



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

Ionosphere  
Integrated

### 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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This publication has been produced with the assistance of the European Union under the Horizon 2020 research and innovation programme under grant agreement No 101007599. The content of this publication is the sole responsibility of the PITHIA-NRF Consortium and can in no way be taken to reflect the views of the European Union.

## In memory of Gabriele “Gab” Pierantoni

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We are all just incredibly sad that our colleague and dear friend Gab Pierantoni is not with us any-more. He passed away shortly before Christmas last year. We all knew that Gab was battling with serious illness. However, this was still unexpected and a shock. He presented his latest ideas to all in PITHIA just a week before. We had meetings scheduled with him for the week after.

Gab and I started to work together in 2011 in an EU project. Later he joined the University of Westminster and my research team. We shared hard work, some fun and precious memories. I know that many in PITHIA have known him even longer. He was the kindest person, the best colleague and a great presenter of his ideas. We will all miss him badly.

—Tamas Kiss



### Joint training school with the T-FORS consortium

In February 2024 the second training school of the PITHIA-NRF project was organised at the KU Leuven in Belgium. This event was organised as a joined activity between PITHIA-NRF and the consortium of the T-FORS project (*Travelling Ionospheric Disturbances Forecasting System*), a Horizon Europe project focusing on the forecasting of travelling ionospheric disturbances. Because of the close relation and complementary of both projects, it was decided to join forces for this event and provide one week-long school.



Fifteen students from nine different countries (Belgium, Brazil, Egypt, Germany, Ghana, Greece, Hungary, Italy and Spain) attended the school. They attended both general, introductory lectures on various aspects of space weather and lectures specifically concerning travelling ionospheric disturbances, and were introduced to using the PITHIA e-Science Centre. At the end of the school, the students also performed some practical exercises, using the e-Science Center to obtain data and run models related to specific research questions.

The lectures given during the school were recorded, and are now available to everyone as webinars via the [YouTube channel of the project](#).

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## TNA activities

One of the objectives of the PITHIA-NRF project is to provide effective and convenient access to the best European research facilities for observations of the upper atmosphere. The individual PITHIA-NRF nodes provide access to key experimental and data processing facilities for studies and modelling of physical processes acting in the Earth's plasmasphere, ionosphere and thermosphere. Access to the nodes is organised through a Trans-National Access (TNA) programme and provides an opportunity for researchers and other users to execute and carry out their own projects at one of the twelve PITHIA-NRF research facilities.

Users can request either physical access (a one-week visit at the node with support at the site) or remote access (one-month access from a distance with weekly support). Users with granted projects learn how to work with the facilities during the complete access cycle, from setting up a campaign to the collection, analysis and finally exploitation of data with the help of tools and services provided by PITHIA-NRF. The TNA program was during 2023 presented at EGU General Assembly and the European Space Weather Week, in addition to several smaller meetings and summer schools.

During the third year of the PITHIA-NRF project, two windows for TNA calls (TNA calls number 4 and 5) have been open, and a third one (TNA call number 6) is open at the present. There are at the moment six ongoing projects in the TNA programme, with activities such as applying radio scintillation data in space weather forecasting, and estimating the ionospheric irregularity layer height using data from GNSS and ISR.

