GAIA simulations of electric potential variations in the equatorial ionosphere after an intense solar flare

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It has been known that intense solar EUV and X-ray radiation by flares increases the electron density in the dayside ionosphere. The density distribution depends on chemical factors such as the ionization rate determined by the solar zenith angle and the loss rate related to the density of molecular nitrogen and oxygen. In addition, recent satellite measurements and modeling studies have shown that flares vary the zonal electric field to further disturb the electron density. The mechanism of the electric field variations by flares is still unknown. One possible mechanism is the conductivity changes by the enhanced ionization. Another candidate is the neutral wind dynamo developed by solar heating. In order to understand how each candidate varies the zonal electric field, we implemented the Flare Irradiance Spectral Model (FISM) to the GAIA model, a coupled model of whole atmosphere-ionosphere system. We performed simulations for the X17 flare on October 28, 2003. We found that the ionization enhancement creates the strong positive electric potential in the pre-sunset sector. We also found that the heating enhancement creates the strong negative potential in the post-sunset sector. The both enhancements intensify the positive eastward electric field from the afternoon to the evening to sustain the TEC enhancement for more than three hours. The electric field variations were most significant at the sunset terminator, which could encourage the growth of plasma bubbles.

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