Fluiddyn project: open-source collaborative Python software for fluid dynamics

Community-driven software for fluid dynamics?

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LEGI
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UGA
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- Open-source Python software for research and teaching in fluid dynamics
- In practice, for my research
  - Geophysical turbulence
  - Lab experiments and numerical simulations
- ~ 10 years of development !

Few packages based on the scientific Python ecosystem

Fluidlab Fluidimage Fluidsim

Fluiddyn Transonic Fluidfft

Formattex
Formatbibtex
Fluidfoam

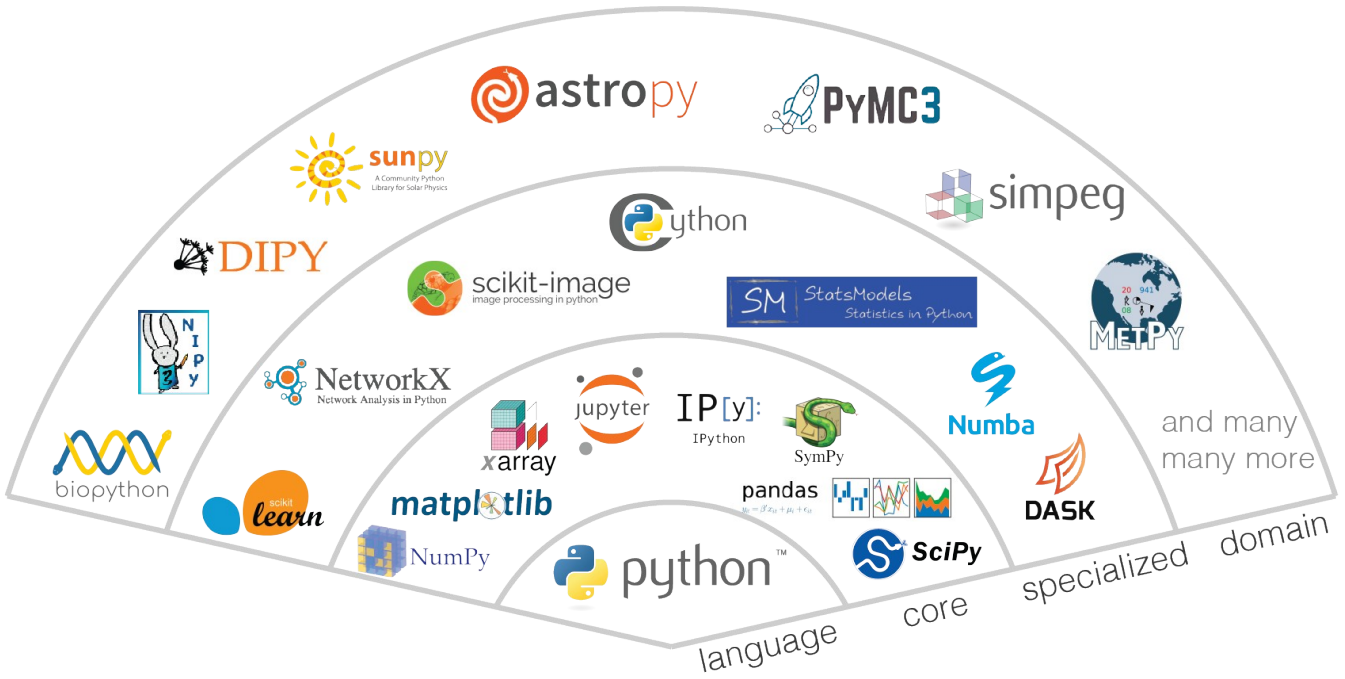
Matplotlib H5py Pandas Scipy

Numpy Pythran

Ipython
Jupyter
mpi4py
OpenCV
Qt
PyVista/VTK
Textual

Python success in 10 years

- First language for several indices (TIOBE, …)
- Basis known by all students



AI & deep learning
- Scikit-learn
- Tensorflow
-
- Pytorch

Supported/used by
- Microsoft
- Google
- Facebook

And in 10 years ?

