COP25 CHILE MADRID 2019
UN CLIMATE CHANGE CONFERENCE
TIME FOR ACTION

ICOS
INTEGRATED CARBON OBSERVATION SYSTEM

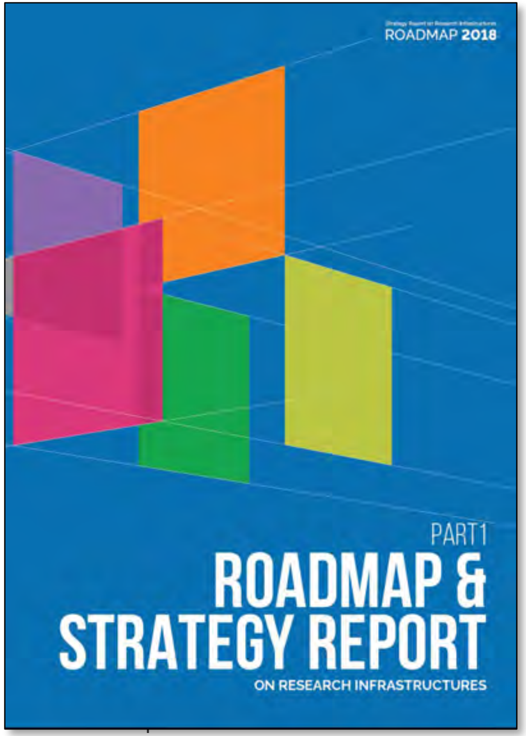
Standardised observations are the base of all climate science

Side event at COP 25, C H I L E, Madrid
4. December 2019, 15 h, Room 1

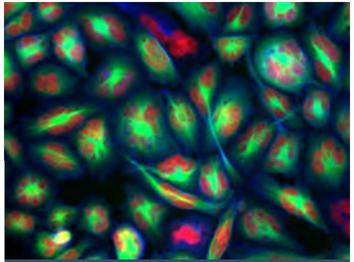
Moderator: ICOS Director General Dr. Werner Kutsch

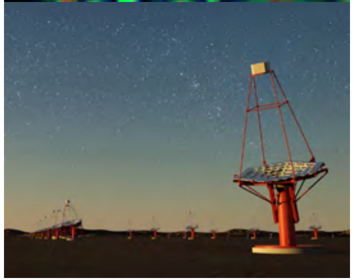
The European Strategic Forum on Research Infrastructures

ESFRI



ESFRI coordinates the joined forces of European countries towards a consistent landscape of sustainable Research Infrastructures enabling well coordinated joint investments aligned in terms of priority setting and funding decisions.





ESFRI

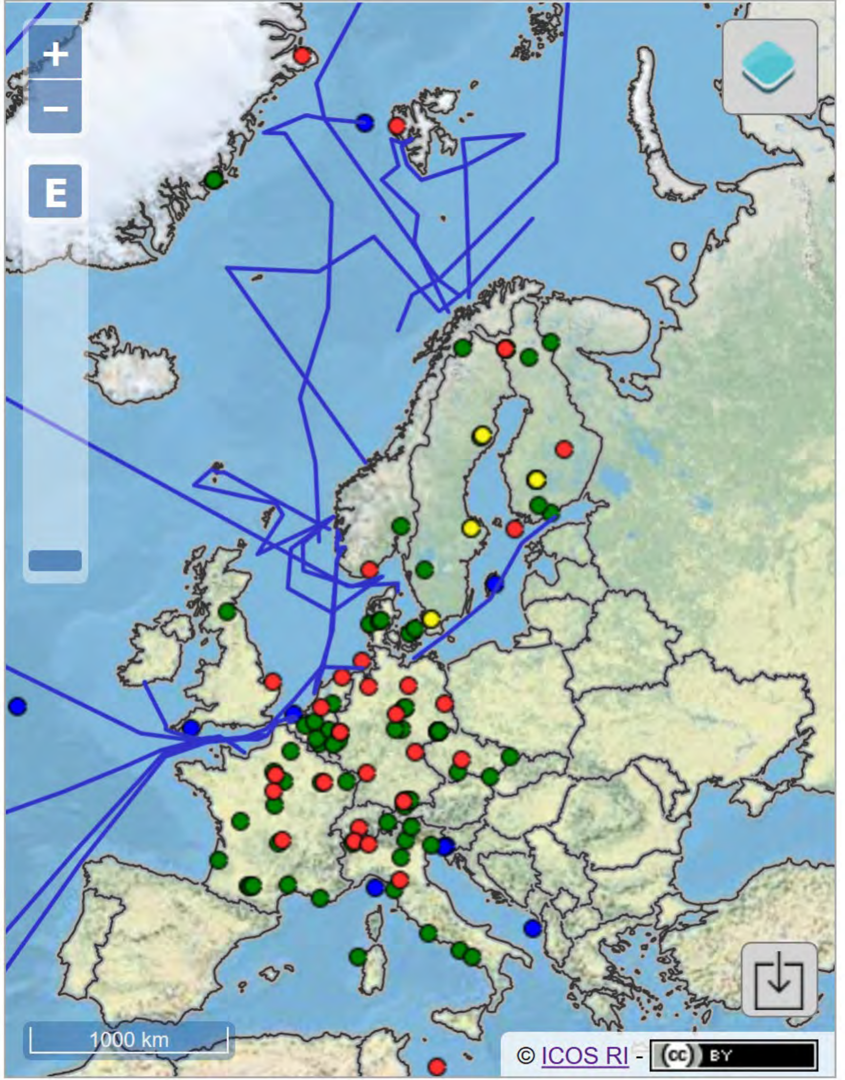
ICOS | INTEGRATED CARBON OBSERVATION SYSTEM

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

TIME FOR ACTION
COP25
CHILE
MADRID 2019
UN CLIMATE CHANGE CONFERENCE

The Integrated Carbon Observation System ICOS is a response of the European Countries and the European Commission to the Paris Agreement and provides standardized high-precision observations on greenhouse gases at more than 130 stations in Europe.

The legal entity ICOS ERIC is Observer at UNFCCC since COP 25, 2019



Why standardisation?

