



## Overview

### PITHIA-NRF Project

*PITHIA-NRF is a Research Infrastructure project funded by the European Commission Horizon 2020 Programme, aiming at building a distributed network that integrates into a unified research environment all key observing facilities, data collections, data processing tools, and prediction models dedicated to ionosphere, thermosphere and plasmasphere research. Through the integration of different assets, the project offers R&D services to expert and early-career researchers and to software and instrument development professionals, enabling leading edge research and fostering innovation.*

*PITHIA-NRF has the ambition to become the European hub that will act as facilitator for coordinated observations, for data processing tools and modelling advances, and for software and data-products standardization, and will advise on the transitioning of models to operations providing e-Science supporting tools so that models can reach the desired accuracy and standards.*

*This e-newsletter aims at communicating to all stakeholders the project developments, specifically regarding the TransNational Access programme, the e-science services, the Training, Dissemination and Communication Activities and potential for collaboration within the Innovation Framework of the project.*

*- Dr. Anna Belehaki, Coordinator of the PITHIA-NRF project*

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### Imprint

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

### PITHIA-NRF Project

PITHIA-NRF aims at building a European distributed network that integrates observing facilities, data processing tools and prediction models dedicated to ionosphere, thermosphere and plasmasphere research.

### PITHIA-NRF Newsletter

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### PITHIA-NRF Training School: building the new generation of Earth's Upper Atmosphere scientists

The First Training School of the PITHIA-NRF project has been held at the INGV headquarters in Rome from May 29 to June 1, 2023. The school addressed the intricate dynamics of Earth's Ionosphere, Thermosphere, and Plasmasphere within the Sun-Earth system, and gave students the opportunity to understand the data and models available in the PITHIA-NRF e-Science Centre and to have hands-on experience with them.

The school was divided into three parts:

1. General lectures on the underlying physical mechanisms that shape the behaviour of the ionosphere, thermosphere, and plasmasphere.
2. Presentation on various datasets and models available through the e-Science Centre.
3. Hands-on Experience: attendees learned to access and exploit data sets and models available in the e-Science Centre, addressing a scientific case study and competing among each other in presenting their results in front of an evaluation committee.

The analytical programme consisted of six lectures on the physical processes and on experimental and observational methods and techniques, and eight lectures on the models deployed by the PITHIA-NRF researchers and on data analysis methodologies. The lecturers prepared several experimental topics aiming to train the students on the tools offered by PITHIA-NRF e-Science Centre to access registered data collections, to process the data and evaluate the results with the purpose to study a specific phenomenon, such as the effect of a geomagnetic storm in the upper atmosphere and the plasmasphere and its impact on the ionospheric plasma and on communications, the effect of atmospheric drag in satellites, the effect of earthquakes in the circulation of plasma in the ionosphere seen as travelling ionospheric disturbances, the effect of scintillations and the impact on satellite communications. On the final day of the school, the students presented the results of their own analysis and an Evaluation Committee ranked the presentations in respect to the completeness and scientific depth of the analysis.

