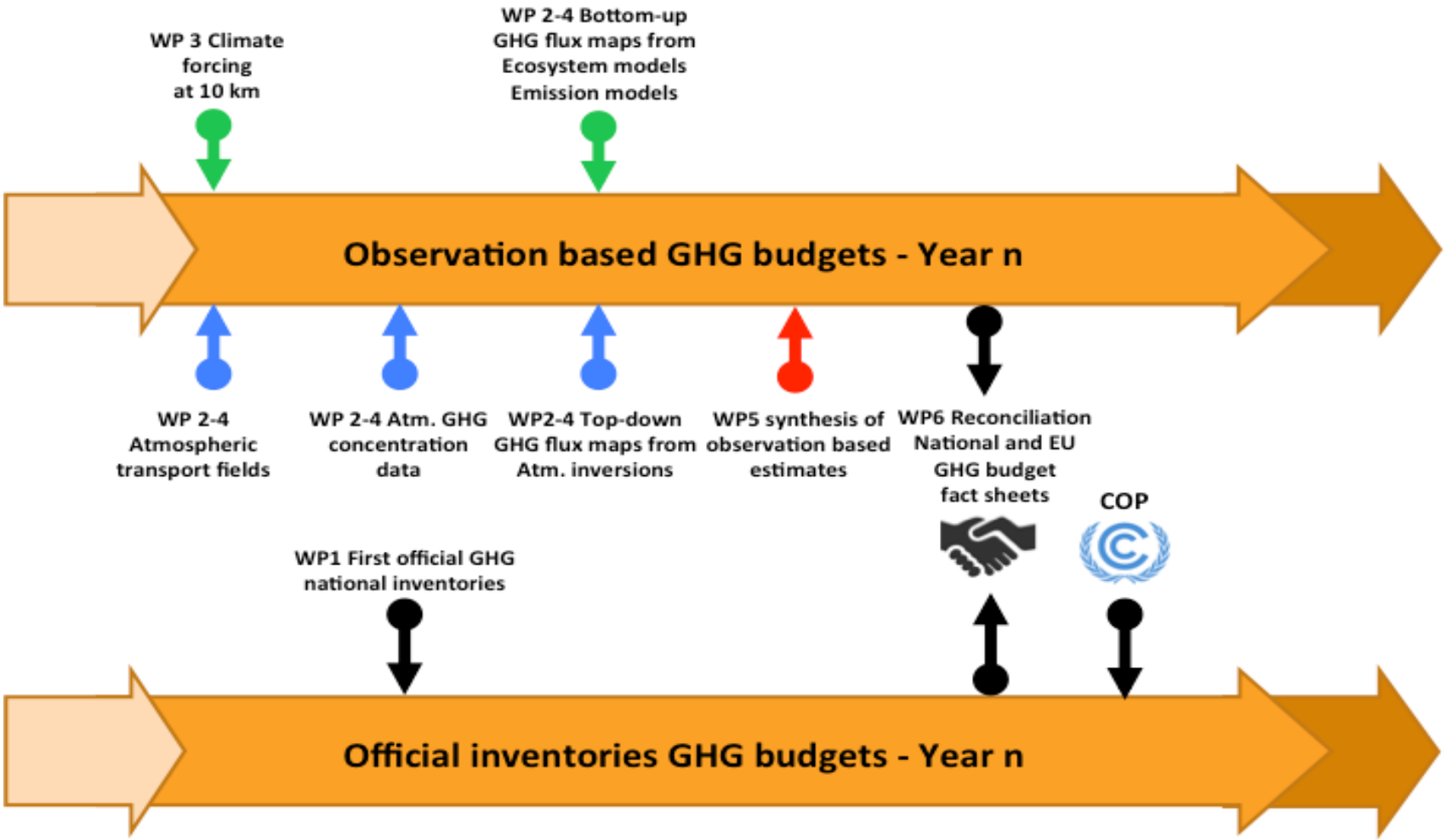
Expeted data time flow

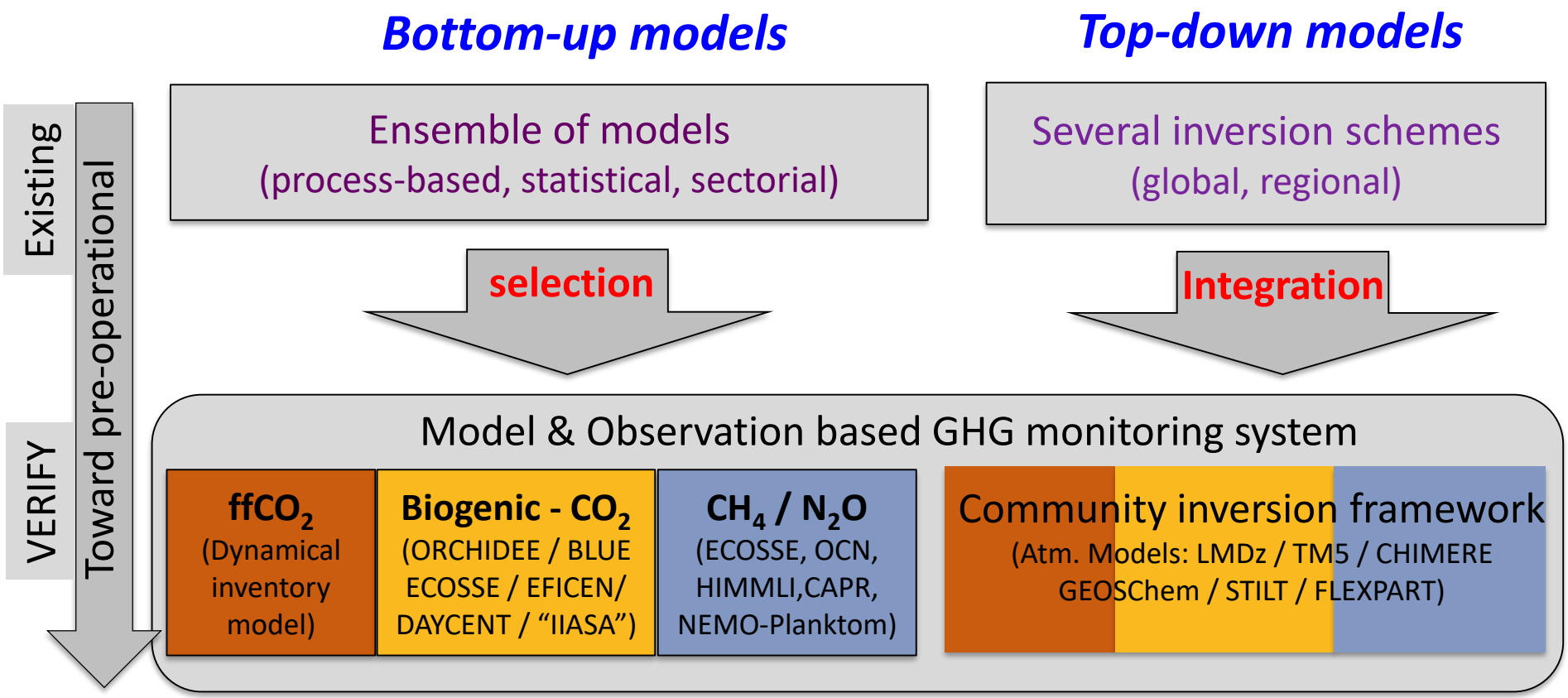


- **<u>Annual updates</u>** of measurement-based GHG national budgets and inventories
- Regional changes in GHG budgets and drivers and Uncertainties analysis
- Tracking progress towards EU mitigation targets (NDCs)

Data flow / data integration

- Important general issues linked to:
  - Timing of the product (GHG flux) delivery
  - Period covered: Target is year -1
  - Coverage: whole geographical Europe
  - Associated uncertainties
  - Country / regions masks
- Specific current issues
  - Availability of Edgard CO2/CH4/N2O fluxes up to yr-1 ?
  - Availability of Atmospheric obs for yr-1 ?

WP2-3-4: Model integration



Data base: proposed solution…

1. Every partner drops their data under a “cloud” repository

2. WE (LSCE) check some consistency / format (QA/QC)
   (Netcdf is preferred)

3. We publish the file under a Thredds server for everyone access
   (protected by a password)

4. We synchronise a simple “data table” to the Thredds repository

5. Later use of the ICOS-CP / CDS facilities for longer term
   storage, archiving, distribution, reference (doi), etc …

Data base: simple catalogue

Ressources available from the Thredds server

Show 25 entries

Search:

Method	Species	Variable	Simulation	Institute	Sector	Region	Timestep	Version	Timestamp	Author	WP	Filetype	Services
ATM	N2O	emissions	XXXX	NILU	ALL	EU	2W	V0	20190114	UNKNOWN	WP3	nc	link
ATM	N2O	emissions	XXXX	NILU	ALL	EU	2W	V0	20181128	UNKNOWN	WP3	nc	link
ECO	CO2	nbp	TRENDYS3	LSCE	ALL	GL	1M	V0	20190311	MCGRATH	WP3	nc	link
ECO	CO2	gpp	TRENDYS3	LSCE	ALL	GL	1M	V0	20190311	MCGRATH	WP3	nc	link
ECO	CH4	wetlandflux	XXXX	MPI	WET	EU	1D	V0	20190401	UNKNOWN	WP4	nc	link

