Medium-Scale Traveling Ionospheric Disturbances Created by Gravity Waves Generated by a Weather Front.

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Abstract

This study explored the meteorology source and vertical propagation of gravity waves (GWs) that drove daytime traveling ionospheric disturbances (TIDs), using SD-WACCM-X and SAMI3 simulations coupled with SD-WACCM-X neutral wind and composition. A weather front exists over the northern-central USA with strong upward airflow during the daytime of October 20th, 2020. GWs with ~500-700 km horizontal wavelengths propagated southward/northward in the thermosphere from north-central USA. Also, their perturbations were successive from the troposphere to the thermosphere; therefore, the GWs could be generated by the strong upward airflow associated with the weather front. The frontal genesis GWs had almost infinite vertical wavelengths below ~100 km as the evanescent mode, implying that the GWs tunneled through their turning layer in the middle atmosphere and became the propagation mode in the thermosphere and ionosphere. MSTIDs also propagated southward together with the frontal GWs, suggesting that the MSTIDs were created by the frontal GWs. Comparison between GNSS TEC observations and MSTIDs modeled by SD-WACCM-X and SAMI3 are conducted. MSTIDs with concentric structures propagated southward in the GNSS TEC observations, and their epicenters were around the front. However, the observed MSTIDs are no one-on-one correspondence to both models. These discrepancies in TIDs could be attributed to different upward airflow and the background wind leading to the simulations of GWs in models. We also found the

discrepancy of the MSTIDs between SAMI3/SD-WACCM-X and SD-WACCM-X can be partly attributed to the difference in model resolutions and ionospheric models.