A versatile Cloud Computing environment to facilitate African-European partnership in research:
EO AFRICA R&D Innovation Lab

F. Adam*, R. Leclair*, B. Mora*, N. Stancioi**, T. Roth***, M. Farnaghi****, **S. Girgin (s.girgin@utwente.nl)** ****, Z. Vekerdy****
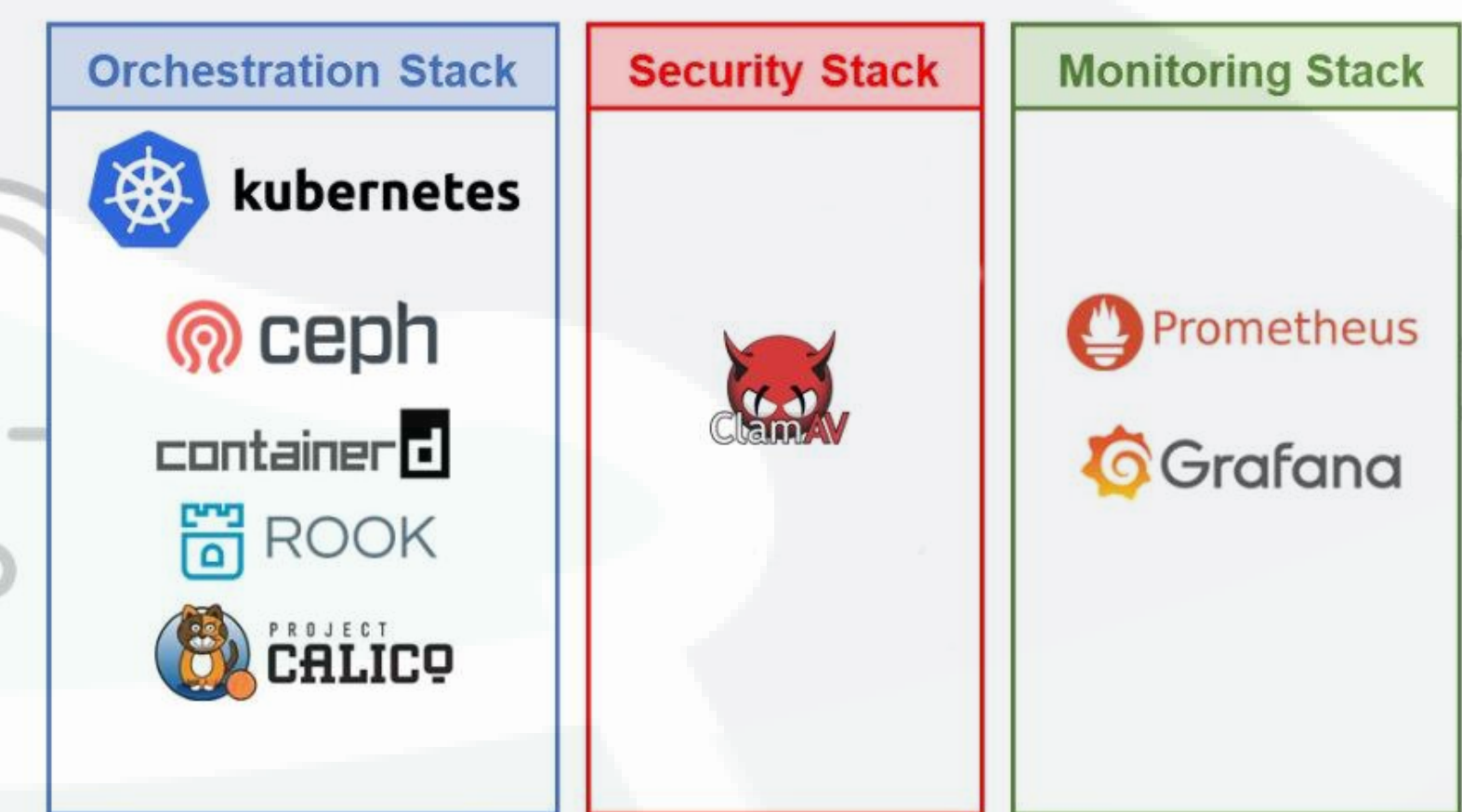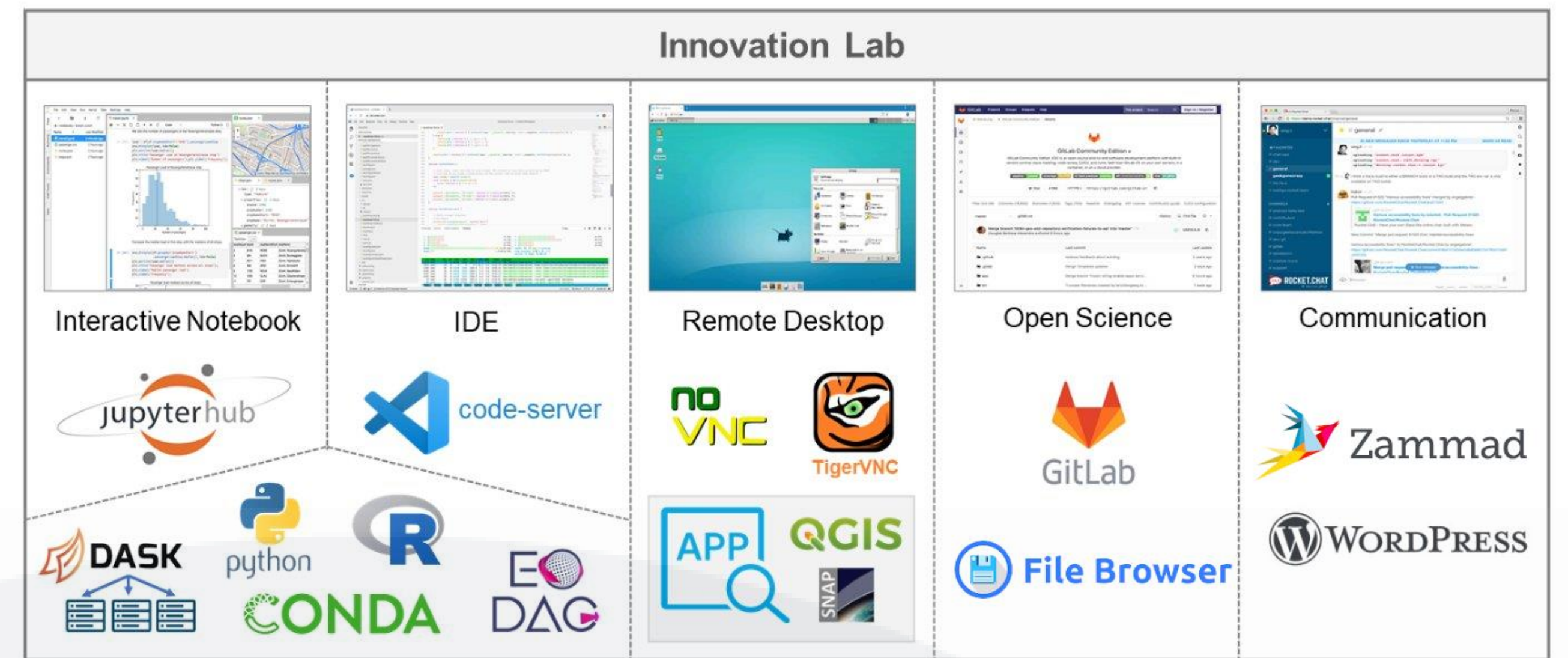
* CS GROUP France   ** CS Group Romania   *** Serco UK & Europe   **** Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente

The African Framework for Research, Innovation, Communities and Applications (EO AFRICA) is an **ESA** initiative in collaboration with the **African Union Commission** that aims to foster an **African-European R&D partnership** facilitating the sustainable adoption of Earth Observation and related space technologies in Africa.

EO AFRICA R&D Facility is the flagship of EO AFRICA with the overarching goals of enabling an **active research community** and promoting creative and collaborative **innovation processes** by providing funding, advanced training, and computing resources.

The Innovation Lab is a state-of-the-art **Cloud Computing infrastructure** provided by the Facility to **30 research projects** of African-European research tandems and participants of the **capacity development activities** of the **Space Academy**. The Innovation Lab creates new opportunities for innovative research to **develop EO algorithms and applications** adapted to African challenges and needs, through interactive **Virtual Research Environments** (VREs) with **ready-to-use research and EO analysis software**, and facilitated access to a wide range of **analysis-ready EO datasets** by leveraging the host **DIAS** infrastructure.
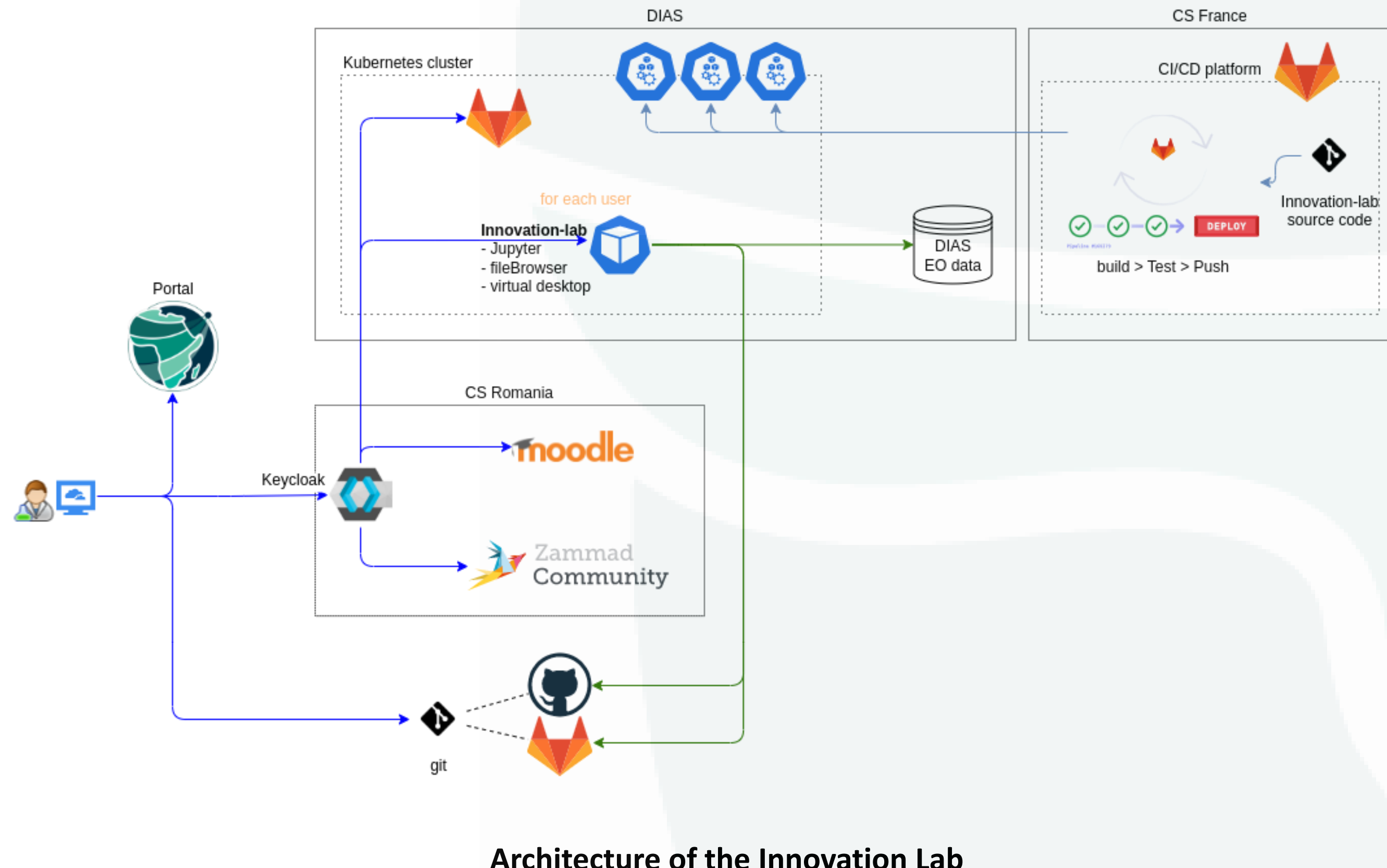
- **Co-located data and computing** services enable fast data exploitation and analysis, which in turn facilitates the utilization of multi-spectral spatiotemporal big data and machine learning methods.
- Each user has **direct access** to all online EO data available on the host DIAS (**CreoDIAS**), especially for Africa, and if required can **request archived data**, which is automatically retrieved and made available within a short delay.
- The Innovation Lab also supports user-provided **in-situ data** and allows access to **EO data on the Cloud** (e.g., other DIASes, CNES PEPS, Copernicus Hub, etc.) through a unified and easy-to-use and open-source data access API (**EODAG**).
- Because all data access and analysis are performed on the server-side, the platform does not require a fast Internet connection, and it is **adapted for low bandwidth** access to enable active collaboration of African – European research tandems.

