CARBON PORTAL STATUS

Alex Vermeulen, CP team

ICOS Carbon Portal, system elements

- ✓ **All services fully scalable and portable (dockerized)**
- ✓ **Open software, shared through GITHUB, GPL licence**
- ✓ **Data objects in trusted long term repository (B2SAFE, 2 replicates)**
- ✓ **Semantic web (WEB 3.0), linked open data**
  - ✓Metadata based on ontology, all elements have (linked) URIs
  - ✓nonSQL, RDF database
  - ✓Open SPARQL endpoint
  - ✓Versioned meta data store: roll-back, time dependent queries
- ✓ **Persistent identifiers, linking to data object and metadata: DOI and/or Handle system**
  - ✓PID based on SHA256 checksum of data object: Data Integrity control
  - ✓Maximum granularity of Data Objects
- ✓ Support for versioning, collections for DOI
- ✓ Machine actionable through standard http(s) protocol, RESTful API in backend and frontend
- ✓ NGiNX proxy redirects to services (https://service.domain.eu), domain completely configurable and stylable
- ✓ Can be deployed as single portal backend with multiple frontends or as set of federated portals using one or more interoperable metadata stores

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Identification as essential basis

- Globally **unique** and **eternally persistent** identifiers
- The identifiers resolve globally in human and machine readable ‘landing pages’
  - Point or give directly access to the data
  - Provide and further link to essential metadata
- Examples:
  - Handle PID: Persistent Identifier, e.g. https://hdl.handle.net/11676/MpfOrQHnpLf3BMDDAGaAEafc
    - In Handle only metadata required is a redirect URL (web link)
  - DOI: Digital Object Identifier (based on Handle), e.g. https://doi.org/10.18160/CE2R-CC91
    - For DataCite additional metadata fields are required (Datacite Metadata Schema V4.2)
    - Metadata include abstract, keyword, authors and other contributors

DataCite
FIND, ACCESS, AND REUSE DATA

FAIRifying, the process

FAIRness involves “everyone”: data producers, data managers and the end users of our data!

- ✓ 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

https://www.coretrustseal.org/

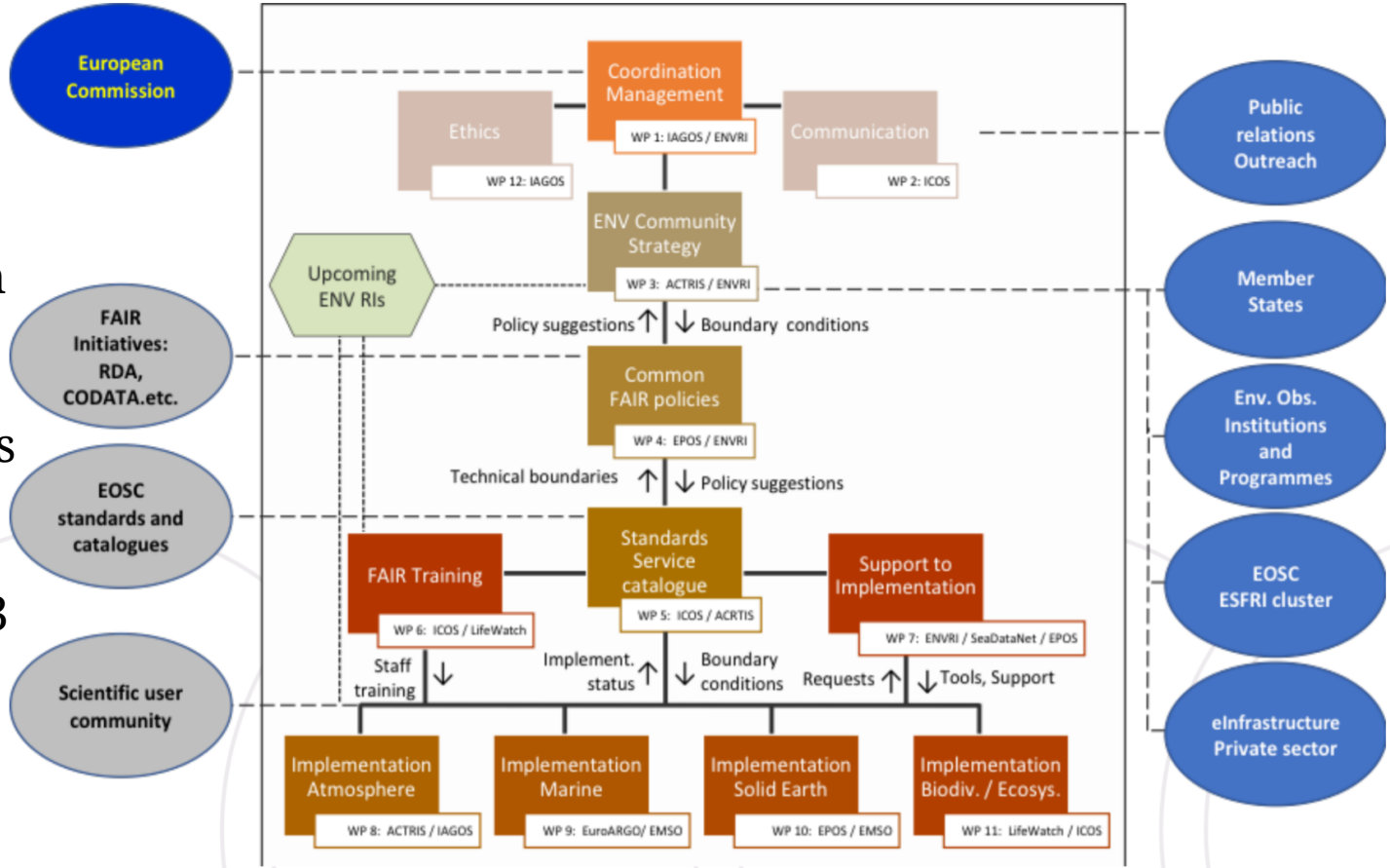
FAIRifying in Europe -> EOSC Cluster project: ENVRIFAIR

12 Env. RIs

Other clusters:

- Life Sciences
- Photo & Neutron Science
- Astronomy + Particle Physics
- Social Sciences

> 100 M€ until 2023



ICOS INTEGRATED CARBON OBSERVATION SYSTEM

ICOS Carbon Portal as an illustration

- In ICOS all data objects, from raw to model analyses get a PID and/or DOI
- ICOS PID contains checksum of data: data integrity assured!
- Identifiers are essential for data citation!

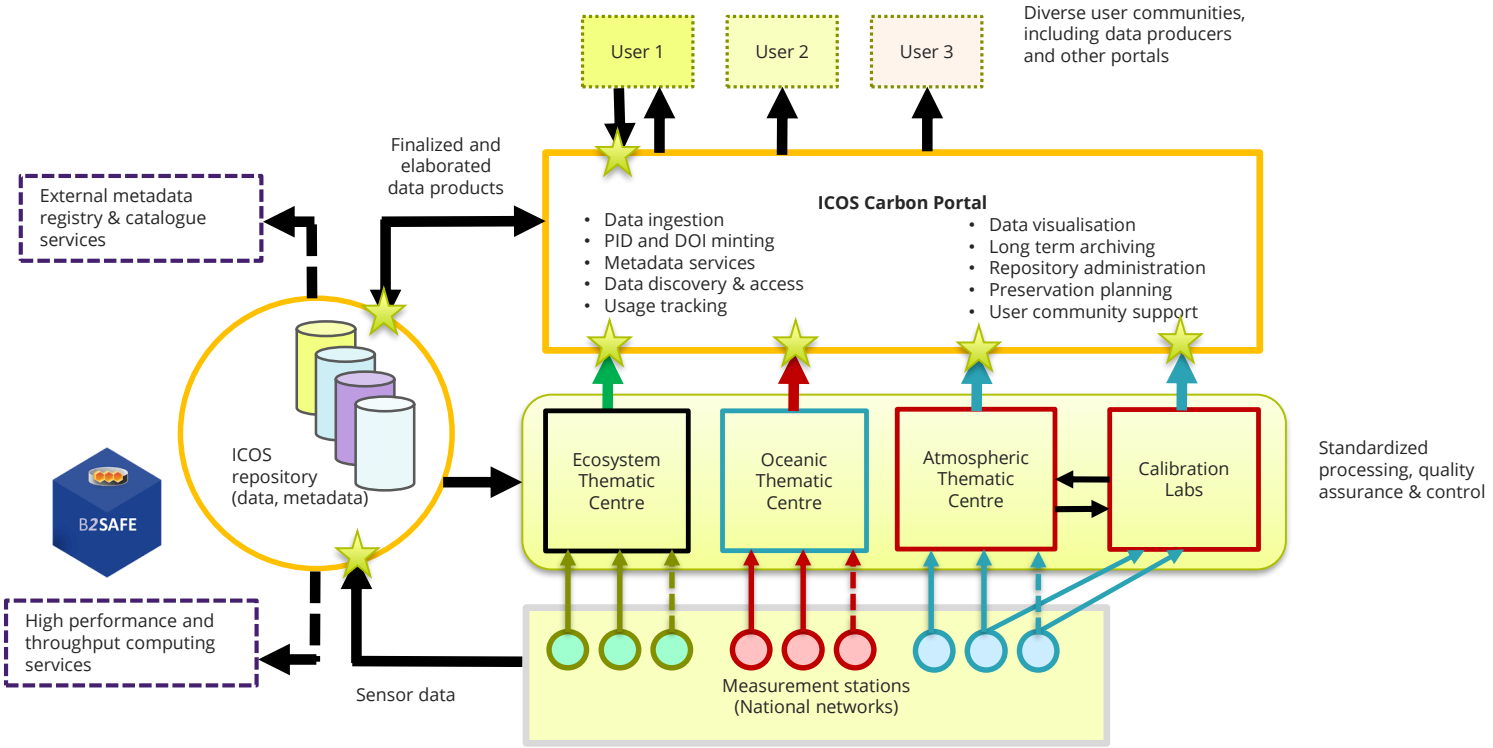
- Support for collections and data versioning
- Access through RESTful interfaces through a simple URL
  Standard HTTP get and put: browser or prompt-cli is enough
- No drivers or proprietary software needed
- All software is versioned and provided open source (e,g, GitHub), ICOS CP: GPL
- Interfaces build on same protocols and Linked Open Data approach

