom to partner. The role of space agencies will be to assess those regional priorities at high level to see whether satellite EO could contribute, and define a series of projects that could 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. A GEO-DARMA Kick-off workshop is scheduled for March 2017 to review possible paths forward for the project, and a Concept Workshop planned during the May 2017 Global Platform Meeting will finalize the content of the first GEO-DARMA projects.

2018-2019: A Prototyping ('pilot') Phase will be implemented based on the results of the Concept phase. The Pilot projects to be implemented will depend on the regional priorities identified. 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.

2017: The GEO Geohazards Supersites and Natural Laboratories (GSNL) Initiative aims to improve our knowledge of geophysical processes posing geohazards, with an initial focus on earthquakes and volcanoes. The effort is led by a global partnership of scientists and satellite (SAR and optical) and in situ (seismic, geologic, geodetic, etc.) data providers, and is compiling comprehensive data sets for selected sites affected by high hazard levels. The much improved data availability, the openly shared research products, and the local coordination by scientific institutions directly involved in DRR activities all ensure that the new scientific results obtained by the global scientific community are rapidly taken up by the risk management community, effectively satisfying the CEOS and GEO objectives for improved societal benefit of Earth observation.

CEOS has officially endorsed Hawaii, Iceland, Turkey (Marmara Sea/North Anatolian Fault Zone), Italy (Mt. Etna Volcano and Mt. Vesuvius/Campi Flegreii), New Zealand, Central Greece (Gulf of Corinth) and Ecuador (Cotopaxi, Tungurahua volcanoes) to receive coordinated space-based EO data acquisitions. A key priority for 2017 will be ensuring the data needs for these permanent supersites are met. The WGDisasters 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 assessment, will provide the related satellite data to the Supersites scientific teams.

WGDisasters will continue to convene discussions between CEOS Agencies on the potential to support a Natural Laboratory in South-East Asia. Support to the proposed San Andreas Fault (USA) Natural Laboratory will be reviewed.

The WGDisasters will continue to operate and develop the Data Coordination Team, which supports other activities, including the GSNL, by providing a single point of contact through which to request and access data from space agencies.

2018-2019: In complement to—or as part of—the current CEOS DRM Pilots related to the GSNL initiative, CEOS Agencies will also regularly monitor the use of space data by the scientific community involved in GSNL and will assess the potential extension of the number of sites supported by CEOS Agencies. Event Supersites, which are agreed and supported for a limited time immediately following a major disaster, will be considered and supported as approved during this time frame.

Observations for Disasters Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
DIS-10: Implementation of Data Acquisition Plan in support to DRM pilots and data coordination for GNSL supersites	Q4 2019	Potential proposals for new GSNL activities (i.e. new permanent & 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 following the procedures endorsed by CEOS. The status of implementation of the plan, and of the pilots and supersites being supported, will be reported at CEOS SIT and Plenary meetings.	WGDisasters
DIS-12: Report on survey of donors for post-2017 operation of a Recovery Observatory	Q2 2018	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 2017 onwards. The survey will commence nine months after the triggering of the Recovery Observatory. The findings of this survey will be presented in a lessons learned report to SIT in 2018 to enable timely consideration by CEOS Agencies.	WGDisasters
DIS-13: Report on follow-on actions to DRM Pilots	Q4 2017	The DRM Pilots are expected to provide important insights into where, and how, Earth observations from space can support the disaster risk reduction community. A report will be prepared to summarize the learnings from these pilots, and to recommend pathways forward. In particular the report will focus on the elements necessary to the sustainability of operational solutions post 2017.	WGDisasters
DIS-15: Support for GEO-DARMA identification of major hazards and DRR issues for each selected region	Q2 2018	GEO-DARMA will seek independent identification of disaster risk management priorities at regional level (e.g. most prevalent hazards and most severe impact; hurdles in implementing effective DRR and resilience measures in the region) by authoritative regional institutions, in line with the priorities from the *Sendai Framework for Disaster Risk Reduction 2015-2030*. 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.	WGDisasters

3.5 Observations for Water

I. Implement the CEOS Strategy for Water Observations from Space

2017-2019: 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 29th 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: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
WAT-3: Feasibility study on satellite missions/instruments focused on water quality measurements	Q2 2017	This study will assess the benefits and technological difficulties of designing a hyperspectral satellite mission focused on inland, estuarine, deltaic and near coastal waters. It will also examine the potential of establishing threshold and baseline observation requirements for sensors suitable for water quality applications.	CSIRO and DLR
WAT-4: Updates on implementation of the CEOS Strategy for Water Observations from Space, including consideration of required adjustments based on activity in GEO	Ongoing	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
WAT-6: Response to satellite-related aspects of the GEO AquaWatch Initiative Implementation Plan	Q4 2017	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

In 2016, CEOS completed an interim report that highlighted the significant opportunities presented by new and emerging approaches to exploitation of satellite data: the so-called "future data architectures" (FDA).

In 2017, CEOS will engage with this theme in more detail across a number of threads, with the objective of an in-depth discussion at the 31st CEOS Plenary Meeting to develop an agreed forward strategy for CEOS to capitalize on these opportunities.

CEOS will also start to embed follow-on activity, primarily aimed at supporting Agencies to share lessons learned and discuss best practices in these areas, into existing structures.

Coordination across activities will be managed by the CEOS Chair (USGS), with responsibility for specific activities being identified in the following table.

I. Preparing to discuss the strategic dimensions of 'FDA'.

2017: Through an extended and more strategically focused Ad Hoc Team on Future Data Architectures, material will be prepared to enable CEOS to discuss how Agencies wish to work together to capitalize on the opportunities presented by future data architectures.

The extended Ad Hoc Team on Future Data Architectures will be co-lead by ESA, USGS and 2016 CEOS Chair CSIRO.

The Ad Hoc Team will work to frame a discussion that enables CEOS Agencies to consider:

- Areas in which CEOS Agencies wish to work together in a close collaboration to, for example, develop integrated CEOS-branded tools for users, or coordinate implementation of common protocols.
- Topics on which CEOS Agencies wish to focus on information sharing and exchange of best practices, with implementation taken forward at an agency or bi-lateral partnership level.
- What opportunities are seen a matter for CEOS Agencies to progress independently, for example because they will not benefit from coordination.

II. Learning by doing - through pilot projects.

2017: Pilot projects will be undertaken to ensure the discussions on the strategic dimensions of FDA are informed by practical evidence, including evidence of how practical it is for CEOS Agencies to work together on technical activities in this area.

The criteria for FDA pilot projects are:

- Clear governance and resourcing.
- User feedback and engagement are incorporated.
- Lessons learned will be relevant to FDA themes, and inform strategic discussions.

- Multiple agencies are engaged, e.g. through:
  - The data that is being used; and/or
  - Contributions to development; and/or
  - Engagement in implementation.

At the time of endorsement of the *CEOS Work Plan 2017-2019*, the CEOS Data Cube activity and the Geohazards Exploitation Platform were accepted as the first FDA pilot projects.

The open source CEOS Data Cube approach, leveraging Analysis-Ready Data, lowers technical barriers to the utilization of satellite data for developed and developing nations in support of many application areas.

The CEOS Data Cube activity will be supported by LSI-VC, in collaboration with WGCV, providing sample Analysis-Ready Data to support trial implementations of the CEOS Data Cube technology.

Additional activities may be proposed as pilot projects under the Future Data Architectures theme at any time, subject to them meeting the above criteria, and according to suitable CEOS governance and process requirements.

III. Supporting CEOS Agencies to benefit from future data architectures.

2017-2019: Existing CEOS Entities will take forward streams of technical work to enable CEOS Agencies to share learnings and support each other to benefit from the opportunities future data architectures within their own internal activities.

Future Data Architectures Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
Preparing to discuss the strategic dimensions of 'FDA'.			

Future Data Architectures Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
FDA-1: Papers and workshops to facilitate strategic discussion of the way forward on future data architectures	Q4 2017 (updates at SIT-32 and SIT Tech Workshop 2017)	In 2017, the extended Ad Hoc Team on Future Data Architectures will develop the necessary material to enable CEOS Agencies to discuss, and agree on, the way forward on the FDA topic at the 31st CEOS Plenary Meeting. Interim discussions/workshops will be undertaken at the SIT-32 meeting and 2017 SIT Technical Workshop to ensure CEOS Agencies are engaged throughout 2017.	FDA AHT
Learning by doing - through pilot projects			
FDA-2: Collaborative development of CEOS Data Cube technology	Ongoing	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.	SEO (with GA, CSIRO and USGS)
FDA-3: CEOS Data Cube technology governance strategy	Q2 2017	A governance strategy will be developed aimed at supporting the CEOS Data Cube to become an inclusive, collaborative, open source project including encouraging contributions from additional CEOS Agencies (e.g. to include data from their missions) and inviting contributions from the broader EO community (e.g. to contribute tools and applications) via GEO.	SEO (with GA, CSIRO, USGS and ESA)
FDA-4: Regional pilot installations of the CEOS Data Cube technology	Q4 2017 (Interim reports)	Regional pilots will generate lessons learnt on how the CEOS Data Cube technology performs in particular contexts (for example High Performance Computing vs cloud, sophisticated vs new users). Where possible, regional pilots will provide evidence of potential value towards GEO strategic priorities (e.g. GEO Flagships/Initiatives). Pilot installations will include: a pilot in Colombia focused on uptake of GFOI outputs (SEO+CSIRO); a project in Australia focused on the nation's largest food-bowl - the Murray-Darling Basin (GA); a project in Vietnam focused on rice monitoring (CSIRO); a project in the United States (USGS); and a project in Switzerland (SEO). Through production/provision of datasets in support of the pilots, LSI-VC will gather evidence on the technical challenges associated with the CEOS Analysis Ready Data For Land (CARD4L) initiative. Where possible, capacity development capabilities will be leveraged through WGCapD.	SEO (coord.) Regional pilot leads (NASA SEO, CSIRO, GA, …) Support from LSI-VC and WGCapD

Future Data Architectures Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
FDA-5: Promote awareness of the CEOS Data Cube technology	Q4 2017 (Interim reports)	With growing interest in the CEOS Data Cube technology, WGCapD will identify required CB material to support rollout of the technology. Materials will range from basic introductions to information relevant to decision makers.	WGCapD
Supporting CEOS Agencies to benefit from future data architectures			
FDA-6: Technical best practices relating to future data architectures opportunities	Q4 2017	WGISS will ensure necessary structures are established to enable sharing of lessons learned and practices relating to the exploitation of the technical opportunities identified in the interim FDA report. WGISS will present at least one 'best practice' document for endorsement at the 31st CEOS Plenary Meeting.	WGISS
FDA-7: Product Specifications in accordance with the CARD4L Framework	Q4 2017	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 commence development of the first concrete specifications for CARD4L-branded products, with at least two such specification documents presented for endorsement at the 31st CEOS Plenary Meeting. Draft versions of these specifications will be used to inform LSI-VC contributions to **FDA-4**.	LSI-VC (with WGCV)

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 will collaborate with UNOOSA, UNESCAP and other UN agencies in bringing out the benefits of EO tools and services; and helping to collect, coordinate, and synergize capacity building resources.

