How the openEO project unifies access to big Earth Observation data processing platforms

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The idea of openEO

Develop an open API that connects various clients to big EO cloud backends in a simple and unified way

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant No 776242.

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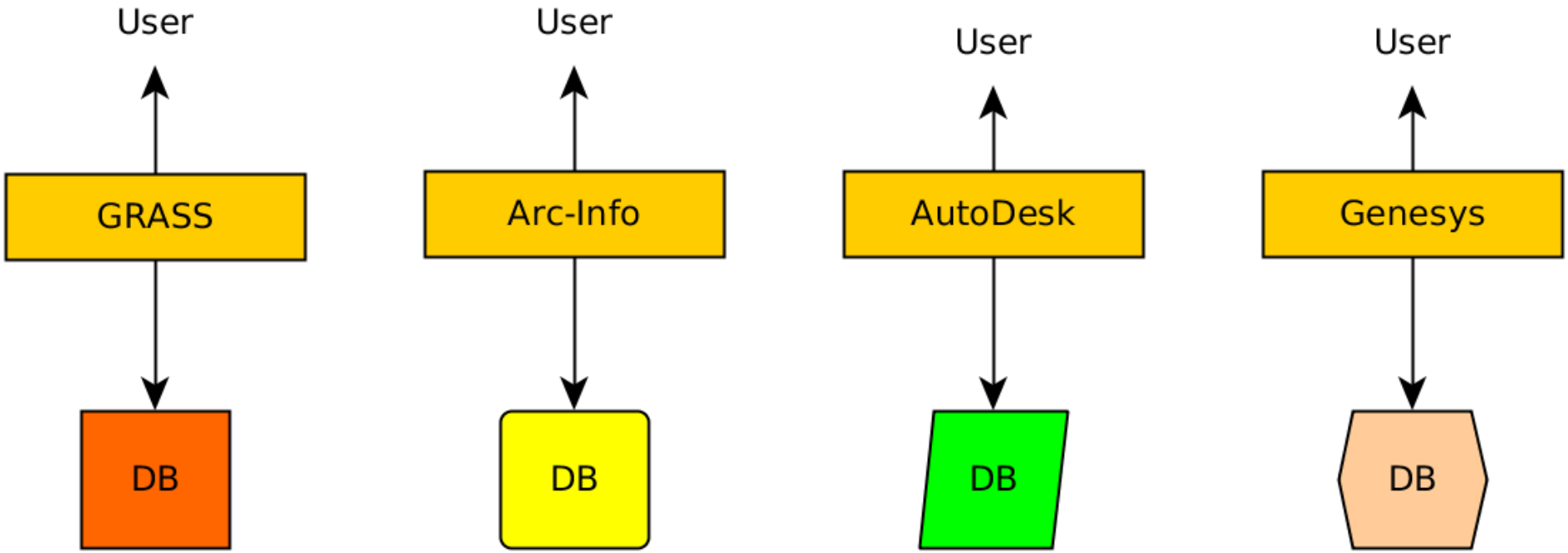
Why?