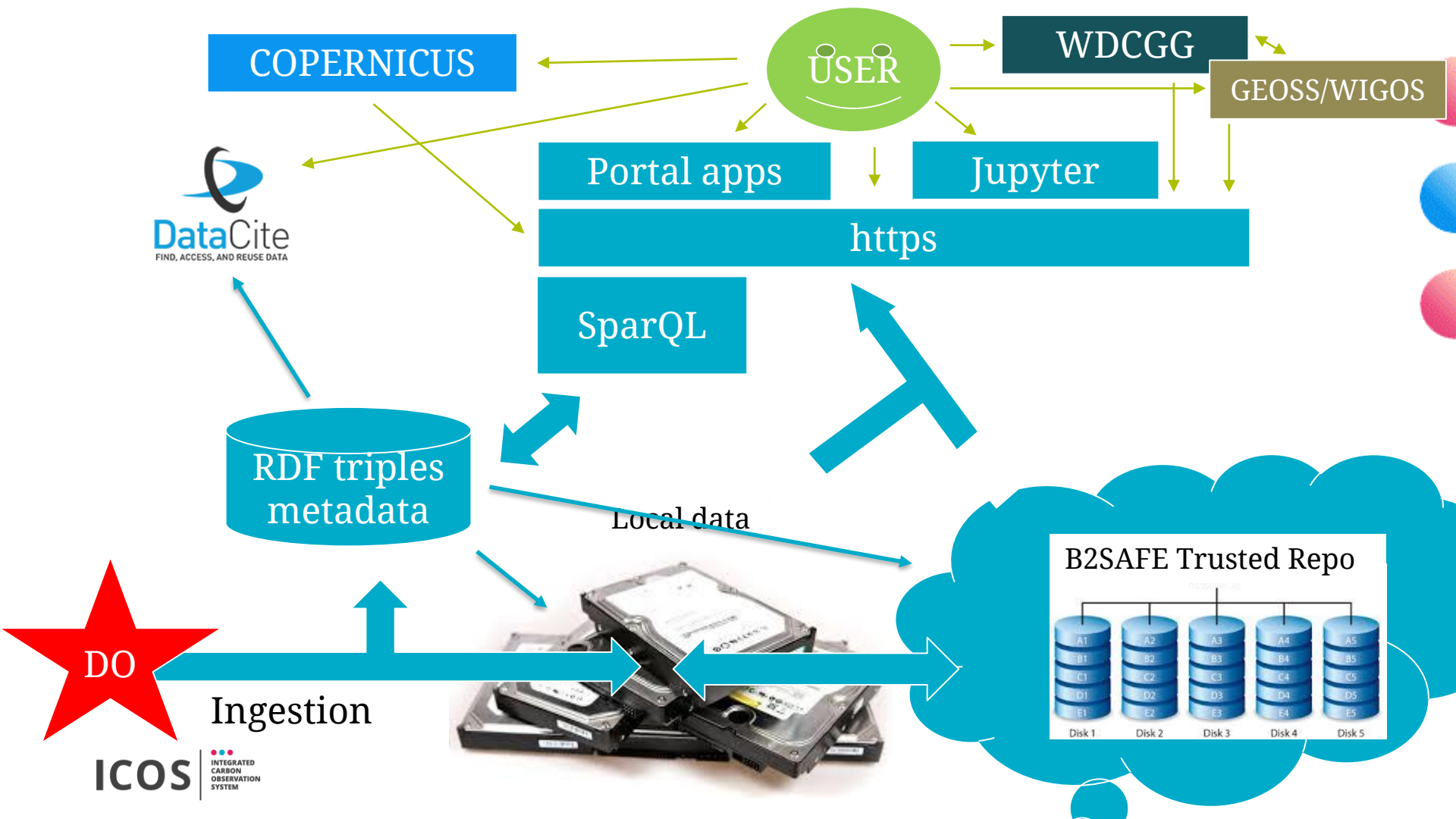
- Upload restricted to known Data Objects supported by correct metadata by specific authorized users, data validated at ingestion
- All data download open and free according to data license (ICOS: CC4BY)

- High reliability and availability: >99%, persistent data storage
- Now operational for multiple domains

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

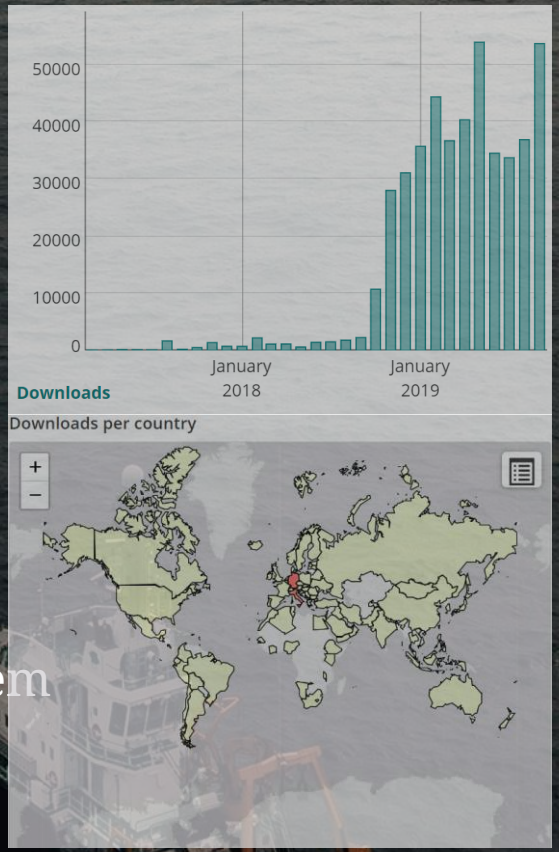
ICOS data flow




COPERNICUS
USER
WDCGG
GEOSS/WIGOS
DataCite
FIND, ACCESS, AND REUSE DATA
Portal apps
Jupyter
https
SparQL
RDF triples metadata
Local data
B2SAFE Trusted Repo
Disk 1
Disk 2
Disk 3
Disk 4
Disk 5
DO
Ingestion
ICOS
INTEGRATED CARBON OBSERVATION SYSTEM

Factsheet Data Sep 2019

- 210 000 data objects
- 450 000 data downloads
- 40 000+ downloads per month
- 24 000 unique users
- 2 700 active users per month
- 294 CP user accounts (56 OrcID)
- 170 users of Nextcloud/OnlyOffice
- >99% uptime
- NRT data for Atmosphere+Ocean, soon Ecosystem
- Level 2 data for all domains
- Jupyter VREs and STILT footprint apps



ICOS INTEGRATED CARBON OBSERVATION SYSTEM

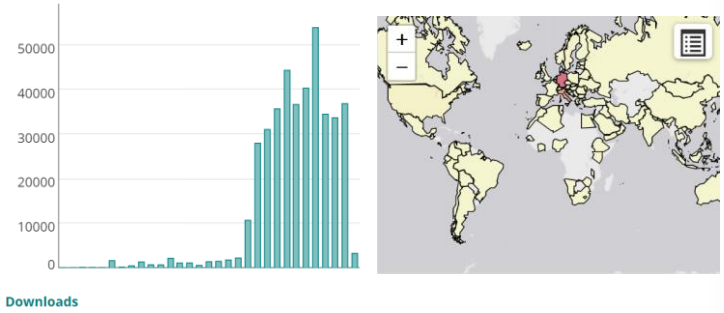
Find, preview and download data

https://data.icos-cp.eu/portal

https://data.icos-cp.eu/portal/#search?theme=%5B%22Atmospheric%20data%22%5D&level=%

- >200 000 visible data objects
- Data cart
- License check
- Download/preview count
  - Per data object
  - Per domain
  - Per contributor
  - Per country

  Etc.



