Characterization of Ionospheric Scintillation at High Latitude in the European Region

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Abstract

The GPS signal propagating through the ionosphere is affected by rapid and irregular fading which is known as ionospheric scintillation. The scattering or diffraction phenomena due to ionospheric irregularities are responsible for the occurrence of this scintillation on signals received on the ground. The percentage of occurrences of scintillation can be high at high latitudes. In this region, the ionospheric irregularities which result in scintillation are generally produced by an instability caused by the presence of an electric field together with a gradient in electron density and also with energetic particle precipitation.

It is well known that severe ionospheric scintillation degrades the reliability of navigation applications using GPS technology. Therefore, further understanding of ionospheric scintillation and its characteristics at high latitude is important. This work studies the characteristics of high latitude ionospheric scintillation over the European region during the solar maximum period and utilizes an extensive data set of GPS observations made between 50˚ N and 75˚N latitude for year 2003 in Northern Europe. It investigates the percentage occurrence of scintillation at auroral and polar regions associated with aurora activity and changes in the interplanetary magnetic field (IMF). The experimental analysis shows that, at high latitudes during nighttime, electron precipitation near the auroral oval boundary extends equatorward causing phase scintillation which is quantified in terms of its percentage of its occurrence. By contrast, in the polar region, scintillation activity is driven by the direct interaction of solar flares into the Earth's atmosphere. The results obtained enhance understanding of the different mechanisms responsible for scintillation at high latitude over European region and will be utilised in the construction of a scintillation prediction tool for this region.

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