Interactive and Flexible Environment for Climate Data Analysis

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Climate Data Distribution through the ESGF

ESGF represents a multinational effort to securely **access**, **monitor**, **catalog**, **transport**, and **distribute** reference **data** for **climate** research experiments and observations.

ESGF
Earth System Grid Federation

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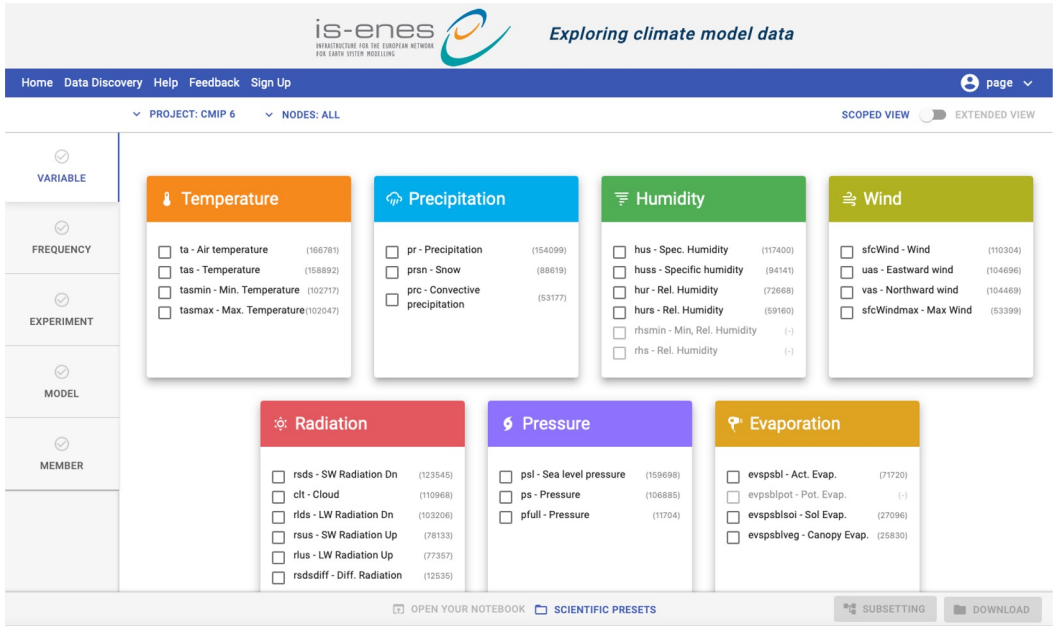
What is the climate4impact (C4I) portal? (1/2)

Platform for researchers to explore climate data and perform analysis

- Front-end to climate data infrastructure (ESGF)
- Tailored Search Interface with view modes
- Jupyter-Lab enhanced environment
- Notebooks gallery
- Flexible analysis features
  - Climate indices calculation: **icclim**
  - Data Staging/Reduction Workflows
  - Personal store for processing outcome
- Automated reproducibility mechanisms and documentation (Data/Analysis)
- Modular Deployment & Decoupled Architecture
- Pages for Models Performance Comparison (**ESMValTool**)



V2: Complete Redesign from V1
Beta version available https://dev.climate4impact.eu