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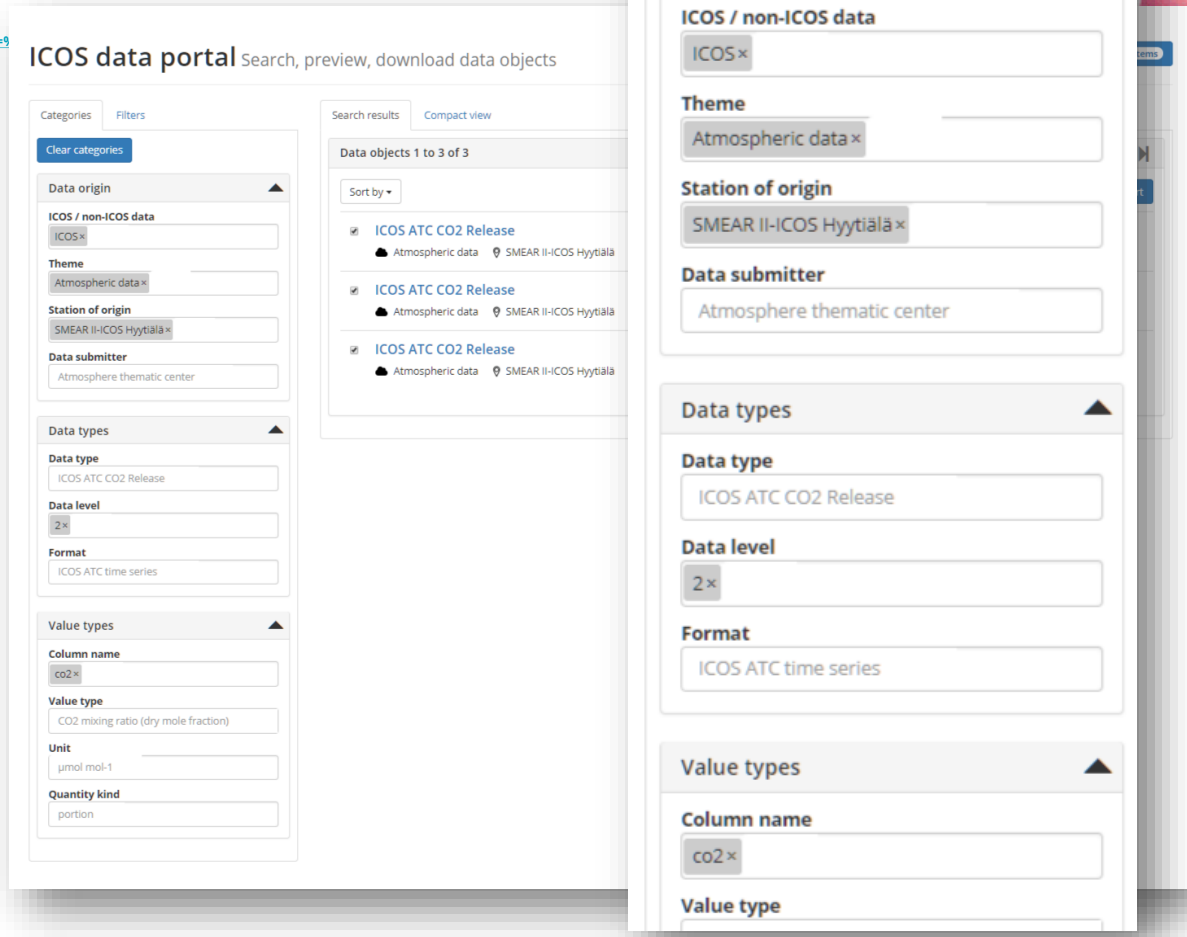
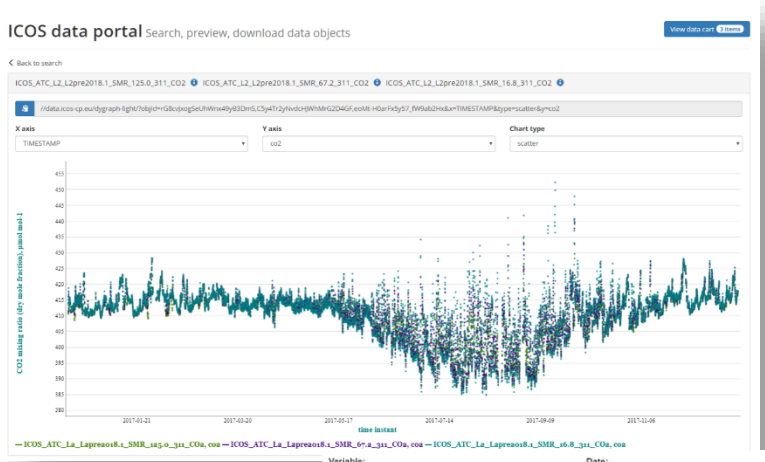
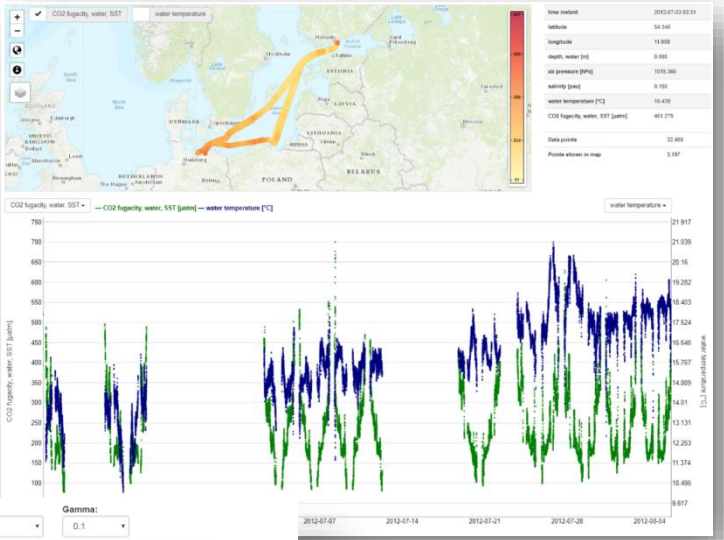
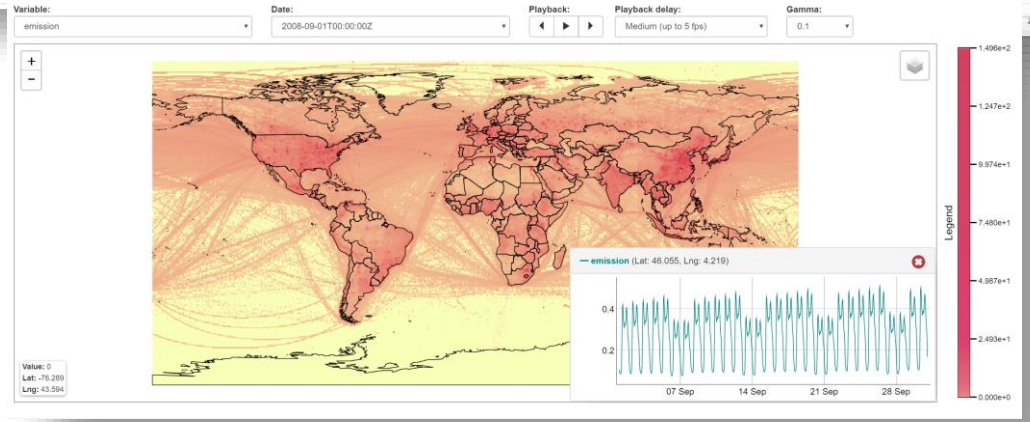


Fully operational, data previews

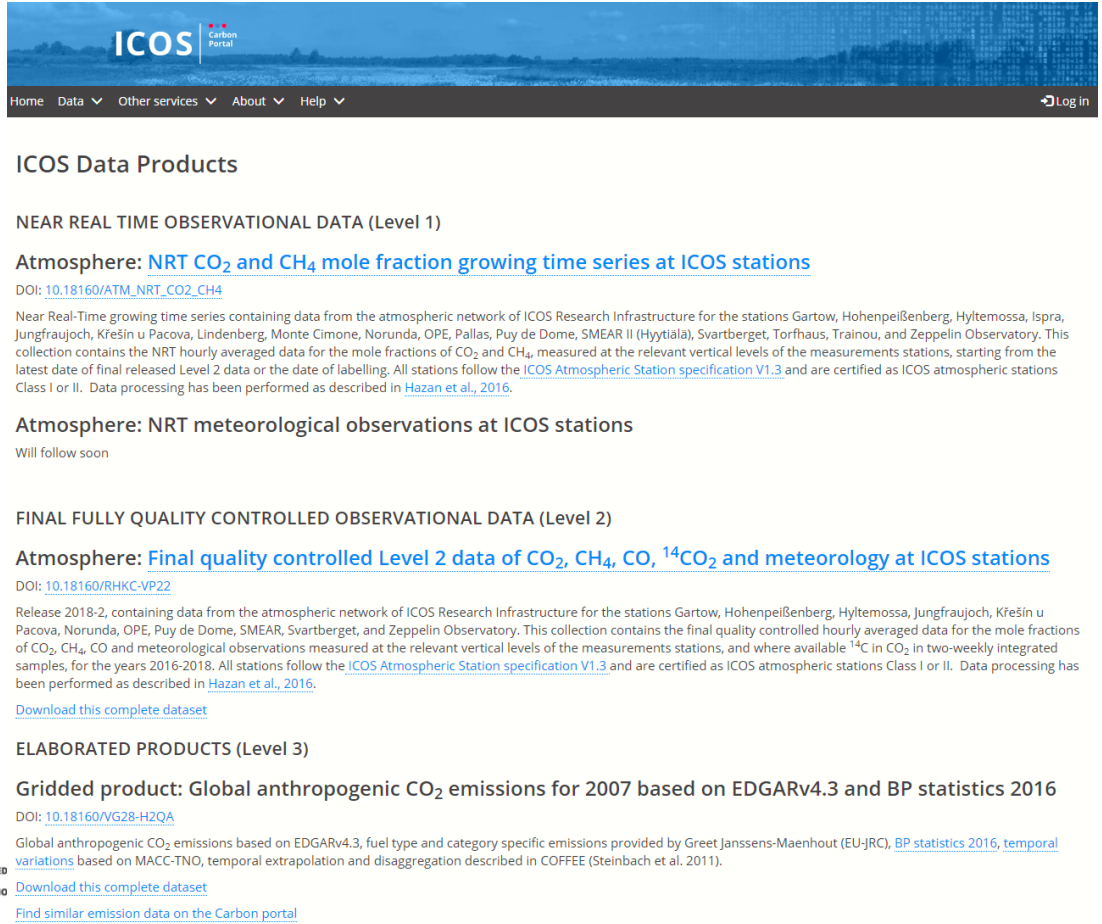






ICOS INTEGRATED CARBON OBSERVATION SYSTEM

www.icos-cp.eu/dataproducts



www.icos-cp.eu/dataproducts

ICOS Near Real-Time (Level 1) Atmospheric Greenhouse Gas Mole Fractions of CO2 and CH4, growing time series starting from latest Level 2 release

Disclaimer: Near Real-Time (NRT, Level 1) data is not the final highest quality ICOS data. This data is generated using only completely automated quality control procedures. These NRT time series are generated within 24 hours after measurement and will not be updated later using improved information or become completed with missing data. For your analysis and publications we recommend to use the final completely quality controlled and flagged (Level 2) data that is released with a delay between 6-12 months, that includes all corrections and maximum completion of missing data, also listed in our data products catalog.

Citation: ICOS Research Infrastructure: ICOS Near Real-Time (Level 1) Atmospheric Greenhouse Gas Mole Fractions of CO2 and CH4, growing time series starting from latest Level 2 release, , doi:10.18160/atm_nrt_co2_ch4, 2018.

