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Title: Global modeling of equatorial spread F with SAMI3/WACCM-X

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Post-sunset ionospheric irregularities in the equatorial F region were first observed by Booker and Wells (1938) using ionosondes. The ionosonde trace of the reflected radio wave from the bottomside ionosphere is normally sharp and increases in altitude up to the F peak. However, Booker and Wells (1938) observed that after sunset the trace was often no longer sharp, but broadened in altitude over tens of kilometers. They attributed this observation to the formation of 'electron clouds with scale sizes of 30 meters.' This phenomenon eventually became known as equatorial spread F (ESF). It is now known that during ESF the equatorial ionosphere becomes unstable because of a Rayleigh-Taylor-like instability: large scale (10s km) electron density 'bubbles' can develop and rise to high altitudes (1000 km or greater at times) [2, 3, 4]. Understanding and modeling ESF is very important because of its impact on space weather: it causes radio wave scintillation that degrades communication and navigation systems.

One of the outstanding problems associated with equatorial spread F and plasma bubble development is the day-to-day variability of this phenomenon [5, 6]. In fact, often times the ionosphere appears identical from one day to the next, yet spread F occurs on one day but not the other. We investigate this issue using a high-resolution version of the coupled SAMI3/WACCM-X for different thermospheric conditions (e.g., associated with season and solar activity). The model is currently one-way coupled: SAMI3 uses the thermospheric conditions provided by WACCM-X but does not feed ionospheric conditions into WACCM-X. However the model captures the global electrodynamics associated with different thermospheric conditions, and self-consistently investigate whether or not equatorial plasma bubbles develop.

The simulation results presented are for two cases: F10.7 = 70 (day-of-year 81) and F10.7 = 150 (day-of-year 184). The models use a spatial resolution of 0.625° in longitude and latitude which corresponds to a grid scale of $\sim$ 70 km in the equatorial region. We find that for the low F10.7 case that equatorial bubbles naturally develop in the Atlantic and African sectors; however, for the high F10.7 case no bubbles develop. This is shown in Figure 1. This suggests the coupled model can capture seasonal and solar activity dependences of ESF. We investigate the underlying causes for the these differences in

ESF behavior (e.g., gravity waves, pre-reve rsal enhancement of the eastward electric field, zonal and meridional winds)

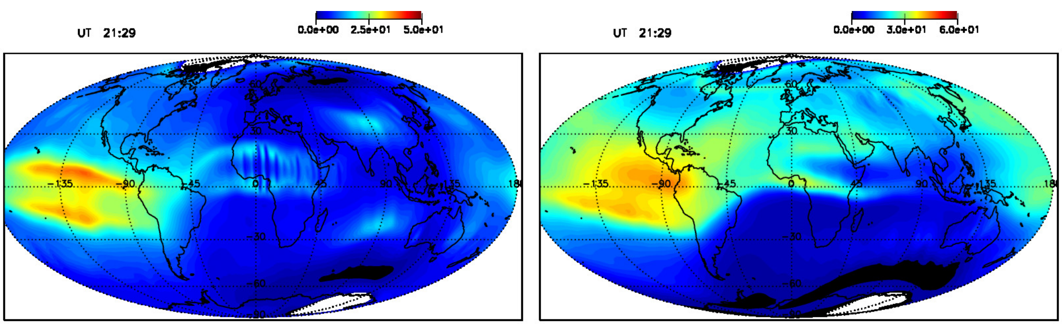

Figure 1. Global total electron content (TEC) for F10.7 = 70 (day-of-year 81) (left) and for F10.7 = 150 (day-of-year 184) (right).

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