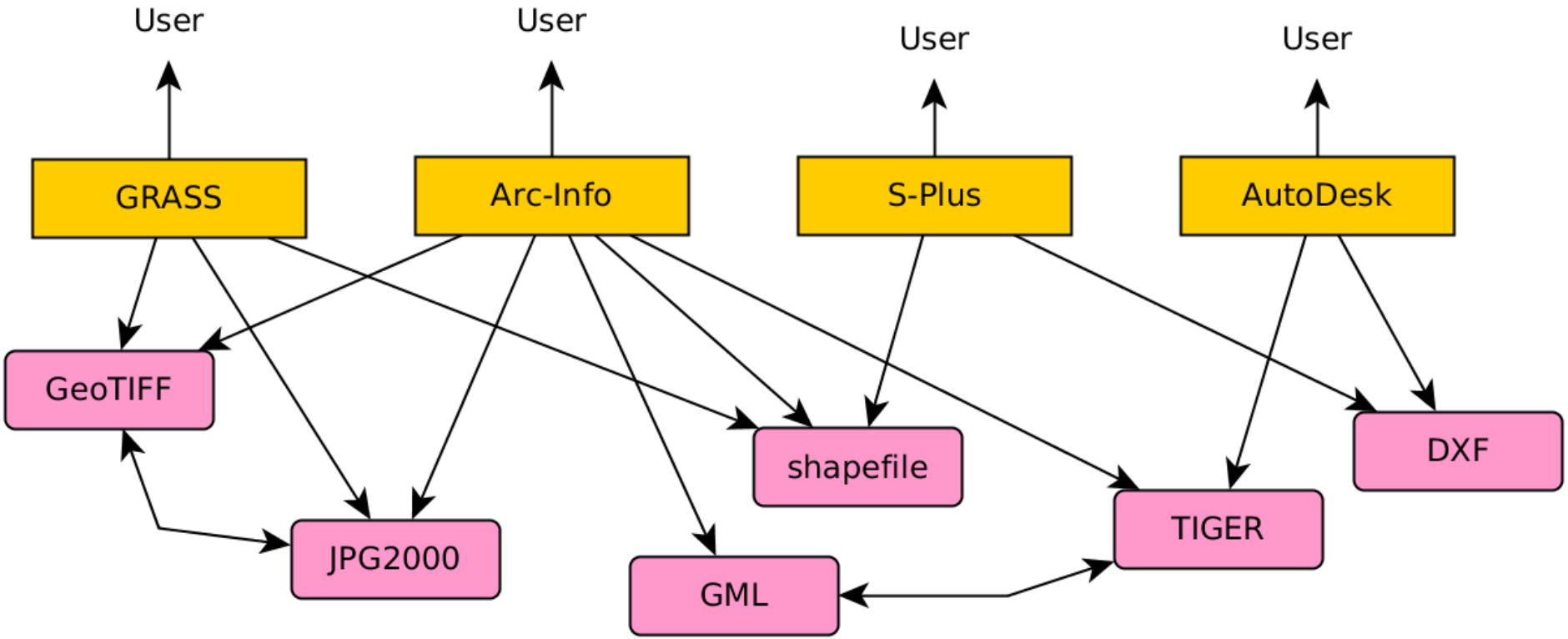
- EO data now **too large to download/handle**
  → EO processing **increasingly cloud-based**

- Cloud-based EO **solutions pop up like mushrooms**
  - DIASs, TEPs, Google Earth Engine, Sentinel Hub, GeoTrellis, Rasdaman, …

Who knows GDAL?



