Science Gateways in EOSC

The NEANIAS Visualisation Gateway

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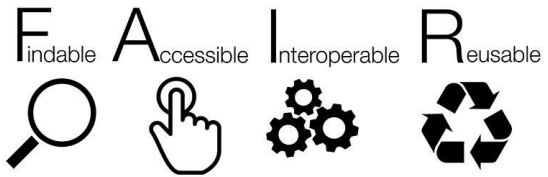
Background

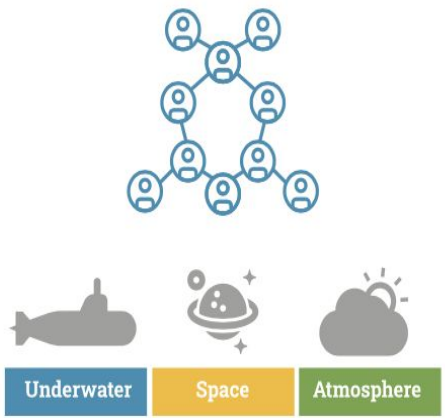
The **European Open Science Cloud (EOSC)** is an emerging virtual environment underpinning the handling of high complexity volumes of information generated by the Big Data revolution.

The EOSC roadmap foresees a seamless **federation** of existing and future research data infrastructures, under the umbrella of a *common policy* to enable **FAIR datasets** to be utilized and shared throughout entire value chains.



H2020 NEANIAS Project

NEANIAS



{NEANIAS}

- Novel EOSC services for Emerging Atmosphere, Underwater & Space Challenges
- Prototyping of new innovative services for the underwater, atmospheric and space research sectors.
- Onboarding thematic and core reusable services on EOSC.

Horizon 2020
European Union Funding
for Research & Innovation

21 partner da **10** stati

H2020 NEANIAS Objectives

O1: Address community-specific needs for *underwater*, *atmosphere* and *space* research sectors

- Developed for integration into EOSC, 13 innovative cross-cutting services for the three thematic sectors.

O2: Onboard communities to the Open Science, EOSC and interdisciplinary research era

- Deployed a set of core services dedicated explicitly to the principles of Open Science. Adopted Zenodo as Research Product Catalogue and Repository.

