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Climate Data Analysis Tools and Datasets to Support Climate Action

Christian Pagé, Abel Aoun, Alessandro Spinuso, Klaus Zimmermann, Lars
Barring

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Christian Pagé (CERFACS, France)

christian.page@cerfacs.fr <https://linkedin.com/in/pagechristian> 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 Barring (SMHI, Sweden)

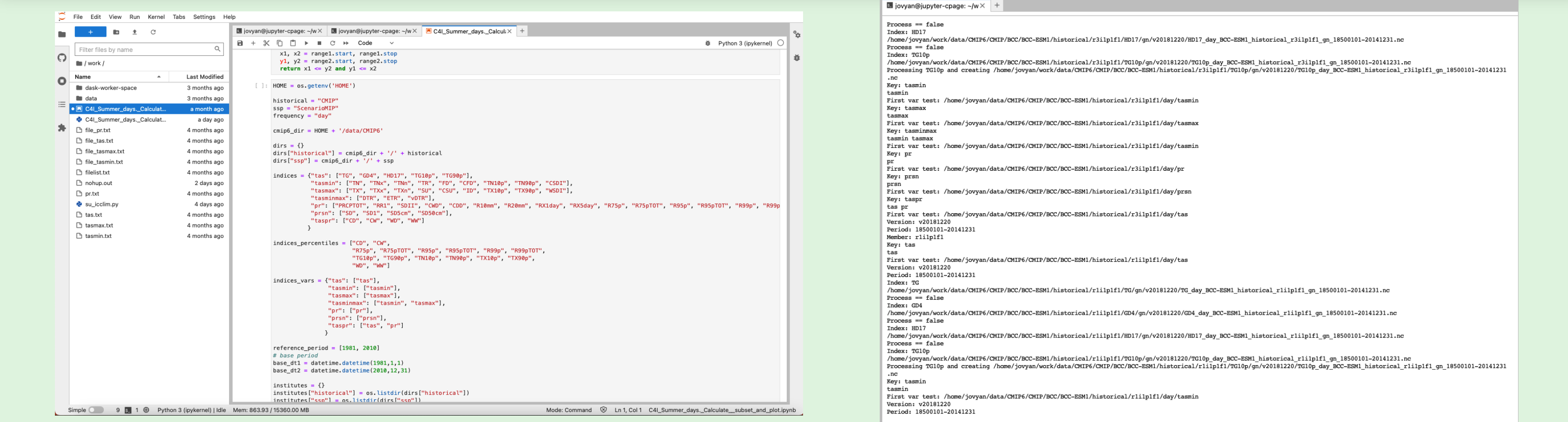
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I Impacts of Climate Change



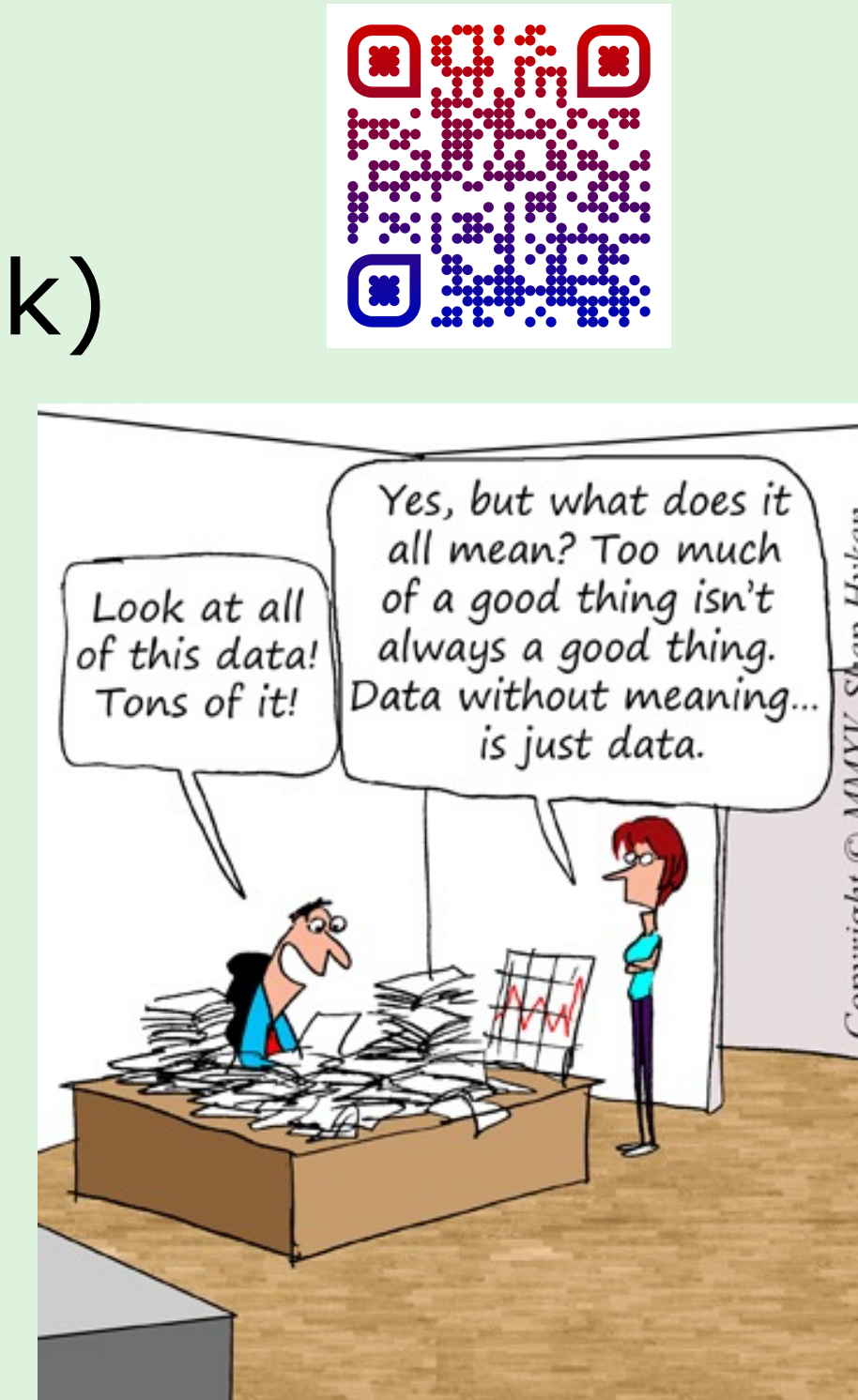
- ▶ Urgent needs of impact assessments
- ▶ Identify mitigation solutions
- ▶ Extreme events attribution
- ▶ Multiple domains: infrastructures, urban, agriculture, transportation, etc.
- ▶ Flexible tools needed for very diverse users
- ▶ **Climate indices and indicators are widely needed**

