



European Union's Horizon 2020 Research and Innovation Programme
Grant Agreement No 101007599



PITHIA-NRF

Plasmasphere Ionosphere Thermosphere Integrated Research Environment and Access services: a Network of Research Facilities

Anna Belehaki, PITHIA-NRF coordinator
Research Director, National Observatory of Athens
TDM, 27 October 2021



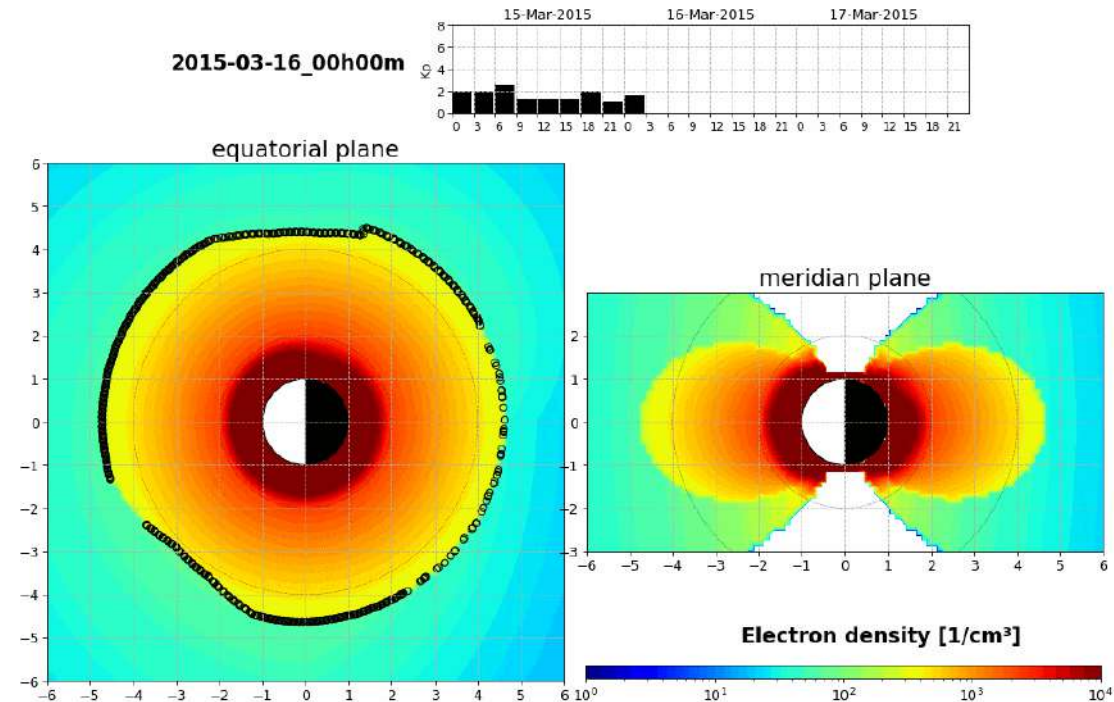
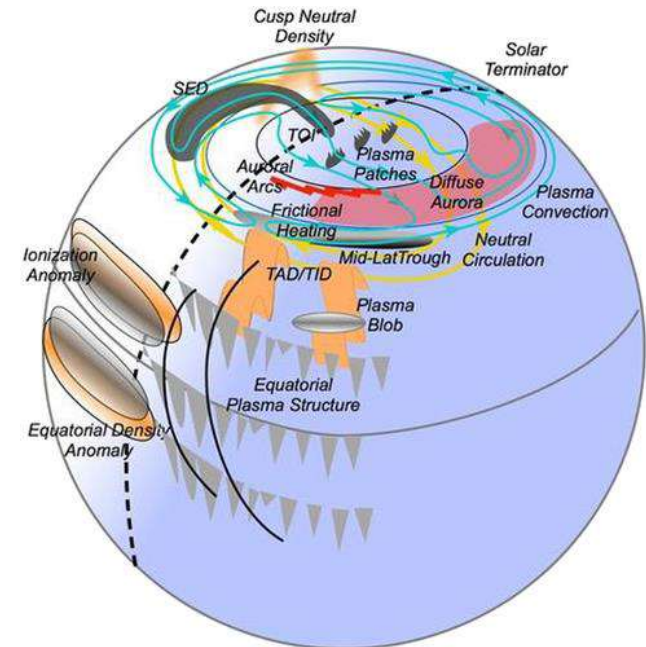


Scientific challenges

The Earth's Ionosphere, Thermosphere, and Plasmasphere is governed by the complex electrodynamic and photochemical system of the upper atmosphere coupled with variable electromagnetic fields and thermospheric winds.

