

EMPIR 19ENV01 traceRadon Training Course #2

The Radon Tracer Method – How to use it

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- The Radon Tracer Method software:

- Code in python hosted on the ICOS Carbon Portal (CP) JupyterLab
- ICOS CP python package to access ICOS site data and calculated footprints
- RTM can be applied to several species when data available CO_2 , CH_4 , N_2O and CO

WARNING

- The version in exploredata is a lighter version than the full one that will be available later on.
- Only the ERA5 flux maps for 2020 and 2021 have been regridded. For these exercises, please select only the 2020 or 2021 ERA5 flux map or the code won't work.
- Also, the option to use ATC database data is not active here, only data from the CP will be used.



- Go to <https://exploredata.icos-cp.eu>



Sign in to Exploredata

Username:

Password:

- Choose a username
- Password: **francis**

I accept that ICOS data is under a
CC BY 4.0 licence

Sign In

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:

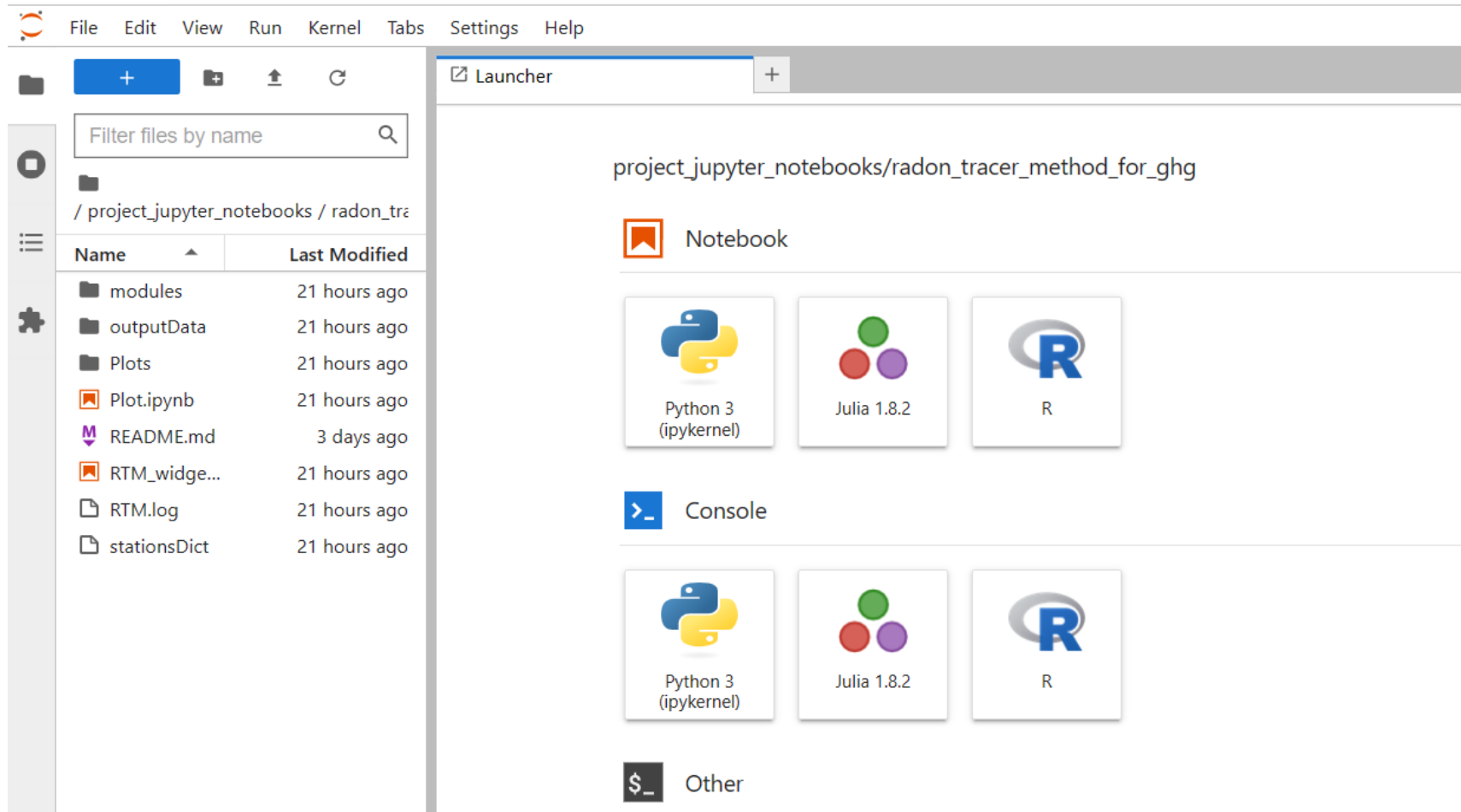
- Education:** includes notebooks that use ICOS data to introduce students to basic principles of climate science and programming
- ICOS Jupyter Notebooks:** contains notebooks processing and presenting ICOS data in interactive visualizations
- Introduction:** contains notebooks that quickly introduce the fundamental principles of Python programming
- Project-specific Jupyter Notebooks:** includes notebooks presenting the scientific output of ICOS projects
- pylib_examples:** includes notebooks with examples on using our 'icoscp' python library to access ICOS data
Source: <https://github.com/ICOS-Carbon-Portal/pylib/>
Documentation <https://icos-carbon-portal.github.io/pylib/>

