

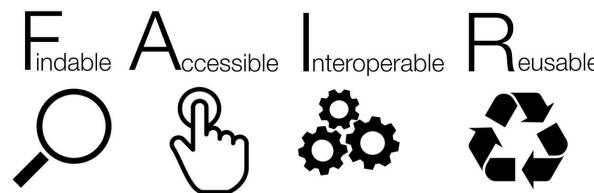
Climate4Impact v2

Alessandro Spinuso (KMMI)
& 2RS Team



Climate4Impact (v2) - Redesign

- Modular Deployment & Decoupled Services
- GUI usability & Help/Feedback pages
- Flexible analysis features (Notebooks, ICCLIM and Data Staging/Reduction Workflows)
- Automated reproducibility mechanisms and link to Documentation (Data/Analysis)



- Model Performance Comparison Functionality (ESMValTool)

Climate4Impact (v2) - Search and Nodes

Interactive Parametrisation made easier

The screenshot shows the Climate4Impact (v2) search interface. On the left, a sidebar lists filters: VARIABLE (variable:tas), FREQUENCY (frequency:day), EXPERIMENT (experiment_id:dcppA-hindcast), MODEL (source_id:CMCC-CM2-SR5), and MEMBER (member_id:r1i1p1f1). The main area displays a grid of variables categorized by model component:

- Temperature:** tas - Temperature, tasmin - Min. Temperature, tasmax - Max. Temperature, ta - Air temperature.
- Precipitation:** pr - Precipitation, prc - Convective precipitation, prsn - Snow.
- Humidity:** huss - Specific humidity, hurs - Rel. Humidity, rhsmin - Min. Rel. Humidity, rhs - Rel. Humidity, hus - Spec. Humidity, hur - Rel. Humidity.
- Wind:** sfcWind - Wind, sfcWindmax - Max Wind, uas - Eastward wind, vas - Northward wind.
- Radiation:** rsds - SW Radiation Dn, rsus - SW Radiation Up, rlrs - LW Radiation Dn, rlus - LW Radiation Up, rsdsdiff - Diff. Radiation, clt - Cloud.
- Pressure:** ps - Pressure, psl - Sea level pressure, pfull - Pressure.
- Evaporation:** evpsb1 - Act. Evap., evpsblpot - Pot. Evap., evpsb1soi - Sol Evap., evpsb1veg - Canopy Evap.

Climate4Impact (v2) - Search and Nodes

Interactive Parametrisation made easier

Exploring climate model data

Home Data Discovery Help Feedback Sign Up

PROJECT: CMIP 6 NODES: ALL

variable:tas frequency:day experiment_id:dcppA-hindcast source_id:CMCC-CM2-SR5 member_id:r1lp1p1

VARIABLE

Temperature

- tas - Temperature (-)
- tasmin - Min. Temperature (-)
- tasmax - Max. Temperature (-)
- ta - Air temperature (-)

Precipitation

- pr - Precipitation (-)
- prc - Convective precipitation (-)
- prsn - Snow (-)

FREQUENCY

EXPERIMENT

MODEL

MEMBER

Radiation

- rsds - SW Radiation Dn (-)
- rsus - SW Radiation Up (-)
- rlrs - LW Radiation Dn (-)
- rlus - LW Radiation Up (-)
- rsdsdiff - Diff. Radiation (-)
- clt - Cloud (-)

Pressure

- ps - Pressure (-)
- psl - Sea level pressure (-)
- pfull - Pressure (-)

Exploring climate model data

Home Data Discovery Help Feedback Sign Up

PROJECT: CMIP 6 NODES: ALL

variable:tas frequency:day experiment_id:dcppA-hindcast source_id:CMCC-CM2-SR5 member_id:r1lp1p1

VARIABLE

Temperature

- tas - Temperature (-)
- tasmin - Min. Temperature (-)
- tasmax - Max. Temperature (-)
- ta - Air temperature (-)

Precipitation

- pr - Precipitation (-)
- prc - Convective precipitation (-)
- prsn - Snow (-)

FREQUENCY

EXPERIMENT

MODEL

MEMBER

Radiation

- rsds - SW Radiation Dn (-)
- rsus - SW Radiation Up (-)
- rlrs - LW Radiation Dn (-)
- rlus - LW Radiation Up (-)
- rsdsdiff - Diff. Radiation (-)
- clt - Cloud (-)

Pressure

- ps - Pressure (-)
- psl - Sea level pressure (-)
- pfull - Pressure (-)

Available ESGF Nodes

Select & enable Rook WPS subsetting

Node	Subsetting Mode
esgf1.dkrz.de	Rook WPS
esgf3.dkrz.de	Rook WPS
aims3.llnl.gov	Opendap
cmip.dess.tsinghua.edu.cn	Opendap
cmip.fio.org.cn	Opendap
cordexesg.dmi.dk	Opendap
crd-esgf-drc.ec.gc.ca	Opendap
data.meteo.unican.es	Opendap
dataserver.nccs.nasa.gov	Opendap
dipesgf03.nccs.nasa.gov	Opendap
esg-cccr.tropmet.res.in	Opendap

Wind

- sfcWind - Wind (-)
- sfcWindmax - Max Wind (-)
- uas - Eastward wind (-)
- vas - Northward wind (-)

Evaporation

- evpsb1 - Act. Evap. (-)
- evpsb1pot - Pot. Evap. (-)
- evpsb1soi - Sol Evap. (-)
- evpsb1veg - Canopy Evap. (-)

