Quantifying the Variability of the Electron Density in the Ionosphere during SSW events

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Abstract:

Three sources have been understood to generate the day-to-day variability in the F-region Ionosphere: the solar flux variation, geomagnetic activity, and lower atmospheric forcing. It has been challenging to evaluate the relative roles of the three sources, partially because the mechanism of how the meteorological perturbations generates the variation in the upper atmosphere is not well understood. The lower atmosphere perturbations are not well represented in previous modelling studies. Recently, our understanding of the mechanism as well as modelling capability to incorporate the lower atmospheric forcing has significantly improved attributing to numerous recent studies on Sudden Stratospheric Warming (SSW) events.

In this project, the degree of the variability of the F-region ionosphere electron density has been quantified during the SSW 2009 event, because many studies have reported the significant importance of the lower atmospheric forcing in the ionospheric variability during the period. Specifically, the NmF2 (F-region peak electron density) and the hmF2 (height of F-region peak electron density) have been analyzed from the National Geophysical Data Center's (NGDC) Space Physics Interactive Data Resource (SPIDR) ionosonde dataset. The variability from the observation is significantly larger than that of the International Reference Ionosphere (IRI), which is an empirical model widely used in the field that depicts mainly the solar and geomagnetic variations. Furthermore, we have compared the observed NmF2 and HmF2 with the physics based Ionosphere-Plasmasphere Electrodynamics (IPE) Model, driven by the thermospheric neutral wind obtained from the Whole Atmosphere Model (WAM) that describes an impact of the meteorological disturbances on the upper atmosphere. The comparison of the variability between the observations and model would help us quantify the relative role of the lower atmospheric forcing.