Findable Accessible Interoperable Reusable

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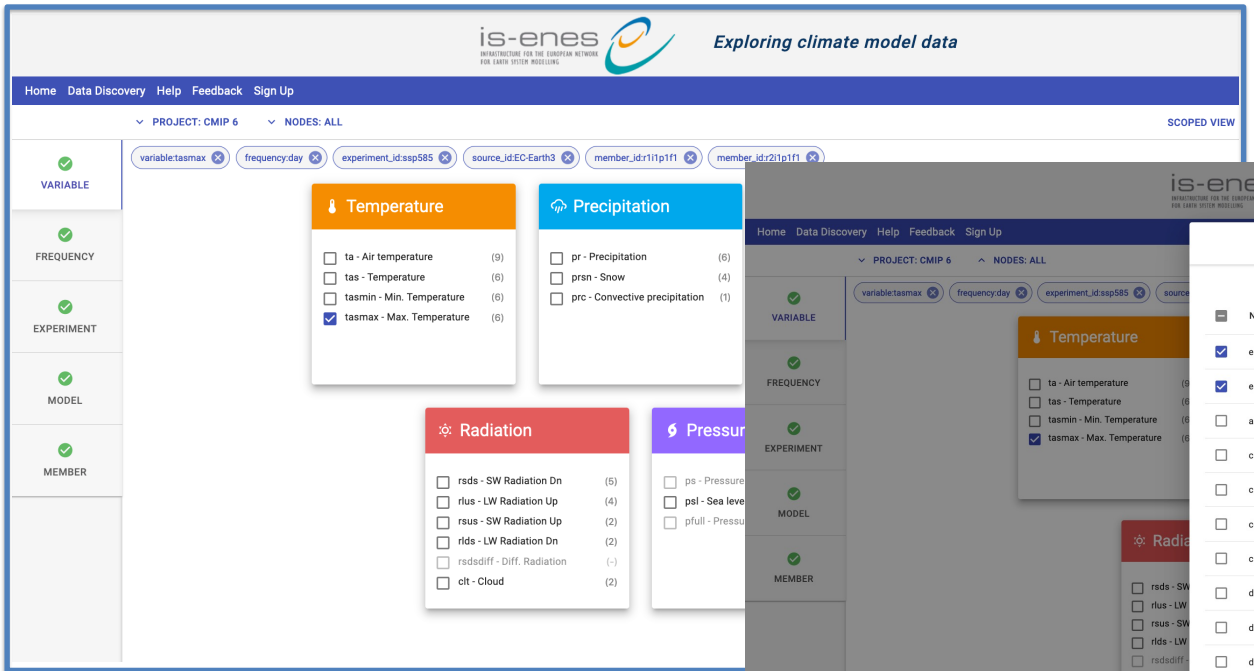
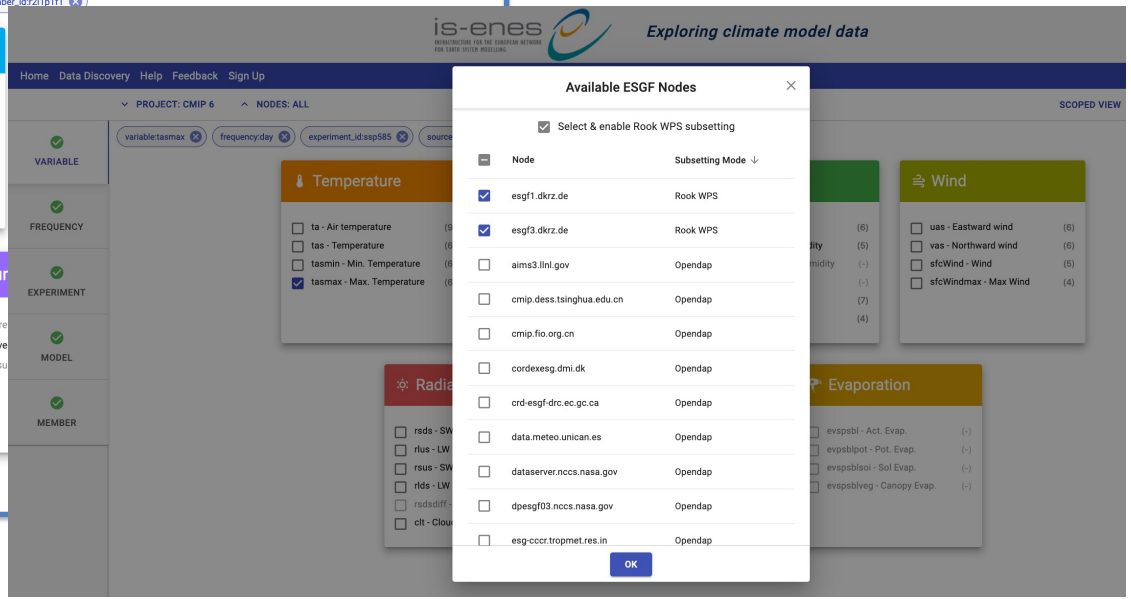
Climate4Impact (v2) Search & Nodes