OK

OPEN YOUR NOTEBOOK SCIENTIFIC PRESETS

SUBSETTING DOWNLOAD

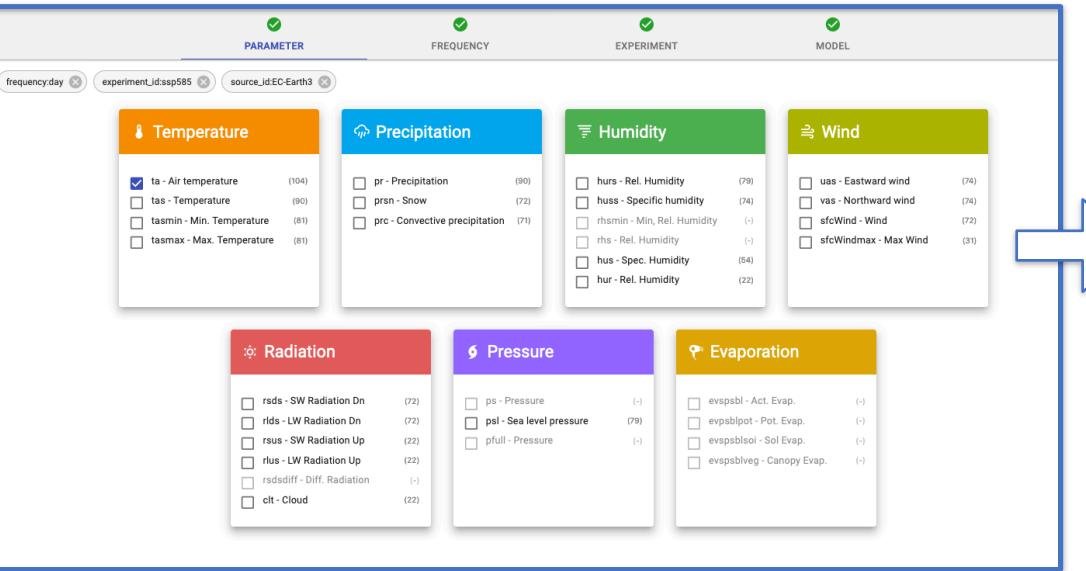
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824084

BASKET LUNIQUE

Climate4Impact (v2) Workflows & Workspaces

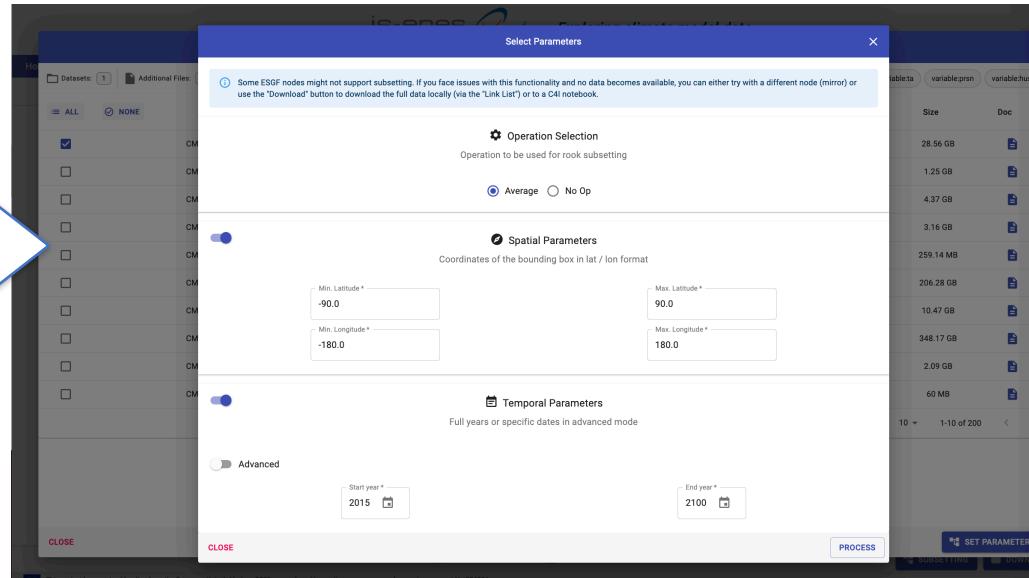
Climate4Impact Search for CMIP5/6
CORDEX Data (Distributed Data)
<https://dev.climate4impact.eu>

Workflows for data staging &
remote subsetting-reduction (WPS)
onto Customisable Notebooks



The screenshot shows the Climate4Impact search interface with a grid of parameters categorized by parameter type. The categories and their contents are:

- Temperature**: ta - Air temperature (104), tas - Temperature (90), tasmin - Min. Temperature (81), tasmax - Max. Temperature (81)
- Precipitation**: pr - Precipitation (90), prsn - Snow (72), prc - Convective precipitation (71)
- Humidity**: hurs - Rel. Humidity (79), huss - Specific humidity (74), rhmin - Min. Rel. Humidity (-), rhs - Rel. Humidity (-), hus - Spec. Humidity (54), hur - Rel. Humidity (22)
- Wind**: uas - Eastward wind (74), vas - Northward wind (74), sfcWind - Wind (72), sfcWindmax - Max Wind (31)
- Radiation**: rsds - SW Radiation Dn (72), rlds - LW Radiation Dn (72), rsus - SW Radiation Up (22), rlus - LW Radiation Up (22), rsdscldiff - Diff. Radiation (-), clt - Cloud (22)
- Pressure**: ps - Pressure (79), psl - Sea level pressure (79), pfull - Pressure (-)
- Evaporation**: evpsbl - Act. Evap. (-), evpsblpot - Pot. Evap. (-), evpsblsol - Sol Evap. (-), evpsblveg - Canopy Evap. (-)

