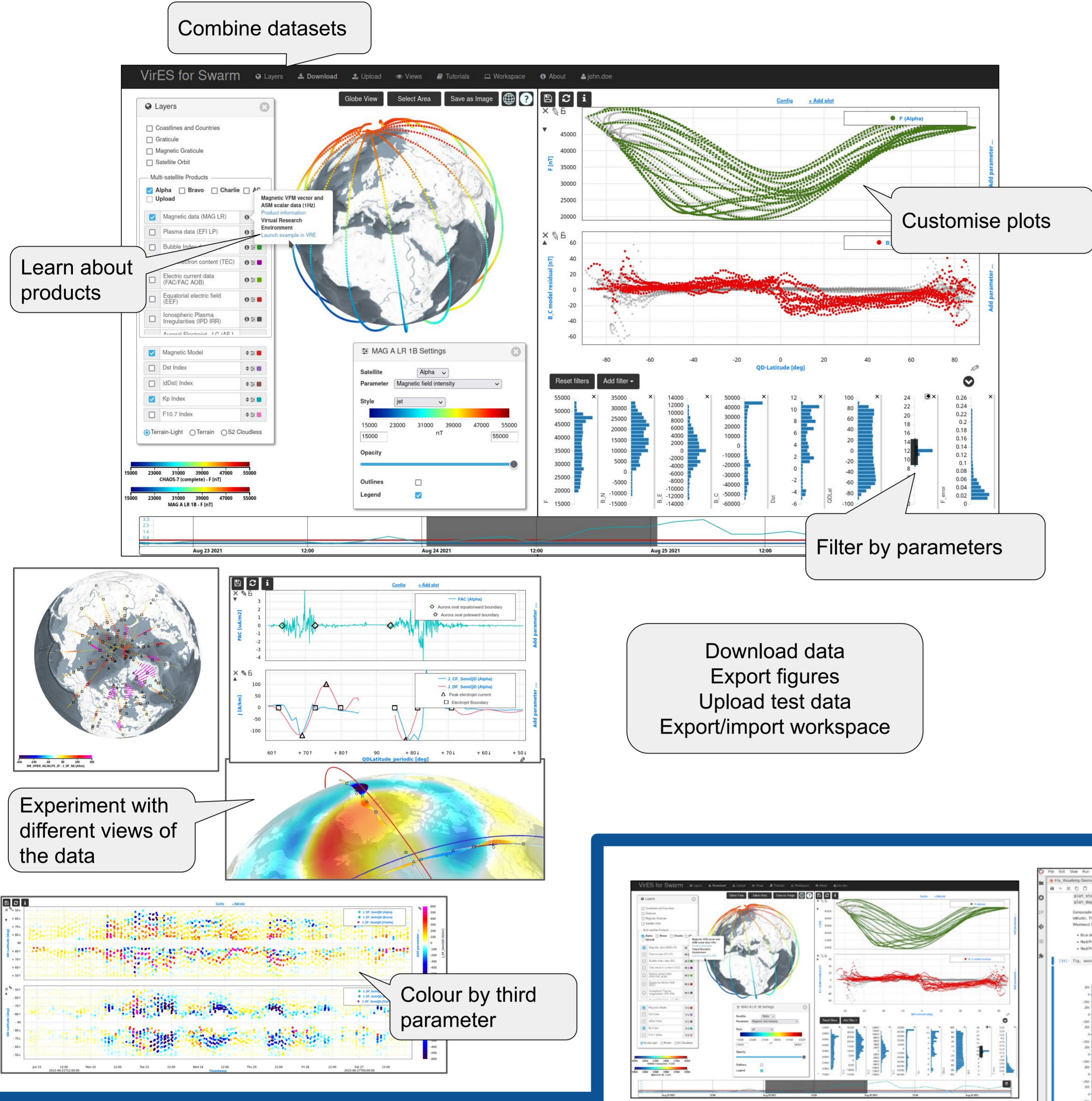


VirES for Swarm & Virtual Research Environment: Serving Swarm data, models, and tools