Search Parametrisation made easier



Nodes Selection by Service



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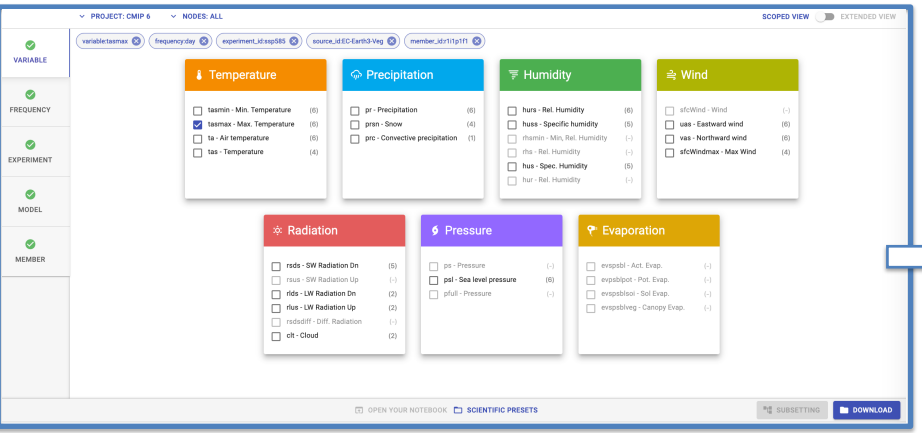
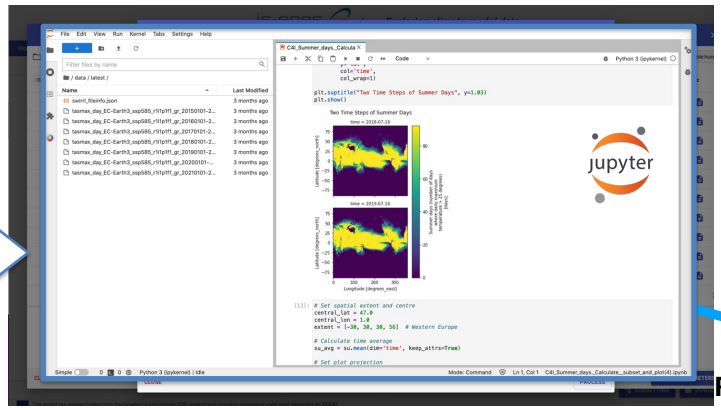
Climate4Impact (v2) Workflows & Workspaces

