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

# icclim: Calculating Climate Indices and Indicators Made Easy

*Christian Pagé & Abel Aoun (CERFACS, France), Alessandro Spinuso (KNMI, Netherlands)*

*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.fr (CERFACS)* *alessandro.spinuso@knmi.nl (KNMI)*

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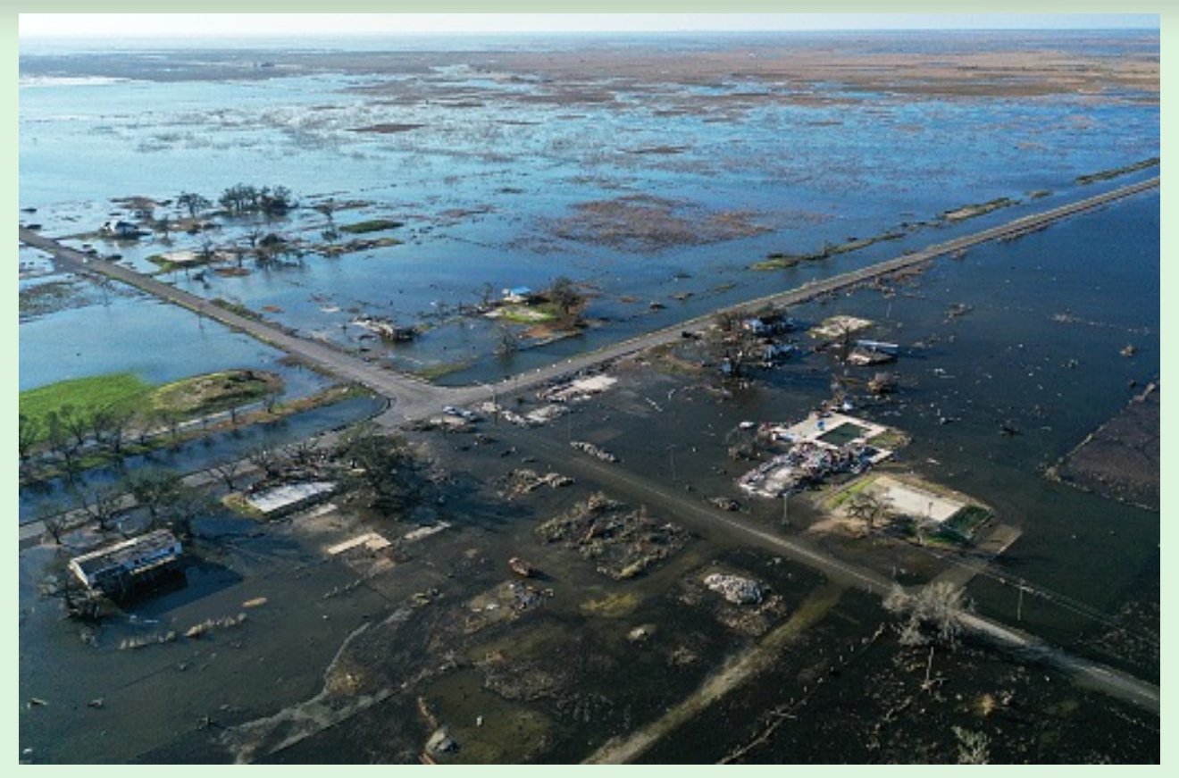
PDF POSTER

## 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
- Multiple domains: infrastructures, urban, agriculture, transportation, etc.
- Easy to use tools are needed for very diverse users
- **Climate indices and indicators are widely needed**