2017-2019: WGCapD has a variety of training and capacity building activities planned, 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.

Specifically, WGCapD will continue delivering SAR training workshops for users in developing countries on data access, awareness, processing, and applications. Two workshops are currently planned for 2017: one in Gabon (February) and one in South Africa (May). WGCapD also plans to develop and/or deliver advanced, application-focused webinars on various other topics.

Recognizing a global need for the collection and coordination of disparate capacity building resources to synergize training resources and increase user awareness of and access to those resources, WGCapD plans to explore methods and tools that (and resources required to) address that need in the most manageable and sustainable way.

In support of broader capacity building and training activities led/organized by the other CEOS Working Groups and Virtual Constellations, WGCapD will draw upon its collective training and capacity building experiences to develop a best practices checklist for both in-person and online training programs that they can use for guidance.

Further, WGCapD plans to collaborate with GEO to strengthen AmeriGEOSS, AfriGEOSS, and Asia-Oceania GEOSS (AO GEOSS) by continuing its contributions to training topics for AmeriGEOSS Week, similar to the Remote Sensing (Optical and Radar) for Disaster Response training offered in 2016, and the SAR trainings that contribute to AfriGEOSS objectives. Potential training contributions to AO GEOSS will be explored.

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

2017: 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.

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 impacting CEOS Agencies, with the aim of preparing CEOS and CEOS Agencies for the future.

2018-2019: 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)*, which will make CWIC and FedEO accessible from external clients such as the GCI. WGISS will also ensure that the IDN will be used as a 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.

2017-2019: 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.

WGCV will maintain the CEOS Cal/Val portal, including the activities of its sub-groups, to provide users with information about achievements in calibration and validation, including the Cal/Val supersites, and to share results from recent efforts that impact interoperability.

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.

2017: WGCV will strengthen its cooperation with GSICS in the topic of sensor calibration by continuing to identify opportunities for cooperation. The working-level framework established between the two to address corrections for sensor differences and traceability will be used to coordinate activities to address interoperability.

2018-2019: WGCV will continue working with the GEO Secretariat, including work to support relevant GEO activities, mainly by extending leadership in Quality Assurance for Earth Observations (QA4EO) to encourage widespread adoption of QA4EO Principles within current and future CEOS activities. WGCV will address the needs of science users and data product providers, by considering the needs of the Atmosphere, Terrestrial, and Ocean communities. The development of calibration infrastructure and comparison campaigns within the frame of WGCV will be used to promote the adoption of QA4EO 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.

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

2017-2019: 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 2017, the ESA CEOS 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.

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
CB-4: Contribute to Capacity Building Portal (GEOCaB Portal)	Ongoing	Populate the GEO Capacity Building Portal. This portal aims at increasing the awareness of the Capacity Building Inventory across CEOS and GEO. See GEONetCab site at http://www.geocab.org/).	WGCapD
CB-10: CEOS Database update survey and release of online version	Survey Q2, release Q4	CEOS Agencies provide resources to support their responses to the update survey issued in the April-May timeframe; release of the updated CEOS Database will be online prior to the annual CEOS Plenary Meeting.	ESA, with support from CEOS Agencies
CB-11: Build awareness and demonstrate the value of EO applications through major conferences	Ongoing	WGCapD members will target major Earth observation and other relevant conferences and workshops, engaging and providing training sessions for academic and other user communities. For example, WGCapD will actively participate in the Public Health and EO Workshop to be held in Montreal in June 2017. This will help clarify the linkage between environment, climate, society and public health and EO data.	WGCapD
CB-12: Build awareness of new CEOS missions and datasets	Ongoing	Within the context of support to CEOS/GEO projects, using webinars, the CEOS Website, newsletters, mailing list server, social media, etc. to improve access to new CEOS Agency missions and datasets.	WGCapD
CB-13: Develop and/or deliver webinars for users in developing countries	Ongoing	Webinars will provide information and training on advanced satellite Earth observation topics, such as data access/availability, data processing, and more. A SAR webinar is planned for Q3/Q4 2017.	WGCapD

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
CB-15: Updated good practices guidance document for in-person and online training and capacity building	Q2 2017	The WGCapD developed a good practices guidance document highlighting key points, areas of consideration, suggestions, and good practices for online and in-person capacity building meant as a resource for other CEOS Working Groups and Virtual Constellations. The WGCapD plans to add more content to this report.	WGCapD
CB-17: SAR Training Workshops	Q2 2017	The WGCapD will deliver two SAR Training Workshops in 2017: one in Gabon (February, 2017) and one in Pretoria (May, 2017). The WGCapD plans to continue providing SAR workshops (on data access, awareness, processing, and applications) to users in developing countries as long as CEOS Agencies continue to release more SAR data.	WGCapD
CB-19: Promote the role of space-based EO in meeting the challenges of the *2030 Agenda for Sustainable Development*	Ongoing	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
CB-20 Provide CB support to regional and thematic GEO initiatives	Ongoing	Includes ongoing support to AfriGEOSS, additional support to AmeriGEOSS and engagement with Asia-Oceania (AO) GEOSS initiative. This would also include other GEO initiatives e.g. with WMO, CGMS, and WGClimate on essential climate variables (ECVs) and with the CEOS Ad Hoc Working Group on GEOGLAM.	WGCapD
CB-21: Explore future options for providing portal-based access to capacity building and training resources	Q4 2017	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
CB-22: Provide capacity building support to WGCV activities	Q2 2018	Collaborate with WGCV to develop materials to promote e.g. QA4EO, LandNet, optical and SAR calibration/validation. The 2017 meeting of the WGCapD will be a key event in defining specific priorities.	WGCapD with WGCV
DATA-2: Full representation of CEOS Agency datasets in the IDN and accessible via supported WGISS standards	Ongoing	As the IDN contains OpenSearch endpoints for data access and is also the link with GCI, it is essential that all CEOS Agencies keep information on the data up-to-date in the IDN.	WGISS

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
DATA-8: Improve WGISS Interoperability Standards Architecture	Q3 2017	Consolidation of current CWIC/FedEO/IDN overall architecture to address identified issues including duplicate datasets holdings	WGISS
DATA-9: ECVs/CDRs Discovery and Access through WGISS Systems	Q3 2017	Facilitate discoverability and accessibility of ECV Products and space-born CDRs relevant for the CEOS Carbon Action via WGISS Interoperability Systems & Standards (FedEO/CWIC/IDN, OpenSearch).	WGISS
DATA-10: Reference model for data stewardship planning and implementation	Q4 2017	Consolidate a reference model that provides guidelines and recommendations for the preservation and improvement of data including a roadmap for scientific data stewardship improvement;	WGISS
DATA-11: Technology Exploration webinars and workshops	Ongoing	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 software technologies, services and other Internet-related software technologies.	WGISS
DATA-12: CEOS data holdings reported in GEO	Ongoing	Provide support to GEO in their efforts of reconciling metrics of CEOS data holdings provided through WGISS interoperable standards and systems.	WGISS
CV-1: Update of general WGCV website to enhance better communication across CEOS and users	Q3 2017	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
CV-3: Workshop on state of the art for pre-flight calibration techniques	Q4 2017	Hold an open-invitation workshop to discuss and promote best practices on pre-flight and onboard calibration of sensors, initially focusing on optical.	WGCV
CV-9: Radiometric Calibration Network (RADCALNET)	Q4 2017	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
CV-13: 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

Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
CV-14: 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 masking in EO applications.	WGCV
CV-15: L1 top-of-atmosphere interoperability	Q4 2017	Develop an initial recommendation of a community reference in collaboration with GSICS.	WGCV
CV-16: 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

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.

2017-2019: 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: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
VC-2: Total ozone dataset validation and harmonization	Q4 2017	Production of peer-reviewed papers on nadir profile intercomparisons and of long term (1979-now) combined total ozone data sets.	AC-VC
VC-3: Air quality constellation coordination	Q2 2017	Prepare document on validation needs for the AQ Constellation.	AC-VC

Advancement of the CEOS Virtual Constellations: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
VC-9: 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 (www.ioccg.org/groups/INSITU-OCR_White-Paper.pdf) and establishment of the INSITU-OCR Secretariat (EUMETSAT, NASA and NOAA). Implementation is following a modular approach.	OCR-VC (with EUMETSAT, NASA and NOAA)
VC-14: Vision for an OSVW Constellation	Q4 2017	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 next IOVWST meeting to be held in Q2 2017.	OSVW-VC
VC-15: 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
VC-17: Support to ECV precipitation parameters	Q4 2017	Precipitation ECV support: Provide the CEOS Response to GCOS Action A-8; ensure continuity of satellite precipitation products through five deliverables.	P-VC
VC-18: Programs for improvement of global precipitation products	Q4 2017	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.	P-VC

