COMPARISON OF GRACE-FO OBSERVATIONS WITH EMPIRICAL IONOSPHERIC AND ATMOSPHERIC MODELS PREDICTIONS DURING FEBRUARY 24-28, 2023

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A comparative analysis of variations in electron and thermospheric mass density was carried out using GRACE-FO satellite data [1] and the empirical ionosphere and atmosphere models (IRI-2020-NeQuick [2] and NRLMSISE-2.0[3], respectively) in the European-African longitudinal sector during February 24-28, 2023. This period is characterized by a strong geomagnetic storm that occurred on February 27, 2023 as well as Sudden Stratospheric Warming conditions that existed during January-March 2023.

A strong daytime enhancement in the topside electron density (by a factor of ~3.5) was observed during the geomagnetic storm on February 27, 2023, in the mid-latitudes of the Northern Hemisphere over central Europe. The ionospheric response to geomagnetic disturbance in the mid-latitudes of the Southern Hemisphere was considerably weaker (the electron density enhancement was only ~25%). The thermospheric mass density during the storm day increased in both hemispheres; however, in the Northern Hemisphere, this enhancement was stronger (~2 times compared to the geomagnetically quiet day of February 24), while in the Southern Hemisphere, the enhancement was by a factor of ~1.5. The obtained results show that the positive ionospheric storm was stronger in the winter (northern) hemisphere, while in the summer hemisphere, this effect was diminished.

Comparison of the observed topside electron density with the empirical ionospheric model predictions (IRI-NeQuick option) revealed a noticeable difference for the disturbed day (by a factor of ~3.8) for the winter hemisphere. In the summer hemisphere, this difference was lower (by a factor of ~2).

The empirical atmosphere model NRLMSISE 2.0 estimates showed a very good agreement with thermospheric density observations for geomagnetically quiet conditions in the winter (northern) hemisphere. However, for the disturbed period, the model underestimates the observed thermospheric density by ~ 35%. In the summer (southern) hemisphere, the model overestimated the satellite observations on ~30-60% both during quiet and disturbed conditions.

References:

1. https://gracefo.jpl.nasa.gov/data/grace-fo-data/

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