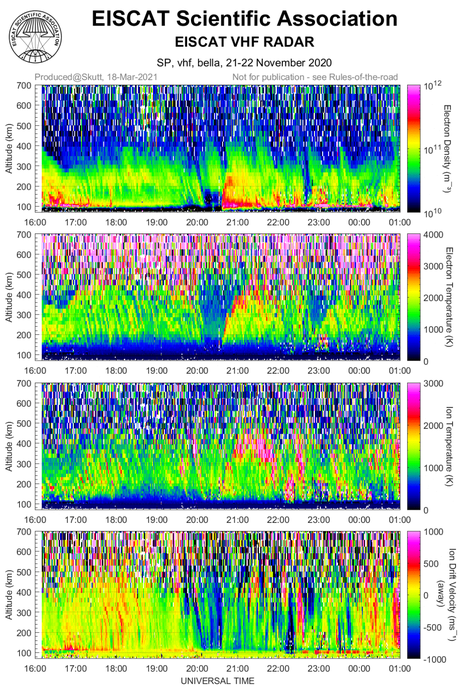
Trans-National Access to plasmaspheric, ionospheric and thermospheric research facilities through PITHIA-NRF

Anders Tjulin and Mária Miháliková (EISCAT Scientific Association, Kiruna, Sweden; PITHIA-NRF TNA centre: tna@pithia-nrf.eu, tna-office@eiscat.se)

Taking part in the PITHIA-NRF Trans-National Access (TNA) programme gives you:

- **Access to key experimental and data processing facilities** for studies and modelling of physical processes acting in the Earth's **plasmasphere, ionosphere and thermosphere**.
- **Opportunity** for researchers, students and other users to execute and carry out their **own projects** at one (or more) of the twelve research facilities (Nodes) connected to PITHIA-NRF
- A **unique opportunity to learn** about instruments, data and models of your interest *(users with granted projects will 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 via the e-science centre)*
- **Training and support from experts** in the field included in the access
- Good possibilities also for a **project of a smaller scale**, such as a Master's thesis or as part of a PhD project.
- **Physical access** or **Remote access** sessions for **one work week** *(the extent of remote access sessions is flexible based on agreement with relevant NODE)*
- **Travel support** and one week of accommodation (in case of physical access)
- **Scientific support** of the project **available for up to 6 months** from its start
- Possibility to apply for **access to multiple NODEs** *(we encourage using data and models from other NODEs of PITHIA-NRF during your access to the primary NODE and you will receive support for those as well)*

Access to the TNA programme can be requested by scientific users from academia, Small and Medium Enterprises, large companies and public organizations by proposing a scientific project and applying through the PITHIA-NRF **website:** https://pithia-nrf.eu/



EISCAT NODE areas of access:

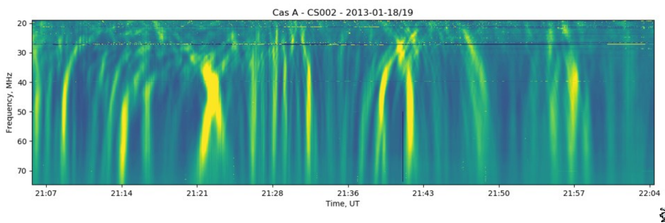
- Polar cap dynamics
- ISR/HF experiments
- Magnetosphere-ionosphere-atmosphere coupling
- Ionospheric phenomena such as aurora, polar mesospheric clouds and summer echoes (PMC and PMSE), sporadic E-layers and naturally enhanced ion-acoustic lines (NEIAL)
- Auroral electrodynamics statistical models
- Space environment-atmosphere coupling at the statistical southern edges of the polar vortex and the auroral oval
- Meteoroids, dust particles and near-Earth objects detection experiments
- Ionospheric 3D imaging