Please be aware, that this service is **restricted**. We allow only a limited amount of users to login and **data is not persistent**. After inactivity, you will be logged out automatically. If you want to save a file you have created/changed, you need to download the file to your computer.

If you are interested in using our Jupyter Notebook Service to do research with ICOS data and elaborated products, please apply for a [personal account](#). Project folders (collaboration space) allows groups of users to have a shared space which is only



- Go to: project_jupyter_notebooks/radon_tracer_method_for_ghg/

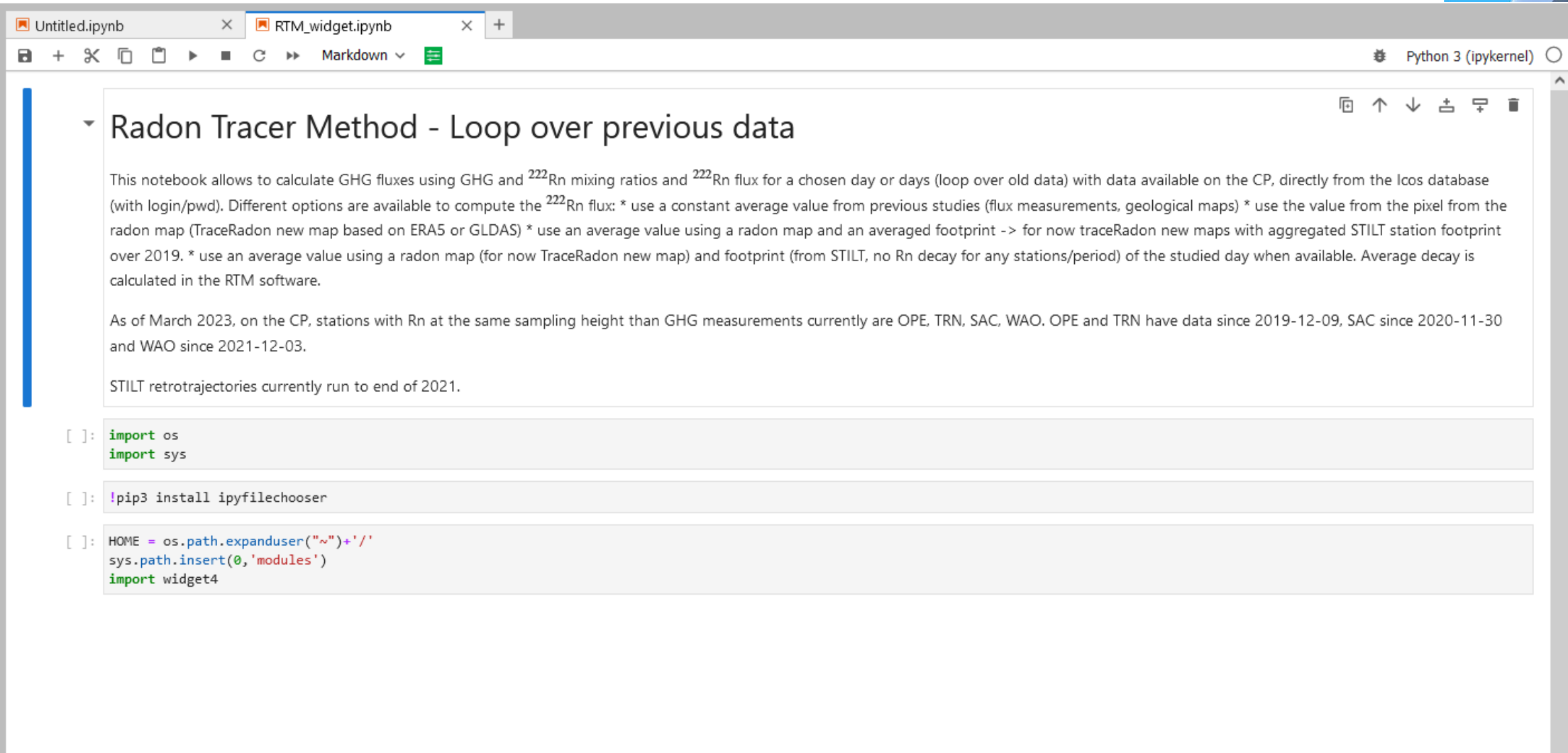


The screenshot shows the JupyterLab interface. On the left is a file browser with a search bar and a table of files. On the right is a launcher with sections for Notebook, Console, and Other, each containing icons for Python 3 (ipykernel), Julia 1.8.2, and R.

Name	Last Modified
modules	21 hours ago
outputData	21 hours ago
Plots	21 hours ago
Plot.ipynb	21 hours ago
README.md	3 days ago
RTM_widge...	21 hours ago
RTM.log	21 hours ago
stationsDict	21 hours ago



- RTM_widget.ipynb



Untitled.ipynb | RTM_widget.ipynb | Python 3 (ipykernel)

Radon Tracer Method - Loop over previous data