## II icclim: Climate Indices

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

Look at all of this data! Tons of it!
Yes, but what does it all mean? Too much of a good thing isn't always a good thing. Data without meaning... is just data.
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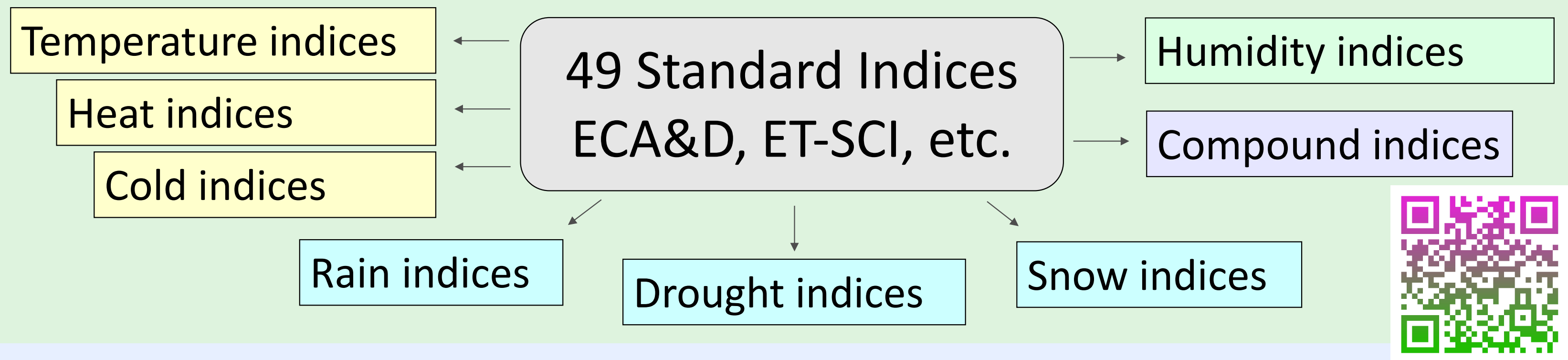
## III icclim: 49 Standard Indices



READTHEDOCS

- 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**
- ...

Example: index **SU**

```
>>> 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.index(index_name='SU', in_files=files, var_name='tasmax', time_range=[dt1, dt2], slice_mode='JJA', out_file=out_f)
```