## Project Achievements

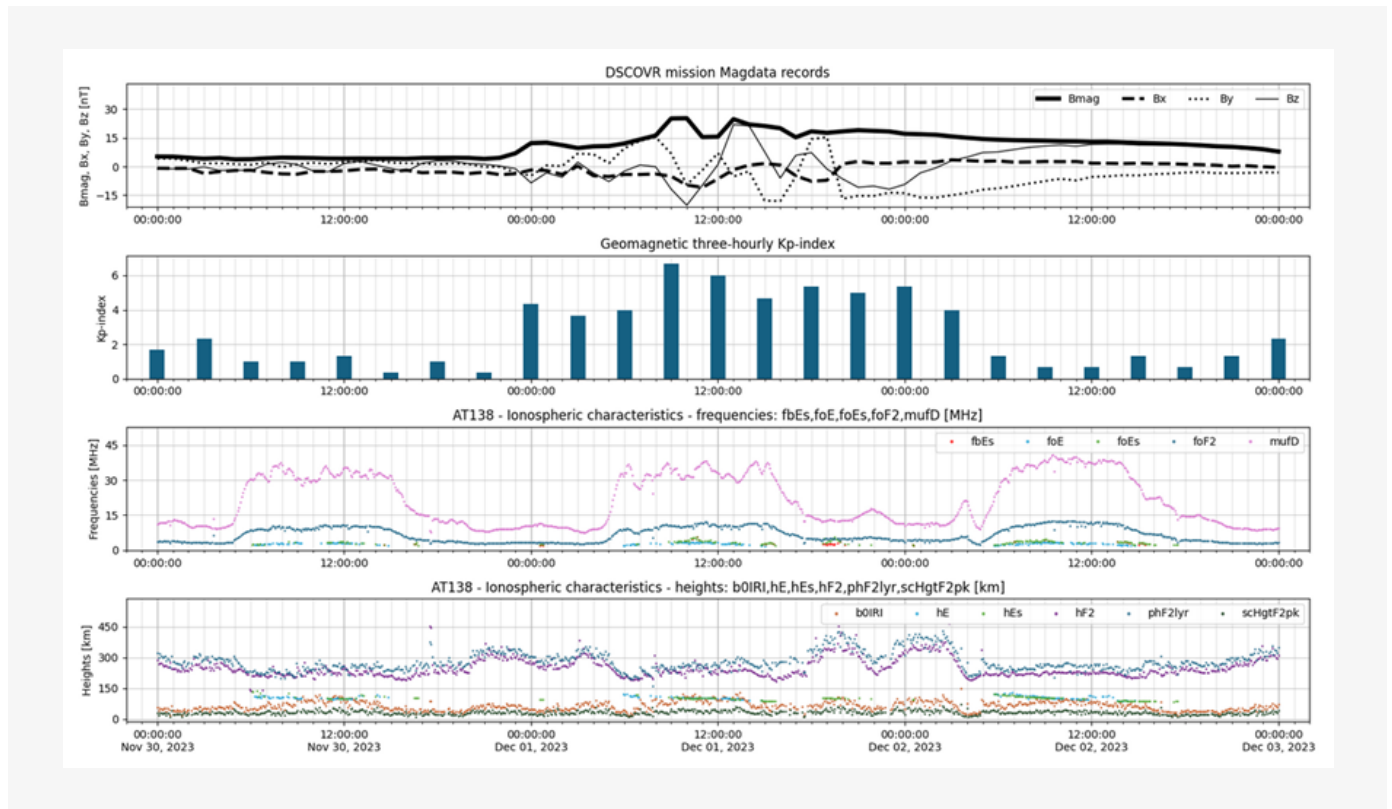
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### Official public release of the PITHIA e-Science Centre

The PITHIA-NRF project is happy to report that the latest official release of the PITHIA e-Science Centre (eSC) is available at [esc.pithia.eu](https://esc.pithia.eu). The e-Science Centre is a central hub to access Data Collections—observational datasets as well as models—related to research on the Earth's ionosphere, thermosphere and plasmasphere. There are currently fifty-seven Data Collections registered in the e-Science Center, including activity indicators, sensor measurements and computational models.

Data Collections are described with a rich set of standardised metadata and the PITHIA Space Physics Ontology that enable users to find and identify the data and models they are looking for. Once found, Data Collections can be accessed directly by navigating to the destination site or through simple but intuitive user interfaces within the e-Science Centre. Accessing Data Collections is completely free and open, requiring no registration. Scientists can simply navigate to the website and start exploring its content. Potential new data providers are also welcome. After registration and approval, they can offer their Data Collections for the community.

The latest developments in the e-Science Centre enable the combination of multiple Data Collections into more complex and automated workflows. Executing such a workflow automates the subsequent execution of multiple tasks which otherwise require tedious manual processes. The output of a workflow for solar wind magnetosphere driven ionospheric response using three separate Data Collections is illustrated below.