Climate4Impact Search for CMIP5/6 CORDEX Data

https://dev.climate4impact.eu



Workflows for data staging & reduction onto iccim powered Notebooks



Save/Share Progress to Git

Reduced Data

MyBinder Reproduce

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

W3C PROV

CERFACS

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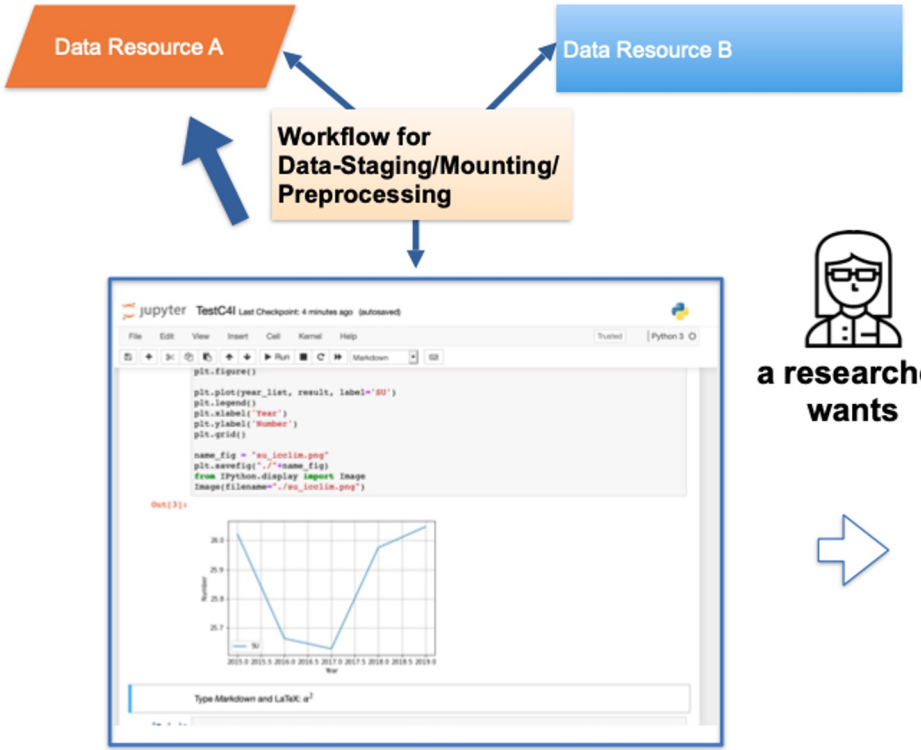
C4I Workspace Use Case



a researcher wants

- **access distributed raw data**
- **develop, document and reuse** methods for processing and visualisation.
- **update/extend** raw data and software
- **Track changes and rollback** (Traceability/Recovery)
- **keep old versions of the data** after updates (Reproducibility)
- **snapshot and restore** the state of a workspace software (Reproducibility)

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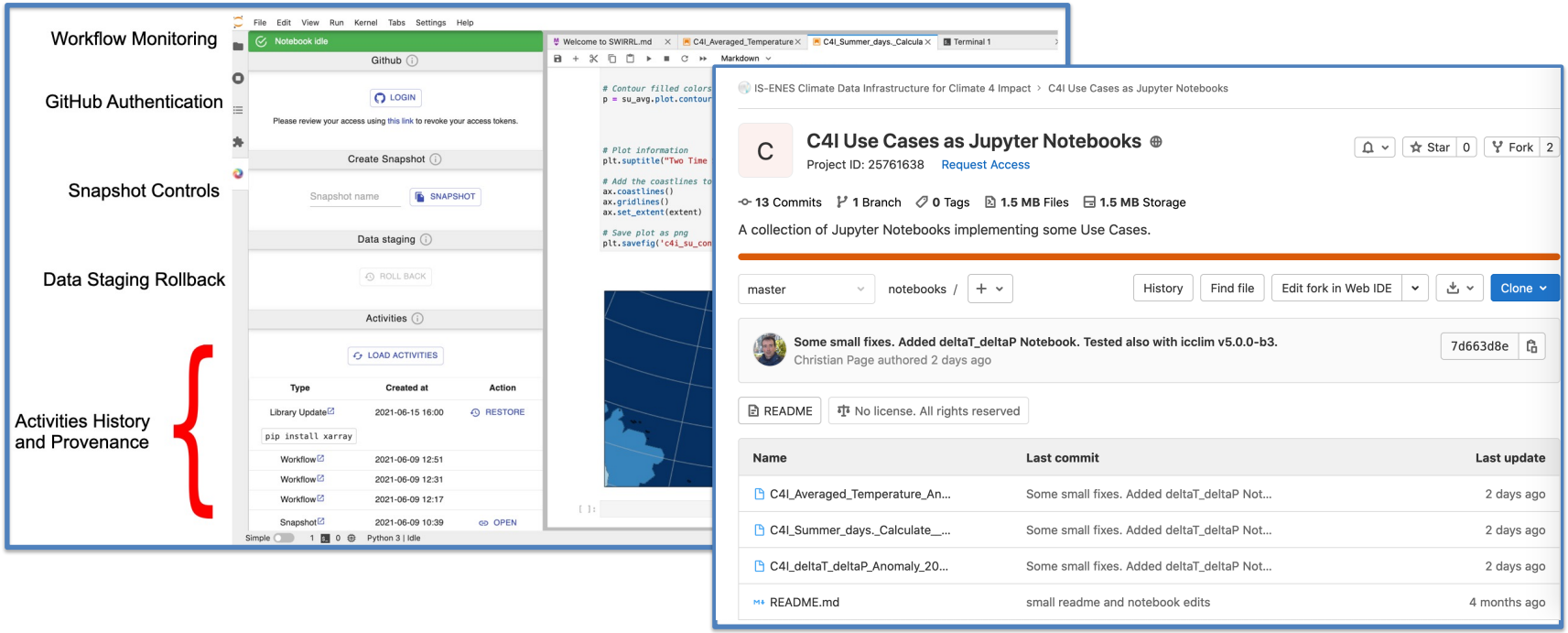
SWIRRL JupyterLab Extension and Sample Notebooks based on icclim (climate indices)