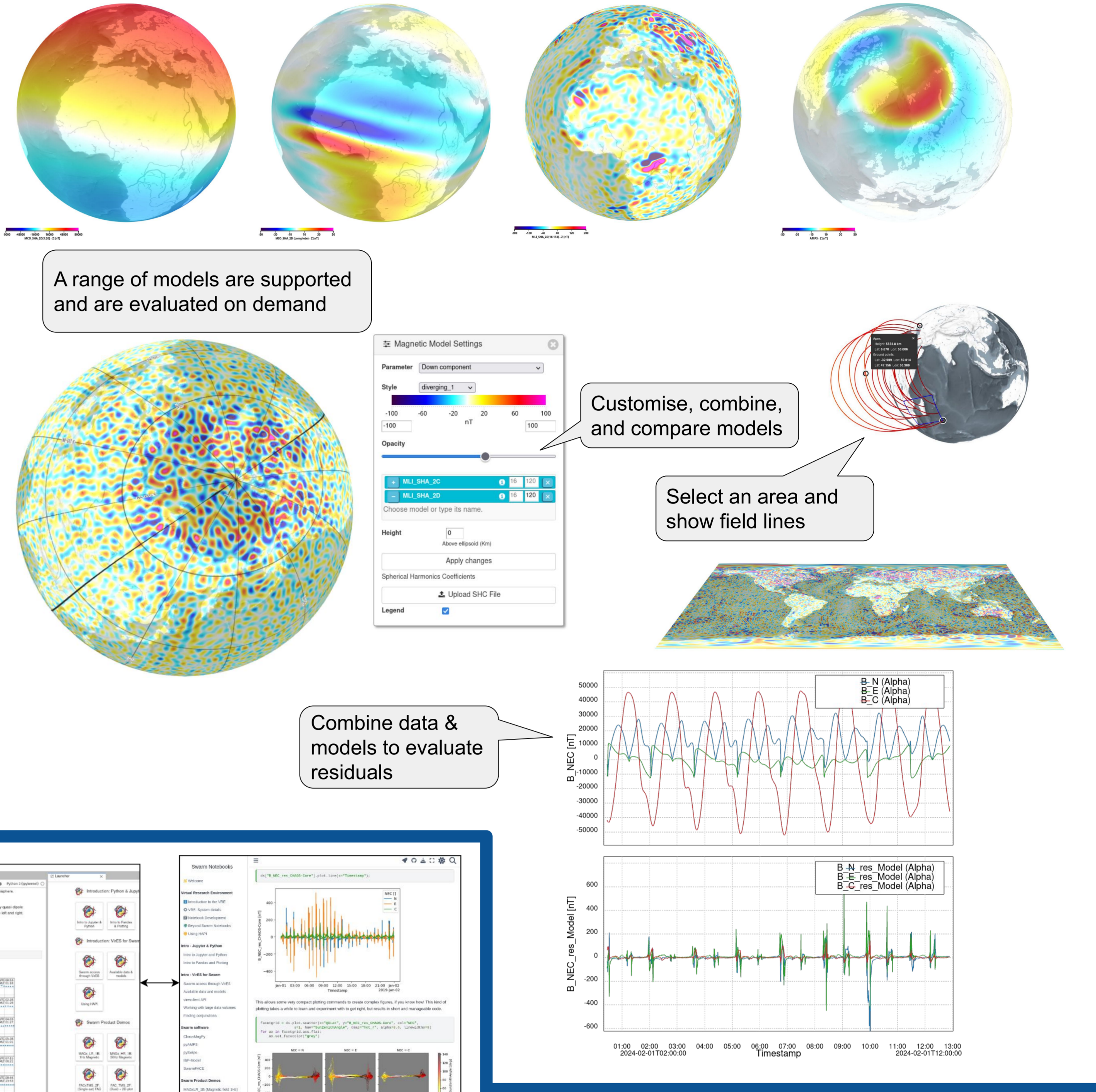
Martin Pačes (martin.paces@eox.at)¹, Daniel Santillan¹, Ashley Smith²
¹EOX IT Services GmbH, ²University of Edinburgh



