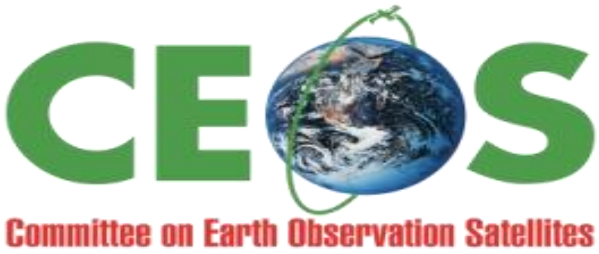

Progress report by the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS) on a coordinated response to UNFCCC needs for global observations

Developed by CEOS and CGMS and submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Subsidiary Body on Scientific and Technological Advice (SBSTA)

* October 2014

Executive Summary

At the 18th session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2012, the 37th session of the Subsidiary Body for Scientific and Technological Advice (SBSTA) invited the Committee on Earth Observation Satellites (CEOS) to provide, at SBSTA 41 and the COP in December 2014, an updated report on progress made by space agencies providing global observations in their coordinated response to the relevant needs of the convention. In 2013, the Coordination Group for Meteorological Satellites (CGMS) joined CEOS in sponsoring a working group on climate. This report thus represents the combined response of CEOS and CGMS to the relevant needs of the Convention.

In 2012, CEOS responded to the requirements for space-based observations in the GCOS Implementation Plan (IP)-10 and its Satellite Supplement. CEOS also responded to the previous GCOS IP in its 2006 report. CEOS prepared and submitted an updated report at SBSTA's 29th session in 2008. The SBSTA requested another update for its 33rd session in 2010, which CEOS prepared and submitted. A comprehensive, updated response to the GCOS IP-10 from CEOS-CGMS will be provided to GCOS in 2015 in time for their assessment of the global observing system to be reported to SBSTA 43/COP-21.

Prompted in part by the invitation from the UNFCCC to provide a coordinated space agency response to the needs of the convention for observations from satellite, CEOS joined CGMS and the World Meteorological Organization (WMO) to produce a report on an architecture for climate monitoring from space. This successful collaboration led to a call for CEOS and CGMS to jointly sponsor a working group on climate, which had originally been organized under CEOS. Section 2 of this report summarizes the report on an architecture for climate monitoring from space, the vision for this new joint working group on climate, and the work plan of the group for the next several years.

Section 3 of this report summarizes the recently completed CEOS strategy for carbon observations from space. The strategy for carbon observations from space is a response to the Group on Earth Observations (GEO) 2010 carbon strategy report. It details the adequacy of past, present, and planned satellite measurements of carbon in the land, oceans and inland waters, and atmosphere domains to support GEO, and it identifies important challenges that CEOS must face and actions CEOS and its agencies must take to meet needs for carbon observations from space. Specifically, it identifies what can be achieved through CEOS actions to better coordinate existing and future capabilities as well as those challenges that require additional resources and/or mandates beyond the present capacity of CEOS and its Member Agencies.

1. Introduction

1.1. Purpose of the Report

The purpose of this report is to respond to the UNFCCC response and invitation to CEOS, and now CEOS-CGMS, from SBSTA 37, specifically the mandate given in document FCCC/SBSTA/2012/5, paragraph 41:

> The SBSTA expressed its appreciation to CEOS for its update on progress made by space agencies providing global observations in their coordinated response to relevant needs of the Convention. It noted the importance of continuing and sustaining satellite observations on a long-term basis, and the role of CEOS in promoting full and open data sharing, in order to support the work under the Convention. It invited CEOS to provide, by SBSTA 41, an updated report on progress made by space agencies providing global observations in their coordinated response to relevant needs of the Convention.

Following a brief background, this report summarizes progress by CEOS-CGMS in two areas: 1) improved space agency coordination on climate monitoring, research, and services; and 2) an overview of the CEOS Strategy for Carbon Observations from Space report.

1.2. Background

The Global Climate Observing System (GCOS), a joint undertaking of the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU), was established in 1992 to ensure that the observations and information needed to address climate-related issues are obtained and made available to all potential users.

