What Drives the Variability of the Mid-Latitude Ionosphere?

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The superposition of processes driving the short-term variability of ionosphere on scales from several minutes to several days remains one of the challenging topics in ionospheric research. In this study, we aim to 1) quantitatively describe short-term variability in the mid-latitude ionosphere and 2) investigate drivers of this variability. We use over 40 years of observations by the Millstone Hill incoherent scatter radar (42.6°N, 288.5°E) to develop updated empirical model of ionospheric parameters, and wintertime data collected in 2004-2017 to study variability in ionospheric parameters, focusing on ion temperature and electron density. We also use NASA MERRA2 atmospheric reanalysis data to examine possible connections between the state of the stratosphere & mesosphere and the upper atmosphere and ionosphere. Our analysis indicates that high-frequency variations (on time scales < 2 hrs) are the dominant contributor to the short-term ionospheric variability. Such variations are often associated with traveling ionospheric disturbances with periods in the range of 40-80 mins. Analysis of anomalies (data-model differences) in ion temperature show significant correlation with high-latitude stratospheric planetary wave 1 amplitude, with positive correlation during daytime and negative correlation at night. We suggest that this correlation results from differences in gravity wave filtering by mesospheric zonal wind altered due to the influence of stratospheric planetary wave 1.

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