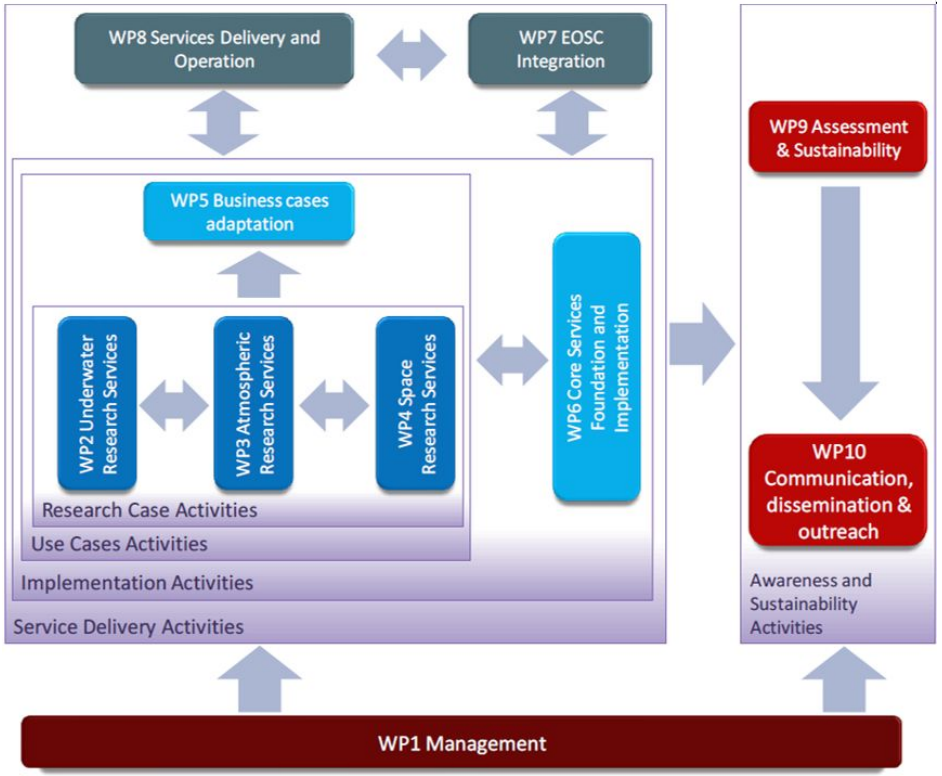
O3: Nurture new business opportunities

- Engaged SMEs as service providers/consumers and business/innovation experts. Actively onboarding new business cases via Open Innovation calls.

O4: Power-up EOSC

- Onboarded communities in underwater, atmospheric, and space sectors and new service providers from academia and SMEs. Also delivered generic core reusable services and instruments and processes for efficient delivery of quality software.

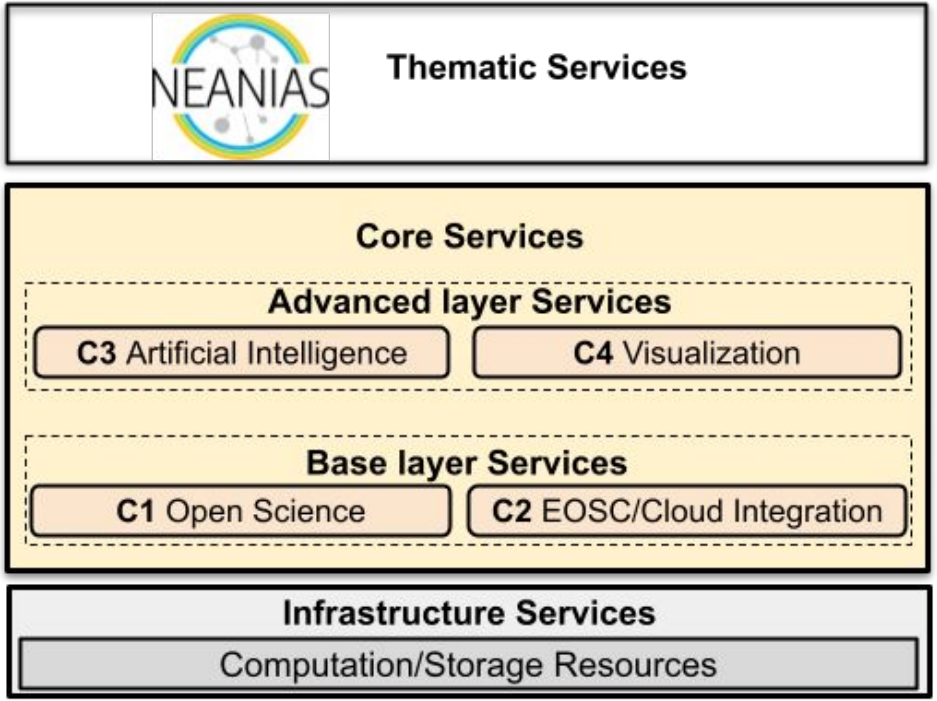
H2020 NEANIAS Work Plan



NEANIAS Core Services

Ecosystem of generic flavour offerings compliant with **Open Science principles** and streamlines access to cloud resources thus paving the way for migration to EOSC.

- Open Science lifecycles (C1)
- EOSC integration (C2)
- Artificial Intelligence (C3)
- Visualization services (C4)



