Sixteenth European Space Weather Week, 18-22 Nov 2019, Liège, Belgium

Ionospheric plasma irregularities at high latitudes studied with the Swarm satellites

Miloch, W et al. Oral

Wojciech Miloch[1], Yaqi Jin[1], Chao Xiong[2], Daria Kotova[1], Andres Spicher[1],Guram Kervalishvili[2], Lasse Clausen[1], Claudia Stolle[2]

[1] Department of Physics, University of Oslo, Oslo, Norway [2] GFZ - Potsdam, German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany

The Earth's ionosphere is often subject to instabilities and turbulence resulting in irregularities in plasma density at various scales and at all latitudes. Plasma irregularities can influence the propagation of trans-ionospheric radio signals, and as such they can impact positioning with the Global Navigation Satellite Systems (GNSS), such as GPS, Galileo or GLONASS. Examples of measurable effects are radio wave scintillations in the phase and amplitude, which are significant issues at low geomagnetic latitudes and in the polar regions. To get more insight into formation of ionospheric plasma irregularities at high latitudes, we use the Ionospheric Plasma IRregularities (IPIR) data product based on in-situ measurements by the Swarm satellites. IPIR allows for a global characterisation of ionospheric irregularities along the whole satellite track. We focus on the irregularity parameters from the electron density in terms of the rate of change of density index and electron density gradients, and also use the rate of change of total electron content index as the irregularity parameter based on the global positioning system data. After demonstrating the use of IPIR with a case study, we perform a larger climatological study. It is shown that plasma irregularities dominate near the dayside cusp, polar cap, and the nightside auroral oval. These irregularities may be associated with the large-scale plasma structures such as polar cap patches, auroral blobs, auroral particle precipitation, and the equatorward wall of the ionospheric trough. The plasma irregularities are also controlled by the solar activity within the current declining solar cycle and their spatial distributions of irregularities depend on the interplanetary magnetic field (IMF) conditions. There is a clear asymmetry in the spatial distribution in the cusp and in the polar cap between the Northern (NH) and Southern Hemispheres (SH). The irregularities in the SH polar cap show a seasonal variation with higher values from September to April, while the seasonal variation in the NH is only obvious around the solar maximum during 2014–2015.