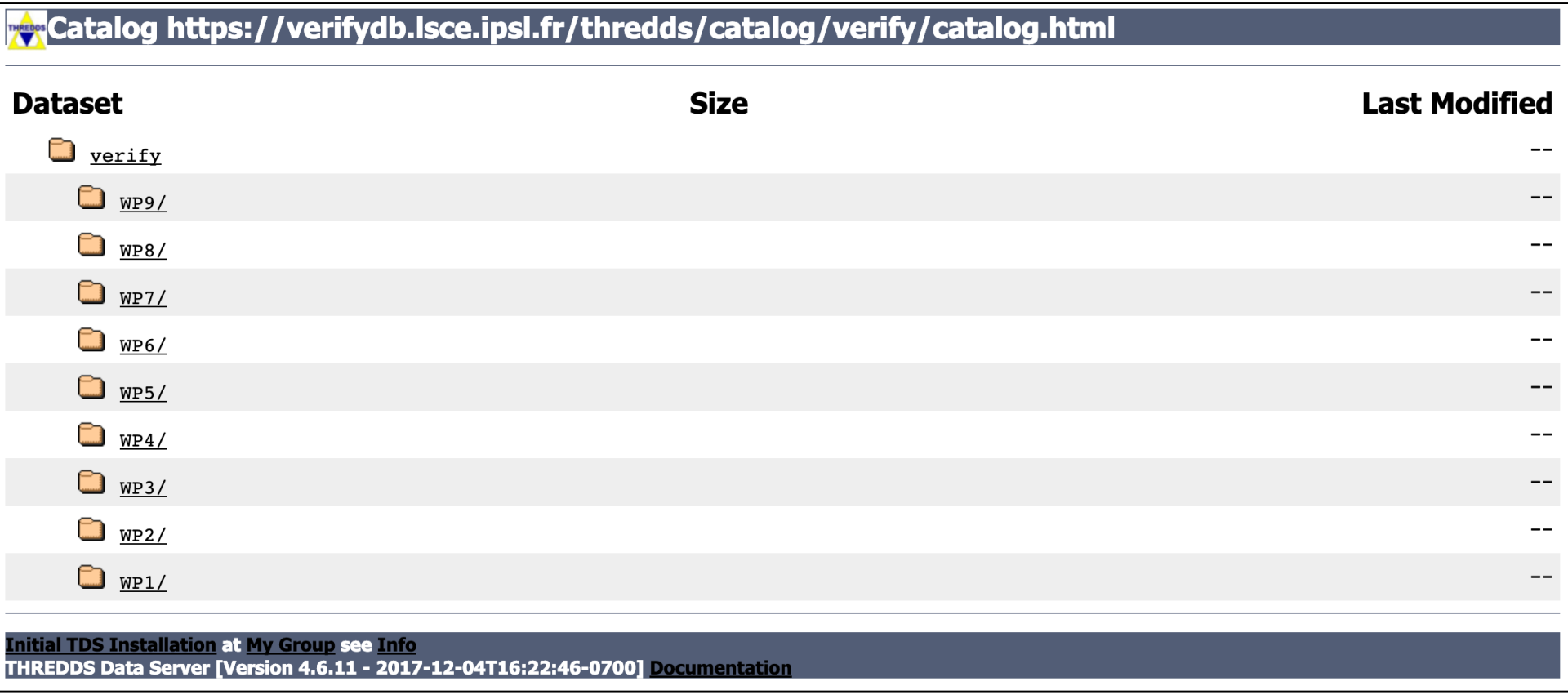
Showing 1 to 5 of 5 entries

Previous 1 Next

Process 1

Data base: using Thredds server

➔ All data are accessible online (ex Web Map Services)



Catalog https://verifydb.lsce.ipsl.fr/thredds/catalog/verify/catalog.html

Dataset	Size	Last Modified
verify		--
WP9/		--
WP8/		--
WP7/		--
WP6/		--
WP5/		--
WP4/		--
WP3/		--
WP2/		--
WP1/		--

Initial TDS Installation at My Group see Info
THREDDS Data Server [Version 4.6.11 - 2017-12-04T16:22:46-0700] Documentation

Data base: using Thredds server

➔ Main services associated to the server

Initial TDS Installation

THREDDS Data Server

Catalog https://verifydb.lsce.ipsl.fr/thredds/verify/WP3/catalog.html

Dataset: WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc

- *Data size:* 4.034 Mbytes
- *Data type:* GRID
- *ID:* verify/WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc

Access:

1. **OPENDAP:** /thredds/dodsC/verify/WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc
2. **DAP4:** /thredds/dap4/verify/WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc
3. **HTTPServer:** /thredds/fileServer/verify/WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc
4. **WCS:** /thredds/wcs/verify/WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc
5. **WMS:** /thredds/wms/verify/WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc
6. **NetcdfSubset:** /thredds/ncss/verify/WP3/ATM_N2O_emissions_XXXX_NILU_ALL_EU_2W_V0_20190114_UNKNOWN_WP3.nc

Dates:

- 2019-03-11T14:53:12Z **(modified)**

Viewers:

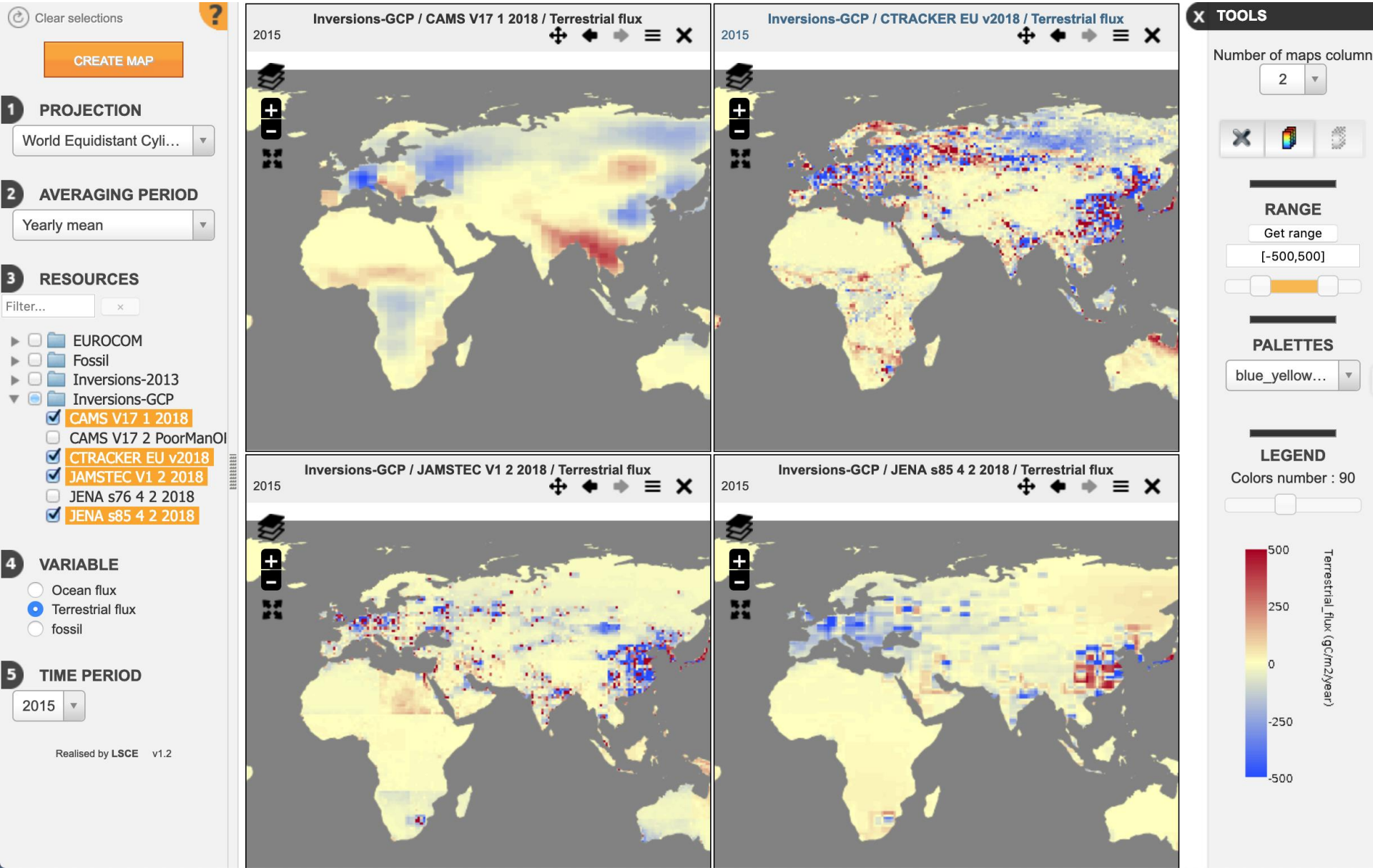
- Godiva2 (browser-based)
- NetCDF-Java ToolsUI (webstart)
- Integrated Data Viewer (IDV) (webstart)