These physical processes are the source of many **scientific, operational, societal, and environmental challenges** that affect the smooth and uninterrupted operation of critical technological systems and of research infrastructures.

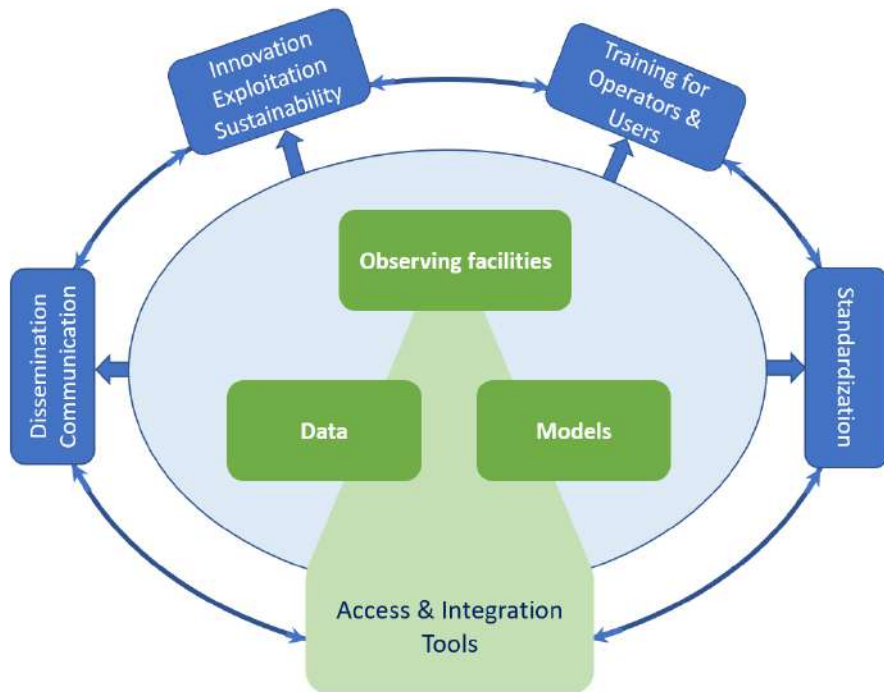
While we understand the broad features of the coupled ionosphere thermosphere plasmasphere system response, we lack the depth of understanding of its variability in long- and short-time scales that would allow us to build **models with real predictive power.**





Overview & Ambition

PITHIA-NRF has the ambition to facilitate the development of validated prediction models and its transition from research to applications



Europe operates excellent observing facilities and is extremely well-placed in developing ionospheric, thermospheric and plasmaspheric models.

However, more is needed to:

- Support the interoperable use of observing facilities;
- Develop standardized processes that lead to FAIR data and data-products;
- Facilitate the use of scientific models' concepts for experimentation purposes;
- Support space applications developers to implement innovative projects.

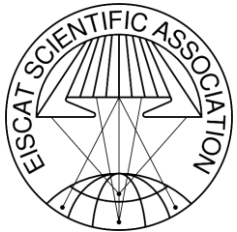
... and all these need to be more reliable.

To achieve this challenge, the scientific research community requires support from a **structured research infrastructure** organized to provide **transnational research services**, including **access** and **standardization**.