graphics from http://r-spatial.org/2016/11/29/openeo.html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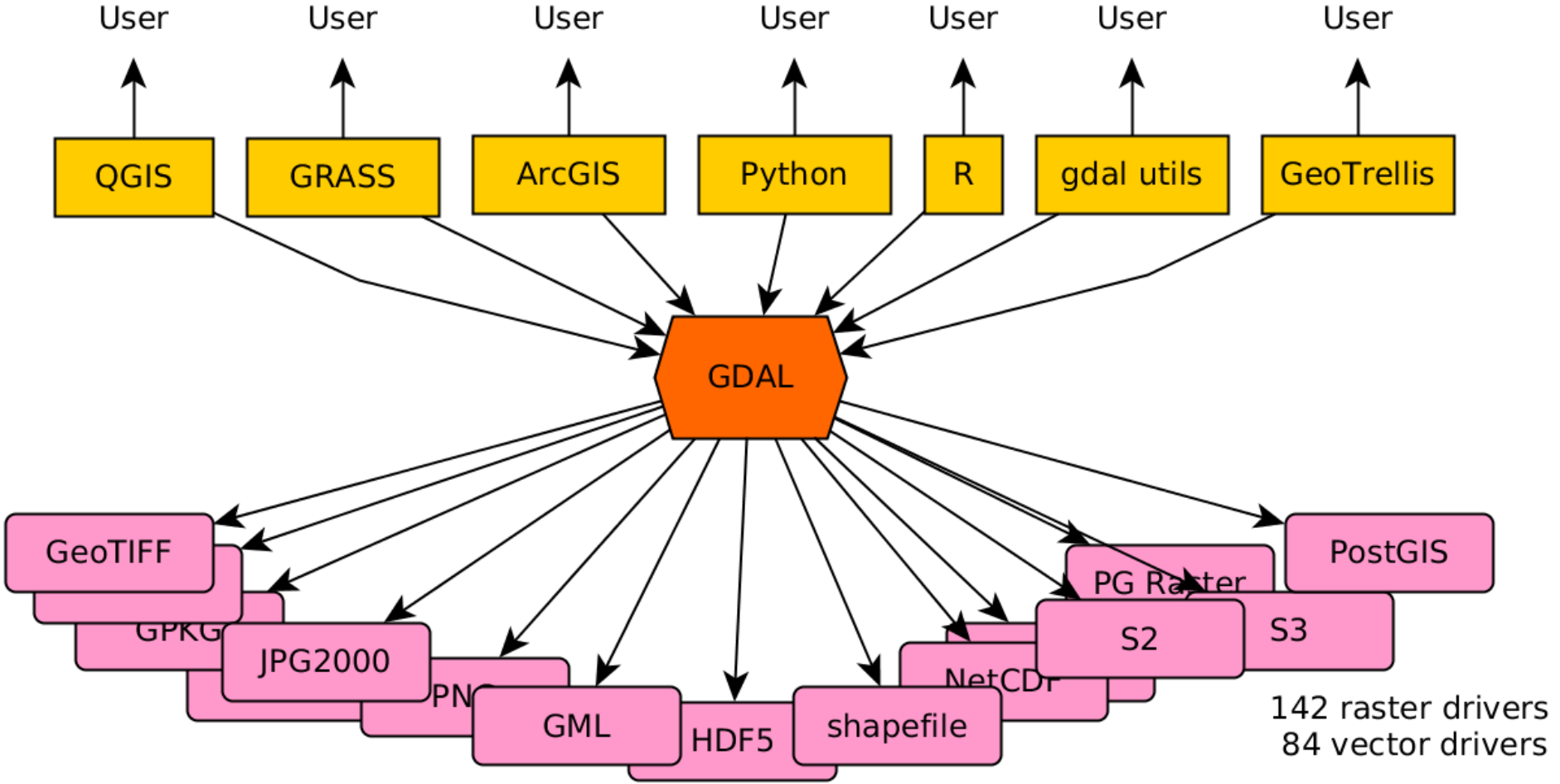
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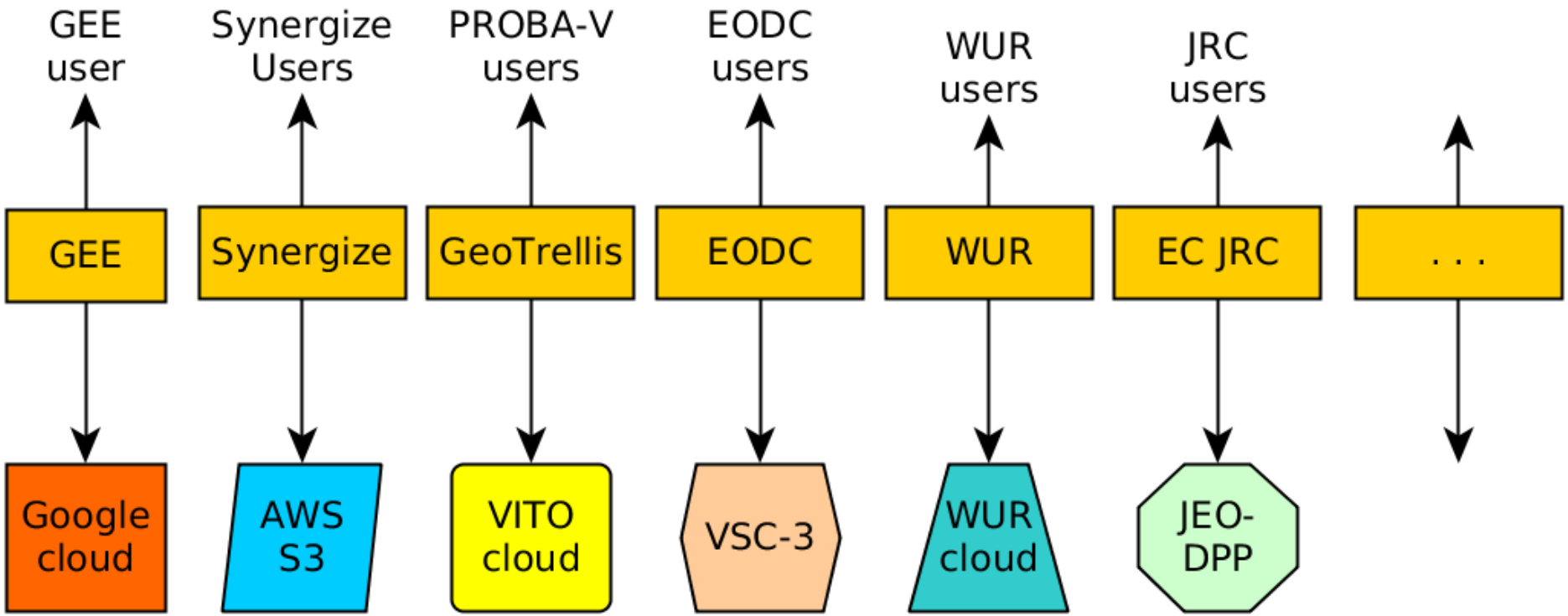