- Comparability
- Reliability
- Easy use for scientists
- Improvement to see small numbers in large pools or fluxes
- Improvement to see trends at high variability
- Solid base for the value chain from observations to political decision making

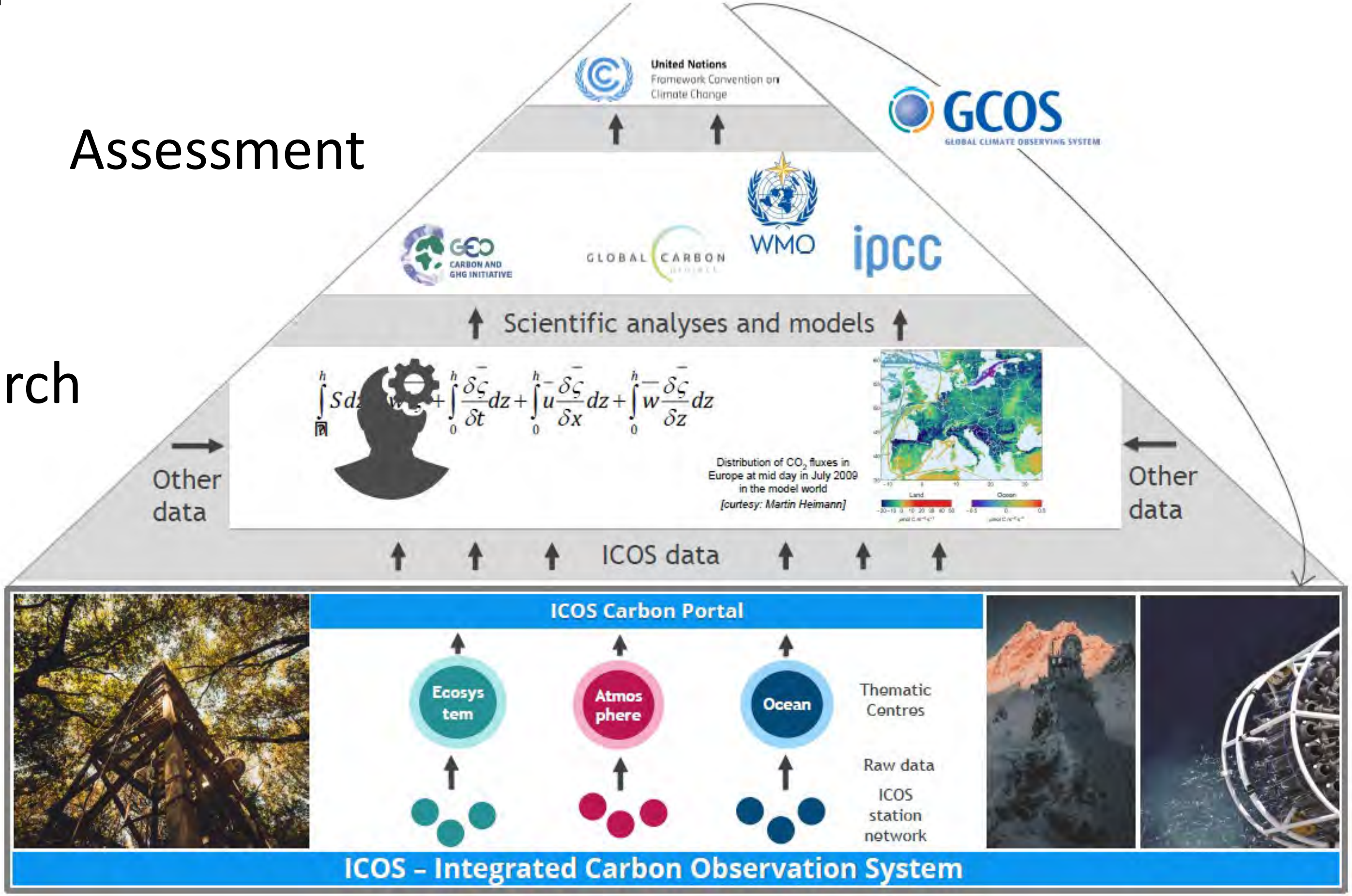
A Value Chain for Essential Knowledge

Political decicion making

Assessment

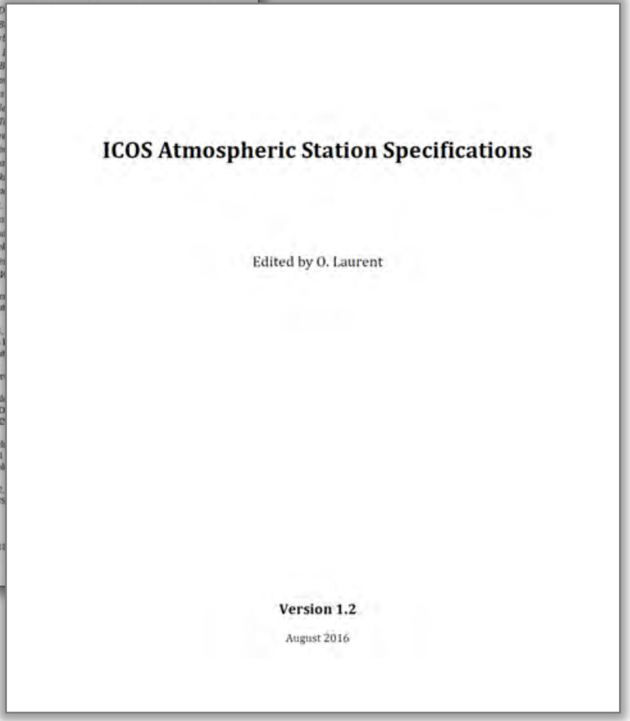
Research

Observation



ICOS INTEGRATED CARBON OBSERVATION SYSTEM

A very strict standardisation and compliance policy


ICOS Atmospheric Station Specifications

Edited by O. Laurent

Version 1.2

August 2016

- ✓ Community efforts towards common protocols
- ✓ Detailed description of station specification
- ✓ Centralised instrument testing and calibration
- ✓ Centralized calibration standards (WMO scale) and flask analyses
- ✓ Centralized quality control
- ✓ Close relation to international standards (e.g. WMO, Fluxnet, SOCAT)

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

ICOS atmosphere data quality

Quality Assurance

- ✓ ATC labeling to ensure compliance to specifications for measurements
- ✓ CAL reference gases to achieve consistent calibration standards

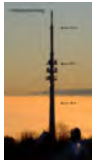
Quality Control

BIPM Key Comparison CO_2 in Air
ICOS-CAL "expert guest laboratory"
(CCQM P188, Apr 2019)

routine comparison with WMO Central Calibration Laboratory

ICOS Atmospheric Stations

ATC-QC tools

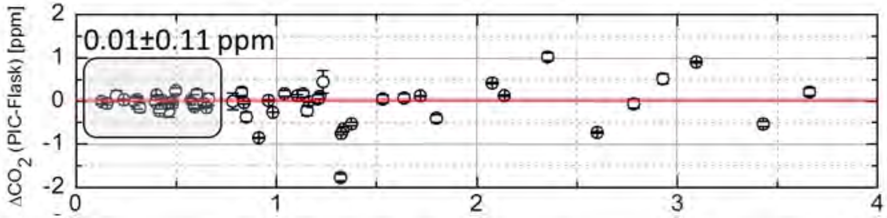


routine comparison
ICOS station - CAL

WMO Round Robin 7 (2020)