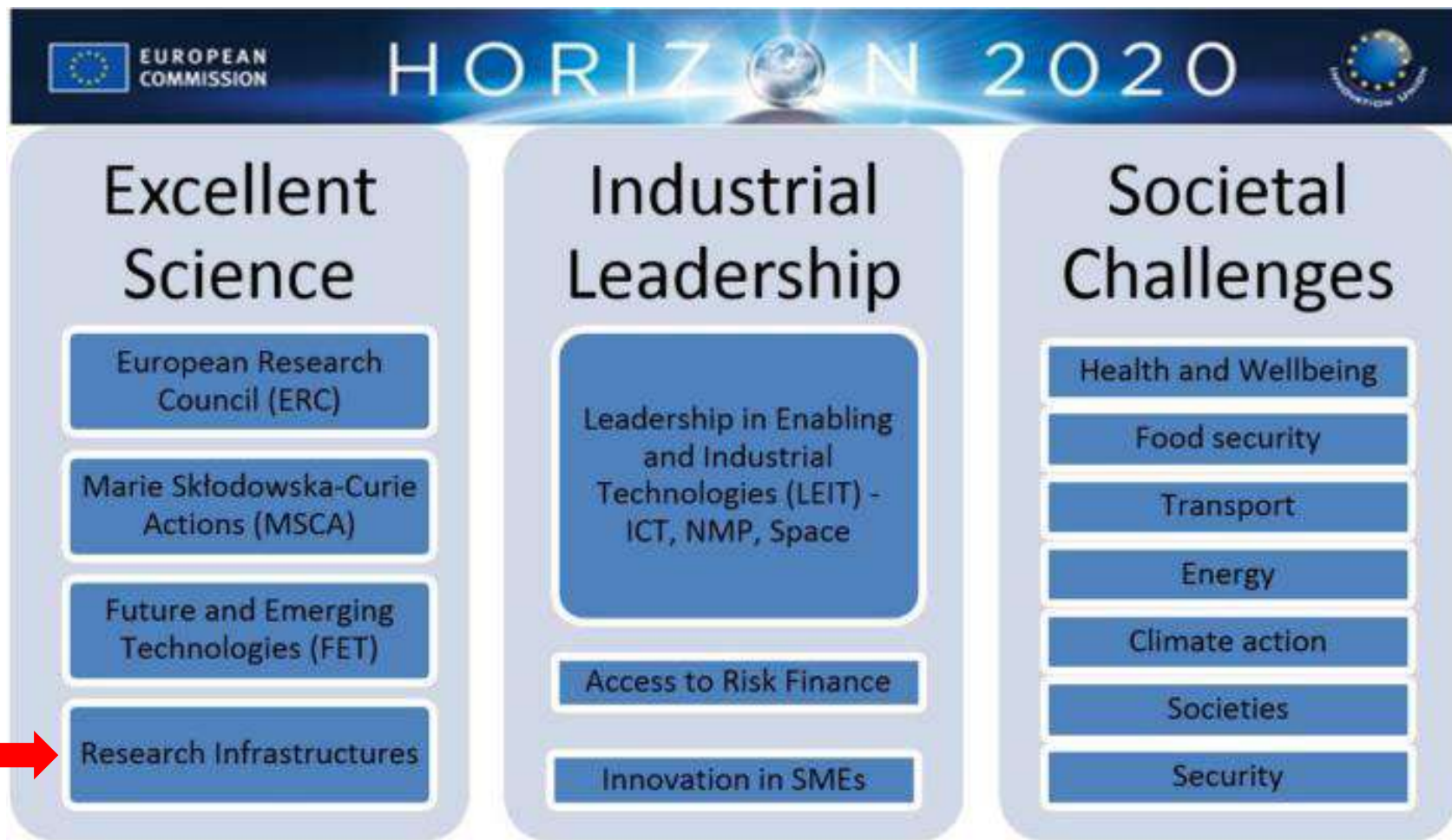
PITHIA-NRF consortium

- 22 Beneficiaries
- 2 Third Parties
- 5 External Advisors
- 52 Expressions of Interest



