RINGO | Readiness of ICOS

Readiness of ICOS for Necessities of integrated Global Observations

Concept for ICOS involvement in carbon and GHG flagship inside GEO and IG3IS program by WMO

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730944

RINGO (GA no 730944)

Internal Document

Deliverable: D5.1	Concept for ICOS involvement in carbon and GHG flagship inside GEO and IG3IS program by WMO
Author(s):	Janne-Markus Rintala, Jouni Heiskanen
Date:	27.04.2018
Activity:	
Lead Partner:	ICOS ERIC
Document Issue:	1
Dissemination Level:	Public
Contact:	janne-markus.rintala@icos-ri.eu

	Name	Partner	Date
From			
Reviewed by	Eija Juurola		
Approved by			

Version	Date	Comments/Changes	Author/Partner
1.0			

CONTENTS

Glossary

CEOS – Commission of Earth Observation Satellites

CMCC – Mediterranean Centre for Combatting Climate Change

COPERNICUS – The European Programme for the establishment of a European capacity for Earth Observation

EC – The European Commission

GCOS – Global Climate Observation System

GAW – Global Atmosphere Watch

GEO – Group on Earth Observations

GEO-C – Group on Earth Observations Carbon and Greenhouse Gas Initiative

GHG – Greenhouse Gas

ICOS – Integrated Carbon Observation System

IG^{3}IS – Integrated Global Greenhouse Gas Information System

IPCC – Intergovernmental Panel on Climate Change

NDC – Nationally Determined Contributions

NIES – National Institute for Environmental Studies in Japan

PA – The Paris Agreement

UN – The United Nations

UNFCCC – United Nations Framework Convention on Climate Change

WMO – World Meteorological Organization

1. Introduction

Scientific understanding requires global collaboration

The mean global temperatures have been rising steadily ever since the eighteenth century Industrial (or energy) Revolution due to human activities, that have caused increased concentrations of greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Concentrations of CO_2 have risen by more than 40% from pre-industrial levels and continue to rise at an increasing rate. They are now higher than they have been in at least about four million years, when global average temperatures were 2 to 3 °C higher than during the nineteenth century and the sea levels were 7 to 25 metres higher than today (Salawich et al. 2017).

While increasing CO_2 levels in the atmosphere is the primary cause of climate change (and e.g. of ocean acidification), the underlying carbon (C) and GHG cycles are complex. Different aspects of these cycles are studied in different scientific fields – and with varying intensity in the World's regions. The C and GHG cycles consist of fast to very slow processes that happen in different spatial scales. This has led to different scientific methodologies when trying to capture and understand these processes – from *in situ* observations to remote sensing and modelling. ICOS is an important component in these observations, but its mission is in the *in situ* part of the observations.

Paris Agreement calls for close interaction with the policy-making framework

The political demand for climate-related information is high. The Paris Agreement (UNFCCC, COP 21) recognizes the importance of scientific knowledge, including research and systematic observations, to support the commitment of reducing GHG emissions to keep global warming below 1.5-2.0°C. Information and observations of the climate system should support decision-making and climate services (Fig. 1).

