

# Climate Data Analysis Tools Along With Pre-Computed Climate Indices Datasets to Support Climate Action



Christian Pagé (CERFACS, France)

christian.page@cerfacs.fr <https://linkedin.com/in/pagechristian> [https://www.researchgate.net/profile/Christian\\_Page](https://www.researchgate.net/profile/Christian_Page)

CECI, Université de Toulouse, CNRS, CERFACS, Toulouse, France

Abel Aoun (CERFACS, France) Alessandro Spinuso (KNMI, Netherlands) Klaus Zimmermann & Lars Bärring (SMHI, Sweden)



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## I Impacts of Climate Change



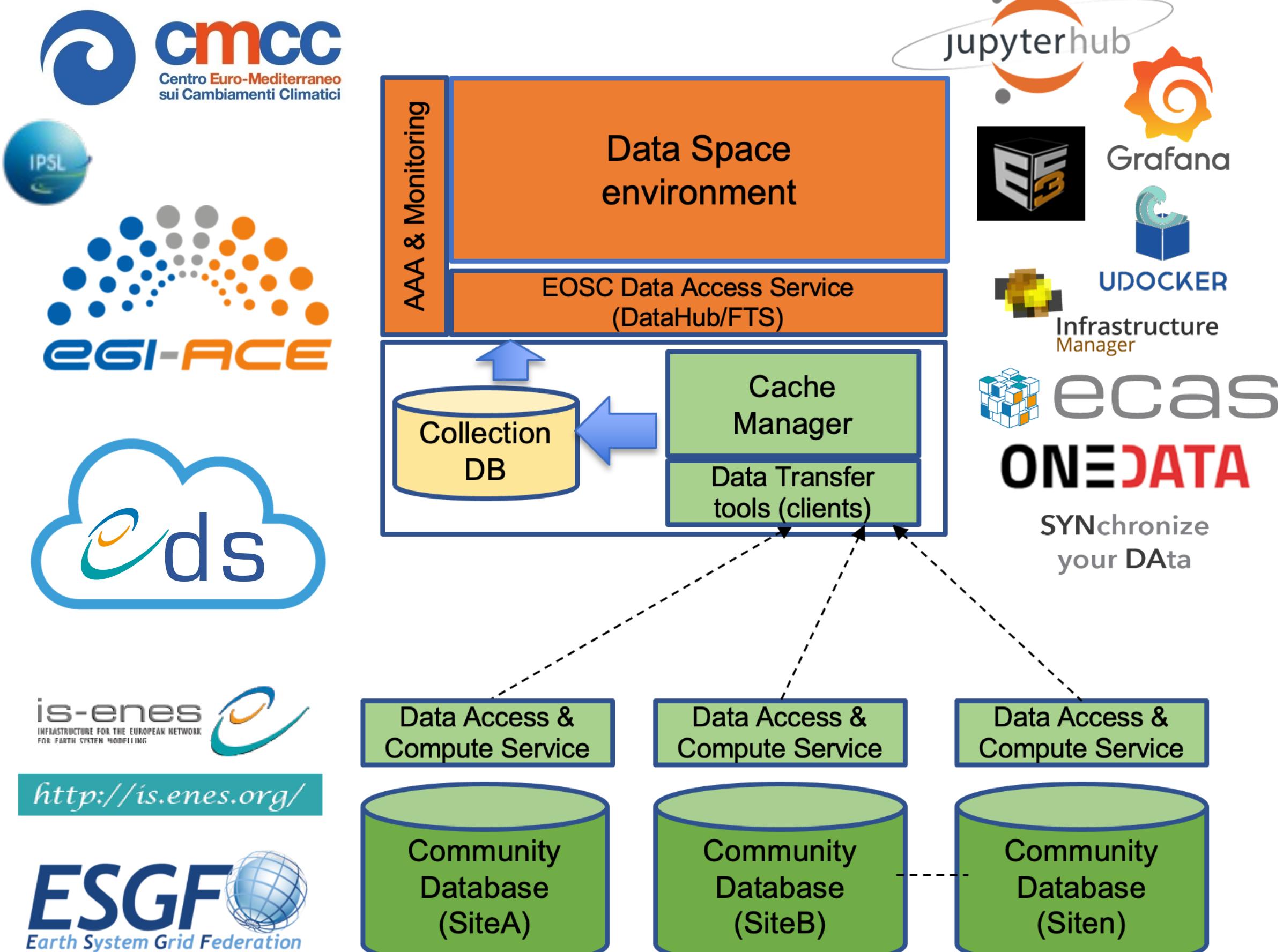
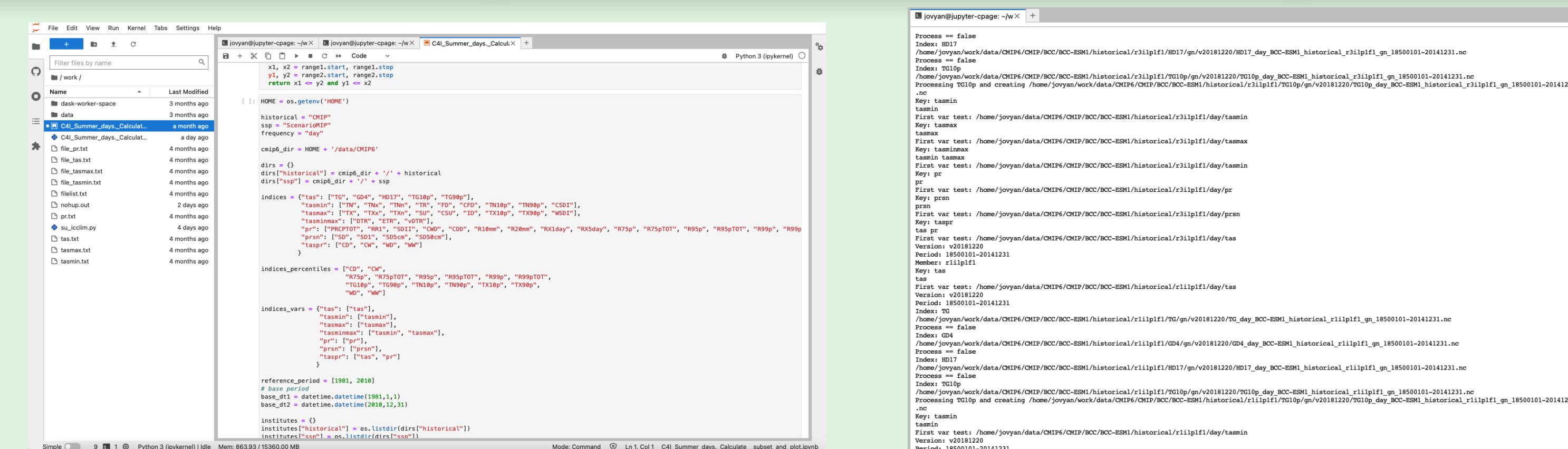
2021 Germany Erftstadt,  
southwest of Cologne