IV Compute: ENES Data Space



II icclim: Climate Indices

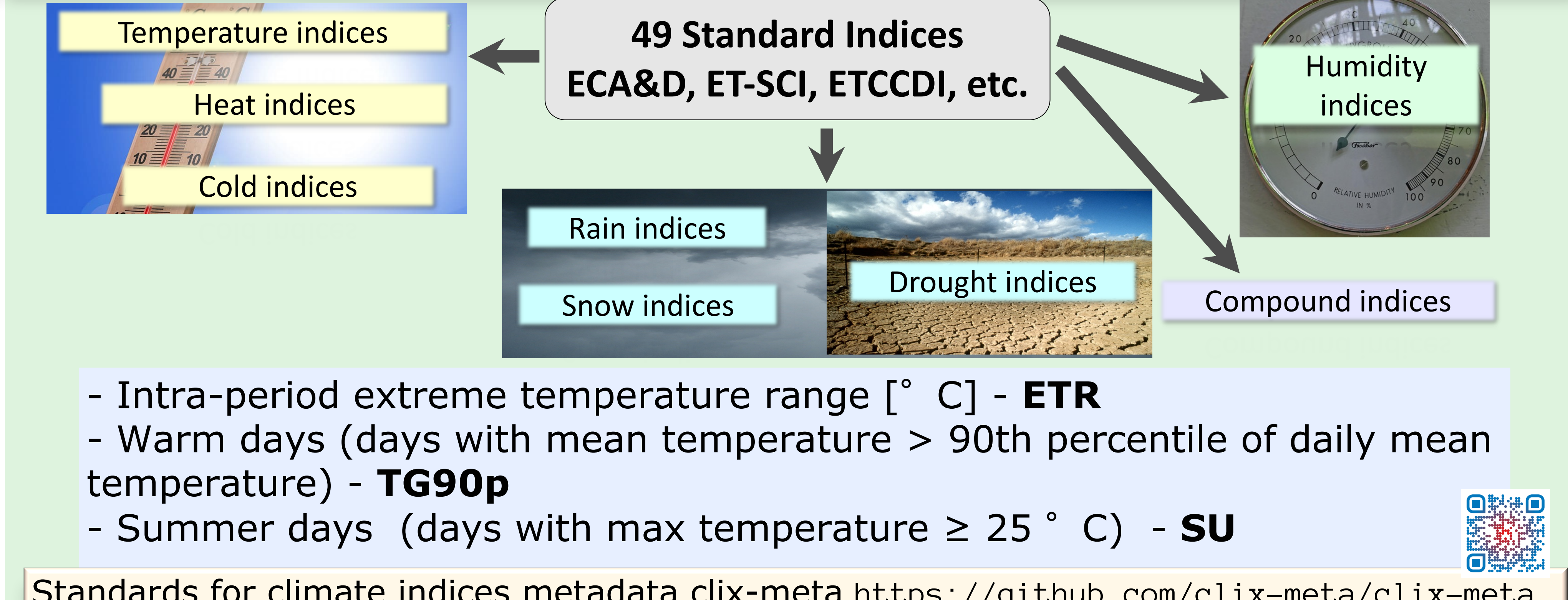
- ▶ Python code developed@CERFACS since 2013
- ▶ Performance optimized (xarray, dask)
- ▶ Fully compliant to CF and Metadata Standards
- ▶ Validated against climact & xclim
- ▶ Easy install: `pip install icclim`
- ▶ Implement the proper percentile indices calculations when calculation period overlaps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