Interactive data discovery with VirES



Geomagnetic models

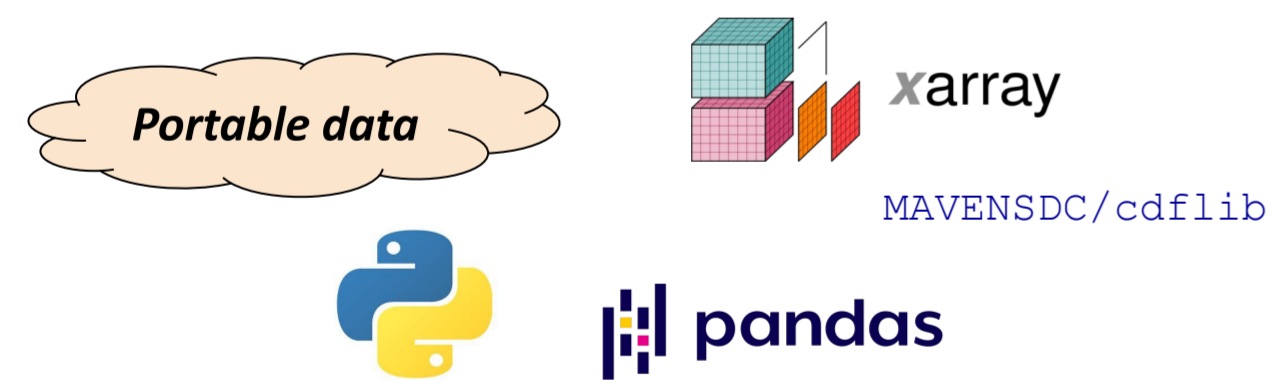


Server-client architecture

The VirES server is accessible through two types of API:

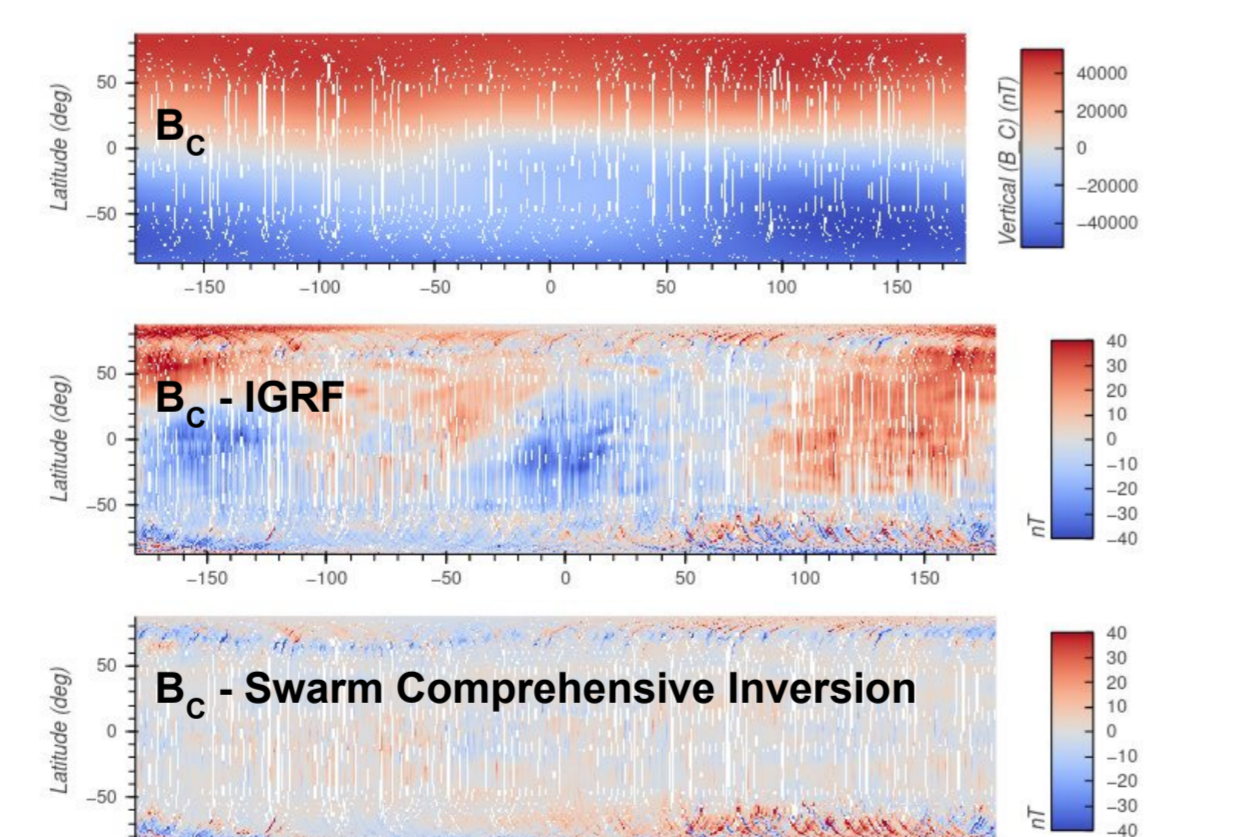
- VirES API has two clients available, web client & Python
 - Heliophysics API (HAPI) connects with heliophysics data environments
- <https://vires.services/hapi>
<https://hapi-server.org>