This notebook allows to calculate GHG fluxes using GHG and ^{222}Rn mixing ratios and ^{222}Rn flux for a chosen day or days (loop over old data) with data available on the CP, directly from the Icos database (with login/pwd). Different options are available to compute the ^{222}Rn flux: * use a constant average value from previous studies (flux measurements, geological maps) * use the value from the pixel from the radon map (TraceRadon new map based on ERA5 or GLDAS) * use an average value using a radon map and an averaged footprint -> for now traceRadon new maps with aggregated STILT station footprint over 2019. * use an average value using a radon map (for now TraceRadon new map) and footprint (from STILT, no Rn decay for any stations/period) of the studied day when available. Average decay is calculated in the RTM software.

As of March 2023, on the CP, stations with Rn at the same sampling height than GHG measurements currently are OPE, TRN, SAC, WAO. OPE and TRN have data since 2019-12-09, SAC since 2020-11-30 and WAO since 2021-12-03.

STILT retrotrajectories currently run to end of 2021.

```
[ ]: import os
import sys

[ ]: !pip3 install ipyfilechooser

[ ]: HOME = os.path.expanduser("~/")+ '/'
sys.path.insert(0, 'modules')
import widget4
```



Station

Pick a beginning Date

First hour of the RTM window (UTC)

Pick an end Date

Last hour of the RTM window (UTC)

Flux map (check the year)

Rn flux from literature (Bq/m2/h):

Species:

Do you want to plot the data?

