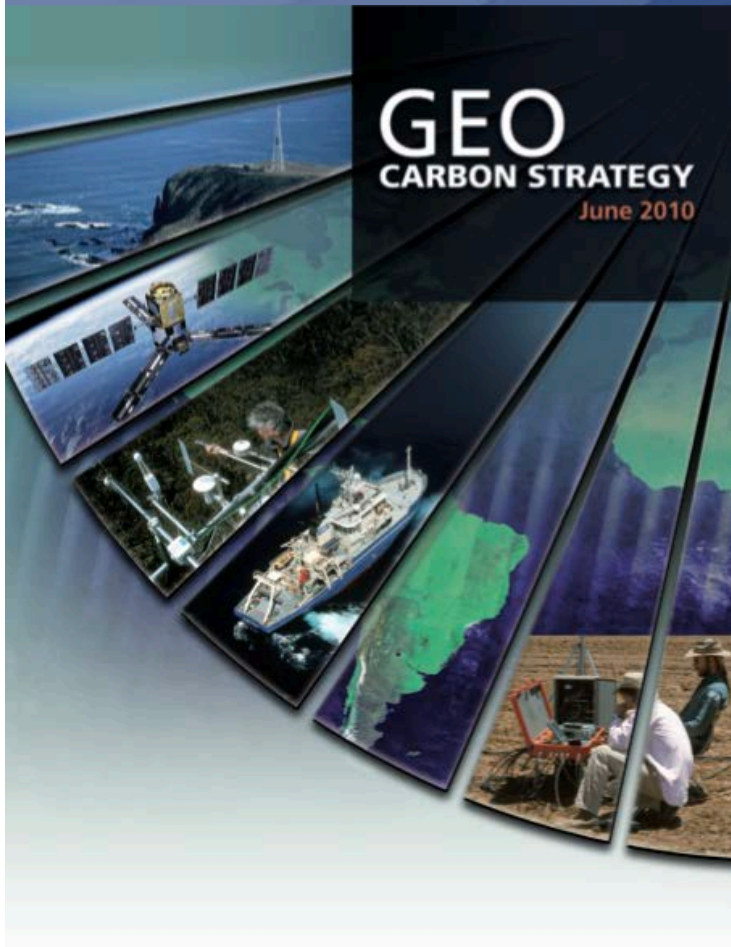


# The CEOS Strategy for Carbon Observations from Space

Shubha Sathyendranath, Stephen Plummer, Diane Wickland, Masakatsu Nakajima

(on behalf of the CEOS Carbon Task Force)

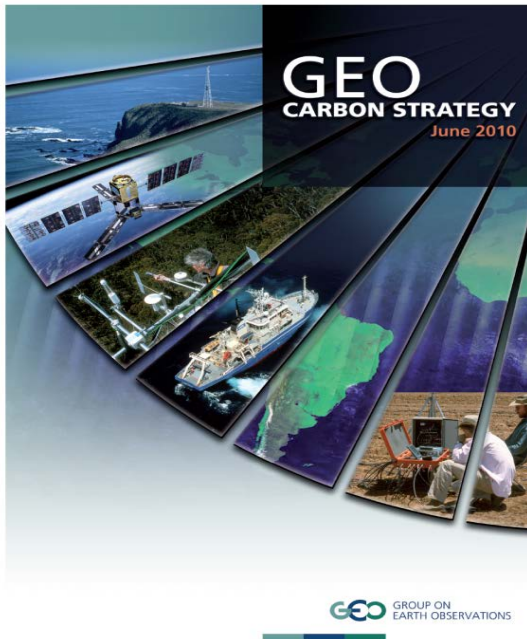


CCI Colocation Meeting  
ESRIN, February 2014

# Rationale



Committee of Earth Observing Satellites



- ❖ GEO Carbon Strategy report of 2010 – updates the IGOS Carbon Theme Report from 2005
- ❖ CEOS has agreed to consider how to respond to the requirements for satellite observations laid out in the GEO Carbon Strategy report
- ❖ CEOS established the Carbon Task Force (CTF) to coordinate the response from the Space Agencies to the GEO Carbon Strategy.
  - Take into account information requirements of both the UNFCCC and IPCC and consider how future satellite missions will support them
  - Also take account of, and be consistent with, the GCOS and GEO Implementation Plans.
  - Help definition of next generation missions for individual agencies
  - Provide a basis for systematic observation and reporting of progress towards satisfying society's carbon information needs



