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Altitudinal response of global ionosphere to short-period recurrent geomagnetic activity during extreme solar minimum

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The deep solar minimum of solar cycles 23/24 was exceptionally quiet, with sunspot numbers at their lowest in at least 75 years. During this unique solar minimum epoch, however, solar wind high speed streams emanating from near-equatorial coronal holes occurred frequently and are the primary contributor to the continuous geomagnetic activity at the Earth. These conditions enable the isolation of forcing by geomagnetic activity on the preconditioned solar minimum state of the upper atmosphere caused by Corotating Interaction Regions (CIRs). Global observations of vertical electron density profiles by Formosat3/COSMIC provided a unique opportunity to study the altitudinal response of global ionosphere to this recurrent geomagnetic force caused by CIRs during the extreme solar minimum. The results indicate that the topside ionospheric response (above 350 km) appears to be dominated by changes in the plasma temperature and/or scale height and exhibits concurrent enhancements with the oscillations in geomagnetic activity during both day and nighttime. However, the electron density response at altitudes between 200 and 350 km is dominated by changes in the neutral composition and exhibits significant latitudinal, local time, and seasonal variations. The results are discussed in light of equatorward wind perturbations during enhanced geomagnetic activity and summer to winter transequatorial neutral wind patterns.

Keywords: Co-rorating Interaction Regions, recurrent geomagnetic activity, ionosphere, solar minimum