Yes
 No

Which database do you want to use?

CP
 CP



- Checking the log file:
 1. Wrong year for the flux map
 - Station: BIR075
 - Dates: 01/01/2021 to 03/01/2021
 - Flux map: ERA5 2020
 - Choose 'No' for the plotting option
 2. Run the code for period with missing data
 - Station: OPE120
 - Dates: 20/03/2020 to 25/03/2020
 - Flux map: ERA5 2020
 - Species: CO
 - Choose 'No' for the plotting option



File Edit View Run Kernel Tabs Settings Help

File browser sidebar showing the directory structure and file list.

Filter files by name

/ project_jupyter_notebooks
/ radon_tracer_method_for_ghg /

Name	Last Modified
modules	3 minutes ago
outputData	2 minutes ago
Plots	2 minutes ago
Plot.ipynb	a day ago
README.md	3 days ago
RTM_widget.ipynb	2 minutes ago
RTM.log	2 minutes ago
stationsDict	3 minutes ago

```
RTM_widget.ipynb x RTM.log x +
```

```
1 INFO:root:2021-05-012021-05-02
2 INFO:root:go
3 INFO:root:Flux calculated!
4 INFO:root:2021-05-022021-05-03
5 INFO:root:go
6 INFO:root:Flux calculated!
7 INFO:root:2021-05-032021-05-04
8 INFO:root:go
9 INFO:root:Less than 2hours of Rn data from the beginning of the window to the Rn max
10 INFO:root:2021-05-042021-05-05
11 INFO:root:go
12 INFO:root:Flux calculated!
13
```



- Getting a flux file:

- Station: SAC100, TRN180 or OPE120
- Dates: few days in 2021
- Flux map: ERA5 2021 map
- Species: CH₄ species
- Choose “yes” for plotting the data