Innovative collection of flask samples

1. Quality Control: comparison of continuous measurements with flask samples



- definition of conditions for obtaining a valid QC sample based on atmospheric variability
- check if conditions were met by automated communication between flask sampler and ATC database

2. Sample collection mode for hourly samples

- hourly averaged concentrations requested for model evaluations
- requirement for dynamic flow function

  → upgrade of software and additional hardware implemented

→ *flask sampler flexible for new flask sampling approaches*

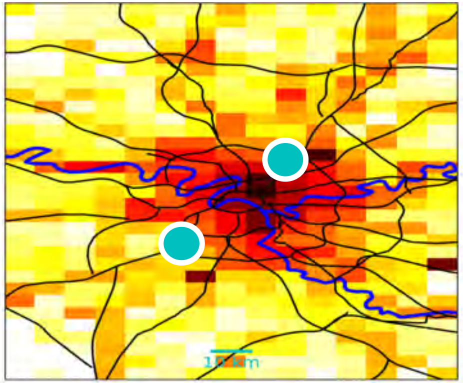
→ *expertise for their elaboration and implementation within ICOS Central Facilities*

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Catching the plume of emission hot-spots

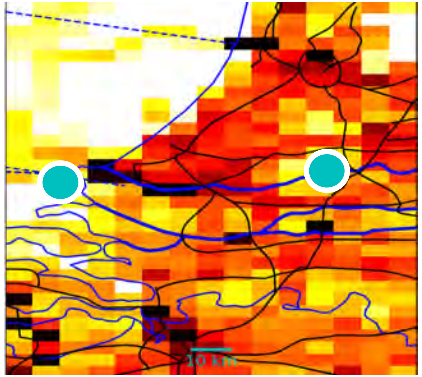
Paris

Population: 10 M



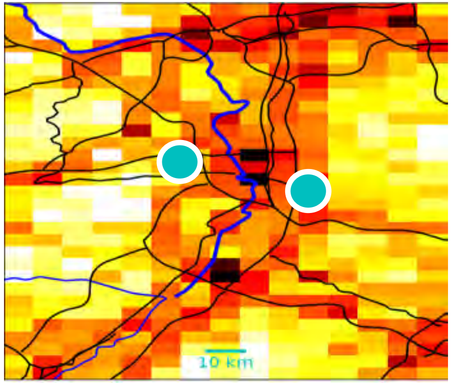
Rotterdam

Population: 1.5 M



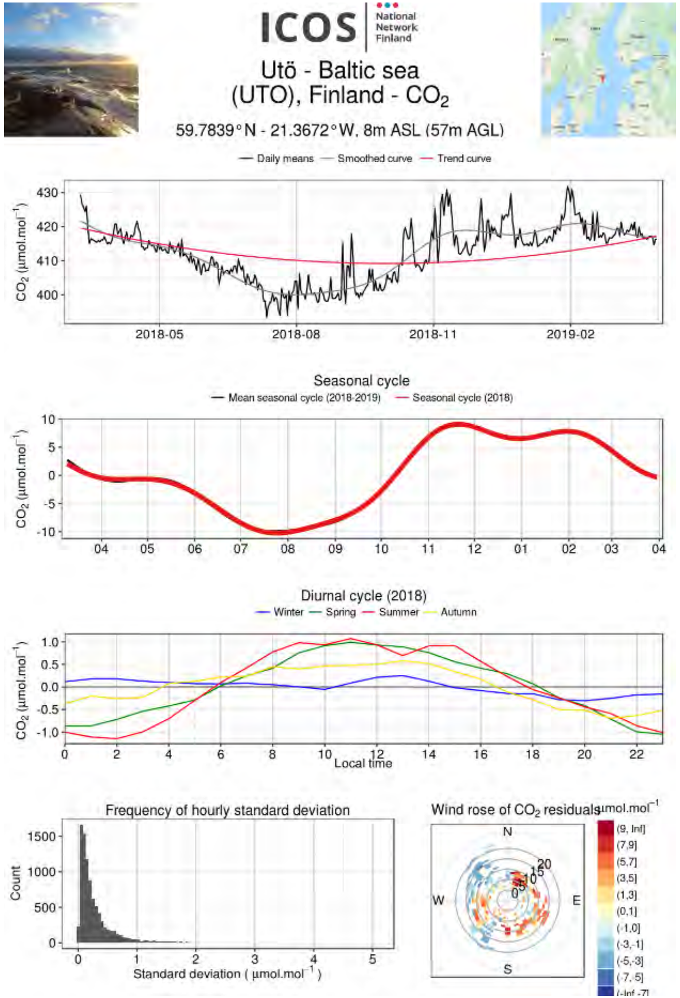
Rhine-Neckar

Population: 0.5 M



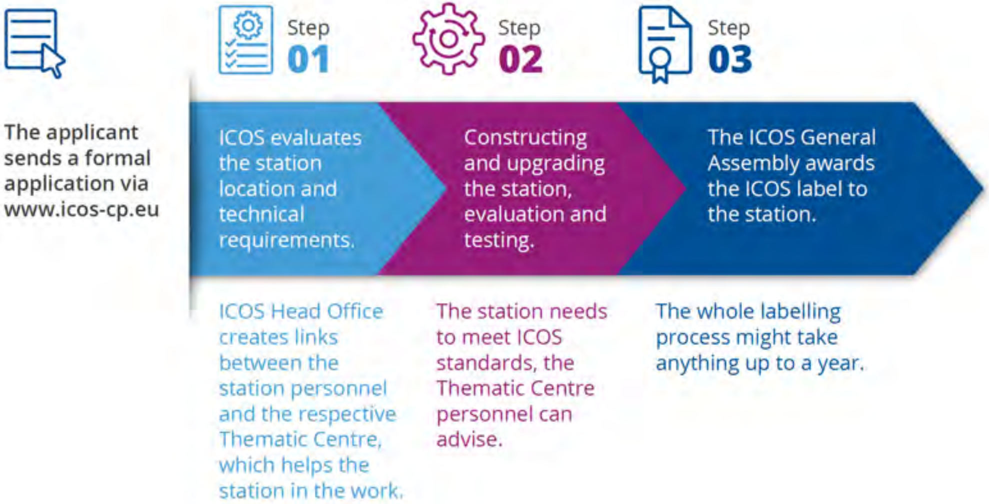