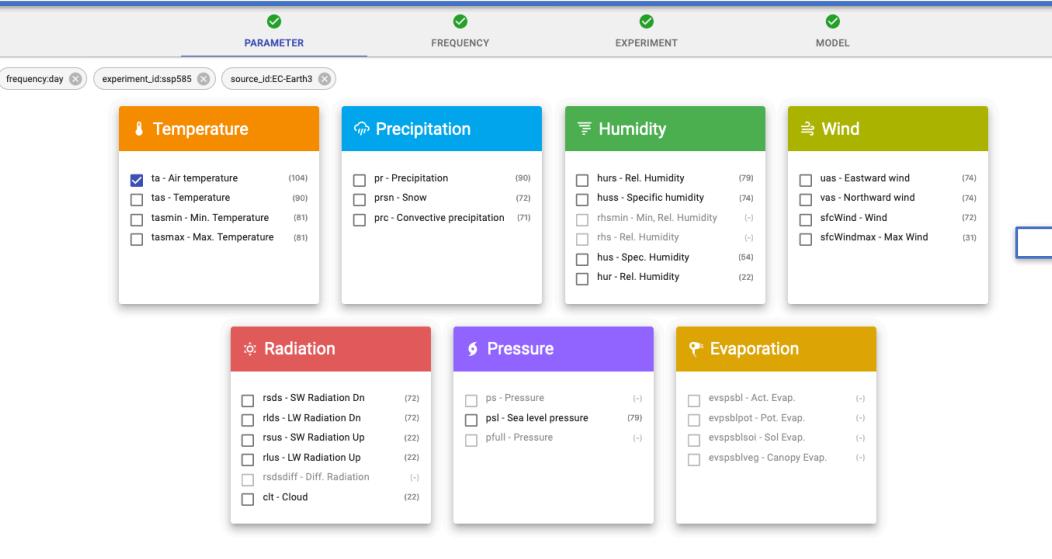


The screenshot shows the 'Select Parameters' dialog for a WPS workflow. The dialog includes:

- Operation Selection**: Average (radio button selected), No Op
- Spatial Parameters**: Coordinates of the bounding box in lat / lon format:
 - Min. Latitude*: -90.0
 - Max. Latitude*: 90.0
 - Min. Longitude*: -180.0
 - Max. Longitude*: 180.0
- Temporal Parameters**: Full years or specific dates in advanced mode:
 - Start year*: 2015
 - End year*: 2100
- Advanced**: Options for processing and output.

Climate4Impact (v2) Workflows & Workspaces

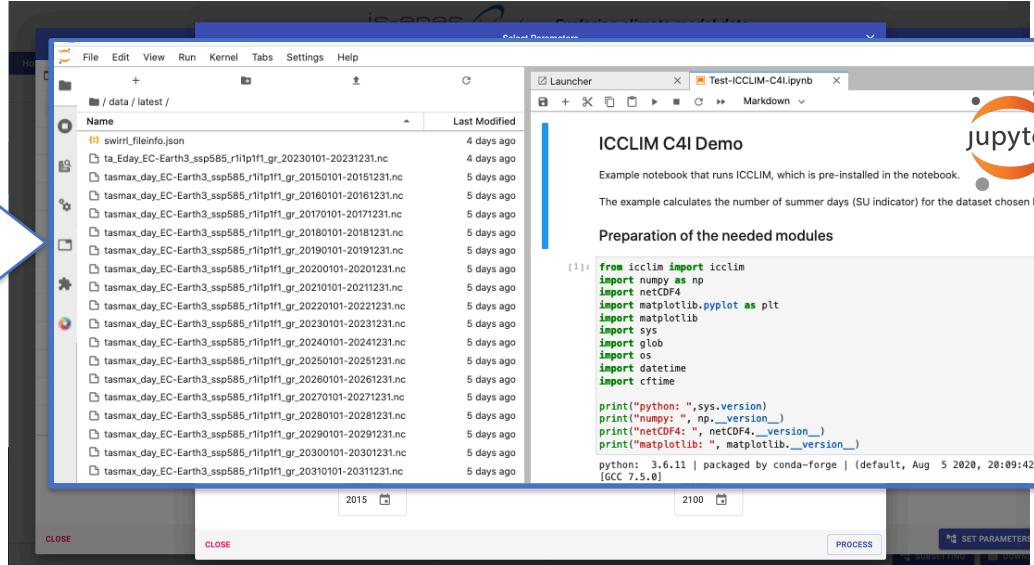
Climate4Impact Search for CMIP5/6
CORDEX Data (Distributed Data)
<https://dev.climate4impact.eu>



The screenshot shows a search interface for Climate4Impact. It features a top navigation bar with tabs for PARAMETER, FREQUENCY, EXPERIMENT, and MODEL. Below this, there are seven main categories: Temperature, Precipitation, Humidity, Wind, Radiation, Pressure, and Evaporation. Each category contains a list of variables with their counts in parentheses. A blue arrow points from this interface towards the Jupyter Notebook on the right.

Category	Variables	Count
Temperature	ta - Air temperature, tas - Temperature, tasmin - Min. Temperature, tasmax - Max. Temperature	(104), (90), (81), (81)
Precipitation	pr - Precipitation, prsn - Snow, prc - Convective precipitation	(90), (72), (71)
Humidity	hurs - Rel. Humidity, huss - Specific humidity, rhmin - Min. Rel. Humidity, rhs - Rel. Humidity, hus - Spec. Humidity, hur - Rel. Humidity	(79), (74), (-), (-), (54), (22)
Wind	uas - Eastward wind, vas - Northward wind, sfcWind - Wind, sfcWindmax - Max Wind	(74), (74), (72), (31)
Radiation	rsds - SW Radiation Dn, rlds - LW Radiation Dn, rsus - SW Radiation Up, rlus - LW Radiation Up, rsdsdiff - Diff. Radiation, clt - Cloud	(72), (72), (22), (22), (-), (22)
Pressure	ps - Pressure, psl - Sea level pressure, pfull - Pressure	(-), (79), (-)
Evaporation	evpsbl - Act. Evap., evpsblpot - Pot. Evap., evpsblsol - Sol Evap., evpsblveg - Canopy Evap.	(-), (-), (-), (-)

Workflows for data staging &
remote subsetting-reduction (WPS)
onto Customisable Notebooks



