

## **Is there link between high-latitude ionospheric irregularities and large-scale traveling ionospheric disturbances?**

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On the case of 19–21 December 2015 geomagnetic storm, we demonstrate advantages on how combination of ground-based GPS and GLONASS observations with space-borne magnetic and plasma measurements allows investigate occurrence of the storm-induced ionospheric irregularities and propagation of large-scale traveling ionospheric disturbances (LSTIDs). Based on the high spatio-temporal resolution mapping approach of the total electron content (TEC) perturbation component deduced from the ground-based GNSS observations, we revealed the ionospheric small- to large-scale disturbances associated with a major source of the LSTIDs generation — auroral activity caused by auroral particle precipitation and field-aligned currents (FACs) intensification during geomagnetic disturbances. Location of ionospheric irregularities associated with auroral particle precipitation was deduced from multi-site ground-based GNSS measurements by rate of TEC index (ROTI) technique, AMPERE and Swarm data products were used to estimate FACs intensity and location. We found that an equatorward expansion of the strong ionospheric irregularities zone and an increase of the FACs magnitude led to a simultaneous intensification of the LSTIDs occurrence at high latitudes. COSMIC RO observations confirmed the E-layer conductivity enhancement due to particles precipitation that can lead to Joule heating intensification and TADs/TIDs excitation. The research is partially supported by the RFBR grant 19-05-00570-A.

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