ICOS INTEGRATED CARBON OBSERVATION SYSTEM

RINGO Readiness of ICOS

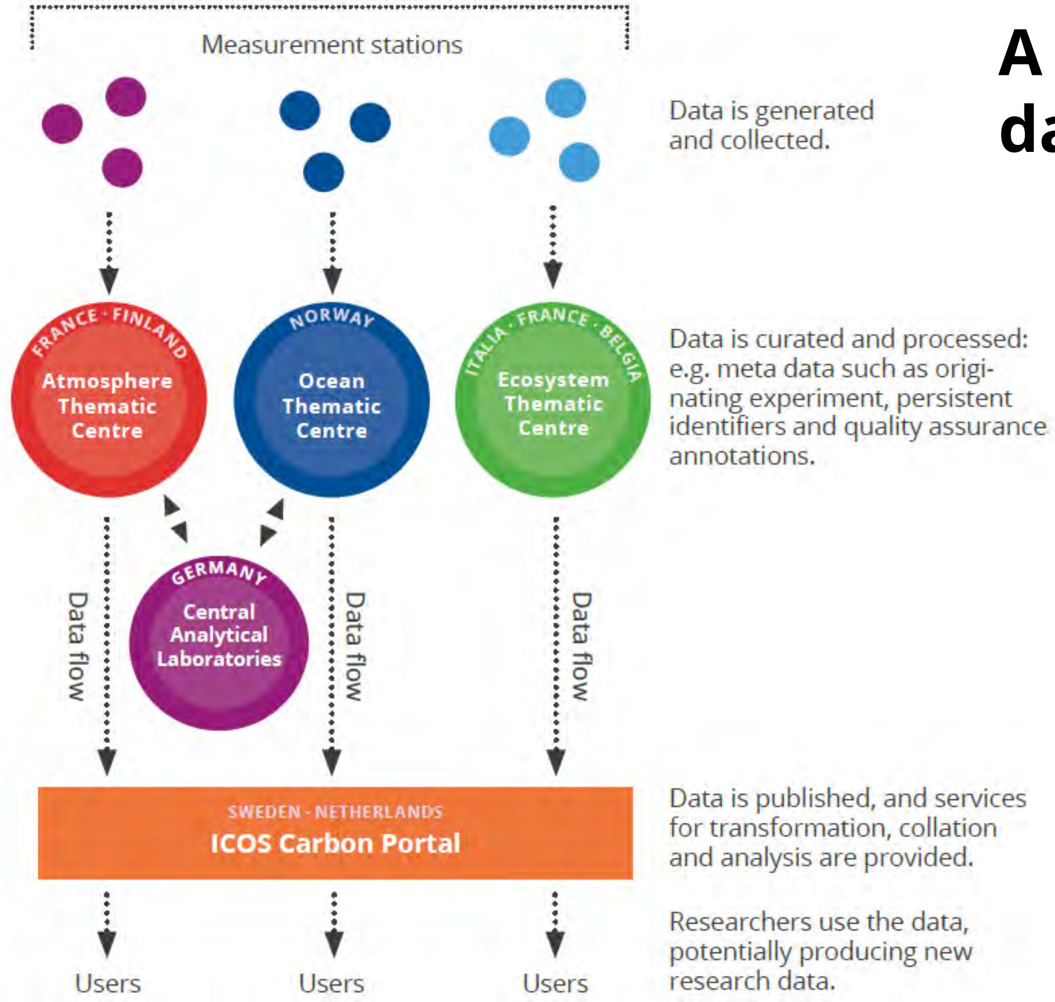


A very strict standardisation and compliance policy

The steps of the ICOS station labelling:



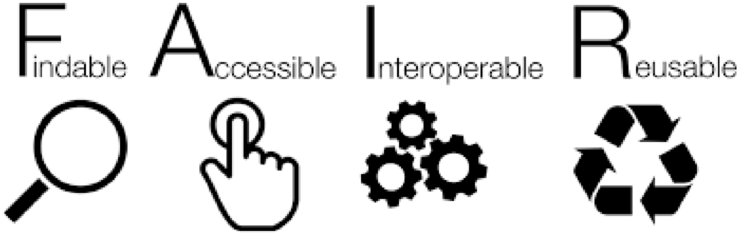
Left: example of a labelling facts sheet.



A well-designed reliable data life cycle

- ✓ Standardized measurements
- ✓ Standardized data processing
- ✓ Centralized quality control
- ✓ Data provenance, curation and archiving
- ✓ Clear open data license
- ✓ Data citation
- ✓ Full data FAIRness

FAIR-ifying, towards more transparent and reproducible science



FAIRness involves “everyone”: data producers, data managers, end users

- Documenting data during collection & processing
- Organized & secure repository for data & metadata
- Persistent identifiers for data & resources
- Web portal for search, visualization & download
- Clear licensing
- Linked data approach for metadata cataloguing
- Interfaces for humans and **machines**
- Support for end users
- Engage with other initiatives projects to share resources