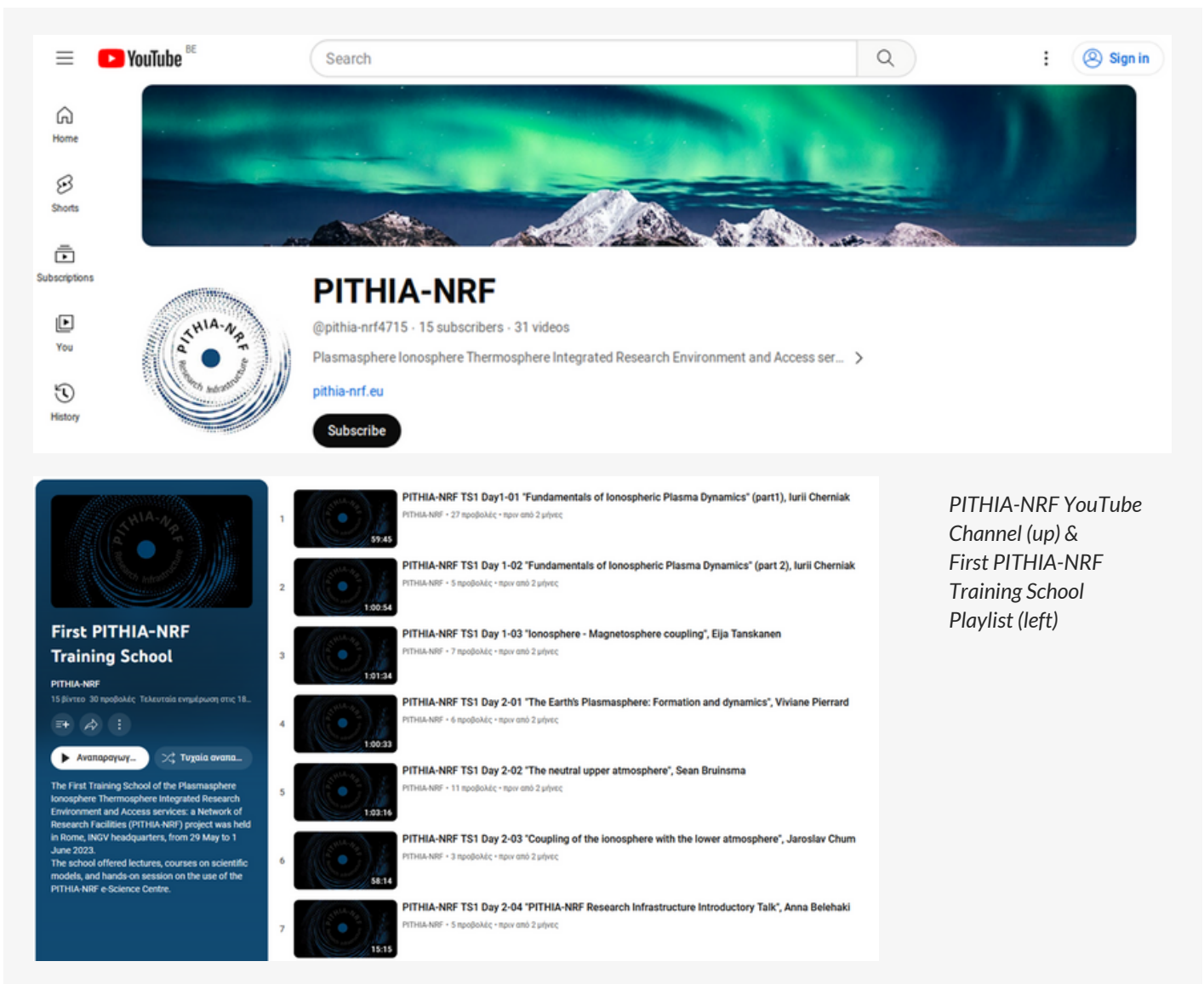


The school was attended by twenty-two students coming from all over the world, and four of them were fully granted with a financial support. The students have filled in a feedback questionnaire about their experience during the school. The response was generally very positive.

We cordially invite researchers and engineers of all levels to join the second PITHIA-NRF Training School in Belgium next year—see the announcement at the end of this newsletter. This opportunity is extended particularly to PhD students and early career scientists, aligning with the school's dedication to their growth.

## Webinars and video lectures

The PITHIA-NRF project has its own channel on YouTube, [accessible here](#). On this channel, all lectures from the First Training School of the project are now freely available. Also, presentation about the various aspects of the PITHIA-NRF e-Science Centre, recorded during earlier project events, are available as webinars to help new users find their way through the e-Science Centre.



The image shows a screenshot of the PITHIA-NRF YouTube channel. The channel name is "PITHIA-NRF" with the handle "@pithia-nrf4715", 15 subscribers, and 31 videos. The channel description is "Plasmasphere Ionosphere Thermosphere Integrated Research Environment and Access ser...". The channel website is "pithia-nrf.eu". There is a "Subscribe" button. Below the channel information, there is a video playlist titled "First PITHIA-NRF Training School". The playlist contains 7 videos:

1. PITHIA-NRF TS1 Day1-01 "Fundamentals of Ionospheric Plasma Dynamics" (part1), Iurii Cherniak (59:45)
2. PITHIA-NRF TS1 Day 1-02 "Fundamentals of Ionospheric Plasma Dynamics" (part 2), Iurii Cherniak (1:00:54)
3. PITHIA-NRF TS1 Day 1-03 "Ionosphere - Magnetosphere coupling", Eija Tanskanen (1:01:24)
4. PITHIA-NRF TS1 Day 2-01 "The Earth's Plasmasphere: Formation and dynamics", Viviane Pierrard (1:00:23)
5. PITHIA-NRF TS1 Day 2-02 "The neutral upper atmosphere", Sean Bruinsma (1:03:16)
6. PITHIA-NRF TS1 Day 2-03 "Coupling of the ionosphere with the lower atmosphere", Jaroslav Chum (58:14)
7. PITHIA-NRF TS1 Day 2-04 "PITHIA-NRF Research Infrastructure Introductory Talk", Anna Belehaki (15:15)