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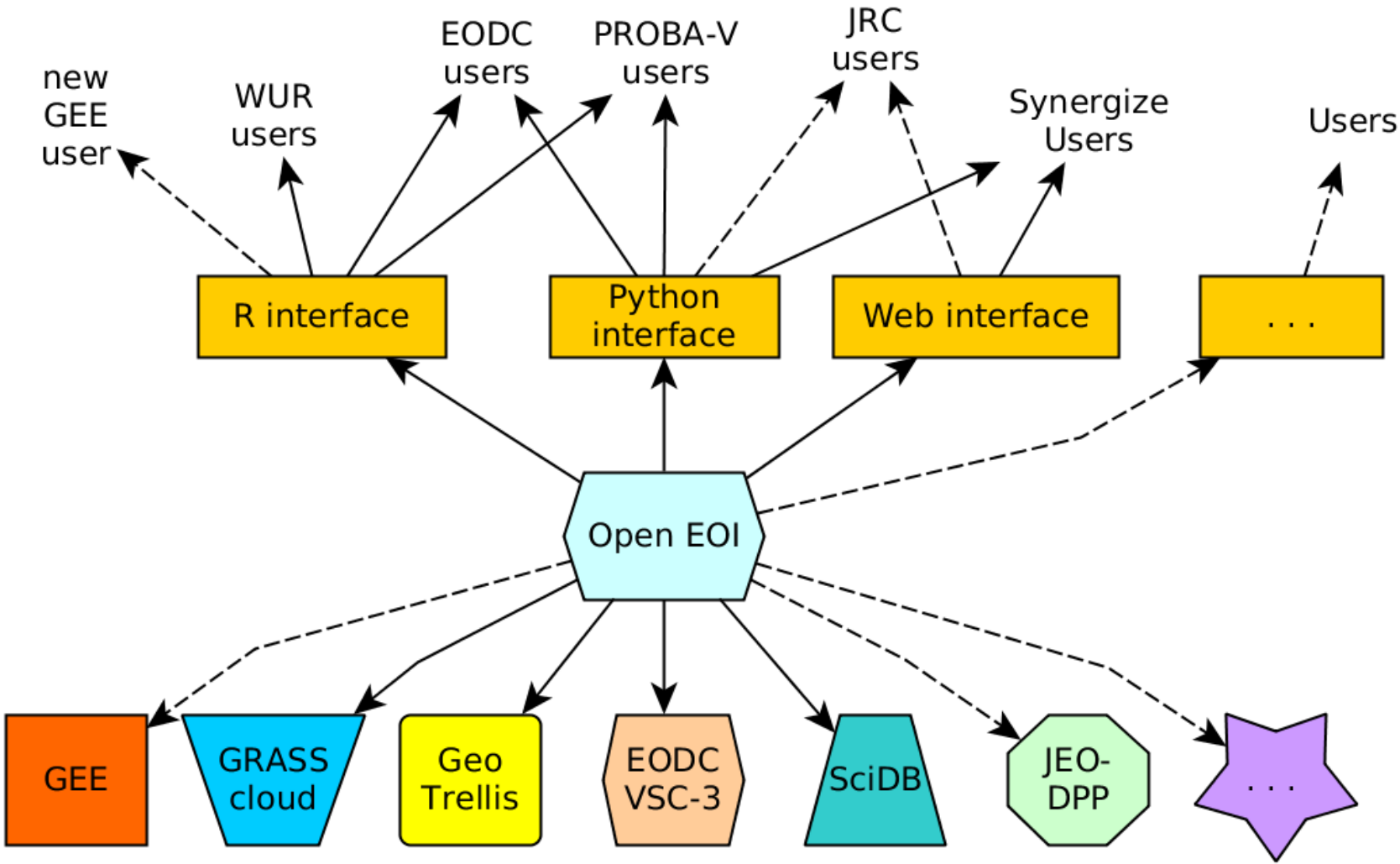
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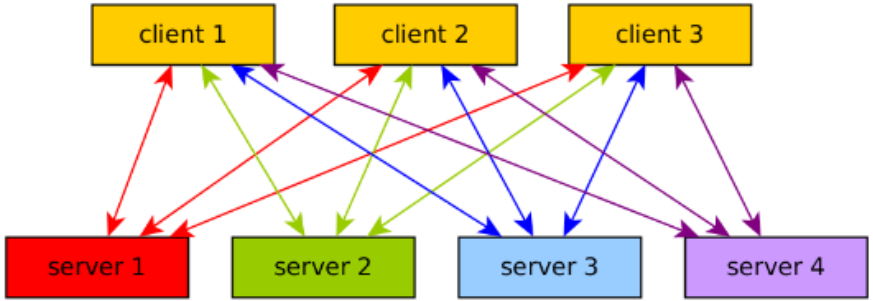