Fluiddyn: good quality software

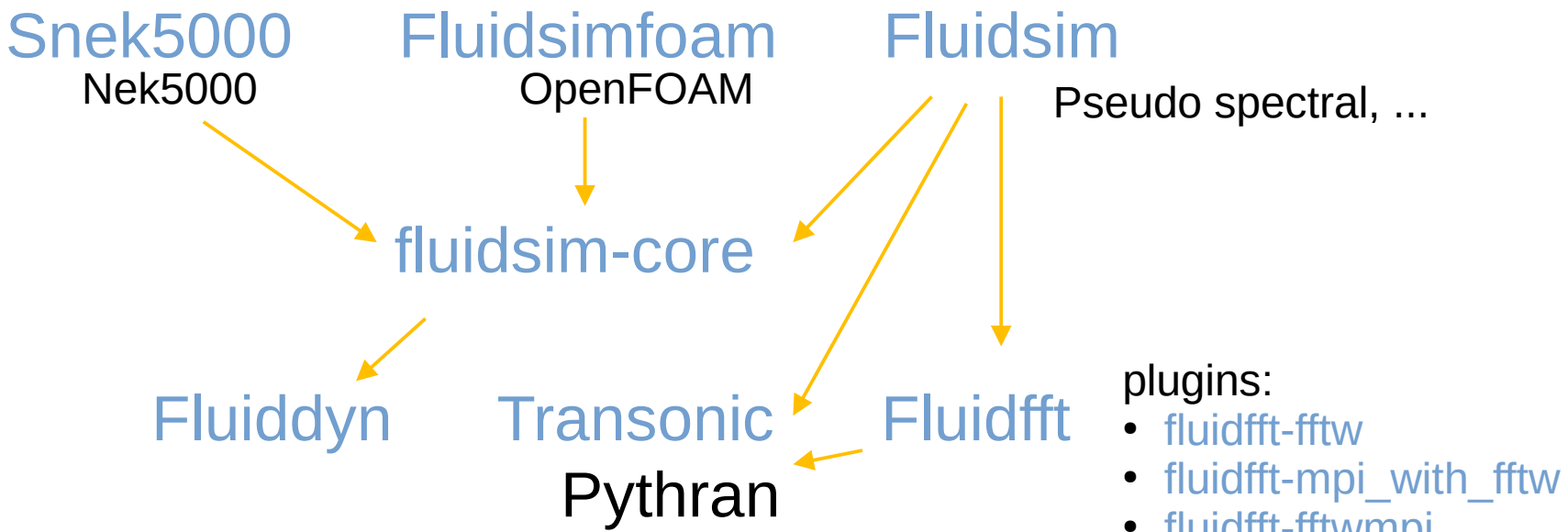
- Documented
  - https://fluiddyn.readthedocs.io
  - https://fluidhowto.readthedocs.io
- Versioned: Mercurial (easier/better than Git)
- Hosted on https://foss.heptapod.net/fluiddyn/ (like Gitlab)
  - Issue tracker, …
- Tested (continuous integration)
- Simple installation (`pip install ...`)

Zoom on Transonic

- Python performance not good enough for HPC
- Need acceleration for some parts
- A lot of projects (Numba, Pythran, JAX, Pyccel, ...)
- Transonic helps us to accelerate Python-Numpy code with compilers (in particular Pythran)
- Nearly invisible for users!

Zoom on Fluidsim / Fluidfft

Our ecosystem for numerical simulations



plugins:

- fluidfft-fftw
- fluidfft-mpi_with_fftw
- fluidfft-fftwmpi
- fluidfft-p3dfft
- fluidfft-pfft
- ...

Zoom on Fluidsim / Fluidfft

Our ecosystem for numerical simulations

FluidSim

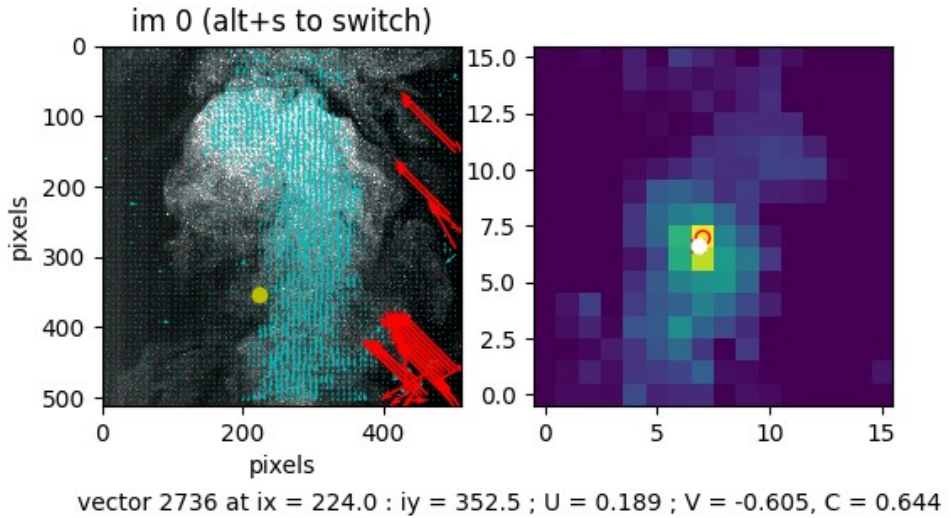
Split the workflow in steps:

1) Describe in Python sets of similar simulations (equations, methods, parameters…),
2) Launch/restart multiple simulations (scripts or commands)
3) Load simulations to read the associated parameters/data and produce figures/movies.

Zoom on Fluidimage

Processing of images of fluids (PIV, BOS, LIF, ...)

- Efficient (algorithms, parallel, …)
- Easy, desktops and clusters



Conclusions

- Fluiddyn packages
  - Good quality
  - Recent improvements, technical maturity
  - Research programs, easy enough for teaching
  - A framework
- Building a Fluiddyn community?
  - Community-driven software for fluid dynamics?
  - People agree with the project? Support? Invest?