Data visualisation

- User friendly tools
  - Based on the the CATLAS (design not technology)
  - View time series and maps
  - Easy comparison to a large ensemble of global products (TRENDY, INVERSIONS, CMIP5, FluxCom…)

- Advanced users
  - Definition of Jupyter notebooks (Python)
  - Develop new and use existing (GCP) notebooks

Data visualisation



Data visualisation

Clear selections

CREATE PLOT

1 REGIONS

Filter...

- Global
- Land
  - 05 Global Land
  - 06 Northern Land
  - 07 Tropical Land
  - 08 Southern Land
  - 09 Tundra
  - 10 North America
  - 11 Europe
  - 12 North Asia

2 AVERAGING PERIOD

Yearly mean

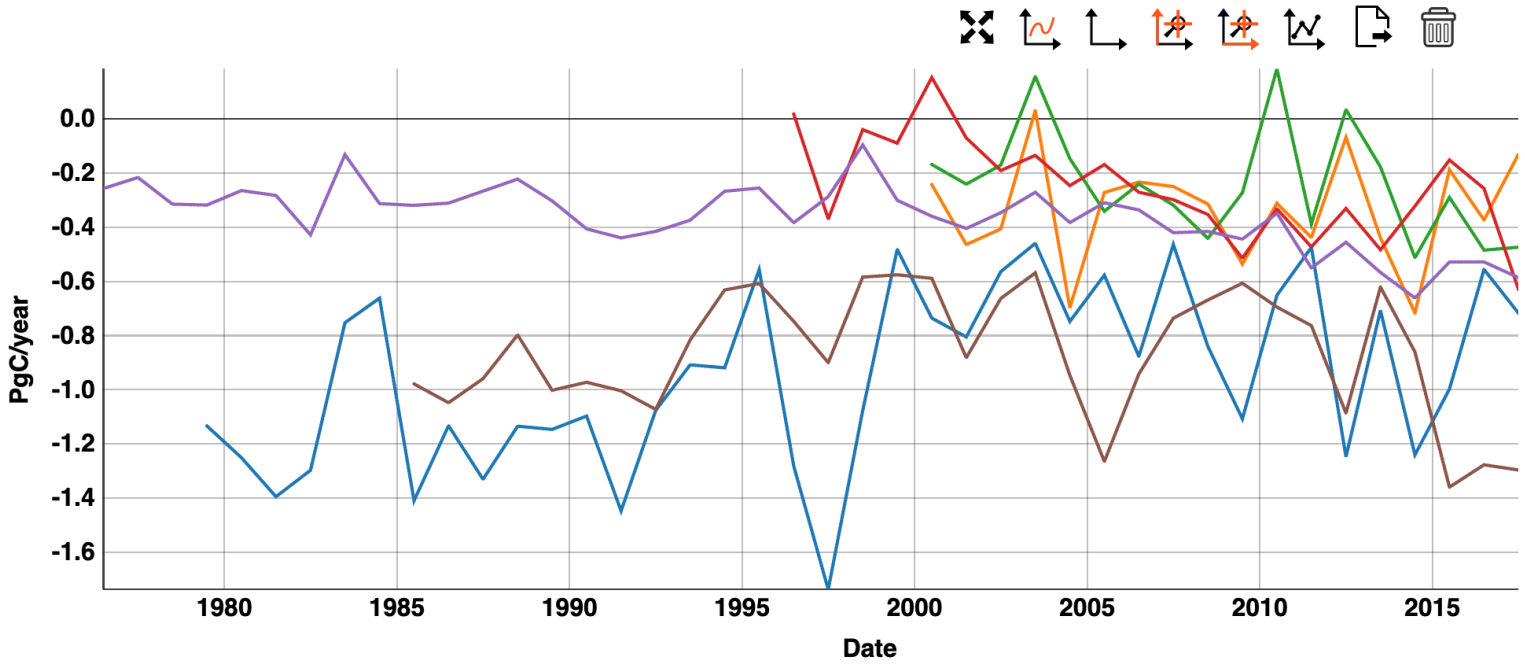
3 RESOURCES

Filter...