Advancement of the CEOS Virtual Constellations: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
VC-19: Documented plan for the SST Virtual Constellation	Q2 2017	Building on Donlon, et al (2010) *Successes and Challenges for the Modern Sea Surface Temperature Observing System,* 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
VC-26: Pilot approaches to conducting integrated assessments of gaps/opportunities in asset usage	Q4 2017	The LSI-VC will, building on the work for land carbon, work towards establishing suitable approaches for analyzing multiple sets of domain-specific requirements and identifying gaps/opportunities for optimization. A joint session of LSI-VC, SDCG for GFOI and the CEOS Ad Hoc Working Group on GEOGLAM will be scheduled for Q3 2017 to progress discussions on this topic.	LSI-VC and SEO with Ad Hoc Teams for GFOI and GEOGLAM
VC-27: Develop a roadmap for the routine production of intercomparable CARD4L	Q4 2018	Building on agreed specifications of CARD4L products, LSI-VC will develop a roadmap for how interested CEOS Agency missions and programs can start processing land surface imaging data with geometrically and radiometrically intercomparable surface reflectance, surface temperature, and analogous radar products.	LSI-VC with WGCV
VC-29: Framework for moderate resolution land sensor interoperability	Q2 2018	Increasing numbers of users are interested in the development of product pipelines that are not completely dependent on the characteristics of a single sensor, when a number of different sensors may be able to provide data that is fit for purpose. Interoperability, however, is challenging to define in a manner that enables such users to move beyond theory and in to practice. The framework to be developed will be generally applicable and address factors including radiometry, geometry, data formats, browse information, metadata, data access, metrics and reporting.	LSI-VC (with WGCV and WGISS)
VC-30: Interoperability case study for Landsat and Sentinel-2	Q4 2017	The framework for moderate resolution land sensor interoperability (refer **VC-29**) will be applied to the Landsat and Sentinel-2 missions.	LSI-VC (with WGCV)

3.9 Support to Other Key Stakeholder Initiatives

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

2017: CEOS Agencies will work, through an Ad-hoc Team on the Sustainable Development Goals (SDGs), to ensure the potential value of space-based EO data in support of the Sustainable Development Goals SDGs is maximized through the various SDG-related actions driven by GEO.

This will include:

- Developing Terms of Reference for the Team and a work plan to be presented at SIT-32.
- Coordinating input from CEOS Agencies to support the CEOS Representative on GEO Programme Board.
- Establishing the Ad Hoc Team as the liaison point between CEOS and the SDG-targeted GEO Initiative "Earth Observations in Service of the 2030 Agenda for Sustainable Development".
- Supporting CEOS Agencies to share experiences of engagement with stakeholders in relation to the Sustainable Development Goals, including best practices, lessons learned, etc.

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

- Support GEO in its SDG-related initiatives.
- Collect and centralize information from individual CEOS Agency work programmes relevant to SDGs.
- Promote space-based EO data as a key source of data for use by national statistic offices (NSOs) to monitor specific SDG indicators.
- 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.

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

2017: As multi-sensor oceanographic satellite observations continue to be successfully transitioned from research into routine and sustained operations (supporting a diverse suite of research, applications and services) there are significant opportunities to support the components and associated priority actions identified in the GEO Blue Planet Initiative. The Ocean Colour Radiometry, Ocean Surface Topography, Ocean Surface Vector Wind, and Sea Surface Temperature VCs will all play significant roles in the sustainment, continuation and harmonization of essential ocean variables to develop coordinated, multi-

sensor ocean products. Individual VCs will likewise continue to identify their own specific contributions to the various Blue Planet Components.

The proposed *CEOS Ocean Variables Enabling Research and Applications for GEO* (COVERAGE) initiative, as well as other associated data coordination and integration activities that coordinate across the ocean VCs, will offer substantial support to Blue Planet goals. Engagement between such CEOS activities and Blue Planet will be driven by the CEOS Blue Planet Expert through the Blue Planet Steering Committee.

In June 2017, the 3rd Blue Planet Symposium is scheduled to be held College Park, Maryland, USA, hosted by NOAA and the University of Maryland. CEOS and CEOS Agencies will have a key role in the planning and execution of the symposium. The symposium presents an opportunity to gather momentum from across the ocean observing community, and more broadly will also continue to enable and facilitate Blue Planet support for the SDGs.

III. **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.

IV. Further develop CEOS contributions to meet biodiversity observation requirements.

2017: The CEOS Biodiversity activity will continue to work closely with the GEO Biodiversity Observation Network (GEO BON) to foster the development of remotely sensed Essential Biodiversity Variables (EBVs). Over the past year NASA and ESA released competitive calls for proposals to solicit community research on the definition and development of remotely sensed EBVs. These efforts build on existing observational products from CEOS Agencies and selections will take place in 2017. GEO BON reorganized in 2016, and several of the new working groups (particularly Ecosystem Structure and Ecosystem Function) are actively working to define remotely sensed EBVs and identify the requirements.

2018-2019: The CEOS Biodiversity activity will continue to work with GEO BON and the broader community. The objective will be to create connectivity among the EBV projects to define common observational remote sensing requirements, work to vet these with the community, and communicate the requirements to space agencies. This is a gradual process that has both a technical as well as a social component.

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

2017: CEOS Agencies will maintain a dialogue with GEO, CGMS, and the World Meteorological Organization (WMO) on their respective interests and coordination initiatives relating to polar observations. Following a request from IOC at the CGMS Plenary, CEOS considered whether a specific CEOS body such as a Virtual Constellation for polar regions should be constituted, but concluded that the WMO Polar Space Task Group (PSTG) represents a competent body for the coordination of polar space observations. CEOS

Agencies will continue to interact with the PSTG 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, through their participation in PSTG, will also continue to support the SAR Coordination Working Group acquisition strategy over the polar regions; collaborate with the WMO Global Cryosphere Watch Programme, approved at the WMO congress in 2015; provide support to the Year of Polar Prediction (YOPP) with a specific focus to support the plans for a Drift Experiment (MOSAiC); and continue to nurture the relationship with the GEO Cold Region Initiative and the U.S. White House Arctic Science Initiative as important high-level activities underway in 2017.

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.

VI. CEOS Ocean Variables Enabling Research and Applications for GEO

2017: 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.

The first phase of COVERAGE, spanning 2017, will focus on important preliminary arrangements, including assembly of the execution team and advisory board, and the establishment of the collaborative framework for stakeholder participation (COV-1). This phase will also involve the compilation of use cases and functional requirements for the COVERAGE system based on priority set of community driven applications, derived through a process of ongoing stakeholder engagement (COV-2).

2018-2019: A detailed COVERAGE project implementation plan and schedule will be formulated within the first quarter of 2018 (COV-3). Associated technical work will involve development of a system architectural design, which will include specifications of source data streams and interfaces.

The second phase of COVERAGE (1 year duration) 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 feedback will integral to this and subsequent phases of the project.

The third phase of the COVERAGE project will commence within 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.

Support to Other Key Stakeholder Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
SDG-1: CEOS engagement with the *2030 Agenda for Sustainable Development*	Q4 2017	The CEOS Ad Hoc Team on Sustainable Development Goals, established at the 30th CEOS Plenary Meeting, will act as a single point of contact between CEOS Agencies and various GEO-led activities relevant to the Sustainable Development Goal (SDG) agenda. This will include efforts by the GEO Programme Board to promote alignment of the GEO Work Programme with the SDGs, as well as efforts to engage statistical agencies, and connect with UN and national processes. The Ad Hoc Team will present a draft Work Plan along with Terms of Reference for discussion at the CEOS SIT-32 meeting in Paris. The Ad Hoc Team will present recommendations on how CEOS engagement with the SDG agenda should be managed beyond 2017, for discussion at the 31st CEOS Plenary Meeting.	AHT SDG
BP-1: Development, compilation and distribution of ocean variables into collocated, synergistic datasets and associated work packages supporting Blue Planet services	Q3 2018	Leveraging suitable activities, such as the proposed COVERAGE initiative, there will be coordinated development, compilation and distribution of ocean variables and facilitated access to collocated, synergistic datasets with fit-for-purpose latency, quality, coverage and information content. The four ocean VCs (in coordination with Blue Planet Steering Committee) will support the sustainment, continuation, and harmonization of (essential) physical, biological and biogeochemical ocean variables.	CEOS Blue Planet Expert (NOAA) with NASA and Ocean VCs

Support to Other Key Stakeholder Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
BP-2: Support the 3rd Blue Planet Symposium	Q2 2017	CEOS will support and coordinate activities for the 3rd Blue Planet Symposium, which comes at an important time in the early stages of the second decade of GEO.	CEOS Blue Planet Expert (NOAA) with NOAA and CSIRO
BP-3: Paper on CEOS involvement in Blue Planet governance structures	Q2 2017	A brief position paper will be delivered for SIT-32 to help coordinate and decide upon appropriate long-term CEOS representation in Blue Planet governance structures (Advisory Board et al.)	CEOS Blue Planet Expert (NOAA)
BP-4: CEOS Action Plan for GEO Blue Planet Initiative Components Implementation Plan	Q4 2017	Building upon the GEO Blue Planet Initiative Implementation Plan (September 2016) and the 3rd 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)
BON-4: Increase the visibility of remote sensing for biodiversity related applications	Ongoing	In September 2016, CEOS and GEO BON biodiversity experts held a knowledge café discussion at the IUCN World Conservation Congress that had over 10,000 attendees. The café presented the concept of EBVs to the conservation community and solicited feedback, with the final summary to be released in early 2017. There was an EBV session at the ESA Living Planet Symposium in May 2016, and a session will be organized at ISRSE in 2017. The Wiley journal "*Remote Sensing in Ecology and Conservation"* has a special issue on remotely sensed EBVs and includes a perspective from space agencies. The group will continue to initiate and participate in symposia to maintain a community base for biodiversity and conservation remote sensing, focusing on EBVs and exploring links to other CEOS activities.	CEOS Biodiversity Experts (DLR and NASA)
BON-5: Develop improved descriptions of candidate remotely sensed EBVs and their sub-variables	Q4 2017	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 EBVs and they will make recommendations to the broader biodiversity community.	CEOS Biodiversity Experts (DLR and NASA)
POL-1: Annual status report	Q4 2017	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)

Support to Other Key Stakeholder Objectives/Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
COV-1: Collaborative framework for COVERAGE	Q3 2017	Establish collaborative framework describing how CEOS Agencies, CEOS Entities and stakeholder groups intend to (VCs, GEO-MBON, GEO-Blue Planet) participate in COVERAGE	COVERAGE Lead (NASA)
COV-2: COVERAGE use cases & focal pilot application	Q4 2017	Determine priority application for COVERAGE via stakeholders engagement and compile use cases/requirements	COVERAGE Lead (NASA)
COV-3: COVERAGE Project Implementation Plan	Q1 2018	Develop detailed project implementation plan and schedule	COVERAGE Lead (NASA)
COV-4: COVERAGE Phase I prototype system	Q1 2019	Development of prototype COVERAGE system demonstrating core functionality for limited datasets	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.