At the 7th Conference of the Parties (COP 7) to the UNFCCC in 2001, the UNFCCC SBSTA invited GCOS to consider an integrated (satellite and in situ) approach, including the exploitation of new and emerging methods of observation for the measurement of climate change. At COP 9 in 2003, GCOS was invited to develop a phased 5–10 year implementation plan. COP 10, in 2004, invited Parties with space agencies to have those space agencies provide a coordinated response to the recommendations in the 2004 implementation plan. At COP 11 in 2005, the United States, Japan, and other Parties supported the offer of CEOS to provide a coordinated response to the recommendations in the GCOS IP. At COP 12 in 2006, the SBSTA:

- Welcomed the CEOS report requested by COP 10 describing the coordinated response by space agencies involved in Earth observations to the needs expressed in the GCOS IP;

- Invited Parties that support space agencies to enable those agencies to implement the actions identified and to continue responding in a coordinated manner through CEOS; and

- Encouraged the continued partnership between GCOS and CEOS.

COP 13 in 2007 commended CEOS on the progress made to date in implementing actions for space agencies identified in the 2004 GCOS IP and invited CEOS to provide an updated progress report at SBSTA 29 in 2008. CEOS prepared and submitted this report. The SBSTA requested another update for its 33rd session in 2010, which CEOS also prepared and submitted.

COP 15 expressed its appreciation to CEOS for its coordinated response, on behalf of Parties that support space agencies involved in global observations, to the needs expressed in the GCOS IP and invited GCOS to update its implementation plan, taking into account emerging needs in climate observation, in particular those relating to adaptation activities.

In line with the conclusions of SBSTA 33, CEOS provided to SBSTA 37, at the COP 18 in November 2012, an updated report on progress made on major achievements in relevant areas (such as responding to space-related needs of the GCOS IP). This report represents the continued commitment of CEOS, and jointly now with the Coordination Group for Meteorological Satellites (CGMS), to coordinate Space Agency progress and plans for climate through a new Joint Working Group on Climate and presents that progress to SBSTA for their review and comment.

2. Improved Space Agency Coordination on Climate Monitoring, Research, and Services

In October 2010, at the 24th CEOS Plenary in Rio de Janeiro, Brazil, CEOS agreed to adopt a new Working Group on Climate (WGClimate) to coordinate and encourage collaborative activities between the world's major space agencies in the area of climate monitoring. The proposal for this group began with the efforts of a CEOS ad hoc Climate Advisory Group established in April, 2010 at the CEOS SIT-25 meeting in Tokyo, Japan. Stephen Briggs (ESA) reported to Plenary on the process undertaken in 2010, resulting in the proposal for CEOS to establish WGClimate.

2.1. An Architecture for Climate Monitoring from Space

One of the first activities of WGClimate was to engage with CGMS and WMO on an overarching framework for the collection, sharing, and use of climate observations from satellites. These groups collaborated on a report focused on the need for an international architecture that ensures delivery of such observations over the time frames required for analysis of the Earth's climate system. The report outlined a strategy for such an architecture—a strategy that is intentionally high-level, conceptual, and inclusive, so that a broad consensus can be reached and all relevant entities can identify their potential

contributions. An architecture typically describes the structure of a system, as reflected in its building blocks, their relationships to each other, and to the environment. The descriptive format of the architecture is generally tailored to the particular needs of the users/stakeholders and makes use of common definitions and standards in its construction.

Based on discussions within the various climate monitoring working groups and related meetings, two main needs/usage scenarios for the architecture emerged. The first need is to promote a common understanding amongst the various stakeholders of the implementation implications of meeting the various climate monitoring requirements. To support this common understanding, the architecture should depict, in a structured and readily accessible format, the functions, information flows, and dependencies of the processes necessary to satisfy the relevant requirements, and it should support the verification by the originators/owners of the requirements that they have been correctly interpreted. While this should encompass the end-to-end climate monitoring processes (i.e., from sensing through decision-making), the initial emphasis is on the upstream processes (e.g., sensing and climate data record creation).