The *GEO Carbon Strategy* states:

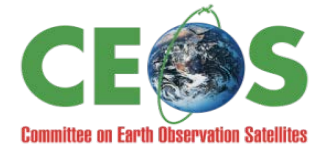
*“a key reason for our lack of understanding of the global carbon cycle is the dearth of global observations,”* and calls for *“an increased, improved and coordinated observing system for observing the carbon cycle as a prerequisite to gaining that understanding.”*

The Committee on Earth Observation Satellites (CEOS) is well positioned to meet this challenge and provide needed coordination for the space-based observations called for in the *GEO Carbon Strategy*.



# Report Structure and Chapter Leads

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## *CEOS Strategy for Carbon Observations from Space*

Executive Summary (Nakajima, Wickland, Plummer)

Chapter 1: Introduction (Nakajima, Wickland, Plummer, and Ward)

Chapter 2: Land Domain (Schmullius and Dubayah)

Chapter 3: Oceans and Inland Waters Domain (Sathyendranath)

Chapter 4: Atmosphere Domain (Moore)

Chapter 5: Integration (Plummer)

Chapter 6: The Way Forward (Wickland, Nakajima, Plummer)

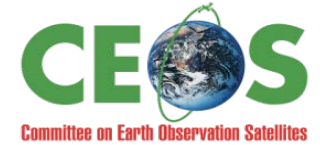
References

Appendices

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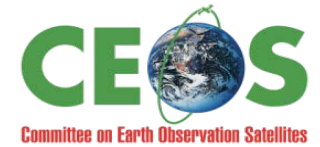
# Major Cross-Cutting Themes



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- A need for improved understanding of the global carbon cycle
  - A need for greater clarity in requirements to support climate policy
  - A need for greater coordination of existing and planned satellite observations
  - A need for an integrated approach to carbon observations – and Earth system approach, not a disciplinary one
  - A need to do more with the data we have (e.g., compatibility within and across domains, transparent product generation and complete documentation), new data products, data products customized for particular uses, secure long-term archives, and free and open access
  - A recognition that satellite-based approaches cannot succeed without key *in situ* observations and networks
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# Summary of Actions: Continuity Missions



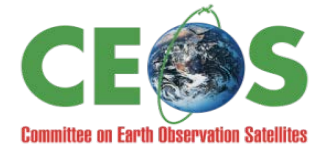
The report calls for CEOS agencies to assign high priority to continuing the following types of measurements for carbon:

- Moderate resolution land remote sensing data (e.g., MODIS)
- Medium resolution land remote sensing data (e.g., SPOT, Landsat)
- Ocean colour, sea surface temperature, and microwave sensor observations that are adequately calibrated and have sustained calibration/validation operations.
- Ocean colour measurements with resolution and frequency of coverage adequate for coastal waters
- Measurements with sufficient spatial resolution and sensitivity for inland water bodies (e.g., Landsat 8 and Sentinel-2 type measurements)
- Atmospheric column measurements of  $X_{\text{CO}_2}$  and  $X_{\text{CH}_4}$  (e.g., GOSAT)

**Note: Mission requirements largely consistent with GCOS Requirements**



# Summary of Actions: New Missions



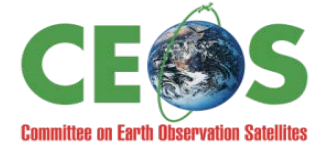
**The report calls for the CEOS member agencies to deploy new missions to acquire high priority, new observations of carbon. These high priority missions are:**