2017-2019: 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 2017 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

2017-2019: 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.

2017-2019: CEOS, through contributions of JAXA, will continue the publication of this valuable, long-standing communication tool. It will be issued twice per year.

IV. Highlight the value of Earth observations from space in delivering societal benefit

2017: Building on the Applications report presented at the 29th CEOS Plenary Meeting, CEOS Agencies will continue to share their national approaches to EO data exploitation and build on their common interests all along the supply chain.

Outreach to Key Stakeholders: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
OUT-1: 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
OUT-2: 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

2017: 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 2017, CEOS Working Groups will complete this task.

Organizational Issues Deliverables: 2017-2019			
Objective/Deliverable	**Projected Completion Date**	**Background Information**	**Responsible CEOS Entity**
ORG-7: Refreshed Terms of Reference for Working Groups	Q4 2017	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-32.	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.

May 20, 2014

CEOS NEW INITIATIVES PROCESS PAPER

1 INTRODUCTION

This paper describes the process for consideration and approval of new initiatives for the Committee on Earth Observation Satellites (CEOS). Sustaining a balance of existing work, while considering the addition of new work, is essential to the relevance, sustainability, and success of the CEOS organization. CEOS must carefully consider proposed new initiatives in relation to the organization's ability to meet existing commitments, and especially existing commitments for which completion dates could be affected, and examine the capacity to accept new commitments. This paper will discuss a systematic approach for review and decisions regarding new initiatives that may arise from internal or external sources.

2 CRITERIA FOR CONSIDERATION OF NEW INITIATIVES

New initiatives must meet the following criteria, as defined in the *CEOS Governance and Processes* document:

(a) Alignment with CEOS strategic goals – New initiatives must align to the goals defined in the reference documents pertaining to the CEOS organization and its working level groups. For example, new initiatives shall align with the CEOS Strategic Guidance document, the CEOS Terms of Reference, and/or the Terms of Reference for any Working Group or Virtual Constellation. New initiatives, once approved, may be added to the relevant work plan, as needed.

(b) Benefit to internal and/or external stakeholders - Intended outcomes of the new initiative must have specific value to internal and/or external stakeholders (e.g., responding to stakeholder requirements). This value may not be monetary, but may be in the form of societal benefit.

(c) Feasibility and Affordability – CEOS Agencies must possess the necessary personnel and fiscal resources to support a new initiative so it can fulfill its intended outcomes. Commitments of key supporting Agencies are required to ensure success. In the case of new activities, CEOS must consider its current priorities and commitments.

The evident concern that CEOS may become overextended justifies more rigorous CEOS consideration of proposals. However, CEOS must be careful not to let its priorities become static and unresponsive to new internal or external developments. CEOS should also give consideration to the minimum number of CEOS Agencies that may be needed to successfully support a new activity, particularly if that proposed activity would not require a large number of CEOS Agencies in order to succeed.

If a proposal for CEOS support is aligned with CEOS and CEOS Agencies' priorities, meets CEOS Agencies' criteria for participation, and if these Agencies believe that CEOS provides a valuable focal point for their collaboration, then other members should not seek to prevent its adoption. In this way, CEOS can remain a dynamic and responsive organization, willing and able to change with the times. If a proposal for support would require major resources and multiple Agency

commitments in order to succeed, then broader Agency support commensurate with the magnitude of the proposed initiative, and thus a higher threshold for CEOS approval, is required. For a major new initiative, this threshold will require review at two CEOS high-level meetings (e.g., Plenary, SIT).

The key to successful proposal review and decision-making lies in a good understanding of required Agency participation and resource commitments, matched against overall CEOS priorities. Increases in scope should not fully occupy CEOS Agencies and their resources, and crowd out the ability for CEOS to entertain new ideas and proposals. The following sections of this paper define a process for approval through which CEOS may decide which proposals to accept and which proposals to reject.

3 CEOS SUPPORT TO NEW INITIATIVES

Proposals for new initiatives should be considered in terms of the types of support that is requested, and the ongoing relationship this support establishes with stakeholders. Questions such as the following should be considered at the start of every new initiative to understand the extent of support and interaction that may be required:

1. Is the new initiative clearly described with a sufficient level of detail, and in particular, does it contain well-formulated requirements on the CEOS Agencies?
2. What data/information products would CEOS generate in support of this initiative/task?
3. To whom is CEOS Agencies' data/information being provided?
4. When would products be made available?
5. How would data/information products be transmitted/provided?
6. Which CEOS Agencies are providing remote sensing data/information?
7. When and how is this data/information being provided?
8. What is the feedback from CEOS external users?

It should be emphasized that "CEOS support" may come in many shapes and sizes. On the one end of the spectrum, there are major initiatives involving a large number of CEOS Agencies, all supporting a global, resource-intensive, long-term task. These initiatives are often initiated at a high administrative level, and implemented in a "top-down" manner. Examples of these initiatives are the Global Forest Observation Initiative (GFOI) or development of an Essential Climate Variable (ECV) Inventory.

On the other end of the spectrum, are smaller-scale projects which involve a smaller number of CEOS Agencies, on shorter-term tasks, involving fewer resources. These actions are often initiated at the Agency-, Working Group-, Virtual Constellation-, or stakeholder-expert level, in more of a "bottom up" manner. Examples of these activities include: development of the Land Surface Imaging moderate resolution optical imaging guidelines, or the Atmospheric Composition Virtual Constellation gap assessment.

It is understood that many activities may fall somewhere in the middle, between these two extremes. As such, greater/lesser numbers of CEOS Agencies and resources would need to be considered on a case-by-case basis. But the same analysis of priority and criteria should be applied. Attention must be given to Agency commitments needed to begin a new initiative and to sustain it. Major new initiative proposals that establish a Working Group (WG) or Virtual Constellation (VC) may be required to include plans for leadership succession to ensure continuity.

4 PROCESS FOR APPROVAL OF NEW INITIATIVES

The external or internal entity proposing a new initiative should provide a written description of the activity to the CEOS Secretariat (SEC), which will act as a "clearinghouse" for proposals to CEOS (refer to Annexes 1 and 2). This written description should include a brief discussion of the new initiative and address in detail the elements needed to measure success, as defined in section 6 of the *CEOS Strategic Guidance* document. After analysis of the written description, the CEOS Secretariat will determine the next steps.

Each proposed new initiative must be sponsored or led by a CEOS entity. If the entity proposing the initiative is external to CEOS, the Secretariat will suggest a CEOS entity to sponsor the initiative. If the new initiative is proposed by a CEOS entity (e.g., a Working Group-WG, Virtual Constellation-VC, or CEOS Agency), then it is assumed that this CEOS entity will lead the proposed initiative. It is expected that new initiatives proposed to the CEOS Secretariat are significant in nature and require discussion and strategic evaluation by CEOS Principals. Decisions regarding new activities at the working level are made in forums such as WG or VC meetings. If approved, such new initiatives would become part of the *CEOS Work Plan* (updated annually). In addition, the new initiative may also become part of a WG Work Plan, a VC Work Plan or part of an Ad Hoc Team set of objectives.

The CEOS sponsor of a new initiative will prepare a presentation, in addition to the written activity description provided to the Secretariat, which will be sent to decision makers at least two weeks prior to the appropriate decision meeting. The CEOS sponsor will make a brief presentation on the proposed activity during the appropriate decision meeting. If the entity that proposed the new initiative is external to CEOS, that entity is not required to make a presentation, but their presence at the decision meeting should be encouraged, as an opportunity to answer any questions, thus facilitating a full and clear understanding of the proposal. Decisions should be made at appropriate meetings by the decision makers identified in Table 3-1 of the CEOS *Governance and Processes* document. Additional decision meetings (perhaps teleconferences) may also be arranged to ensure that relevant key decision makers have an opportunity to participate in the decision process.

Sufficient time should be reserved on the agenda of the meeting at which the decision will be made to discuss the proposed activity. This discussion should be led by the chair of the decision meeting and the CEOS sponsor and, if applicable, the external entity proposing the new activity. To ensure that sufficient emphasis is placed on decision making, meeting agendas should include a "decision-making session" to discuss all proposed decisions, or clearly highlight the agenda items that are "for decision" rather than "for information."

ANNEX 1: CHECKLIST FOR NEW INITIATIVES FOR CEOS CONSIDERATION

1. Is the proposed activity appropriate for CEOS, rather than for another existing coordination group or private sector organization/association? (Yes/No; if Yes, then continue)

2. Is the proposed activity closely aligned with CEOS priorities, as stated in the CEOS *Strategic Guidance* Document? (Yes/No; if Yes, then continue)

3. Is the proposed activity well-aligned with a sufficient number of individual CEOS Agencies' Earth Observation priorities? (Yes/No; if Yes, then continue)

4. Can a sufficient number of CEOS Agencies successfully respond based on their existing technical and financial resources? (Note: a "sufficient number" of CEOS Agencies could vary widely, based on the size and scope of the proposed activity.) (Yes/No; if Yes, then continue)

5. If Agencies have sufficient technical capacity and interest, are there additional policy considerations that would encourage or discourage their involvement – *e.g.*, overarching data policies or prevailing public/private partnerships? (If no additional policy barriers exist, then support proposed activity.)

6. Is the proposed activity well-aligned with existing activities of CEOS, e.g. Virtual Constellations, Working Groups, or other initiatives? (If so, identify those activities and entities)

7. For proposed new initiatives other than the creation of Working Groups or Virtual Constellations, when is the activity/initiative expected to be completed and what are the milestones that will lead to its completion?