The screenshot shows a Jupyter Notebook interface. The left pane displays a file browser with a list of netCDF files in the 'data/latest/' directory. The right pane shows the notebook code and its execution output. A blue arrow points from the Climate4Impact search interface on the left towards this Jupyter Notebook on the right.

```
from icclim import icclim
import numpy as np
import netCDF4
import matplotlib.pyplot as plt
import matplotlib
import sys
import glob
import os
import datetime
import cftime

print("python:", sys.version)
print("numpy:", np.__version__)
print("netCDF4:", netCDF4.__version__)
print("matplotlib:", matplotlib.__version__)

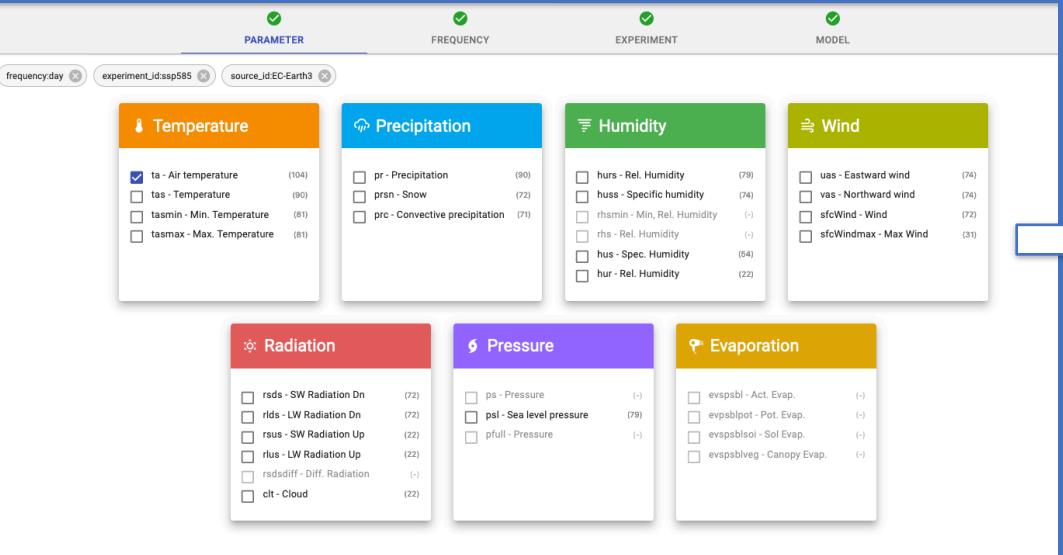
python: 3.6.11 | packaged by conda-forge | (default, Aug 5 2020, 20:09:42)
[GCC 7.5.0]
```



Save Progress
to Git

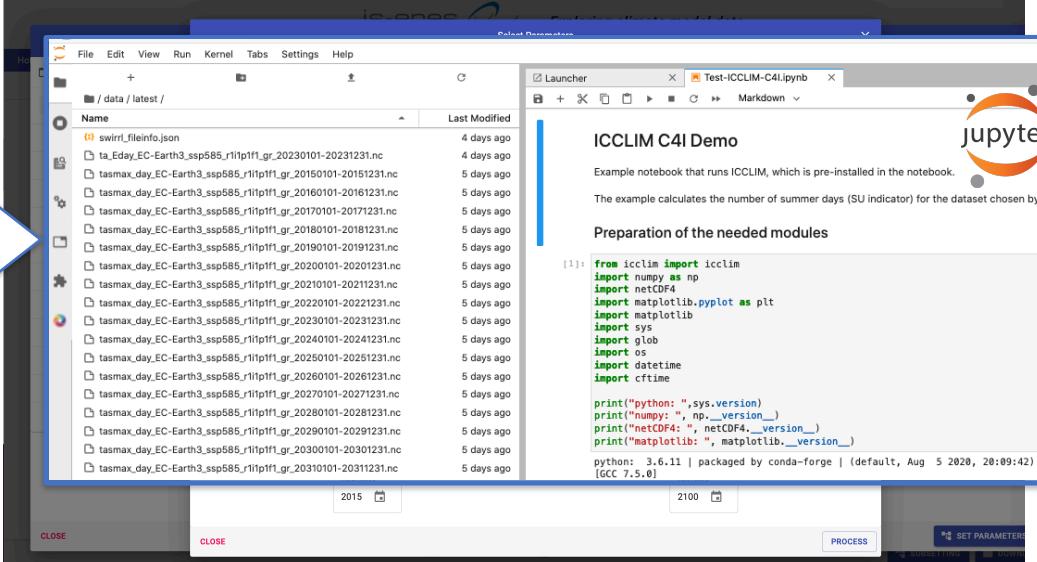
Climate4Impact (v2) Workflows & Workspaces

Climate4Impact Search for CMIP5/6
CORDEX Data (Distributed Data)
<https://dev.climate4impact.eu>



The screenshot shows a search interface for Climate4Impact. It features a top navigation bar with tabs for PARAMETER, FREQUENCY, EXPERIMENT, and MODEL. Below this, there are seven main categories: Temperature, Precipitation, Humidity, Wind, Radiation, Pressure, and Evaporation. Each category contains a list of variables with their counts in parentheses. For example, under Temperature, there are entries for ta - Air temperature (104), tas - Temperature (90), tasmin - Min. Temperature (81), and tasmax - Max. Temperature (81). A large blue arrow points from this interface to the Jupyter notebook interface on the right.

Workflows for data staging &
remote subsetting-reduction (WPS)
onto Customisable Notebooks