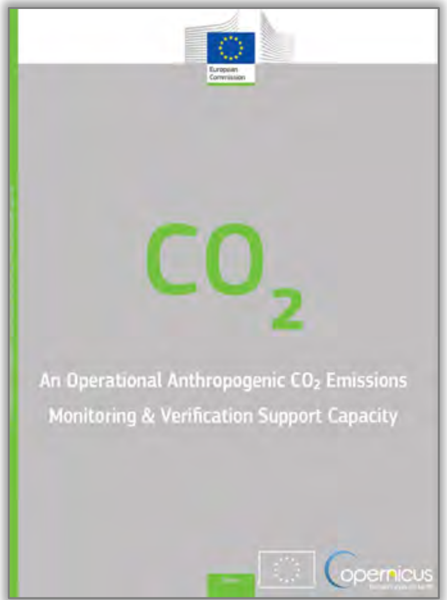
CORE TRUST SEAL

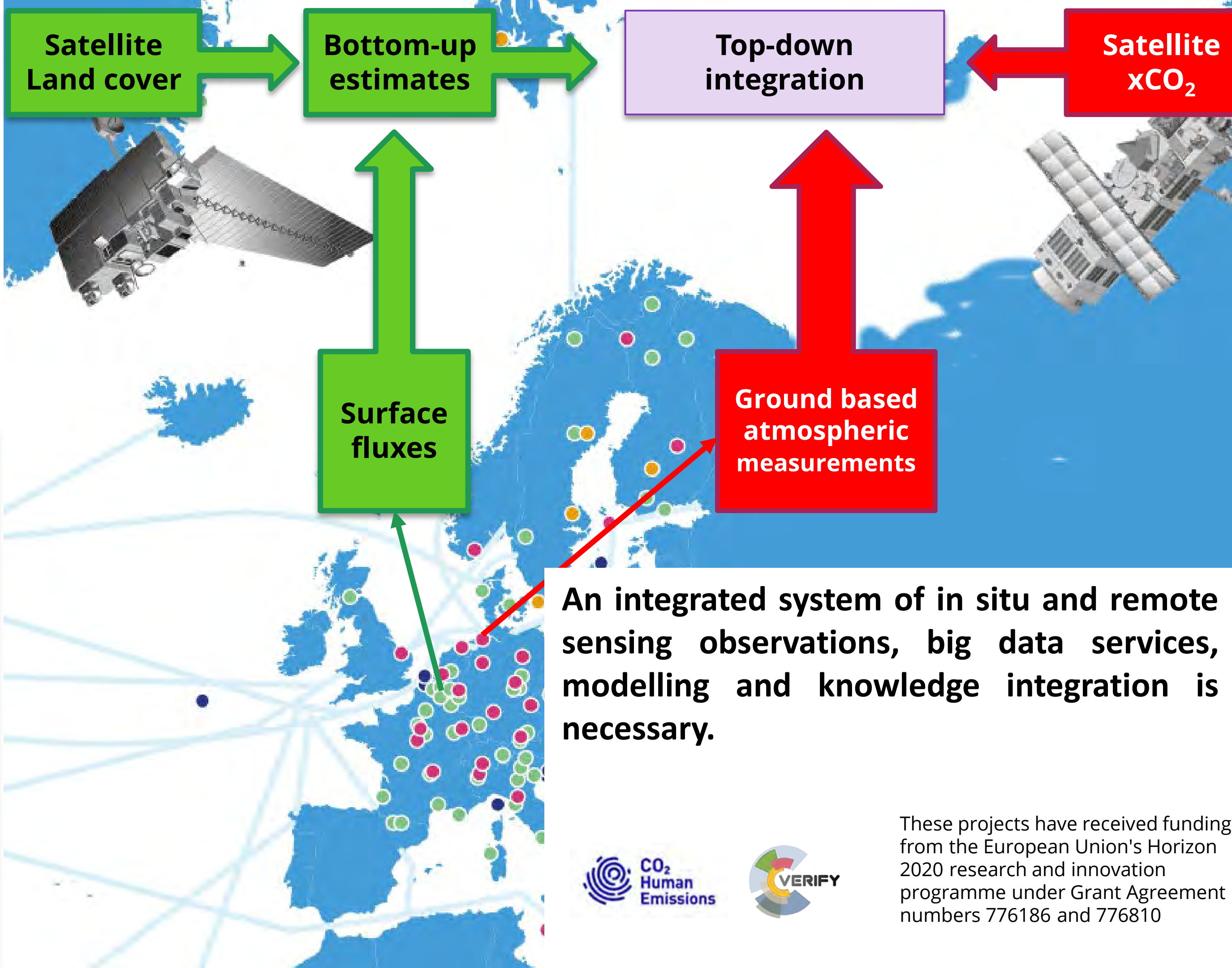
www.coretrustseal.org

ENVRI FAIR

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Standardisation is essential for an Integrated System





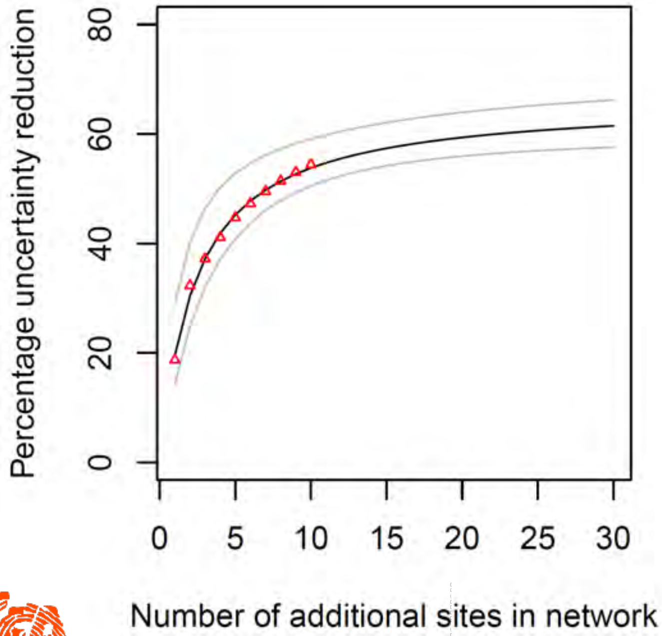
An integrated system of in situ and remote sensing observations, big data services, modelling and knowledge integration is necessary.

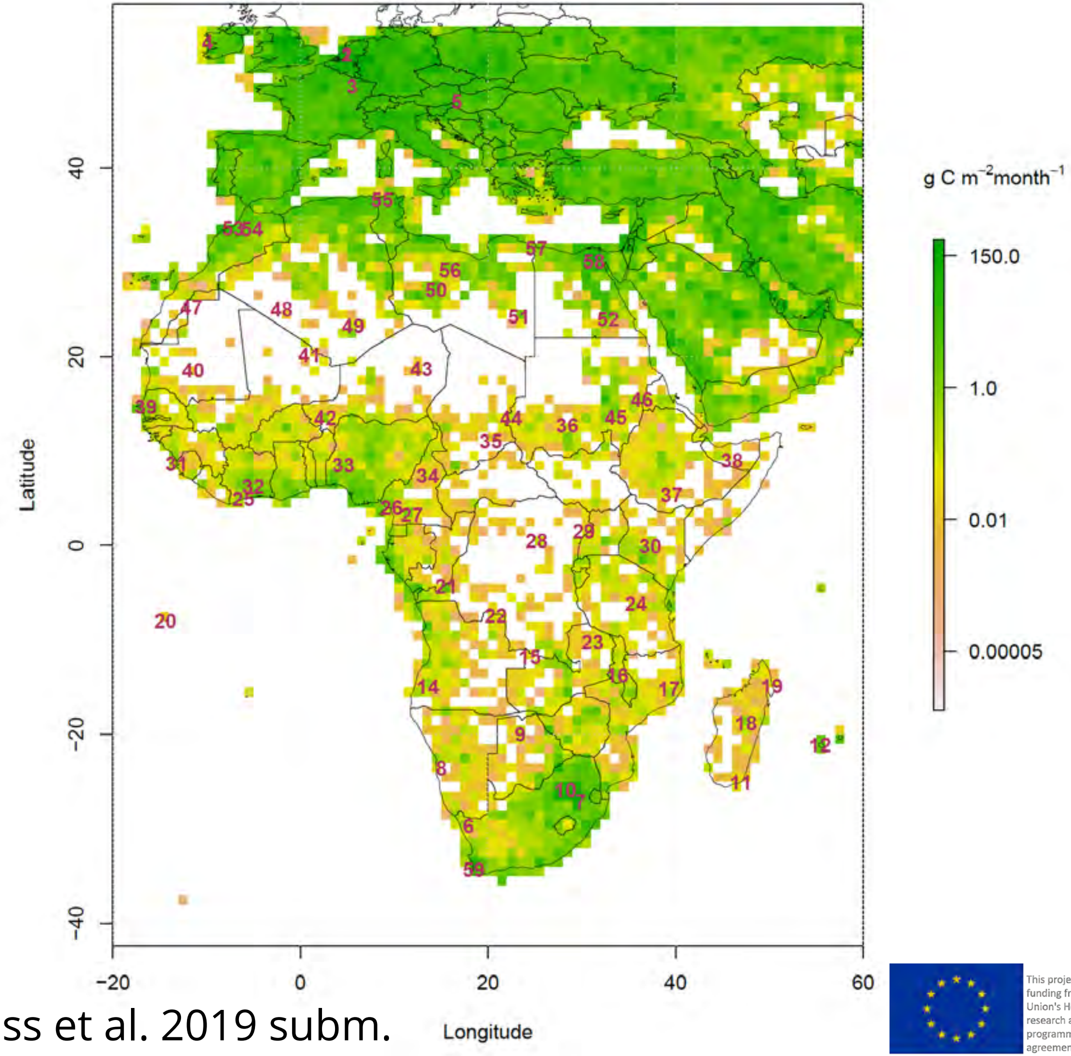
CO2 Human Emissions

VERIFY

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement numbers 776186 and 776810