ANNEX 2: PRESENTATION OF A NEW INITIATIVE TO CEOS

STEP 1- PRESENTATION OF A NEW INITIATIVE TO CEOS SECRETARIAT

Who: CEOS Sponsor

Where: CEOS Secretariat (SEC)

When: as required. Allow time for iterative process – at least two SEC meetings

What: New Initiative Proposal

Output: CEOS SEC's endorsement for presentation at a high-level meeting (Plenary or SIT)

New Initiative Proposal:

It is recommended that the proposal cover the following points:

1- Description:
   - Expected output /outcome of this initiative/task?
   - Who will benefit from it?
   - Which CEOS Agencies are providing remote sensing data/information/resources?
   - To whom is CEOS Agencies' data/information being provided?

2- Alignment with CEOS strategic goals
   - How does it align with CEOS goals?
   - How does it align with WG or VC Terms of Reference (if appropriate)?

3- Benefit to internal and/or external stakeholders –
   - What is the value of the initiative to CEOS Stakeholders?

4- Feasibility and Affordability
   - What are the required resources / levels of efforts?
   - Is this initiative competing for resources with another CEOS initiative?

5- Expected Duration
   - If applicable, when is the activity/initiative expected to be completed? What are the milestones that will lead to its completion?

Additional details of points 2-4 can be found in Section 3 of the *Governance and Processes* Document

STEP 2- PRESENTATION OF INITIATIVE AT A CEOS HIGH-LEVEL MEETING

Who: CEOS Sponsor(s)

Where: CEOS Plenary or SIT

When: following the specific requirement of the meeting organizer (at least two weeks before meeting)

- If the initiative fits within an existing WG or VC, more iteration may not be needed. It is to be determined at the meeting. If it required the creation of a new Ad Hoc Team, VC or WG, it is likely that iteration will be needed to define the proposed new initiative. The Sponsor of a major new initiative (e.g., an initiative requiring major resources and

multiple CEOS Agency commitment) should plan to make presentations on the proposed new initiative at two CEOS higher-level meetings before endorsement.

What: New Initiative Presentation

Output: CEOS Plenary endorsement

New Initiative Presentation

It is recommended that the presentation cover the following points:

1- New Initiative Proposal
2- Success measures as defined in section 6 of the *CEOS Strategic Guidance* document.
3- CEOS Agencies commitments to lead
4- CEOS Agencies commitments to support
5- Decision required

May 20, 2014

CEOS WORKING GROUP PROCESS PAPER

1. INTRODUCTION

The Committee on Earth Observation Satellites (CEOS) **Working Groups** are one of two permanent working-level mechanisms for coordinating CEOS Agencies' multilateral activities. Working Groups typically address topics that are cross-discipline such as calibration/validation, data portals, capacity building, and common data processing standards, as well as thematic topics such as climate and disasters, which are shared across a wide range of Earth observation domains. As a consequence, their activities are intimately connected with, and complementary to, the work of the CEOS Virtual Constellations (please see the *CEOs Virtual Constellations Process Paper*, November 2013). Furthermore, the activities of Working Groups are usually structured to respond to requirements from the Group on Earth Observations (GEO) and other organizations, both internal and external to CEOS. Working Groups may also be led jointly by CEOS and another international organization with shared interest in the activities of the Working Group to ensure synergies among international Earth observation community.

History

CEOS Working Groups were initially established to ensure the long-term continuity of work in areas where the magnitude and complexity of a task was not suitable for short-term, project-based solutions. "Standing" Working Groups, as they were previously known, did not require annual confirmation by the CEOS Plenary

2. GOVERNANCE AND PRIORITIES

Governance

Each Working Group will prepare Terms of Reference, which may be supported by a short Working Group Work Plan that is consistent with the *Strategic Guidance* Document and relevant activities outlined in the CEOS Three-Year Work Plan. The Working Group Terms of Reference require CEOS Plenary approval while the Working Group Work Plans, if prepared, do not.

The Working Group Terms of Reference should include the following:

- Purpose (Mission of the Working Group)
- Organization (including membership and leadership)
- Objectives of the Working Group
- Key external and internal stakeholders

The Working Group Work Plan, if prepared, should provide a credible way forward for the realization of overall CEOS and specific Working Group objectives and for achievement of the deliverables set forth in the CEOS Work Plan.

The Working Group will also prepare relevant inputs to follow-on CEOS Three-Year Work Plans, as appropriate.

The Working Group inputs to the CEOS Three-Year Work Plan, and if appropriate, to the detailed Working Group Work Plan, may include the following:

- Proposed implementation strategy and coordination issues
- Key activities, outcomes, and deliverables identified to accomplish the CEOS priorities
- Other activities identified to accomplish secondary Working Group priorities

As stated previously, joint Working Groups may be established with other organizations, if agreed by Plenary based on mutually agreed Terms of Reference. In such case, the Chair of the Joint Working Group will also prepare a unique report to the parent organizations, and if appropriate or desired, a Joint Working Group Work Plan.

Priorities

It is understood that the Working Groups sometimes involve entities and organizations whose priorities, interests, and objectives may not be directly aligned with established CEOS priorities. The Working Group members have the ability to pursue activities in support of other entity or organization activities but such activities should not be in conflict with the execution and implementation of CEOS priorities.

3. Working Group Organization

Leadership

Each Working Group is led by a Chair and a Vice Chair, with a two-year term for each position. It is expected that the Vice Chair will assume the duties of the Chair at the end of the Chair's two-year term, thus the Agency sponsoring the Vice Chair is essentially committing to a four-year term (two years as Vice Chair and two years as Chair). Each Working Group has the authority to select the Vice Chair. Candidates for Vice Chair must demonstrate technical and leadership skills relevant to the Working Group and have the commitment of their Agency (i.e., financial resources and personnel time) to support the approximately four-year leadership term. A candidate for Vice Chair, therefore, will be required to provide a formal letter from their Agency to the current Working Group Chair confirming the Agency is committed to supporting the Vice Chair candidate for the four-year term. The CEOS Chair, Strategic Implementation Team (SIT) Chair, and Executive Officer (CEO) will be copied on the letter. Some Working Groups require specific secretarial support and if applicable, the Agency commitment letter will also state that the Agency is committed to providing secretarial support during the two-year period when the Agency is the Working Group Chair.

All efforts will be made to ensure only one CEOS Agency at a time is invited to serve in the position of Vice Chair but there may be instances where multiple CEOS Agencies are interested. In the case where more than one viable candidate for Vice Chair occurs, the Working Group will adhere to principle of consensus decision making where the clear majority of Working Group

members is reflected in the decision on one candidate for Vice Chair who will be proposed to the Plenary (refer to *CEOS Governance and Processes*).

The Vice Chair must be approved and endorsed by the CEOS Plenary. The terms for the Chair and Vice Chair will begin with the CEOS Plenary, normally held in October/November each year.

In the case where a Vice Chair candidate from a CEOS Agency cannot be found, the CEOS Chair will ask that the current Working Group Chair bring this issue to the attention of CEOS leadership at the next CEOS Secretariat teleconference or SIT/Plenary meeting for discussion. CEOS leadership and the Working Group Chair will then determine a path forward that is reasonable for all parties and consistent with CEOS goals and priorities.

In the case where a Chair, for any reason, cannot fulfill the duties of their term, the Working Group Vice Chair will assume the duties as the Chair. If the Vice Chair is unable to fulfill the duties as Chair, the Working Group will attempt to resolve the issue internally first in consultation with the CEO (i.e., select an interim Chair first from the Chair's Agency and then within the Working Group Members) and second, consult CEOS leadership to determine a path forward that is reasonable for all parties. If for any reason a Chair/Vice Chair for the Working Group cannot be identified, then the Working Group will be put in a "pause" status upon the completion of the current Chair's term, awaiting new leadership and endorsement from a CEOS Agency sponsor. It is incumbent on CEOS leadership to assist in resolving matters of Working Group succession in a timely manner, preferably well before a Working Group is considered for pause status.

Membership

Representatives from all CEOS Agencies are invited to participate in all Working Groups and to nominate a Point of Contact, failing which the Working Groups will keep the formal CEOS Contact for the Agency informed with respect to Working Group activities. CEOS Agencies (Members and Associates) will constitute the core membership of each Working Group. Working Groups, however, have the flexibility to invite individuals from other organizations that are not CEOS Agencies to participate in the Working Groups. Any organization invited to participate must have an endorsement from a CEOS Agency to participate. These organizations will be referred to officially as "observers" or "experts", depending on the role that the Working Group leadership has deemed appropriate.

Structure

The Working Groups have the flexibility to structure themselves internally, as appropriate, to execute their respective activities. Some Working Groups have instituted a structure of subgroups or interest groups to emphasize particular tasks or activities. Subgroups and interest groups are not self-standing CEOS entities and cannot commit CEOS resources to a particular activity without first getting approval from CEOS leadership, in this case through the Working Group Chair/Vice Chair, CEOS Executive Officer, and CEOS Chair. Working Groups will typically meet formally at least once per year, with the decision to meet more frequently left to the leadership of the Working Group.

4. Execution of Activities

Reporting

Each CEOS Working Group's primary reporting path is to the CEOS Chair, with a secondary reporting path to the SIT Chair, if so delegated by the CEOS Chair.

Working Group Chairs, Vice Chairs, or other nominated representative, shall report at each CEOS Plenary session on accomplishments and future plans of the Working Group. Working Group Chairs or Vice Chairs also report on activities during monthly CEOS Secretariat (SEC) teleconferences.

A Joint Working Group may have additional reporting responsibilities to the Plenary or other annual meeting of the partner organization. In addition, a Working Group may also have an external reporting responsibility and those responsibilities should be clearly articulated in the Working Group Terms of Reference.

5. Proposing a New Working Group

Generally, a Working Group is proposed because there is a significant interest in enhancing technical cooperation among CEOS Agencies in specific topical areas with broad international benefit. The establishment of a new Working Group shall first be considered a "new initiative." The criteria for consideration, the process for submitting a proposal, and the process for approval are all defined in the *CEOS New Initiatives Process Paper*. Any proposal for a new Working Group shall be considered "significant in nature" and require discussion, review, and approval by CEOS Principals at the CEOS Plenary. This approval process is in line with the Working Group's primary reporting path to the CEOS Chair.

The proposal of a "new initiative" shall define the scope of the links to the existing Working Groups and Virtual Constellations and initiatives. A "new initiative" shall make use as much as possible of the products of the existing CEOS entities and shall iterate the proposal in advance with the concerned CEOS entity, in order to optimize the synergies that can be achieved in objectives and activities.

