PROCESS

PROviding Computing solutions for ExaScale ChallengeS

Towards Exascale-ready Data Service Solutions

Maximilian Höb

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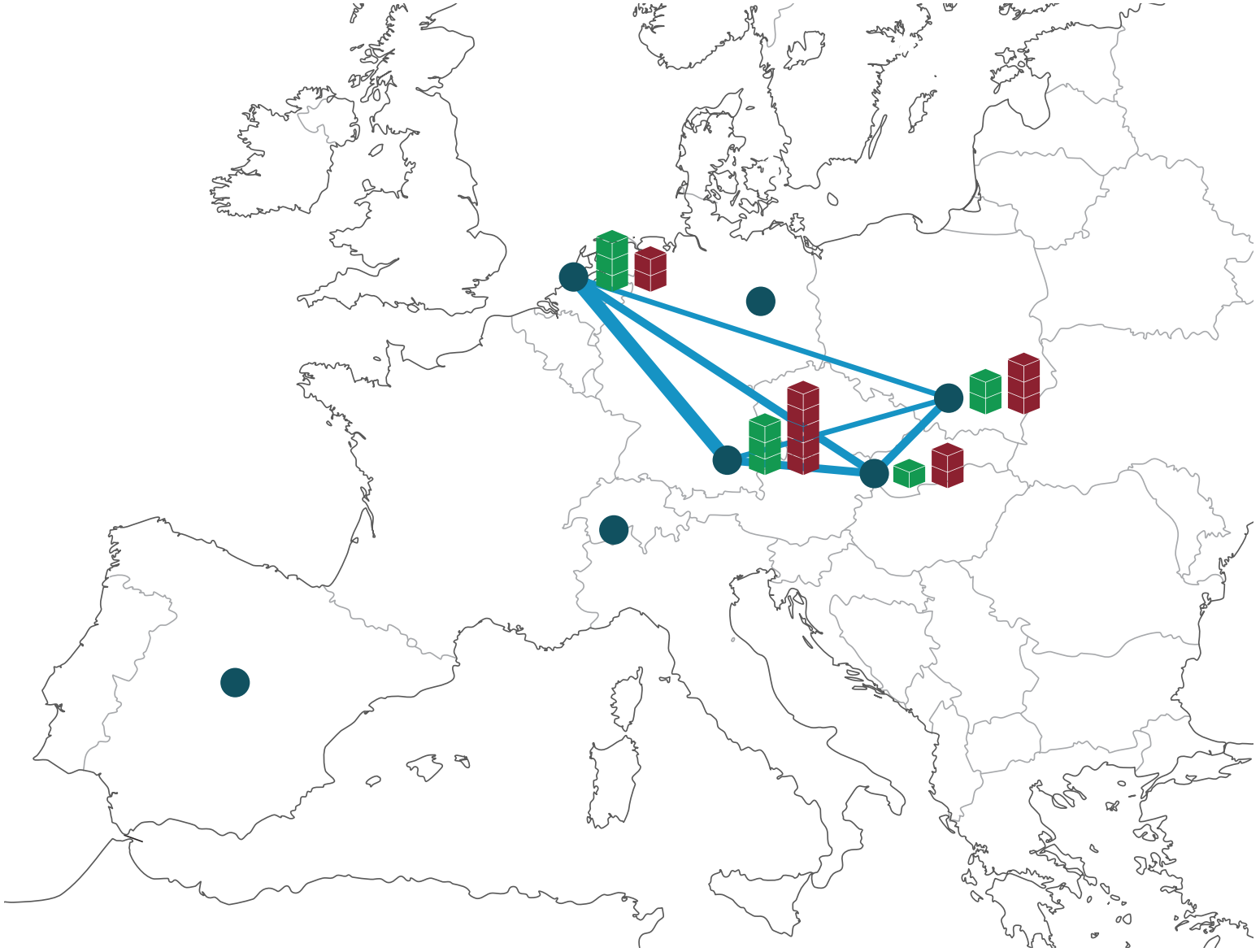
Consortium

- Ludwig-Maximilians-Universität München, Germany
- Universiteit van Amsterdam, The Netherlands
- Stichting Netherlands eScience Center, The Netherlands
- Haute école spécialisée de Suisse occidentale, Switzerland
- Lufthansa Systems GmbH & Co. KG, Germany
- Inmark Europa SA, Spain
- Ústav informatiky, Slovenská Akadémia Vied, Slovakia
- Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie, Poland

Storage and Computing Centres



Partner‘s location

Storage Resources

Compute Resources

Vision of PROCESS

PROCESS will deliver a comprehensive set of **mature service prototypes and tools** specially developed to enable **extreme scale data processing** in both **scientific research and advanced industry** settings

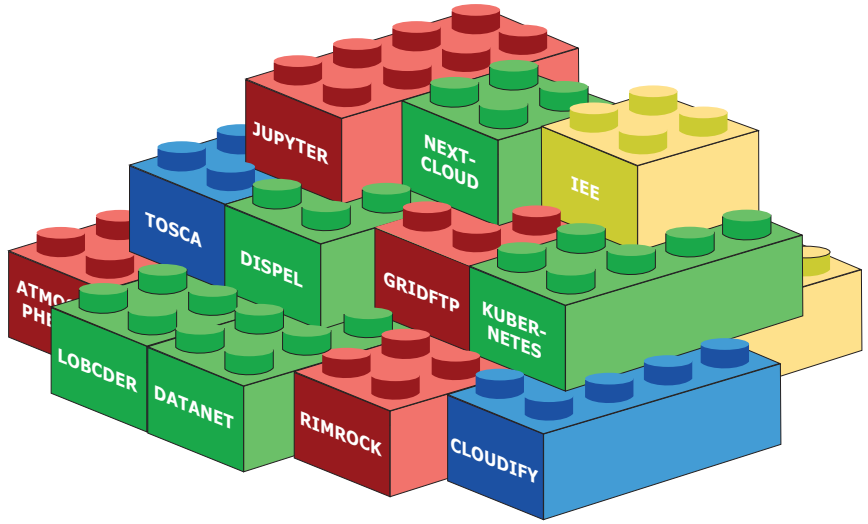
3 Principles

1. Leapfrog beyond the current state of the art
2. Ensure broad research and innovation impact
3. Support the long tail of science and broader innovation

PROCESS Concept

A user-friendly modular exascale service platform to combine data and computational services on top of European research infrastructures

SuperMUC-NG
Leibniz Supercomputing Centre Munich

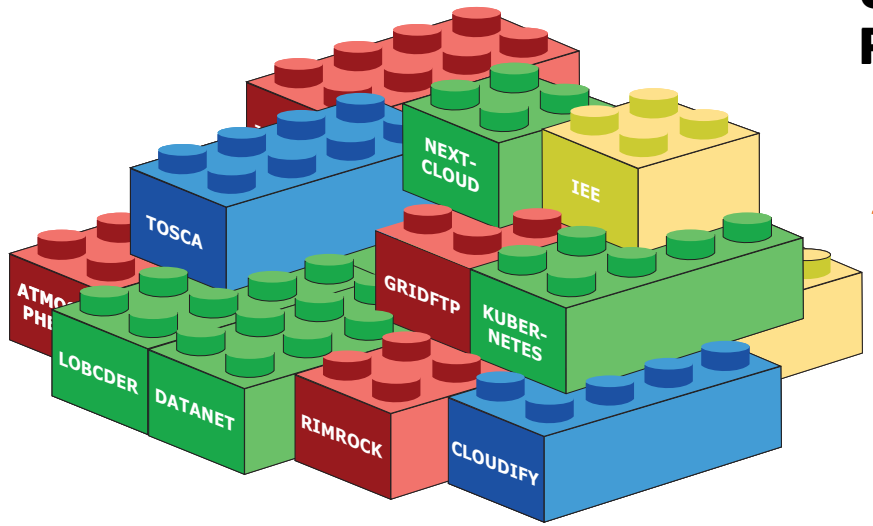


Goals of PROCESS

Mature, modular, generalizable Open Source solutions for user friendly exascale data.

