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Investigating Storm-Time Dynamics with High-resolution WACCMX+DART

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1 Extended Abstract

During significant geomagnetic storms a nighttime ionospheric localized enhancement (NILE), which is plasma confined to a few hundred km extent and co-rotating on the mid-latitude nightside, has been observed at times [1, 2]. While a number of possible mechanisms have been proposed, first-principles models do not predict the NILE. However, data assimilation has the potential to assist models to adapt to the evidence of the NILE.

In this work we use the Whole Atmosphere Community Climate Model with thermosphere and ionosphere eXtension with the data assimilation research testbed (WACCMX+DART) [3, 4] to investigate the possible role of the pre-reversal enhancement and polarization terminator on the formation of the NILE via ion drift. WACCMX+DART is run at 1.9 x 2.5 deg and vertical pressure level grid, and hourly cadence for the 17 March 2015 storm. WACCMX+DART models the physics of the atmosphere from the surface to the exobase, and models the transport of $O+$ in the F-region [3] self-consistently solving for the global electrodynamics, which are based on TIEGCM and driven by the low-to-mid-latitude wind dynamo and the Heelis [5] convection pattern at high latitudes. WACCM-X+DART ingests ground-based Global Positioning System (GPS) vertical Total Electron Content (vTEC) every 6 hours, which are obtained from the Madrigal data center.

Assimilating data at this resolution and cadence, we show the electron density as a function of altitude and latitude during the occurrence of the NILE, and find that WACCMX+DART is able to resolve the NILE feature. We also show the ion drifts at low-to-mid-latitudes during the dusk and evening during the time when the NILE persists. These drifts are partly consistent with those of the polarization terminator.

References

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