UNIVERSITY OF WESTMINSTER





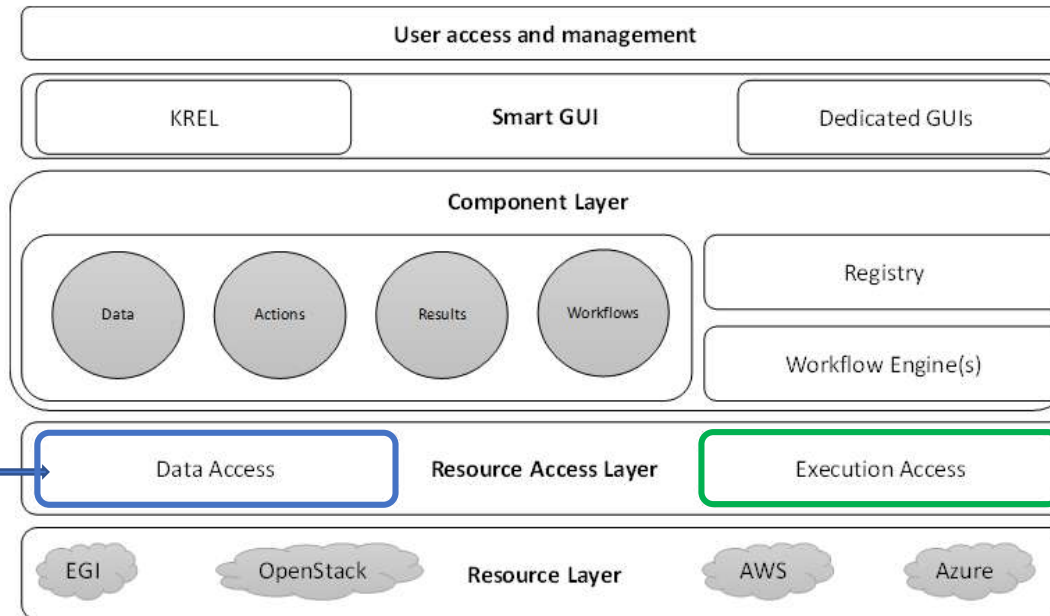


Objectives

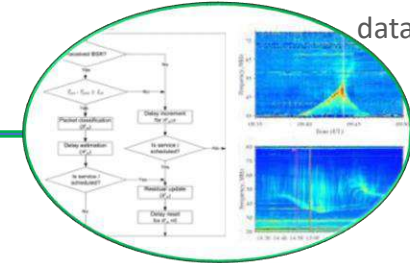
Objective 2

PITHIA-NRF develops **integration tools** that enable the establishment of a comprehensive Research Infrastructure. This set of tools is provided through the PITHIA-NRF **e-science center**, a dedicated knowledge hub that provides open access to FAIR data and higher-level data-products. These tools cover data discovery, data standardization, data quality control, publicly-accessible workflow applications to automate the calculation of data-products, and tools to enable the registration of new datasets and new models. An additional set of integration tools targets to the **optimization of observing strategies** through the release of standardized operation protocols, management tools, and training procedures for operators. These integration tools are expected to lead to the **optimal use and joint development of the PITHIA-NRF observing facilities**.