UC#1: Exascale learning on medical image data

UC#2: Analysis of Radioastronomy Observations

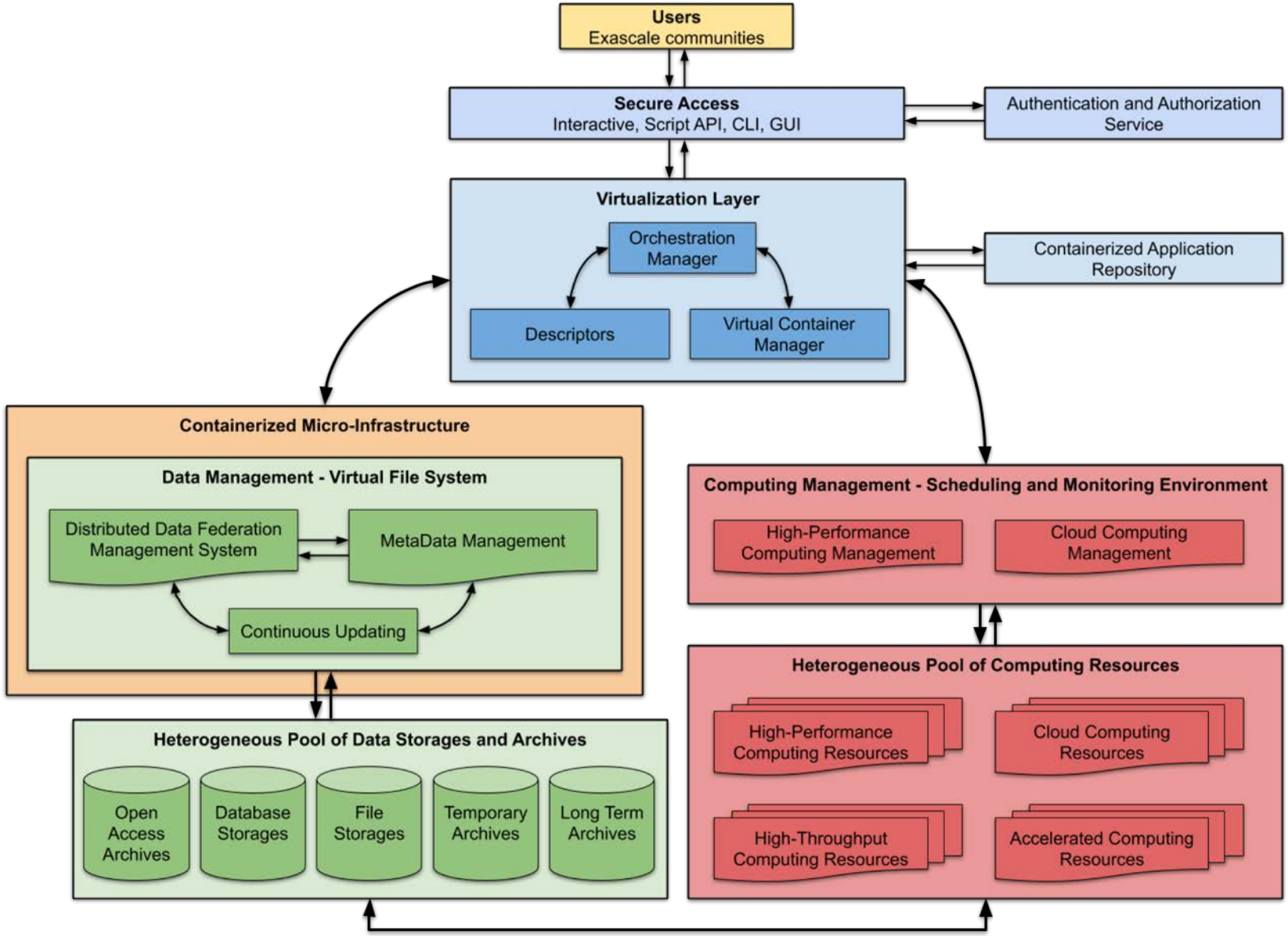


UC#3: Supporting innovation based on global disaster risk data

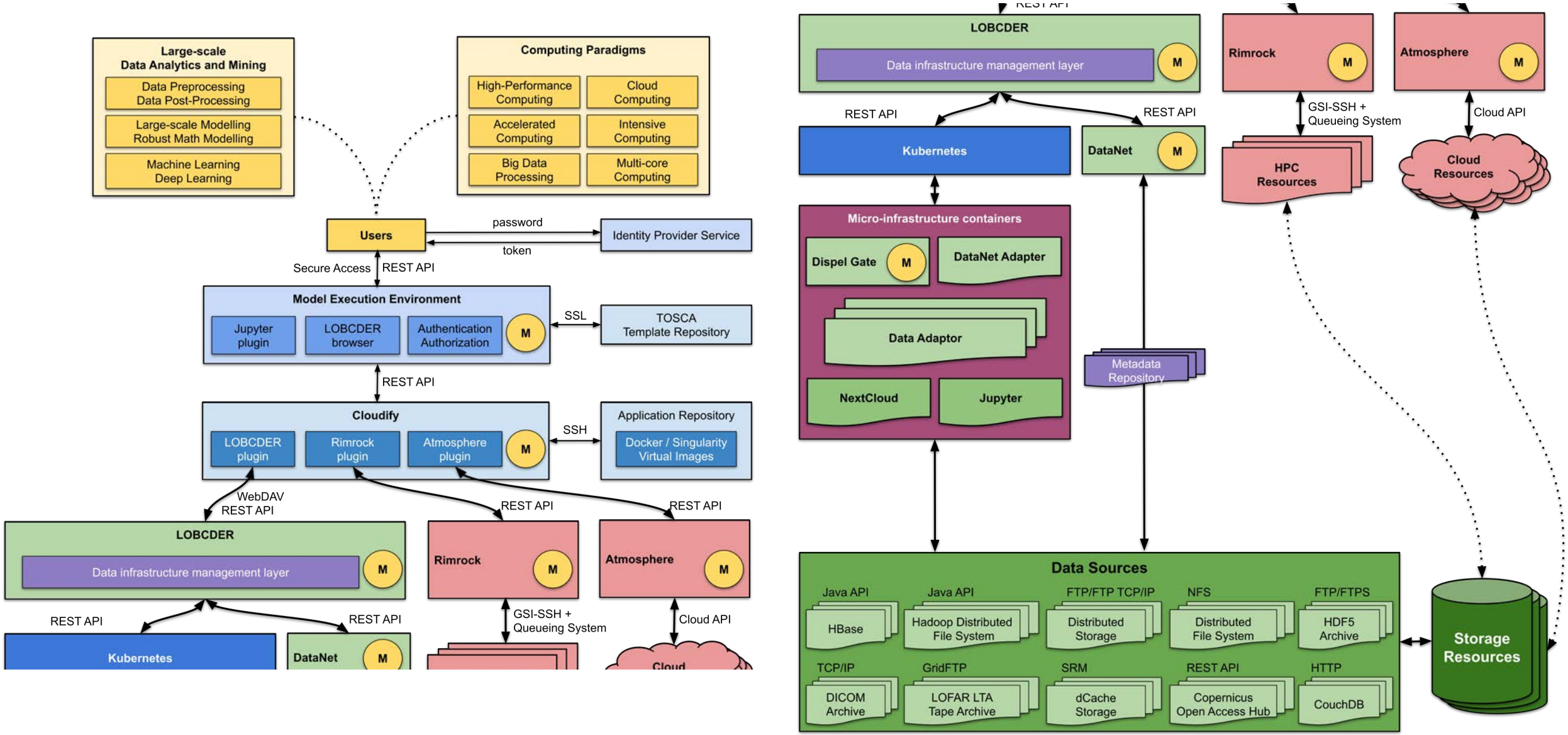
UC#5: Agro-Copernicus (correlating data between simulation and observation)

UC#4: Ancillary pricing/airline revenue management

PROCESS Architecture



PROCESS Architecture



Approach: Tiered system with a layer of virtual (data) nodes facilitating:

- data transfers,
- distributed management,
- scheduling and staging.