The second need is to support an assessment of the degree to which the current and planned systems meet the requirements and generate an action plan to address any identified shortfalls/gaps. It is anticipated that such an action plan would help fulfill user needs through the coordinated implementation of activities across agencies. This information could be used to assess the capability of the upstream processes to support both current and new decision-making processes (e.g., as part of policy making) and, working backwards, to ensure that the appropriate sensing data, corresponding processing, and applications are in place.

Based on the two identified usage scenarios, an architecture with two main "views" is proposed: a logical view and a physical view. The logical view serves the first usage scenario. It represents the requirements baseline as a set of interlinked functions and associated data-flows. Leaving aside performance considerations (accuracy, uncertainty, stability, coverage, etc.), the logical view could be considered the "target" for a climate monitoring system and, in the sense that it is applicable to all essential climate variables (ECVs), this representation is generic. As this view is intimately tied to the requirements baseline (and not to the physical implementation of a climate monitoring system), it is as stable as the requirements baseline itself and, once established, should only need to be updated when the functional aspects of the requirements change.

The logical view is "end-to-end" and, as a result, a four-pillar logical architecture is proposed (see Figure 1). The information flow starts with the sensing of the Earth environment (by EO satellites). The resultant observations are then assembled, processed, and converted to climate records. These records are used by the relevant applications to generate reports that are, in turn, used by decision-making entities (including policy-makers) to decide on a course of action.

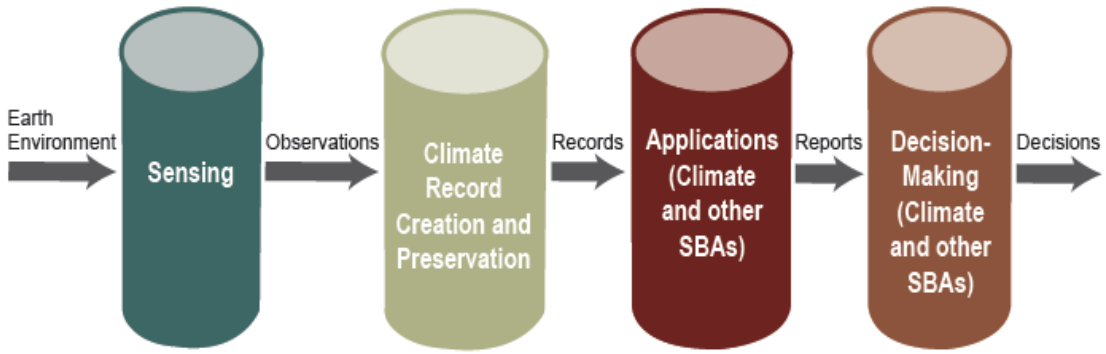

Figure 1. Climate monitoring logical architecture

The physical view of the proposed architecture, that is, how the various functions of the logical view are or will be implemented, is being captured by establishing an ECV questionnaire to populate a database (referred to as the ECV inventory) of the observing system implementation of agencies and scientific investigators, archives of both the raw data and ECV products, and quality information on the ECVs.

Finally, the architecture report recommends a constellation of research and operational satellites with broad open data-sharing policies and contingency planning. It includes recommendations for agreements that are essential for bringing the same continuity to long-term and sustained climate observations that we have today for weather observations. The task of climate monitoring, however, has requirements that must extend beyond the capabilities of one-time research missions and operational satellite systems in existence today. The report, therefore, identifies an important activity for research and operational agencies to undertake: the development of a joint framework for stewardship of climate information. Climate record processing requires a sustained expert understanding of both new and legacy climate sensors as well as a sustained web of support activities, including a significant effort on calibration and validation; research to reduce uncertainties; establishment of "community reference standards"; and collaborative product assessment and intercomparison. The sustained involvement of both research and operational agencies is a prerequisite for success.