## 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](#).

- A. Calabia, N. Imtiaz, D. Altadill, et al., “Uncovering the divers of responsive ionospheric dynamics to severe space weather conditions: A coordinated multi-instrumental approach,” *Journal of Geophysical Research: Space Physics* 129(3), e2023JA031862, 2024, DOI:[10.1029/2023JA031862](https://doi.org/10.1029/2023JA031862)
- G.V. Khazanov, V. Pierrard, Q. Ma, and E. Botek, “The Role of Plasmasphere in the Formation of Electron Heat Fluxes,” *Journal of Geophysical Research: Space Physics* 128(11), e2023JA032013, 2023, DOI:[10.1029/2023JA032013](https://doi.org/10.1029/2023JA032013)
- N.K. Porayko, M. Mevius, M. Hernández-Pajares, et al., “Validation of global ionospheric models using long-term observations of pulsar Faraday rotation with the LOFAR radio telescope,” *Journal of Geodesy* 97, 116, 2023, DOI:[10.1007/s00190-023-01806-1](https://doi.org/10.1007/s00190-023-01806-1)
- L. Alfonsi, C. Cesaroni, M. Hernández-Pajares, et al., “Ionospheric response to the 2020 Samos earthquake and tsunami,” *Earth, Planets and Space* 76, 13, 2024, DOI:[10.1186/s40623-023-01940-2](https://doi.org/10.1186/s40623-023-01940-2)

- M. Hernández-Pajares, A. García-Rigo, E. Monte-Moreno, et al., “GNSS Solar Astronomy in real-time during more than one solar cycle,” *Advances in Space Research* (in press), 2023, DOI:[10.1016/j.asr.2023.12.016](https://doi.org/10.1016/j.asr.2023.12.016)
- T.G.W. Verhulst, G. De Franceschi, and C. Cesaroni, “Ionospheric effects of the Hunga Tonga Volcanic Eruption of 15 January 2022,” *Radio Science Bulletin* 378, pp. 95ff., 2023.
- H. Haralambous, M. Guerra, J. Chum, et al., “Multi-Instrument Observations of Various Ionospheric Disturbances Caused by the 6 February 2023 Turkey Earthquake,” *Journal of Geophysical Research: Space Physics* 128(12), e2023JA031691, 2023, DOI:[10.1029/2023JA031691](https://doi.org/10.1029/2023JA031691)

A new book has been published: V. Pierrard, *Effects of the Sun on the space environment of the Earth*, Presses Universitaires de Louvain, ISBN:9782390614425, 208 p., 2024.

This university course aims to summarize the main physical mechanisms active in the space environment of the Earth. It has been written for the master students in physics or in climatology at Université Catholique de Louvain for the course Physics of upper atmosphere and space, and may also interests the wide public for the descriptive parts.

A specific chapter is dedicated to the ionosphere and plasmasphere (Chapter 9) and another one to the neutral atmosphere including the thermosphere (Chapter 10) in direct relation with the PITHIA-NRF project. Most chapters are very tutorial describing the Sun, our star (Chapter 1), the interplanetary space (Chapter 2), the interactions between the solar wind and the magnetic field of the Earth (Chapter 6), the space weather (Chapter 7), the effects of the solar radiation (Chapter 11) and the atmospheres of the planets (Chapter 12). These parts are accessible to any reader who would like to know more about space physics, stars, solar wind, comets, cosmic rays, polar aurora, climate changes, space weather, atmospheric chemistry, etc.

Some parts are more specialized and provide the physics equations allowing us to better understand the observations, especially the kinetic theory of gases and plasmas (Chapter 3), the hydrodynamic theory as a macroscopic approach (Chapter 4), the applications of these equations to the atmospheres (Chapter 5), and the movement of particles trapped in the magnetic fields of the planets (Chapter 8).