- CMIP5
- Data-driven
- EUROCOM
- Fossil
- Inversions-2013
- Inversions-GCP
- Inversions-others
- TRENDY-Land-V1
- TRENDY-Land-V7
- TRENDY-Ocean-V1

4 VARIABLE

- Ocean_flux
- Terrestrial_flux
- fossil



- CAMS V17 1 2018 / Terrestrial_flux / 11 Europe / Yearly mean
- CAMS V17 2 PoorManORC / Terrestrial_flux / 11 Europe / Yearly mean
- CTRACKER EU v2018 / Terrestrial_flux / 11 Europe / Yearly mean
- JAMSTEC V1 2 2018 / Terrestrial_flux / 11 Europe / Yearly mean
- JENA s76 4 2 2018 / Terrestrial_flux / 11 Europe / Yearly mean
- JENA s85 4 2 2018 / Terrestrial_flux / 11 Europe / Yearly mean

For raw data access, please contact:

- for Inversions P.Peylin@lsce.ipsl.fr
- for TRENDY S.A.Sitch@exeter.ac.uk

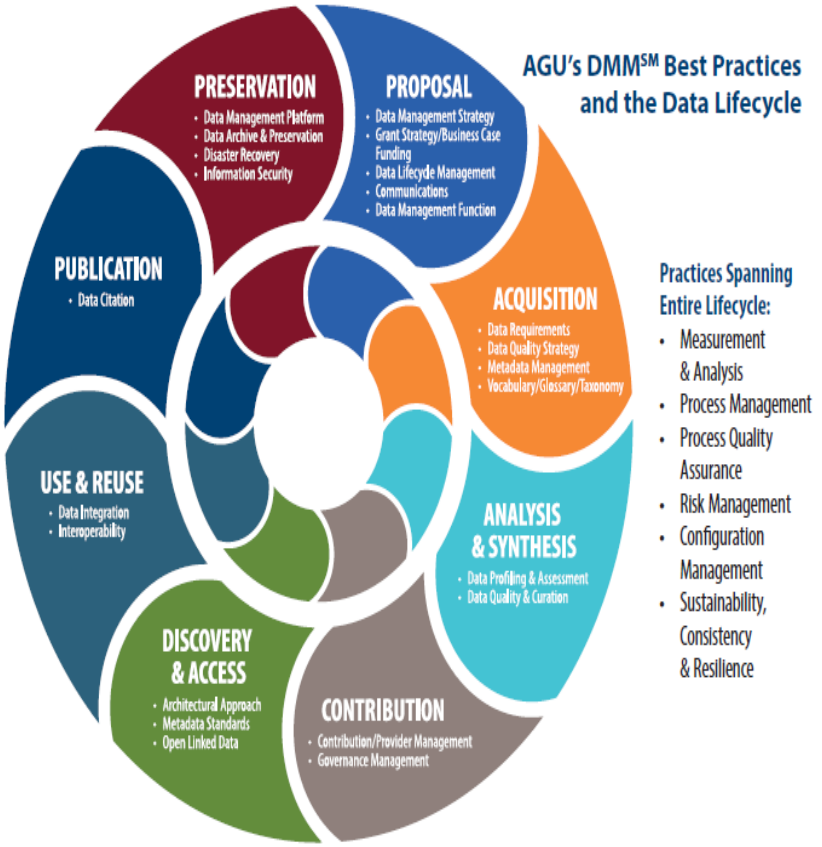
CHE data and ICOS CP

Alex Vermeulen, Wouter Peters, Ute Karstens, Naomi Smith

Long term support of all stages of data lifecycle

- Intermediate data
- Staging to repository
  - Transparent
  - Strong identification
  - Attribution: contributors and projects/framework
  - Styling to project(s)
  - Keep data and metadata together!
  - Data integrity certified
  - Open access (simple web links)
  - Web 3.0 technology
- Publication
- Publishing (Datacite DOI)

