INTEGRATED CARBON OBSERVATION SYSTEM

Using Jupyter Notebooks to introduce services to (new) end users

Maggie Hellström

ICOS Carbon Portal

ENVRI-FAIR webinar, June 23, 2022

Why Jupyter Notebooks?

- Easy to set up and make available
- Support for several languages (Python, R, Julia, ...)
- Allows mix of text, executable code, images,...
- Demonstrators
 - RIs can showcase their data products (static or dynamic presentations)
- Tutorials
 - Seamless mix of instructional text with interactive code examples
 - Train users on APIs, libraries, ... + explain optimal usage of data products & services
- Research environments & support
 - Documented scripts can accompany publications
 - Expert end users can collaborate around code for analysis

ICOS use of Notebooks

- ICOS data are available via the Carbon Portal <u>https://icos-cp.eu/</u>
- Search, visualise, download: basic functionality via web interface
- Jupyter Notebooks offer extended functionalities for explorers and researchers alike
- Jupyter Hub service for advanced users
- Exploredata service at https://exploredata.icos-cp.eu/
 - Open to anyone!
 - Gives practical examples of how to visualise, analyse, ... ICOS data
 - Introduces the ICOS python library & related documentation



Exploredata: logging in



Sign in to Exploredata

Us	ername:
n	nargareta.hellstrom@nateko.lu.se
Pas	ssword:
•	
	I accept that ICOS data is under a CC BY 4.0 licence ((c)) BY



This is a service from the ICOS Carbon Portal to showcase how Python Notebooks with Jupyter can be used to access the ICOS data products. The **password** required to access this service is provided when you attend one of our webinars or you can request it here. Please read our Documentation. Once you login, you will find the following structure with examples to play with:

Username: your e-mail address

Password: francis

Important: you <u>must</u> accept the ICOS data license statement!

Once logged in, your session is time limited, and nothing will be saved on the server

TRY IT OUT!

BY license

Exploredata Notebooks

💭 Jupyter <mark>hub</mark>	Logout	Control Panel
Files Running Clusters Nbextensions Select items to perform actions on them.	U	pload New - 2
	Name Last Mod	ified File size
education	3 months	s ago
icos_jupyter_notebooks	a day	y ago
	a day	y ago
project_jupyter_notebooks	a day	y ago
pylib_examples	a day	y ago
index_notebook.ipynb	3 months	s ago 2.6 kB
README.md	3 months	s ago 1.48 kB

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Exploring data (demonstrator)



Exploring ICOS data

Notebooks processing ICOS data products by applying various methods, computing statistics, and presenting results in interactive visualizations (i.e. plots, maps, tables, etc.)

Some examples:

- Curve fitting methods ICOS atmospheric for CO2 time series
- Explore ICOS atmospheric observations
- ICOS atmospheric observation statistics

- observations vs STILT
 - modelled values
- Characterization of atmospheric
 - measurement networks

- Radiocarbon measurements
- Visualization of average footprints





ICOS



























ICOS INTEGRATED CARBON OBSERVATION SYSTEM

Tutorial (code examples)



The ICOS python library

- A set of functions for accessing & using data and related metadata
- All code in GitHub: <u>https://github.com/ICOS-Carbon-Portal/pylib</u>
- Documentation in markdown <u>https://github.com/ICOS-Carbon-</u> <u>Portal/pylib/tree/master/docs</u>
- Human-friendly version <u>https://icos-carbon-portal.github.io/pylib/</u>



pylib manual @github.io

ICOS Carbon Portal pylib

🔺 »About

 \equiv

Welcome to the ICOS Carbon Portal Python Library

ICOS

The Integrated Carbon Observation System, ICOS, is a European-wide greenhouse gas research infrastructure. ICOS produces standardised data on greenhouse gas concentrations in the atmosphere, as well as on carbon fluxes between the atmosphere, the earth and oceans. This information is being used by scientists as well as by decision-makers in predicting and mitigating climate change. The high-quality and open ICOS data is based on the measurements from 134 stations across 12 European countries. For more information please visit https://www.icos-cp.eu/.



https://icos-carbon-portal.github.io/pylib/



pylib manual @github.io

Content

The following modules are available in the library to find and access data hosted at the Carbon Portal. After a successful installation into your python environment you should be able to load the modules with:

- from icoscp.cpb.dobj import Dobj
- from icoscp.station import station
- from icoscp.collection import collection
- from icoscp.stilt import stiltstation
- from icoscp.sparql.runsparql import RunSparql
- from icoscp.sparql import sparqls



https://icos-carbon-portal.github.io/pylib/

pylib manual @github.io

C	ntont					
	Dobj					
The						
Por	This is the basic module to load a digital object (data set) into memory. You need to know a vali					
mo	persistent identifier (PID/URL) to access the data. Either you can browse the data portal to find					
	PID's or you can use the 'station' package to find PID's programmatically (see section station). In					
•	Load the module with:					
•	from icoscp.cpb.dobj import Dobj					
•						
	classmethod Dobj(digitalObject=")					
	You can initialise a Dobj with a PID. The following two statements yield the same result.					
•						
	<pre>myDobj = Dobj('https://meta.icos-cp.eu/objects/j7-Lxlln8_ysi4DEV8qine_v') myDobj = Dobj('j7-Lxlln8_ysi4DEV8qine_v')</pre>					



https://icos-carbon-portal.github.io/pylib/

The ICOS python library

- A set of functions for accessing & using data and related metadata
- All code in GitHub: <u>https://github.com/ICOS-Carbon-Portal/pylib</u>
- Documentation in markdown <u>https://github.com/ICOS-Carbon-Portal/pylib/tree/master/docs</u>
- Human-friendly version <u>https://icos-carbon-portal.github.io/pylib/</u>
- Usage examples as Notebooks!
 - Access data & metadata
 - Explore the ICOS stations
 - Using multiple data sources
- Access data &
 metadata of collections
- Load data based on sparql queries
- Explore STILT model results
- STILT footprint
 animation
- STILT footprints and time series

Notebook "Access data & metadata"



ICOS INTEGRATED CARDON OBSERVATION SYSTEM

Notebook "Access data & metadata"

File Edit View	Insert Cell	Kernel Navigate Widgets Help	Not Trusted	Python 3 O
8 + % 4 6	↑ ↓ ► Run	EC Markdown V E		
ontents C C ICOS Carbon Portal P Example: Access data Documentation		Meta data Ask for information (meta data) about the data set. For a attributes, please check the <u>documentation</u> .	a full list of available	*
Create a data objec Meta data	In []:	dobj.colNames		
Get the data Make a plot	In []:	dobj.citation		
	In []:	dobj.licence		
	In []:	<pre>## Print all meta data for this object for i in dobj.info: display(i)</pre>		Ц,
		Get the data		
	In []:	dobj.data.head()		
		Make a plot		
	In []:	<pre>dobj.data.plot(x='TIMESTAMP', y='ch4', grid=T</pre>	'rue)	
	In []:			

ICOS INTEGRATI OBSERVATI SYSTEM

Thanks for listening

You're welcome to get in touch with Maggie with your questions via margareta.hellstrom@nateko.lu.se

ICO