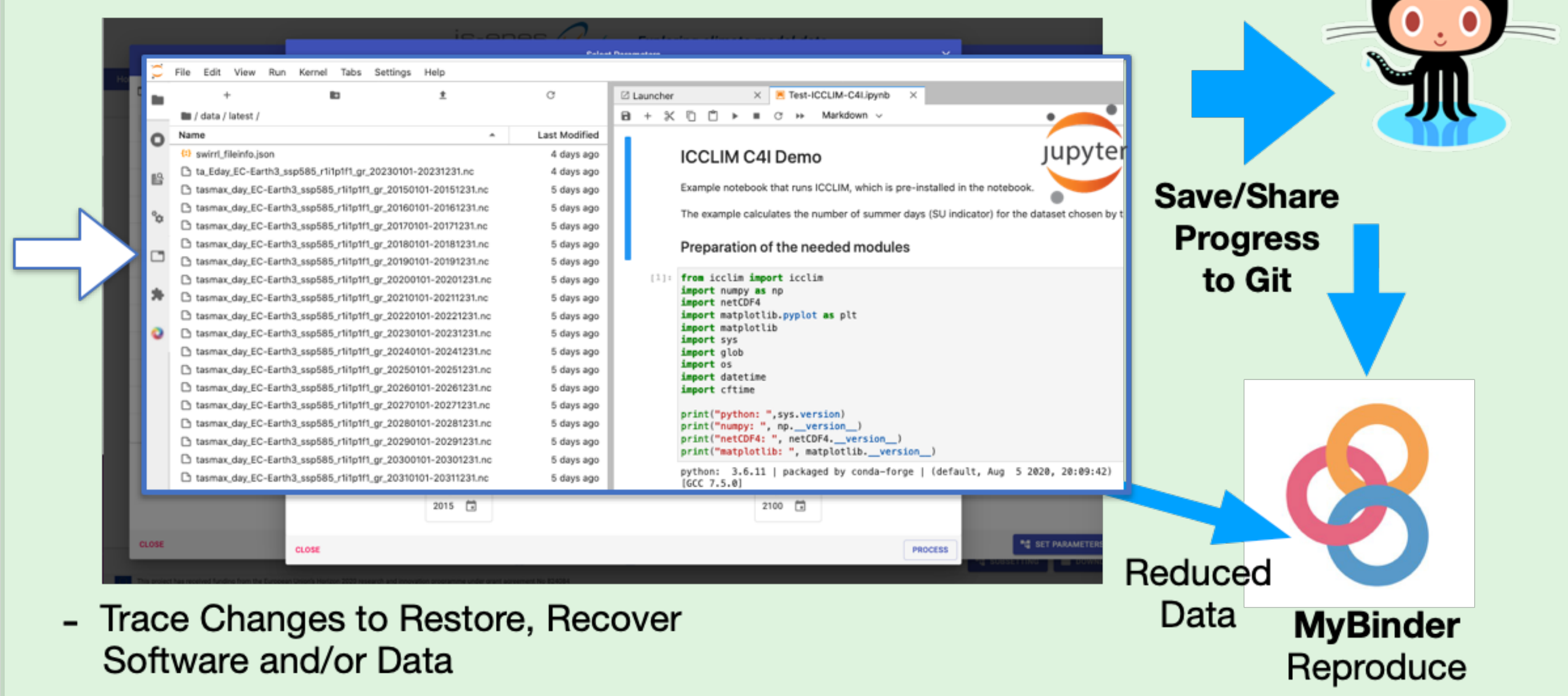
## Take Home 🏠 Messages ☑

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. **Provenance & Lineage is very important for reproducibility**
4. **Standards are essential for sharing results**

## IV climate4impact (C4I)

- Flexible analysis features (Notebooks with **icclim** - Data Staging/Reduction Workflows)
- Automated reproducibility mechanisms and documentation (Data/Analysis)

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



/ data / latest /

| Name | Last Modified |
|---|---|
| swirrl_fileinfo.json | 4 days ago |
| ta_Eday_EC-Earth3_ssp585_r1i1p1f1_gr_20230101-20231231.nc | 4 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20150101-20151231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20160101-20161231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20170101-20171231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20180101-20181231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20190101-20191231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20200101-20201231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20210101-20211231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20220101-20221231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20230101-20231231.nc | 5 days ago |
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| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20280101-20281231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20290101-20291231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20300101-20301231.nc | 5 days ago |
| tasmax_day_EC-Earth3_ssp585_r1i1p1f1_gr_20310101-20311231.nc | 5 days ago |

ICCLIM C4I Demo

Example notebook that runs ICCLIM, which is pre-installed in the notebook.

The example calculates the number of summer days (SU indicator) for the dataset chosen by t

Preparation of the needed modules

```
[1]: 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]
```