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

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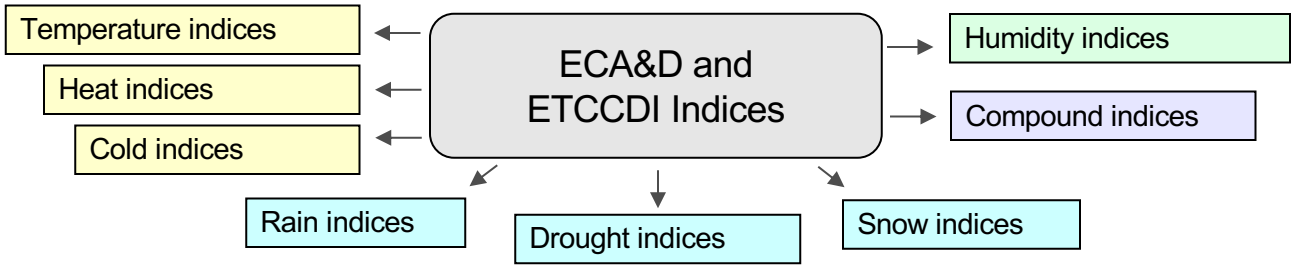
On-demand calculations

Climate indices calculation in climate4impact: **icclim**



- Intra-period extreme temperature range [°C] - **ETR**
- Warm days (days with mean temperature > 90th percentile of daily mean temperature) - **TG90p**
- Summer days (days with max temperature > 25 °C) - **SU**
- ...

- Python code developed at Cerfacs since September 2013
- Funded by EU FP7 IS-ENES2, FP7 CLIPC and H2020 IS-ENES3
- Generic and modular approach, can be reused in other environments
- New V5 completely rewritten and using underlying xclim functions, based on xclim, xarray and dask
- I/O interface is structured for optimal performance
- Implement the proper percentile indices calculations when calculation period overlaps reference period (called bootstrapping method)

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icclim: climate indices

Documentation: https://icclim.readthedocs.io/en/latest/python_api.html
Source code: https://github.com/cerfacs-globc/icclim
Current Version 5.3: https://github.com/cerfacs-globc/icclim/releases/tag/5.3

`icclim.index(**kwargs)`

Parameters:

- **in_files** (*str | list[str] | Dataset | DataArray,*) – Absolute path(s) to NetCDF dataset(s), including OPeNDAP URLs, or path to zarr store, or xarray.Dataset or xarray.DataArray.
- **index_name** (*str*) – Climate index name. For ECA&D index, case insensitive name used to lookup the index. For user index, it's the name of the output variable.
- **var_name** (*str | list[str] | None*) – `optional` Target variable name to process corresponding to `in_files`. If None (default) on ECA&D index, the variable is guessed based on the climate index wanted. Mandatory for a user index.
- **slice_mode** (*str*) – Type of temporal aggregation: {"year", "month", "DJF", "MAM", "JJA", "SON", "ONDJFM" or "AMJJAS"}. Default is "year". See slice_mode for details.
- **time_range** (*list[datetime.datetime]*) – `optional` Temporal range: upper and lower bounds for temporal subsetting. If `None`, whole period of input files will be processed. Default is `None`.
- **out_file** (*str | None*) – Output NetCDF file name (default: "icclim_out.nc" in the current directory). Default is "icclim_out.nc". If the input `in_files` is a `Dataset`, `out_file` field is ignored. Use the function returned value instead to retrieve the computed value. If `out_file` already exists, icclim will overwrite it!
- **threshold** (*float | list[float] | None*) – `optional` User defined threshold for certain indices. Default depend on the index, see their individual definition. When a list of threshold is provided, the index will be computed for each thresholds.