Standardisation is essential when filling observational gaps





Nickless et al. 2019 subm.

Greenhouse Gas Observation
& Climate-Smart Agriculture

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730995

Current status and challenges of GHG observations: Japan's contribution to the Paris Agreement

Nobuko Saigusa

Director of the Center for Global Environmental Research, National Institute for Environmental Studies (NIES), Japan.

She specializes in terrestrial carbon cycle, and was a lead author of Chapter 6 of IPCC Special Report on Climate Change and Land (SRCCL).

WMO approach to high-quality measurements of atmospheric composition

Claudia Volosciuk

A researcher at GAW, in the Atmospheric Environment Research Division, Research Department of WMO.

Within WMO, the Global Atmosphere Watch (GAW) is responsible for global measurements of atmospheric composition.

Systematic observations for monitoring the global climate

Carolin Richter

Director of the Secretariat of GCOS, the Global Climate Observing System within WMO.

GCOS regularly assesses the status of global climate observations of the atmosphere, land and ocean and produces guidance for its improvement.

The role of atmospheric observations in the Global Carbon Budget

Matthew Jones

Senior Research Associate at the Tyndall Centre for Climate Change Research, University of East Anglia.

For more info: https://people.uea.ac.uk/matthew_w_jones

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Research Infrastructures as providers of standardised observations

Werner Kutsch

Director General of ICOS, Integrated Carbon Observation System.

He is a biologist, plant ecologist and ecosystem scientist, and has worked with ecosystem carbon cycling for 25 years in Europe and Africa.

He has also is experience in data acquisition, post-processing, data analysis and modeling of ecosystem carbon budgets.


Thank you!
ICOS
INTEGRATED
CARBON
OBSERVATION
SYSTEM

ICOS | INTEGRATED CARBON OBSERVATION SYSTEM

STANDARDISED OPBSERVATIONS ARE THE BASE OF ALL CLIMATE SCIENCE

ICOS Side Event at COP25

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Catching the impact of climate change

...

2019 Australia drought and wildfires

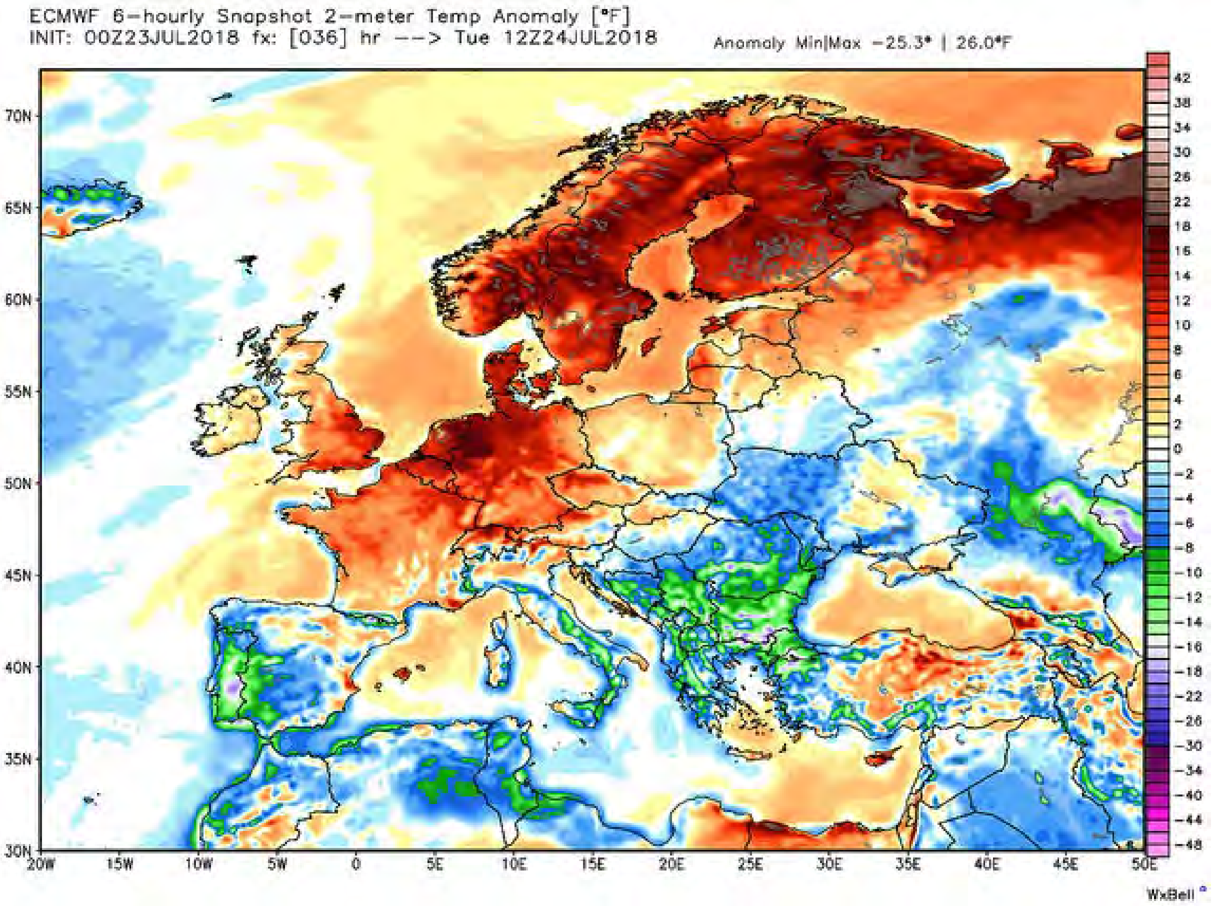
2019 California drought and wildfires

2019 Mozambique Cyclone Kenneth

2018 European drought

2018 Hurricanes and Typhoones

...