Accessible through Python
viresclient
github.com/ESA-VirES/VirES-Python-Client
hapiclient
github.com/hapi-server/client-python



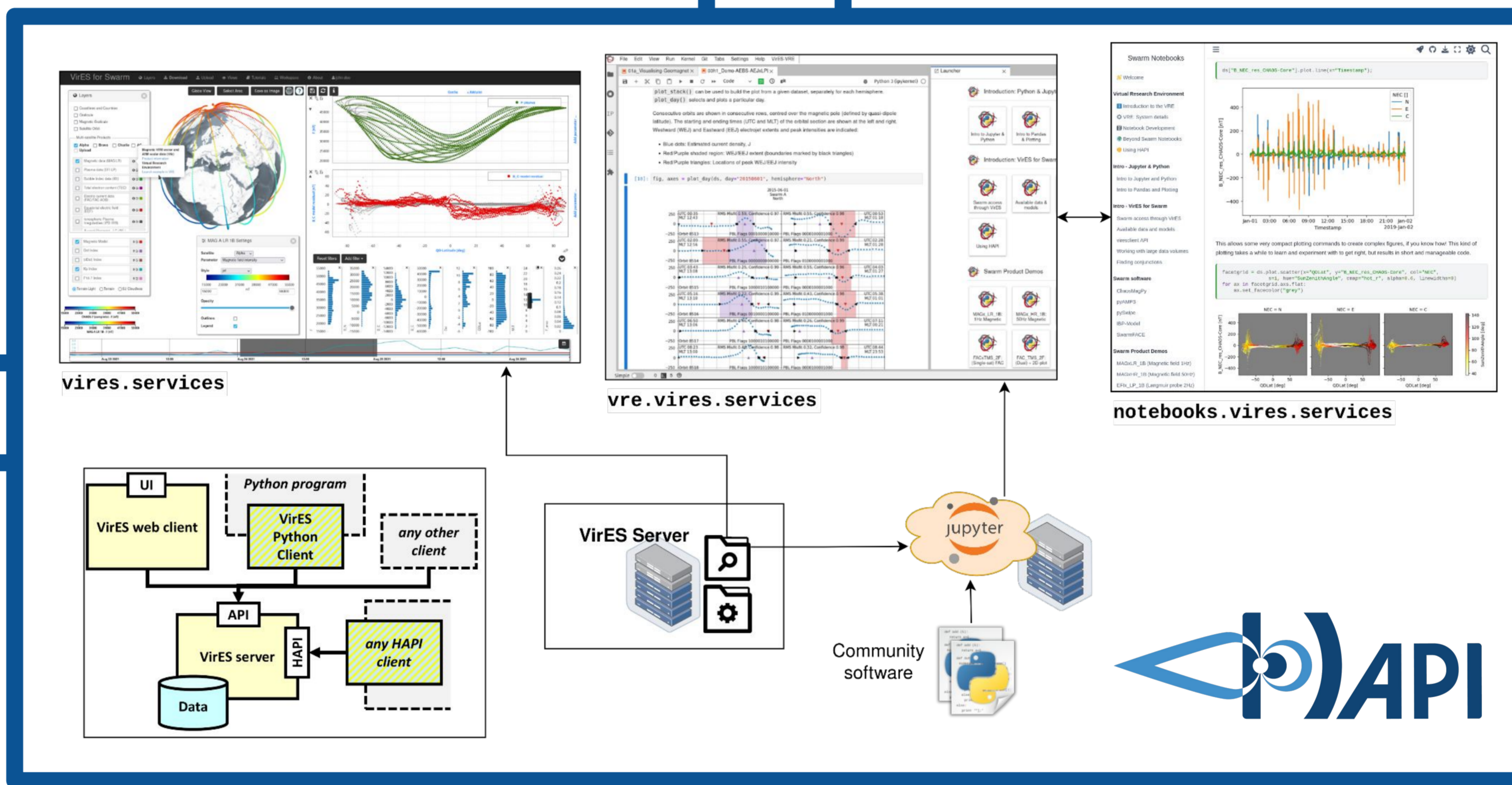
```
from viresclient import SwarmRequest
ds = (
    SwarmRequest()
    .set_collection("SW_OPER_MAGA_LR_1B")
    .set_products(
        measurements=["B_NEC"],
        sampling_step="PT10S",
        models=["IGRF", "SwarmCI"],
        residuals=True,
        auxillaries=["MLT", "QDLat"]
    )
    .set_range_filter("Kp", 0, 2)
    .get_between("2018-01-01", "2018-02-01")
    .as_xarray()
)
ds.hvplot.scatter(...)
```

