



Polar Cap Patches in the High-Latitude Ionosphere in Northern Deep Winter: The Presence and Absence of Scintillation

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The high-latitude ionosphere is a highly complex plasma containing electron density structures with a wide range of spatial scale sizes. Large-scale structures with horizontal extents of tens to hundreds of km exhibit variation with time of day, season, solar cycle, geomagnetic activity, solar wind conditions, and location. One type of large-scale structure is a polar cap patch. Large-scale structures can also cause smaller-scale irregularities that arise due to instability processes. These smaller scale structures can disrupt trans-ionospheric radio signals, including those used by Global Navigation Satellite Systems (GNSS).

A multi-instrument case study has been conducted using the EISCAT (European Incoherent Scatter) radars, a GNSS scintillation receiver, the SuperDARN radars and optical instruments. Two large-scale plasma structures were observed drifting antisunward on the evening of the 14th December 2015 under moderately disturbed conditions ($K_p=5$). One of these structures was associated with particle precipitation and scintillation of GNSS signals passing through this volume was observed. The other structure was identified as being a polar cap patch and it showed an absence of both particle precipitation and scintillation. This suggests that small-scale irregularities had not grown within this large-scale plasma structure as it was transported across the polar cap.