Design Principles

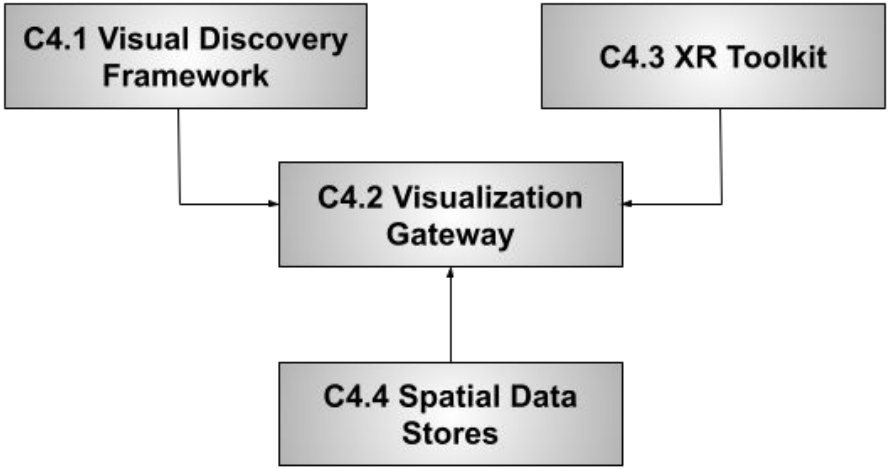
- The core services ecosystem in NEANIAS is manifested as a **service-oriented architecture**
- Support mechanisms for various degrees of **composability** and **integration**
- Fully embrace the **REST paradigm** and **FAIR principles**
    - REST designs are commonly deployed in EOSC for optimal offerings in terms of modifiability, performance and scalability.
    - FAIR in core services ensures data compliant with findable, accessible, interoperable and reusable mechanisms.
- Deploy **microservices** to enforce *single responsibility principles*, decoupling components for reusing, according to the interoperability scenario on hand.

Visualization Services

Core Visualization (C4) services in NEANIAS lie within the upper layer of the core services cluster.

Each service can be viewed as a *fundamental building block* of a typical scientific visualization workflow, focusing on:

- visual discovery frameworks
- science gateway
- Cross-Reality (XR) frameworks to support virtual reality
- spatial data stores

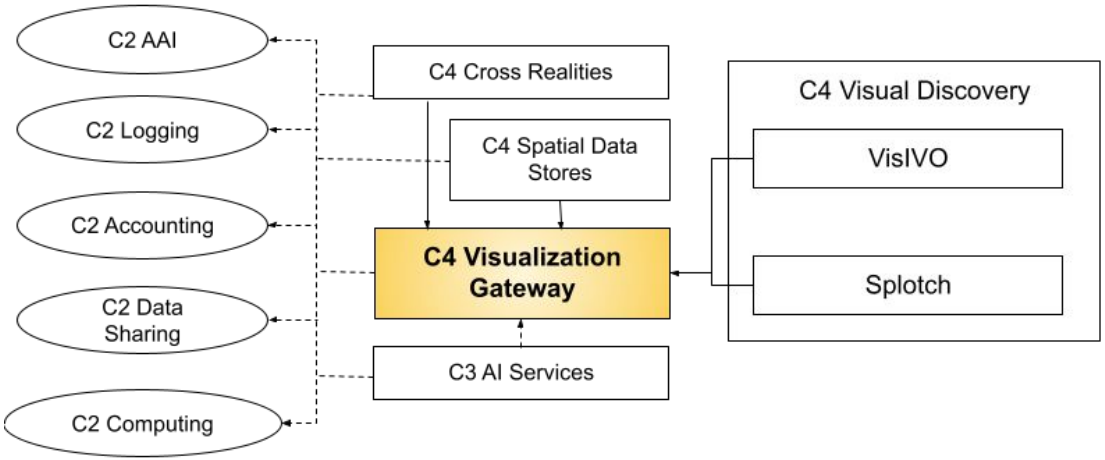


Sciacca, Eva, et al. "Scientific Visualization on the Cloud: the NEANIAS Services towards EOSC Integration." *Journal of Grid Computing* 20.1 (2022): 1-18.

Visualization Gateway (VG)

The **Visualization Gateway** enables visualization workflows.

The two *Visual Discovery* services (VisIVO and Splotch) are exposed to the end-users and interlink also with other NEANIAS core services.



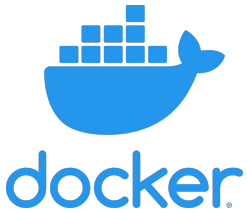
All services are integrated with C2 services for *AAI, logging, accounting, data sharing* and *computing access*.