2020 Hurricane Delta causes  
damage to Louisiana's Gulf Coast

- ▶ Urgent needs of impact assessments
- ▶ Identify mitigation solutions
- ▶ Extreme events attribution
- ▶ Multiple domains: infrastructures, urban, agriculture, transportation, etc.
- ▶ Flexible tools needed for very diverse users
- ▶ **Climate indices and indicators are widely needed**

## IV Compute: ENES Data Space

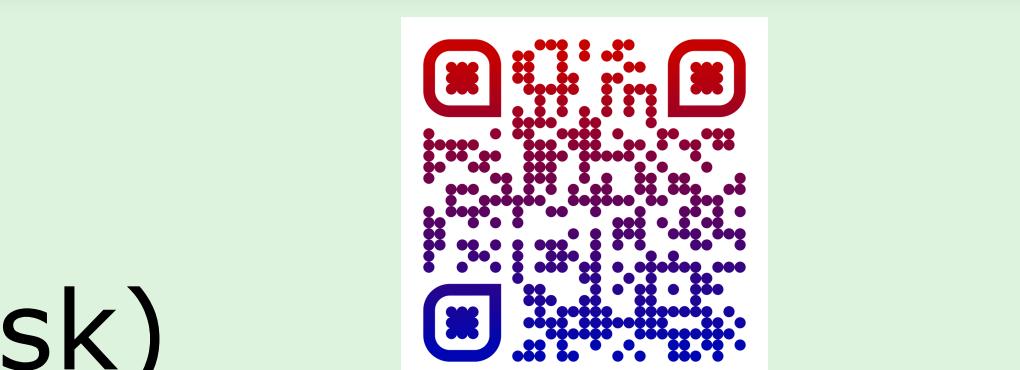
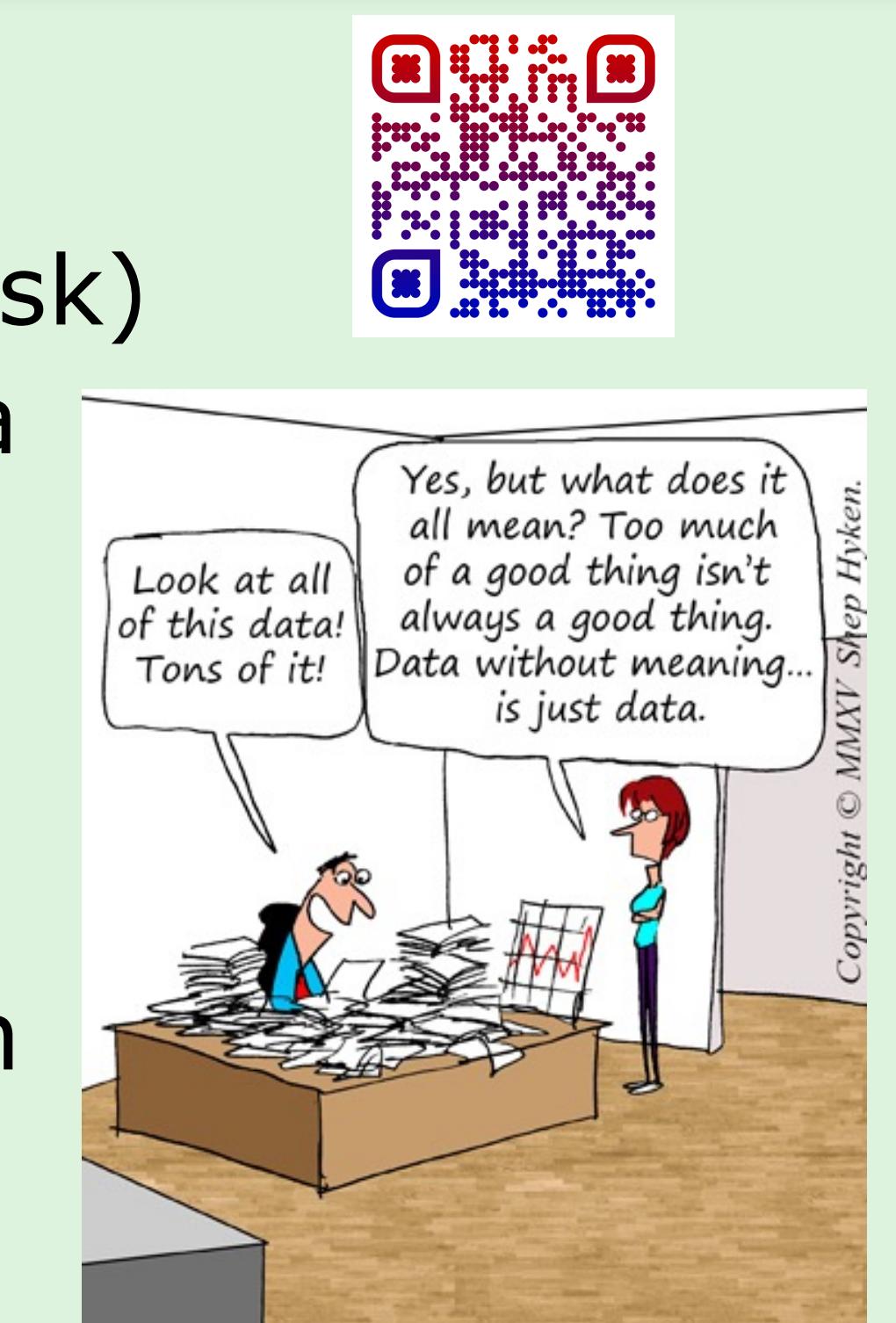


