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Topside ionospheric response to geomagnetic storms: multi-instrumental observations

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ABSTRACT

Ionospheric behavior during geomagnetic storms is not well understood yet, especially in the topside ionosphere (i.e., above the ionization maximum). New multi-instrumental era, with a large number of ground-based instruments installed, along with operations of multiple satellite missions, made a big progress in our understanding of the storm-time redistribution of the ionospheric plasma. In particular, the use of data of multiple satellite missions allowed demonstrate that in some cases the F-layer and the topside ionosphere do not react in the same manner during geomagnetic storms, and can even show opposite effects [1, 2, 3, 4, 5]. Thus, Yizengaw et al., 2006 [5] found no strong ionospheric response in the topside ionosphere and plasmasphere during the 20 November 2003 superstorm. At the same time, data of ground-based GPS receivers indicated a large dayside enhancement. Such difference in the ionospheric response was shown to be due to strong storm-time disturbance dynamo effects that caused ionospheric plasma downdrift on the dayside. Astafyeva et al., 2015 [1] demonstrated the occurrence of the opposite hemispheric asymmetries in the ionospheric response to the geomagnetic storm of 30-31 August 2004. While the ground-based GPS-receivers and ionosondes recorded large positive storm in the southern hemisphere, the satellite data from CHAMP and GRACE mission showed strong increase in the northern hemisphere.

These examples show the importance of a more detailed analysis of the ionospheric response at different altitudes, which is crucial for better understanding of the fundamental physical processes driving the ionospheric storm-time alterations, and, at the same time, is useful for model validation.

In this work, we discuss the peculiarities of ionospheric storms in the F- and in the topside regions on the example of two geomagnetic storms: a moderately intense storm of 30-31 August 2004 and the 2nd strongest storm of the current 24th solar cycle of 22-23 June 2015. For this purpose, we use multiple instruments, both ground-based and space-borne.

Key words: Topside Ionosphere, GNSS, space-borne GPS-receivers, multi-instrumental approach

References:

[1] E. Astafyeva, I. Zakharenkova and E. Doornbos (2015a). Opposite hemispheric asymmetries during the ionospheric storm of 29-31 August 2004. *J. Geophys. Res. - Space Physics*, V.120, 697-

714, doi:10.1002/2014JA020710.

[2] E. Astafyeva, I. Zakharenkova, and M. Foerster (2015b). Ionospheric response to the 2015 St. Patrick's Day storm: a global multi-instrumental overview. *J. Geophys. Res.- Space Physics*, V.120, N10, 9023-9037, doi: 10.1002/2015JA021629.

[3] Lei, J., Q. Zhu, W. Wang, A. G. Burns, B. Zhao, X. Luan, J. Zhong, and X. Dou (2015), Response of the topside and bottomside ionosphere at low and middle latitudes to the October 2003 superstorms, J. Geophys. Res. Space Physics, 120, 6974–6986, doi:10.1002/2015JA021310.

[4] Pedatella, N. M., J. Lei, K. M. Larson, and J. M. Forbes (2009), Observations of the ionospheric response to the 15 December 2006 geomagnetic storm: Long-duration positive storm effect, *J. Geophys. Res.*, 114, A12313, doi:10.1029/2009JA014568.

[5] Yizengaw, E., M. B. Moldwin, A. Komjathy, and A. J. Mannucci (2006), Unusual topside ionospheric density response to the November 2003 superstorm, *J. Geophys. Res*., 111, A02308, doi:10.1029/2005JA011433.

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