- Sustainibility> 20 years
- 5 programmers/4 (data) scientists

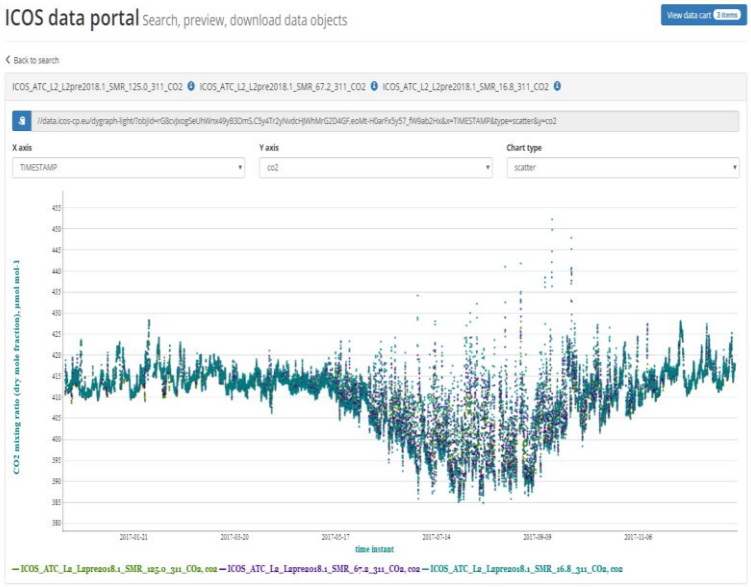


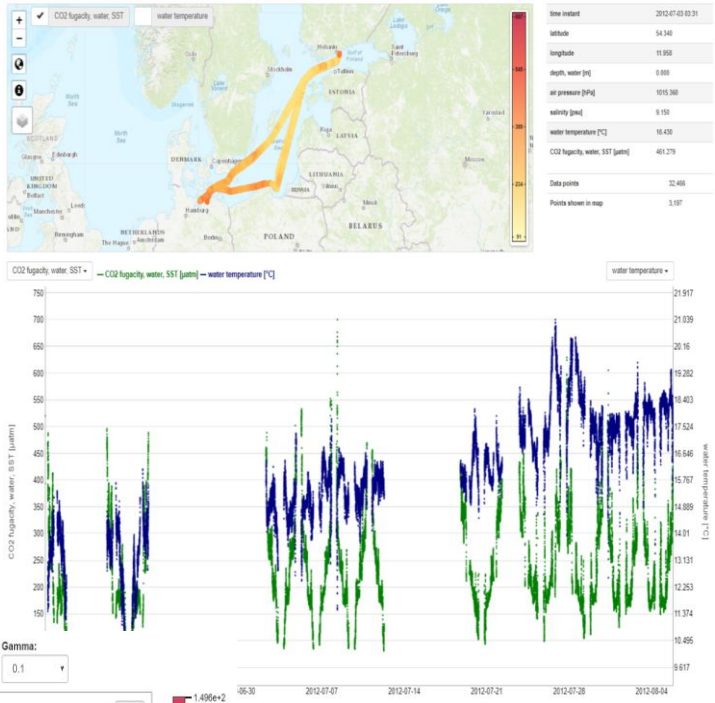
Community data services support

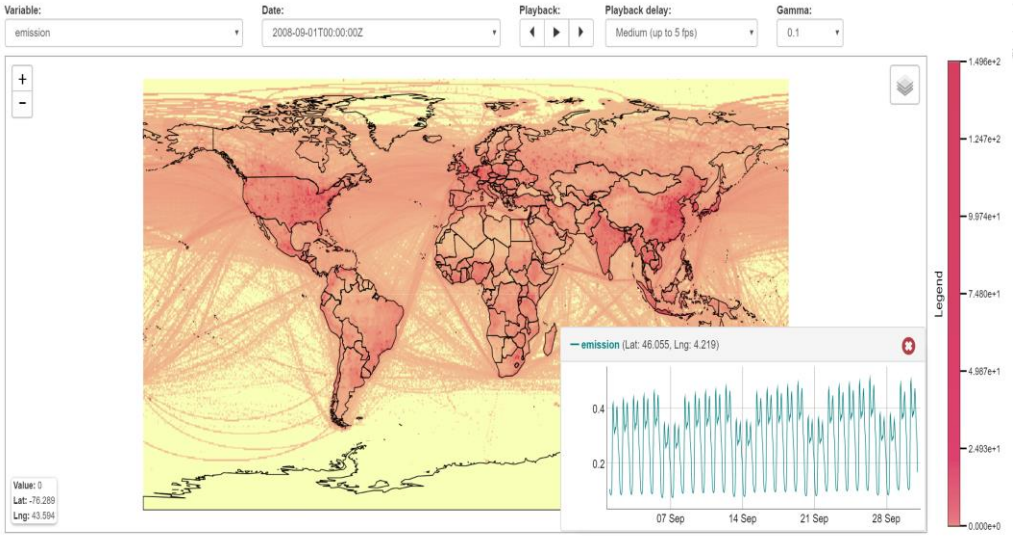
- Cloud data storage, individual groups (https://fileshare.icos-cp.eu)
  - Easy data sharing public/private
  - Data accessible directly through Jupyter notebooks
  - Online collaborative editing of documents/presentations etc
- Data publishing (https://data.icos-cp.eu)
  - Datacite DOI minting
  - Long time storage (20+ years), trusted repository
  - Real time data usage tracking
  - Staged directly from cloud storage
  - Attribution of contributors and styling for projects/frameworks
  - Linked open data, designed to be FAIR (easy DMP), connected to EOSC and CDI

- Jupyter notebook/lab collaboration (https://jupyter.icos-cp.eu)
  - Directly linked to cloud storage and repository
  - Already used successfully in GCP and EUROCOM
  - Staging of services and publishing on the web

Fully operational, data previews







Usage tracking

ICOS Data Statistics

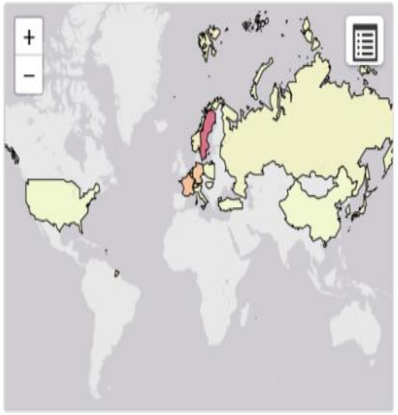
Data object specification filter

Specification	Specification
Format	Format
Data level	Data level
Stations	Stations
Contributors	Alex Vermeulen×
Theme	Theme
Country codes	Country codes

Data objects 1 to 4 of 4

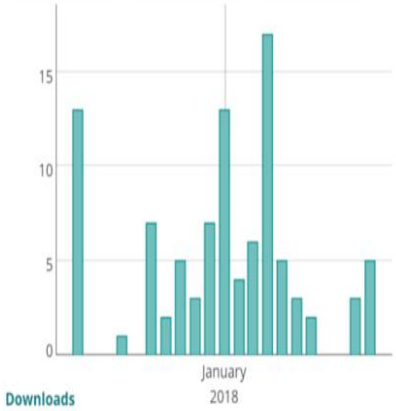
File Name	Landing Page	Count
INGOS_CH4_release2014.rar	DWdS18nrTlilcGS4VRZWOx4V	46
INGOS_CH4_release2014.rar	jDf17GEVm78p5GEz9hYMSNki	39
INGOS.RAR	JsY0mNz-2qZzuuD3uo0Dmr-U	6
COMET_ECN.rar	k_uxwoz8nqA9y-F-XJ_0BMpl	5

