

Back from

GeoPython 2023

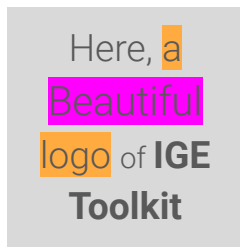
Basel Switzerland

March 06-08



Jean Baptiste Barré

IGE Toolkit - 12/04/2023



IGE Toolkit

A self-organized group of **researchers**, scientists, and engineers within **IGE** who engage in sharing the latest and most effective **techniques** and **methodologies** for conducting their scientific research.



<https://github.com/IGE-numerique/IGE-Toolkit>



<https://ige-toolkit.slack.com>



ige-numerique@univ-grenoble-alpes.fr



Python and Geospatial
applications, its toolkits and
applications.

GIS/Mapping

Geography / Geophysics / Geodesy / Geomatics

Earth Sciences / Environmental Sciences

Geovisualization

Smart Cities

Spatial Data / Geodata

Geospatial Webservices

Big Data

Data Processing

(Spatial) Databases

Computer Vision

Remote Sensing

Image Processing

Machine Learning / Deep Learning

Mobile Mapping

Indoor Mapping and Modelling

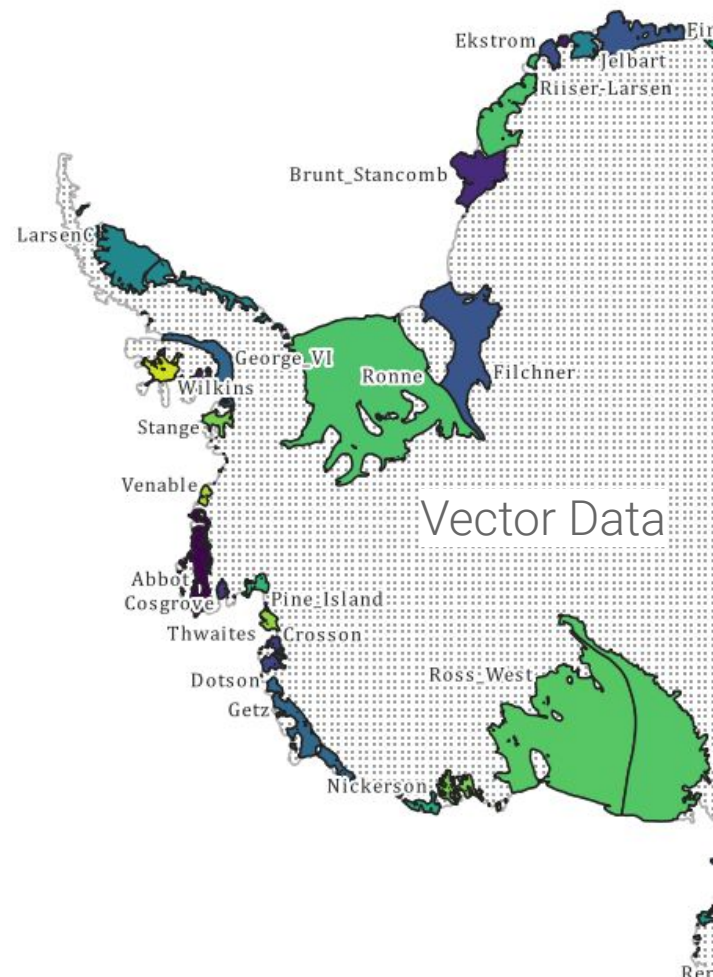
Raster Data

Satellite imagery included

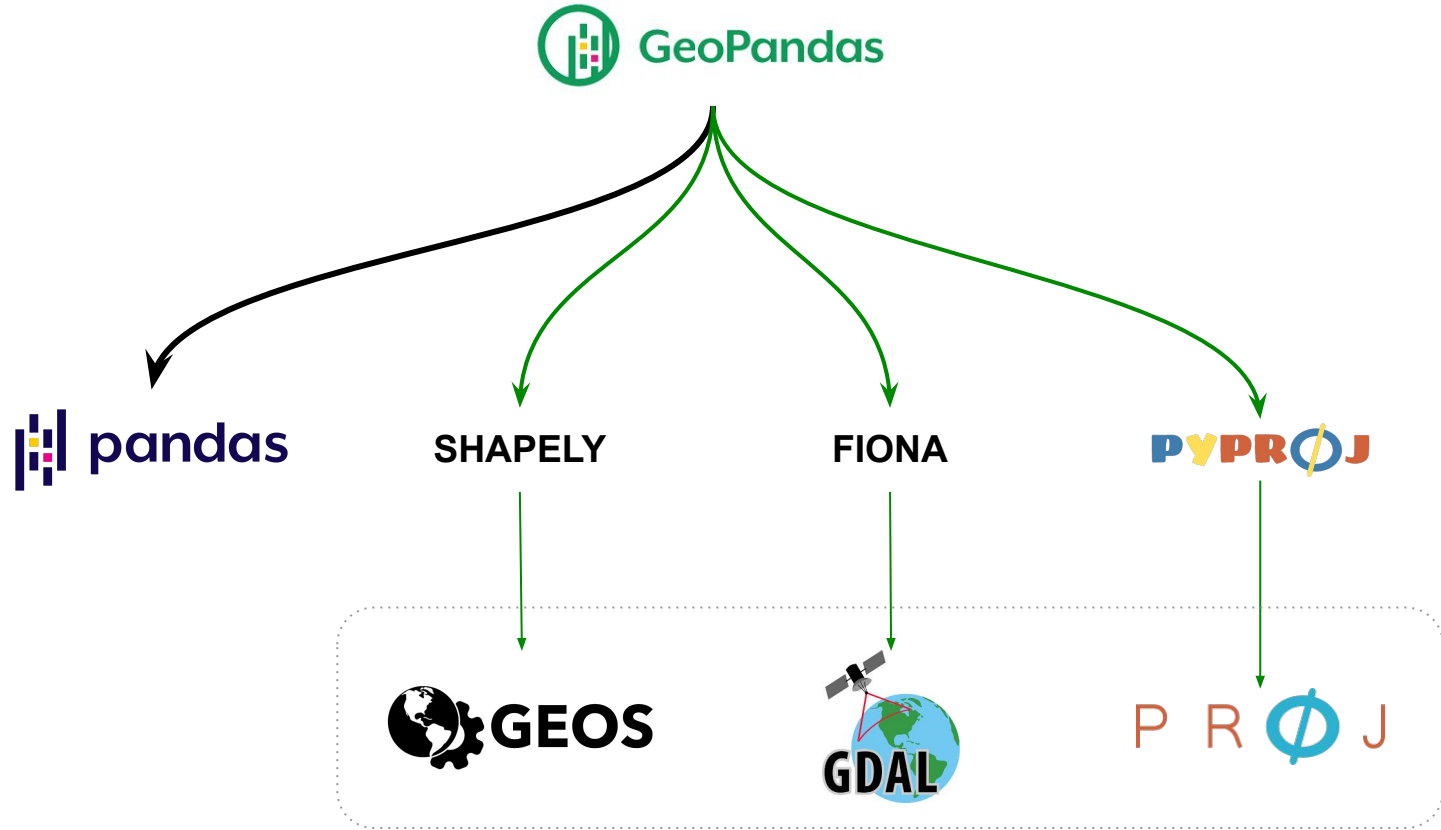


GeoSpatial Data

Point Cloud Data



Geospatial computing with Python



Not python specific !

Geospatial computing with Python



```
[1]: import geopandas
```

```
path_to_data = geopandas.datasets.get_path("nybb")  
gdf = geopandas.read_file(path_to_data)  
  
gdf
```