- Check outputData

- RTMflux_species_site_radon flux map_dates.
- 10 cells

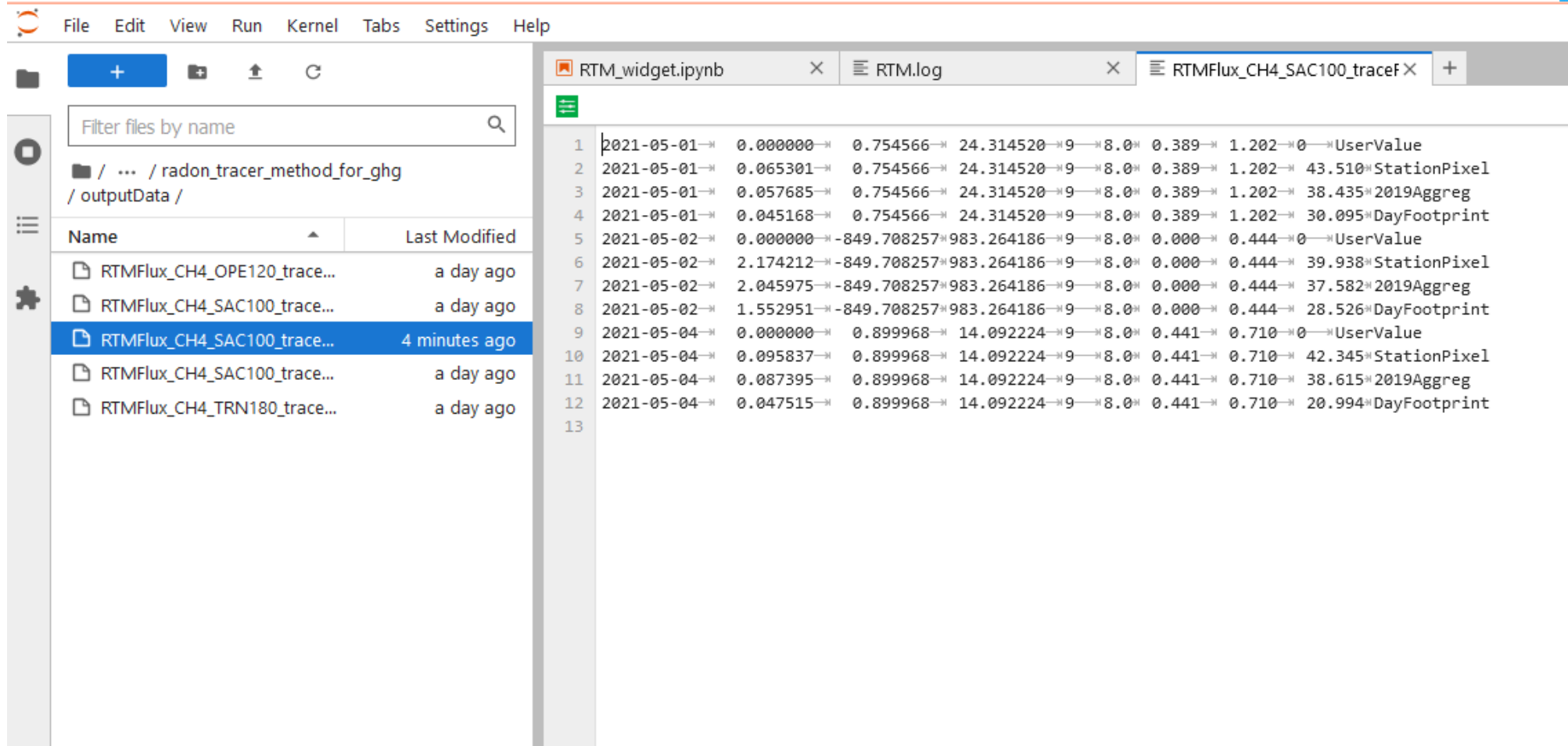
Date	Jghg	R2	Error	Nb_pts	Nb_hrs	Rise_stop	Rn_amplitude	JRn	Type
------	------	----	-------	--------	--------	-----------	--------------	-----	------



- **Jghg**: flux calculated for the chosen species
- **R2**: R^2 of the correlation between Rn and GHG data
- **Error**: error on the fit
- **Nb_pts**: number of data points used for the fit
- **Nb_hrs**: number of hours used in the fit, for hourly data
- **Rise_stop**: difference between the radon maximum and the last data point of the period. If it is positive, the radon stopped increasing before the end of the period showing it is a local/regional event, if it's negative, it may be a larger synoptic event and the flux will not be representative.
- **Rn_amplitude**: difference between the max and min Rn over the window
- **JRn**: radon flux used to do the calculation
- **Type**: indicates the way Rn flux was calculated
 - UserValue: the value entered in the dialog window
 - StationPixel: the value for the station pixel for the chosen flux map
 - 2019Aggreg: the combination of the chosen flux map and the aggregated 2019 footprints
 - DayFootprint: the combination of the chosen flux map and the footprint of the studied period



- outputData



File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / radon_tracer_method_for_ghg / outputData /

