Committee on Earth Observation Satellites

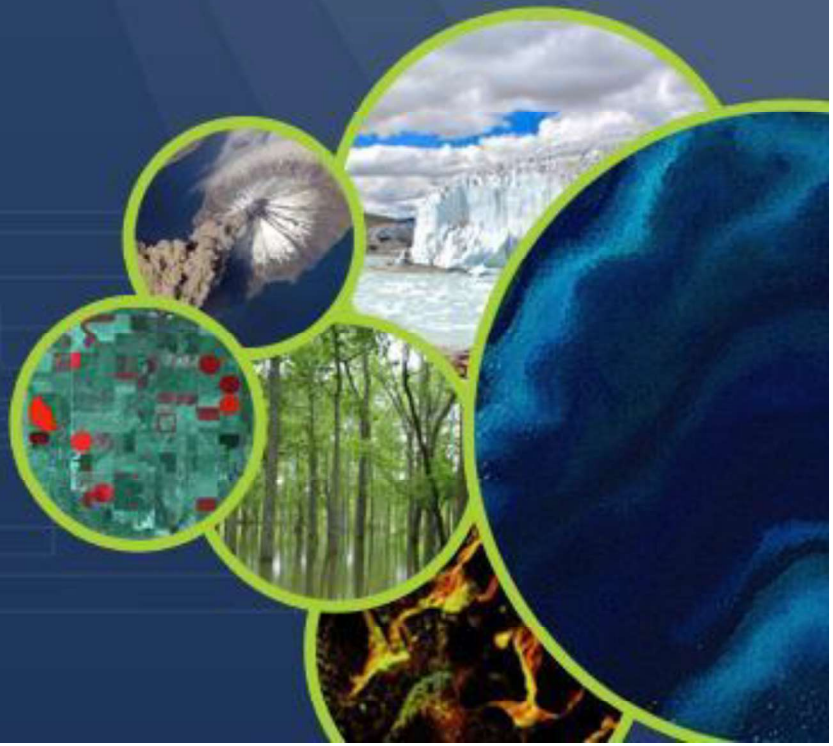
GHG Roadmap

Mark, Albrecht et. al.

CEOS Plenary 2020

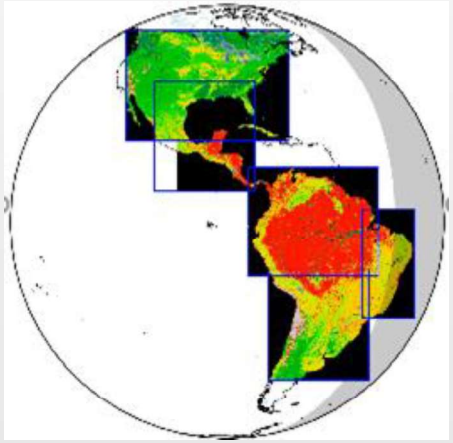
Agenda Item #3.4

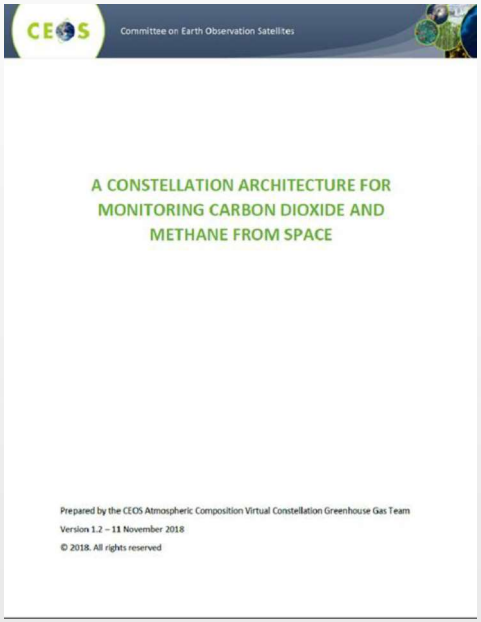
20 – 22 October 2020



The Architecture for Monitoring Atmospheric CO_2 and CH_4 Concentrations

- **The CEOS Atmospheric Composition Virtual Constellation (AC-VC) white paper defines a global architecture for monitoring atmospheric CO_2 and CH_4 concentrations from instruments on space-based platforms**
- 166-page document, 88 authors from 47 organizations
- Executive Summary (2 pages)
- Body of report (75 pages)
- Technical Appendices (42 pages)