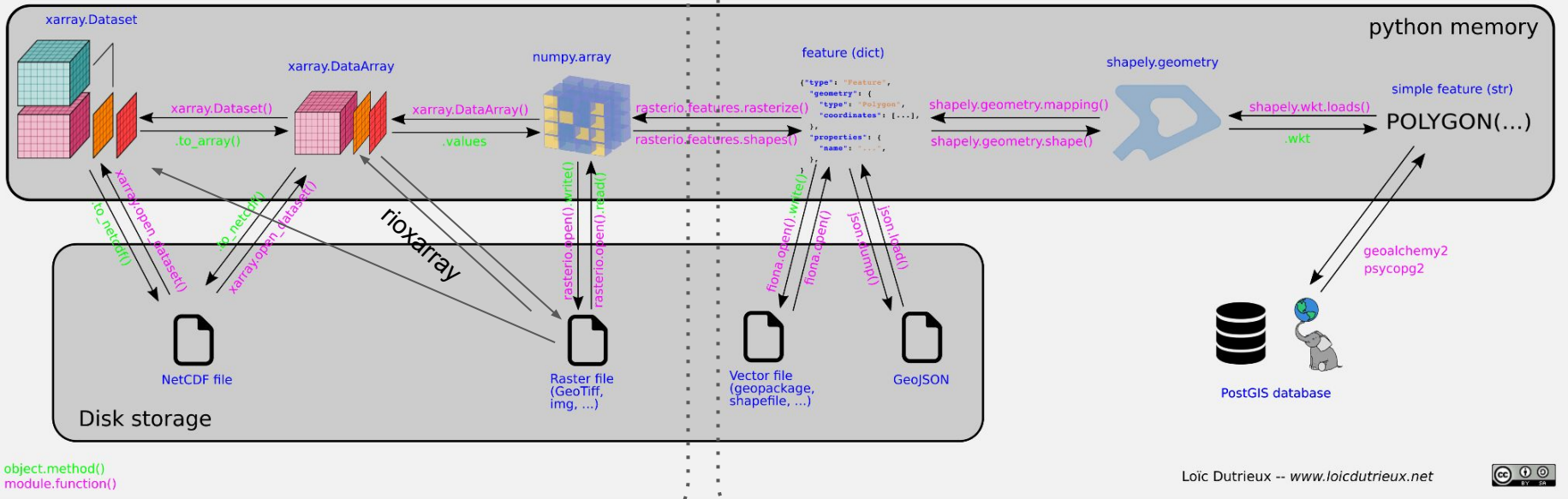
```
[1]:
```

	BoroCode	BoroName	Shape_Leng	Shape_Area	geometry
0	5	Staten Island	330470.010332	1.623820e+09	MULTIPOLYGON (((970217.022 145643.332, 970227....
1	4	Queens	896344.047763	3.045213e+09	MULTIPOLYGON (((1029606.077 156073.814, 102957...
2	3	Brooklyn	741080.523166	1.937479e+09	MULTIPOLYGON (((1021176.479 151374.797, 102100...
3	1	Manhattan	359299.096471	6.364715e+08	MULTIPOLYGON (((981219.056 188655.316, 980940....
4	2	Bronx	464392.991824	1.186925e+09	MULTIPOLYGON (((1012821.806 229228.265, 101278...

Geospatial computing with Python



The python geospatial ecosystem



Loïc Dutrieux -- www.loicdutrieux.net

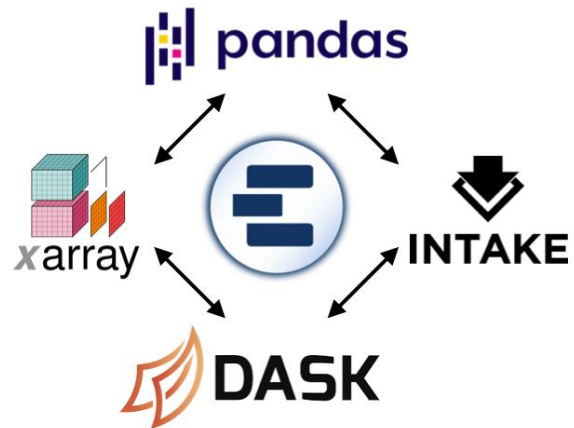


Raster data

Where **raster data cubes** refer to data cubes with raster (x- and y-, or lon- and lat-) dimensions,

Vector data

vector data cubes are n-D arrays that have (at least) a single spatial dimension that maps to a set of (2-D) vector geometries. [Edzer Pebesma](#)



PANGEO to know more about this key stack.

<https://gallery.pangeo.io/repos/pangeo-data/pangeo-tutorial-gallery/index.html>

Shapely 2.0.1

Perform operations with vector data and python.