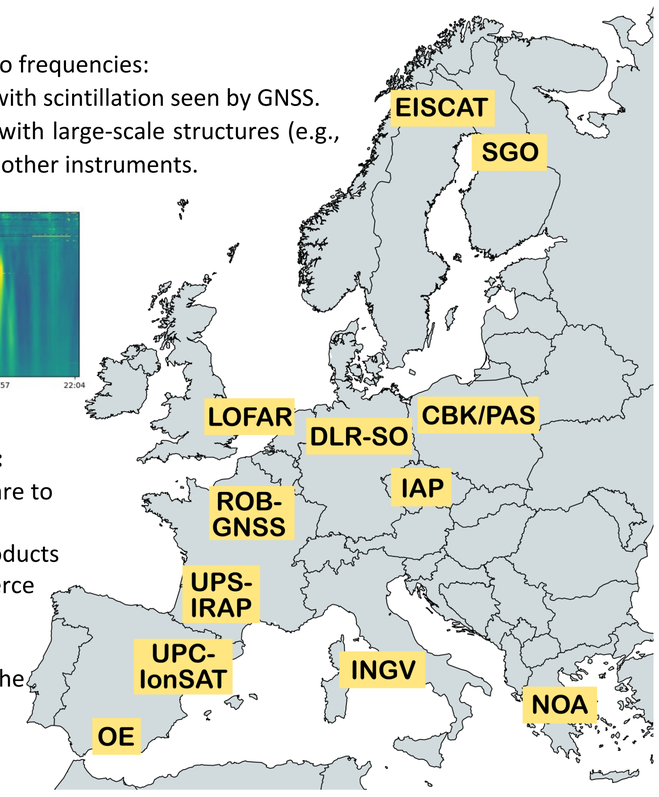
SGO NODE areas of access:

- Auroral electrodynamics using the entire PuMa network, comparison to visual auroral oval and exploitation of IL and IU indices.
- Electron precipitation from KAIRA, comparison to model result.
- Ionospheric D region radio wave absorption using riometer data and KAIRA observations.

LOFAR NODE areas of access:

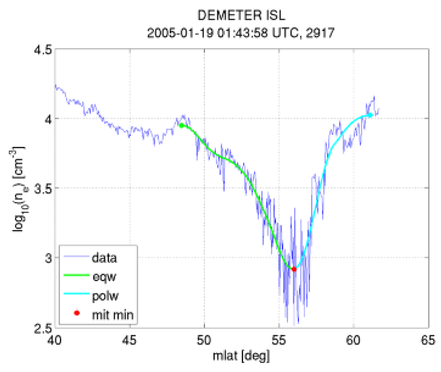
- Ionospheric scintillation at low radio frequencies:
  - Assessment of any association with scintillation seen by GNSS.
  - Assessment of any association with large-scale structures (e.g., TIDs) detected and modeled by other instruments.





ROB-GNSS NODE areas of access:

- Adaptation of the ROB-IONO software to process global data.
- Post-processing and nowcasting products on vTEC and sTEC at ionospheric pierce points.
- Test for Galileo inclusions in the processing.
- Multi-GNSS comparison to test interoperability of the different systems.
- GNSS hardware delay estimation.



CBK/PAS NODE areas of access:

- Quantification of the impact of magnetosphere–ionosphere coupling on auroral region boundary layers behaviour using satellite in situ measurements from DEMETER, Relec, COSMIC, as well as measurements from ground-based infrastructures.
- Implementation of novel techniques based on LOFAR diagnostics for determining the characteristics of small and middle scales ionospheric irregularities.

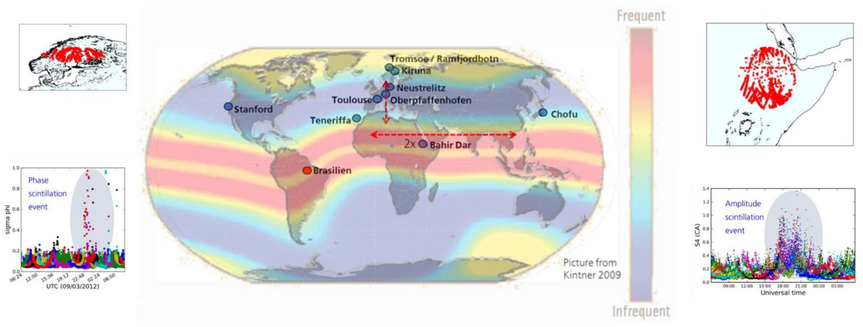
DLR-SO NODE areas of access:

- Solar flare monitoring and analysis of the ionospheric response.
- Impact analysis for HF communication and GNSS performances by combination with GNSS measurements (TEC, TEC rates).
- Spectral analyses to study radiation impacts on the lower ionosphere.
- Research and analysis of D-Layer ionosphere disturbances from below (Gravity waves, Earthquakes, Hurricanes, radiation sources).
- Analysis of ionospheric response during Solar Eclipse events.
- Cross correlation with external data sets from users (e.g., in the domain of GNSS-positioning or communication) to check the vulnerability of their systems to solar flare events.
- Specification of topside ionosphere and plasmasphere electron density using NPSM.

UPS-IRAP NODE areas of access:

- Validation of the IPIM model results, especially during solar eclipses, solar flares, CIRs or CMEs, using data from ionospheric stations, SuperDARN radars and GNSS satellite signals.
- Quantification of Joule heating and energetic particle precipitation heating at auroral latitudes, through IPIM modeling fed with realistic inputs such as SuperDARN convection, satellite particle precipitation.
- Assessment of the thermosphere characteristics during perturbed periods (CIRs, CMEs) and their effect on the IPIM ionosphere modelling at high and middle latitudes. Comparison with ionospheric observations from, for instance, ionosondes and EISCAT radars.

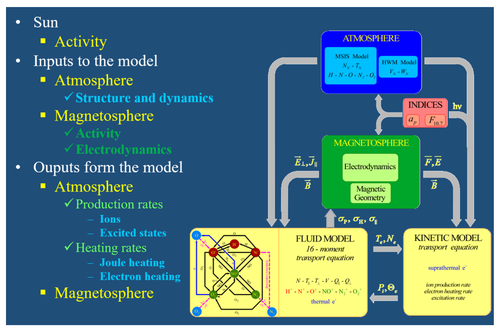
EVNET: High Rate GNSS Receiver Network:
The EV-NET is a network of high rate GNSS receivers (50-100 Hz) for the detailed investigation of small-scale ionospheric disturbances and related phase and amplitude scintillations.



UPC-IonSAT NODE areas of access:

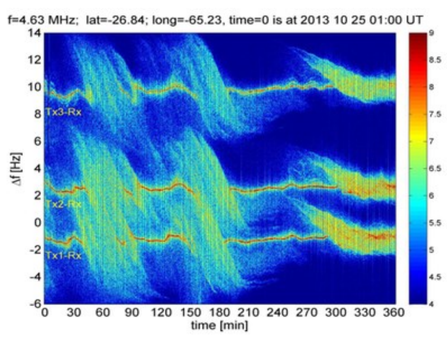
- New combinations of Global and European Ionospheric Maps.
- New improvements and applications of high-rate Global Ionospheric Maps.
- Improvements of GNSS proxy of solar EUV flux rate during flares.
- Correlation of thermospheric and ionospheric parameters to study coupling mechanisms using ground-based and space-born (in situ and remote observed) data.
- Model developments to improve GNSS positioning performance.

IPIM architecture:



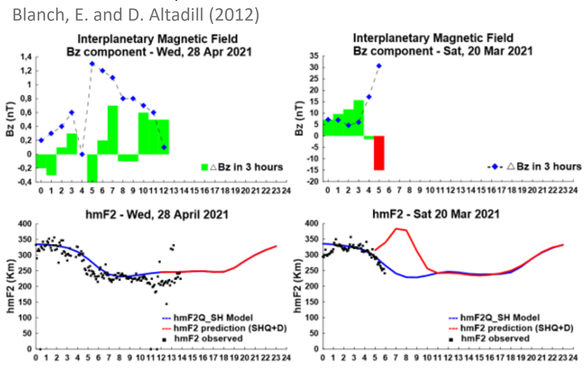
IAP NODE areas of access:

- Analysis of wave coupling processes and consequences in the whole atmosphere and ionosphere using CDSSs and European Digisonde network measurements.
- Validation of medium scale TIDs detection techniques.
- Ionosphere/gravity wave climatology.
- Troposphere – upper atmosphere – solar wind coupling studies exploiting atmospheric electricity, ionosphere and solar wind data.