Architecture of the Innovation Lab

After a 6-month development and testing, the **Innovation Lab** became operational in **September 2021**. The first field testing of the platform took place in November 2021 during a **3-day hackathon** jointly organized by **EO AFRICA R&D, GMES & Africa, and CURAT** as part of the **AfricaGIS 2021** conference. 40 participants utilized the platform to develop innovative solutions to food security and water resources challenges, such as the impact of the **COVID-19 pandemic on agricultural production** or linking the decrease in **agricultural production to armed conflicts**. Similar activities will be organized during major GIS and EO conferences in Africa during the lifetime of the project. **30 research projects** of African-European research tandems granted by the Facility will utilize the Innovation Lab to develop innovative and **open-source EO algorithms and applications** adapted to African solutions to African challenges in food security and water scarcity. The call for the first 15 research projects was published in November 2021, and the projects will start using the Innovation Lab in May 2022.

The **Innovation Lab** also provides the computing environment for the **capacity development** activities of the EO AFRICA R&D Facility, which are organized under the umbrella of the **EO AFRICA Space Academy**. The capacity development activities include **MOOCs, webinars, online and face-to-face courses** designed and tailored to improve the knowledge and skills of African researchers in the utilization of Cloud Computing technology to work with EO data. Participants of the capacity development activities are using the Innovation Lab during their **training**. Moreover, the instructors use it to **develop the training materials** for the **Space Academy**. Access to the Innovation Lab will also be granted to individual researchers and EO experts depending on the use case and resource availability. Application for access can be made easily through the EO AFRICA R&D web portal after becoming a member of the **EO AFRICA Community**.