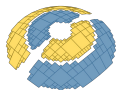
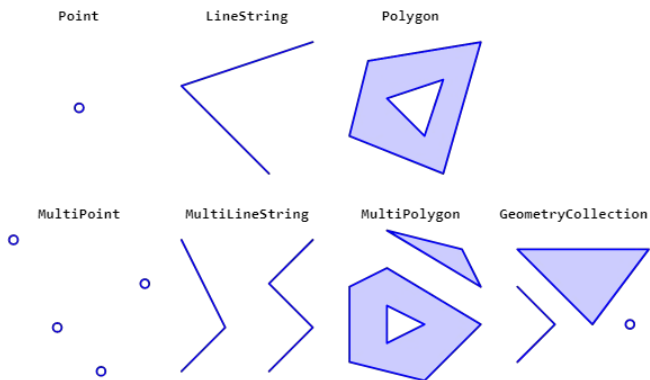


GEOS: C/C++ library for computational geometry with a focus on algorithms used in geographic information systems (GIS). GEOS is a core dependency of PostGIS, QGIS, GDAL, and Shapely.

Perform PostGIS type geometry operations outside of an RDBMS.

Planar geometries only.

Last version implements vectorization to improve performances.



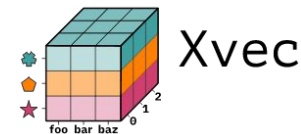
Spherely

The upcoming solution for spherical geometry.

Xvec: Vector data cubes for Xarray

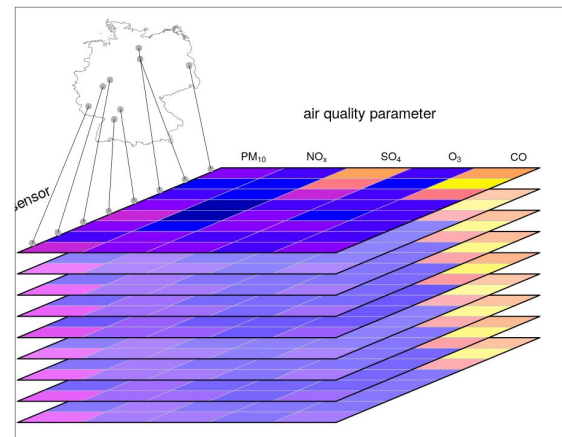
Martin Fleischmann

(Early stage of development)



Xarray, Shapely 2.0 and GeoPandas under the hood.

Selecting and indexing data based on labels as well as geometries,
spatial queries or nearest geometries.



<https://r-spatial.github.io/stars/>

Joblib or Pickle to save your data cube

```
import pickle
import joblib

import geopandas as gpd
import xarray as xr
import xvec

[...]

with open("cube.pickle", "wb") as f:
    pickle.dump(cube, f)

with open("cube.joblib.compressed", "wb") as f:
    joblib.dump(cube, f, compress=True)
```