http://ceos.org/document_management/Virtual_Constellations/ACC/Documents/CEOS_AC-VC_GHG_White_Paper_Publication_Draft2_20181111.pdf

High Level GHG Roadmap Timeline

Global Stock Take 1 using inventories through 2021

Global Stock Take 2 using inventories through 2026

2015 2017 2019 2021 2023 2026 2028

CEOS GHG Whitepaper

Pilot atmospheric CO_2/CH_4 Data sets

Consultation of Inventory requirements

Refined atmospheric GHG requirements

Initial Operational GHG Constellation Deployment

Atmospheric GHG data sets from operational system

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

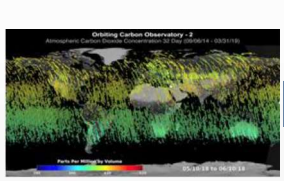
Proposed Architecture Actions

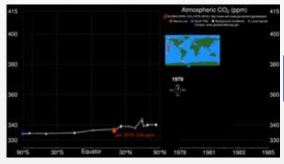
1. Link the atmospheric GHG measurement and modeling communities and stakeholders in the national inventory and policy communities (through UNFCCC/SBSTA).

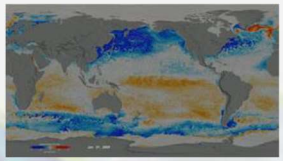
2. Exploit the capabilities of the CEOS and CGMS member agencies and the WMO Integrated Global Greenhouse Gas Information System (IG^3IS) to integrate surface and airborne measurements of CO_2 and CH_4 with those from available and planned space-based sensors to develop a prototype for the 2023 global stock take.

3. to implement a complete, operational, space-based constellation architecture with the capabilities needed to quantify atmospheric CO_2 and CH_4 concentrations that can serve as a complementary system for estimating NDCs in time to support the 2028 global stock take.

A System Approach is Adopted to Deliver Atmospheric CO_2 and CH_4 Inventories







Observations

- **Satellite Measurements of CO_2 and CH_4**
- **Ground and Airborne Measurements of CO_2 and CH_4**
- **Meteorology** Satellite & in-situ
- **Auxiliary Data** Satellite observations of CO, NO_2, clouds, aerosols …

Prior Information

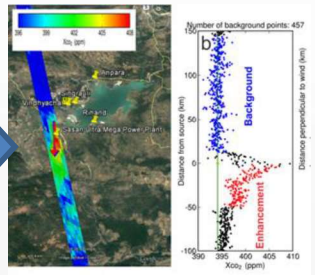
Fluxes, model parameters, emission reports, economic statistics.

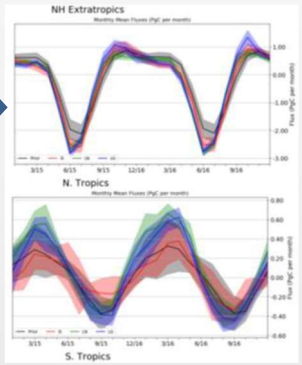
Integration & Attribution

- **Estimation system** Data assimilation and uncertainty estimation
- **Models** Transport, land & ocean carbon cycle, fossil fuel emissions.