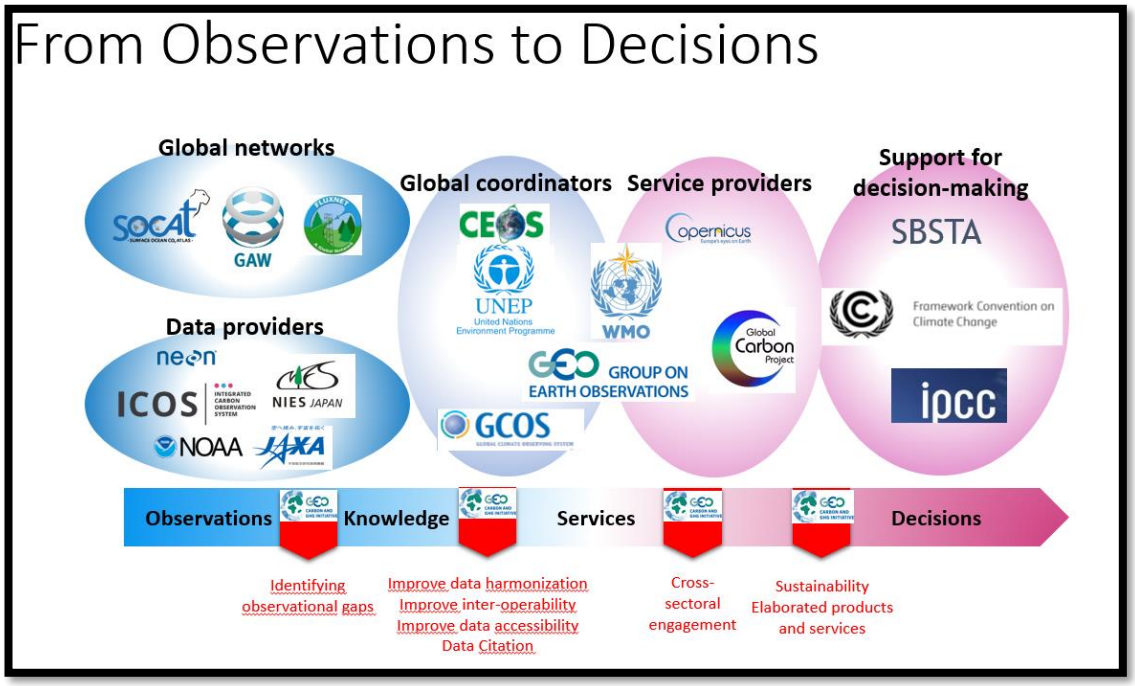

Fig. 1. Schematic presentation showing operators within the knowledge chain from observations to decision-making.

As a result of the Paris Agreement, individual countries have committed to reduce their GHG emissions by nationally determined contributions (NDCs). These have been set so that the Paris Agreement goal could be reached – this also means that they will be periodically revised and when needed, adjusted. To assess the progress a new periodical effort will be initiated, global stocktake, where the realised impact of

NDCs will be evaluated. All these need to be based on best available science. This is a new kind of challenge for the scientific community, one in which research infrastructures with their systematic, sustained and standardised observations are in key role.

Towards global cooperation

During the past years, there have been significant advances towards globally coordinated Earth Observations that are becoming essential contributors to the scientific and political needs. The climate change community published numerous reports stressing further emphasis on carbon cycle and GHG research, for example: Verifying Greenhouse Gas Emissions: Methods to Support International Climate Agreements (NAS 2010); GEO Carbon Strategy (Ciais et. al. 2010); IPCC Task Force on National GHG Inventories: Expert Meeting Report on Uncertainty and Validation of Emission Inventories (IPCC 2010). With the climate change being mostly of human origin, and that current efforts to mitigate climate change need to be based on best available science and observations – both disturbances in the natural cycles and anthropogenic influence – ICOS needs to align to these societal needs. As the statutes of ICOS ERIC state, ICOS is built to support the quantification of GHG atmospheric concentrations and fluxes, it contributes to timely information relevant to the GHG policy and decision-making, and facilitates these actions in and beyond Europe. This document outlines the ICOS involvement in two major global endeavours, the GEO Carbon and Greenhouse Gas Initiative (GEO-C) and Integrated Global Greenhouse Gas Information System (IG^{3}IS).

2. Group on Earth Observations and GEO-C Initiative

Thorough understanding of the Planets' carbon cycle is vital in order to make the correct decisions on the future of our planet. The Group on Earth Observations (GEO) is an intergovernmental organisation that aims to globally coordinated global Earth Observations that provide benefits to the society. It consists of over 100 Member countries and 120 Participating Organisations, one of which is ICOS. One of the three major focus areas of GEO is the Paris Agreement on climate change.

Climate change mitigation is a challenge that concerns many levels of the society (Fig. 2). Even though many processes are political, science is present in various ways. In the highest level, COP decisions within the United Nations framework bind countries to report and reduce their GHG emissions. This system is based on best available science. The national GHG inventories are largely based on emission factors which are defined by scientific publications. On the other hand, recent scientific developments lead to the capability of direct observations of national and global GHG sinks and sources.