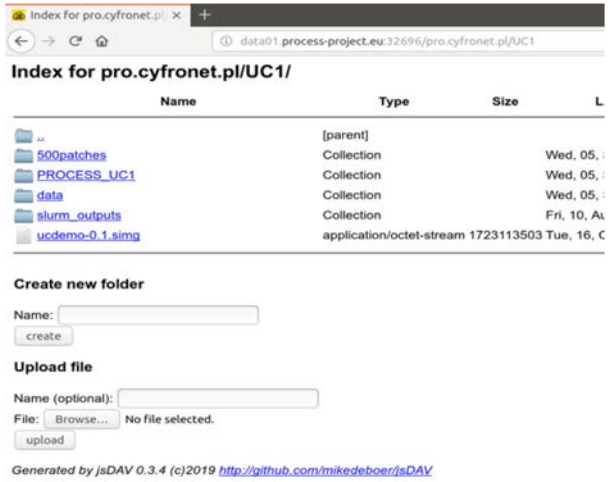
Through → **A programmable micro-infrastructure**

enable ↓

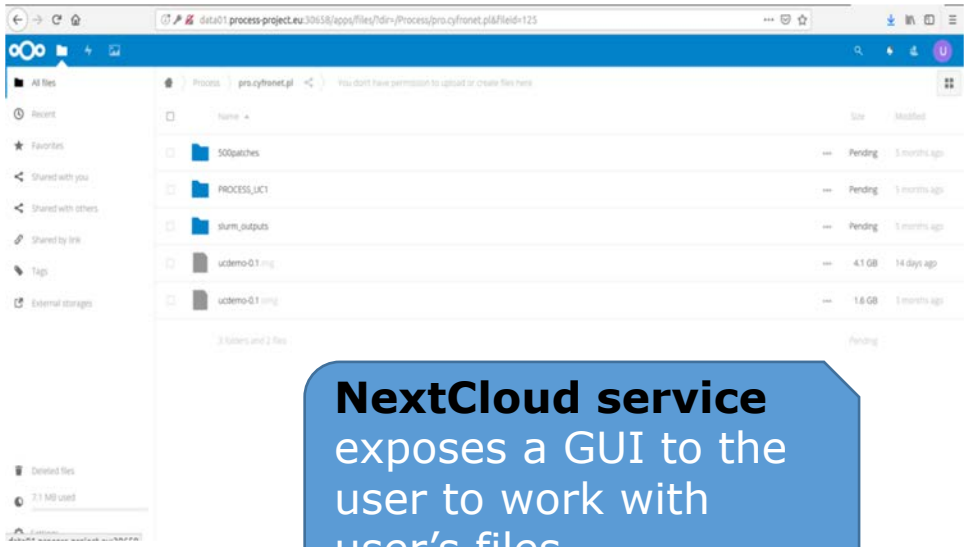
- Independent of resource providers (storage & computing)
- Work with data across distributed provider data.
- collaboration across research groups

Implementation: container-centric, orchestrated using Kubernetes.
software: https://github.com/recap/MicroInfrastructure

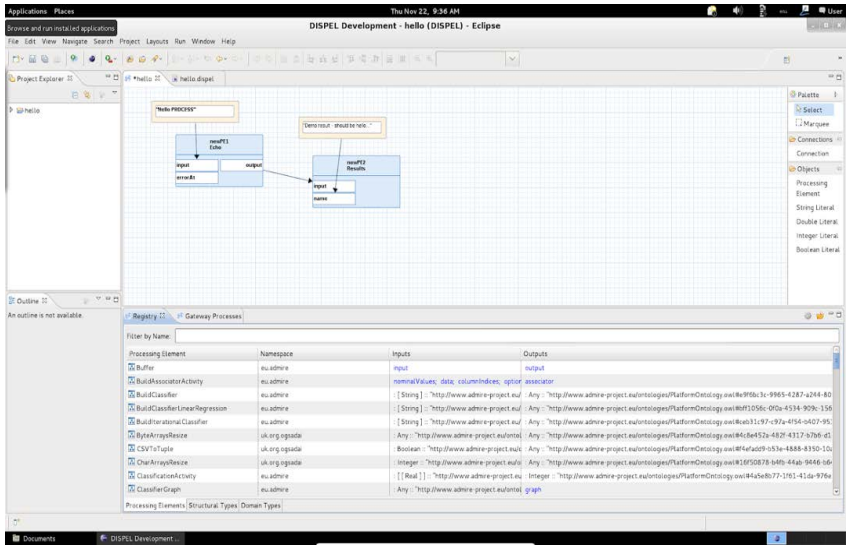
Data Management with containerized Services



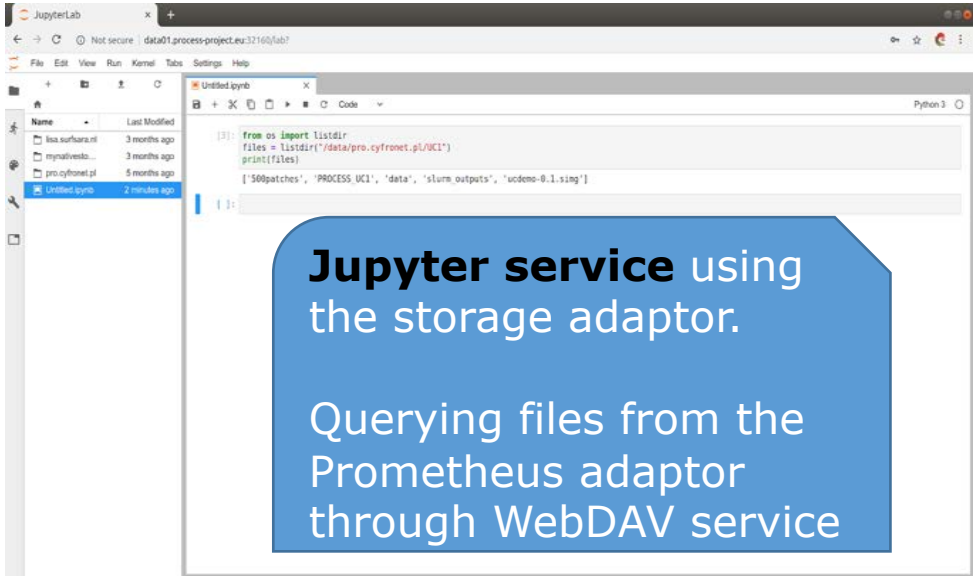
WebDAV service deployed through the micro-infrastructure. Through the API the user sets the user-name and password which will protect the WebDAV point



NextCloud service exposes a GUI to the user to work with user's files



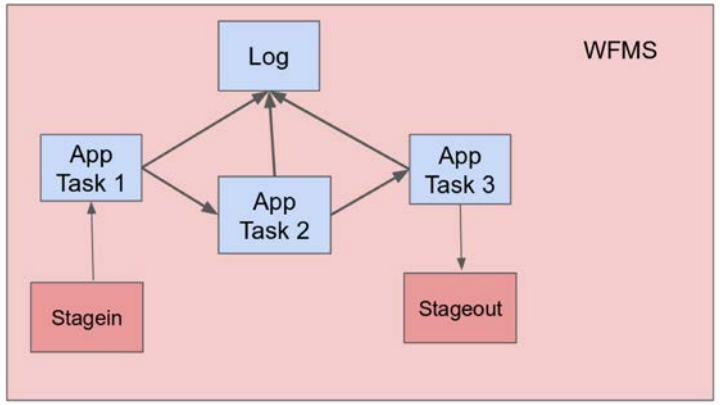
DISPEL graphical authoring and execution environment based on Eclipse