Outputs

- **CO_2 and CH_4 emissions & removals from Hot-spots** with uncertainties
- **Country/region CO_2 and CH_4 emissions & removals** with uncertainties
- Other Carbon Cycle Products





Recent RSO conclusions

SBSTA 51 (2019) FCCC/SBSTA/2019/5 Earth Information Day 2019

35. The SBSTA welcomed the work of the scientific community, Parties, climate service providers, and space agencies in **collecting, managing and openly sharing data and processed data products** for addressing climate change and current and future climate risk.

The SBSTA **urged Parties and relevant organizations to continue to establish and support open data sharing, and the development of openly available, relevant and accessible data products**, particularly for supporting and monitoring adaptation and mitigation.

40. Recalling the conclusions of SBSTA 47, the SBSTA welcomed the continued work of the Joint CEOS/CGMS Working Group on Climate in response to the GCOS implementation plan.

It **recognized the systems approach of the constellation architecture**, which combines satellite, in-situ and modelling components for emission estimates, for monitoring CO_2 and CH_4 from space.

It encouraged meaningful engagement among the space agencies, modellers and Parties in the implementation and use of the system.

Constellation architecture recognized by the SBSTA

GHG Roadmap Objectives and Status

- **The GHG Roadmap was established to coordinate ongoing and planned greenhouse gas measurement and analysis activities across space agencies and foster the development of interfaces with stake holders and users.**

- **The GHG Roadmap (v2.4) describes an approach for implementing the GHG Strategy and specifies resource needs**
  - Maintained by the WGClimate GHG Task Team
  - Considered to be a living document whose Actions (Annex C) provide a snapshot of the work plan, which will be updated over time

- This version of the Roadmap was submitted to the 2020 CGMS Plenary for endorsement.

Roadmap Table of Contents

Interface to and Feedback from External Communities

Engagement with external stakeholders and end users is fundamental to the success of the implementation of the system approach:

- Engagement with the emission inventory community is critical to the iterative feedback approach, both:
  - Through existing international coordination mechanisms (e.g. Global Emissions InitiAtive - https://www.geiacenter.org)
  - Through working with champion users on real applications – «beta testers»
- Continued engagement with international policy frameworks, i.e. UNFCCC/SBSTA, IPCC TFI
- Engagement with technical implementing entities at international level, i.e. WMO IG^{3}IS and Joint Programmes supporting the Convention, i.e., GCOS, as well as the broader modelling community.

Making inroads in GEIA

1. GEIA Meeting (154 participants) on 24 June 2020. The polls have identified the following research priorities:
   - a. How do we best facilitate the information flow between global and local scale?
   - b. How can we best use satellite observations to constrain emissions in regions with less available/reliable information bottom-up?
   - c. How tackling energy sources in local/urban pollution (not only from transport, but also small scale industry, fugitive dust, waste, agriculture)?
   - d. How do we facilitate and guide the use of uncertainty information in models and inventories?
   - e. How to better deal with source apportionment for emissions of natural sources, dust, fires, agriculture?
2. More specific on the GEIA working group monitoring GHGs:

Call for collaborating in Working Group for Monitoring GHGs & Co-emitted Species Across Scales with:

- a. Global scale information is feeding into local scale, but how can we go back from the local scale and using the detailed information for a revision of global scale databases in a systematic way?
  i. GHG emission gridmaps near real time
  ii. Co-emitted species
  iii. Use of atmospheric measurements in situ and space-borne
  iv. Focus: 2019-2020, to prepare for 2021 = base year for Paris' Global Stocktake
- b. We call for BRIDGING COMMUNITIES AND EXCHANGING PRACTICES to demonstrate GHG monitoring and verification in- and outside EU.
- c. A follow-up meeting will be organized in Autumn 2020. In case of interest, please contact: greet.maenhout@ec.europa.eu

3. Upcoming GEIA Steering Committee meeting will try to progress on the WG for monitoring GHGs

Expected Outcomes of the Roadmap Activities

Roadmap Products

- The delivery of pilot datasets of CO_2 and CH_4 fluxes to enhance the uptake of Earth Observation satellite data sets in support of the Global Stocktake 2023;
- The delivery of an operational system for producing future atmospheric CO_2 and CH_4 flux products to support the Global Stocktake 2028; and
- The refinement of user requirements in preparation of the implementation of the operational system.

