The GEO initiative on Carbon and Greenhouse Gases: Integration across domains

Werner L. Kutsch, Director General, ICOS ERIC

UNFCCC EarthInfoDay, Marrakech, 8. November 2016
Simulation of total column CO$_2$ (XCO$_2$) over Europe 20 Mar – 30 Apr 2008 at 7 km x 7 km resolution
Animation by Dominik Brunner (Empa), model simulation by Yu Liu and Nicolas Gruber (ETH)
The Integrated Carbon Observation System
A European Research Infrastructure
Starting with a vision: A global observation system on carbon and GHG fulfilling the needs of the 21. Century
Observations

Models

Integration

ICOS

INTEGRATED CARBON OBSERVATION SYSTEM

CARBON AND GHG INITIATIVE
Models

Observations

Integration
From Observations to Decisions

Communication

SBSTA

Framework Convention on Climate Change

Observations → Services → Knowledge → Decisions

1. From data to knowledge
   - Model-Data Fusion projects

2. Improve data harmonization
   - Data sharing management (incl. metadata)

3. Identifying observational gaps
   - Improve data accessibility
   - Data Citation

4. Sustainability
   - Capacity building
Activities of the GEO Carbon and GHG Initiative

**Task 1 - User needs and policy interface:**

to engage with users and policy makers and ensure the consistency with their evolving needs in order to drive the activities of the GEO Carbon and GHG Initiative and address the policy agenda.

**Task 2 - Data access and availability:**

to provide long-term, high quality and open access near-real-time data and data products, complying with the GEOSS principles, from a domain-overarching carbon cycle and GHGs monitoring system.

**Task 3 - Optimization of observational networks:**

to develop and implement a procedure for achieving observations of identified essential carbon cycle variables within user-defined specifications and at minimum total cost.

**Task 4 - Budget calculations and breakdown across scales:**

To support the development of consistent budgets of GHGs (CO$_2$, CH$_4$, and N$_2$O) across scales using a combination of observations, inventories, models and data assimilation techniques.
GEO-XII Plenary & Ministerial Summit
Mexico City 9-13 November 2015

• **Ministerial Declaration** that focuses on harnessing critical environmental observations

• Adoption of a ten year **Strategic Plan** (2016-2025)

“GEO will supply the requisite Earth observations in support of effective policy responses for climate change adaptation, mitigation and other impacts across the SBAs.”
New Societal Benefit Areas (SBAs)

Climate change and its impacts cut across all SBAs
“GEO through its Members and Participating Organizations, has begun work to implement a global carbon observation and analysis system addressing the three components of the carbon cycle (atmosphere, land and ocean) to provide high quality information on carbon dioxide (CO₂) and methane (CH₄) concentrations, and emission variations.”

“This report, the CEOS Strategy for Carbon Observations from Space, is a response from the Committee on Earth Observation Satellites (CEOS) to the GEO Carbon Strategy. 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...”

“Improve the inter-operability with other carbon observation systems, contributing to the new GEO Strategy and the new GEO 10 years Implementation Plan (IP) for 2016-2025.”
COPERNICUS CONCEPT FOR A VERIFICATION SYSTEM (CIAIS ET AL. 2015)

Independent verification of emissions
Improved UNFCCC reporting
Assess effectiveness of voluntary emission reductions (regions, cities)
Carbon management

2015
- Research

2025
- Pre-operational

2030-35
- Operational
  - Robust emission maps + uncertainties

Space infrastructure
- XCO₂ sounders (GOSAT, OCO2)
- In-situ rural CO₂ stations (ICOS, GAW)
- Pilot urban CO₂ networks

In-situ infrastructure
- Systematic ¹⁴C isotope monitoring infrastructure
- Urban CO₂ networks

Data Assimilation system for emissions
- Global & regional transport models
- Inversion system
- Frequently updated Global emissions maps
- With temporal dynamics
- ≈ 1km / hourly

Inventories Energy data
- Rarely updated global emissions maps
- with no temporal dynamics
- ≈ 10 km

Phase 1

Phase 2

Phase 3

Decision Support system
- Constellation of LEO imagers
- GEO
- In-situ urban CO₂ + ¹⁴C monitoring infrastructure
- Operational Inverse modeling of emissions
- Operational Emissions maps per sector + errors
- (= 1km / hourly)

Operational

GEO

Decision Support system
The Data life cycle of ICOS

Measurement stations (National networks)

ICOS Carbon Portal
- Data ingestion
- Metadata services
- Data discovery & access
- Usage tracking
- Data management
- Repository administration
- Preservation planning
- User community support

Diverse user communities, including data producers and other portals

ICOS repository (data, metadata)

High performance computing services

Sensor data

Finalized data products

ICOS Carbon Portal

Ecosystem Thematic Centre

Oceanic Thematic Centre

Atmospheric Thematic Centre

Calibration Labs

Metadata registry & catalogue services

Sensor data

Metadata services

Data discovery & access

Usage tracking

Data management

Repository administration

Preservation planning

User community support

Standardized processing, quality assurance & control

Diverse user communities, including data producers and other portals

B2SAFE

B2FIND

B2STAGE

PID

AAI

PID

PID

PID

Metadata

registry &
catalogue

services

B2SAFE

B2FIND

B2STAGE

High performance computing services

Sensor data

Metadata registry & catalogue services

Standardized processing, quality assurance & control

Measurement stations (National networks)

Data ingestion

Metadata services

Data discovery & access

Usage tracking

Data management

Repository administration

Preservation planning

User community support

Diverse user communities, including data producers and other portals

B2SAFE

B2FIND

B2STAGE

High performance computing services

Sensor data

Metadata registry & catalogue services

Standardized processing, quality assurance & control

Measurement stations (National networks)
Task 2 - Data access and availability: the GEO workflow

**GEO Initiatives and Flagships**

**Community Activities**

**GEOSS**

**Development**
- Enabling elements (Data Sharing, RF Protection)
- Providers Coordination
- GEONETCast, Communication Networks
- GCI Development
- Data & info generation

**Operations**
- GCI Operations

**Foundational Tasks**

**Policy Mandate**

**Communication and Engagement**

**Products & Services**

**Capacity Building**

**Capacity Building Coordination**

**Discovery and Access**

**Outreach**

SBA's Process
- User needs
- Observation requirements
- Knowledge

**Dr. habil. Werner L Kutsch**, [werner.kutsch@icos-ri.eu](mailto:werner.kutsch@icos-ri.eu), [www.icos-ri.eu](http://www.icos-ri.eu)
Task 3 - Optimization of observational networks:

- Closing spatial observational gaps
- Supporting new technologies and concepts
- Translating user needs to observational concepts.
Features of the GEO Carbon and GHG Initiative

A framework / platform for cooperation
that is seeking integration across domains.

Builds on existing infrastructures
and supports their efforts to cooperate.

Providing opportunities
to optimize the data fabric from observations to decisions,
to identify geographical or conceptual gaps,
to gather additional resources from member countries.

Not running in parallel or duplicating other efforts
but seeking cooperation and communication.

Dr. habil. Werner L Kutsch, werner.kutsch@icos-ri.eu, www.icos-ri.eu
THANK YOU FOR YOUR ATTENTION!