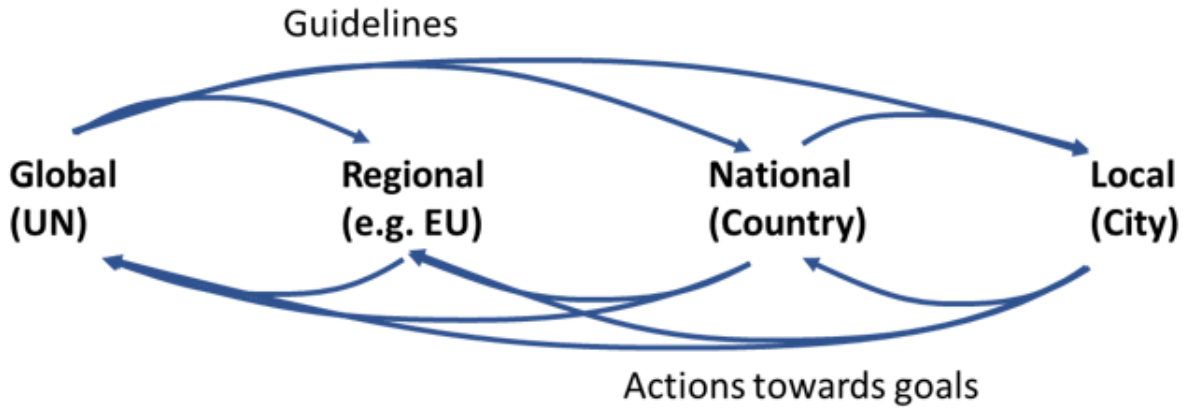

Fig. 2. Guidelines and requirements for climate policies cascade from the highest level, the United Nations framework, towards actors in smaller scale. The actions then start from smaller entities and become combined national and regional contributions to the EU and UN systems.

Within GEO, the community activities towards more coherent, global observations of carbon and GHGs have developed into a joint effort, GEO Carbon and Greenhouse Gas Initiative (GEO-C). GEO-C is an informal forum for discussions between key scientific organisations and operators in the UNFCCC framework that aims towards globally coordinated observations directly in support to answer the challenges of climate change. ICOS has actively supported the establishment of the initiative. One important activity in RINGO Task 5.1 has been to assess the importance of GEO-C for ICOS to reach the mission set in statutes. It has been concluded that GEO-C is highly important initiative that could grow into the role of global body for cooperation between scientific and political operators related to climate change. Within RINGO, ICOS has made progress towards more sustained contributions in GEO-C and offered to host the GEO-C Secretariat established in 2017. With unanimous approval, ICOS now hosts the secretariat whose other members are from CMCC (Italy), NIES (Japan), GEO Secretariat (Switzerland).

As a first task, GEO-C Secretariat worked towards establishing high-level Steering Committee, which then had its first face-to-face meeting in February 2018 in Geneva. Besides ICOS, it consists of members from UNFCCC, IPCC, EC, Copernicus, CEOS, GCOS and WMO/IG^{3}IS. The contributions of ICOS were well noticed and appreciated by the Steering Committee, as ICOS Director General was selected as vice chair of the Committee. This guarantees close interactions between ICOS and the key players in global carbon and GHG observations.

ICOS aims to actively contribute to the success of the initiative in the future. There are many benefits for ICOS and broader climate change community in supporting GEO-C. Some of the important short-term outcomes of GEO-C are

- Providing a global forum for highly-valuable informal discussions to identify the complementary roles and responsibilities within the carbon observation landscape
- Mapping the carbon observations landscape, with the goal to support planning, outreach and communication efforts.
- Identifying observational requirements for disciplines beyond traditional meteorological and climate data, and define requirements for a global carbon monitoring system.
- Developing a concept of how science and policy-making are linked together
- Identifying current contributions from key actors, which leads to identification of existing gaps and jointly agreed roadmap to reach the goals
- Common terminology
- Explore cross-boundary opportunities between science and society.

For ICOS, also concrete scientific outcomes are of specific interest. ICOS is involved in EuroGEOSS project proposal with carbon and GHG pilot that aims to improve terrestrial and ocean flux estimations which would then be fed into Global Carbon Project data products. The project would offer direct support for scientists in ICOS network and facilitate important global terrestrial and ocean data provision.

Providing timely high-quality data is one of the major topics both in ICOS and in the organisations involved in GEO-C. GEO-C community is also wide spread, composed from several different global networks and hence it is also already fragmented. Collaboration should be further enhanced in order to improve inter-operability, data ontologies and harmonization as well as identifying observational gaps. This would be beneficial for everyone as it would improve data accessibility and increase their usage. FAIR Data principles are a set of guiding principles to make all data findable, accessible, interoperable and reusable world-wide (Wilkinson et al. 2016), and is pledging for cross-sectoral engagement. ICOS is on the forefront in developing automated, reliable and interoperable systems complying the FAIR principles. The roadmap developed in GEO-C will address joint strategy towards global data streams. This is an important opportunity for ICOS to share the best practices based on the experience of organising data flows within distributed RI, and to promote FAIR data principles.