## II icclim: Climate Indices

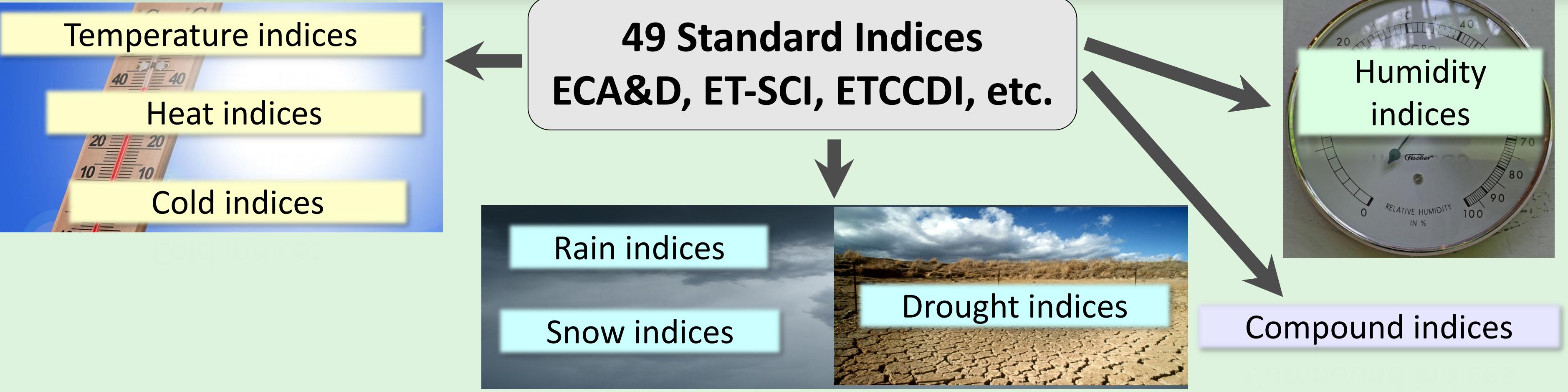
- ▶ Python code developed@CERFACS since 2013
- ▶ Performance optimized (xarray, dask)
- ▶ Fully compliant to CF and Metadata Standards
- ▶ Validated against climact & xclim
- ▶ Easy install: `pip install icclim`
- ▶ Implement the proper percentile indices calculations when calculation period overlaps reference period: bootstrapping method

### Take Home Messages

1. Wide needs for tools to easily calculate climate indices
2. icclim is a flexible, robust and fast python software for calculating climate indices
3. Creating pre-calculated standard indices datasets for CMIP6 is really a need
4. A web platform for easy and FAIR-enabled access to climate data, tools and actionable products is essential