- A lidar mission to measure forest canopy height and vertical structure
- Geostationary observations of ocean colour with high temporal resolution for coastal waters
- An ocean salinity mission with higher spatial resolution than current missions
- A constellation of passive and active LEO satellites measuring  $X_{\text{CO}_2}$  and  $X_{\text{CH}_4}$
- A constellation of passive GEO satellites measuring  $X_{\text{CO}_2}$  and  $X_{\text{CH}_4}$



## Current Status of Report

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**Report is being revised based on review comments received.**

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Report contains links and references to the ESA Climate Change Initiative:

“...there is a need to equate the land cover classes with Plant Functional Types ... For example, in the framework of the on-going ESA Land Cover Climate Change Initiative, MERIS-retrieved land cover products are being translated into PFTs for carbon-flux assessments in Dynamic Global Vegetation Models...”

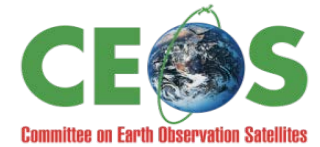
“...programs such as the Climate Change Initiative of the European Space Agency are moving away from a mission perspective to a product perspective, highlighting the need for bringing many missions together in a consistent fashion to produce long time series of essential climate variables...”

It also shares similarity of vision, for example, with respect to engaging users.

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# Interacting with User Communities

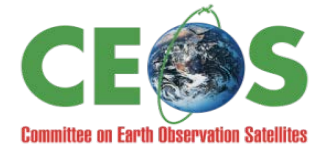


The primary beneficiaries are the international carbon cycle science community, GEO, UNFCCC, UN-REDD, and other organizations interested in information about changes in carbon within the Earth system. CEOS must establish strong and sustained interactions with these stakeholders.

- Regular communications with the GEO Carbon Community of Practice, Global Carbon Project of the IGBP and eventually Future Earth
- Identify and work closely together with GEO on shared tasks for carbon (e.g., currently the GEO CL-02 Task). CEOS and GEO should also consider joint conceptualization and endorsement of relevant workshops, conferences, and special activities.
- CEOS should act to make sure space-based observations, data products and information are made readily available in clear and understandable ways to the policy makers developing and implementing climate mitigation and adaptation policies.