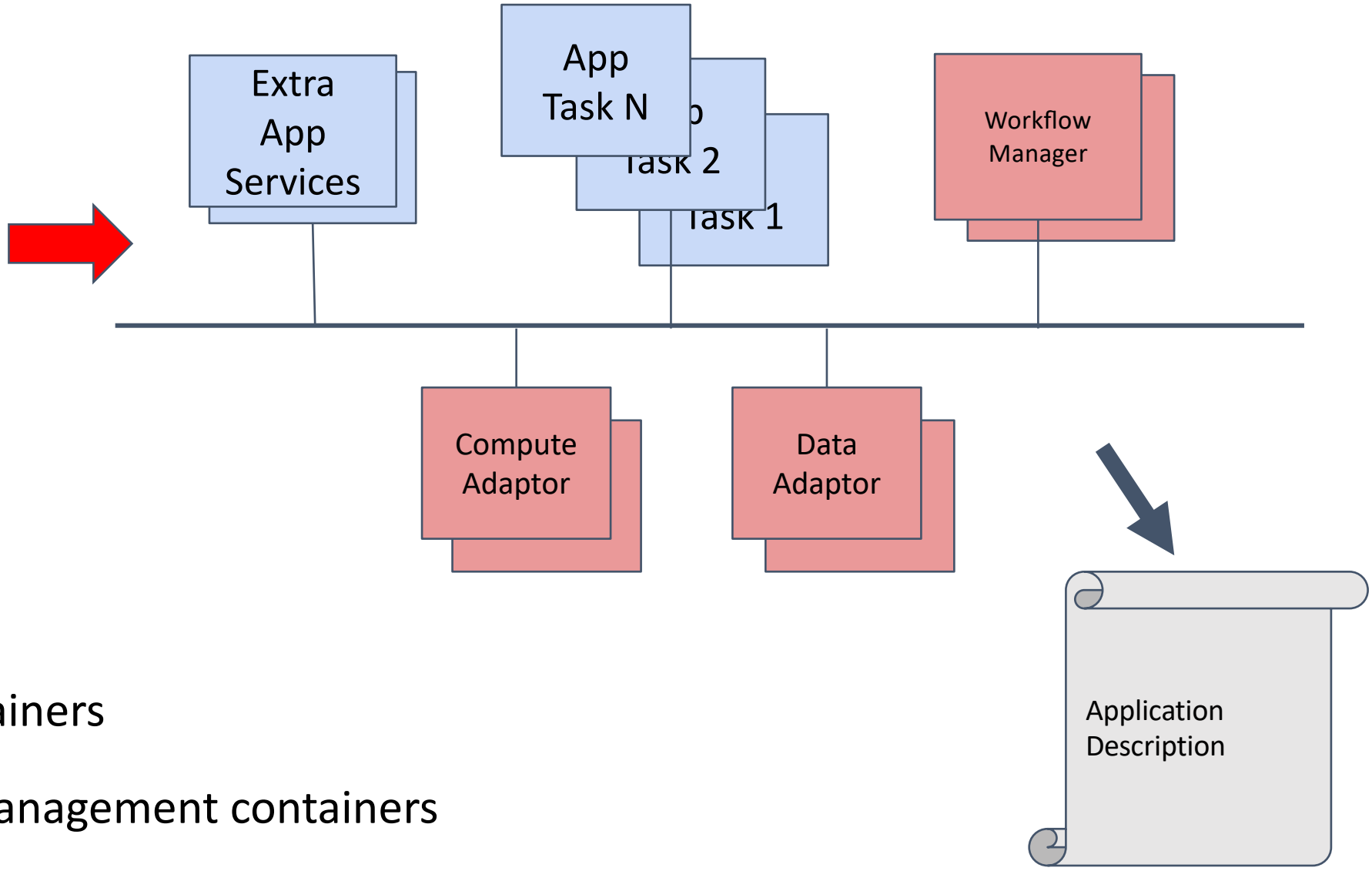


Jupyter service using the storage adaptor.