Link to data: Carbon Portal Search

DOI: 10.18160/ATM_NRT_CO2_CH4

Abstract: Near Real-Time growing time series containing data from the atmospheric network of ICOS Research Infrastructure for the stations Gartow, Hohenpeißenberg, Hyltemossa, Ispra, Jungfraujoch, Křešín u Pacova, Lindenberg, Monte Cimone, Norunda, OPE, Pallas, Puy de Dome, SMEAR II (Hyytiälä), Svartberget, Torfhaus, Trainou, and Zeppelin Observatory. This collection contains the NRT hourly averaged data for the mole fractions of CO2 and CH4, measured at the relevant vertical levels of the measurements stations, starting from the latest date of final released Level 2 data or the date of labelling. All stations follow the ICOS Atmospheric Station specification V1.3 (https://www.icos-ri.eu/fetch/ba12290c-3714-4dd5-a9f0-c431b9900ad1;1.0) and are certified as ICOS atmospheric stations Class I or II. Data processing has been performed as described in Hazan et al., 2016 (doi:10.5194/amt-9-4719-2016).

CO_2 preview

Station	height 1	height 2	height 3	height 4	height 5	
Gartow (ATC_413)	30.0	60.0	132.0	216.0	341.0	All
Gartow (ATC_489)	30.0	60.0	132.0	216.0	341.0	All
Hohenpeißenberg (ATC_382)	50.0	93.0	131.0			All
Hyltemossa (ATC_463)	30.0	70.0	150.0			All
ICOS Utö – Baltic sea (ATC_486)	57.0					All
Ispra (ATC_619)	40.0	60.0	100.0			All
Jungfraujoch (ATC_225)	5.0					All
Karlsruhe (ATC_458)	30.0	60.0	100.0	200.0		All
Karlsruhe (ATC_489)	30.0	60.0	100.0	200.0		All
Křešín u Pacova (ATC_172)	10.0	50.0	125.0	250.0		All
Lindenberg (ATC_399)	2.5	10.0	40.0	98.0		All
Lutjewad (ATC_465)	60.0					All
Monte Cimone (ATC_590)	8.0					All
Norunda (ATC_462)	32.0	59.0	100.0			All
Observatoire Pérenne de l'Environnement (ATC_187)	10.0	50.0	120.0			All
Observatoire Pérenne de l'Environnement (ATC_379)	10.0	50.0	120.0			All
Observatoire Pérenne de l'Environnement (ATC_728)	10.0	50.0	120.0			All
Pallas (ATC_485)	12.0					All
Puy de Dome (ATC_473)	10.0					All
SMEAR II–ICOS Hyytiälä (ATC_311)	16.8	67.2	125.0			All
Svartberget (ATC_464)	35.0	85.0	150.0			All
Torfhaus (ATC_271)	10.0	76.0	110.0	147.0		All
Torfhaus (ATC_457)	10.0	76.0	110.0	147.0		All

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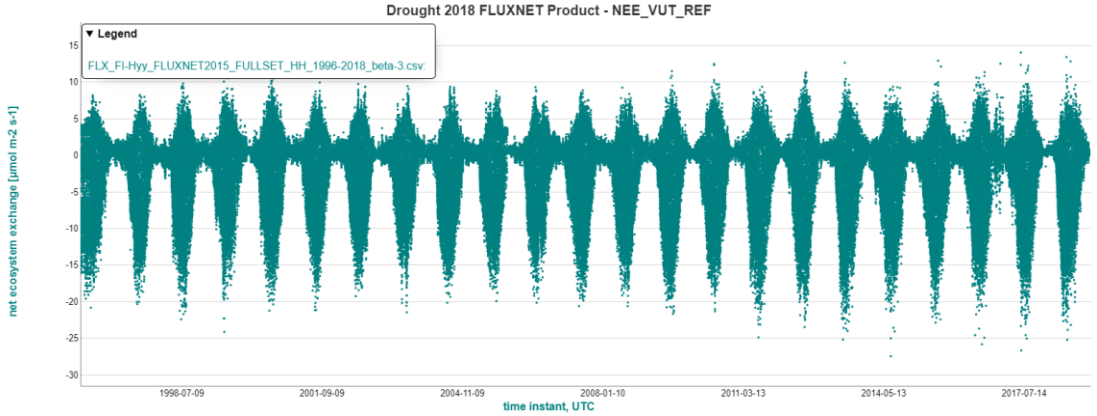
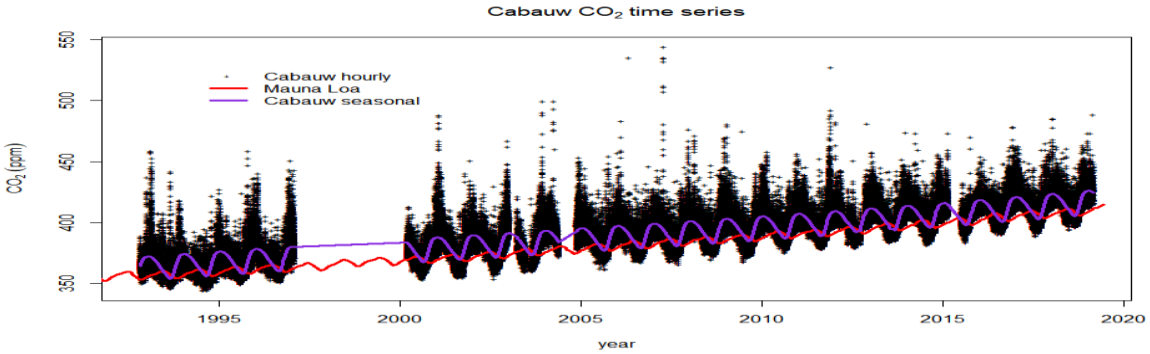
Long high quality time series





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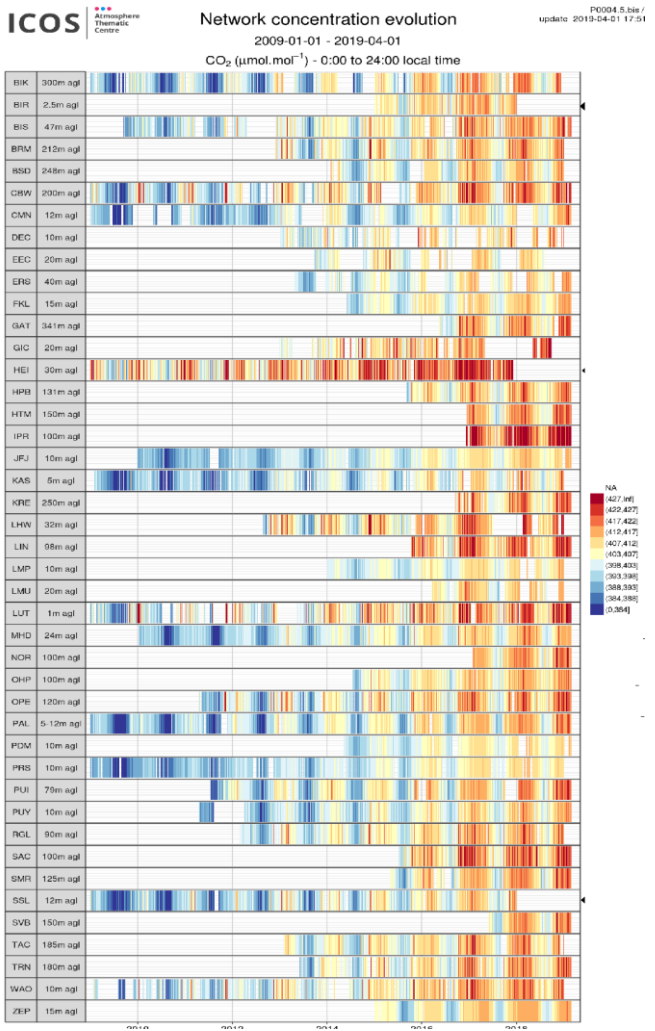
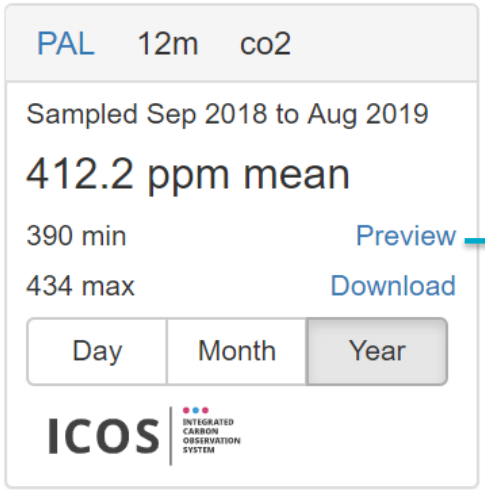
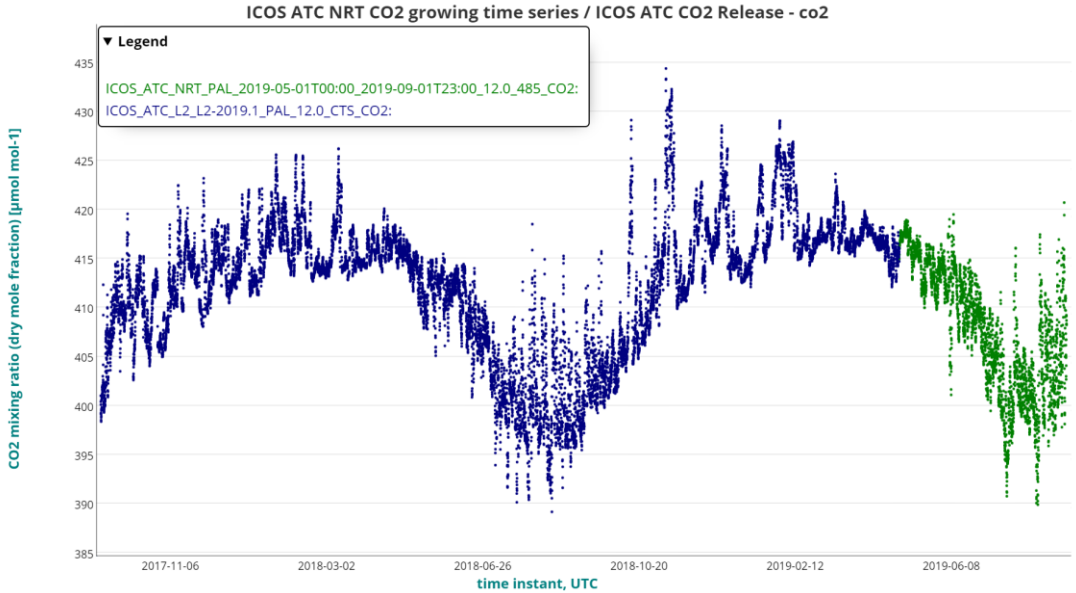