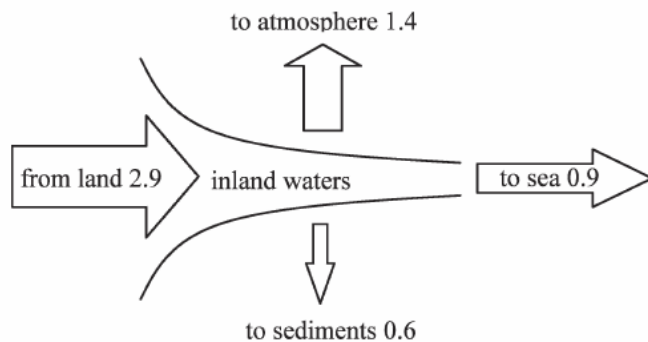
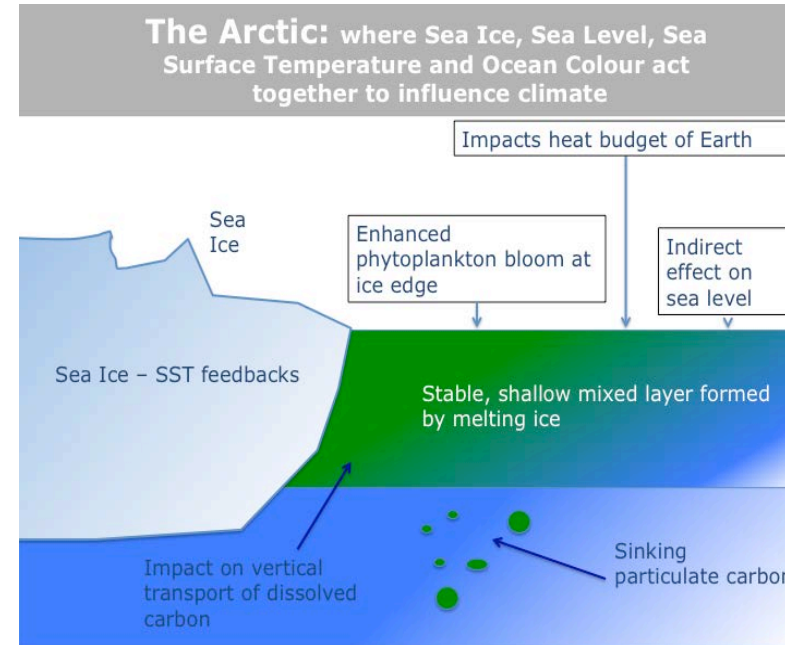
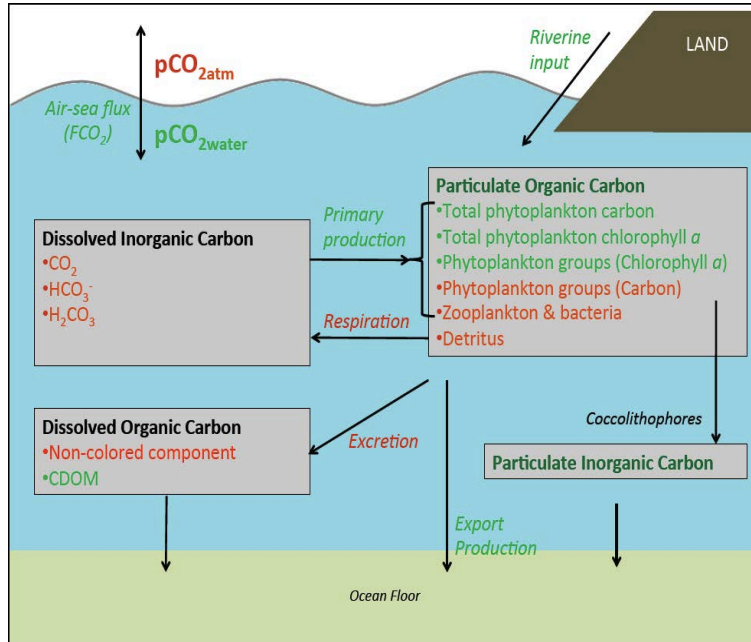


# Summary of Actions: Institutional Linkages



The report contains several recommendations for CEOS and its member agencies to engage with other groups and the carbon science community in order to improve communications and optimally address actions. These include:

- Interactions with the [GEO Carbon Community of Practice](#) and the [GEO Blue Planet initiative](#) to advance work on new products and data product intercomparisons
- Interactions with [the carbon and climate modeling communities](#) and CEOS Working Group on Climate in support of data-model intercomparisons
- Interactions with the GEO carbon community of practice to understand science needs and priorities for missing measurements that satellites could provide beyond 2020



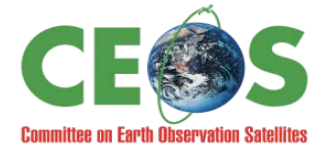
“an observing system does not constitute a carbon observation system until the data products have been expressed in carbon units and can contribute to **accurate estimates of carbon pools and fluxes**”

Recognises the importance of cross-domain fluxes and interactions

Multi-ECV requirements are highlighted



# Summary of Actions: New Data Products



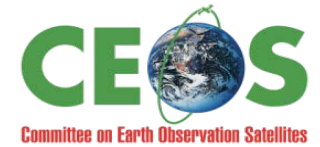
The report calls for CEOS to encourage the development of new data products from existing missions. These include:

- Maps of wetlands, inundated areas and small water bodies
- Ocean colour-type products for inland water bodies
- Ocean carbon pool products
- River discharge and sediments
- Merged time series products (same variable from differing sensors and platforms), using a product-based approach
- Estimates of anthropogenic emissions



## Thinking beyond CCI Phase 2

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**The CEOS Report contains many elements on which to build a successor to CCI**

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