Querying files from the Prometheus adaptor through WebDAV service

Workflow to infrastructure

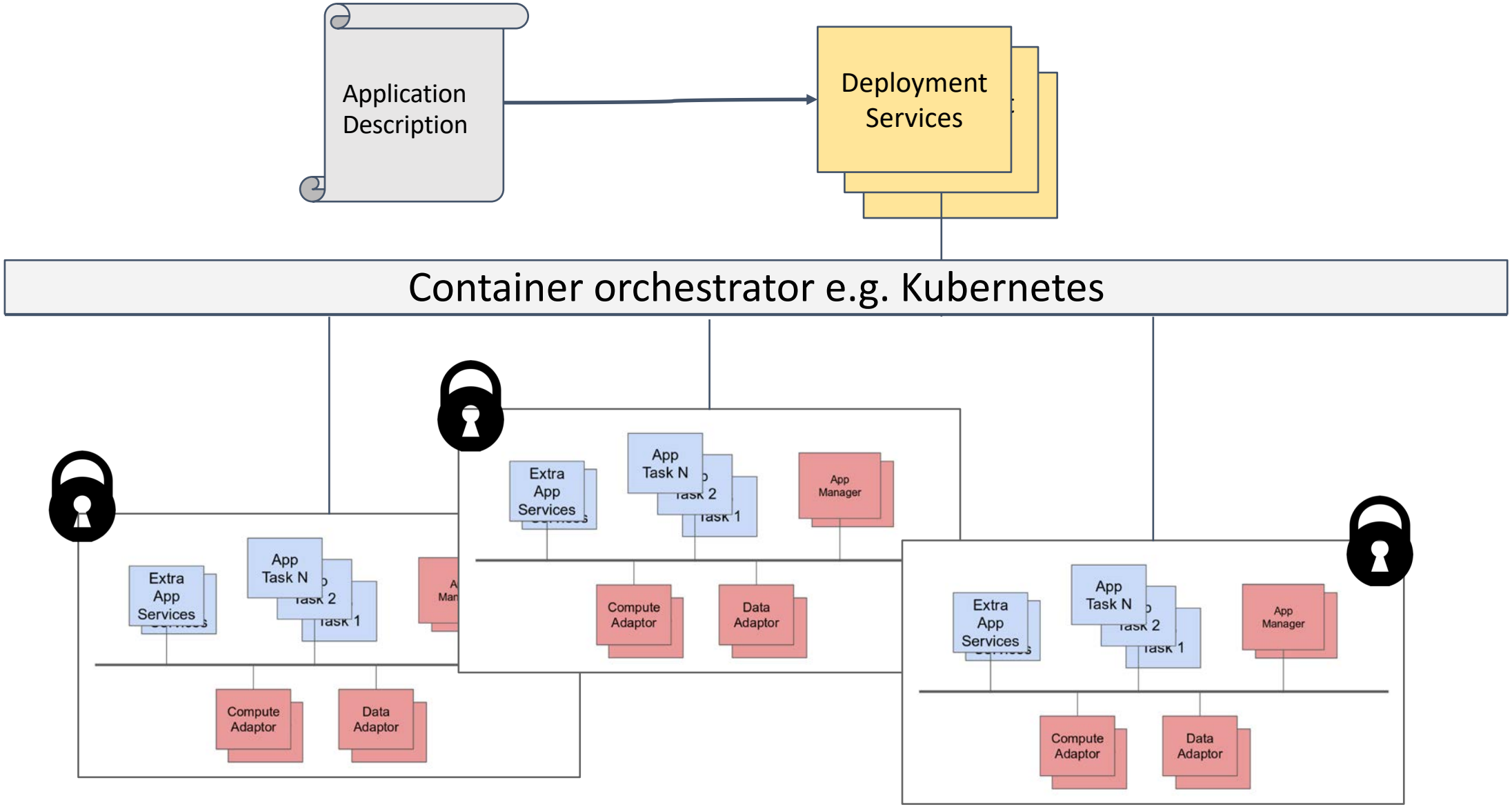




Application logic containers

Application specific management containers

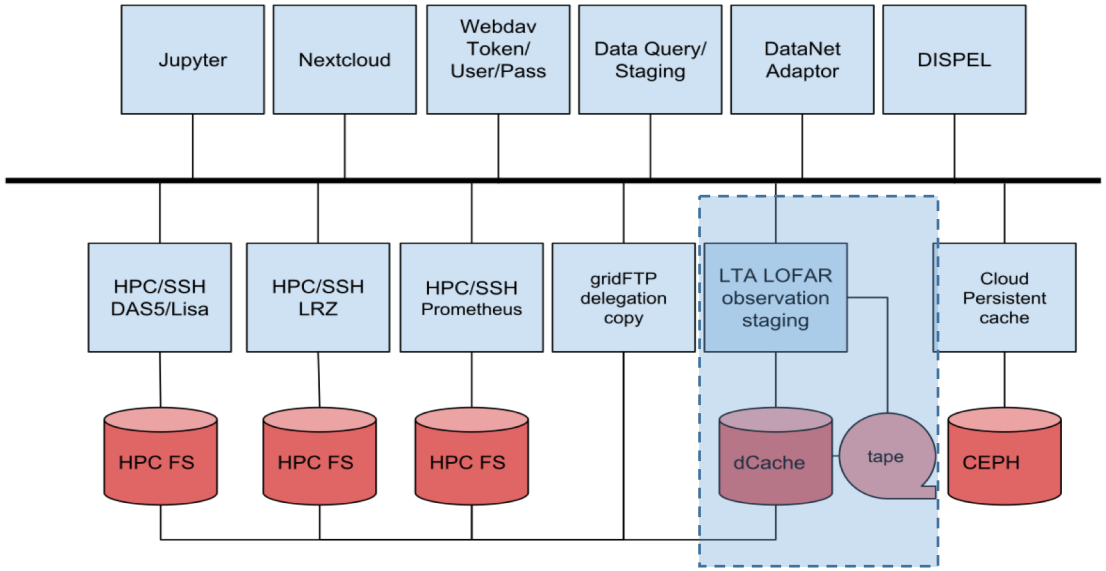
Deploy application infrastructure

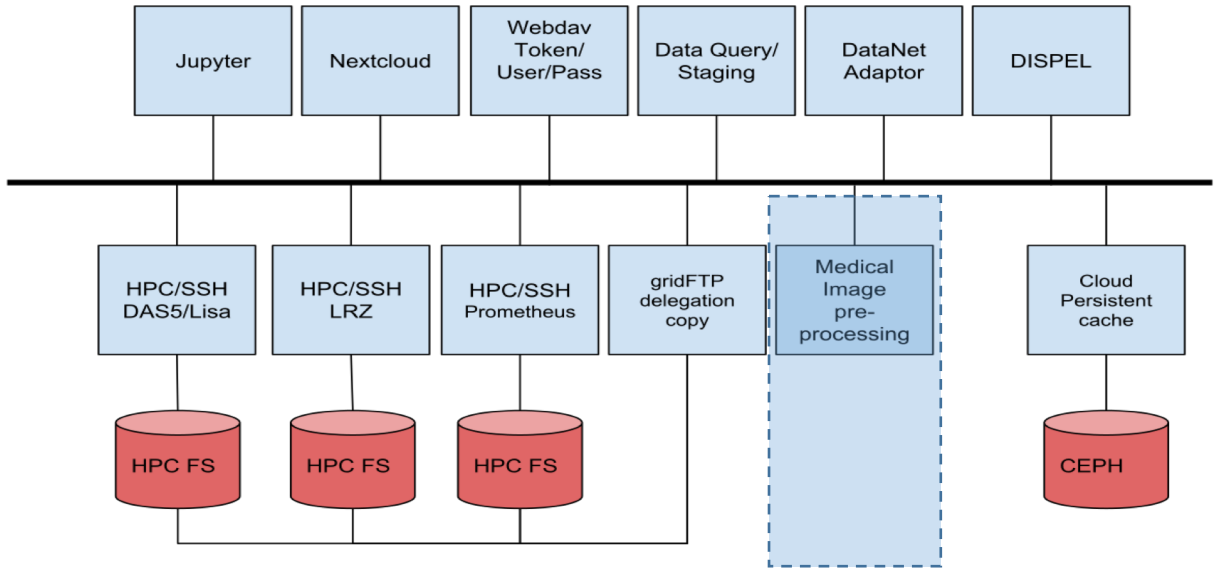


Data infrastructure

PROCESS Data infrastructure including data adaptors for UC#1 and UC#2:

- **Reuse** of container adaptors **across use cases**
- Ability to **add new application specific container** adaptors





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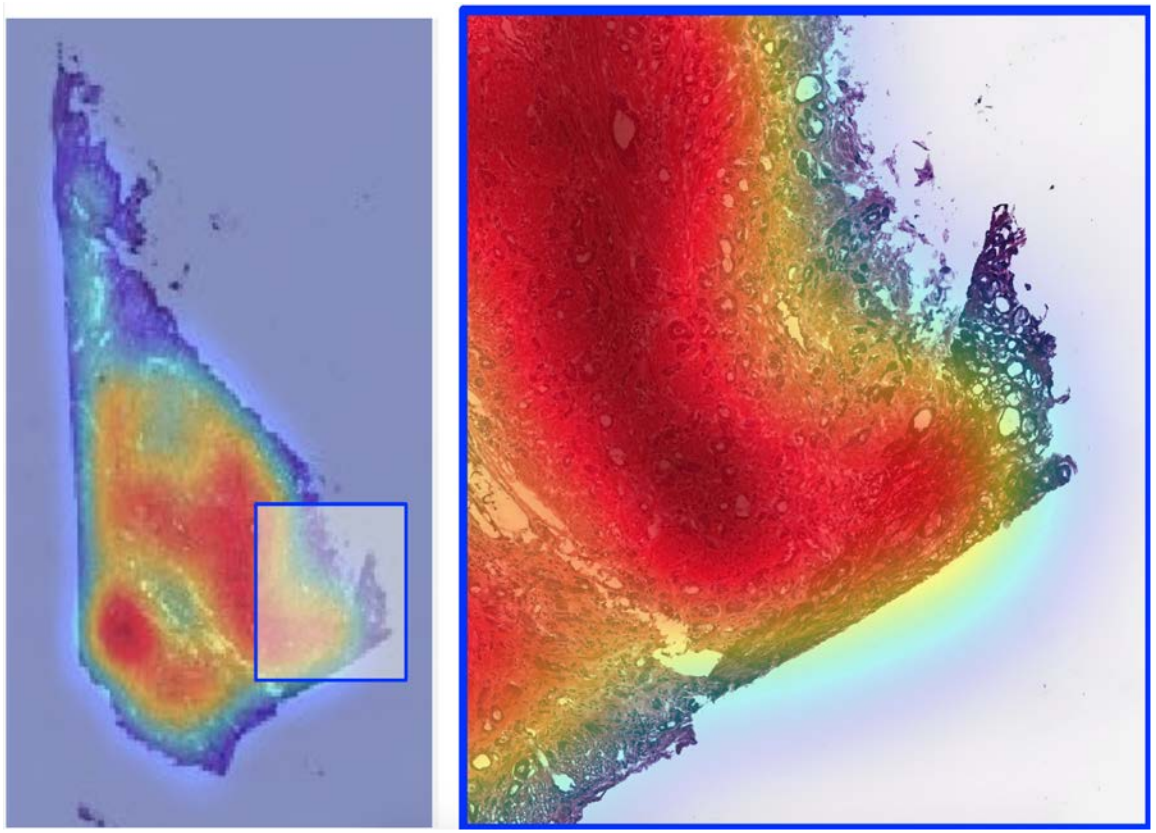
Use Case 1

Machine Learning in Medical Imaging

Hes·so

Haute école spécialisée

de Suisse occidentale, Switzerland



Use Case Scenario and Objectives

- Use of machine learning to analyse large histopathology images (>100,000x100,000 pixels)
  - Cut into small patches for treatment
  - Mainly for cancer care to highlight regions of interest
- Use of standard tools such as Keras, Tensorflow, … for Deep learning.