viresclient
 Provides data/model access
<https://viresclient.readthedocs.io>



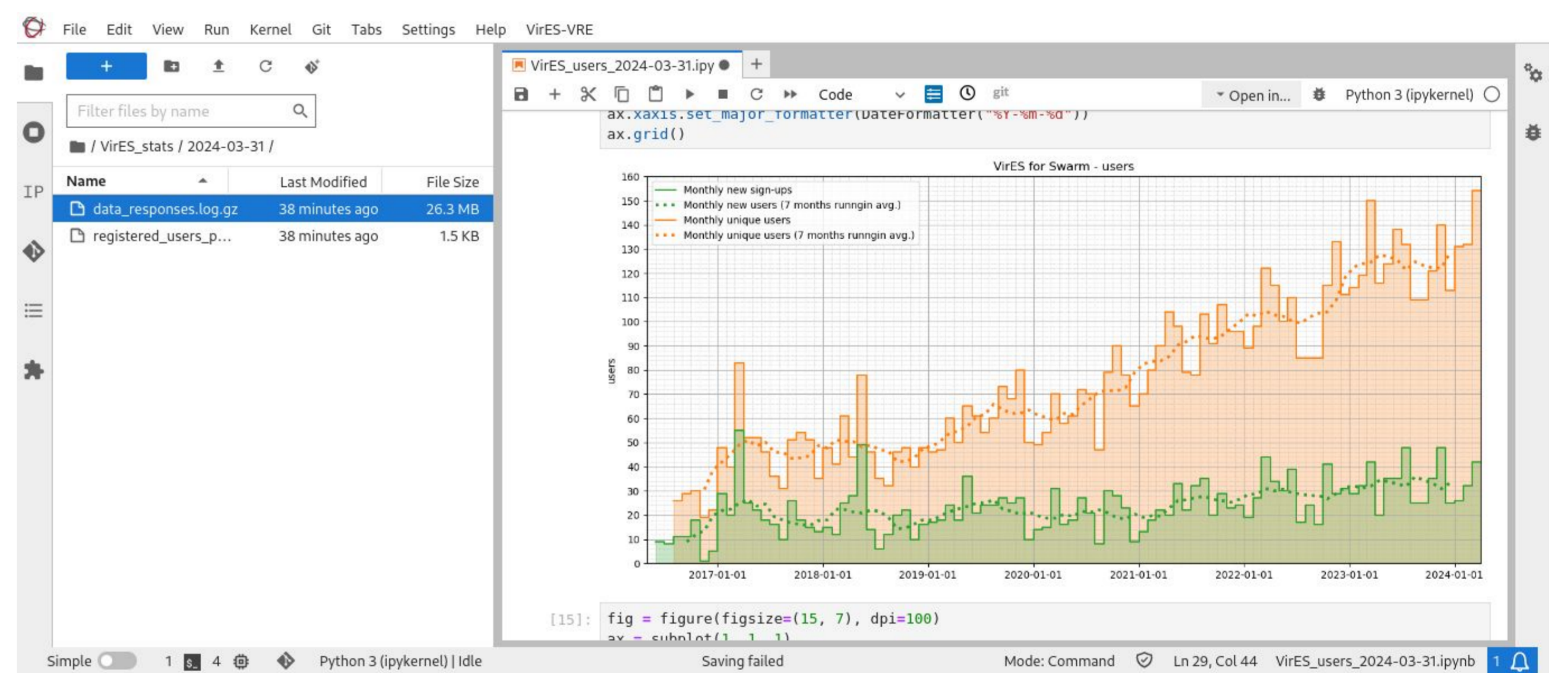
- > 90 collections
 - > 200k product files
 - > 5.3TiB of data
- Swarm (OPER, FAST), CHAMP, CryoSat-2, GOCE, GRACE, GRACE-FO, ground observations

Each collection is a separate time-series for a product type and spacecraft/sensor. Time-series abstraction hides file details while preserving traceability to the original products. Selection of variables, merging (interpolation) of datasets, data filtering, calculated variables (models) are supported.