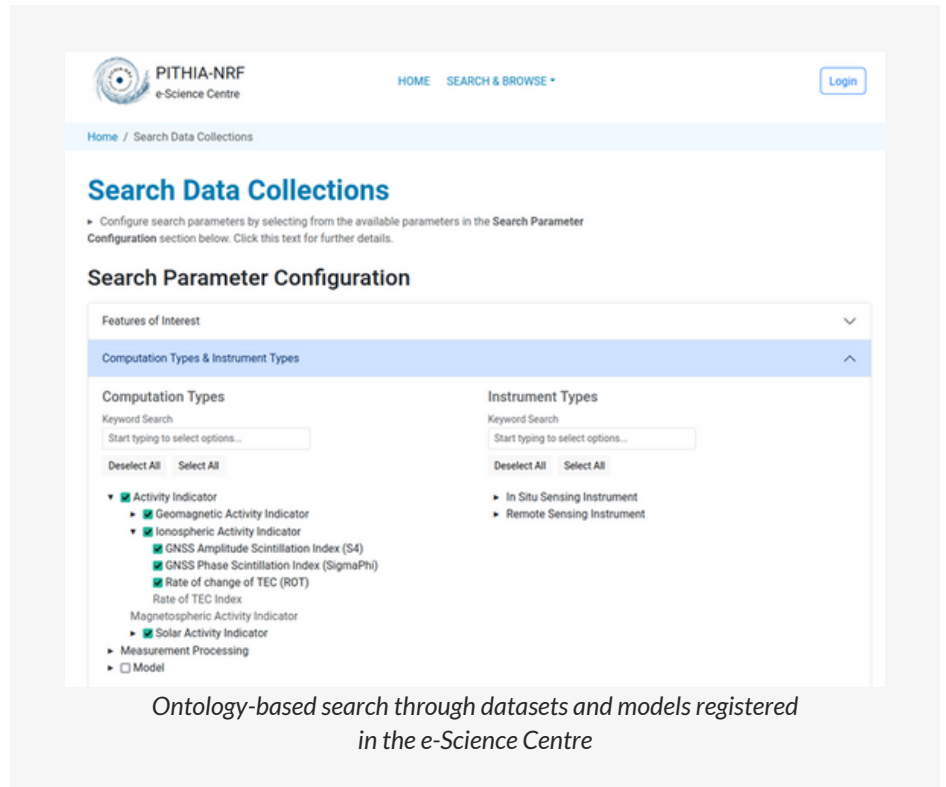
On the right side of the screenshot, there is a caption: "PITHIA-NRF YouTube Channel (up) & First PITHIA-NRF Training School Playlist (left)".

# Project Achievements

## First public release of the e-Science Centre

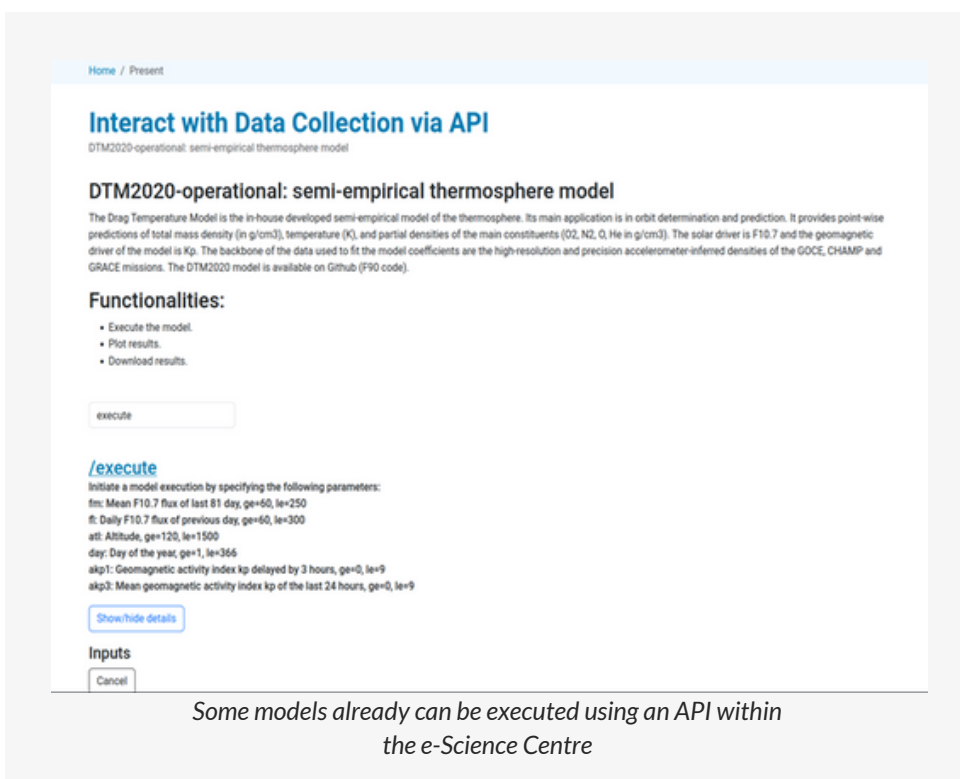
The PITHIA-NRF project is happy to announce that the very first open public release of the PITHIA e-Science Centre is now available.