2.2. Improvement of Space Agency Coordination on Climate – the CEOS-CGMS Joint Working Group on Climate

At the 27th Plenary meeting in 2013, CEOS approved a motion to join with the CGMS in sponsoring the WGClimate. CGMS provides an international forum for the exchange of technical information on geostationary and polar orbiting meteorological satellite systems. The Terms of Reference of the predecessor CEOS WGClimate were updated slightly to accommodate this partnership with CGMS and now include the following overarching goals:

- Provision of a structured, comprehensive, and accessible view as to what Climate Data Records (CDRs) are currently available;

- Creation of the conditions for delivering further CDRs; and
- Optimization of the planning of future satellite missions and constellations to expand existing and planned CDRs, both in terms of coverage and record length, and to address possible gaps with respect to GCOS requirements.

The CEOS-CGMS Joint WGClimate has adopted a three-year work plan (2014–2016). It will complete the first version of the ECV inventory. This inventory will form the basis for a gap analysis and the subsequent development of a coordinated action plan to address the identified gaps and opportunities. Guidelines for ECV assessments of both process and scientific metrics will also be developed to support the gap analysis and subsequent development of the action plan. The ECV assessment guidelines will be applied in collaboration with the CEOS Virtual Constellations.

Once a first version of the ECV inventory, gap analysis, and action plan have been delivered, the ECV inventory will be further developed with additional records, leading to new versions of the gap analysis and associated action plan to further optimize ECV coverage and depth. This update cycle is anticipated to start in the second half of the Work Plan's three-year period. In addition, an effort is underway to collaborate with the in situ community.

The CEOS-CGMS Joint WGClimate will continue to cooperate with GEO, GCOS, and WMO by implementing space 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. The Joint WGClimate will also contribute to the WMO's Global Framework for Climate Services (GFCS).

Completion of the ECV inventory, gap analysis, and action plan will allow CEOS to provide continuous feedback to climate monitoring and research efforts. These actions will allow CEOS to be prepared to respond to the GCOS Adequacy Report/Satellite Supplement (or equivalent), when published by GCOS.

3. Summary of Carbon Task Force – CEOS Strategy for Carbon Observations from Space

The CEOS Strategy for Carbon Observations from Space report is a response to the GEO Carbon Strategy, published by the Group on Earth Observations (GEO) in 2010. It details the adequacy of past, present, and planned satellite measurements of carbon in the land, oceans and inland waters, and atmosphere domains to support GEO, and it identifies important challenges that CEOS must face and actions CEOS and its agencies must take to meet needs for carbon observations from space. Specifically, it identifies what can be achieved through CEOS actions to better coordinate existing and future capabilities as well as those challenges that require additional resources and/or mandates beyond the present capacity of CEOS and its member Agencies.

The GEO Carbon Strategy calls for an Integrated Global Carbon Observing system (IGCO) to meet pressing needs for policy-relevant scientific information about the carbon cycle.

Carbon observations deserve very special attention because the increasing concentrations of atmospheric CO_2 and CH_4 play a central role in driving global climate change. Carbon cycling is also fundamental to the Earth system because of its intimate coupling across the land, oceans and inland waters, and atmosphere domains and with Earth's climate. Information about carbon cycle changes will be absolutely essential for climate policy development, implementation, and verification.

The GEO Carbon Strategy clearly explains the limitations of our current knowledge of the global carbon cycle and explains why improved scientific understanding will be essential to underpinning societal responses to global climate change. The report unequivocally states that "a key reason for our lack of understanding of the global carbon cycle is the dearth of global observations," and calls for "an increased, improved, and coordinated observing system for observing the carbon cycle as a prerequisite to gaining that understanding." CEOS recognizes that the GEO requirements for carbon observations from space are well-judged and technically feasible, but challenging in terms of a complete, sustained, and coordinated response. At its 24th Plenary meeting in Rio de Janeiro, in 2010, CEOS charged its Carbon Task Force (CTF) to develop a response to the GEO Carbon Strategy, describing the approach CEOS will take in meeting the GEO requirements for space-based observations of carbon.