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SWIRRL-API

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

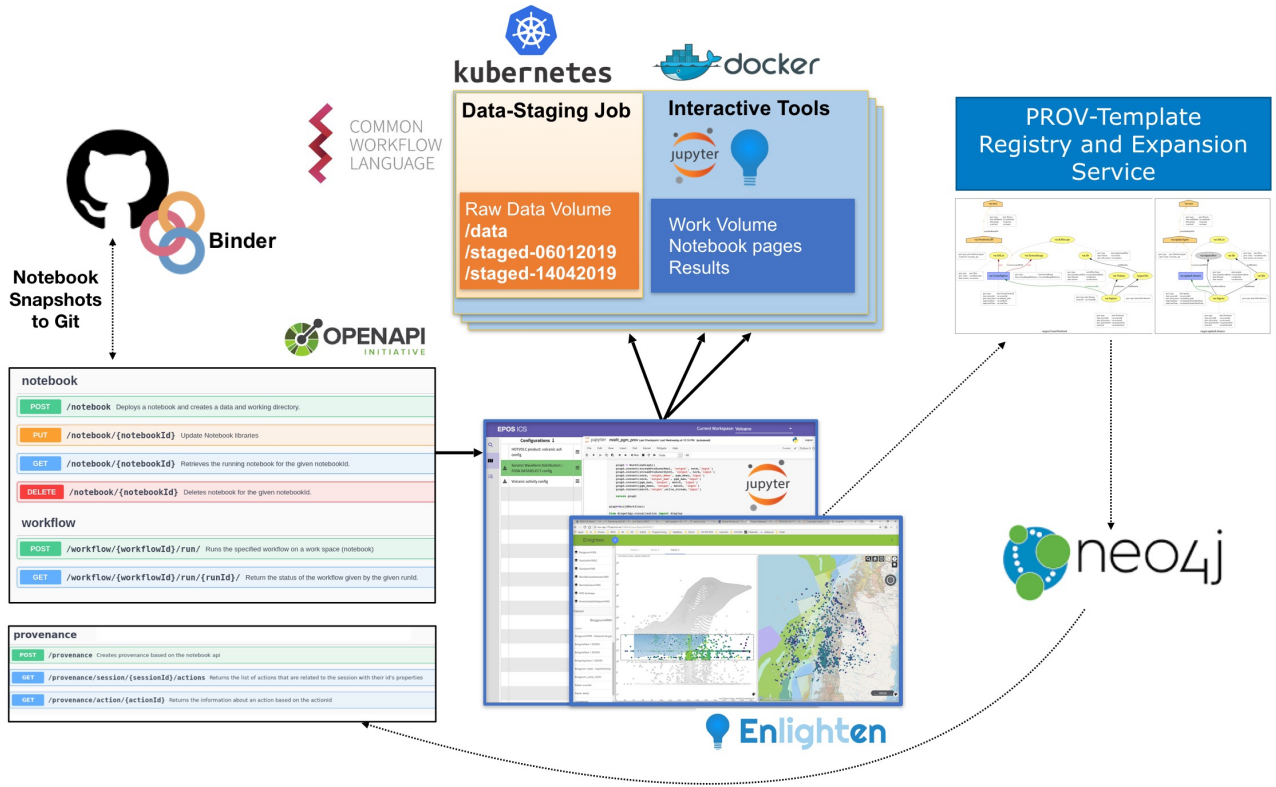
Integrates Interactive Tools (Notebooks, Workflows, GIT, Binder)

