4th Carbon from Space Workshop

Stephen Plummer

25/10/2022

Welcome and Logistics

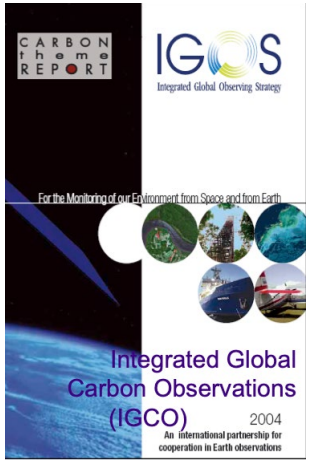
Scope

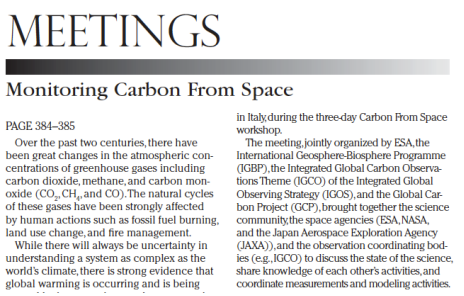
'a forum to discuss the carbon cycle cutting across the traditional scientific domains of Land, Ocean and Atmosphere AND improve interactions between the in situ, modelling and Earth observation communities with the objective to improve understanding and observation of the carbon cycle.'

The meetings are coordinated by ESA
co-sponsored by NASA, CEOS, Global Carbon Project and the European Commission

A Brief History ……of Meetings

..the underlying theme of the meeting was the need for interaction within and among the scientific community, the agencies responsible for coordinating observations and programs, and the space agencies responsible for space-based observations and satellites





MEETINGS

Monitoring Carbon From Space

PAGE 384–385

Over the past two centuries, there have been great changes in the atmospheric concentrations of greenhouse gases including carbon dioxide, methane, and carbon monoxide (CO_2, CH_4, and CO). The natural cycles of these gases have been strongly affected by human actions such as fossil fuel burning, land use change, and fire management.

While there will always be uncertainty in understanding a system as complex as the world's climate, there is strong evidence that global warming is occurring and is being

in Italy, during the three-day Carbon From Space workshop.

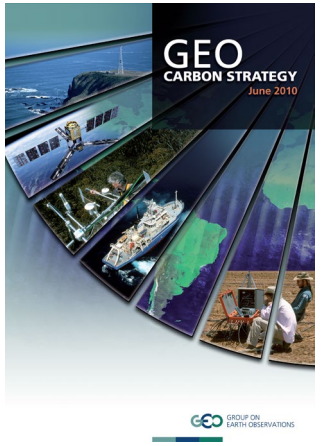
The meeting, jointly organized by ESA, the International Geosphere-Biosphere Programme (IGBP), the Integrated Global Carbon Observations Theme (IGCO) of the Integrated Global Observing Strategy (IGOS), and the Global Carbon Project (GCP), brought together the science community, the space agencies (ESA, NASA, and the Japan Aerospace Exploration Agency (JAXA)), and the observation coordinating bodies (e.g., IGCO) to discuss the state of the science, share knowledge of each other's activities, and coordinate measurements and modeling activities.

EOS Meeting Report

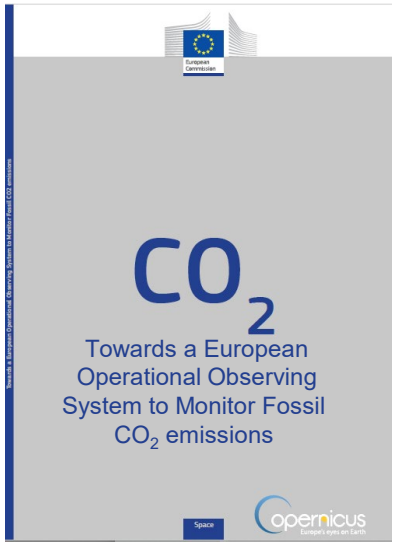
2005

2010

Group on Earth Observations (GEO) Carbon Strategy (Ciais et al., 2010, 2014), Committee on Earth Observation Satellites (CEOS) Strategy for Carbon Observations from Space (CEOS, 2014)



A Brief History ……of Meetings



2016

44 recommendations for activities

2022

3rd CfS Recommendations

Recommendations for Action from the 3rd Carbon from Space Meeting (Land)
Progress in the last 5 years

The following series of recommendations were made during the 3rd Carbon from Space meeting in 2016. At the Living Planet Symposium we have organised an Agora discussion session to review progress against these recommendations and look ahead to the 4th Carbon from Space meeting.