Downloads per country



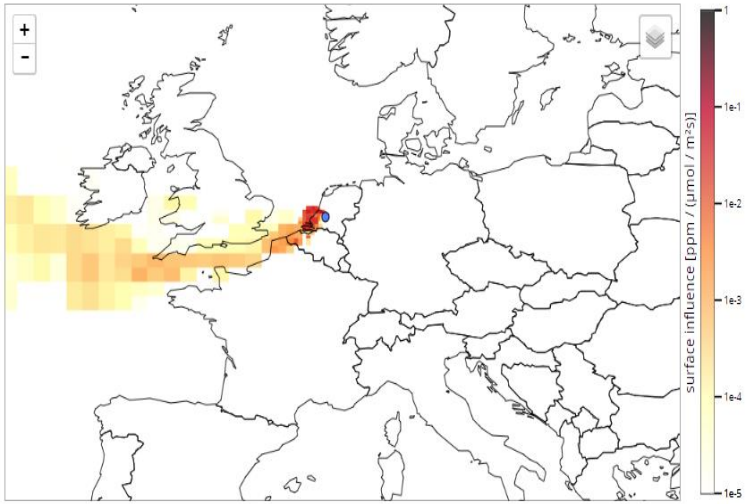
Downloads per time period

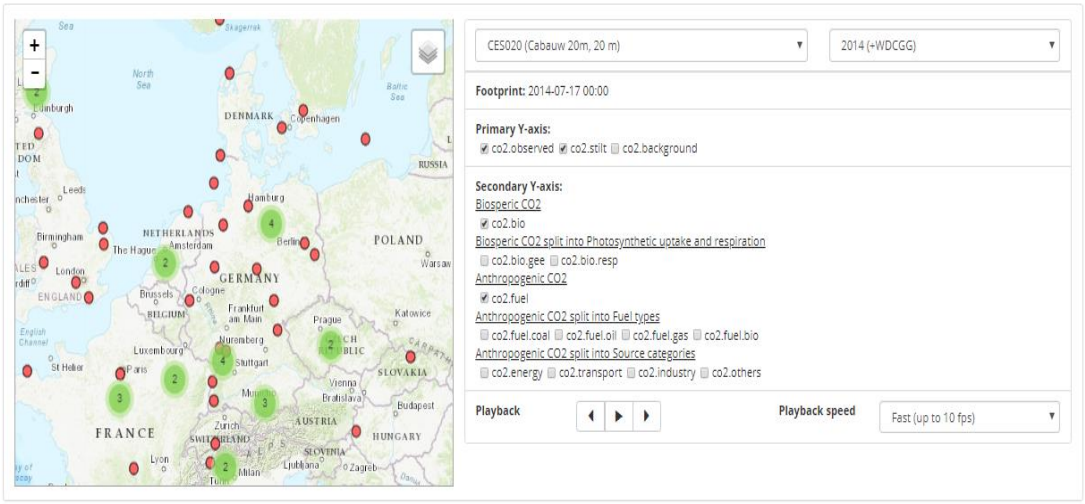
Per week | ✓ Per month | Per year

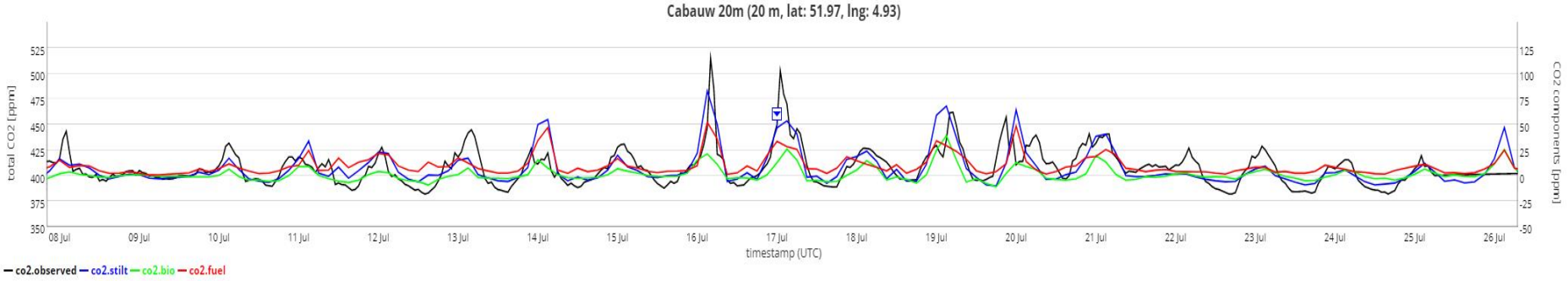


Dynamic linking of elaborated and obs data

https://stilt.icos-cp.eu/viewer/



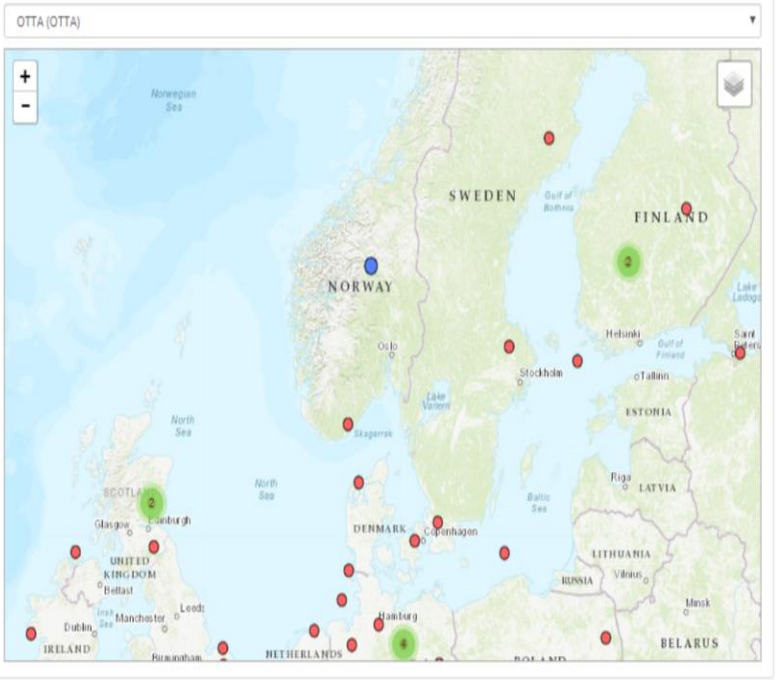




VRE to run atm transport model, workflow

https://stilt.icos-cp.eu/worker/

Existing STILT footprints



Create new STILT footprint

Latitude (decimal degree)

61.78

Longitude (decimal degree)

9.56

Altitude above ground (meters)

100

Site id (usually a 3 letter code)

OTTA | Load data

Start date (YYYY-MM-DD)

