Spatial Variation of the Pre-reversal Enhancement – Model Results

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The pre-reversal enhancement (PRE) is one of the most important phenomena controlling the nighttime ionosphere and the generation of equatorial spread F (ESF). In the passed few decades some theories have been proposed, but its causal mechanism is still not fully understood. Radar and satellite observations provide us important but incomplete information about it: radars can only observe local time variations at a specific location, while satellites provide data mainly at a single altitude. The NCAR Thermosphere Ionosphere Mesosphere Electrodynamics General Circulation Model (TIME-GCM) is capable of simulating ionospheric phenomena and the pre-reversal enhancement. In this research, we run the model under moderate solar activity (F10.7=150) and geomagnetic quiet conditions to monitor the variation of ionospheric parameters when the maximum upward drift of the PRE is occurring in the Peruvian longitude (75°W). Since it is a three dimensional model, it can provide us ion drift velocities, current flows, electric field changes, electron density and conductivity variations in Peruvian longitude and also longitudes to the east (after PRE) and west (before PRE). From the results, we are able to picture the three dimensional spatial variations of the ionosphere surrounding the PRE and to evaluate effects due to wind driven current, gravity driven current, the equatorial electrojet, and conductivity gradients. In addition, we evaluate the effects of winds and conductivities separately in the ionospheric E and F regions on the PRE, to understand and diagnose the complex electrodynamic processes. With detailed study of the phenomenon, the relationship with the irregularities in the nighttime ionosphere can also be better understood.