Monitoring ionospheric gradients using SWARM satellite data

M.M. Hoque (1), N. Jakowski (1), A. Cahuasqui (1), S.C. Buchert (2), M. Kriegel (1), P. David (1), D. Vasylyev (1), J. Berdermann (1), K. Nielsen (3)

(1) German Aerospace Center (DLR), Neustrelitz, Germany

(2) Swedish Institute of Space Physics (IRF), Uppsala

(3) Technical University of Denmark - DTU Space, Lyngby

Abstract:

The Swarm data products are well-suited to address a number of crucial topics for space weather science and monitoring, such as investigating spatial and temporal characteristics of ionospheric irregularities or improving topside approaches in ionospheric models for monitoring and forecasting the dynamics of the geo-plasma environment. Precision and safety of life applications using trans-ionospheric signals require key information on space weather conditions in particular on the perturbation degree of the ionosphere. Such applications are particularly vulnerable against severe spatial gradients and rapid changes of the electron density (Ne) as well as the total electron content (TEC) measured along different satellite-receiver links. Here, we propose two new Swarm products 1) the TEC Gradient Ionosphere indeX (TEGIX) and 2) the Ne Gradient Ionosphere indeX (NEGIX). The TEGIX estimates spatial TEC gradients in the topside ionosphere (Swarm up to GNSS orbit) using GNSS Precise Orbit Determination (POD) measurements whereas the NEGIX estimates spatial Ne gradients using Swarm onboard Langmuir probe (LP) measurements (2 Hz sampled). The approach takes benefit from the coordinated flight of satellites A and C at an orbit height of about 460 km. We will present a first version of both products and will explore their potential impact, utility, and use through case studies.

Acknowledgement:
The work is funded by the MIGRAS (Monitoring of Ionospheric Gradients At SWARM) project under the Swarm DISC Subcontract Doc. no: SW-CO-DTU-GS-133, Rev: 1, 13 September 2022.