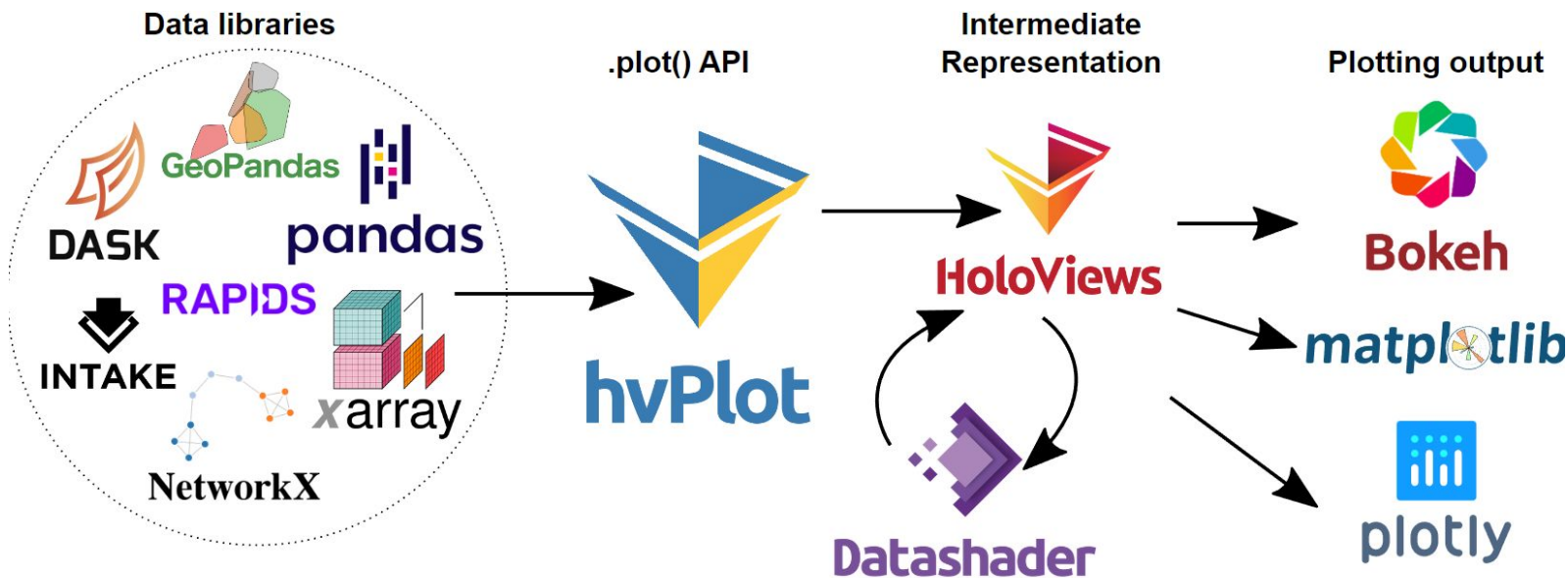
`pickle` may be significantly faster, especially on large collections of native Python objects.

`joblib` (pure Python) if you data contains mostly numpy array.



HoloViz

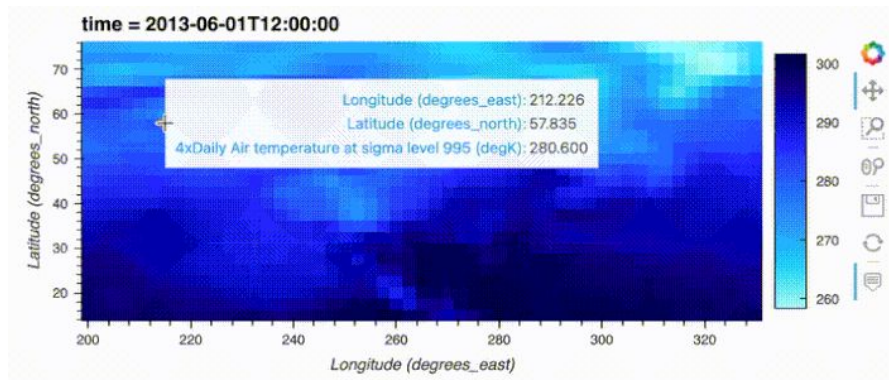
High-level tools to simplify visualization in Python





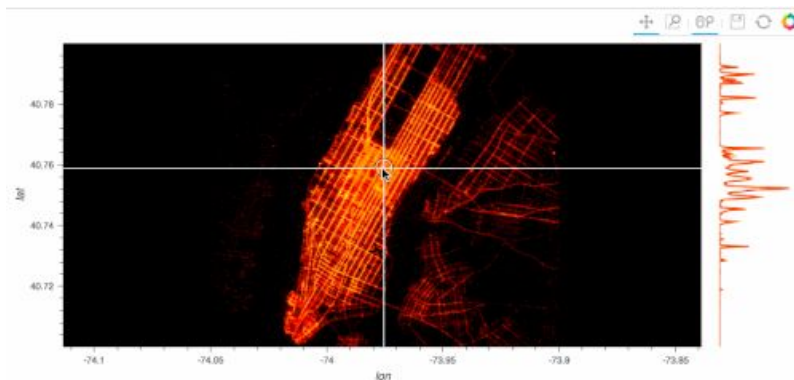
```
import hvplot.xarray
import xarray as xr
```

```
xr_ds =
xr.tutorial.open_dataset('air_temperature').load().sel(time='2013-06-
01 12:00')
xr_ds.hvplot()
```