The CEOS Strategy for Carbon Observations from Space report was written by an international team of scientists from a range of research institutions and CEOS agencies recruited by the CEOS CTF. To directly respond to the GEO Carbon Strategy, it was important to provide updates on scientific developments and measurement capabilities that occurred since the 2010 publication of that report and to anticipate the carbon information needs for climate policy [e.g., UNFCCC and Intergovernmental Panel on Climate Change (IPCC)]. This CEOS report also takes into account, and attempts to be consistent with, the GCOS IP and its requirements for ECVs.

3.1. Purpose

The Strategy for Carbon Observations from Space report presents the CEOS strategy for the planning and coordinated provision of space-based observations of the carbon cycle and its components in support of scientific and societal needs for carbon-related information. Specifically, it focuses on the satellite observations and the efforts of space agencies to provide them, and of CEOS to coordinate and encourage a well-balanced and integrated suite of space-based observations.

It guides future CEOS actions, priorities, and planning, and provides the basis for systematic monitoring and reporting of progress toward satisfying the carbon information needs of science and society—specifically with regard to the establishment, sharing, and coordination of space-based Earth observations of carbon and related Earth system properties.

The report is intended to inform and be a resource for GEO as it works to coordinate efforts to build a Global Earth Observation System of Systems (GEOSS) and for the UNFCCC as it strives to set the framework for nations to limit average global temperature increases and resulting climate change, and to cope with the impacts of climate change. Other stakeholders that will find the information and plans for future CEOS activities and coordination of interest include: the international scientific community, the International Council for

Science's (ICSU) International Geosphere-Biosphere Programme (IGBP), the Earth System Science Partnership (ESSP), and the new Future Earth initiative.

3.2. Background and Context

The IPCC Fourth (2007) and Fifth (2013) Assessment Reports both conclude that warming of the climate system is unequivocal and that anthropogenic emissions of greenhouse gases are responsible for most of the increase in global average temperatures. The ocean and terrestrial biosphere are currently absorbing about half of the CO_2 emitted by anthropogenic activities (primarily fossil fuel combustion), reducing the rate of atmospheric CO_2 buildup and its effects on the climate. However, the nature and location of these carbon sinks is still inadequately understood. The efficiency of CO_2 sinks and CO_2 and CH_4 sources may also change as the climate warms, introducing large uncertainties in the future net flux of these gases. An improved understanding of global carbon cycling processes and quantitative measurements of changes in carbon pools and fluxes are urgently needed to reduce uncertainties in projections of future global warming and climate change. They are also needed to inform planning for societal actions to mitigate and/or adapt to climate change and to monitor and quantify the effects of those actions.

The 2010 GEO Carbon Strategy Report identified the need for and possible approach to the implementation of an IGCO to address the three components of the carbon cycle (atmosphere, land, and ocean) and their interactions. The Report noted:

> Understanding the global carbon cycle, and predicting its evolution under future climate scenarios is one of the biggest challenges facing science today; there are huge societal implications… A key reason for our lack of understanding of the global carbon cycle is the dearth of global observations. An increased, improved, and coordinated observing system for observing the carbon cycle is a prerequisite to gaining that understanding.

The basis for GEO's IGCO was initially developed through the Integrated Global Observing Strategy Partnership (IGOS-P) in 2004–05 and described in the 2005 Integrated Global Carbon Observations Theme Report. The IGOS-P was a particularly effective framework in bringing together user communities, scientists, and in situ and space observation organizations to produce a focused and coherent statement of needs and capabilities for a number of selected Earth system components—of which the carbon cycle was one. The IGOS-P themes have since been integrated into the GEO framework, as Communities of Practice (CoP), and the Carbon CoP continued the task started by the IGOS-P Carbon Theme team. Given significant advances in science and changes in observing system capabilities and plans, the GEO Carbon CoP produced the 2010 GEO Carbon Strategy report as an update of the Integrated Global Carbon Observations Theme Report. The GEO Carbon Strategy was followed by a publication in which many of the same authors highlighted the needs for a policy-relevant carbon observing system.

