



EGNOS performance degradation during the passage of travelling ionospheric disturbances

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One of the strongest geomagnetic storms during solar cycle 24 occurred on 17th March 2015. This storm, which is frequently called St. Patrick's Day storm, was a two stage geomagnetic storm resulting from the superposition of two successive, moderate storms, driven by two successive, southward IMF structures [1]. The St. Patrick's Day storm was accompanied by significant perturbations in the ionosphere and thermosphere. In the European sector, intensive heating in the Auroral region generated storm wind cells and Atmospheric Gravity Waves (AGW) propagating equatorward. Prompt penetration electric fields and the winds caused a strong enhancement of the total electron content (TEC) over Europe [2].

The European Geostationary Navigation Overlay Service (EGNOS) is the European satellite-based augmentation system and has been deployed to provide safety of life navigation services to aviation, maritime and land-based users over most of Europe. It supplements the GPS, GLONASS and Galileo by reporting on the reliability and accuracy of their positioning data and sending out corrections. During the St. Patrick's Day storm 2015, EGNOS stations indicated significant degradation. Horizontal Protection Level (HPL) and Vertical Protection Level (VPL), which describe the region assured to contain the indicated horizontal/ vertical position, significantly increased during the course of the storm.

In this study we present a comparison of ionospheric disturbances over Europe, with EGNOS VPL information. Focal point is the analysis of Large Scale Travelling Ionospheric Disturbances (LSTIDS), which are signatures of AGWs. TEC measurements derived from a dense network of ground based Global Navigation Satellite System (GNSS) stations are used to detect the LSTIDs. Numerous LSTIDs occurred between 14 UT and 19 UT in central Europe. Exactly during this time EGNOS stations calculated enhanced VPL. Stations in the North suffered heavier degradations than those in the South.

1. I. Cherniak, I. Zakharenkova "Dependence of the high-latitude plasma irregularities on the auroral activity indices: a case study of 17 March 2015 geomagnetic storm" *Earth, Planets and Space*, **67**, 151, 2015 doi: 10.1186/s40623-015-0316-x

2. C. Borries, A. M. Mahrous, N. M. Ellahouny, R. Badeke, "Multiple ionospheric perturbations during the Saint Patrick's Day storm 2015 in the European-African sector" *Journal of Geophysical Research: Space Physics*, **121**, 2016, doi: 10.1002/2016JA023178.