Example dashboard servlet

Station L2+NRT data average for dissemination, e.g. as servlet in news web site:
https://data.icos-cp.eu/dashboard/?stationId=PAL&valueType=co2&height=12





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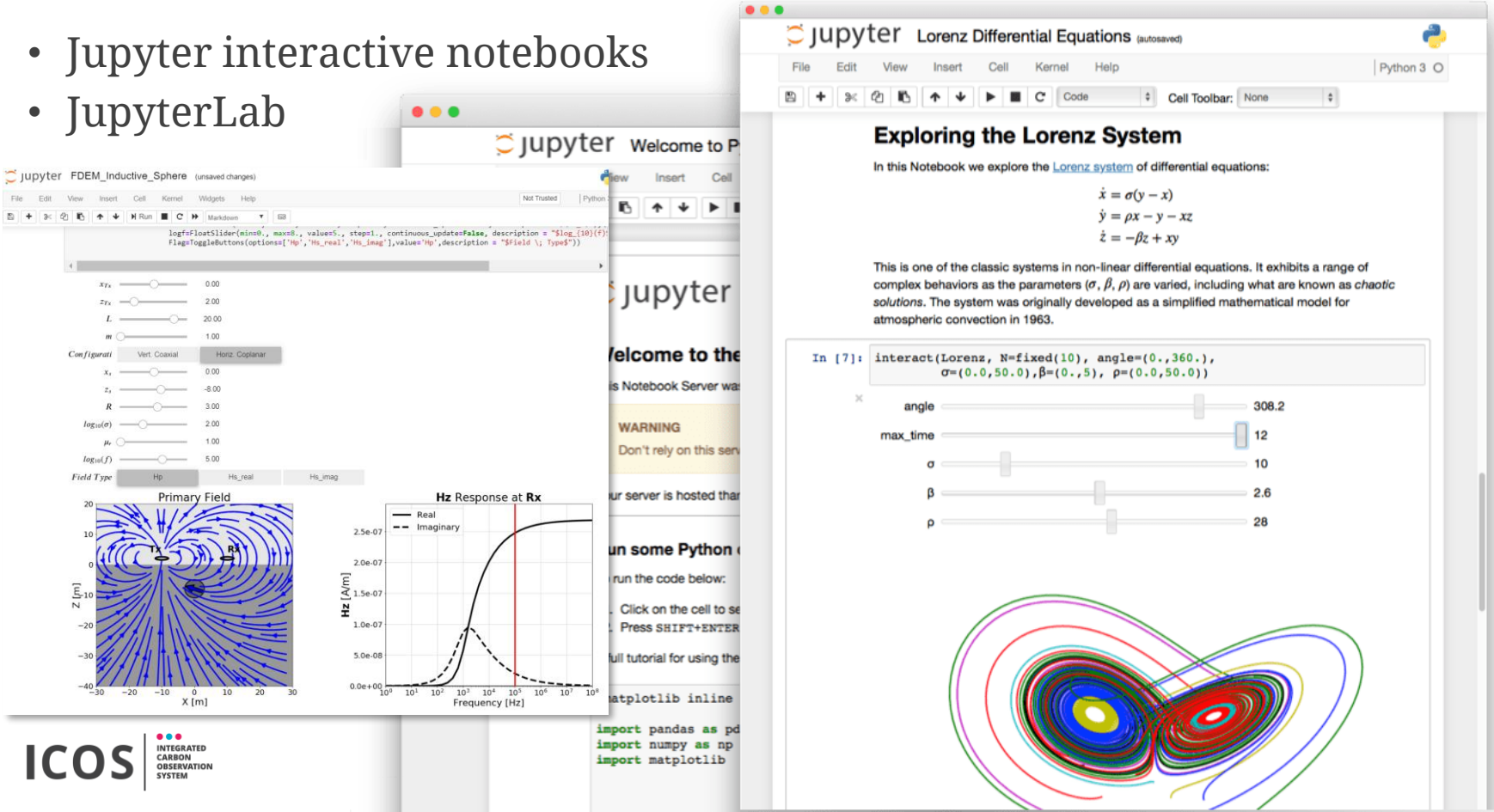
The future of the research data lifecycle

- Jupyter interactive notebooks
- JupyterLab



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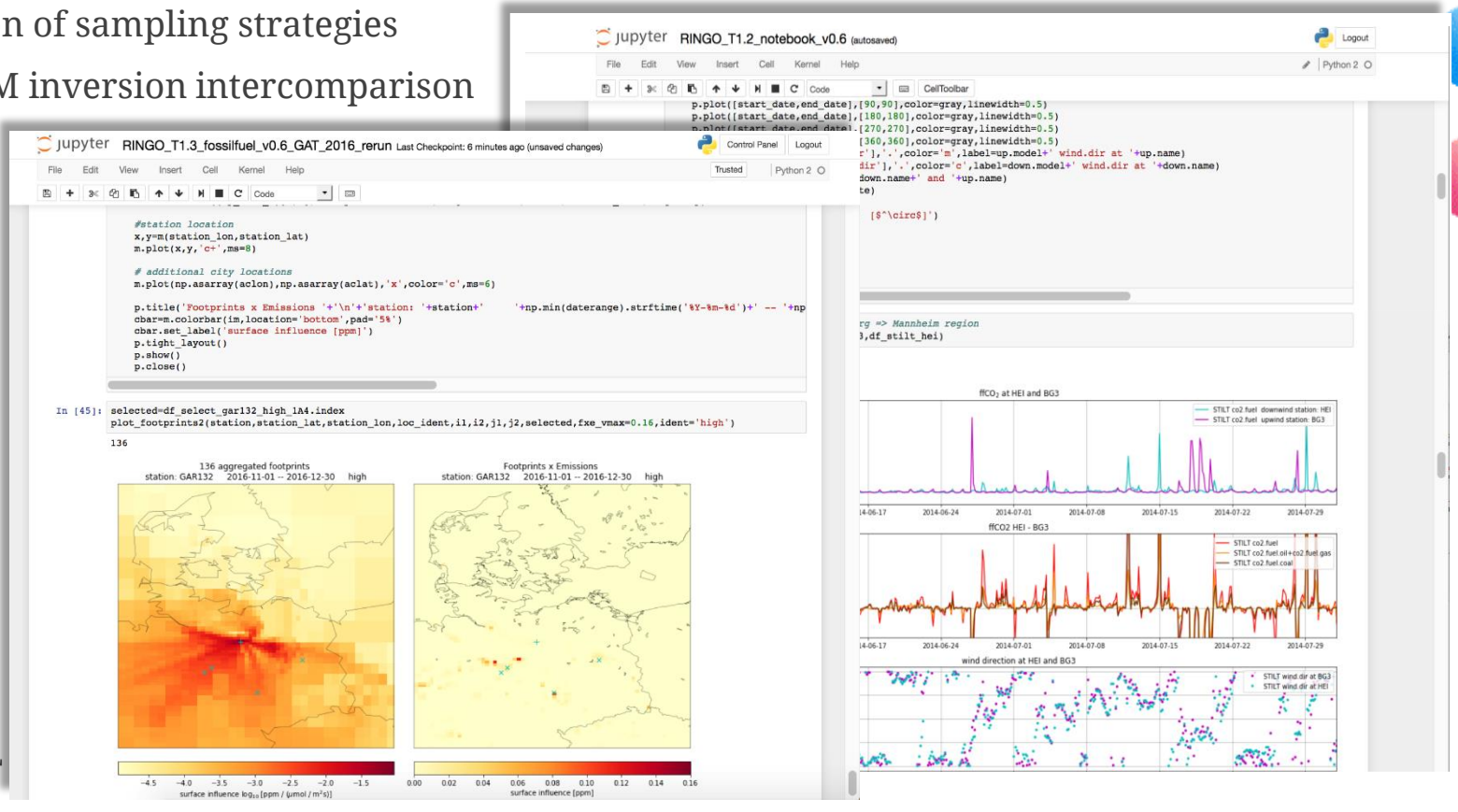
Interactive analysis tools for model results & data

- Analysis of simulated fossil fuel CO_2 time series (RINGO)
- Evaluation of sampling strategies
- EUROCOM inversion intercomparison
- …