2015 2100

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

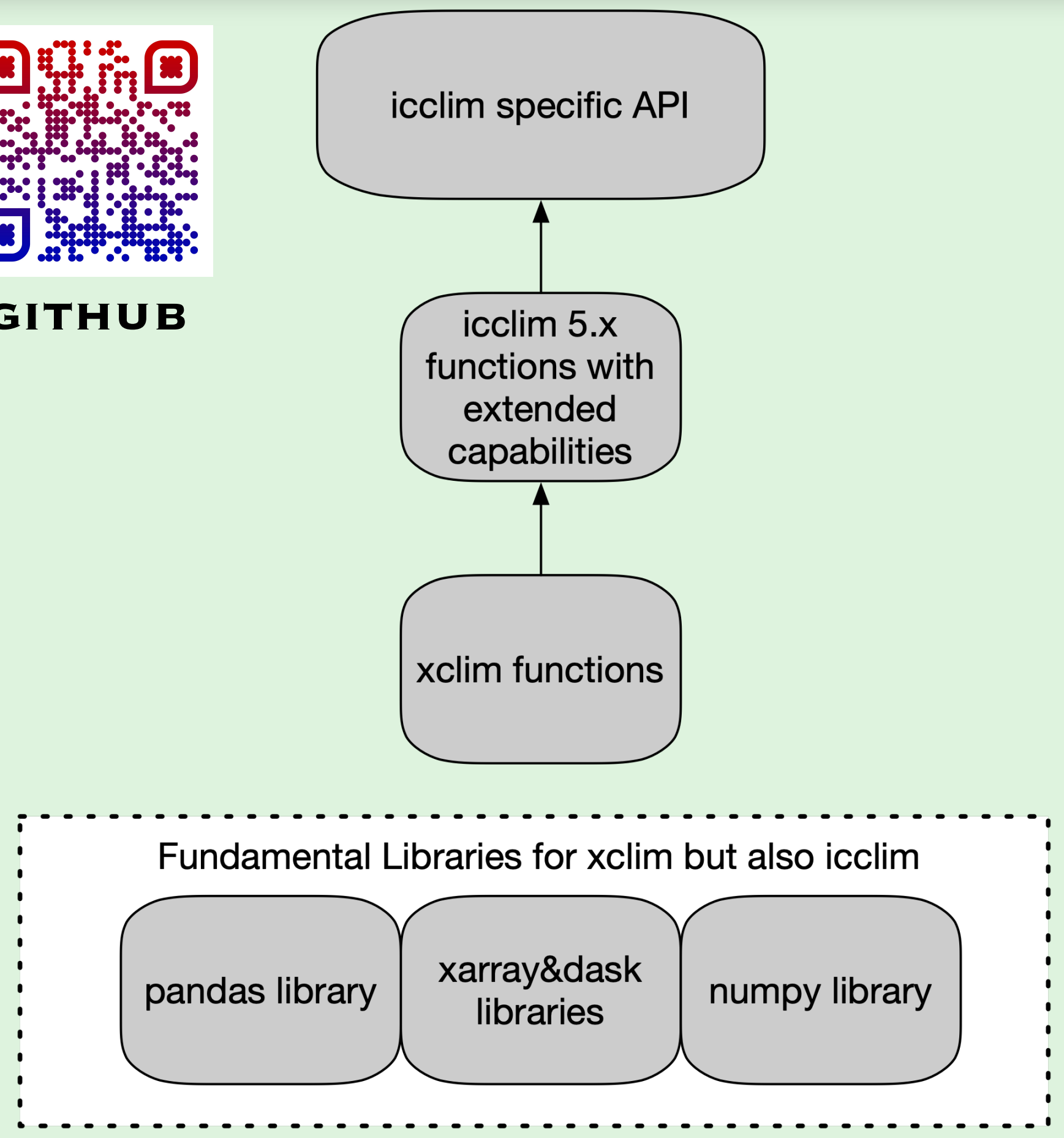
W3C PROV

*https://dev.climate4impact.eu*

## V icclim: Code Architecture

- Using xclim climate indices functions as building blocks
- xclim functions are using xarray, dask, pandas and numpy: optimized and parallel execution
- icclim v5 implements a specific API very similar to v4
- Extended capabilities: user-defined indices, user-specific thresholds, etc.