VG Implementation (1)

The Visualisation Gateway is built on top of **JupyterHub** for its use by the scientific community.

It can easily spawn **hubs** with different **environments** which is especially useful for the NEANIAS use cases

It includes **Splotch**, **VisIVO** and **ADAM-API** which are containerised using **Docker**.

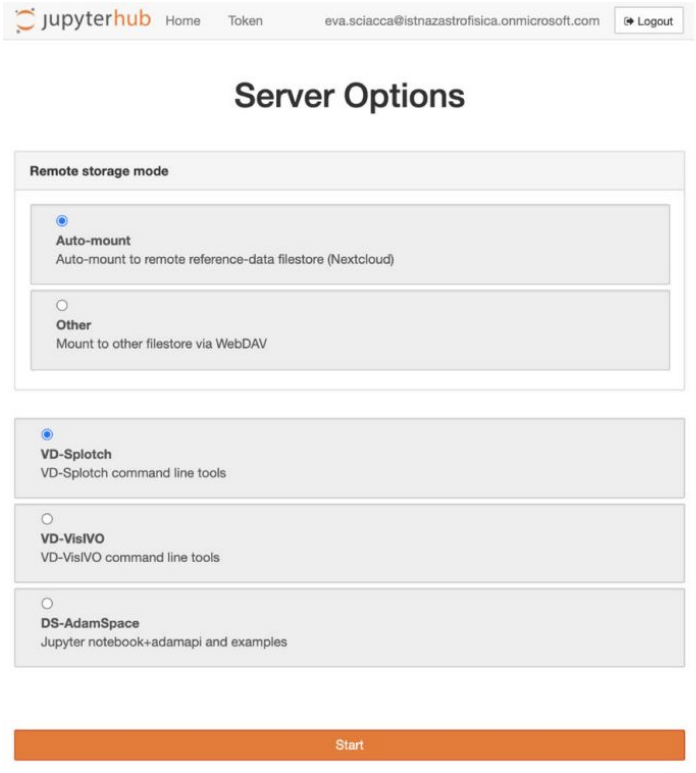


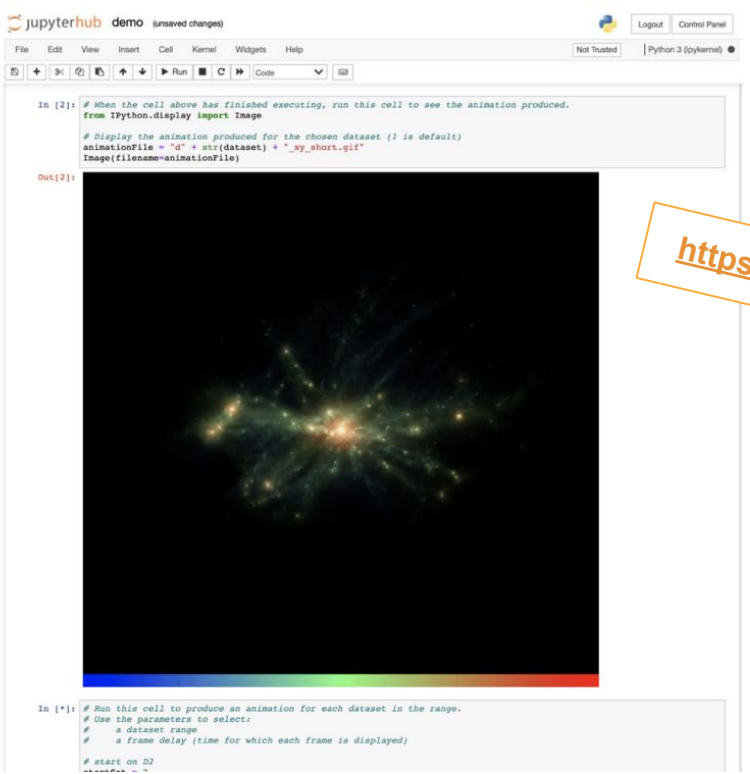
Containers are stored on **GitLab** with the mounting of demo data files and demo notebook files through **NextCloud**.