Offers a REST Web API

Manages Metadata (Provenance)

Findable Accessible Interoperable Reusable

Supports Reproducibility



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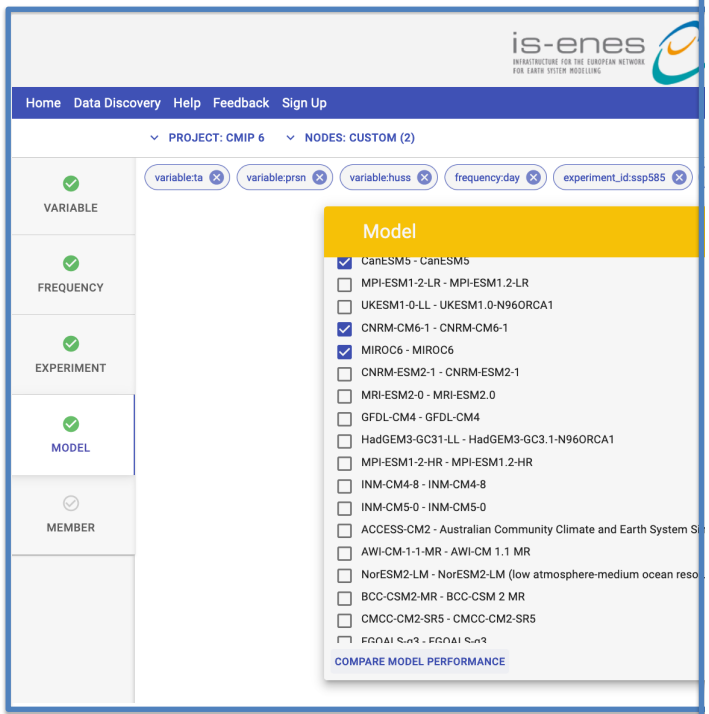
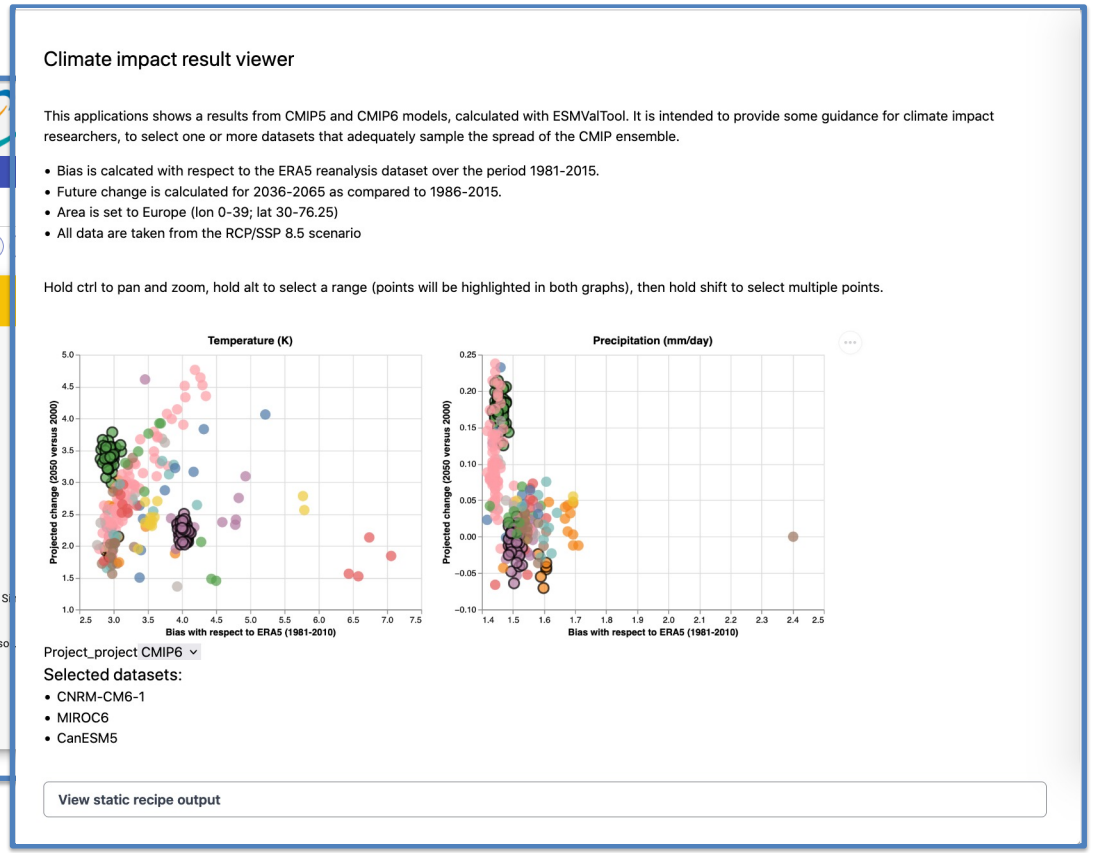
ESMValTool in C4I
Models' Performance Comparison