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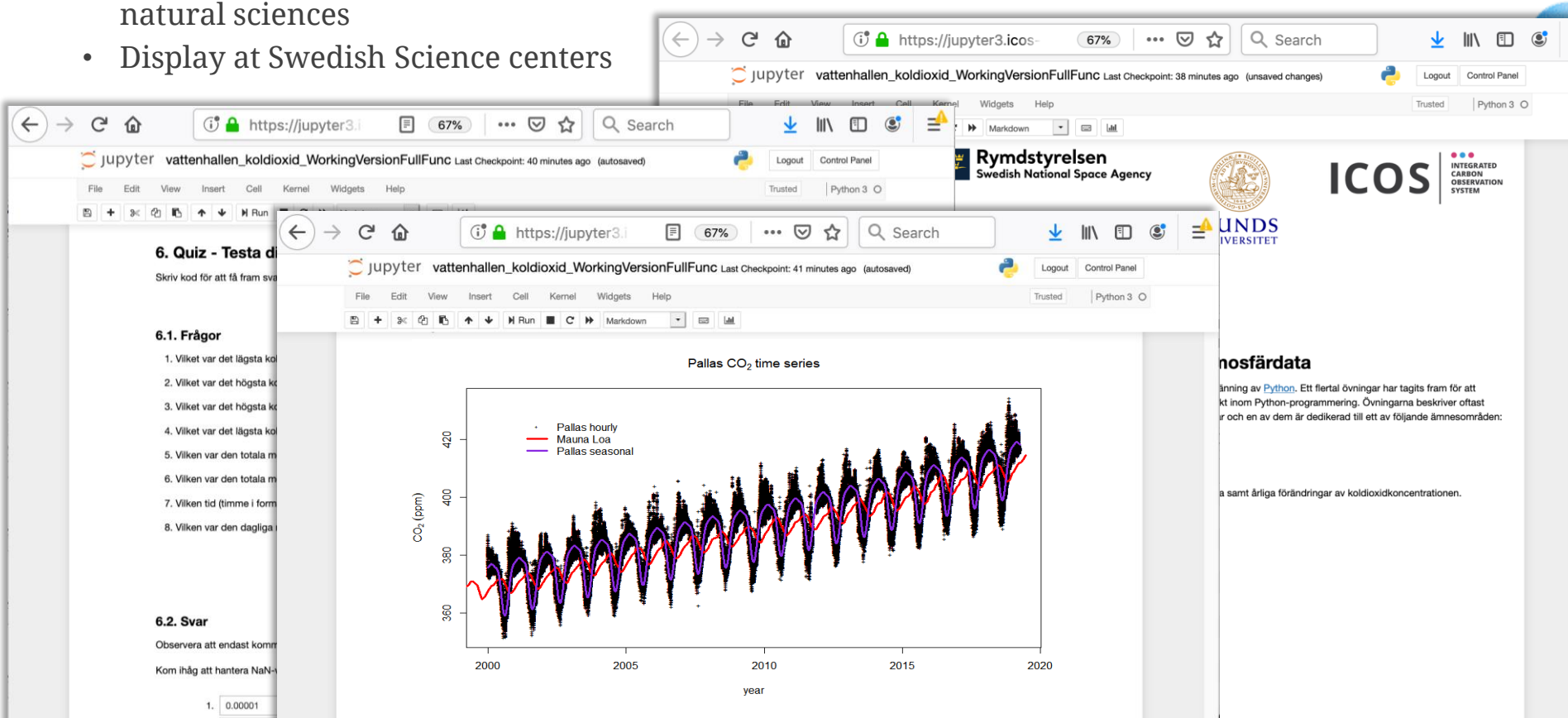
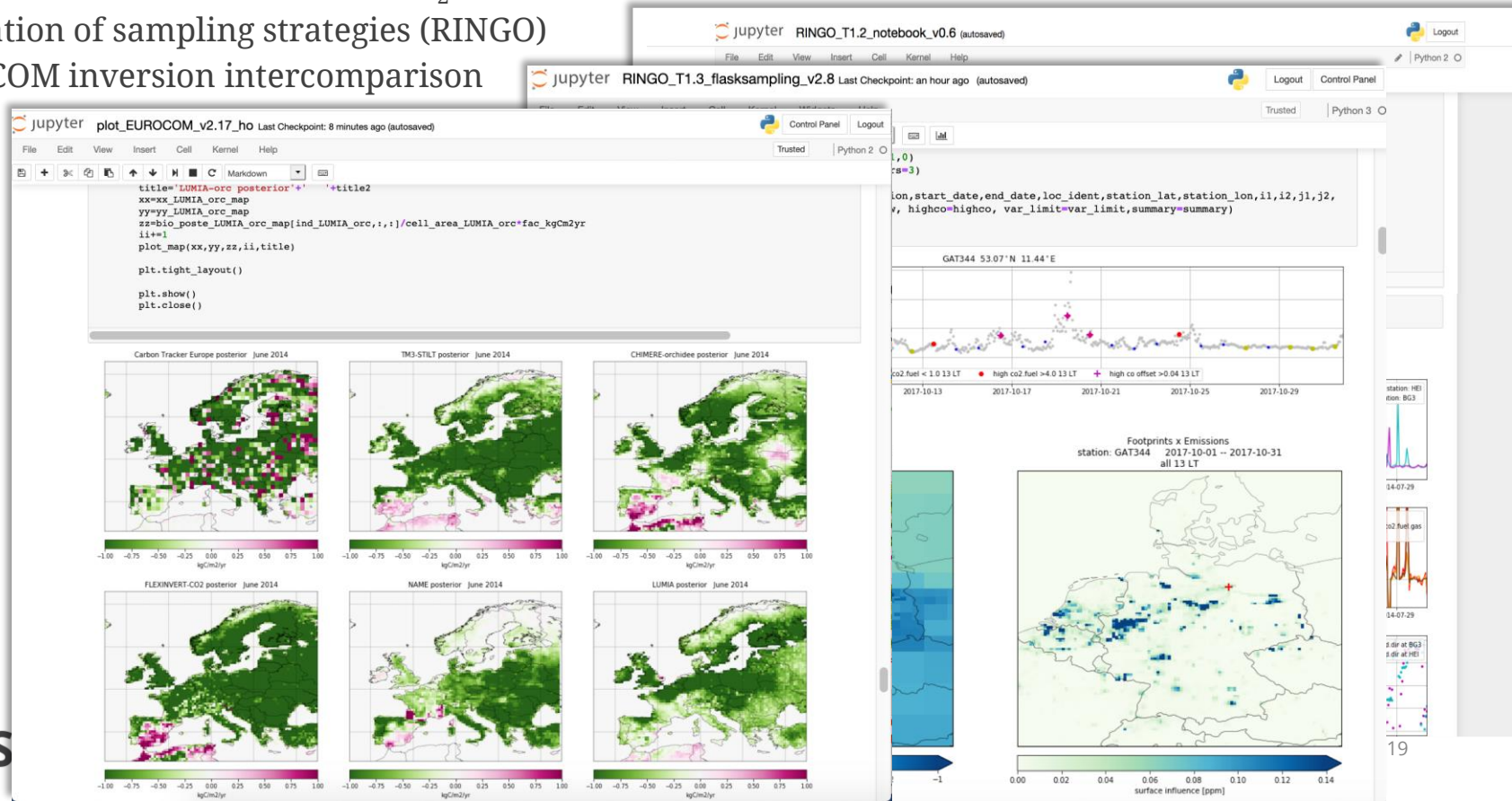
Jupyter notebooks for educational purposes

- Teaching material for university and high-school combining data analytics, coding, and natural sciences
- Display at Swedish Science centers

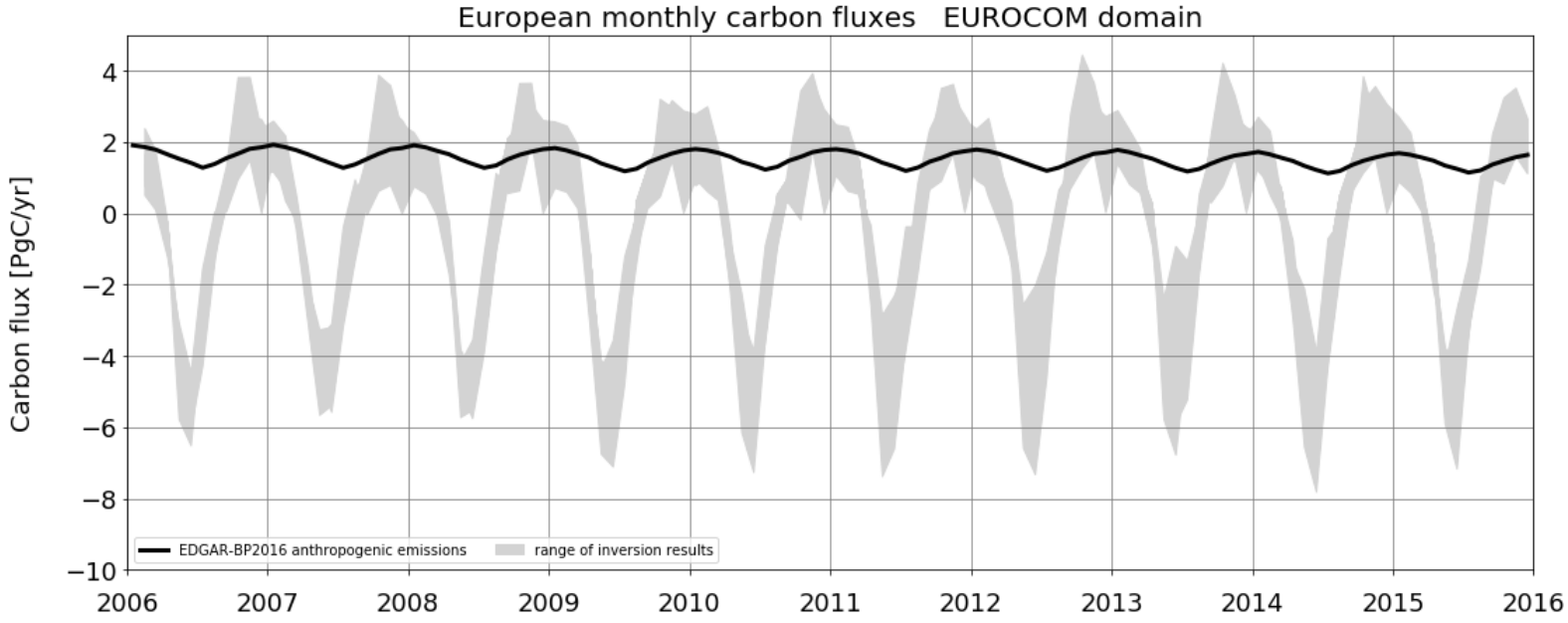


Project-specific Jupyter notebooks

- Analysis of simulated fossil fuel CO_2 time series (RINGO)
- Evaluation of sampling strategies (RINGO)
- EUROCOM inversion intercomparison
- …



EUROCOM inversions: fuel & biospheric CO_2 flux estimates



- Inversion results still show large differences => model development & inherent uncertainties
- Inversion results will be uploaded soon at ICOS CP
- Inversions are currently extended to 2018

