32nd URSI GASS, Montreal, 19-26 August 2017

Irregularities and Scintillations, end-to-end from Swarm to the Ground

Sharon Aol[(1)], Stephan Buchert*[(2)], Edward Jura[(1)] and Ernst van Groningen[(3)]
(1) Mbarara University of Science and Technology, Mbarara, Uganda
(2) Swedish Institute of Space Physics, Uppsala, Sweden
(3) Uppsala University, Uppsala, Sweden

Extended Abstract

In the ionosphere, structures of the plasma density can develop over scales between several meters to kilometers, called irregularities. They are the major cause of scintillations, quasi-random fluctuations in amplitude and phase of radio signals at frequencies up to a few GHz passing across density variations. To model effects of irregularities on radio signals, measurements of both the plasma density and affected radio signals are useful. However, simultaneous measurements of these parameter at a signal path are rarely available.

Since their launch in November 2013 the three Swarm satellites have completed more than 100,000 crossings of the equator at altitudes between about 450 and 520 km. Electron density and temperature data from the Langmuir probes (LPs) and magnetic field vector measurements are available for nearly all the orbits. The LPs sample at 2 Hz, the vector magnetometers at 50 Hz which in the standard data set is averaged to 1 Hz. In roughly 2/3 of the time a faceplate for the electric field instrument is operated as a planar Langmuir probe providing additional high resolution density data at 16 Hz corresponding to a spatial resolution of about 400 m. The magnetic field vector data are used to estimate wavelengths of irregularities from the observed variations in time, assuming that the wave normals are nearly perpendicular to *B*.

We have searched all Swarm passes for irregularities coincident with scintillations seen at the SCINDA station in Mbarara, Uganda, and where the GNSS signal pierces the ionosphere at the satellite orbit or at least close, typically within at most a few tens of kilometers. Cases where scintillations are seen without clear density variations in the satellite data suggest that irregularities can be effective quite locally, horizontally or in height or both. When both irregularities and scintillations are observed, we apply the well-known phase screen model to study the relation between both in detail.