It runs a **FileBeat** data sharing pod alongside that allows to connect to the NEANIAS Logging and Accounting infrastructure.

Deployed on the **GARR cloud platform** on the NEANIAS **Kubernetes** cluster.

VG Implementation (2)





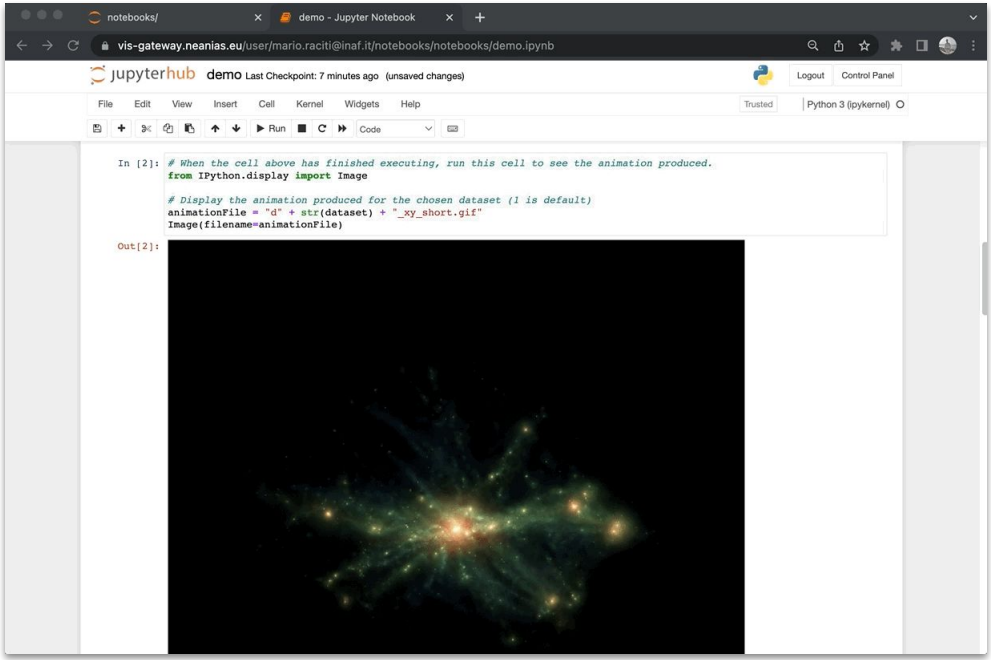
https://vis-gateway.neanias.eu/

Use Cases

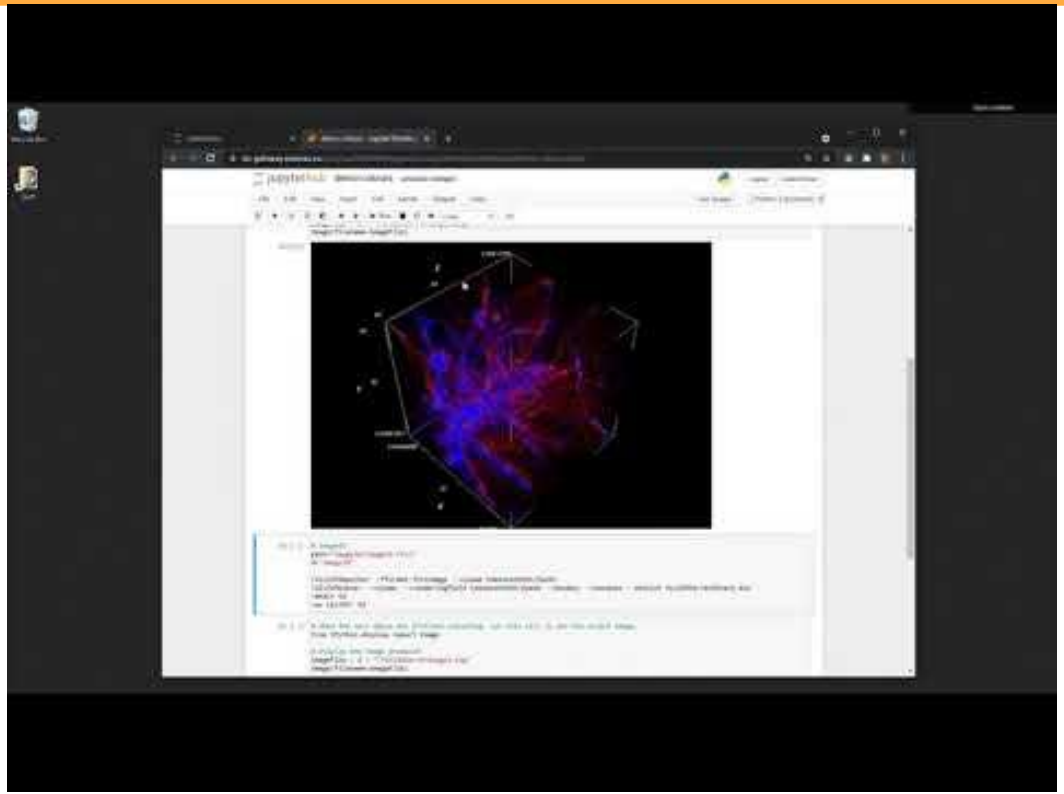
- **Particle based visualization**, enabled by the VD-Splotch environment, which makes available the suite of tools provided by **Splotch** for data processing and visual discovery.
- **Multi-dimensional visualization**, enabled by the VD-VisIVO environment, which allows the visualization pipelines available within **VisIVO** for exploration of large-scale datasets.
- **Spatial Data-store visualization**, enabled by the DS-AdamSpace environment.

Use Cases - Particle based visualization (Splotch)

Splotch supports very large-scale datasets and an array of diverse parallelization models for fast, high-quality distributed volume rendering of particles, coming from numerical simulations in many file formats, e.g., smoothed particle hydrodynamics from astrophysical simulations.