6. Working Group Evolution

By default, Working Groups shall continue their existence and not require annual CEOS Plenary approval. A Working Group may at any time propose to modify its focus and activities. Any proposed modifications must be reflected in the Working Group Terms of Reference and presented for decision at CEOS Plenary.

If the consensus of the CEOS Plenary is such that a Working Group is no longer required, the Plenary may recommend that the Working Group be discontinued, with or without a proposal from the Working Group.

CEOS VIRTUAL CONSTELLATIONS

PROCESS PAPER

UPDATED NOV 2013

1. INTRODUCTION

Understanding the Earth system is crucial to maintaining and enhancing human health, safety and welfare, alleviating human suffering including poverty, protecting the global environment, reducing disaster losses, and achieving sustainable development. Observations of the Earth system constitute a critical input for advancing such an understanding. This has been the driving force behind the establishment of the Group on Earth Observations (GEO), four ministerial-level Earth Observation Summits, and the development of the Global Earth Observation System of Systems (GEOSS).

The purpose of GEOSS is to achieve comprehensive, coordinated, and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system. GEOSS meets the need for timely, quality long-term global information as a basis for sound decision- making, and enhances delivery of benefits to society. The implementation of GEOSS requires effective consultation and cooperation, with international and national agencies sponsoring or co-sponsoring the component observing systems upon which GEOSS is built. GEOSS leverages the value of Earth observation research programs, and facilitate their transition to sustained operational use. It provides a means to share observations and products with the system as a whole, and takes the necessary steps to ensure that the shared observations and products are accessible, comparable, and understandable, by supporting common standards and adaptation to users needs. GEOSS includes *in situ*, airborne, and space-based observations.

In support of GEO objectives and in order to harmonize efforts among space agencies to deploy Earth observation missions and with the aim to close emerging data gaps, the Committee on Earth Observation Satellites (CEOS) has established the concept of Virtual Constellations for GEO, whereby a number of both existing and already approved satellites or instruments and their observations, when coordinated in their operation and exploitation, can merge or integrate data and derived information to contribute to a (quantitative) analysis/measurement goal. The value of the Constellations concept is its guidance (requirements) for design, development and operation of future systems to meet the broad spectrum of Earth observation requirements. GEO and GEOSS will benefit from this effort because Virtual Constellations can help agencies avoid duplication and overlap in Earth observation efforts, close information gaps for all GEO Societal Benefit Areas (SBAs), and establish and sustain a global Earth observation network.

A brief account of the early historical development of the CEOS Virtual Constellation concept is provided in Annex 1.

DEFINITION: A CEOS Virtual Constellation is a set of space and ground segment capabilities operating together in a coordinated manner, in effect a virtual system that overlaps in coverage in order to meet a combined and common set of Earth observation requirements. The individual satellites and ground segments can belong to a single or multiple owners. The Constellation concept builds upon or serves to refocus already existing projects and activities. The Virtual

Constellations (hereinafter referred to as Constellations) effort provides a unique forum to achieve political visibility and increase mutual benefit among space and other environmental agencies in support of crosscutting GEO Tasks and Targets. In particular, it offers opportunities to share experience in the development of algorithms; standardize data products and formats; exchange information regarding the calibration and validation of measurements; facilitate timely exchange of and access to data products from existing and planned missions; and facilitate planning of new missions—ranging from coordinating orbits to optimizing observational coverage to sharing implementation of mission components. The interim goal of a Constellation is to demonstrate the value of a collaborative partnership in addressing a key observational gap; the end goal is to sustain the routine collection of critical observations. Implementation of Constellation activities is ultimately dependent on the coordination of formal agreements among participating agencies.

This definition of CEOS Constellations for GEO was formally adopted together with this document at the 2008 CEOS Plenary.

The concept of Virtual Constellations has not been "invented" by CEOS. Several satellite Constellations pre-date the CEOS initiative. Examples of cooperation include the World Meteorological Organization (WMO) Global Observing System, the "A-Train," the Global Precipitation Measurement mission, ocean altimetry satellite cooperation, and the International Charter "Space and Major Disasters," which could be regarded as models for new CEOS Virtual Constellations. Additional information on these examples of Virtual Constellations is provided in Annex 2.

CEOS recognizes the strength of the Constellations concept, and the benefits that would stem from its adoption. The original intention of the Constellations was to provide CEOS with an outcome-focused vehicle for thematic coordination of space agency missions. As far as possible they were to be tightly-focused projects with a fixed duration and measurable achievements - rather than be ongoing, general coordination frameworks. In practice, the evolution of the original and subsequent Constellations has resulted in a range of different emphases, some of which stress the importance of long-term coordination of some measurement types through the relevant Constellation team.

2. GOALS

The concept of the "CEOS Constellations" has been agreed by CEOS Agencies as a means to better address space-based Earth observation needs on a global basis – without eroding the independence of individual agencies. CEOS recognizes that national/regional observing requirements will continue to dominate space agency spending and that any grand design for implementation of global observing systems will always be dependent on individual agency funding priorities. CEOS Constellations will:

- Move space agencies' coordination efforts from the generic to the specific – *i.e.*, adopting a problem-focused approach to achieve significant results in terms of actual implementation and physical outputs (such as new products or contribution to Fundamental Climate Data Records) within a relatively short time;
- Improve considerably the extent to which the combined outputs of the various agency programs are relevant to specific applications, such as climate and other GEO SBAs, and respond to the requirements for space-based observations expressed in, *e.g.*, Integrated

Global Observing Strategy (IGOS) Theme reports and the Global Climate Observing System (GCOS) Implementation Plan;

- Facilitate the participation of smaller contributors;
- Recognize that existing assets could be used more effectively in support of the ongoing GEOSS 10-Year Implementation Plan;
- Realize the overall potential benefits at global scale that would result from reduced redundancy and improved continuity and overlap among missions;
- Create the conditions, through the adoption of a series of requirements and guidelines which satisfy key GEOSS requirements, whereby all agencies – large and small – as well as other contributors, are able and indeed encouraged to make their contributions to the common objective of developing the space segment of GEOSS; and,
- Use an accreditation/recognition process, based on an agreed set of metrics, to ensure that proposed contributions to a Constellation will help to satisfy the relevant community needs.

Processes for proposing, initiating, developing, implementing and promoting a CEOS Virtual Constellation are outlined in Sections 4 and 5.

3. THE CURRENT CEOS CONSTELLATIONS

As of November 2013, the seven current CEOS Constellations are:

- **The CEOS Constellation for Atmospheric Composition (AC-VC)**: The AC-VC's objective is to collect and deliver data to improve monitoring, assessment and predictive capabilities for changes in the ozone layer, air quality, and climate forcing associated with changes in the environment through coordination of existing and future international space assets. The AC Constellation directly addresses the SBAs of disasters, health, energy, climate, and ecosystems.
- **The CEOS Constellation for Land Surface Imaging (LSI-VC)**: The LSI-VC's objective is to define a broad range of detailed guidelines for optimal capabilities to acquire, receive, process, archive, and distribute land surface image data to the global user community. Information from the LSI Constellation primarily benefits the SBAs of disasters, energy, climate, water, ecosystems, agriculture, and biodiversity.
- **The CEOS Constellation for Ocean Surface Topography (OST-VC)**: The OST-VC's objective is the implementation of a sustained, systematic capability to observe the topography of, and the significant wave height on, the surface of the global oceans ranging from basin-scale to mesoscale. It focuses on global sea level rise, the role of the oceans in climate, and operational oceanography. Information from the OST Constellation supports the SBAs of disasters, climate, water, and weather.
- **The CEOS Constellation for Precipitation (P-VC)**: The P-VC's objective is to establish an international framework to guide, facilitate, and coordinate continued advancements of multi-satellite global precipitation missions. Through this framework, existing and planned missions can work synergistically to meet international user community requirements. Information from the Precipitation Constellation primarily benefits the SBAs of disasters, climate, water, and weather.

- **The CEOS Constellation for Ocean Colour Radiometry (OCR-VC)**: The OCR-VC's objective is to provide a time series of calibrated aquatic radiances at key wavelengths from ocean color satellite sensors. Well-calibrated aquatic radiances enable the estimation of many optical, biological, biogeochemical, and ecological properties of Earth's aquatic environments. Activities include on-orbit and vicarious calibration, data validation, merging of satellite and *in situ* data, product generation, as well as development and demonstration of new and improved applications for scientific and management purposes. Information from the OCR Constellation primarily supports the SBAs of climate, water, and weather.
- **The CEOS Constellation for Ocean Surface Vector Winds (OSVW-VC):** The OSVW-VC's objective is the implementation of a sustained, systematic capability to observe the wind fied at the surface of the oceans from basin-scale to mesoscale. It focuses on the role of ocean surface wind fields in operational oceanography and meteorology, such as in supporting improvements in operational marine warnings and forecasts through the use of ocean surface vector winds from satellite scatterometry (together with significant wave height, SWH, from the Ocean Surface Topography Virtual Constellation). OSVW also characterizes the OSVW field for use in climate-quality data records and facilitates research related to the influence of wind forcing on the circulation of the oceans. Information from the OSVW Constellation primarily benefits the SBAs of weather, disasters, climate and water.
- **The CEOS Constellation for Sea Surface Temperature (SST-VC):** The SST's objective is the development and improvement of sea surface temperature products including the SST Essential Climate Variable. SST seeks to develop and implement metrics for SST services, products and users, to improve calibration and validation of the relevant instruments, and to develop training activities for satellite SST practitioners. SST serves as the formal link between CEOS and the Group for High Resolution Sea Surface Temperature (GHRSST). Information from the SST Constellation primarily benefits the SBAs of climate, weather and water.
- Each of the current Constellations is defined by one or more Earth properties and one or more satellite measurement techniques:
- Single property with single measurement technique:
    - Ocean Surface Topography Constellation: altimetry supplemented with tide gauges and other *in situ* sensors.
    - Ocean Surface Vector Winds Constellation: microwave scatterometry supplemented with other microwave measurements.
    - Ocean Colour Radiometry Constellation: calibrated ocean colour radiances (OCR) at key wavelength bands supplemented by in-situ data for vicarious calibration, validation et al.
- Single property with multiple measurement techniques:
    - Precipitation Constellation: precipitation radar supplemented with microwave radiometry.
    - Sea Surface Temperature Constellation: infrared and passive microwave imaging radiometers complemented by in situ observations.
- Multiple-property/domain-based with multiple measurement techniques:

- Atmospheric Composition Constellation: various parameters (radiative and chemically active gases, aerosol, etc.) in the atmospheric column with multiple measurement techniques;
- Land Surface Imaging Constellation: various parameters (related to land use/cover, fire, volcanic eruptions, etc.) with multiple measurement techniques.