Progress

- Established critical interfaces with the UNFCCC SBSTA and GCOS.
- Made progress pilot atmospheric CO_2 and CH_4 inventory
  - Delivery of the OCO-2 version 10 XCO_2 and SIF data products
  - Advances in GHG flux inversion models by the NASA OCO-2 and CMS and Copernicus CAMS

Resource Implications and Needs from CEOS/CGMS

Three broad categories of resources are envisaged and requested for consideration by Agencies (introduced at CEOS Plenary 2019):

1. **Dedicated human resources** supported through Agency programmes & grants :

– Agencies are asked to provide support to the WGClimate Task Team (~17 PM/yr) Assumption: 15 members with 1PM/yr effort per member & 2 PM/yr effort for the two leads

– Agencies are asked to continue, and in some cases increase support to the GHG relevant staff (time & travel) contributing to the technical implementation tasks in CEOS and CGMS

2. **Support for travel and hosting of workshops** and networking with:
    - National inventory community
    - Atmospheric GHG measurement and modelling communities
    - Stakeholders (GCOS, UNFCCC/SBSTA)

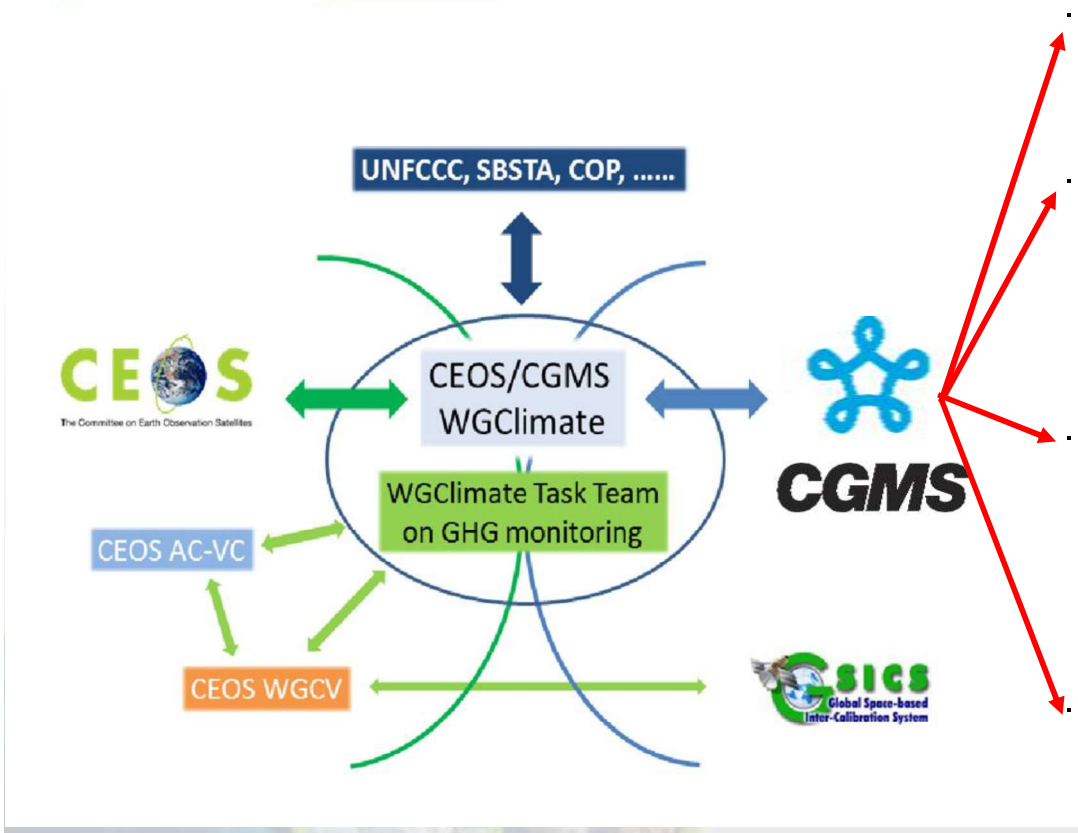
3. [On longer-term] Through internal funding mechanisms support research, development and infrastructure for priorities identified by GHG Task Team and Roadmap Implementation (annual updates will be provided to Agencies)