- Adapt the machine learning tools to large data centres and make them scale to improve the amount of training data and thus improve the quality of the models
  - Histopathology data is produced in massive quantities constantly
- Use a safe environment for possibly confidential data
- Have a simple user interface to test new pipelines

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Use Case 2

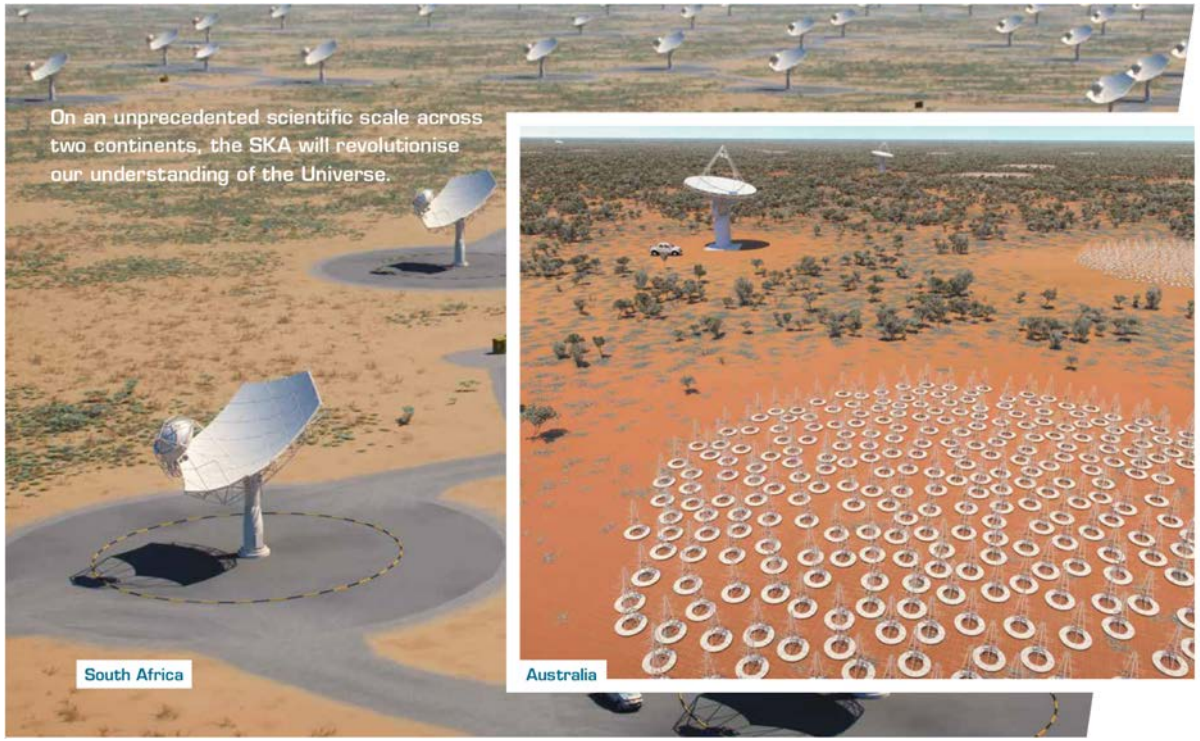
Analysis of Radioastronomy Observations LOFAR / SKA

Stichting Netherlands eScience Center, The Netherlands

Analysis of Radioastronomy Observations

Images courtesy of: ASTRON

LOFAR: Low Frequency Array radio telescope – is a “distributed software telescope” consisting of ~88.000 antennas in ~51 stations scattered over Europe. It produces up to **35 TB/h of intermediate data** (visibilities) which is stored for further analysis.

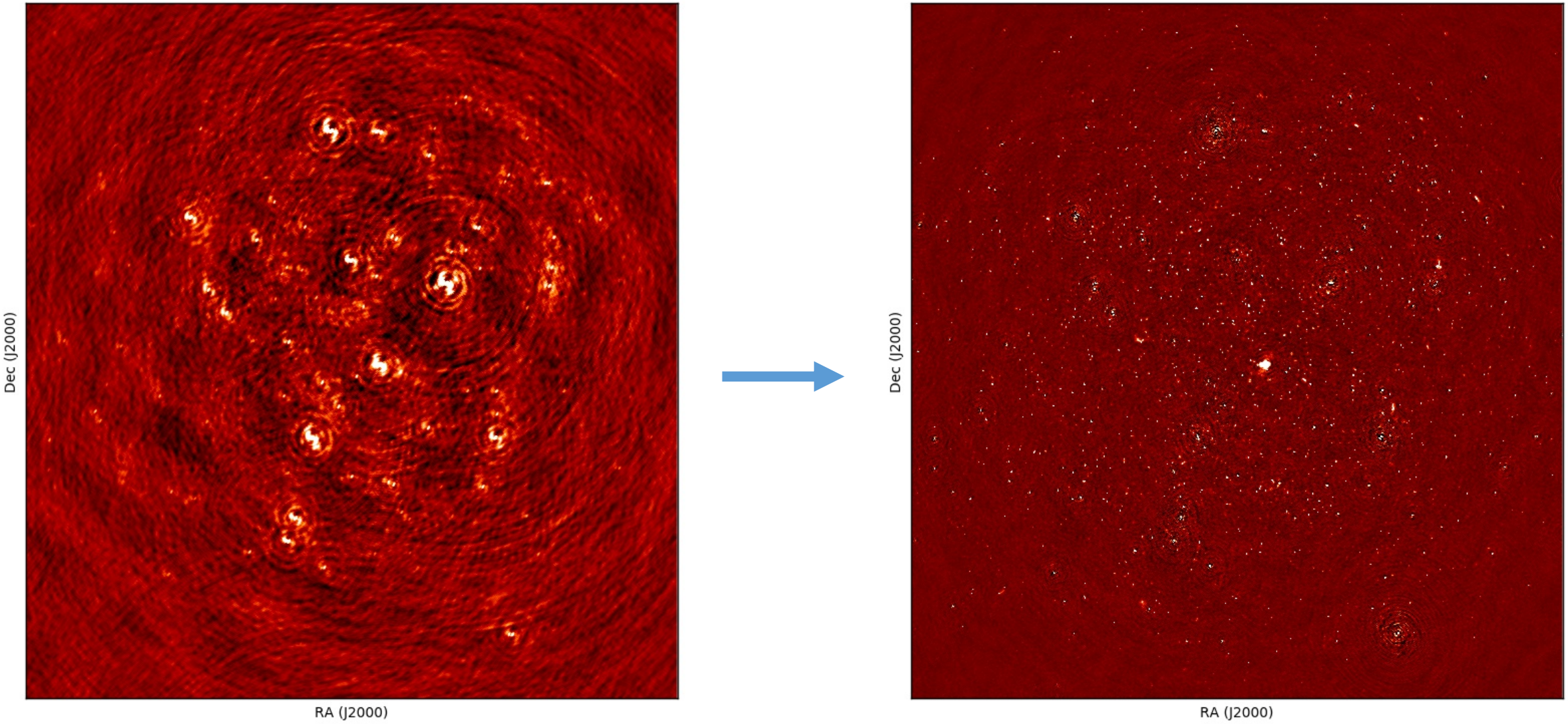


SKA: Square Kilometer Array (Operational in 2022+)

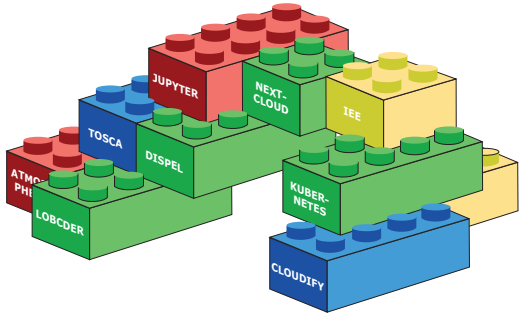
130K ~ 1M (LOFAR-style) antenna in Australia + 200 ~ 2000 dishes in South Africa. Wider frequency range and higher sensitivity and survey speed than existing telescopes.
Zettabytes/year **raw** data: **130~300PB/year of correlated data**

