

GPS phase scintillation during the geomagnetic storm of March 17, 2015: The relation to auroral electrojet currents

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Ionospheric irregularities cause rapid fluctuations of radio wave amplitude and phase that can degrade GPS positional accuracy and affect performance of radio communication and navigation systems. The ionosphere becomes particularly disturbed during geomagnetic storms caused by impacts of coronal mass ejections compounded by high-speed plasma streams from coronal holes. Geomagnetic storm of March 17, 2015 was the largest in the current solar cycle. The high-latitude ionosphere dynamics is studied using arrays of ground-based instruments including Global Navigation Satellite System (GNSS) receivers, HF radars, ionosondes, riometers and magnetometers. GPS phase scintillation index is computed for L1 signal sampled at the rate of up to 100 Hz by specialized GNSS scintillation receivers of the Expanded Canadian High Arctic Ionospheric Network (ECHAIN) and the Norwegian Mapping Authority network supplemented by additional GNSS receivers operated by other institutions. To further extend the geographic coverage, the phase scintillation proxy index is obtained from geodetic-quality GPS data sampled at 1 Hz. In the context of solar wind coupling to the magnetosphere-ionosphere system, it has been demonstrated that GPS phase scintillation is primarily enhanced in the cusp, tongue of ionization (TOI) broken into patches drawn into the polar cap from the dayside storm-enhanced plasma density (SED) and in the auroral oval during energetic particle precipitation events, substorms and pseudo-breakups in particular. In this paper we examine the relation to auroral electrojet currents observed by arrays of ground-based magnetometers and energetic particle precipitation observed by DMSP satellites. Equivalent ionospheric currents (EICs) are obtained from ground magnetometer data using the spherical elementary currents systems (SECS) technique developed by Amm and Viljanen (1999) that has been applied over the entire North American ground magnetometer network by Weygand et al. (2011).

References:

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