*4th URSI AT-RASC, Gran Canaria, 19-24 May 2024*

# GNSS Scintillation Associated with Auroral Activity over Dronning Maud Land, Antarctica

Daria S. Kotova*(1), Luca Spogli(2), Yaqi Jin(1), and Wojciech J. Miloch(1)

(1) Department of Physics, University of Oslo, Oslo, Norway, e-mail: daria.kotova@fys.uio.no; yaqi.jin@fys.uio.no; w.j.miloch@fys.uio.no
(2) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy, e-mail: luca.spogli@ingv.it

This study uses the dataset from the all-sky camera and 50 Hz data from two GNSS Ionospheric Scintillation and TEC Monitor (GISTM) receivers in Dronning Maud Land, Antarctica. The All-Sky Imager is at the Norwegian Research Station Troll and has been operating since 2019. The NovAtel GPStation-6 receiver is also installed the Troll station, co-located with the All-Sky-Imager. We also use ground-based data acquired by the Septentrio PolaRx5S receiver from South African Research Station SANAE IV[1], which is located 186 km from Troll. Both stations are located on the equatorward edge of the quiet auroral oval. Thus, observatories are in the optimal location to study the ionospheric response to geomagnetic disturbances and the effect of aurora forms and particle precipitation on transionospheric signal and accuracy of positioning.

In this study, we continue our work started in [2] but focus on to the auroral zone in Antarctica and consider large event statistics focusing on geomagnetic events. Using a combination of two carrier phase measurements at different frequencies, we calculate Ionosphere-Free Linear Combination (IFLC) [3]. The IFLC allows to get rid of the first-order refractive contribution due to the ionosphere on phase measurements and understand in more detail the processes behind the scintillations during auroral activity. It also allows us to assume the size of irregularities involved in the plasma structuring in this area. We show that the relationship between the onset and intensification of aurora and severe scintillations. The correlation of scintillations with the precipitation of charged particles and the passage of an intense aurora is duscussed. An intense aurora can lead to strong phase scintillation associated with diffractive variations due to small-scale irregularities (smaller than the Fresnel scale for L-band signals and GNSS observational geometry from ground-based receivers).

DK, YJ, WM acknowledge funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (ERC Consolidator Grant agreement No. 866357, POLAR-4DSpace). The station in SANAE IV was deployed in the framework of the DemoGRAPE project funded by PNRA 564 (Progetto di Ricerca 2013/C3.01) and it is run under the Memorandum of Understanding between INGV and SANSA (Delibera CdA INGV 297/2016). LS express his gratitude Dr. Emanuele Pica, Carlo Marcocci, Rayan Imam, and Lucilla Alfonsi of INGV for the help and support with raw data from the SANAE IV receiver.

1. Upper atmosphere physics and radiopropagation Working Group, Cesaroni C., De Franceschi G., Marcocci C., Pica E., Romano V., Spogli L. (2020). Electronic Space Weather upper atmosphere database (eSWua) - GNSS scintillation data, version 1.0. Istituto Nazionale di Geofisica e Vulcanologia (INGV). https://doi.org/10.13127/eswua/gnss

2. F. Enengl, L. Spogli, D. Kotova, Y. Jin, K. Oksavik, N. Partamies, and W. J. Miloch, "Investigation of ionospheric small-scale plasma structures associated with particle precipitation," *Space Weather*, **22**, 2024, e2023SW003605, doi:10.1029/2023SW003605.

3. C. S. Carrano, K. M. Groves, W. J. McNeil, and P. H. Doherty, "Direct measurement of the residual in the ionosphere-free linear combination during scintillation," in *Proceedings of the 2013 international technical meeting of the institute of navigation*, 2013, pp. 585–596.