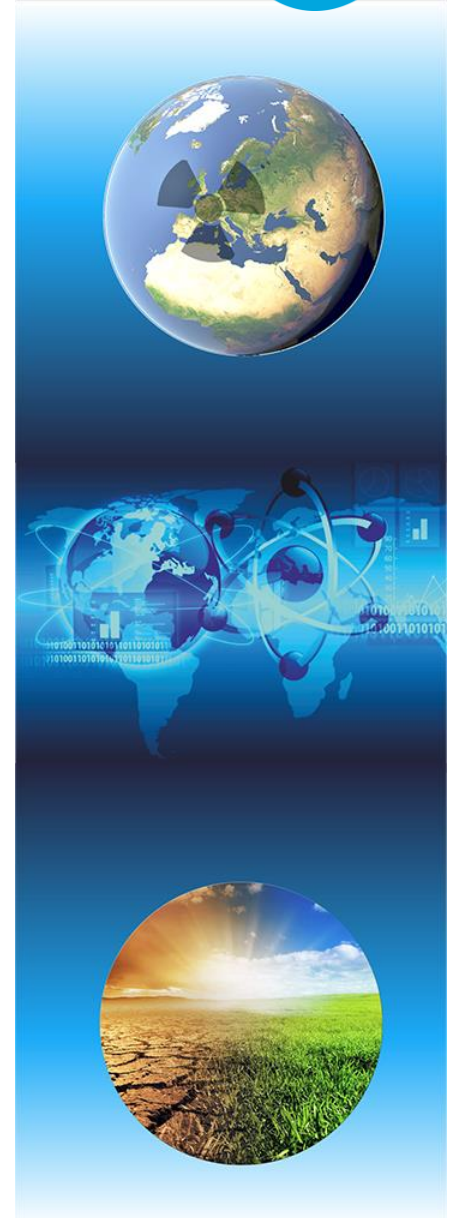
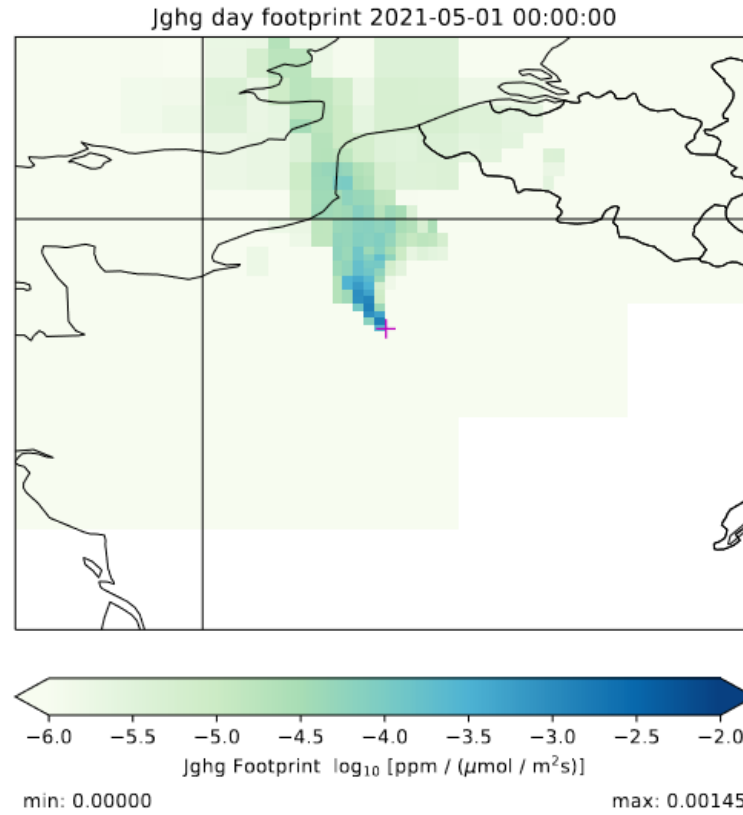
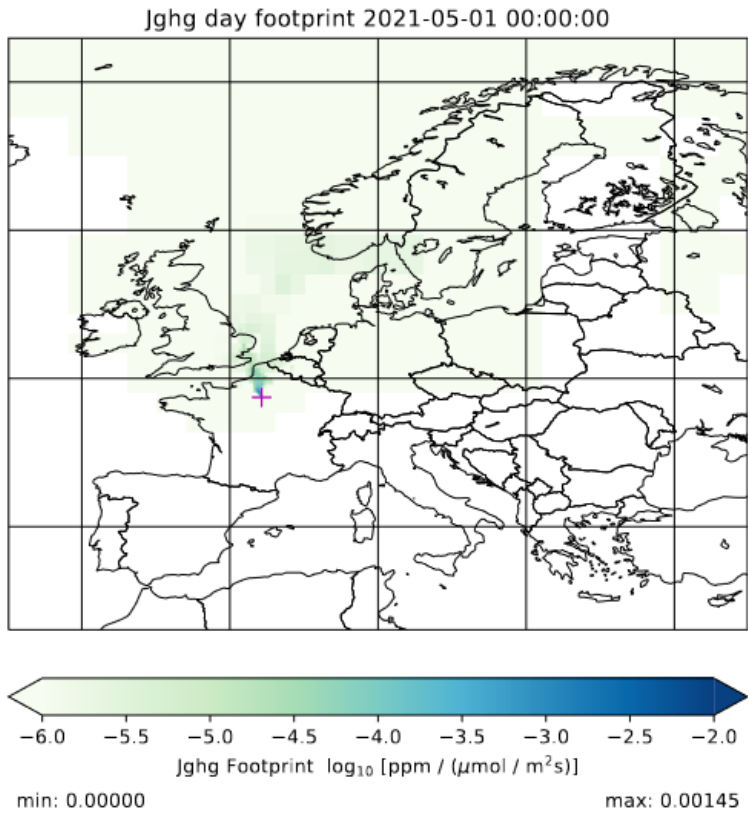
Name	Last Modified
RTMFlux_CH4_OPE120_trace...	a day ago
RTMFlux_CH4_SAC100_trace...	a day ago
RTMFlux_CH4_SAC100_trace...	4 minutes ago
RTMFlux_CH4_SAC100_trace...	a day ago
RTMFlux_CH4_TRN180_trace...	a day ago

```

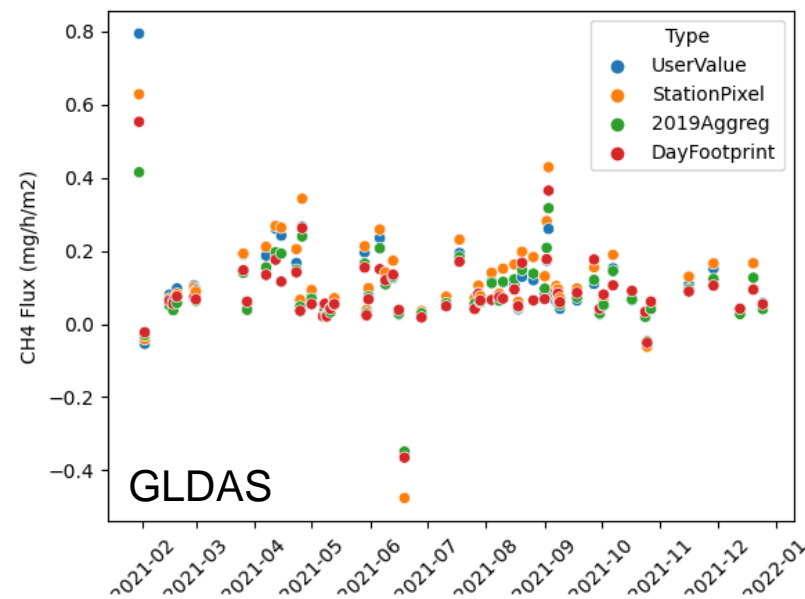
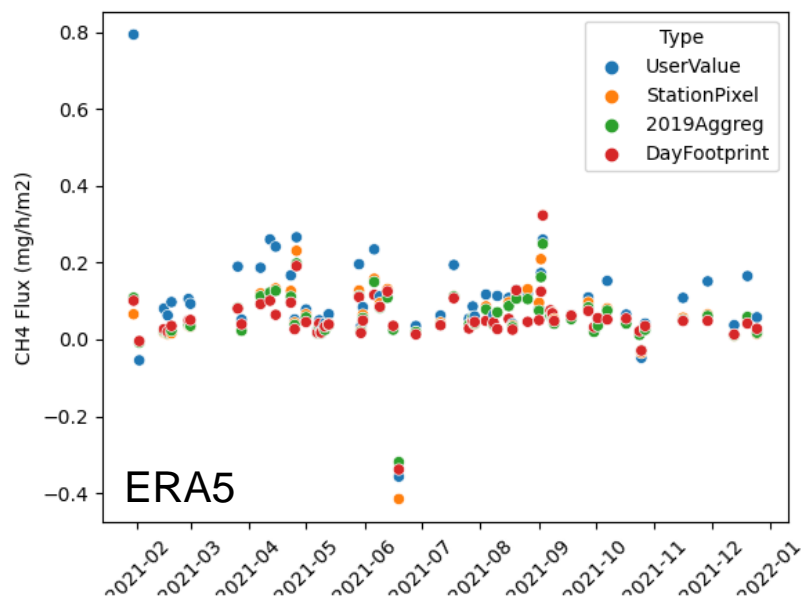
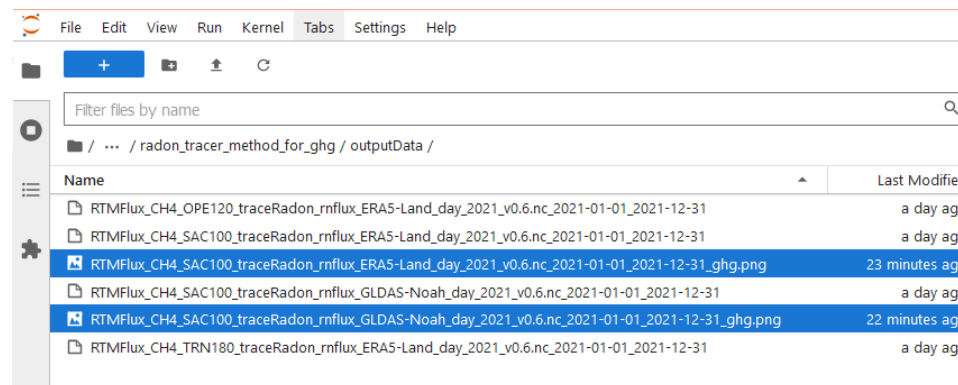
1 2021-05-01→ 0.000000→ 0.754566→ 24.314520→9→8.0→ 0.389→ 1.202→0→UserValue