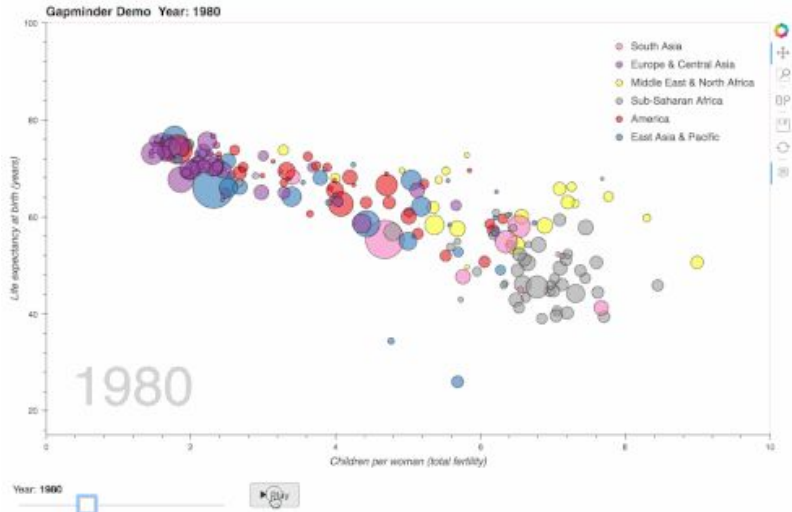
Datashader

Display millions of points in your notebook.