## EFFECTS OF THE SUN ON THE SPACE ENVIRONMENT OF THE EARTH

COURS UNIVERSITAIRES

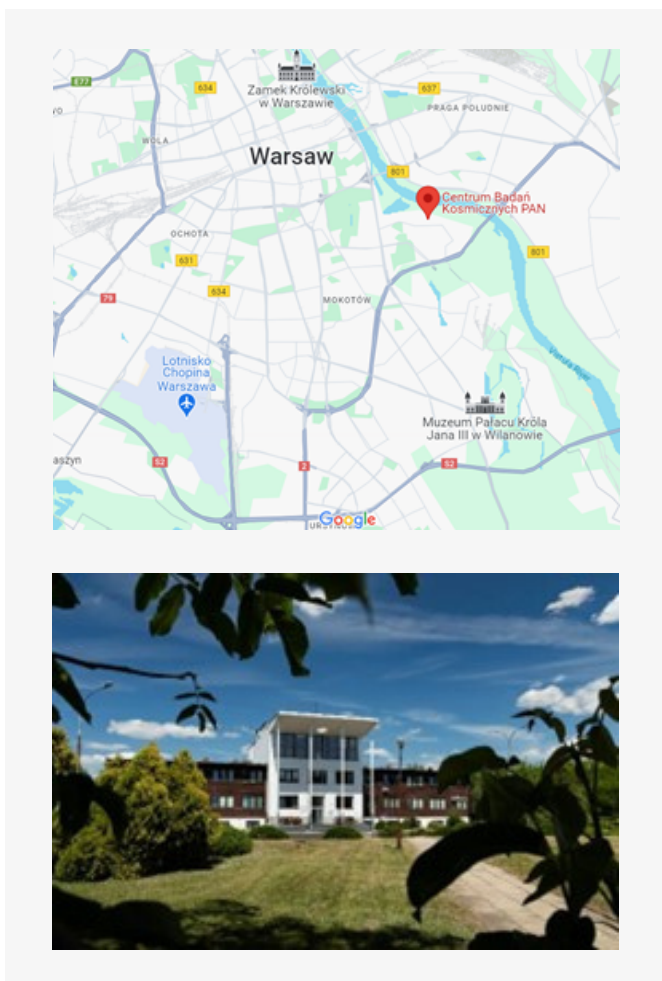
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## Upcoming Events

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### Third PITHIA-NRF Innovation Day



The PITHIA-NRF Third Innovation Day will be held at the Space Research Centre of the Polish Academy of Sciences in Warsaw, Poland, on **12 June 2024**.

It is the last of the three planned Innovation Days that are focused on bringing together users from various industries, including but not limited to SMEs, the aerospace sector, and civil organisations, with experts in upper atmospheric research.

Through Innovation Days, we want to introduce users to the European distributed infrastructure that provides a range of research support services in the field of upper atmosphere research and set standards for future collaborations.

Previous events were organised in Rome in 2022 and Brussels in 2023 and resulted in fruitful discussions and exchange of ideas. They also introduced to the participants the new avenues of collaboration offered by PITHIA-NRF. The registration for the meeting is currently open, until 31 May 2024. More information can be found [here](#).

### Upcoming scientific conferences

Members of the project consortium will be presenting their scientific research at various international conferences:

- General Assembly of the European Geophysical Union, 14–19 April, Vienna, Austria
- URSI Atlantic Radio Science Meeting, 19–24 May, Gran Canaria, Spain
- COSPAR 45th Scientific Assembly, 13–21 July, Busan, South-Korea

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## Sixth TNA call and further activities

The sixth call for trans-national access projects is currently open, until 31 May. Both remote and physical access to space weather research infrastructure can be requested by users from academia as well as the private and public sector. All practical information can be found via the [project websites](#).

The evaluation of proposed projects is done on rolling basis as they arrive, meaning that the start time of the project can be as soon as within one month after the submission of an application. This is the last TNA access call that can be used by applicants for physical access, so it is a great opportunity for those who want to learn about instruments or models in person.

A shorter call limited to only remote access projects is planned for the second half of 2024 as the accepted TNA projects must be all finished by the end of February 2025.

To finalise the PITHIA-NRF TNA Programme the TNA centre is also planning to arrange a second Online PITHIA-NRF TNA User Meeting in the beginning of February 2025, which will provide a great opportunity for the TNA users to present their research realised with the help of PITHIA-NRF. It is still in planning stages right now but we are looking forward to see you there either as a presenter or in the audience.

### Imprint

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