3. WMO and IG^{3}IS initiative

The World Meteorological Organization (WMO) is an Intergovernmental organization belonging to the United Nations. It is the authoritative technical voice on weather, climate and water within the United Nations system. WMO recently announced that the global average temperature in 2016 was about 1.1 °C higher than the pre-industrial period. The conclusion of the Fifth Assessment Report (AR5) by the Intergovernmental Panel on Climate Change (IPCC) in 2013 was that climate change is real, human activities are the cause, and negative impacts on society, such as sea level rise, are rapidly climbing up. Due to the cumulative effect of GHGs in the atmosphere, the window of opportunity to meet the Paris Agreement objectives is closing very fast (Stoecker 2013).

The Paris Agreement (PA), signed by 197 countries, requires more certainty in GHG estimations in order to achieve the long-term temperature goal, set below 1,5˚C temperature increase. To this regard, the PA includes an enhanced transparency framework, to track countries' progress towards achieving their individual targets and a periodic global budget estimated to assess the countries' collective progress towards the long-term goals. A specific challenge for GHG observations is the anthropogenic direct and indirect emissions (Fig. 3). Specifically, for this purpose, WMO with its' 191 Member States and Territories have called for a plan for an Integrated Global Greenhouse Gas Information System (IG^{3}IS) in June 2015.

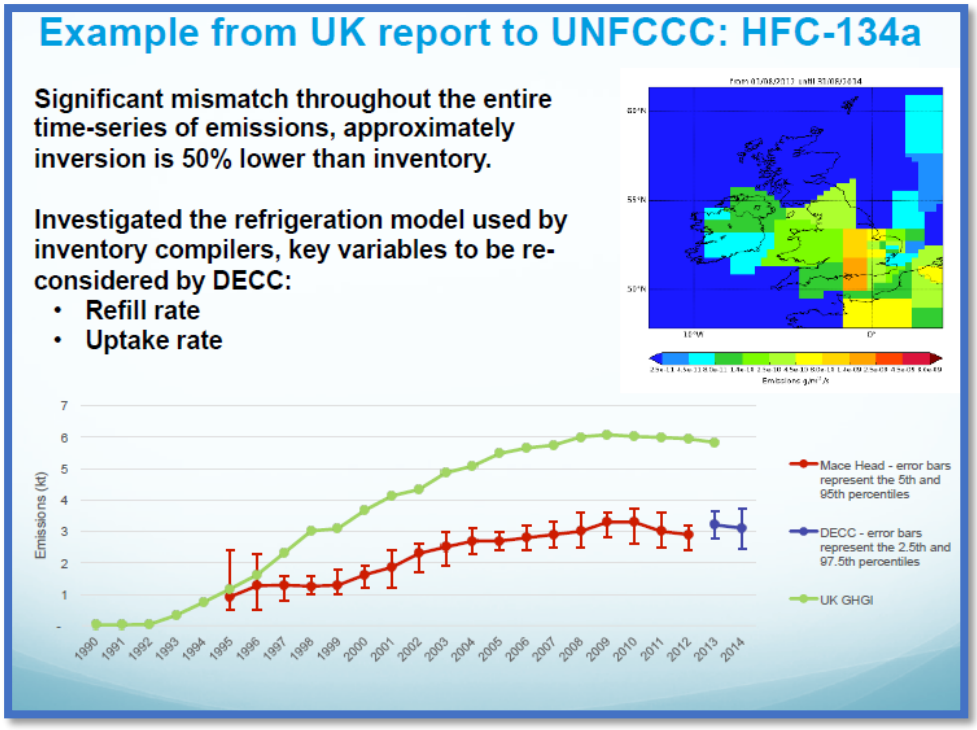

Fig. 3. Mismatch between a measurements and national inventory.

IG^{3}IS is specifically focusing on reducing the uncertainty of emission inventory reporting and providing information to support national and sub-national mitigation efforts. It is science-based system to understand anthropogenic GHG emissions, and it aims to coordinate existing efforts and create standards for improving emission inventories. Short-term aims are to detect urban GHG emissions, CH_4 emissions from oil and gas supply chain, and improve national inventory reporting of those countries that apply atmospheric measurements and inverse methods. Following the progress and supporting the process of capability to observe anthropogenic emissions is in the interests of ICOS. ICOS can also support this process both by its integrated approach of atmospheric and ecosystem stations which allows detailed studies for flux driving mechanisms, and by the understanding of natural GHG cycles.