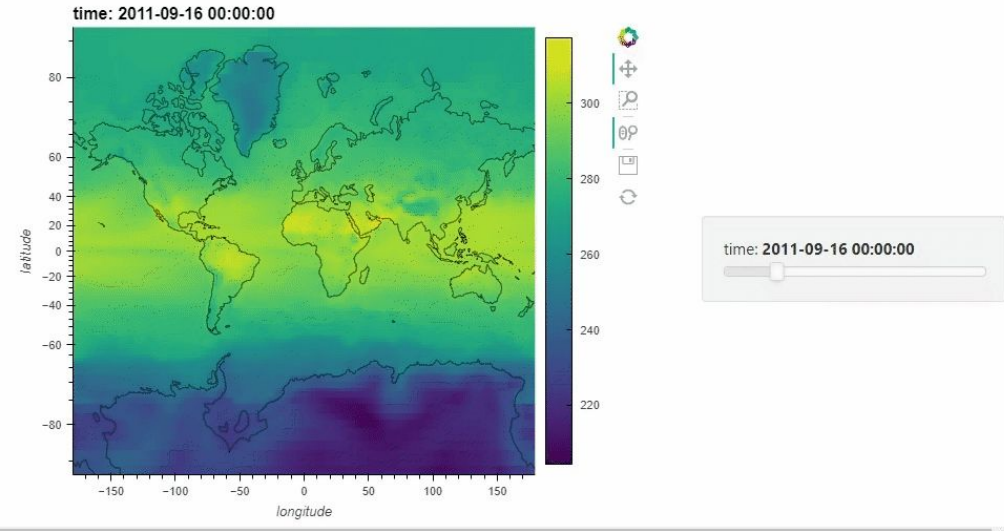




Interactive Data Visualization



Interactive Geospatial Data Visualization



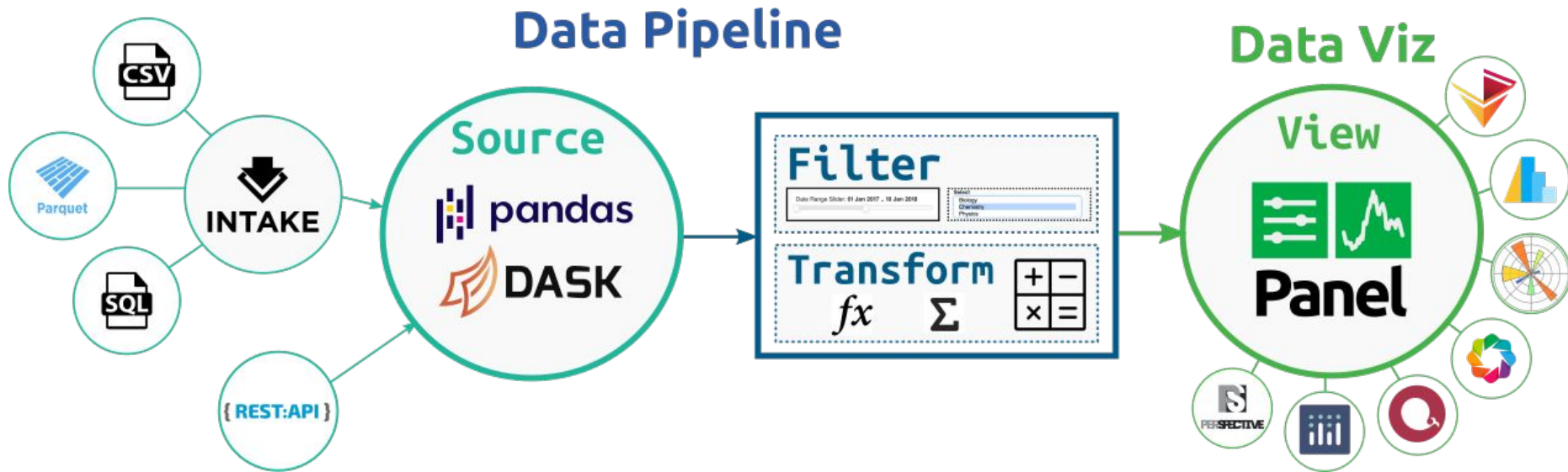


Sophia Yang
<https://sophiamyang.medium.com/>