ICOS INTEGRATED CARBON OBSERVATION SYSTEM

We need to observe the impact of extreme events on the global carbon cycle.

Climate feeds back to the carbon cycle:

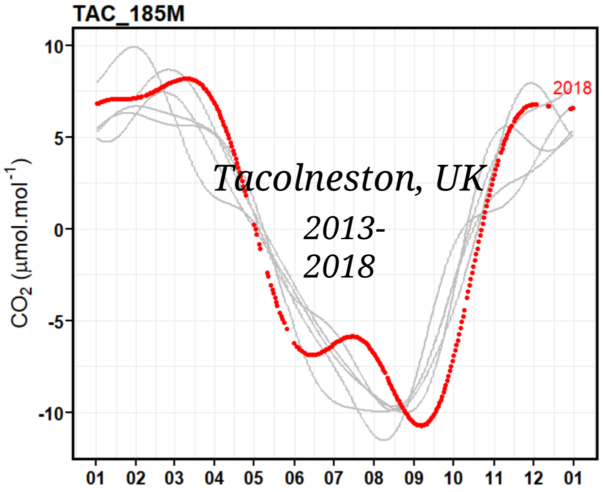
Strong reduction of carbon fixation due to drought in boreal forests in Sweden.

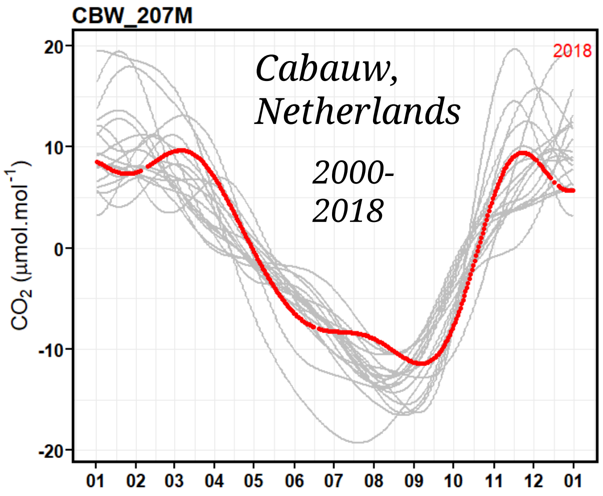
Credits:
ICOS Sweden,
Tobias Biermann

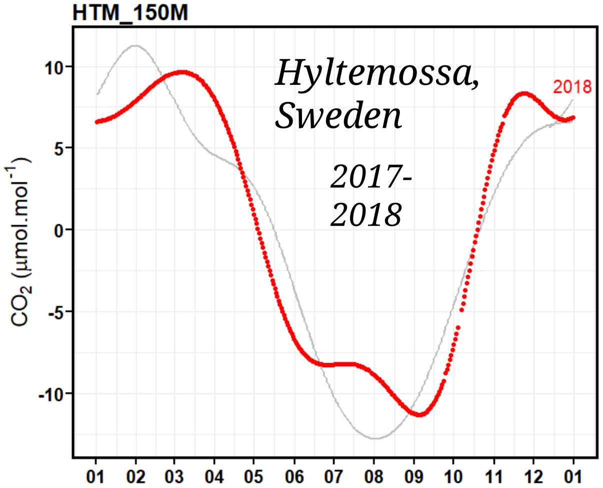
ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Climate feeds back to the carbon cycle:

Strong reduction of carbon fixation due to drought also visible in the atmosphere.





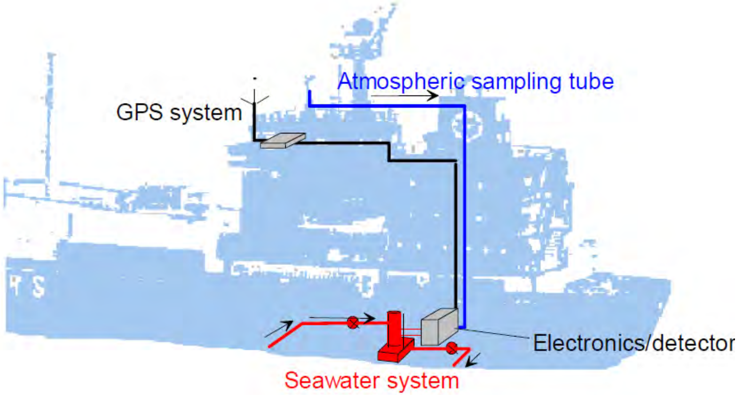


Credits:
M. Ramonet and
ICOS Atmosphere
Network PIs

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

In situ ocean observations

http://www.socat.info



Fugacity of CO_2 (fCO_2) and partial pressure of CO_2 (pCO_2)

$$fCO_2 = \gamma\ pCO_2 = [CO_2] / K'0$$

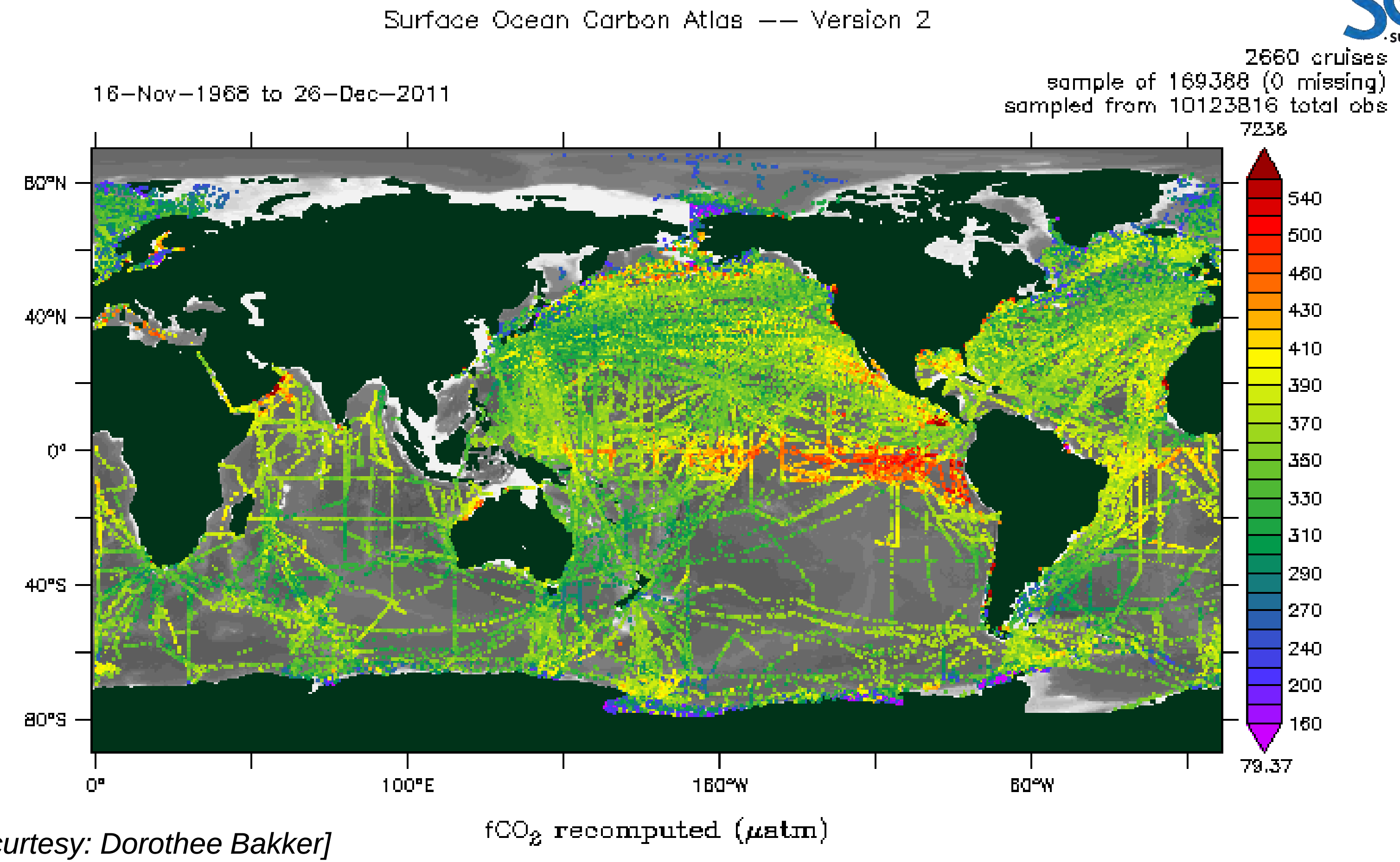
($\gamma \sim 0.996\text{-}0.997$)