Use Cases - Multi-dimensional visualization (VisIVO)



Use Cases - Spatial Data-store visualization (AdamSpace)

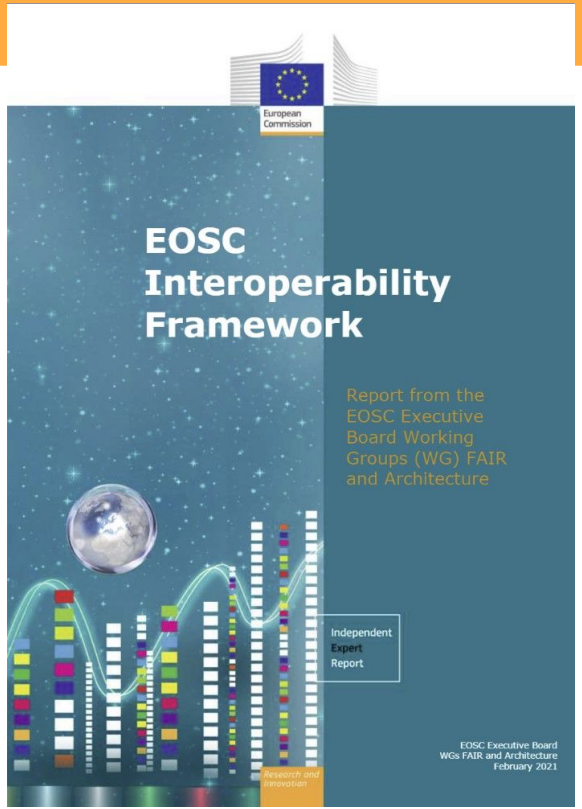
AdamSpace API accesses to a set of reference systems and data structures by means of data referencing, access, and retrieval services provided by the Spatial Data Store, in a standardized manner based on positional/location criteria.

Useful to navigate maps related to the Earth or other planetary bodies such as Mars.

EOSC Interoperability

The Visualization Gateway accomplishes different aspects of technical interoperability recommendations, as defined in the *EOSC Interoperability Framework*, namely:

- Use **open specifications**.
- Define a common **security and privacy framework** and establish processes to ensure secure and trustworthy data exchange.
- **Easy access to data sources** available in different formats.
- EOSC **PID policy**, accommodating any appropriate PID usage.