2017-01-01

End date (YYYY-MM-DD)

2017-12-31

Submit STILT job

Submitted STILT jobs

Show details

Finished computations

Site 'PRS'

Site 'HTM150'

Site 'HTM150'

Site 'PRS'

STILT calculation service Dashboard

Logged in as alex.vermeulen@nateko.lu.se

Computational resources

Node	Free CPUs	Total CPUs
akka.tcp://StiltCluster@localhost:2551	10	10
akka.tcp://StiltCluster@localhost:2553	10	10

Finished computations

Site id: ***ROM*** **(lat:** 42.01, **lon:** 12.3), **alt:** 100, **start:** 2011-12-25, **stop:** 2011-12-27, **done:** 17 of 17 - submitted by alex.vermeulen@nateko.lu.se

Site id: ***ROM*** **(lat:** 42.01, **lon:** 12.3), **alt:** 100, **start:** 2011-12-25, **stop:** 2011-12-28, **done:** 25 of 25 - submitted by alex.vermeulen@nateko.lu.se

Site id: ***LUX*** **(lat:** 55.71, **lon:** 13.2), **alt:** 100, **start:** 2012-01-01, **stop:** 2012-01-08, **done:** 57 of 57 - submitted by margareta.hellstrom@nateko.lu.se

Site id: ***JFJ*** **(lat:** 46.55, **lon:** 7.98), **alt:** 720, **start:** 2012-08-01, **stop:** 2012-08-05, **done:** 33 of 33 - submitted by hardistyar@cardiff.ac.uk

Site id: ***ROM*** **(lat:** 42.01, **lon:** 12.3), **alt:** 100, **start:** 2011-12-18, **stop:** 2011-12-25, **done:** 57 of 57 - submitted by margareta.hellstrom@nateko.lu.se

Site id: ***ROM*** **(lat:** 42.01, **lon:** 12.3), **alt:** 100, **start:** 2012-01-01, **stop:** 2012-01-02, **done:** 9 of 9 - submitted by margareta.hellstrom@nateko.lu.se

To the job starter

Interactive collaborative model result intercomparison in Jupyter notebooks, publication ready output

jupyter GCP-inversions-comparison_v4.0 ATV Last Checkpoint: 08/14/2017 (autosaved)

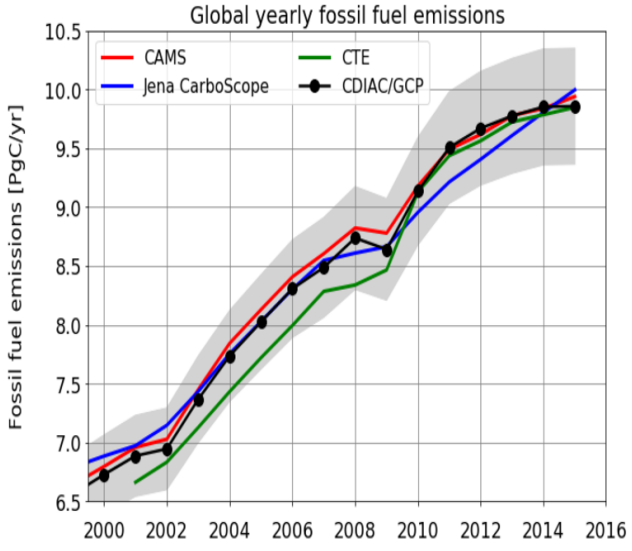
Control Panel | Logout

File Edit View Insert Cell Kernel Widgets Help | Python 2

Markdown | CellToolbar

1990 1995 2000 2005 2010 2015

In [14]:
```
#Plot fossil fluxes used in the inversions
#Options are available for monthly and annual (see above)
fig=plt.figure(figsize=(10,7))
plt.plot(plot_df_CAMS.index,plot_df_CAMS.ff_CAMS,label='CAMS',linewidth=3,color='red')
plt.plot(plot_df_Jena.index,plot_df_Jena.ff_Jena,label='Jena CarboScope',linewidth=3,color='blue')
plt.plot(plot_df_CTE.index,plot_df_CTE.ff_CTE,label='CTE',linewidth=3,color='green')
plt.plot(df_cdiac.index,df_cdiac['FF'],'o-',markersize=10,label='CDIAC/GCP',color='black')
plt.fill_between(df_cdiac.index,df_cdiac['FF']-0.05*df_cdiac['FF'],df_cdiac['FF']+0.05*df_cdiac['FF'],color='lightgray')
plt.ylim(6.5,10.5)
#plt.ylim(5.5,11)
plt.xlim(dt.datetime(2000,1,1),dt.datetime(2016,1,1))
if Temporal_Resolution == 'yearly':
    plt.xticks(np.arange(dt.datetime(2000,7,1),dt.datetime(2017,1,1),dt.timedelta(2*365)))
plt.title('Global %s fossil fuel emissions'%Temporal_Resolution,size=20)
plt.ylabel('Fossil fuel emissions [PgC/yr]', labelpad=20)
plt.legend(loc='best',fontsize=16,ncol=2)
plt.tick_params(axis='x', pad=12)
fig.savefig('data/figures/Fossil_fuel_comparison_%s'%Temporal_Resolution,dpi=300)
```



Atmospheric CO2 growth rate

Applicability outside Europe

➔ Transfer of information, tools and replicability of methods on GHG monitoring to other regions, making use of existing collaborations

- ***US:*** Exchange of data & model tools, rigourous benchmarking of GHG budgeting methods; collaborations with NOAA, official inventory agencies, and groups leading the SOCCR report.

- ***China:*** Is a key test-case study for the VERIFY methodologies. Joint workshops on HR emissions mapping, inverse modeling & uncertainty assessments with Beijing University and the Chinese Academy of Science.

- ***Indonesia:*** highest CH4 emission region for agriculture and central interest for land use change. Direct collaboration with the national inventory agency.