Measurement, Reporting, and Verification (MRV, also referred to as Monitoring, Reporting and Verification or Measuring, Reporting, and Verifying) has emerged recently as a central issue for effective tracking of progress by parties to the UNFCCC in meeting their national commitments and achieving the Convention's overall goals. MRV involves quantitative measurement of carbon emissions to the atmosphere and/or of the efficacy of mitigation actions to reduce carbon emissions; compilation and integration of the information into

reports and inventories; and independent evaluation of the accuracy and utility of the information. It seems clear that satellite data products could have enormous value within an MRV system. However, the requirements of decision makers with respect to the need for MRV are not yet completely clear. They will depend on the policies that are enacted, the spatial and temporal scales of significance for monitoring, and the accuracies desired. Projects in support of Reducing Emissions from Deforestation and Forest Degradation (REDD) provide current MRV examples [e.g., the Global Forest Observation Initiative (GFOI)].

CEOS plays an influential role in coordinating the implementation of the satellite component of GEOSS – which is the vision pursued by GEO for linking existing and planned observing systems around the world and supporting development of new systems where gaps currently exist. This responsibility includes the coordination of space observations in support of the Climate Societal Benefit Areas (SBA); there are nine SBAs in GEO whose requirements are expressed in the GCOSIP (released in 2006, updated in 2010) and complemented by detailed requirements on space agencies gathered in the GCOS Satellite Supplement. Upon the request of GCOS, CEOS has already implemented a systematic process for reporting to the UNFCCC on space agency progress made in responding to the space-related needs of the GCOS IP of 2010, and this process represents a model that could be adopted for the implementation of recommendations from this report. Recognizing the increasing importance of carbon observations to a range of societal needs (including, but not restricted to the Climate SBA and potentially MRV), this report is an important opportunity to develop a more specific and detailed assessment focused on the planning for carbon-related observations from space. Through CEOS, space agencies worldwide will be able to provide a concerted response to the needs identified by the carbon community and to work with GEO towards the vision of an IGCO.

3.3. Scope, Objectives, and Summary of Chapters

CEOS has determined that its Strategy for Carbon Observations from Space should:

- Be comprehensive, defining a strategy for space-based observations in support of global carbon measurement requirements, covering atmospheric, terrestrial, and oceanic observations as well as observations of the interfaces among them;
- Require the acquired data to be cross-calibrated and validated to make it possible to use the data in combination and over long time periods;
- Provide a long-term outlook, to 15 years hence, with the goal of a sustained observation system in support of societal needs and in recognition of the long-term nature of climate data records and needs for on-going measurement, monitoring, and assessment strategies;
- Address the needs of science, policy, industry, and the public for information about carbon in the environment, taking into account the scientific requirements detailed in the GEO Carbon Strategy and the needs for carbon information expressed in the IPCC's Fourth Assessment Report, by the UNFCCC, and in the GCOS IP;
- Address the establishment of appropriate and effective institutional arrangements, within CEOS and between CEOS and other institutions, for realization of the space component of the IGCO; and
- Provide a framework for monitoring, reporting, and communicating progress towards implementation of the space component of IGCO.

Following an introductory chapter, chapters 2, 3, and 4 address the land, oceans and inland waters, and atmosphere domains, respectively. Each considers and characterizes the nature of the requirements for satellite observations in its respective domain. The current status of carbon and carbon-related observations is summarized and the prospects and trends for the coming years outlined. These capabilities are assessed for their adequacy versus the requirements identified to fulfill future needs in support of the IGCO. This assessment provides the basis for the recommended actions regarding future CEOS efforts.

Each of these three chapters reinforces the requirements for space-based carbon observations articulated in the GEO Carbon Strategy and also provides an updated perspective, incorporating information available since 2010 as well as additional detail on satellite measurement capabilities and plans. The CEOS System Engineering Office provided gap analyses for the ocean and atmosphere domains chapters for current and planned satellite missions and the adequacy of the data from these missions. A preliminary analysis was performed for the land domain chapter, but a full-scale analysis was not requested because a significant fraction of the land variables of interest for carbon are not reported in the CEOS Mission, Instruments, and Measurements (MIM) database. The balance of content and emphasis within each of the domain chapters differs as a result of the maturity and diversity of space-based carbon and carbon-related observations currently available, planned, and needed for that domain.