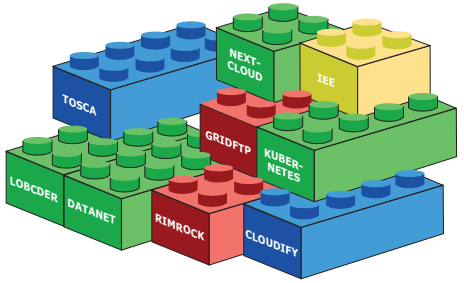
Huge data and processing problem

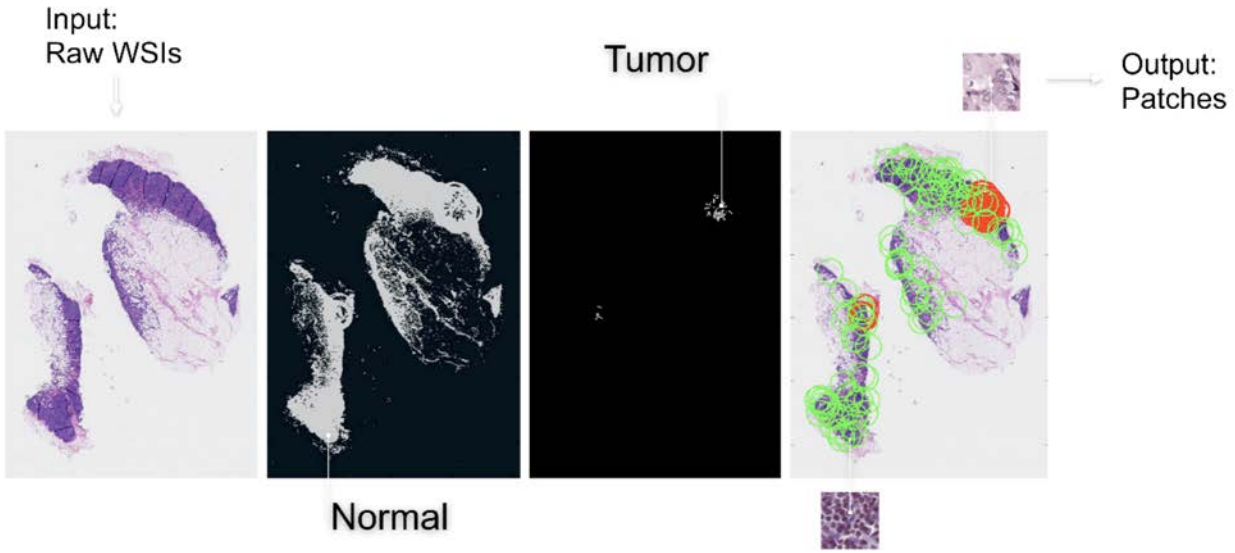
Effect of Processing

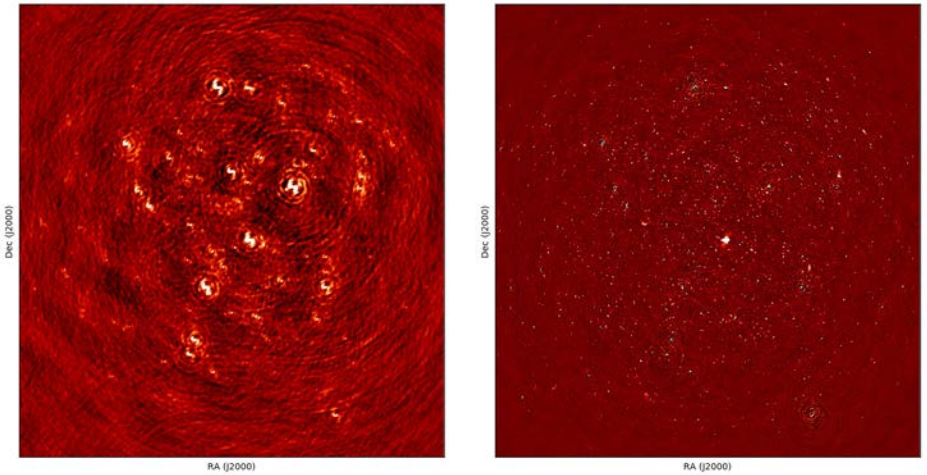


UCs prototypes based on modular services

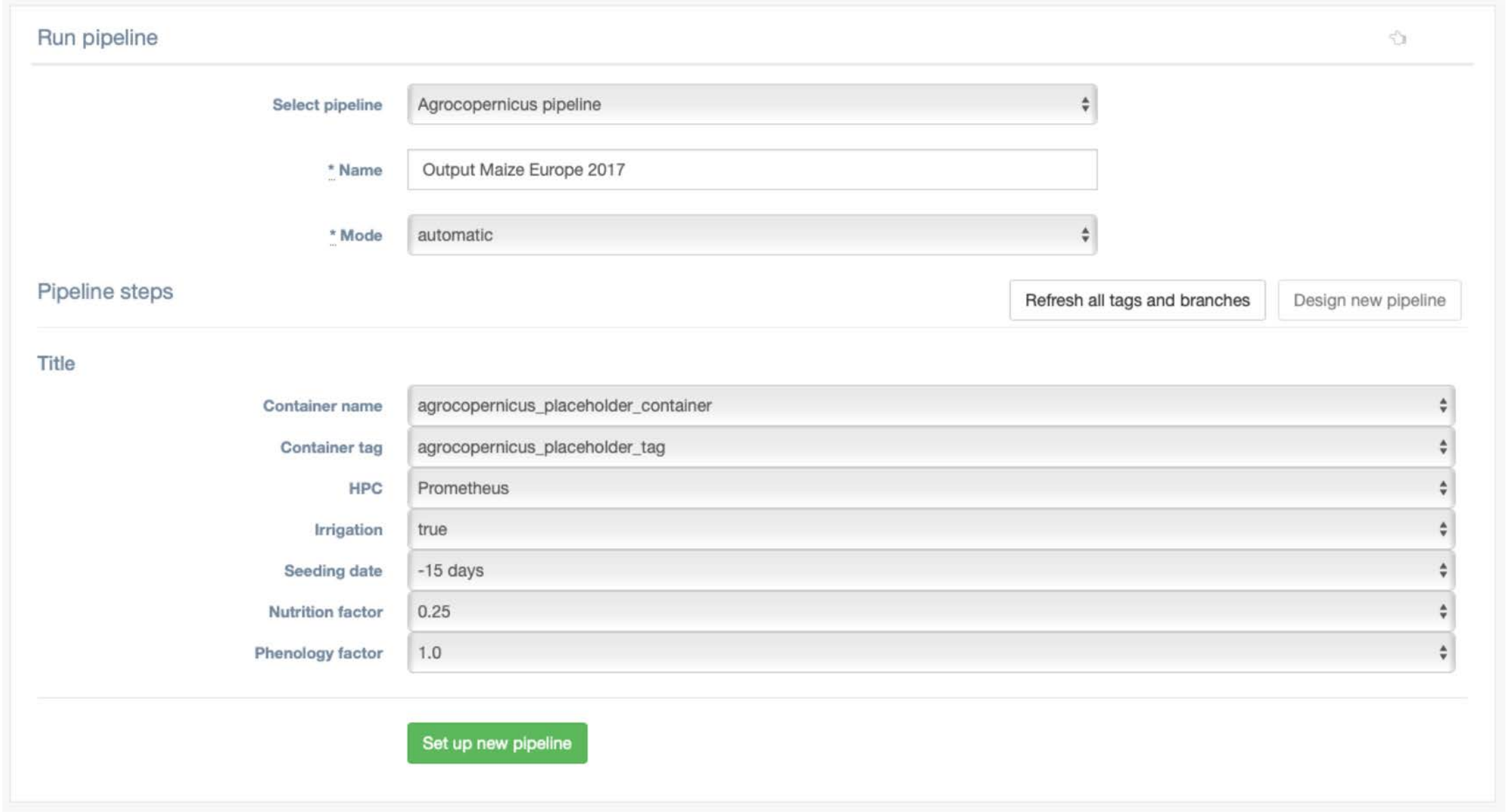




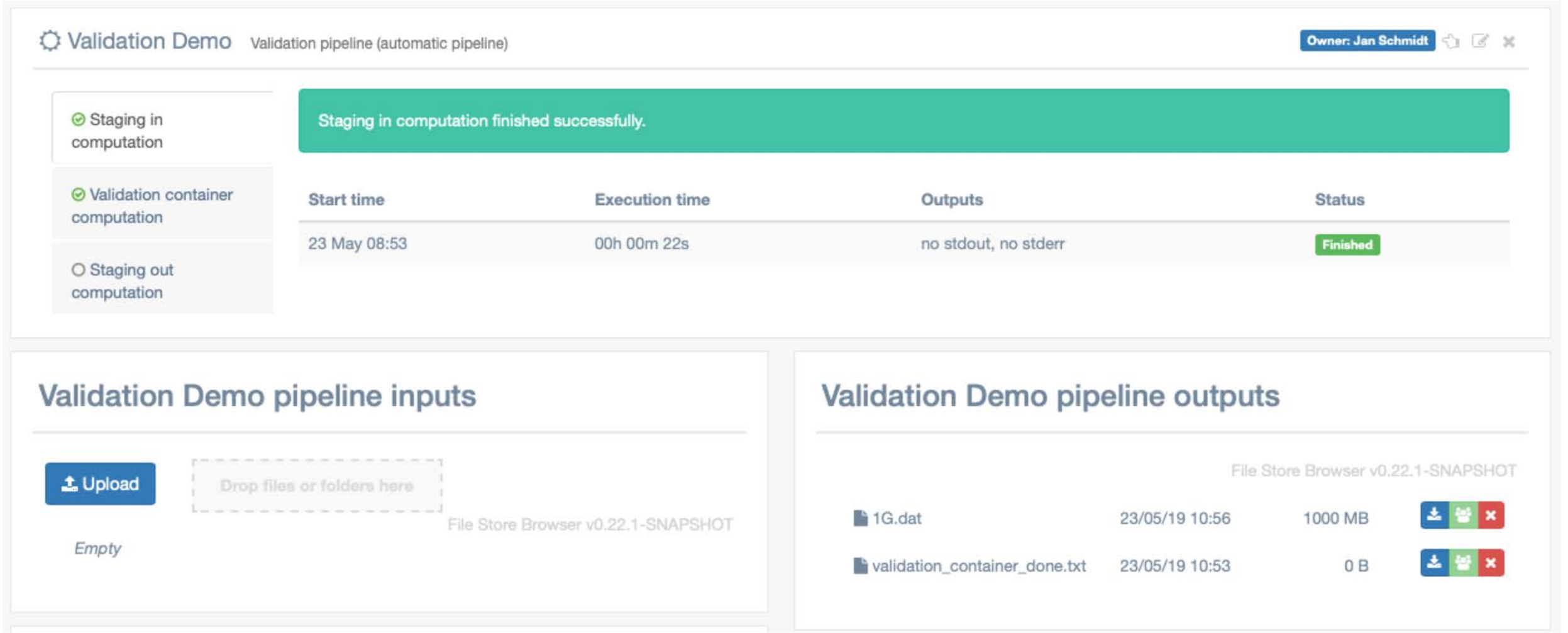




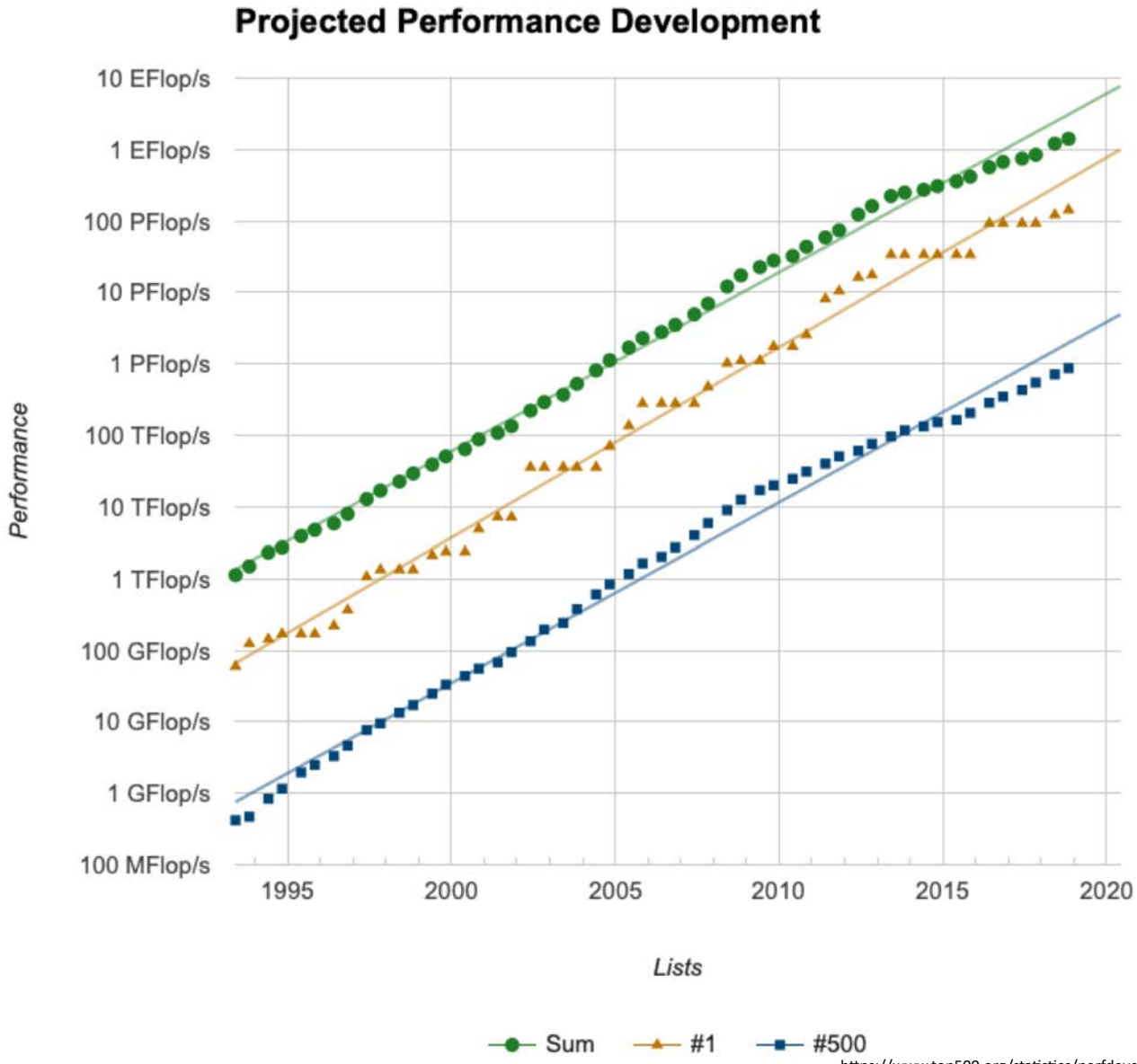
Pipeline and Workflow Configuration Portal



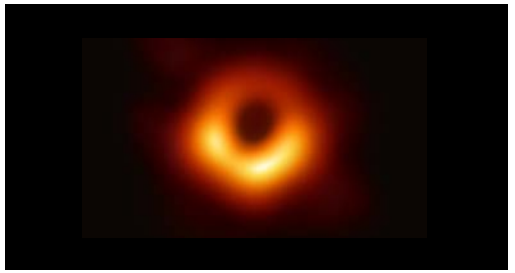