Schuster and Watson (2007) JGR

[curtesy: Dorothee Bakker]

In situ ocean observations

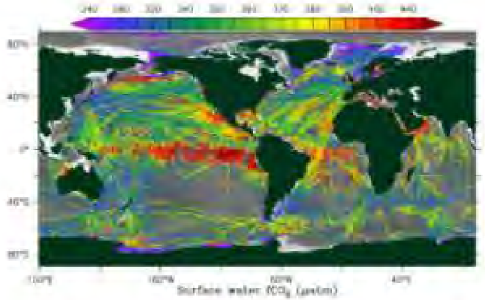
http://www.socat.info



[curtesy: Dorothee Bakker]

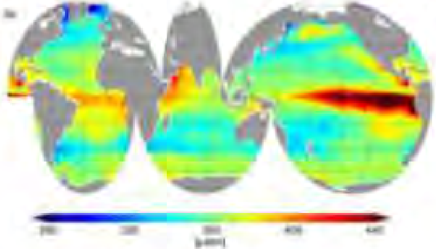
In situ ocean observations

http://www.socat.info



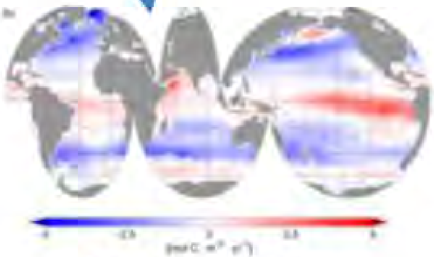
A SOCAT data product
(synthesis or gridded)

A mapping method



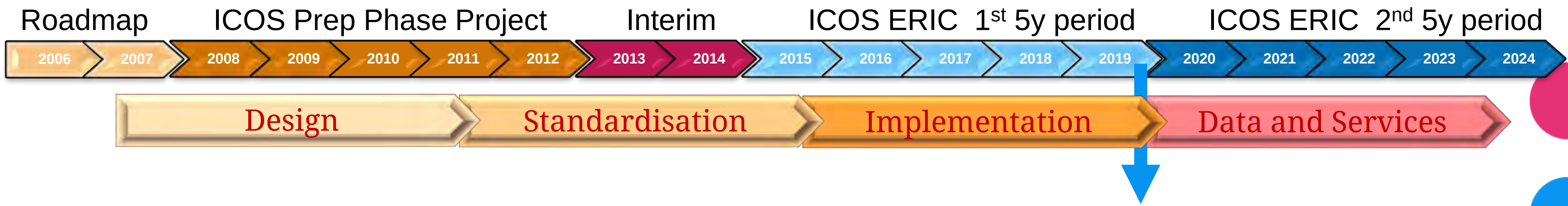
Surface water fCO_2
(here 1998-2011)

Gas transfer parameterisation,
wind speed

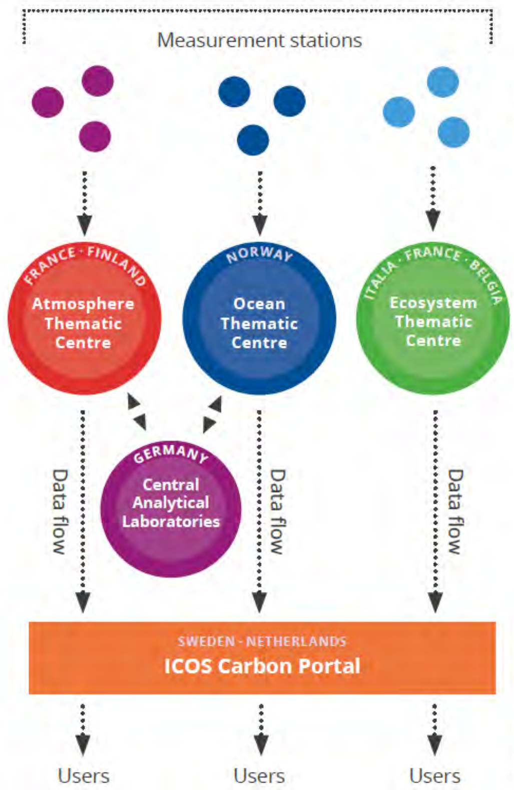


Air-sea CO_2 flux
(here 1998-2011)

The (spatial/temporal) variability in data-based air-sea CO_2 flux estimates can improve land CO_2 flux estimates by atmospheric inversion (Rödenbeck et al., 2014). (Figures Bakker et al., 2014; Landschützer et al., 2014).



A well-designed reliable data life cycle



Data is generated and collected.

Data is curated and processed: e.g. meta data such as originating experiment, persistent identifiers and quality assurance annotations.

Data is published, and services for transformation, collation and analysis are provided.

Researchers use the data, potentially producing new research data.

- ✓ Standardized measurements
- ✓ Standardized data processing
- ✓ Centralized quality control
- ✓ Data provenance, curation and archiving
- ✓ Clear open data license
- ✓ Data citation
- ✓ Full data FAIRness