2 2021-05-01→ 0.065301→ 0.754566→ 24.314520→9→8.0→ 0.389→ 1.202→ 43.510→StationPixel
3 2021-05-01→ 0.057685→ 0.754566→ 24.314520→9→8.0→ 0.389→ 1.202→ 38.435→2019Aggreg
4 2021-05-01→ 0.045168→ 0.754566→ 24.314520→9→8.0→ 0.389→ 1.202→ 30.095→DayFootprint
5 2021-05-02→ 0.000000→-849.708257→983.264186→9→8.0→ 0.000→ 0.444→0→UserValue
6 2021-05-02→ 2.174212→-849.708257→983.264186→9→8.0→ 0.000→ 0.444→ 39.938→StationPixel
7 2021-05-02→ 2.045975→-849.708257→983.264186→9→8.0→ 0.000→ 0.444→ 37.582→2019Aggreg
8 2021-05-02→ 1.552951→-849.708257→983.264186→9→8.0→ 0.000→ 0.444→ 28.526→DayFootprint
9 2021-05-04→ 0.000000→ 0.899968→ 14.092224→9→8.0→ 0.441→ 0.710→0→UserValue
10 2021-05-04→ 0.095837→ 0.899968→ 14.092224→9→8.0→ 0.441→ 0.710→ 42.345→StationPixel
11 2021-05-04→ 0.087395→ 0.899968→ 14.092224→9→8.0→ 0.441→ 0.710→ 38.615→2019Aggreg
12 2021-05-04→ 0.047515→ 0.899968→ 14.092224→9→8.0→ 0.441→ 0.710→ 20.994→DayFootprint
13
  
```



- Plotting



- Use already compiled data





Thank you for your
attention!