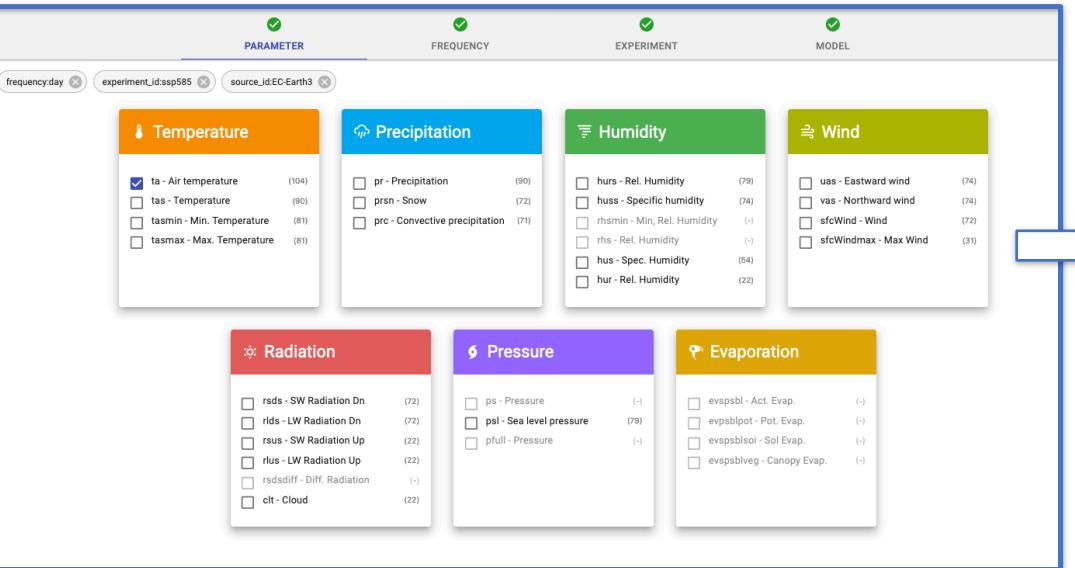
The screenshot shows a Jupyter notebook interface. The title bar says "Test-ICCLIM-C4i.ipynb". The notebook contains code for preparing modules and running ICCLIM. The code includes imports for icclim, numpy, netCDF4, and matplotlib, along with print statements for the Python and NumPy versions, and the netCDF4 and matplotlib versions. The code is run in cell [1]. A large blue arrow points from the Climate4Impact search interface on the left to this Jupyter notebook interface.

- Trace Changes to Restore, Recover Software and/or Data

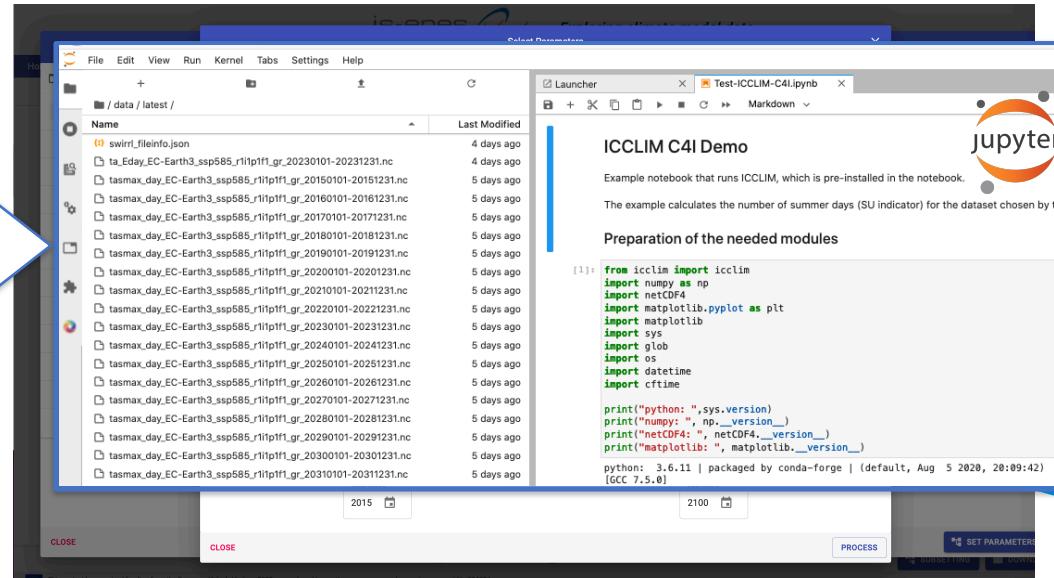


Climate4Impact (v2) Workflows & Workspaces

Climate4Impact Search for CMIP5/6
CORDEX Data (Distributed Data)
<https://dev.climate4impact.eu>



Workflows for data staging &
remote subsetting-reduction (WPS)
onto Customisable Notebooks

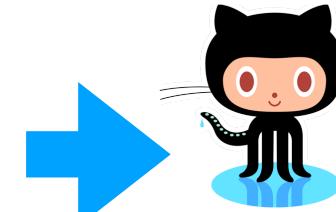


```
from icclim import icclim
import numpy as np
import netCDF4
import matplotlib.pyplot as plt
import matplotlib
import sys
import glob
import os
import datetime
import cftime

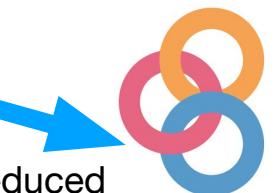
print("python:", sys.version)
print("numpy:", np.__version__)
print("netCDF4:", netCDF4.__version__)
print("matplotlib:", matplotlib.__version__)

python: 3.6.11 | packaged by conda-forge | (default, Aug 5 2020, 20:09:42)
[GCC 7.5.0]
```

- Trace Changes to Restore, Recover Software and/or Data



Save Progress
to Git



Reduced
Data
MyBinder
Reproduce

Notebook Presets based on ICCLIM

Workflow Monitoring

GitHub Authentication

Snapshot Controls

Data Staging Rollback

Activities History
and Provenance

{}

The screenshot shows a Jupyter Notebook interface with several tabs at the top: 'Welcome to SWIRRL.md', 'C4I_Averaged_Temperature...', 'C4I_Summer_days_Calcul...', and 'Terminal 1'. The main area contains Python code for generating a contour plot of summer days. The plot shows a map of Europe with color-coded contours representing the number of days where daily maximum temperature is above 25 degrees. A color bar on the right indicates values from 0 to 75. The code includes imports like 'xarray' and 'cmap=RdBu_r', and uses 'contourf' to fill the contours.

```
# Contour filled colors
p = su_avg.plot.contourf(levels=levels,
                           cmap='RdBu_r',
                           extend='both',
                           transform=ccrs.PlateCarree())

# Plot information
plt.suptitle("Two Time Steps of Europe Summer Days", y=1)

# Add the coastlines to axis and set extent
ax.coastlines()
ax.gridlines()
ax.set_extent(extent)

# Save plot as png
plt.savefig('c4i_su_contours_icclim.png')
```

The bottom of the interface shows the terminal output: 'height = 2.0, spatial_ref = 0'. The status bar at the bottom indicates 'Mode: Command' and 'Ln 1, Col 1 C4I_Summer_days_Calcul...'.