PITHIA-NRF Nodes Scientific Instrumentation



PITHIA-NRF Scientific data & Models

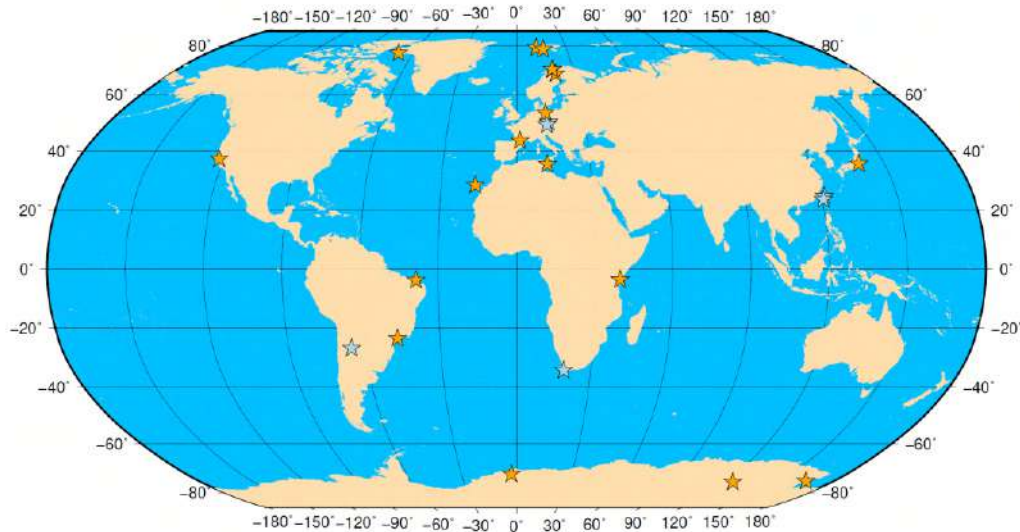




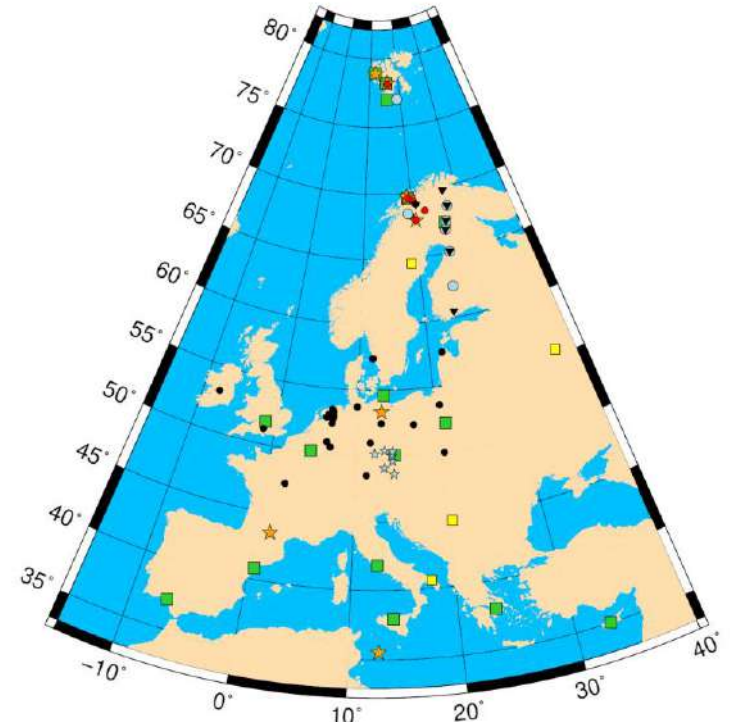
Objectives

Objective 3

Through connection with the European Open Science Cloud, the e-science center of PITHIA-NRF provides **long-term observational data**, required for advancing our knowledge in the Ionospheric, Thermospheric and Plasmaspheric research domain. PITHIA-NRF provides access to data from ground-based instruments such as GNSS ground based receivers, Ionosondes, Digisondes, Dynasondes, Doppler Sounders, Incoherent Scatter Radars, Riometers, All Sky Imagers, and the LOFAR radio telescope. It also provides access to data from satellite experiments, including in situ, Radio Occultation and Topside Sounding observations.



The World map shows GNSS high sampling rate and CDSS sites only.



- ionosondes with real-time data delivery ■
- ionosondes without real-time data delivery ■
- IAP CDSS transmitters and receivers (on both maps) ★
- INGV + DLR GNSS scintillation receivers (on both maps) ★
- EISCAT transmitters and receivers light blue circles: SGO riometer chain ●
- SGO pulsation magnetometer chain ▼
- LOFAR sites and sites associated with LOFAR ●

GNSS sites of standard networks (such as EUREF and IGS) are too numerous to be shown. The ionosondes (mostly Digisondes) with near real-time data provision are owned or operated by consortium partners or outside the consortium but offer free data access.