https://sophiamyang.github.io/hvplot_interactive/hvplot_interactive.html

Panel

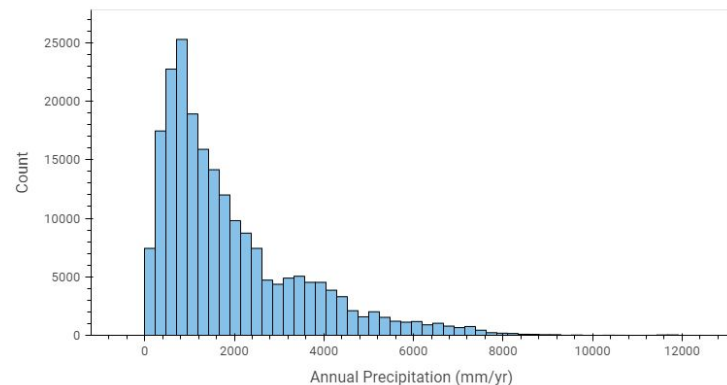
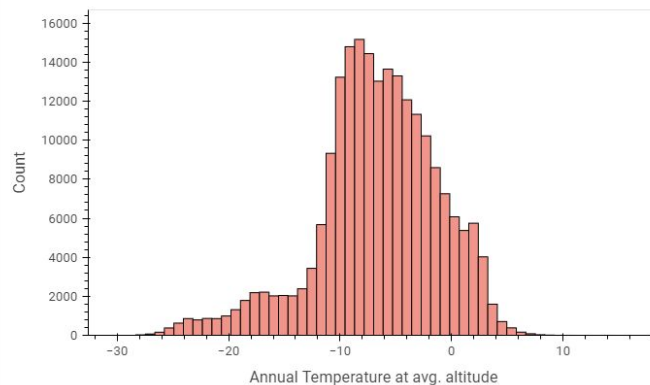
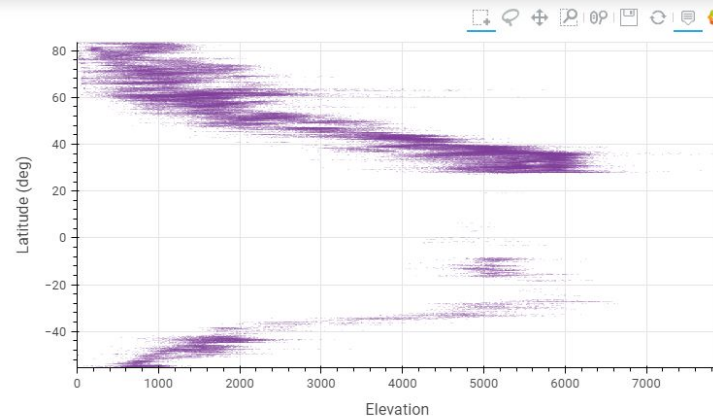
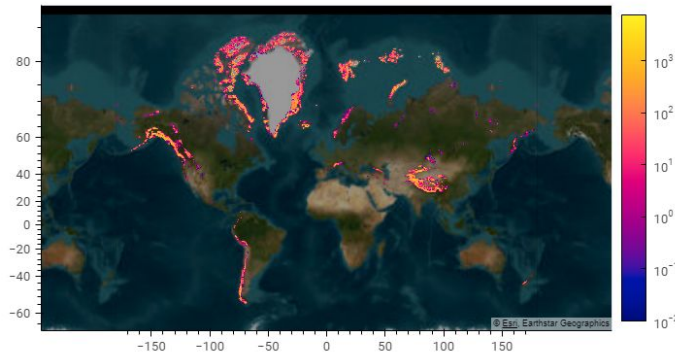