Pipeline Deployment and Output

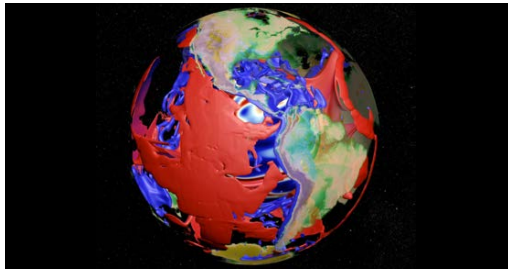


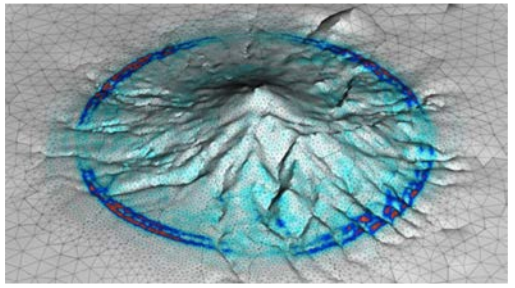
Enabling Exascale

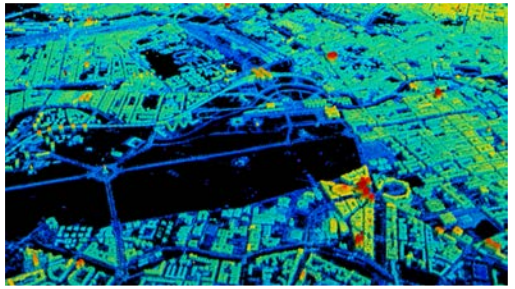


https://www.top500.org/statistics/perfdevel/









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eScience Workshop

Platform-driven e-Infrastructure Innovations

September 24, 2019, San Diego, USA

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