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Modeling Ionospheric Daily Variability with SAMI3/WACCM-X

It is well known that physics-based models, such as SAMI3 (Sami3 is Another Model of the Ionosphere) are unable to capture the daily variability of the bottomside ionosphere. In times of relatively low solar activity, these variations are primarily driven by tides and weather from the lower atmosphere, so to account for these effects it is necessary to use lower atmospheric specifications to drive the ionospheric dynamics. This work examines the one way coupling of an ionosphere model (SAMI3) with a whole atmosphere model WACCM-X (Whole Atmosphere Community Climate Model). In this study, WACCM-X (with specified dynamics) is nudged with atmospheric data assimilation products from the Navy Operational Global Atmospheric Prediction System-Advanced Level Physics High Altitude (NOGAPS-ALPHA) that extend from the ground to ~90km. Inclusion of lower atmospheric weather provides day-to-day variability in the thermospheric winds and temperatures that in turn affect the ionosphere.

The daily variability of the ionosphere is quantified in this study by comparing to ionosonde measurements at different latitudes. The MoJo (Modernized Jones) raytrace tool is utilized to simulate ionograms at different locations over a time period of a month (January 2010). The simulated ionograms allow for comparisons of virtual height at different frequencies as a function of time, which provides more insight into the variation of the bottomside structure than simply comparing the peak height and density of the F-region ionosphere. The comparisons cover a range of low and mid latitude stations in order to investigate to what extent the bottomside variability differs with respect to latitude. In addition, the physical mechanisms for the variability (changes in winds, composition, etc.) and how much they change as a function of altitude are examined.