Box-select on each plot to subselect; clear selection to reset.
See the [Jupyter notebook](#) source code for how to build apps like this!



Panel



Geometric and spectral fusion of multi-sensor, multi-spectral satellite images

Daniel Scheffler

German Research Centre for Geosciences Potsdam



Open-Source Image
Co-Registration Software for
Multi-Sensor Satellite Data

SpecHomo

Spectral **homogenization**
of multispectral satellite
data

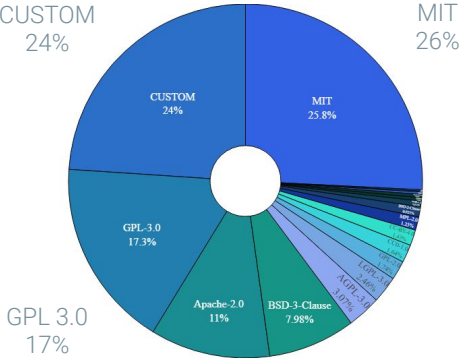


Open Source in Environmental Sustainability

Tobias Augspurger

This study provides the first analysis of the open source software ecosystem in the field of sustainability and climate technology. <https://report.opensustain.tech/chapters/topics.html>

Licence



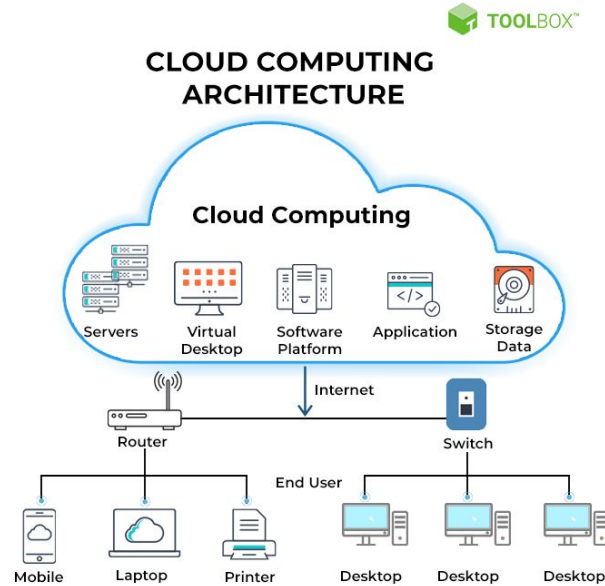
Datasets

Dimension	Value
Total number of projects	1339
GitHub projects	1187
GitLab projects	27
Other platforms	125



Code-Centric Infrastructure as Code (IaC) using Pulumi with Python

handling Cloud Infrastructure through code



Tips and tricks




Don't

conda install geopandas

but, do

mamba install geopandas



Don't save vector data using shapefile format  (switchfromshapefile.org).
Use Geopackage as an alternative.

Workshop

Discover the GeoPython ecosystem: <https://github.com/martinchristen/geopython2023>

Writing efficient code for GeoPandas and Shapely in 2023: <https://github.com/martinfleis/efficient-geopandas-workshop>



OPEN CODE = BETTER SCIENCE

A Decade of Supporting Open Science
U.S. based non profit corporation.

\$23M of budget (2022) to support the **development of open source tools** such as Numpy, Matplotlib, xarray, dask, conda, zarr, scikit-image, Gdal, pandas,..... (55 sponsored projects in total)

Thank you!