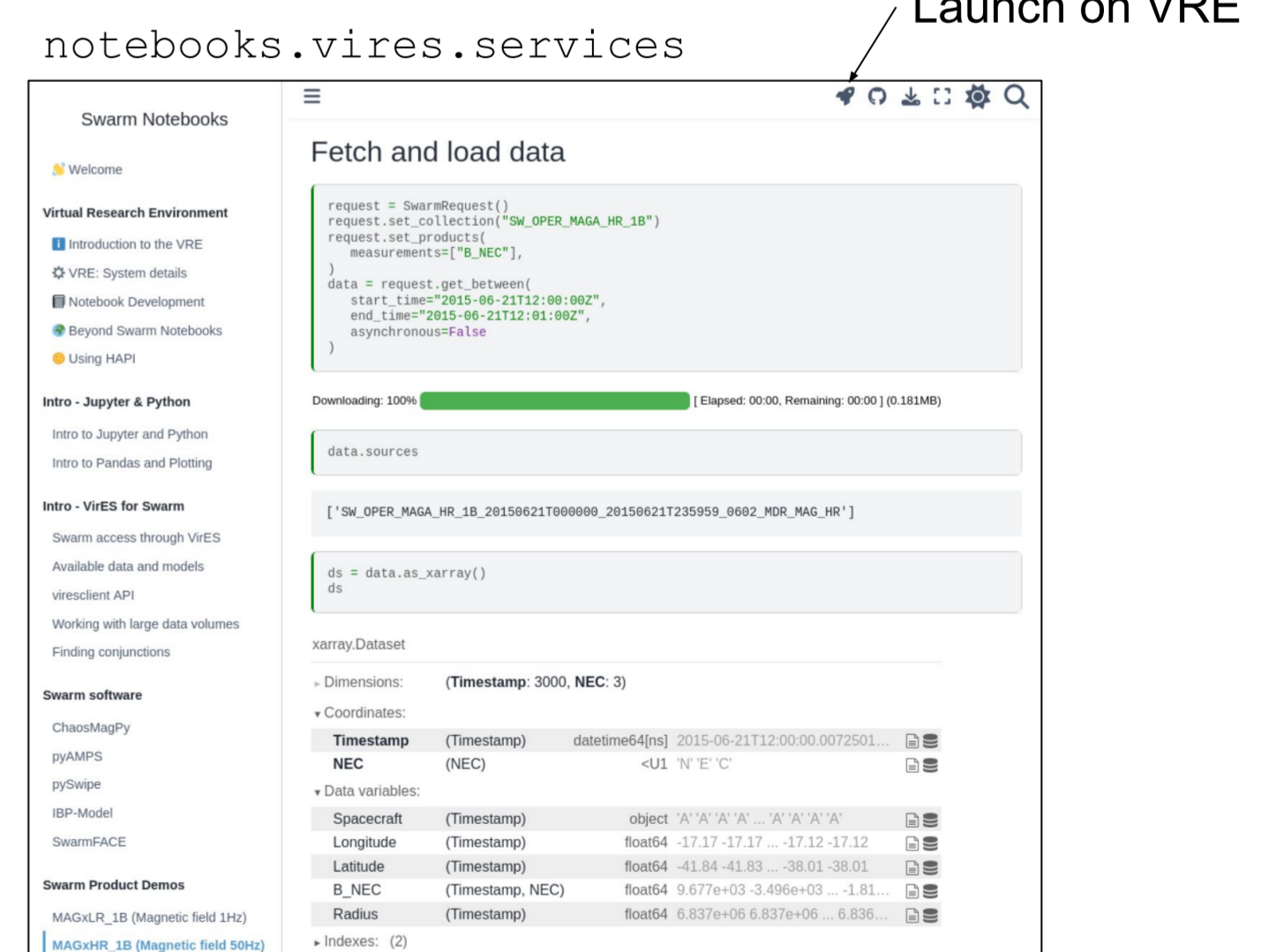


Virtual Research Environment

- Dedicated JupyterLab environment
- Pre-installed thematic Python tools
- Library of example notebooks
- Scalable multi-user Kubernetes JupyterHub deployment



- Swarm Notebooks:
- Provide usage examples of products & software
 - Searchable on the web
 - Link directly to VRE to run them
 - Systematically tested and re-published when there are updates to underlying software
 - Developed openly on GitHub



- <https://vires.services>
- VRE Guide: <https://notebooks.vires.services>
- Python client: <https://viresclient.readthedocs.io>
- Blog posts: <https://eox.at/tag/swarm>

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