Each Constellation is unique and matures at its own pace. Constellation Leads/Co-Leads work together with the CEOS SIT Chair in addressing what SIT and CEOS, through its agencies, might do to assist Constellation implementation. They are also involved in GEO Tasks and contribute in a timely manner to their implementation. The CEOS Systems Engineering Office (SEO) is prepared to assist CEOS Constellations, as appropriate, to develop traceable system-level requirements to facilitate SBA impact assessments, to perform instrument and mission gap analyses, and to support future architecture planning. Constellation Leads/Co-Leads meet with the SIT Chair every four months to review progress and adjust implementation plans; provide Task Team-related progress reports to the GEO Secretariat, as required; and brief the SIT and CEOS Plenary Meetings on Constellation developments, as required.

The distribution and application of data products and services from a given Constellation may involve a range of Service Providers, external to CEOS, providing integration and value-added support tailored to the needs of different SBAs. The Constellations and the products and services supported by them in most cases typically support multiple SBAs in a cross-cutting fashion (as noted in the descriptions of the above current Constellations).

4. PROPOSING NEW CONSTELLATIONS

CEOS SIT will address new Constellation proposals on a case-by-case basis in connection with procedures outlined in Section 5. Lessons learned from the existing Constellations will also be taken into account when designing an overall strategy and selecting new Constellations. A new CEOS Constellation may be proposed by two or more CEOS Agencies, be they Members or Associates.

CEOS endorses the following set of procedures for development and implementation of potential future CEOS Constellations, and encourages existing Constellations to also adapt to them, as practicable, realizing, however, that each Constellation is unique. This process will normally consist of two phases:

Phase I – An *Initial Proposal* to the SIT with a request to determine CEOS Agency interest in a possible Constellation;

Phase II – A *Full Proposal* for SIT approval – including an Implementation Plan.

5. PHASES OF THE CONSTELLATION PROPOSAL PROCESS

5.1. PHASE I – INITIAL PROPOSAL

The *Initial Proposal* should be a short explanatory paper (four to six pages) provided to the SIT Chair at least four weeks in advance of an upcoming SIT Meeting (or SIT session at CEOS Plenary). The core of the paper should be the *Draft Terms of Reference* for the proposed Constellation, following the structure and headings provided in Annex 3.

The purpose of the *Initial Proposal* is to allow SIT and its member agencies to understand the

scope and scale of the proposed constellation, and to accurately characterize its context among existing constellations and related ongoing or planned activities in the community. It should seek to develop a consensus among those agencies sponsoring the related satellite missions to support the development of the proposed Constellation and can serve as a focus for the necessary coordination.

If given a go-ahead by the SIT Chair, the proposers of the candidate Constellation will make a presentation on the *Initial Proposal* at the upcoming SIT meeting.

5.2. PHASE II – FULL PROPOSAL & IMPLEMENTATION PLAN

The SIT will decide whether the *Initial Proposal* has sufficient support to proceed and whether any adjustments are necessary to the proposed scope, objectives etc – given the context of CEOS strategic objectives and activities. If positive, the SIT Chair will request the proposers proceed with developing a *Full Proposal & Implementation Plan* - due to the SIT Chair within six months of the SIT meeting at which the *Initial Proposal* was presented.

The *Full Proposal* should be a comprehensive characterization of the proposed Constellation, and should expand on all the points listed in the *Initial Proposal*, including expanded and Final Terms of Reference, covering:

- Confirmed space agency members and representatives; desired space agency members; nomination of Constellation Co-Lead agencies and representatives. CEOS Agencies are expected to fully support Co-Leads from their Agencies, also ensuring their continued active involvement. It must be made clear where participation and resources have been agreed and where these still remain to be sought.
- Identification of the critical decisions and actions regarding CEOS agency mission coordination (at any level: space segment, ground segment, products/services etc) that represent the value-add of the constellation against the context of the existing plans of the contributing agencies. These issues will represent the basis/substance of the reports to SIT and the metric for managing and monitoring progress of each of the VCs. Impediments to achievement of the VC outcomes and deliverables should be clearly communicated as the challenges for CEOS to address.
- Definition of the outcomes and deliverables from the VC activities, including support for relevant ECVs. The accomplishments resulting specifically from the VC value-adding activities should be defined – distinct from the individual existing plans of contributing agencies.
- An outline of requirements and guidelines for potential contributors to the VC - including technical measurement criteria, inter-comparison and calibration/validation targets, data access and format guidance, including an assessment of compliance to GCOS requirements, including the GCOS Climate Monitoring Principles (GCMPs), wherever applicable. Particular attention should be paid to continuity and comparability of contributing measurements.

The *Implementation Plan* should provide a credible way forward for realization of the Constellation objectives and for achievement of the deliverables and outcomes. Outputs may well be on several different timescales, and a phased approach should be adopted, focusing initial effort on a small number of achievable results - described in terms of the output (product, service, Fundamental Climate Data Record, continuity, etc.) rather than technology.

The Team should ensure the necessary involvement of the relevant user communities, to ensure that the products envisaged are compatible with their stated needs (as, for example, in the GCOS Implementation Plan for climate). Outlining of an end-to-end "value chain" involving such users is desirable.

The *Implementation Plan* must include the following items:

Requirements and Specifications

The Constellation must encompass all aspects of the user experience, such as:

- The science value and justification for the measurements being undertaken, consisting of a specification of the spatial, spectral and radiometric performance required;
- Current accepted technical specifications for inter-calibration with other spacecraft in the Constellation and with ground systems, and a definition of accepted calibration practices; and,
- Current technical specifications for the data formats and existing inter-operability of the data acquisition and distribution networks.

Documentation of these specifications as they currently exist will support the evaluation of Constellation progress and allow assessments or gap analyses.The CEOS System Engineering Office (SEO) may be available to support development of requirements and assessments/gap analyses. The expertise of the CEOS Working Groups should be called upon as necessary (eg Working Group on Calibration and Validation (WGCV) - to help define calibration requirements; and the Working Group for Information Systems and Services (WGISS) - to help define data and services requirements).

Schedule

A detailed time schedule is required, indicating the various steps and milestones proposed for implementation (*e.g.*, negotiation of a Memorandum of Understanding) and, wherever possible, identifying potential obstacles. This schedule would enable SIT to monitor progress and, where necessary, assist in obtaining contributions which are behind schedule. Implementation reports will be provided to the SIT at regular intervals, providing opportunities for measuring the successful development of the project.

Accreditation and Recognition Metrics

Teams must formulate accreditation/recognition criteria, which are measurable against an agreed set of metrics. This requirement is intended to streamline and focus the process and bring maximum benefit to the relevant user communities within reasonable timescales. It is important to stress that it is not the intention of CEOS to offer an evaluation of the submitted programs as such; this is strictly the business of the owners of the programs.

The criteria need to be tied very closely to the user requirements (including CEOS strategic objectives, GEO SBAs or GEO Work Plan Tasks) and the Team should resist the temptation to add further criteria, which would unnecessarily complicate the implementation of its proposed Constellation.

The underlying Constellation concept encourages participation from all space agencies, as well as other entities that may have data holdings or other contributions to offer. Care will therefore need to be taken in defining criteria and metrics, which do justice to the sometimes conflicting

desires for inclusiveness and efficiency. Technical interoperability, data quality, formats, integration and merging, timeliness, availability and compatibility, access and dissemination, storage, compliance with GEO data sharing principles, are amongst the criteria to be used. A lightweight, easy-to-use, end-to-end user test scenario, involving non-CEOS users, can be developed and applied as appropriate.

Funding

CEOS has no budget of its own. Therefore, *Implementation Plans* must indicate where additional funding is required with, where possible, a suggestion as to the agency or agencies which might be persuaded to provide this support or which have already pledged such support. Potential agency funding obstacles ought to be identified as early as possible in the process, rather than appear when significant work has already been invested.

Following receipt of the *Full Proposal & Implementation Plan*, the SIT Chair, in consultation with SIT Members, will decide at the next scheduled SIT or CEOS Plenary meeting, whether to approve the proposed Constellation.

6. THE ROLE OF SIT IN THE CONSTELLATIONS PROCESS

The SIT is responsible, under the authority of the CEOS Chair, for approving the Constellation *Proposals* & *Implementation Plans*. The assessment and approval process will be done by discussion and decision during regular SIT meetings or SIT sessions at CEOS plenary. Reports and other papers intended for decision in SIT meetings need to be sent to the SIT Chair 4 weeks before a scheduled meeting. It is recognized that this approval process should not lead to unnecessary delays, and the SIT Chair will take the necessary steps to ensure timely responses.

The SIT Chair and/or Vice-Chair, together with their supporting staff, are encouraged to have regular consultations with Constellation Co-Leads and may well be able to help Constellation teams in obtaining support from agencies, provided that the request can be precisely defined and its utility explained. Co-Leads should also bear in mind the possibility of contributions from the SEO and CEOS Working Groups. This can be sought either directly from the Chairs of the Working Groups, or through the SIT Chair.

The purpose of asking the CEOS Constellations to develop and maintain standard Terms of Reference (as of 2013) is to support SIT in communication with, and management of, the various Constellation Teams. Significant emphasis is put on the outcomes and deliverables anticipated of each Constellation; and on identifying the value-added that Constellations seek to deliver – distinct from individual CEOS agency programmes and plans. The periodic dialogue between SIT and Constellation Teams will focus on the critical decisions and actions regarding CEOS agency mission coordination that represent this value-added.

SIT Chair is required to report annually to CEOS Plenary on the progress towards the GEOSS Space Segment. The inclusion of future horizons for deliverables and outcomes from the Constellations in the Terms of Reference format allows SIT Chair to develop ‘big picture’ snapshots of the space segment coordination in CEOS – for reporting internally and externally.