GITHUB

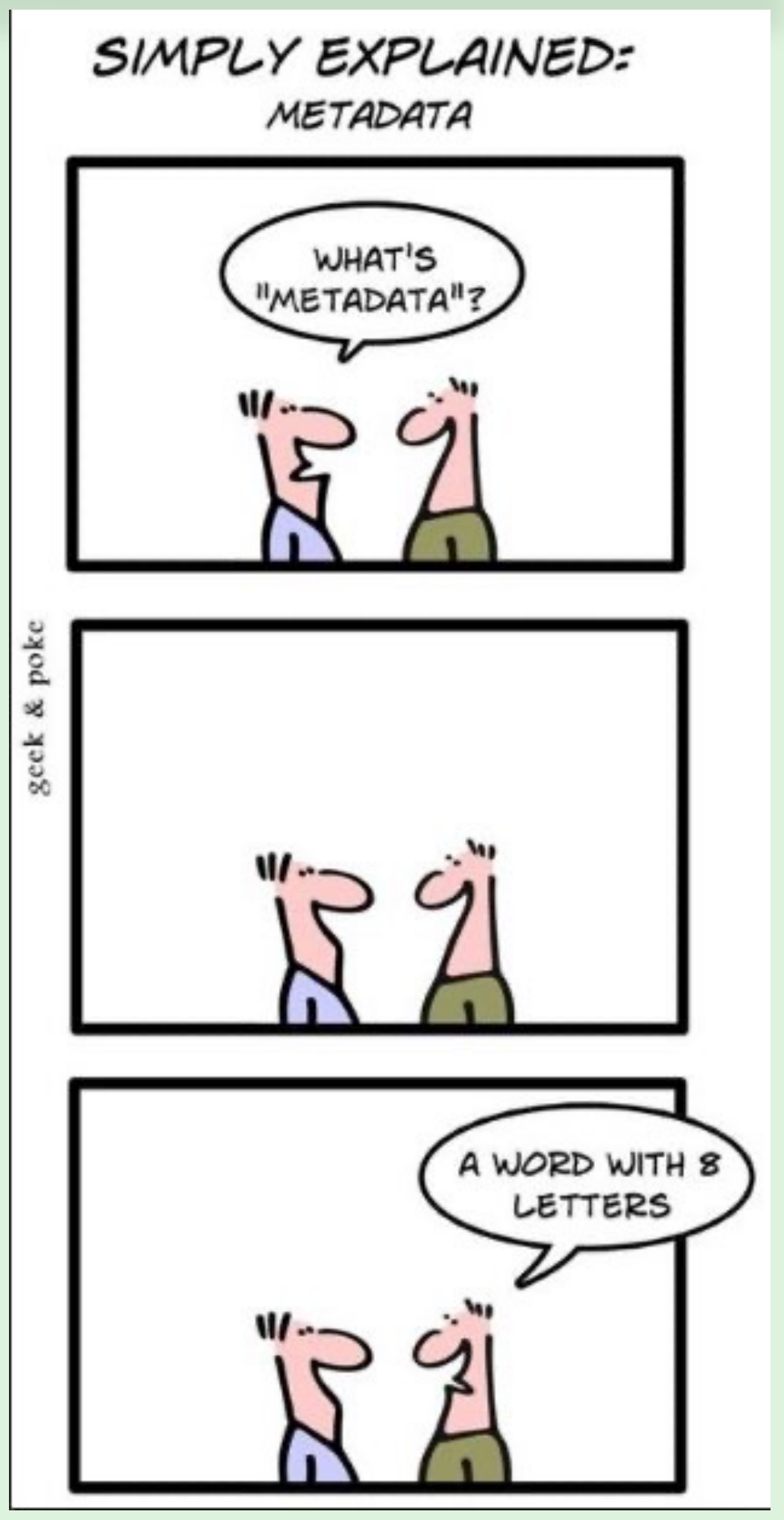

icclim specific API
icclim 5.x functions with extended capabilities
xclim functions
Fundamental Libraries for xclim but also icclim
pandas library
xarray&dask libraries
numpy library

## VI Work Plan

- Fix remaining issues in 5.0.0rc2 in order to release 5.0.0, expected on 31 Jan 2022
- Will be integrated in the Copernicus CDS toolbox early 2022
- Implement full support of provenance information (PROV-O)
- Finalize standards for climate indices clix-meta
  `https://github.com/clix-meta/clix-meta`
- Release support tools: testing suite
- Provide more Jupyter Notebooks to include in C4I
  `https://gitlab.com/is-enes-cdi-c4i/notebooks`

CLIX-META

JUPYTER NOTEBOOKS



IS-ENES: https://is.enes.org/ icclim 5.0.0rc2: https://github.com/cerfacs-globc/icclim (`pip install icclim`) climate4impact 2.0 beta: https://dev.climate4impact.eu/

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`https://rebrand.ly/icclimposter`