An example of observations of oblique spread structures in the Doppler shift spectrogram recorded at Tucuman from 01:00 UT to 07:00 UT on 25 October 2013. Such a spread has never been observed by the Czech Doppler network at mid-latitudes.

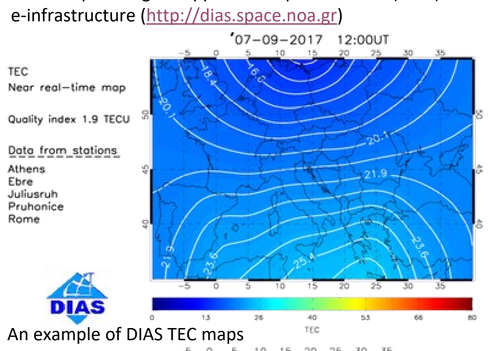
hmF2 Model under quiet and disturbed conditions:
Blanch, E. and D. Altadill (2012)



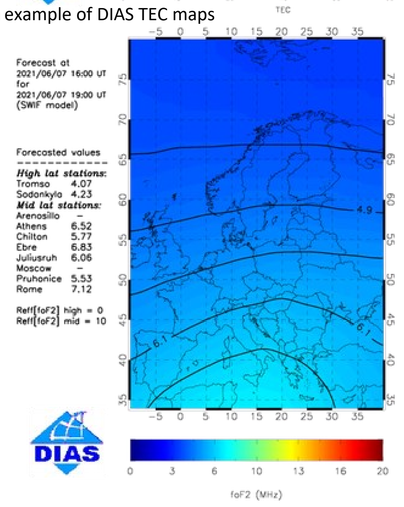
OE NODE areas of access:

- Identification and specification of Large Scale Travelling Ionospheric Disturbances.
- Identification and specification of Plasma Depletions.
- Retrospective validations of the prototype warning system for monitoring and predicting ionospheric height disturbances related to severe Space Weather Events.
- Solar flare absorption effects on Ionograms.
- Characterization of the Ionospheric tilts.
- Characterization of vertical propagation on ionospheric disturbances.
- Scheduling and running specific campaigns of DIGISONDE soundings or experiments, onsite and bistatic to improve ionospheric specification in west Europe.
  - HF D2D, NVIS, VIS, OIS

The European Digital Upper Atmosphere Server (DIAS) e-infrastructure (http://dias.space.noa.gr)



An example of DIAS TEC maps



An example of DIAS forecasting maps

INGV NODE areas of access:

- Ionospheric scintillations: Monitoring, modelling and forecasting.
- Detection and characterization of TIDs at mid-latitudes.
- Mitigation algorithms/techniques for HF communications (Ray tracing) and for ionospheric scintillations on high accuracy positioning (PPP, NRTK) and Synthetic Aperture Radar Imaging.
- Ionospheric correction for augmentation systems in challenging areas (high and low latitudes).
- New combinations of Global and European Ionospheric Maps.
- Multi-parametric studies on Lithosphere-Atmosphere-Ionosphere coupling.

The front-end: eSWua website http://eswua.ingv.it

NOA NODE areas of access:

- Ionospheric modelling for nowcasting and forecasting purposes. Indicatively:
- Modelling formulation of ionospheric storm effects at middle latitudes driven by solar wind input;
- Data-driven ionospheric specification models, using different training data sets and/or deep-learning techniques ;
- Ensemble modelling for ionospheric predictions using heliospheric forecasting models;
- Reconstruction of electron density profile by ingesting ground and space-based observations.
- Validation of ionospheric specification models compatible with international practices, such as the recommendations by the Community Coordinated Modeling Center (CCMC) of NASA and the Space Weather Service Network of ESA.
- Ionospheric data control: development of higher-level data products based on ionospheric auto-scaled data filtering algorithms.
- Ionospheric irregularities and travelling ionospheric disturbances (TIDs). Research and application activities on:
  - Identification and propagation patterns for TIDs
  - Bottomside and topside ionosphere interactions
  - Identification of post-seismic effects in the ionosphere
  - Ionospheric 3D imaging
- Digisonde experiments:
  - Vertical Soundings
  - Joint experiments/special campaigns with bistatic HF sounders' operations.

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