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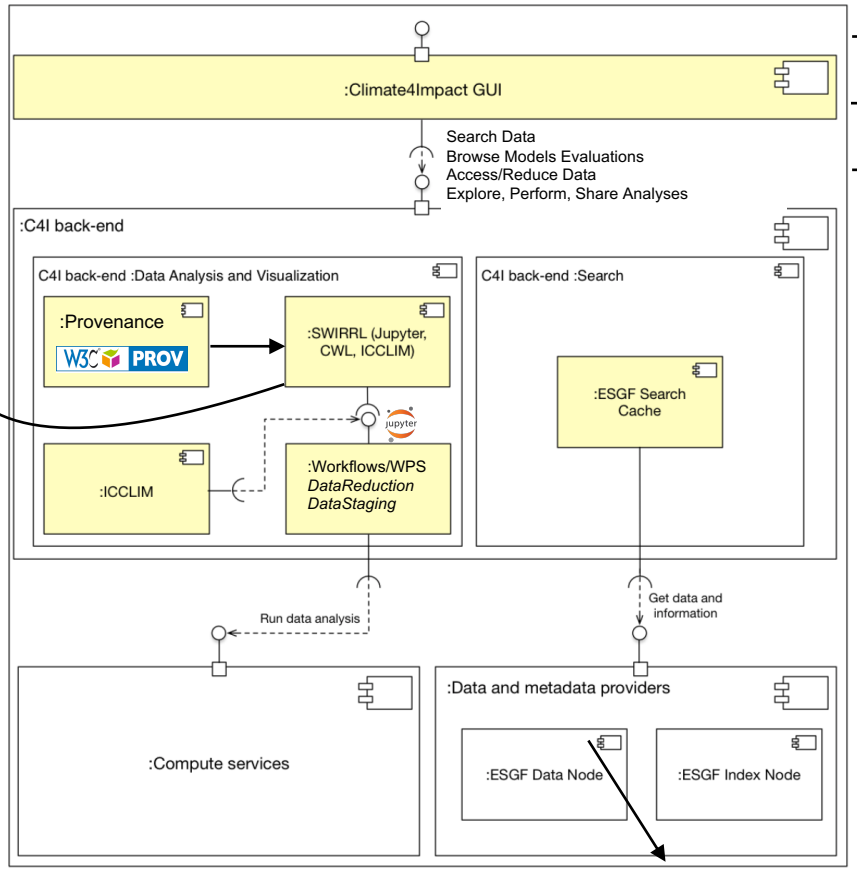
Climate4Impact (v2) - ENES CDI



Git Store/Share Analyses

Binder Reproduce

→ **SSO with IDeA AAI**

→ **ESMValTool Evaluation pages**

→ **Link to DOI Pages ES-DOC**

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Thanks !

On behalf of the climate4impact and icclim teams
https://dev.climate4impact.eu
https://icclim.readthedocs.io/en/stable/

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