Main Components of the Innovation Lab

The user interface of the **Innovation Lab** allows the use of interactive **Jupyter** notebooks through the **JupyterLab** environment, which is served by a **JupyterHub** deployment with improved security and scalability features. For advanced research code development purposes, the Innovation Lab features a web-based **VS Code** integrated development environment, which provides specialized tools for programming in different languages, such as **Python** and **R**. Code analytics tools are also available for **benchmarking**, code **profiling**, and memory/performance **monitoring**. For specific EO workflows that require exploiting **desktop applications** (e.g., ESA SNAP, QGIS) for pre-processing, analysis, or visualization purposes, the Innovation Lab provides a web-based remote desktop with ready-to-use EO desktop applications. The users working environments are **customizable** by using standard package managers. As a minimum configuration, each user has access to computing units with **4 vCPUs, 32 GB RAM, 100 GB local storage, and 1 TB network storage**. To a limited extent and for specific needs (e.g., AI applications like Deep Learning), **GPU-enabled** computing units are also provided. As endorsed by the European Commission **Open Science** approach, **data and code sharing and versioning** are crucial to allow reuse and reproduction of the algorithms, workflows, and results. The Innovation Lab has tools that provide direct access to code repositories and allow easy version control. The assets (e.g., files, folders) stored on the platform can be easily accessed and shared externally through the **FileBrowser** tool.
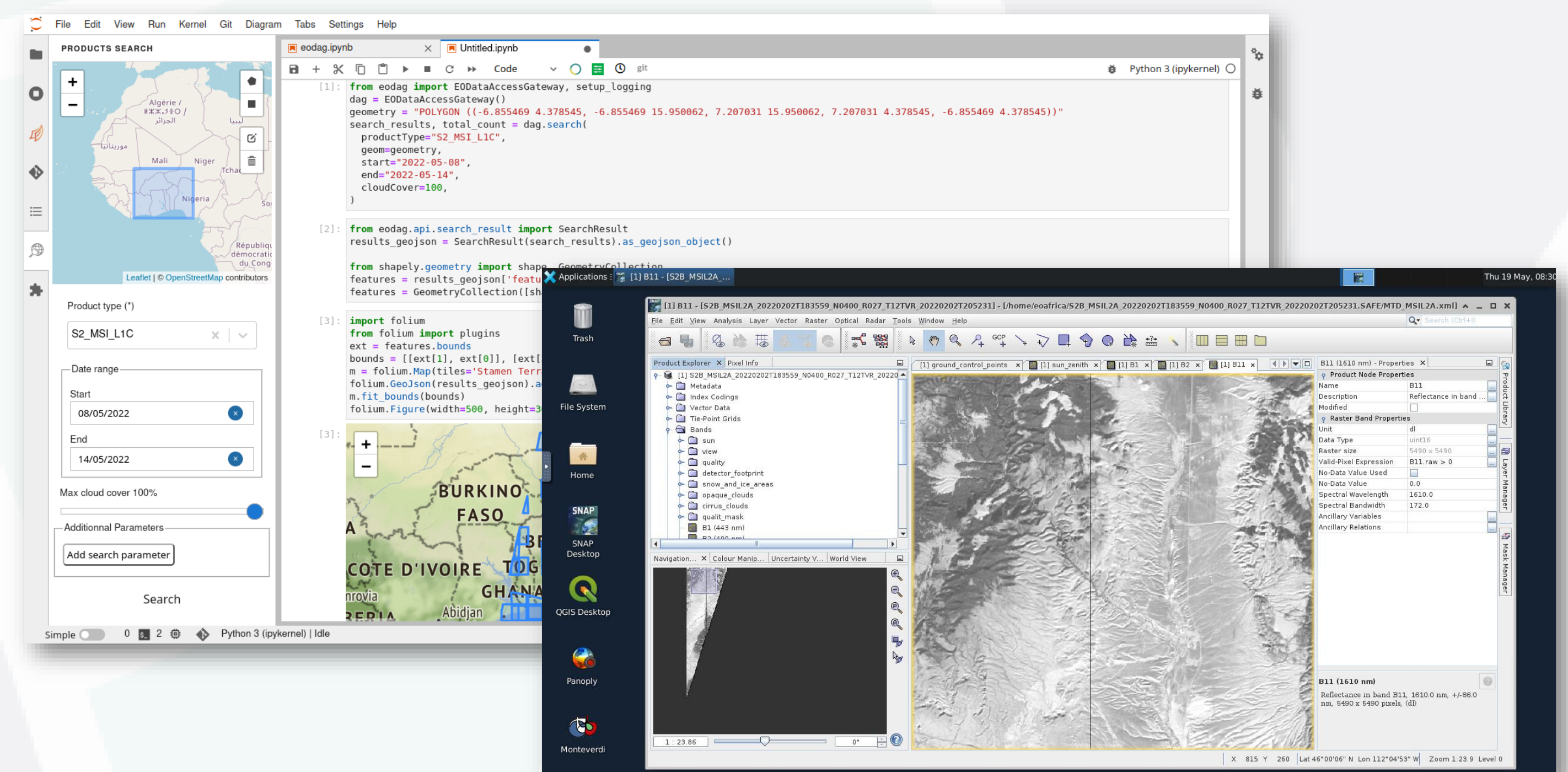
Besides providing a state-of-the-art computing infrastructure, the **Innovation Lab** also includes other **necessary services** to ensure a comfortable virtual research experience. All research projects granted by the EO AFRICA R&D Facility receive **dedicated technical support** for the Innovation Lab facilities. **Scientific support and advice** from senior researchers for developing geospatial computing workflows are provided. Users are able to request support contacting a **helpdesk via a dedicated ticketing and chat** system.

Interface of the Innovation Lab

For more information: https://eoafrica-rd.org

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