Chapter 5 discusses observations at the interfaces among the three domains, integration of information across the different domains, and common requirements for observations, data products, supporting activities, and infrastructure. Many of the latter requirements may apply to other types of satellite observations as well, but this report stresses their importance as related to carbon observations.

Chapter 6 discusses the way forward for CEOS in implementing this Strategy for Carbon Observations from Space and meeting the space component needs of the IGCO. The challenges ahead are described. Recommendations regarding CEOS mechanisms for implementation, oversight, and reporting are described.

Throughout the report, important missions, data products, and related activities are identified to move carbon cycle science and its policy applications forward and to achieve goals identified by the IGCO in the GEO Carbon Strategy. In some cases, the ability and authority to take action fall outside the purview of CEOS and its coordination functions, and it is unreasonable for CEOS to accept full responsibility for the recommendation and its completion. These goals, however, represent major challenges that nations, intergovernmental organizations, and the scientific and policy communities must work together to address in the long run, with CEOS playing a key role.

This report takes the unusual step of offering recommendations of two types: Challenges and CEOS Actions. “Challenges” are recommendations that CEOS will acknowledge as important, legitimate needs and agree to factor into its planning for future CEOS coordination activities and priorities. “CEOS Actions” are specific activities that CEOS commits to implement, track, and report on following established procedures. Specific CEOS Actions may represent small steps toward meeting the larger Challenges.

The CEOS Actions are grouped in each chapter according to the following five types: Mission-Related; Product-Related; Calibration/Validation-Related; Interactions/Linkages/Communications-Related; and CEOS Mechanisms- and Future Planning-Related. Actions are numbered in order of occurrence in the document and are repeated (but with same reference number) if pertinent to the recommendations of more than one chapter. When possible, specific CEOS Working Groups, Virtual Constellations, or other internal CEOS entities are identified as appropriate recipients of a CEOS Action. In some cases individual CEOS agencies may be associated with an Action.

This report does not analyze or discuss in depth priorities for supporting observations of climatic and other variables (satellite or in situ) that are used in conjunction with observations of carbon and carbon-related properties (e.g., to drive carbon models or to analyze or evaluate data products). However, the need for such observations is noted in relevant sections. In order to keep a sharp focus on carbon and not repeat the work of others, this report relies on GCOS and IGOS reports, the ongoing work of the CEOS WGClimate, and other relevant reports and groups to analyze and detail the requirements for supporting climatic and other observations.

3.4. Actions and Next Steps

The authors of the CEOS Carbon Strategy report have identified high priority needs for decisions, resources, and actions that go well beyond the scope of what CEOS alone can do and that exceed the mandates and current capacities of many of its Agencies. These needs are contextual challenges that CEOS should acknowledge and does, as Challenges and CEOS Actions (described in the preceding section). Actions to coordinate existing and planned satellite missions and challenges associated with developing and deploying missions to make new, high-priority measurements feature prominently in this report's findings. The report also calls for CEOS to devote additional attention to improvements in data products; development of new data products; calibration and validation work; and promoting long-term archive and availability of carbon-related satellite data and products for science and policy. In total, the CEOS Strategy for Carbon Observations from Space identifies 20 contextual Challenges and 42 CEOS Actions.

The Ad Hoc CEOS Carbon Strategy Implementation Study Team (CSIST) was created at SIT-29 (April 2014) and tasked with developing a set of implementation options for the 42 Actions contained within this report. This set of implementation options was presented for consideration at the CEOS SIT Workshop in September 2014. Based on the outcome of the SIT Workshop discussions, a recommended way forward will be proposed for consideration and decision by the CEOS Plenary in October 2014.

Reference web sites for reports identified in this summary:

Committee on Earth Observation Satellites: http://www.ceos.org/

Coordination Group for Meteorological Satellites: http://www.cgms-info.org

Global Climate Observing System: http://www.wmo.int/pages/prog/gcos/

Intergovernmental Panel on Climate Change: http://www.ipcc.ch/

United Nations Framework Convention on Climate Change: http://unfccc.int/2860.php