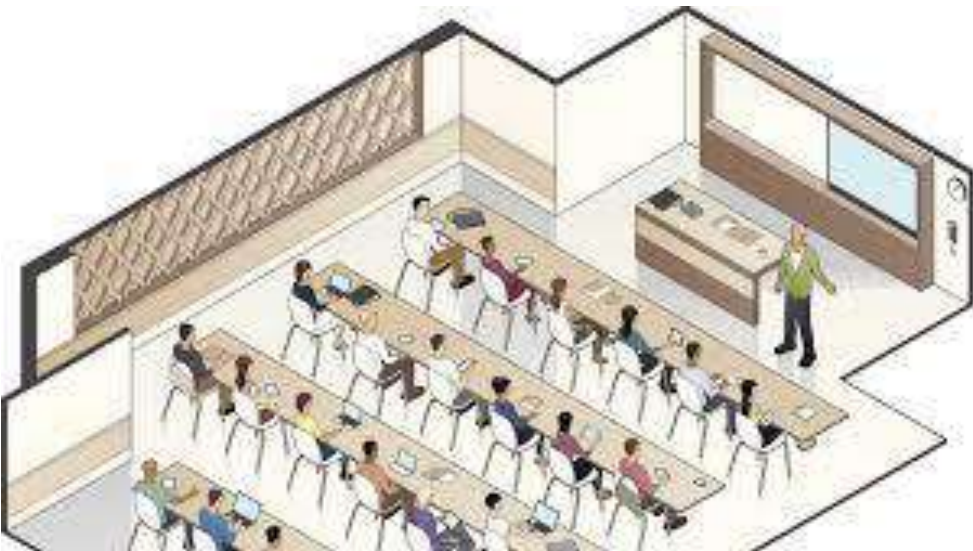
Objectives



Objective 4

PITHIA-NRF provides **organized and systematic training** on the use of observing facilities and of the integration tools.

- Training towards project partners in the use of integration tools
- Training towards external users, in particular students, scientists from countries with no tradition in space research, engineers from the R&D departments of private companies and large organizations.



- Training is provided through workshops, schools and webinars.
- To get access to PITHIA-NRF nodes, successful participation to on-site sessions is required.



Objectives

Objective 5

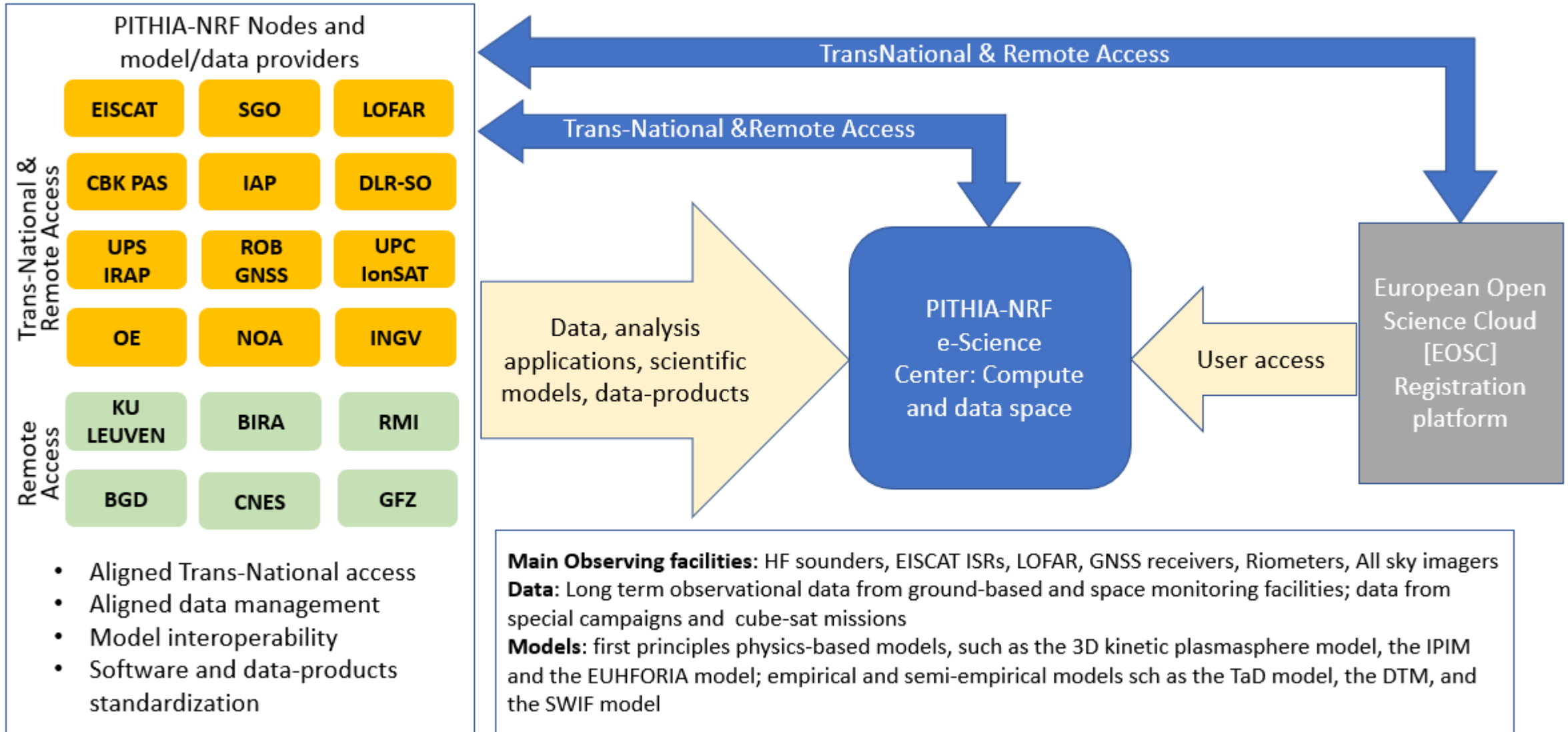
PITHIA-NRF builds the **innovation** platform to promote **cooperation between stakeholders** and sets the standards for future collaboration (i.e. the IPR policies for the exploitation of the services). It also provides the **tools** for continuous interaction with users, **promotion** of the PITHIA-NRF activities and services to the public and to the stakeholders, and promotes **joint public-private collaboration** for high-risk innovation and close-to-market activities.