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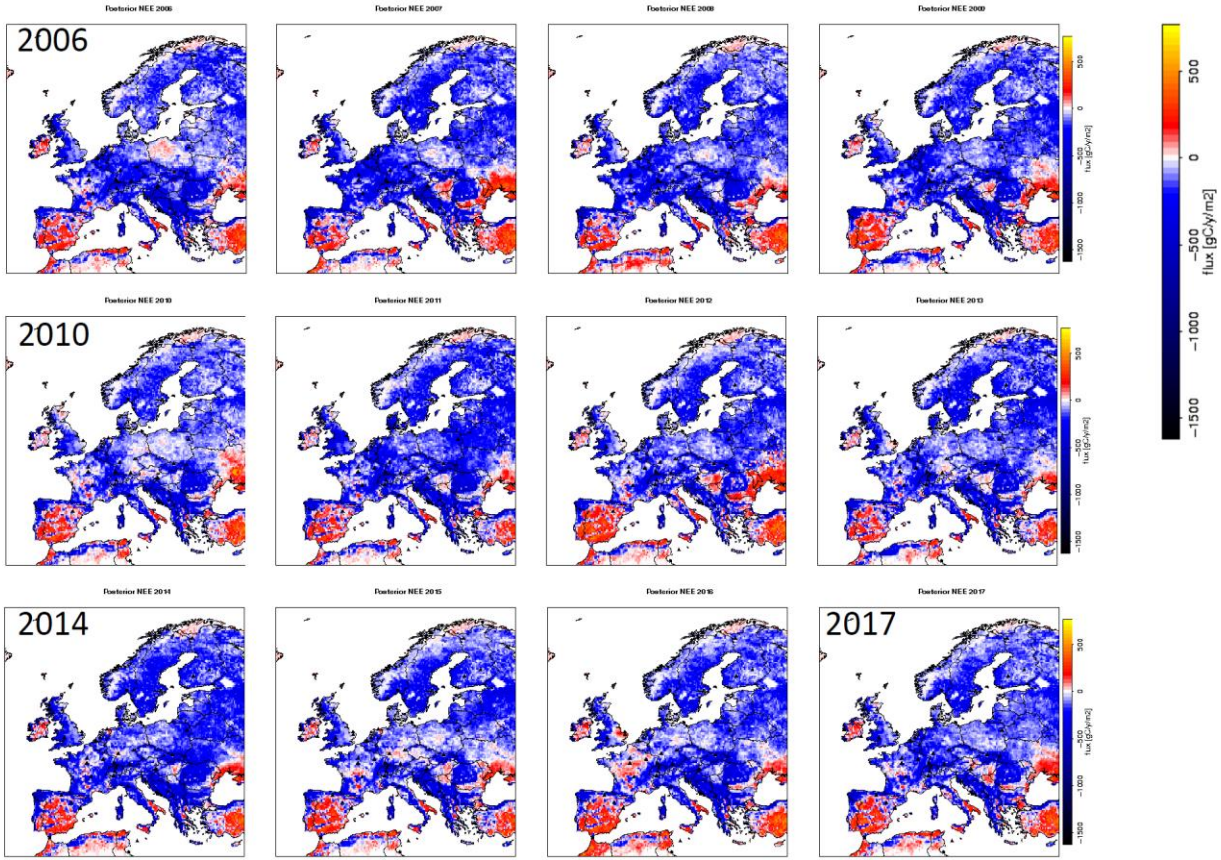
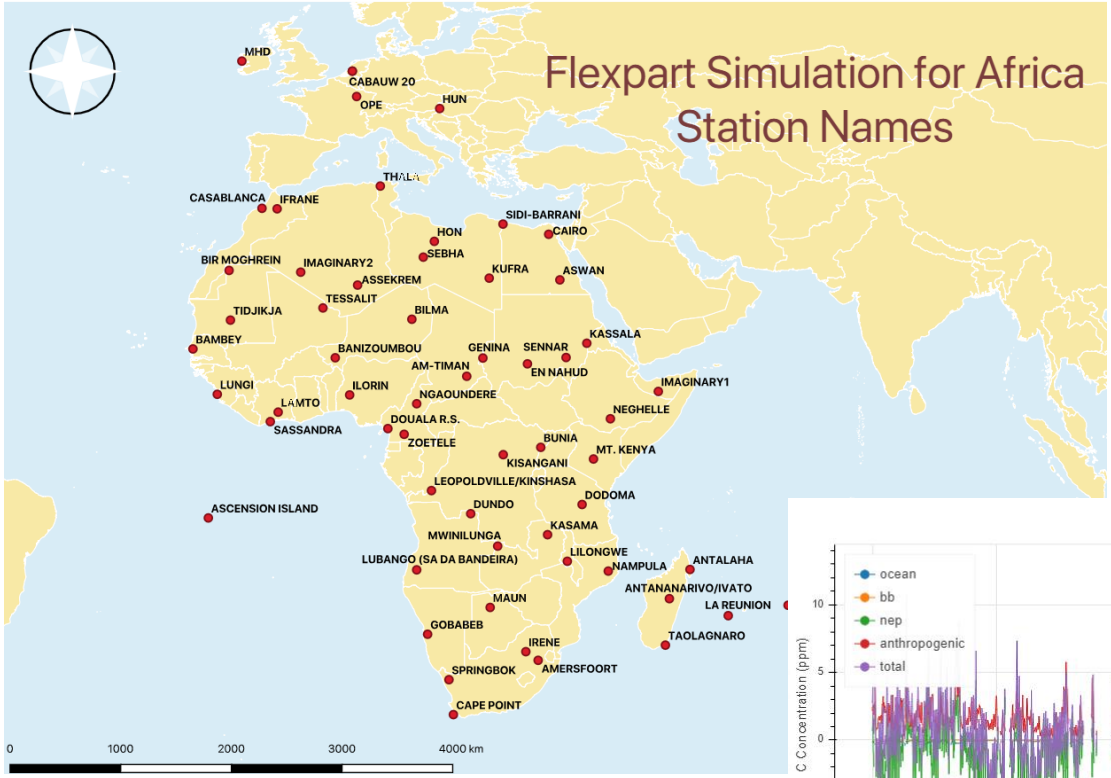
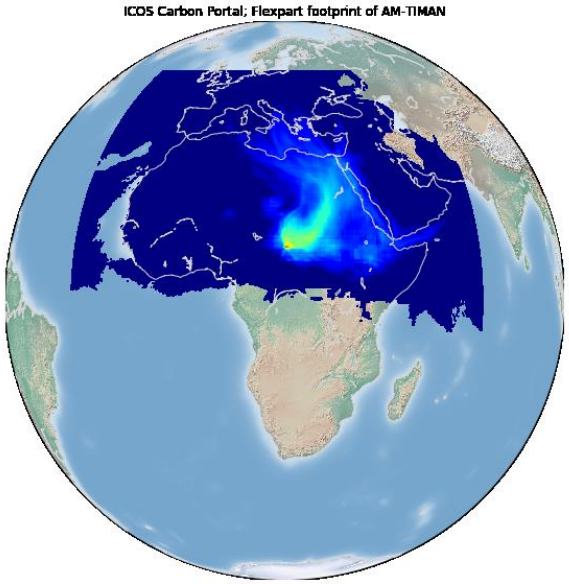
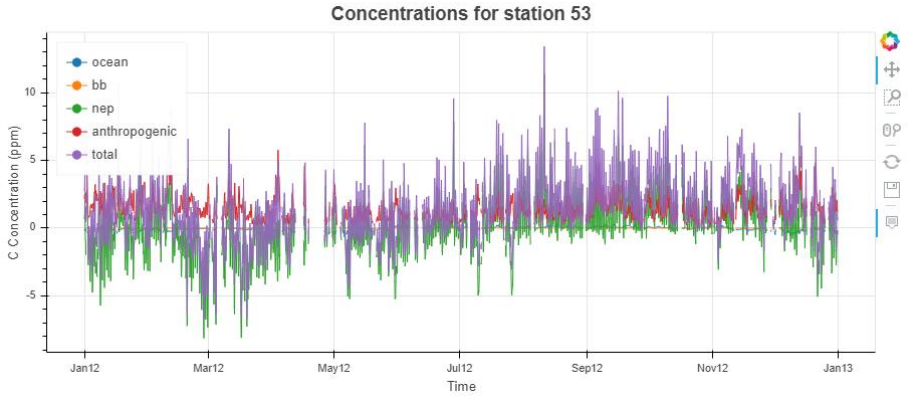
VERIFY regional inversion results 2006-2017