EOSC Integration (1)

Accomplished thanks to the different types of compositions and integration implemented to ensure links with both **EOSC Core** and **EOSC Exchange** services that are the fundamental building blocks in EOSC.

EOSC-Core

- Provides the functionality that is required to enable Open Science practices
- Occurring across domains and countries
- According to the EOSC interoperability framework.

EOSC-Exchange

- A digital marketplace that builds on the EOSC-Core to offer a progressively growing set of services.
- Services are expected to exploit FAIR data and encourage its reuse by publicly funded researchers.
- Include Data Services, such as those that store, preserve or transfer research data as well as Compute Services that process data.

EOSC Integration (2)

The **Visualization Gateway**:

EOSC-Core

- is composed with resources available within the EOSC-Core to make it **interoperable in EOSC** (e.g. NEANIAS AAI)
- has **horizontal added value services** (e.g., the GARR container computing service)

EOSC-Exchange

- is **interoperable horizontally** with other resources from different scientific clusters (integration with the NEANIAS Data Sharing service)
- is able to compose scientific resources to **create added value solutions to handle complex scientific workflows** (e.g. data from the XR-toolkit are reached and visualized using VD-VisIVO within the gateway)

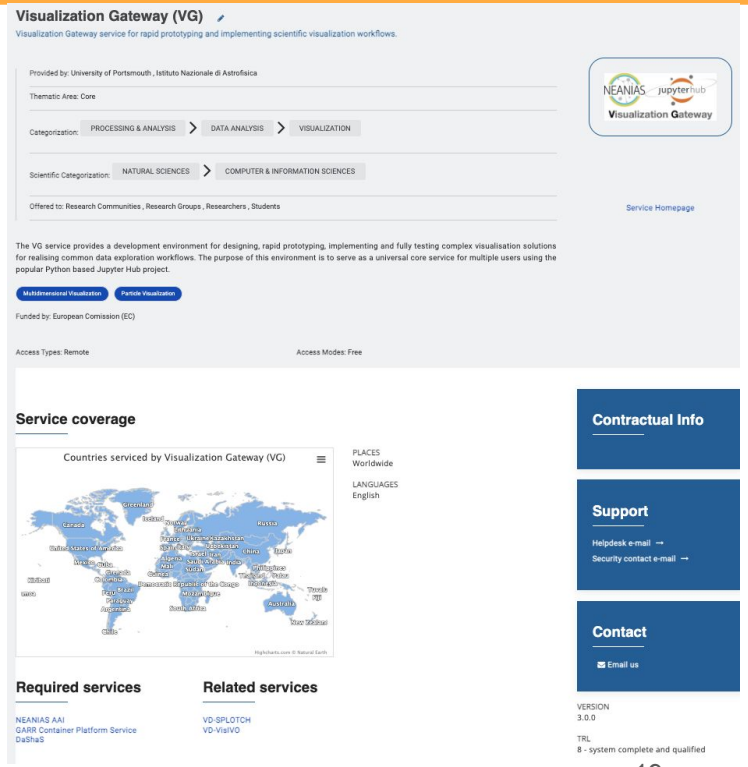
EOSC Onboarding

Onboarding the gateway to the EOSC Portal

EOSC Provider -> University of Portsmouth + INAF (in progress)

EOSC Resource -> Visualization Gateway (in progress)

Process facilitated by employing the NEANIAS Service Catalogue that already contains all the needed information and metadata.



Conclusions and Future Works

We presented the **NEANIAS Core Visualization Gateway** service which is tailored for *visual discovery*, and integrating with *cross-reality services* and *spatial data stores*.

The development of NEANIAS services is being finalized and will be completed by the end of 2022.

NEANIAS jupyterhub
Visualization Gateway

Save the date! VG Webinar
June 22, 2022; 15:00 CEST

For more information or questions, please contact us: mario.raciti@inaf.it, eva.sciacca@inaf.it