7. USER COMMUNITY ENGAGEMENT

It is important to have a clear and common statement of the primary user community requirements as the basis for any Constellation. Full use should be made of existing requirement statements – IGOS-P theme reports, GEO 10-Year Implementation Plan, GEO Work Plans, GCOS Implementation Plan, CEOS Work Plan etc – and the team should avoid as far as possible introducing new requirements. As noted above, Constellations are encouraged to develop end-to-end value chains in planning engagement with the user community.

Throughout the proposal and implementation phases, it is essential to have regular contributions from senior representatives of the appropriate user community, in order to better serve their needs. Their cooperation is essential in validating the proposed Constellation's criteria, requirements, and ensuring worthwhile objectives and measureable results.

ANNEX 1 – SOME HISTORICAL BACKGROUND

The following piece of text is based on excerpts from the CEOS Virtual Constellation Concept Paper prepared by Daniel Vidal-Madjar and Stephen Ward in March 2006.

The 19th CEOS Plenary, held in London in November 2005, recognized that the *CEOS Implementation Plan for Space-Based Observations for GEOSS* should:

- Identify the supply of space-based observations required to satisfy the requirements expressed by the 10-Year Implementation Plan for GEOSS; and
- Propose an innovative process whereby the many disparate types of Earth observing programs funded by CEOS Member agencies might contribute to the supply of the required observations.

CEOS further recognized:

- The variety of national/regional needs and capacities – scientific, industrial, economic, etc.– that drive Earth observing programs of the countries and regions covered by CEOS. At least part of this difficulty has stemmed from the lack of a clear and common statement of need from the target user communities.
- The notable exceptions of the relatively well-organized meteorology and defense user communities whose ability to express and demonstrate pressing needs for data provision has secured continuity of relevant observing programs.
- The lack of a common requirement for observations for other domains – including most of those which are addressed within the GEOSS Societal Benefit Areas (SBAs) – which has meant that continuity of supply of observations and consistency of technical performance and application of observations has not been systematic, but rather *ad hoc* – except in some instances.

This situation creates a number of shortcomings and impediments from a user perspective:

- Instruments are often not comparable in terms of performance and types of measurement;
- There is no guarantee that data from a group of missions with the same general objectives can be used in an integrated way;
- Data formats, distribution, and access can vary tremendously from agency to agency;
- The absence of a procurement strategy to ensure the continuity of missions results in a waste of financial resources and substantial additional costs.

The concept of the "*CEOS Virtual Constellations*" has been proposed as the basis for a process aimed at addressing these shortcomings in the international planning process for space-based Earth observations without eroding the independence of individual agencies. The basic idea for the establishment of the *CEOS Virtual Constellations* is:

- To extract from the target user communities, a clear and common statement of requirements – as the basis for planning by CEOS space agencies; the heritage of application of space-based observations is now such that this is feasible in most domains – and the GEO process and GEOSS 10-Year Implementation Plan can serve as the reference for many of these requirements (recognizing that some SBAs are more mature than others).
- To define a series of 'Virtual Satellite Constellations' to satisfy these requirements; each Constellation would be the focus for the planning and coordination by CEOS agencies

individually and collectively; each definition would serve as a guide to all agencies as to the characteristics of the space and ground segment for their mission which would best satisfy the needs of the agreed users.

- At the heart of the application of the Constellations concept is the definition of a series of standards – required to be satisfied for a mission to be included in the Constellation – and a process of recognition/acceptance, whereby an agency applies to CEOS to have one or more of their missions (ideally from the outset of planning) recognized as meeting the Constellation standards and thereby satisfying the relevant user community needs. Since part of the purpose of the Constellations Concept is to allow all space agencies, from the largest to the smallest, to plan to contribute to the coordination effort, the standards should be set using a balanced approach.

The Constellations approach will at least provide optimal circumstances for the user communities to make best use of whatever observing assets are provided by CEOS agencies, and will allow space agencies to see how best their planned missions could help meeting the needs of the SBAs. The minimum standards will include:

- Science requirement for the measurement being undertaken, consisting of a specification of the spatial, spectral and radiometric performance required to use the measurement for the intended application.
- Technical specifications for inter calibration (with other spacecraft in the Constellation and with ground systems) and definition of common calibration practices;
- Technical specifications for the data format and inter-operability of the data acquisition and distribution networks;
- Agreement on some general principles of data policy, e.g., the WMO resolution 40 or, preferably, the GEO Data Sharing Principles currently under preparation, at least for a part of the data, taking into account that the mission could have been decided for other purposes than to fulfill GEOSS requirements.

With the objective to build an inclusive coordination process, which means that it must remain open to all agencies or institutions, participation in a particular virtual Constellation could include such contributions as: a fully-fledged space mission, which could comprise instruments, satellite, ground segment and a distribution system or a part of it; an instrument on-board a third-party mission; a part of a receiving network; or, an element of a ground calibration system.

ANNEX 2 – EXAMPLES OF EXISTING VIRTUAL CONSTELLATIONS

It is worth noting that the concept of Virtual Constellations has not been "invented" by CEOS. Actually several satellite Constellations pre-date the CEOS initiative. Examples of cooperation include the World Meteorological Organization (WMO) Global Observing System, the "A-Train," the Global Precipitation Mission, ocean altimetry satellite cooperation, and the International Charter "Space and Major Disasters," which could be regarded as models for new CEOS Virtual Constellations.

- The space-based component of the Global Observing System of the WMO World Weather Watch includes a Constellation, involving a number of satellites in geosynchronous and polar orbits, each being provided by different national or international agencies, and coordinated by the CGMS (Coordinating Group of Meteorological Satellites).
- The international "A-Train" is a "real" Constellation, involving a number of satellites flying in formation, provided by the U.S., Canada and France.
- The Global Precipitation Measurement mission (GPM) with cooperation among the U.S., Japan and Europe, as well as other nations, has long been proposed as a "mission cooperative", indeed a Constellation. And it's predecessor, TRMM (Tropical Rainfall Measuring Mission), has been producing global integrated products of precipitation from a de facto real constellation of US, Japanese, and European satellites since 1998.
- The series of ocean altimetry satellites, including the U.S.-French Topex/Poseidon and Jason, the European ERS-1, ERS-2 and Envisat, and the U.S. Geosat, have been operated as a *de facto* Constellation, and all their data are quasi-operationally merged into integrated products for ocean users, even in the absence of established agreements between all mission providers.
- The International Charter "Space and Major Disasters" operate a Virtual Constellation of Earth observation satellites providing data to support disaster management through a voluntary agreement among space agencies.

ANNEX 3 – TERMS OF REFERENCE FOR THE CEOS VIRTUAL CONSTELLATIONS

INTRODUCTION

Each of the CEOS Virtual Constellations (VCs) has its own scope, objectives, emphasis, approach and membership. These terms of reference format adopted in 2013 seek to characterise each of these unique teams in a consistent way that supports their clear characterisation and value-added in the context of the development of the space segment for the GEOSS and of the multitude of outcomes and deliverables that CEOS seeks to provide – for GEO and for other users and frameworks. Emphasis is given to the outcomes and deliverables provided by the VCs and to identifying the coordination and implementation decisions and actions required of CEOS SIT – as the basis for the communication and management of the progress of each of the VCs.

Terms of Reference are required as part of the process of proposing a new VC and all VCs are required to maintain current Terms of Reference – being updated at least every 2 years and with changes clearly highlighted to CEOS SIT so as to identify changes to schedule or objectives.

This document provides the template for development of VC Terms of Reference.

TERMS OF REFERENCE FOR THE CEOS VIRTUAL CONSTELLATIONS

CONSTELLATION NAME: Following the convention of the existing Constellations (e.g. Sea Surface Temperature Virtual Constellation, SST-VC).

MISSION STATEMENT & OBJECTIVES: A mission statement with a succinct description of the objectives, the problem being addressed, the relevant user communities, the value the Constellation would add, and the benefits it would bring - wherever possible, in terms of the GEOSS 10-Year Implementation Plan long-term objectives. A clear statement of the primary user community requirements as the basis for the Constellation.

CHARACTERISATION OF THE MEASUREMENTS AND DATA COLLECTIONS WITHIN SCOPE: Including the status of, and plans for, data discovery and access to the relevant data collections. Requirements and guidelines including technical measurement criteria should be included for contributing agencies.

CHARACTERISATION OF THE SPACE SEGMENT CONCERNED: Identification of the core missions and agencies within scope of the constellation's ambitions. Inclusion of a timeline chart.

ACTIVITIES, OUTCOMES AND DELIVERABLES: Definition of the outcomes and deliverables from the VC activities using the following headings, and including support for relevant ECVs. The accomplishments resulting specifically from the VC value-adding activities should be defined – distinct from the individual existing plans of contributing agencies. The space segment characterisation should identify the missions or sensors contributing to the VC, and which might be regarded as part of the GEOSS Space Segment.

	3-year horizon	5-years or more horizon
Space Segment		
Ground Segment & Information Systems		
Products & Services		

Reports to SIT from the VCs will emphasise progress towards achievement of these outcomes and deliverables and the issues and obstacles for SIT attention.

IMPLEMENTATION AND COORDINATION ISSUES TO BE ADDRESSED BY SIT: Identification of the critical decisions and actions regarding CEOS agency mission coordination (at any level: space segment, ground segment, products/services etc.) that represent the value-add of the constellation against the context of the existing plans of the contributing agencies. These issues will represent the basis/substance of the reports to SIT and the metric for managing and monitoring progress of each of the VCs. Impediments to achievement of the VC outcomes and deliverables should be clearly communicated as the challenges for CEOS to address.

SCHEDULE: Further detail on the overall schedule in addition to the requested 3- and 5-year horizon outcomes and deliverables.

MEMBERSHIP AND LEADERSHIP: Identification of the agencies involved, the proposed or current lead agencies and individuals, and relevant partners outside CEOS.

RESOURCES: the costs of developing and maintaining the Constellation, and how these will be met by CEOS agencies and their partner organisations. Identify dependencies on, and relationships with, the CEOS Working Groups for transverse activities such as capacity building, information systems etc.