GHG TT Skill Request

For WGClimate GHG Task Team, the following “profiles” are needed:

- Core team ensuring linkages to internal CEOS/CGMS entities (i.e., WGClimate – Dowell/von Bargen, AC-VC – Crisp, WGCV – Kuze)
- CEOS and CGMS Agency staff representing GHG missions/programmes
- Agency staff from “operational” agencies to ensure operational transition
- Agency Staff/Experts with links to Inventory Community
- Agency Staff/Experts involved in modelling aspects

CGMS involvement in the GHG Task Team



Working Group I: Ensuring that the implementation of the GHG roadmap addresses the objectives of the WIGOS vision

Working Group II: Facilitating the definition and application of standards for operational GHG constellation products and operational aspects of the satellite data production systems at international level

Working Group III: Mapping the CGMS agency plans for CO_2 and CH_4 relevant measurements onto the CGMS baseline, identifying continuity issues and proposing contingency planning

Working Group IV: Addressing operational access and end user support as well as training for GHG constellation products in cooperation with CEOS WGISS and WGCapD

As reported by Jörg Schulz: [The CGMS] Plenary endorsed the GHG roadmap version 2.4 and welcomed the proposal to have dedicated Points of Contacts (PoCs) for the JWG Climate GHG Task Team identified in all CGMS Working Groups (I - IV). The lead of the GHG Task Team is requested to define priorities for CGMS WG contributions

Agencies who have offered resources

- Mark Dowell (EC, WGClimate, Task Team lead)
- Albrecht von Bargen (DLR, WGClimate Vice-chair, deputy Task Team lead ex officio)
- Frederic Chevallier (LSCE/IPSL)
- David Crisp (NASA, CEOS AC-VC)
- Carole Deniel (CNES)
- Richard Engelen (ECMWF)
- Hiroshi Suto (JAXA)
- Akihiko Kuze (JAXA, CEOS WGCV)
- Rüdiger Lang (EUMETSAT)
- Yaska Meijer (ESA)
- Paul Palmer (UKSA)
- Hiroshi Tanimoto (NIES)
- Alisa Young (NOAA)
- N.N. (agency representative)
- N.N. (CGMS WG representative)
- N.N. (CGMS WG representative)
- N.N. (GSICS representative)

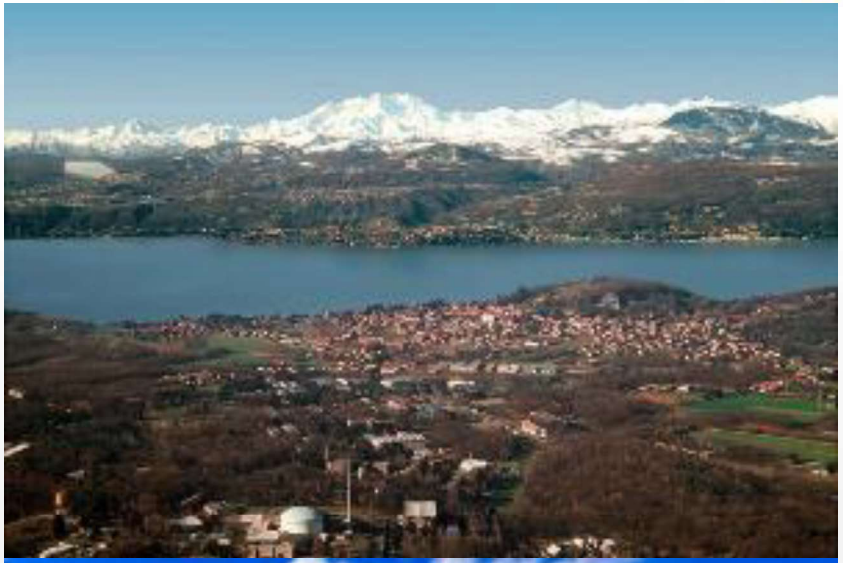
CEOS Plenary is invited to endorse:

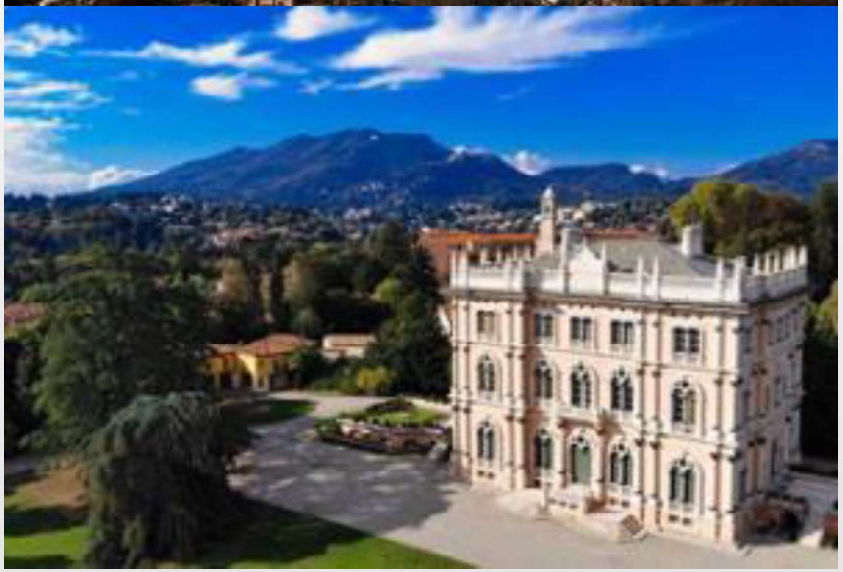
The GHG Roadmap document (v2.4), describing an approach and resource needs for the implementation of the GHG Constellation Strategy. This is to be considered a living document and the Actions in Annex C provide a current snapshot of the work plan definition which will be updated over time. CEOS Agencies will strive to provide the identified resources for the specific activities and entities.

Starting Discussion
GHG-AFOLU Workshop

Workshop on synergies and opportunities between GHG and Agriculture Forestry and Other Land Use (AFOLU) Earth Observation communities working in support of UNFCCC

- [**Postponed**] Originally planned July 9-10th 2020 Varese-Italy
- Start dialogue between the different Earth Observation communities addressing the needs of UNFCCC.
- In particular, atmospheric GHG monitoring and those addressing aspects of the AFOLU sector (incl. REDD+).
- Co-organised, based on an identified gap, both at the European level through discussions in Copernicus as well as at the international level CEOS, GEO





GHG-AFOLU Workshop

The workshop plans to address:

- both the "soft" coordination and stakeholder engagement aspects of the interface with the Convention, the UNFCCC Secretariat and,
- Parties (including through their inventory agencies/compilers) but also more technical aspects of reporting, outputs datasets, formats, avoiding "double-accounting" and the longer-term ambition of using diverse earth observation datasets in the modelling and data integration systems being developed.

Now postponed till ~Q2 2021, but plan:

- initial discussion at CEOS SIT Technical Workshop [Done]
- European discussion in context of CHE-VERIFY Q4 2020 (organised by ECMWF).
- International meeting in 2021 should include CEOS/CGMS, GFOI, GEO, UNFCCC Sec, GCOS, GOFC-GOLD etc.