Notebook Presets based on ICCLIM

The screenshot shows a desktop environment with two main windows. On the left, a terminal window displays the command `git clone https://gitlab.com/is-enes-cdi-c4i/notebooks`. On the right, a web browser is open to the GitLab repository page for "C4I Use Cases as Jupyter Notebooks". The repository details are as follows:

Project ID	Commits	Branches	Tags	Files	Storage
25761638	13	1	0	1.5 MB	1.5 MB

The repository description states: "A collection of Jupyter Notebooks implementing some Use Cases." Below this, a commit history is shown:

Commit	Author	Date	Message
7d663d8e	Christian Page	2 days ago	Some small fixes. Added deltaT_deltaP Notebook. Tested also with icclim v5.0.0-b3.

At the bottom of the repository page, a table lists the notebooks:

Name	Last commit	Last update
C4I_Averaged_Temperature_An...	Some small fixes. Added deltaT_deltaP Not...	2 days ago
C4I_Summer_days._Calculate_...	Some small fixes. Added deltaT_deltaP Not...	2 days ago
C4I_deltaT_deltaP_Anomaly_20...	Some small fixes. Added deltaT_deltaP Not...	2 days ago
README.md	small readme and notebook edits	4 months ago

On the left side of the image, there is a vertical stack of five interface snippets with labels:

- Workflow Monitoring
- GitHub Authentication
- Snapshot Controls
- Data Staging Rollback
- Activities History and Provenance

A large red curly brace is positioned to the left of the first four snippets, indicating they are part of a single integrated system.

<https://gitlab.com/is-enes-cdi-c4i/notebooks>

SWIRRL-API



SWIRRL hides the complexity of orchestrating Workspaces in a target **Cloud resource based on Kubernetes Cluster**

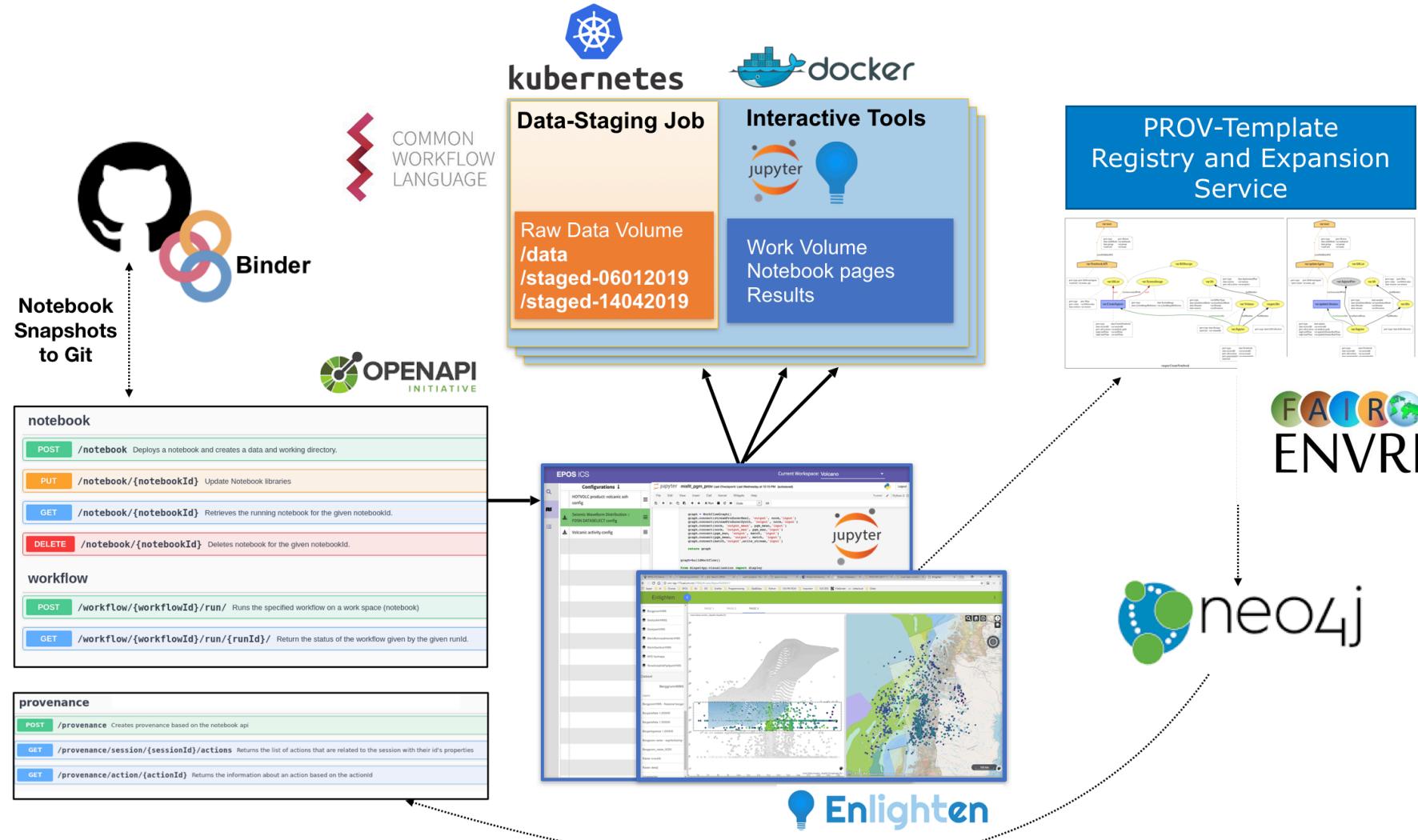
Integrates Interactive Tools
(Notebooks, Workflows, GIT, Binder)

Offers a REST Web API

Manages Metadata (Provenance)

Findable Acessible Interoperable Reusable

Supports Reproducibility



ESMValTool in C4I Models' Performance Comparison

is-enes INFRASTRUCTURE FOR THE EUROPEAN NETWORK FOR EARTH SYSTEM MODELLING Exploring climate model data