## III icclim: 50 Standard Climate Indices



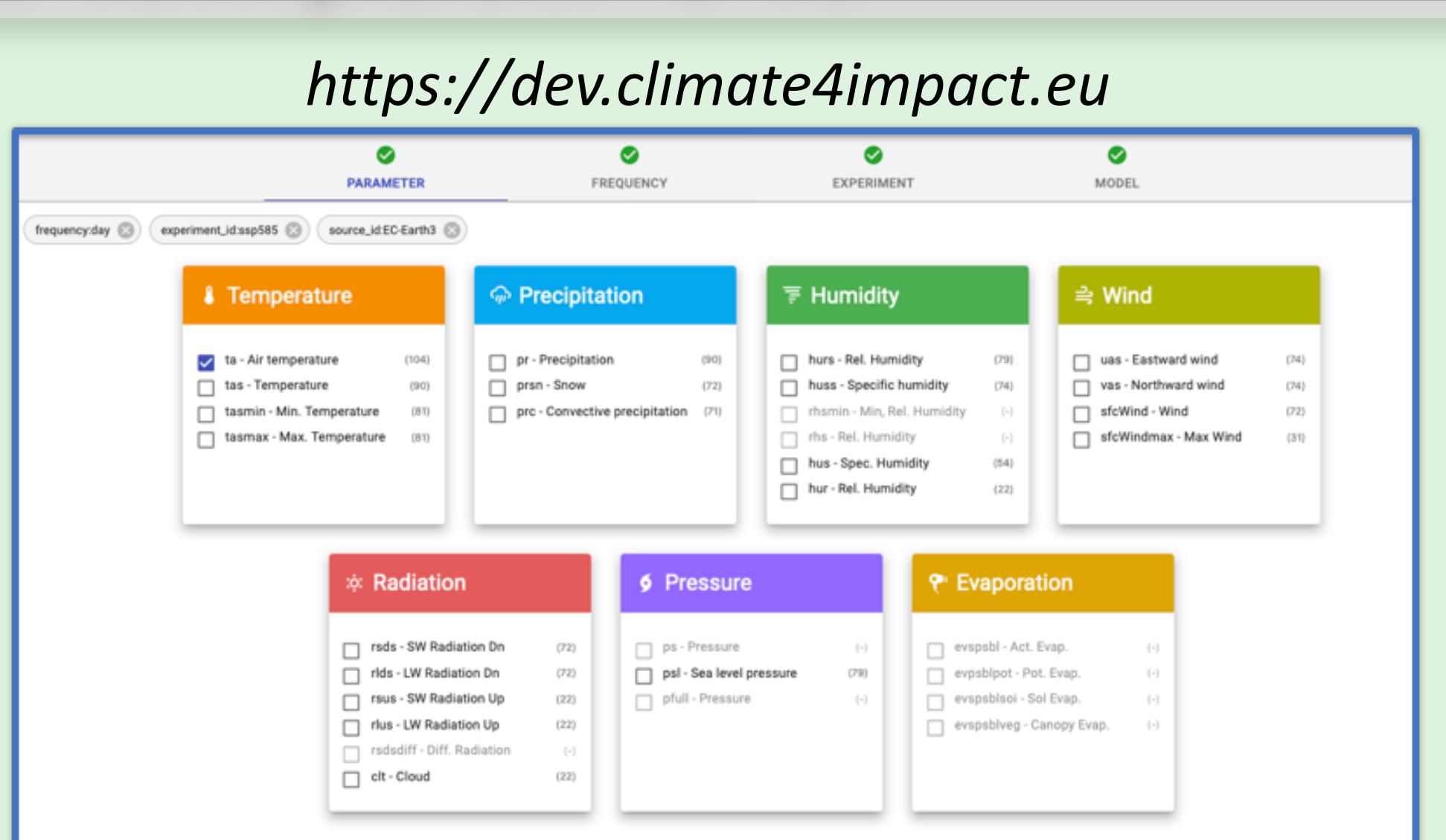
- Intra-period extreme temperature range [° C] - **ETR**
- Warm days (days with mean temperature > 90th percentile of daily mean temperature) - **TG90p**
- Summer days (days with max temperature ≥ 25 ° C) - **SU**

Standards for climate indices metadata clix-meta <https://github.com/clix-meta/clix-meta>

```
>>> files = ['tasmax_day_CNRM-CM5_historical_r1i1p1_19950101-19991231.nc', 'tasmax_day_CNRM-CM5_historical_r1i1p1_20000101-20041231.nc', 'tasmax_day_CNRM-CM5_historical_r1i1p1_20050101-20051231.nc']
>>> dt1 = datetime.datetime(1998, 1, 1)
>>> dt2 = datetime.datetime(2005, 12, 31)
>>> out_f = 'SU_JJA_CNRM-CM5_historical_r1i1p1_1998-2005.nc'
# OUTPUT FILE: summer season values of SU
>>> icclim.su(in_files=files, time_range=[dt1, dt2], slice_mode='JJA', out_file=out_f)
```