This activity supports the **overarching aim of the PITHIA-NRF project for the establishment of a European distributed research infrastructure that will provide a range of services to the upper atmosphere community for R&D projects.**



Integrating facilities, data and models





Expected Impact

Improved **access**

Educate the **new generation of researchers**

Wider **sharing** of information, knowledge and technologies across fields and between academia and non-academic stakeholders

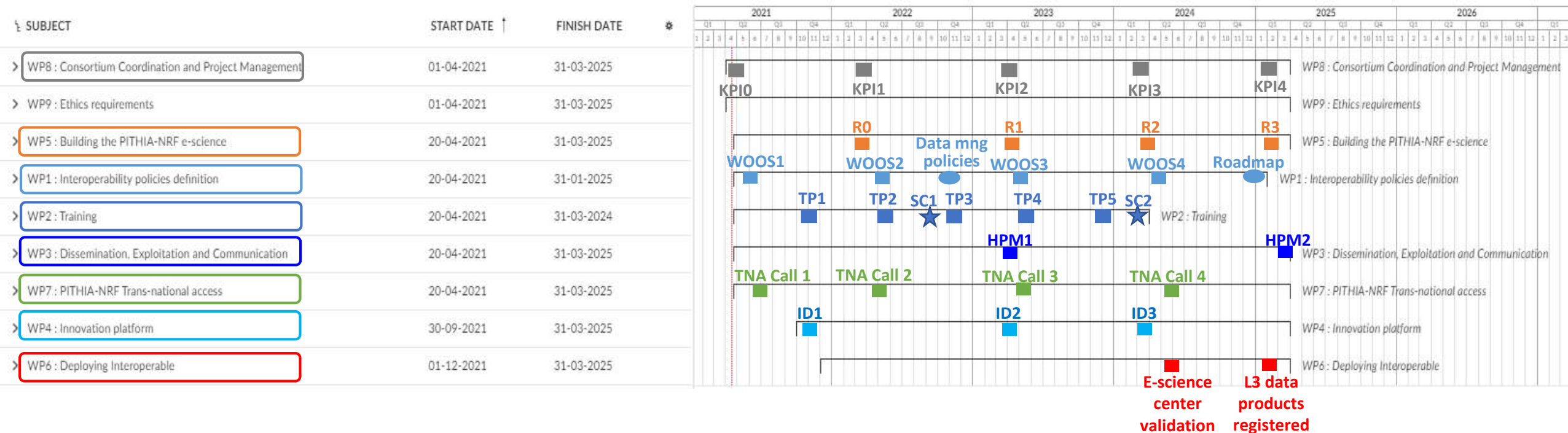
Integration of major scientific equipment and standardized management

New services made available to the wider community

Facilities' operators develop synergies that lead to **economies of scale**



Gantt chart



Project implementation period: April 2021 – March 2025



Thank you for your attention!

WEB: <https://www.pithia-nrf.eu>



The PITHIA-NRF project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007599