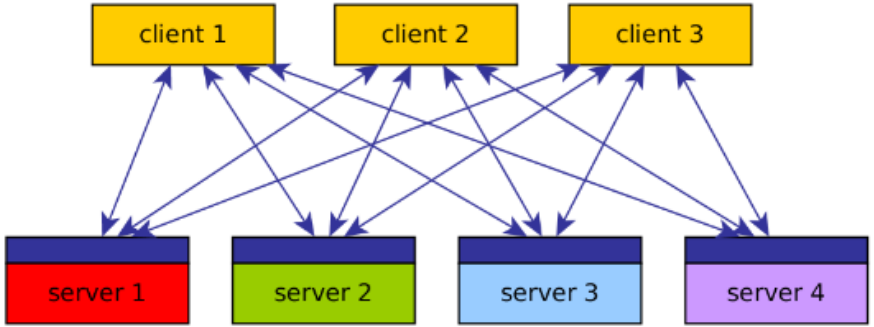

graphic from openEO deliverable 5

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  → EO processing **increasingly cloud-based**
- Cloud-based EO solutions **pop up like mushrooms**
  - DIASs, TEPs, Google Earth Engine, Sentinel Hub, GeoTrellis, Rasdaman, …
- **Combine** different backends
- **Extensibility**
- Compare/validate results → **reproducibility**
- So far: Google Earth Engine the only feasible offering?
  - It’s easy and ready -- **but not open.**

What we do

- Define a **RESTful API**
- Implement **reference implementations**
  - 7 backends
  - 3 client libraries
- Define a **process catalogue**
  - extendable by user-defined functions
- Everything's **open source**: https://github.com/Open-EO/