We would be very grateful for any observations on what has been done over the last 5 years and what is still to be done, what new issues have arisen.

1. Budgets – Regional

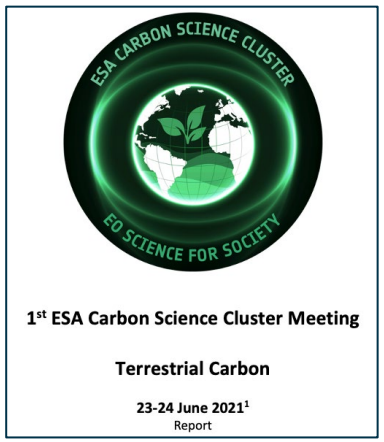
Number	Description	Progress made	What needs to be done
1	Improve partitioning between land and ocean at the regional scale		
2	Reduce discrepancies between methods to estimate regional carbon sinks and uncertainties in models at the regional level.		
3	Improve understanding of actual drivers of sinks at both global and regional levels;		
4	Reduce uncertainty in emissions (both fossil and LUC) and generate annual estimates of LUC to account for important processes (e.g., ENSO-related variability);		
5	Improve understanding of and characterise the CO_2 effect versus the effect of climate (and land-use).		
6	Explicitly include transport of carbon from land to the oceans		
7	Address inconsistency within inversions for both natural CO_2 and CH_4 fluxes		
8	Investigate regional differences between satellite and in-situ observation inversions for natural CO_2 fluxes.		
9	Estimates of the global terrestrial carbon sink need to be explicitly derived rather than being based on the residual derived from the difference of the other components		
10	For long-term (decadal) carbon balance, improve information on disturbance and regrowth, for an assessment of the site history: Biomass and biomass change; High resolution atmospheric CO_2 concentrations Fluoresc Soil mois Diurnal c		

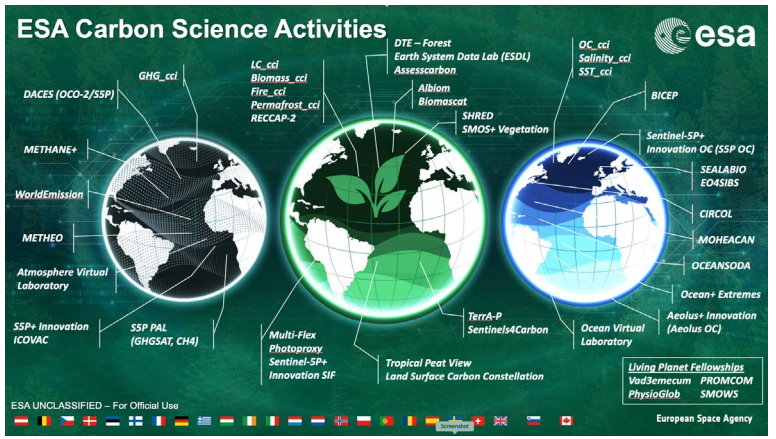
9 Recommendation groups	Number
Budgets – Regional	10
Fluxes – Regional	3
Fluxes - Land-atmosphere	5
Attribution	4
Extremes	2
Tipping Point/Sensitive Regions	10
Fossil Fuel CO2	5
Address key areas	4
Improve coordination	1

10	For long-term (decadal) carbon balance, improve information on disturbance and regrowth, for an assessment of the site history: Biomass and biomass change; High resolution atmospheric CO_2 concentrations Fluorescence Soil moisture Diurnal cycles
14	Need further development and testing of data assimilation systems with multiple data streams in parallel with forward model developments e.g. TRENDY project and model-independent data-driven machine learning approaches.
42	Key areas: Carbon dynamics in the boreal permafrost region

