

# PITHIA-NRF TNA Success story: LONG (LONGitudinal differences in traveling ionospheric disturbance characteristics at midlatitudes)

The ionosphere is a natural detector of the processes of interaction of the Earth's atmosphere with sources of both cosmic and terrestrial origin. The reaction of the ionosphere manifested itself in the occurrence of disturbances of various spatial and temporal scales. Of particular interest are perturbations capable of propagating over global distances, such as traveling ionospheric disturbances (TIDs).

Thanks to PITHIA-NRF TNA, two groups of researchers from the Institute of Ionosphere (Kharkiv, Ukraine) and the Institute of Atmospheric Physics (Prague, Czech Republic), using a combination of various radiophysical methods managed to study the ionosphere behavior to the moderate magnetic storm occurred in 22-24 September, 2020 over European region. The results obtained in the project allow to expand our knowledge about the regional behavior of TID characteristics and improve the prediction capabilities of ionospheric models.

Three ionosondes located in Juliusruh, Pruhonice and near Kharkiv, and the Kharkiv incoherent scatter radar were employed to study temporal and spatial TID signatures in ionospheric F2 peak density and height and electron density variations at the heights of 100–300 km. The TIDs which were originated during enhancement in auroral activity, as well as by local sunrise terminator passage were detected. The following TID parameters were determined: diurnal occurrence at each location, predominant period, vertical and horizontal phase velocity and wavelength, relative amplitude of electron density fluctuations and propagation direction. In addition, the authors demonstrated day-to-night variations of hmF2 and NmF2 with their clearly visible gradual increases over all three sites as the intensity of the storm increases.

Based on the project results, papers were published and presented at the EGU, IUGG and URSI GASS 2023 conferences:

- Panasenko, S.V., K. D. Aksonova, D. Buresova, O. V. Bogomaz, T. G. Zhivolup, O.V. Koloskov. Large-scale traveling ionospheric disturbances over central and eastern Europe during moderate magnetic storm period on 22–24 September 2020, *Advances in Space Research*, 2023. <https://doi.org/10.1016/j.asr.2023.09.035>
- Aksonova, K. D., Sopin, A. O., Buresova, D., Zalizovski, A. V., and I. F. Domnin. Synchronous observations of traveling ionospheric disturbances by the multipoint Doppler sounding, ionosonde and the Incoherent Scatter Radar: case study. *Advances in Space Research*, 2024. <https://doi.org/10.1016/j.asr.2024.01.032>
- Buresova, D., Panasenko, S. V., D. Aksonova, K., Bogomaz, O. V., Zhivolup, T. G., and Koloskov, A. V. Multiinstrumental observations of traveling ionospheric disturbances over Europe, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-6707, 2023. <https://doi.org/10.5194/egusphere-egu23-6707>
- Aksonova, K., Panasenko, S. V., Buresova, D. (2023): Characteristics of traveling ionospheric disturbances over the European mid-latitude region during 24 Solar Cycle, XXVIII General Assembly of the International Union of Geodesy and Geophysics (IUGG), Berlin 2023. <https://doi.org/10.57757/IUGG23-0709>



Kharkiv incoherent scatter radar



Location of the instrumentation involved in the analysis