SEACRIFOG







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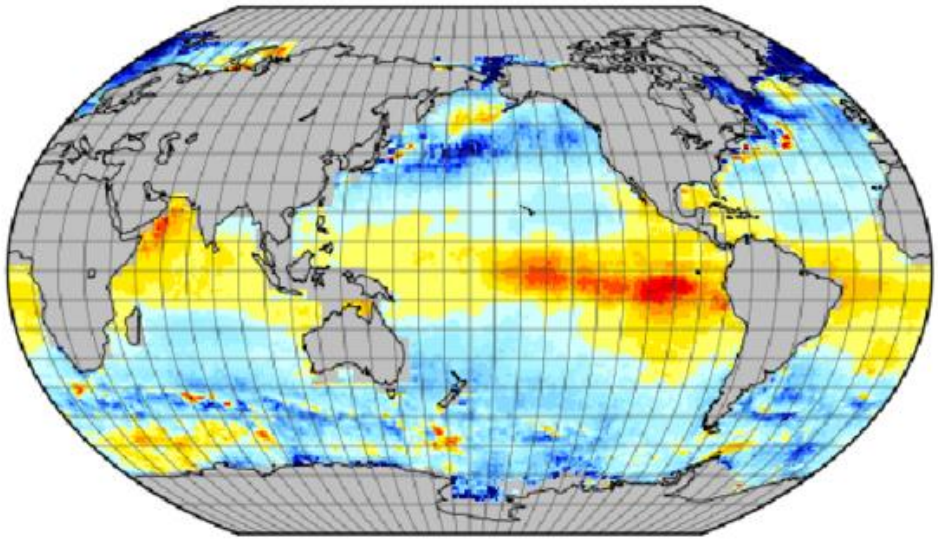
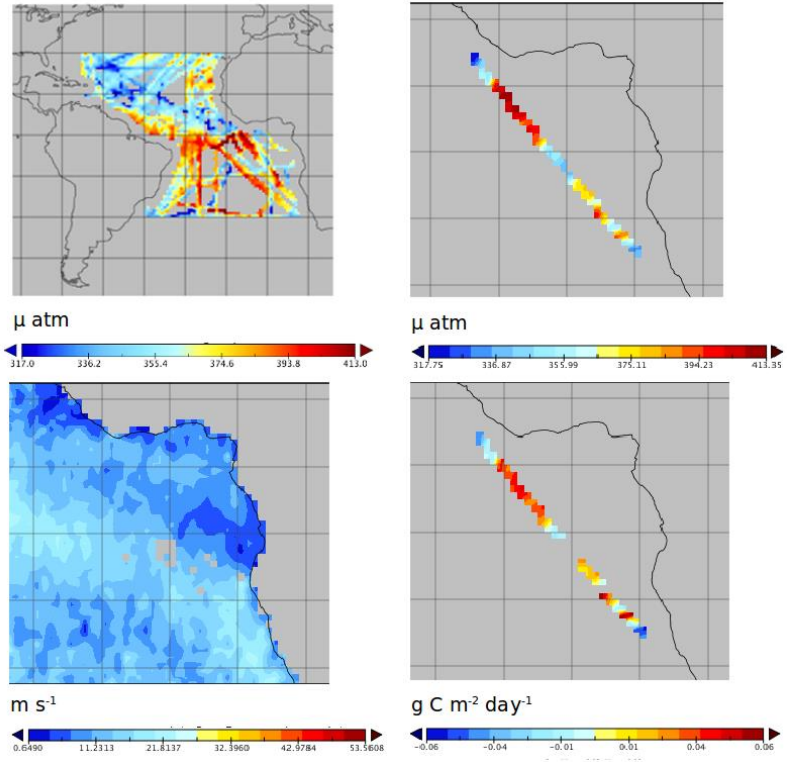
Examples of potential operational science products





Fluxengine:
http://www.oceanflux-ghg.org/Products/FluxEngine

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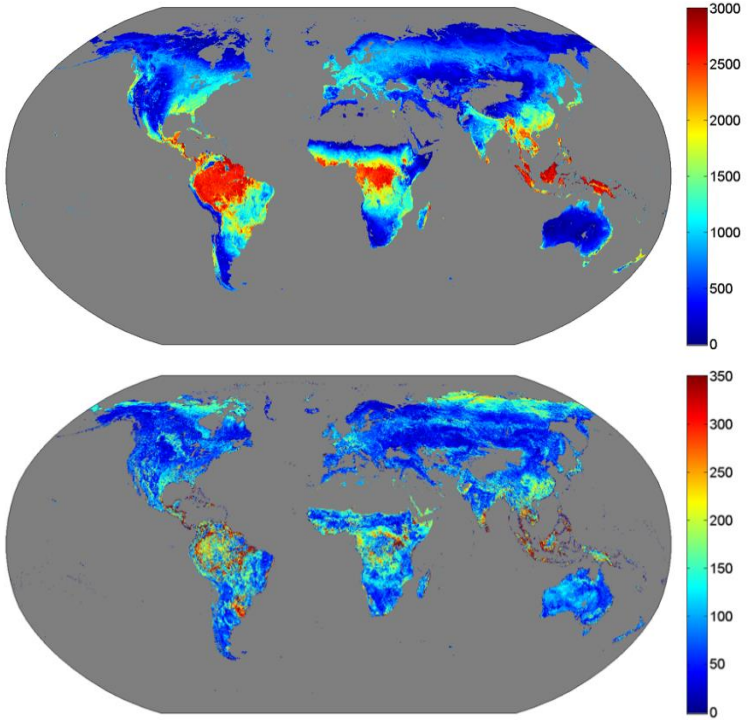
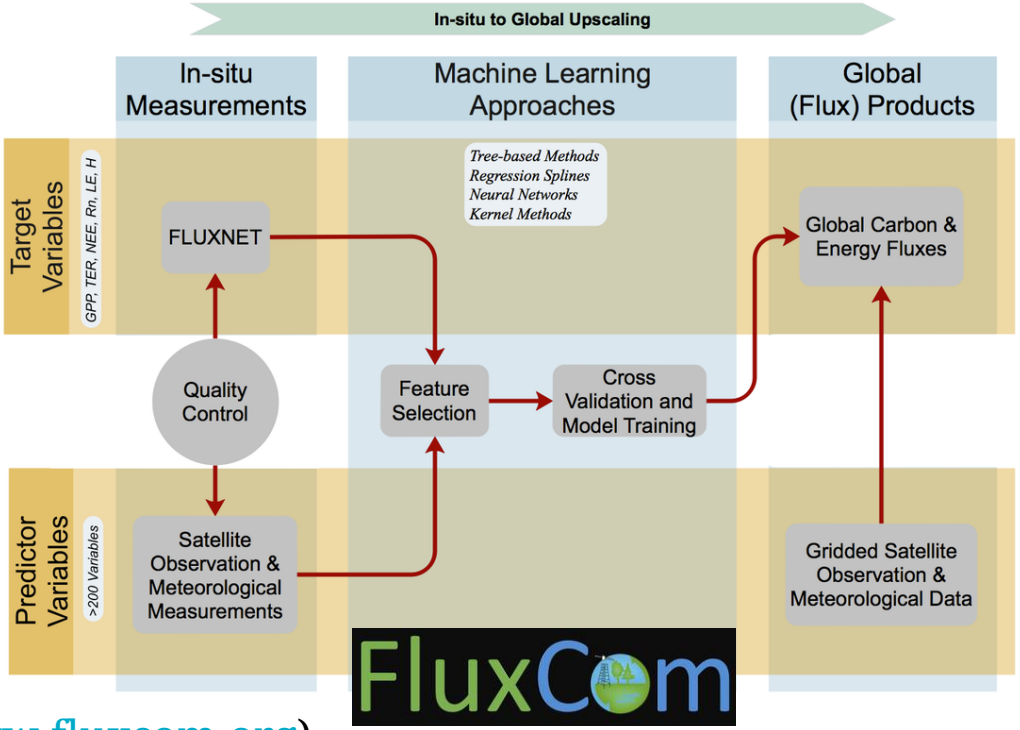
Examples of potential operational science products





FLUXCOM GPP+uncertainty (http://www.fluxcom.org)
Model-data fusion upscaling of ecosystem flux obs+meteo model+satellite+DGVMs

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High impact

BBC NEWS

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Climate change: Impacts 'acceleratir as leaders gather for UN talks

By Matt McGrath
Environment correspondent

22 September 2019 | Science & Environment

The signs and impacts of global heating are speeding up, the latest science on climate change, published ahead of key UN talks in New York, says.

The data, compiled by the World Meteorological Organization (WMO), says the five-year period from 2014 to 2019 is the warmest on record.

Sea-level rise has accelerated significantly over the same period, as CO2 emissions have hit new highs.

The WMO says carbon-cutting efforts have to be intensified immediately.

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United In Science: High-level synthesis report of latest climate science information convened by the Science Advisory Group of the UN Climate Action Summit 2019

REPORT from UN Environ

Published on 22 Sep 2019

The United in Science R climate science organizatic assessment in preparation

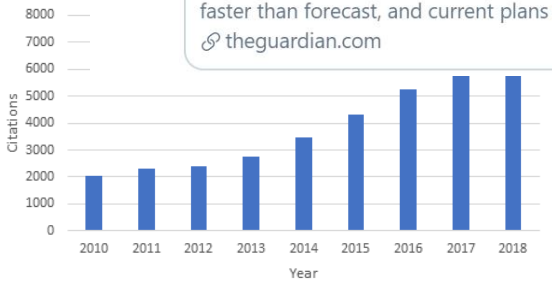
The report underlines the targets to tackle global w urgency for the developme and actions. The current st the changes that are proj report.

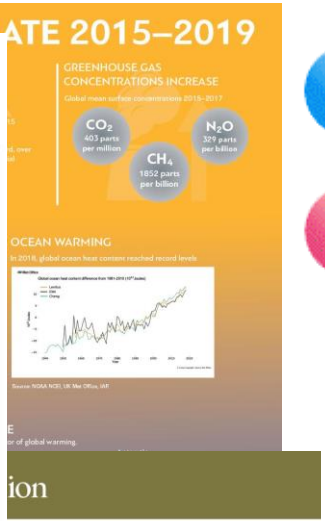
The UN Environment Pro report, The Emissions Ga November. It assesses the future greenhouse gas em likely to be and where we r there.

ICOS Carbon Portal @ICOS_CP · 1m

Countries must triple climate emission cut targets to limit global heating to 2C

Countries must triple climate emissions targets to limit global heating t...
United in Science report ahead of UN summit says climate is changing faster than forecast, and current plans would lead to 'catastrophic' glob...
theguardian.com





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Some selected links to the ICOS data portal

https://data.icos-cp.eu/portal	Main search interface
https://exploredata.icos-cp.eu	Anonymous Jupyter notebooks (any name+ password=msa)
https://www.icos-cp.eu/data-products	Main ICOS obs. data products
https://stilt.icos-cp.eu/viewer/	View footprints and concentrations
https://stilt.icos-cp.eu/worker/	Calculate your own footprints
https://github.com/ICOS-Carbon-Portal	ICOS CP source code repo
https://data.icos-cp.eu/stats/	Download statistics
Account required:	
https://cpauth.icos-cp.eu/login/	Login/create account
https://jupyter2.icos-cp.eu	Jupyter service (sep. account needed)
https://meta.icos-cp.eu/uploadgui/	User friendly data upload
https://doi.icos-cp.eu/	DOI minting and metadata edit service
https://meta.icos-cp.eu/sparqlclient/	GUI for open SparQL endpoint
https://fileshare.icos-cp.eu	ICOS fileshare, online document editing

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Thank you!

ICOS | INTEGRATED CARBON OBSERVATION SYSTEM