Home Data Discovery Help Feedback Sign Up

PROJECT: CMIP 6 NODES: CUSTOM (2)

variable:ta variable:prsn variable:huss frequency:day experiment_id:ssp585 source_id:CanESM5 source_id:CNRM-CM6-1 source_id:MIROC6

SCOPE VIEW

VARIABLE

FREQUENCY

EXPERIMENT

MODEL

MEMBER

Model

- CanESM5 - CanESM5 (57)
- MPI-ESM1-2-LR - MPI-ESM1.2-LR (50)
- UKESM1-0-LL - UKESM1.0-N96ORCA1 (20)
- CNRM-CM6-1 - CNRM-CM6-1 (17)
- MIROC6 - MIROC6 (10)
- CNRM-ESM2-1 - CNRM-ESM2-1 (9)
- MRI-ESM2-0 - MRI-ESM2-0 (7)
- GFDL-CM4 - GFDL-CM4 (6)
- HadGEM3-GC31-LL - HadGEM3-GC3.1-N96ORCA1 (6)
- MPI-ESM1-2-HR - MPI-ESM1.2-HR (6)
- INM-CM4-8 - INM-CM4-8 (5)
- INM-CM5-0 - INM-CM5-0 (5)
- ACCESS-CM2 - Australian Community Climate and Earth System Simulator Climate Model Version 2 (4)
- AWI-CM-1-1-MR - AWI-CM 1.1 MR (4)
- NorESM2-LM - NorESM2-LM (low atmosphere-medium ocean resolution, GHG concentration driven) (4)
- BCC-CSM2-MR - BCC-CSM 2 MR (3)
- CMCC-CM2-SR5 - CMCC-CM2-SR5 (3)
- FGOALSg3 - FGOALSg3 (2)

COMPARE MODEL PERFORMANCE

ESMValTool in C4I Models' Performance Comparison

is-enes INFRASTRUCTURE FOR THE EUROPEAN NETWORK FOR EARTH SYSTEM MODELLING

Exploring climate models

Home Data Discovery Help Feedback Sign Up

PROJECT: CMIP 6 NODES: CUSTOM (2)

variable:ta variable:prsn variable:huss frequency:day experiment_id:ssp585 source_id:CanESM5 source_id:CNRM-CM6-1

