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Effects of meteorological forcing on the thermosphere and ionosphere as simulated by numerical models

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The ionosphere-thermosphere system is influenced not only by solar and magnetospheric processes, but also by meteorological variability. Ionospheric observations of total electron content during the current solar cycle have shown that variability associated with meteorological forcing is important during solar minimum, and also can have significant ionospheric effects during solar medium to maximum conditions. Numerical models can be used to help understand the mechanisms that couple the lower and upper atmosphere over the solar cycle. This presentation gives an overview of the different proposed lower to upper atmosphere coupling mechanisms from a modeling perspective. Gravity and planetary waves along with tides play a crucial role in coupling the troposphere and stratosphere to the upper atmosphere. These waves and tides, when they dissipate, alter the background atmosphere which leads to changes in the tidal and planetary wave propagation. Some tides and waves reach the E-region around 100-150 km and change the low latitude plasma drift via the wind-driven electrodynamo. The vertical drift is one factor which determines the low latitude F-region ionosphere structure during the daytime. There is also observational evidence that tides propagate into the upper thermosphere and directly influence the plasma distribution. In addition, numerical simulations have suggested that tides and waves alter the upper thermospheric composition which in turn influences the F-region ionosphere. Including meteorological variability in numerical models increases the ionospheric variability, and enable us to reproduce some of the observed effects of strong meteorological disturbances, e.g, during Stratospheric Sudden Warming periods. We will allude to the need for further model development to improve the numerical model performance when meteorological variability is included.