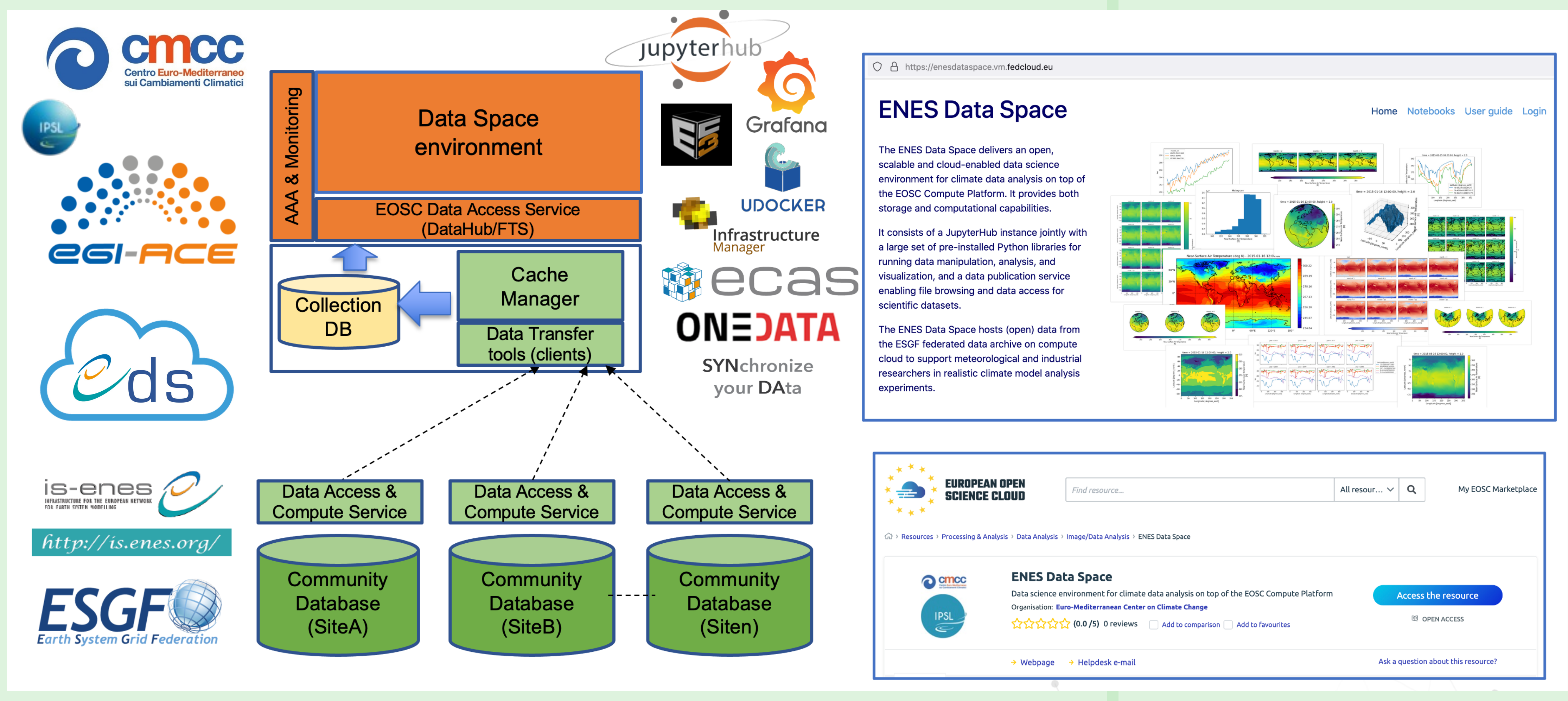


Standards for climate indices metadata clix-meta <https://github.com/clix-meta/clix-meta>

```
>>> files = ['tasmax_day_CNRM-CM5_historical_r11p1_19950101-19991231.nc', 'tasmax_day_CNRM-CM5_historical_r11p1_20000101-20041231.nc', 'tasmax_day_CNRM-CM5_historical_r11p1_20050101-20051231.nc']
>>> dt1 = datetime.datetime(1998,1,1)
>>> dt2 = datetime.datetime(2005,12,31)
>>> out_f = 'SU_JJA_CNRM-CM5_historical_r11p1_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
- Save/Share Progress to Git
- Reduced Data MyBinder Reproduce
- Trace Changes to Restore, Recover Software and/or Data



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, ...
- Special thanks to the EGI-ACE and CMCC support!