VARIABLE

FREQUENCY

EXPERIMENT

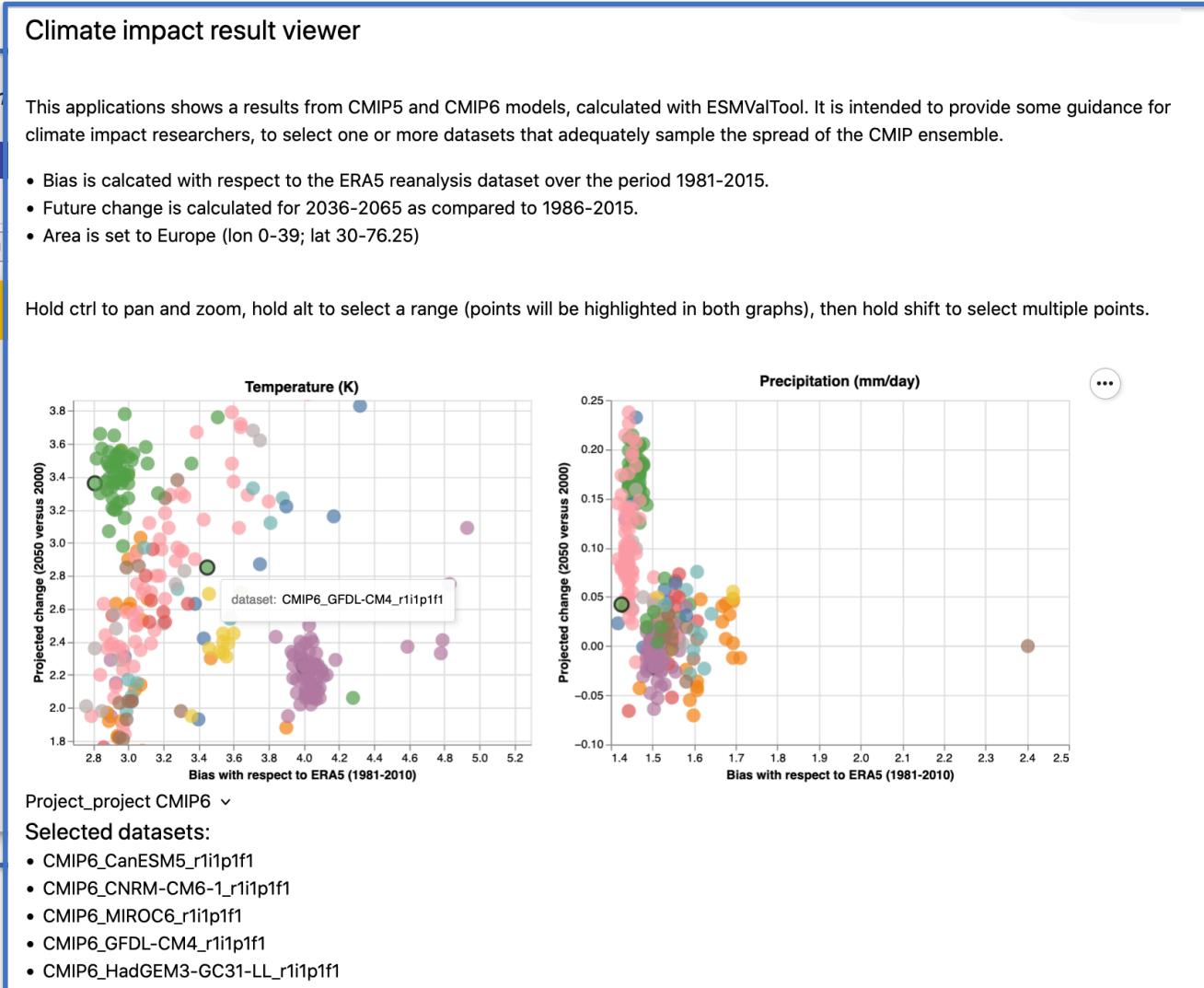
MODEL

MEMBER

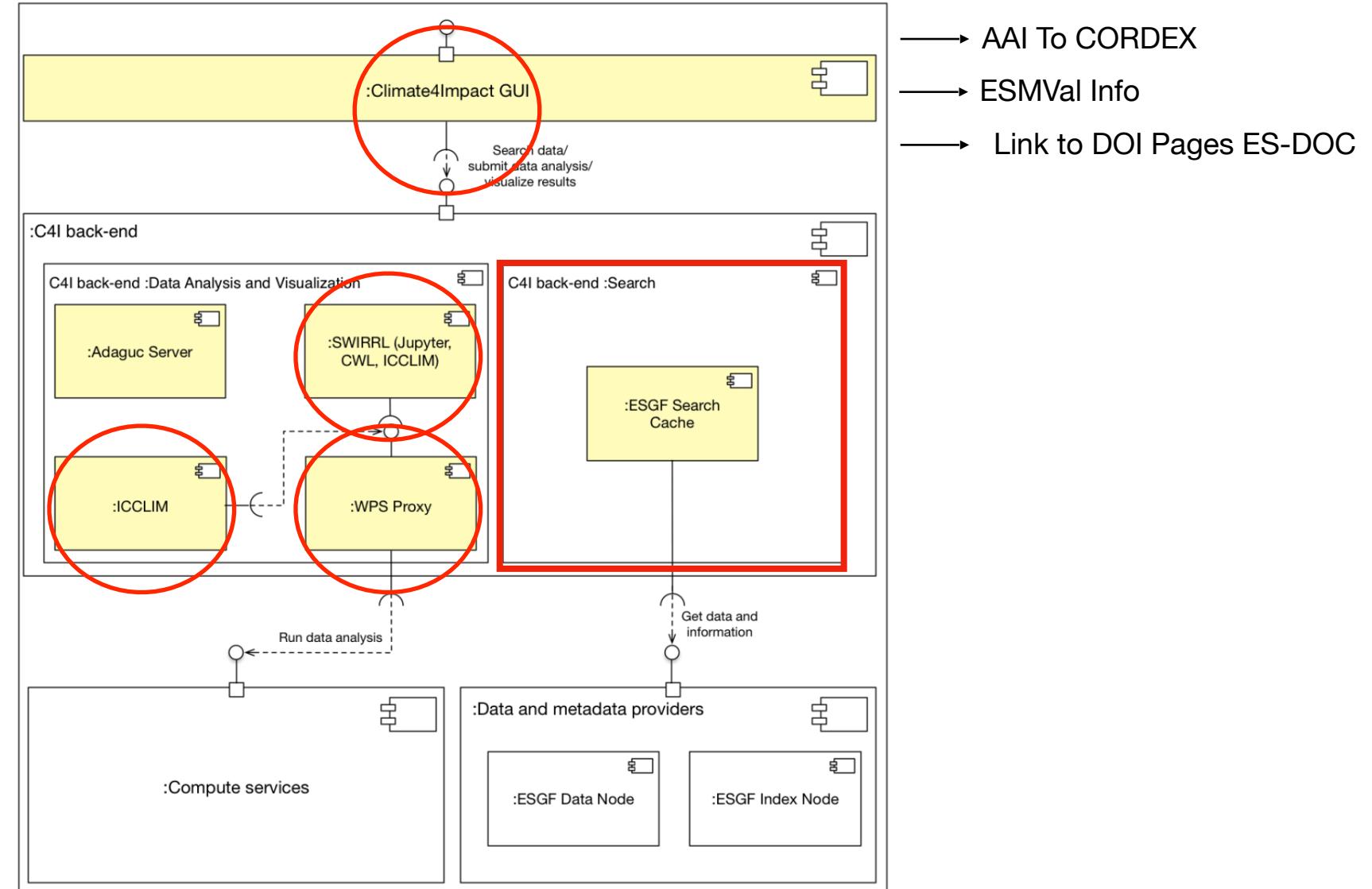
Model

- CanESM5 - CanESM5
- MPI-ESM1-2-LR - MPI-ESM1.2-LR
- UKESM1-0-LL - UKESM1.0-N96ORCA1
- CNRM-CM6-1 - CNRM-CM6-1
- MIROC6 - MIROC6
- CNRM-ESM2-1 - CNRM-ESM2-1
- MRI-ESM2-0 - MRI-ESM2.0
- GFDL-CM4 - GFDL-CM4
- HadGEM3-GC31-LL - HadGEM3-GC3.1-N96ORCA1
- MPI-ESM1-2-HR - MPI-ESM1.2-HR
- INM-CM4-8 - INM-CM4-8
- INM-CM5-0 - INM-CM5-0
- ACCESS-CM2 - Australian Community Climate and Earth System Simulator Climate Model Version 2
- AWI-CM-1-1-MR - AWI-CM 1.1 MR
- NorESM2-LM - NorESM2-LM (low atmosphere-medium ocean resolution, GHG concentration driven)
- BCC-CSM2-MR - BCC-CSM 2 MR
- CMCC-CM2-SR5 - CMCC-CM2-SR5
- FGOALS-g3 - FGOALS-g3

COMPARE MODEL PERFORMANCE



Climate4Impact (v2) - ENES CDI



Climate4Impact (v2) - Future work



Alpha Tester Wanted!

- Register at <https://dev.climate4impact.eu>
- More Notebooks Presets (CERFACS/Icclim)
- Enable Collection of Usage stats (KPIs)
- Access to CORDEX (via Future Architecture IdP)

CrossWP Activities

- *Wider support for remote data reduction Workflows (with partners)*
- *PoC of updating to new ESGF Search STAC*

THE CONSORTIUM

Coordinated by CNRS-IPSL, the IS-ENES3 project gathers **22 partners** in **11 countries**



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°824084



Our website
<https://is.enes.org/>



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Contact us at
is-enes@ipsl.fr



Follow our channel
IS-ENES3 H2020