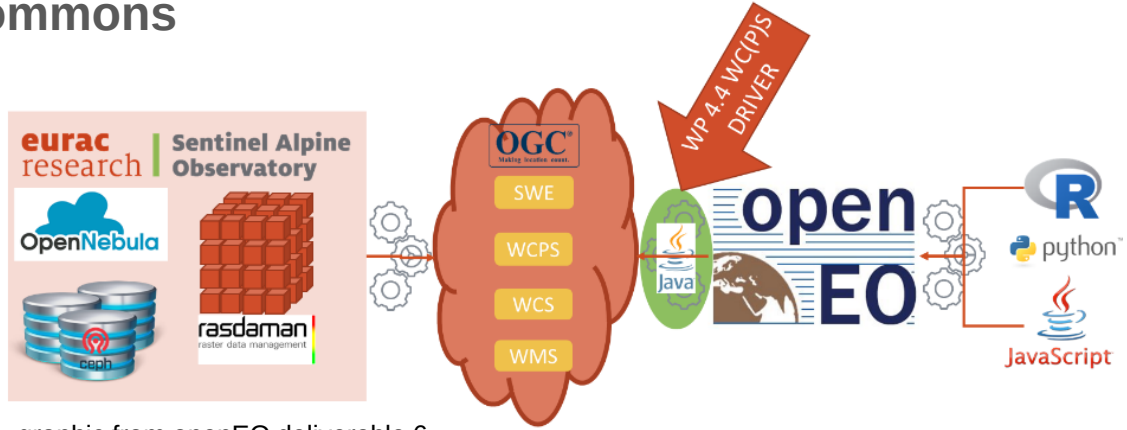
Live Demo

http://hub.openeo.org/

Standards

- Used existing standards **where possible**
  - REST, OpenAPI, GeoJSON, OpenID Connect, EPSG codes…
- Processing: **not WPS** (doesn't support chaining) -- but driver for WCPS!
- Results: Exposing **web services** possible (WMS, WMTS, WCS, XYZ, ...)
- Compliant to **OGC API Commons**
- Working on **STAC**

  (data discovery)



graphic from openEO deliverable 6

What we had

- 3 clients
- 7 backends
- 3 use cases
- a handful of processes

Progress over the last year

- **New process graph structure**
  - Parallelised processing
  - Callbacks
  - Multiple results
  - Process graph variables
- **Adaption** of client libraries and backend drivers
- Compatibility to **OGC API - Commons**
- Full process catalogue with **100+ processes defined**
  - Backends can support arbitrary subset
  - Extendable by own definitions
- **UDF reference implementations** in R and Python

My lessons learned

- Programmers don’t read the docs
- Choosing and detailedly describing processes takes time
- Standardising the algorithms is feasible
- But it’s quite hard to standardise the data (“Analysis Ready Data”)
  - Non-uniform naming (e.g. “SENTINEL-2” vs. “COPERNICUS/S2” etc.)
  - Scientific vs. easy-to-use

Still to come

- Implementation of processes in backends
- Full compatibility to newest API version
- Fully tested, stable, 1.0-release-ready versions of everything
- ...

Challenges (content)

- Uniform **naming** of data collections
- Incorporating **everything into one API**
  - Dropped the idea of including everything, e.g. user management, settings, payments, ...
- **User-defined functions**
  - reference implementations in Python and R
- **Efficient access** to big data
  - data cube (raster and vector)
- **Validating** backends against each other (**reproducibility**)
  - Master thesis on comparing output
- **Cost estimates**
  - Billing model, but giving a “What would this cost?” quote seems hard

Challenges (project)

- Ensure **user adoption** (clients *and* servers)
  - Conferences, workshops, hackathons, social media, science slam ...
- Extend openEO to **more backends**
  - There are many more than the ones we address -- we can’t solve this alone
- Ensure **project continuation**
  - Big players on board (e.g. Google Earth Engine, Sinergise SentinelHub)
  - Consortium includes companies that will use openEO in production → interest to maintain it
  - Community project

Thanks for your attention!

Any questions?

https://openeo.org/ https://**github**.com/Open-EO https://**twitter**.com/open_EO