The e-Science Centre can be accessed at <https://esc.pithia.eu/>.



*Ontology-based search through datasets and models registered in the e-Science Centre*

The e-Science Centre currently provides access to over forty Data Collections related to ionosphere, thermosphere and plasmasphere research, including both datasets and scientific models. This number is still steadily growing. The e-Science Centre also comes with an ontology-based search facility, based on the Space Physics Ontology developed within the framework of the PITHIA-NRF project, building on the results of the earlier ESPAS project.



*Some models already can be executed using an API within the e-Science Centre*

Accessing the e-Science Centre and its content is free, open and does not require registration. However, if scientists are interested in providing their own data and models to be made accessible for the research community through the e-Science Centre, they are advised to contact the PITHIA-NRF project for further information.

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## Recent publications

Here we list only the articles published since the last issue of this newsletter. A full list of publications, presentations and reports related to PITHIA-NRF can be found on the [project website](#).

### Papers

- N.A. Frissell, B.A. Witvliet, et al., “Heliophysics and Amateur Radio: Citizen Science Collaborations for Atmospheric, Ionospheric, and Space Physics Research and Operations”, *Frontiers in Astronomy and Space Science*, 2023, DOI: <https://doi.org/10.3389/fspas.2023.1184171>
- Barata T., Pereira J., Hernández-Pajares M., Barlyaeva T., Morozova A. “Ionosphere over Eastern North Atlantic Midlatitudinal Zone during Geomagnetic Storms”, *Atmosphere*, 14, 949, 2023, DOI: <https://doi.org/10.3390/atmos14060949>
- Christovam A. L., Prol F. S., Hernández-Pajares M., Camargo P. O., “Plasma bubble imaging by single-frequency GNSS measurements”, *GPS Solutions*, 27(3), 124, 2023, DOI: <https://doi.org/10.1007/s10291-023-01463-z>
- Christovam A. L., Prol F. S., Jerez G. O., Hernández-Pajares M., Camargo, P. O., “PPP at low latitudes with ionospheric model exclusively based on single frequency GNSS measurements”, *Space Weather*, 21(8), e2023SW003513, 2023, DOI: <https://doi.org/10.1029/2023SW003513>
- Gulyaeva T., Hernández-Pajares M., & Stanislawska I., “Ionospheric Weather at Two Starlink Launches during Two-Phase Geomagnetic Storms”, *Sensors*, 23(15), 7005, 2023, DOI: <https://doi.org/10.3390/s23157005>
- Monte-Moreno E., Hernandez-Pajares M., Yang H., “Power Law distribution of rapid ionosphere electron content fluctuations via GNSS measurements”, *IEEE Transactions on Geoscience and Remote Sensing*, 2023, DOI: <https://doi.org/10.1109/TGRS.2023.3313171>
- Olivares-Pulido G., Hernández-Pajares M., Monte-Moreno E., Lyu H., Graffigna V., Cardellach E., Hoque M., Prol F.S., Notarpietro R., Garcia-Fernandez M., “Real-Time Tomographic Inversion of Truncated Ionospheric GNSS Radio Occultations”, *Remote Sensing*, 15(12), 3176, 2023, DOI: <https://doi.org/10.3390/rs15123176>



## Upcoming Events

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### Fifth TNA Call

The fifth call for trans-national access projects has been launched, providing opportunities to access the best European research facilities for observations of the upper atmosphere, including the plasmasphere, ionosphere and thermosphere. This call was opened on September 1, and will close on November 30. This is an open call, and applications are handled as they arrive with evaluation times of two to three weeks. Accepted projects can commence immediately. All practical information can be found on the [website](#).

### Second PITHIA-NRF Training School

The 2nd PITHIA-NRF Training School for early career researchers will be held at the University of Leuven, Belgium from 5 to 9 February 2024. This event will be organised jointly with the training school of the Horizon Europe project T-FORS. The school will consist of a combination of theoretical lectures and hands-on sessions using various models and datasets related to the ionosphere/thermosphere/plasmasphere environment. Limited funds are available for travel support for selected students. All information can be found [here](#).

### European Space Weather Week

The [European Space Weather Week 2023](#) (ESWW 2023) will take place 20–24 November in Toulouse. PITHIA-NRF organises a Topical Discussion Meeting (TDM) at the ESWW 2023 on Wednesday 22 November 2023 at 11:45-12:45 CET ([TDM-06](#) “PITHIA-NRF Research Infrastructure Users’ Meeting”). Moreover, there will be several contribution by various partners of the PITHIA-NRF consortium.



## Imprint

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