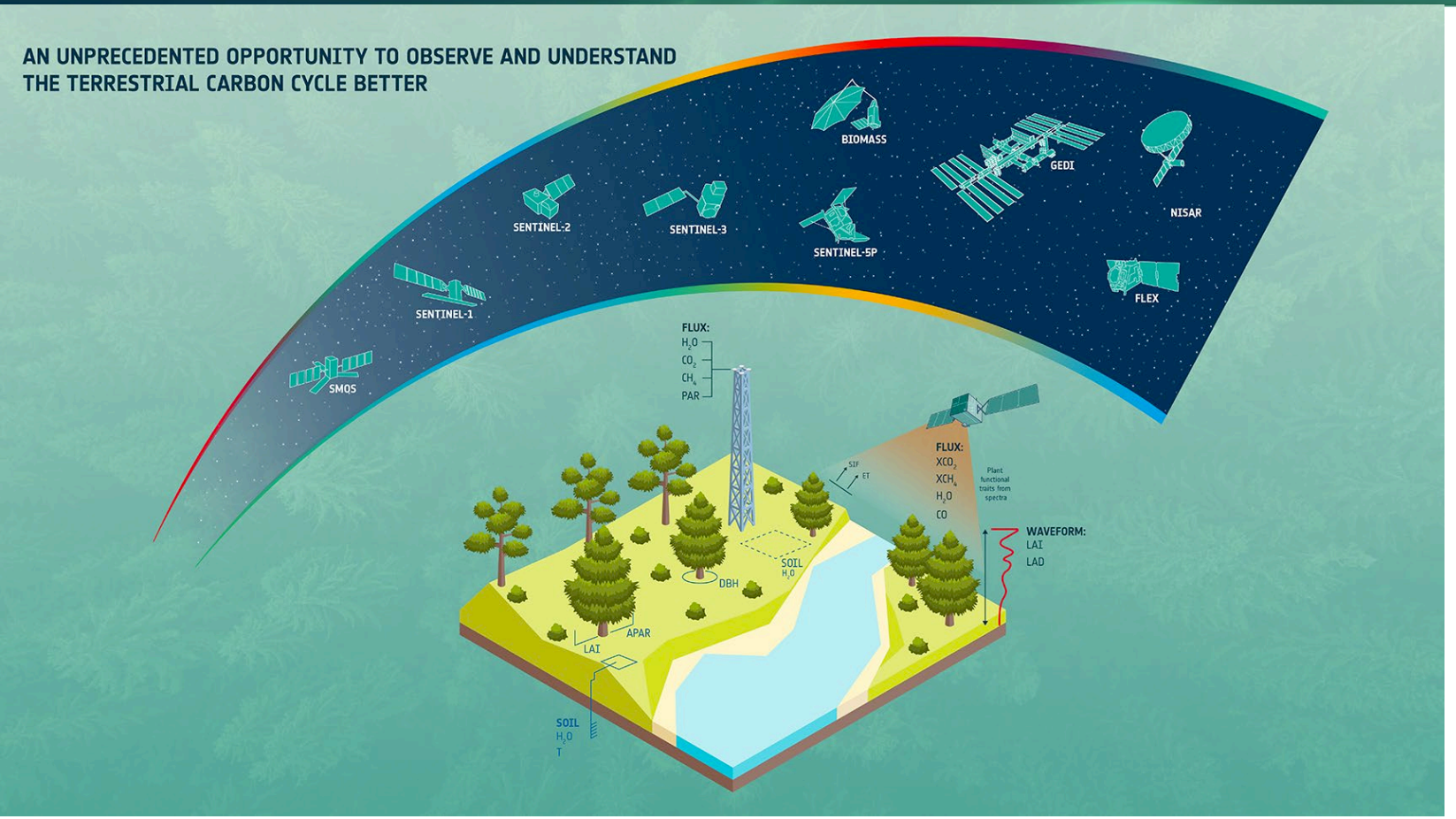
3rd CfS Recommendations

Num	Recommendation	Progress made	What needs to be done
44	To coordinate between existing structures e.g. NASA CMS, WMO IG3IS, and research efforts of GCP e.g. RECCAP, UCRM and infrastructural networks such as ICOS, NEON and TERN	• Improved in situ/satellite contacts • Improved coordination across projects e.g. ESA Carbon Science Cluster • Improved coordination across agencies e.g. AMPAC, EC-ESA ESSI • Improved use of satellite data in e.g. RECCAP-2 • Support for RECCAP-2	





Objective 2022



To establish a revised strategic plan of research and development activities on terrestrial carbon research for the time frame 2023–2028 in light of:

- Upcoming satellite launches (BIOMASS, NISAR, FLEX)
- Long-term improvements consistency of satellite observations e.g. Copernicus Sentinels
- Better coordinated in situ networks (NEON, ICOS, TERN).
- Improved estimates of the global and regional GHG budgets (CO_2, CH_4, N_2O)
- New technological opportunities and collaborations between partners

To bring together the EO, in situ and Earth system science communities to identify gaps, challenges and issues to address in understanding the **terrestrial carbon cycle**.