In the atmospheric domain, ICOS is already endorsed as regional network in the Global Atmosphere Watch (GAW) Program coordinated by WMO. IG^{3}IS aims to extend the international WMO GAW network of in situ sampling stations to fill in underrepresented regions globally, thereby improving national sampling of regional greenhouse gas emissions, and improve transport models to capture a small footprint on global scales. ICOS can provide substantial support in this as it is participating in EU-Africa project (SEACRIFOG) which aims to build a roadmap towards pan-African Earth observation network. This is the first step to reach sufficient spatial coverage of GHG observations in Africa.

ICOS is looking for scientific and technical improvements to answer contemporary challenges in all domains. Supporting and contributing to IG^{3}IS is one important way to develop also ICOS atmosphere network. ICOS is working towards closer cooperation between remote sensing communities and organisations, and thus ICOS and IG^{3}IS share mutual interest in this context.

ICOS is involved in IG^{3}IS in several ways. Many ICOS atmosphere stations are already joint GAW stations Furthermore, the Carbon Portal director is active as chair of the GAW scientific advisory board for greenhouse gases and he is a member of the executive steering group of IG^{3}IS. IG^{3}IS and WMO are also contributing to GEO-C, and thus GEO-C initiative provides an important forum where ICOS and IG^{3}IS can increase collaboration. ICOS aims to continue supporting IG^{3}IS to reach its goals, and when plausible, contribute to scientific projects which fill gaps in current understanding in anthropogenic GHG cycles.

Positive examples and successes should be kept in mind and actively used in the outreach for society and in the high-level advocacy work to enhance the motivation to pursue towards the common goals. For example, the Global Atmospheric Watch (GAW) measurements of ozone-depleting gases have played and continue to play a critical role in the successful response of the Montreal Protocol to stratospheric ozone depletion. GHG measurements from GAW are recognized by the IG^{3}IS as a key component of its implementation plan under the UNFCCC.

4. Useful literature

Basu, S., J. B. Miller, and S. Lehman (2016): Separation of biospheric and fossil fuel fluxes of CO2 by atmospheric inversion of CO2 and 14CO2 measurements: Observation System Simulations, - Atmos. Chem. Phys.,16(9), 5665-5683.

Bréon, F. M., Broquet, G., Puygrenier, V., Chevallier, F., Xueref-Rémy, I., Ramonet, M., Dieudonné, E., Lopez, M., Schmidt, M., Perrussel, O., and Ciais, P. (2014): An attempt at estimating Paris area CO2 emissions from atmospheric concentration measurements, Atmos. Chem. Phys. Discuss., 14, 9647-9703, 2014, www.atmos-chem-phys-discuss.net/14/9647/2014/, doi:10.5194/acpd-14-9647-2014

CEOS (2014). CEOS Strategy for Carbon Observations from Space. The Committee on Earth Observations Satellites (CEOS) Response to the Group of Earth Observations (GEO) Carbon Strategy. 202pp.

Ciais, P., dolman, A.J., Dargaville, R., Barried, L., Bombelli, A., Butler, J., Canadell, P., moriyama, T. (2010). Geo Cargon strategy Geo Secretariat Geneva, /FAO, Fome 48pp.

Pinty B., G. Janssens-Maenhout, M. Dowell, H. Zunker, T. Brunhes, P. Ciais, D. Dee, H. Denier van der Gon, H. Dolman, M. Drinkwater, R. Engelen, M. Heimann, K. Holmlund, R. Husband, A. Kentarchos, Y. Meijer, P. Palmer and M. Scholze (2017) An Operational Anthropogenic CO_2 Emissions Monitoring & Verification Support capacity - Baseline Requirements, Model Components and Functional Architecture, doi: 10.2760/39384, European Commission Joint Research Centre, EUR 28736 EN. 102pp.

Salawitch et al., 2017: Paris Agreement: Beacon of Hope, ISBN DOI 978-3-319-46939-3 at Springer Climate.

Stocker, T. F. (2013): The Closing Door of Climate Targets. Science 339 (6117): 280-282, DOI: 10.1126/science.1232468

Wilkinson M. D. et al. 2016: Scientific Data, Comment The FAIR guiding Principles for scientific data management and stewardship. NATURE 3:160018 | DOI: 10.1038/sdata.2016.18