## V Climate4Impact: C4I

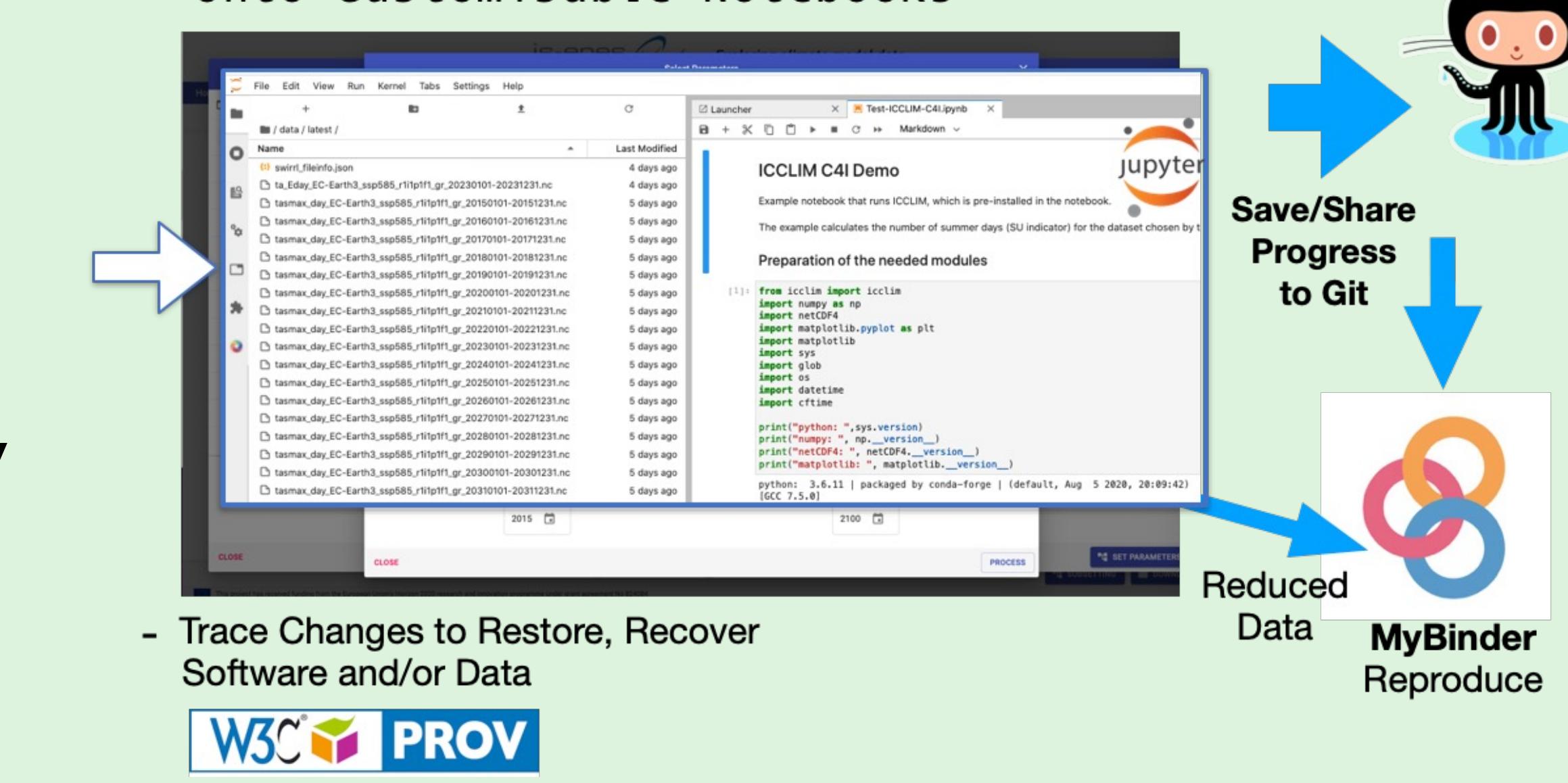
- ▶ Front-end to climate data infrastructure (ESGF)
- ▶ Tailored Search Interface with view modes
- ▶ Jupyter-Lab enhanced environment SWIRRL
- ▶ Notebooks gallery
- ▶ Flexible analysis features
- ▶ Climate indices calculation: icclim
- ▶ Personal store for processing outcome
- ▶ Pages for Models Performance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



<https://dev.climate4impact.eu>

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

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



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

**W3C PROV**

## VI Climate Indices Database

50 standard climate indices over most of CMIP6 simulations

- ▶ Institutes/Climate Models
- ▶ Historical and SSPs
- ▶ Members
- ▶ Versions
- ▶ Time Periods (1850-2100)
- ▶ Can be extended to CORDEX, CMIP5, ERA5, ...

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IS-ENES: <https://is.enes.org/>



icclim v6.1.5: <https://github.com/cerfacs-globc/icclim> (pip install icclim)



climate4impact 2.0 beta: <https://dev.climate4impact.eu/>



<https://rebrand.ly/climateindices>