ESA Carbon Science Cluster Themes

Interfaces to Ocean and Cryosphere

Permafrost
Blue Carbon

Vegetation State and Processes

Carbon Stocks (Biomass)

Vegetation Processes

ESA CARBON SCIENCE CLUSTER

EO SCIENCE FOR SOCIETY

1st ESA Carbon Science Cluster Meeting

Terrestrial Carbon

23-24 June 2021[1]

Report

Land Use and Emissions

Land Use, Land Use Change, Agriculture

Dynamics and Disturbance

Disturbance, Extremes and Vegetation Dynamics

ESA Carbon Science Cluster Projects

The land projects from the CCI are also a resource

Interfaces to Ocean and Cryosphere

Cryobiolinks
AMPAC-net

Analysis Tools

DTE – Forest
Earth System Data Lab (ESDL)
DeepESDL

Land Use and Emissions

Photoproxy
Multi-Flex
WorldCover

Vegetation State and Processes

Albiom
Biomascat
Forest Carbon Monitoring

TerrA-P
Sen4GPP
TROPOSIF
SMOS+ Vegetation
PMVOS

RECCAP-2
Vad3emecum
IMITATE
Land Carbon Constellation

Dynamics and Disturbance

SHRED
S14Amazonas
Sense4Fire
SeasFire
Hi-Five

4th Carbon from Space Sessions

Interfaces to Ocean and Cryosphere

Carbon in the Arctic
Methane in the Arctic Permafrost

Analysis Tools

Carbon in a Digital Twin Earth

Land Use and Emissions

Land Use Change and Agriculture
Forests and the Glasgow Declaration

Vegetation State and Processes

Opportunities with new data

Model-data interfaces

Dynamics and Disturbance

Disturbance, Extremes and Vegetation Dynamics
Observing Carbon-Climate Feedbacks from Space:

Synergistic use of observations for constraining the carbon cycle across scales

Not just Talking Carbon

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Cameroon	741
Colombia	60
Ecuador	25
Ghana	50
Kenya	715
Madagascar	75
Tanzania	165

ESA Phi Week
1230 trees

living planet symposium BONN 2022

ESA Living Planet Symposium
300 trees

100 trees

201 trees

100 trees
(to be added)

House Rules

On site speakers:

1. Please upload your presentation via USB stick, on the dedicated laptop of the speaker ready corner.
2. The presentation is **directly launched by the technician**. Slides can be changed with the "**slide advance device**" placed on the podium (please do not touch the computer!!)
3. The Podium PC is directly connected to the WebEx link and to the registration audio for remote participant(s) to hear and see the Magellan room.

On line Speakers:

1. Online speakers have full control via WebEx, can **mute/unmute and share** to present the content.
2. The Session chair conducts session flow and he will advise the speaker when 2 minutes are left.

Discussion Sessions

At the end of each session there is an Open Discussion where **all the attendees** can ask questions through the chat or from the meeting room in presence.

The session is also visible on the main screen of the Magellan where the technicians will project the WebEx call.

Session leads will manage the flow. **Please wait for a microphone or an invite for Webex questions**

Scene Setting

Introduction and Scene Setting

09:30 - 09:45	Introduction to the 4th Carbon from Space Workshop Stephen Plummer (ESA)
09:45 - 10:00	The Terrestrial Carbon Cycle – Perspectives on the Contribution of ESA Earth Observation Rune Floberghagen (ESA)
10:00 - 10:15	The Terrestrial Carbon Cycle – Outlook from NASA Kathleen Hibbard (NASA)
10:15 - 10:30	The EC-ESA Earth System Science Initiative Franz Immler (EC RTD)
10:30 - 10:45	Terrestrial carbon cycle priorities – Global Carbon Project Pep Canadell (GCP)
10:45 - 11:00	Discussion