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Theoretical and statistical studies of the magnetic storm effects to ionosphere

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Magnetic storm affects the ionospheric electron density structure through modifications of the ionospheric electric field, thermospheric neutral winds and compositions. The electric field disturbances are produced by prompt penetration electric field, shielding electric field and neutral wind disturbance dynamo, while the neutral wind and composition disturbances are produced by global circulation changes as a result of energy deposition at the high latitude/aurora region. The electric field disturbances modulate the equatorial plasma fountain and ionospheric height leading to ionospheric electron density disturbance. On the other hand, the neutral wind disturbance affects the plasma transport, and the composition change by reducing the [O]/[N2] ratio speeds up the recombination loss process of the ionospheric plasma. As the electric field, neutral wind and composition effects are often mixed during the storm period, the resulting ionospheric plasma structure becomes complex. In this study, we first review theoretical simulations of these combined ionospheric storm effects by using the NCAR thermosphere ionosphere electrodynamic general circulation model (TIEGCM) and the Sheffield University Plasmasphere Ionosphere Model (SUPIM). From theoretical modeling tasks, relative importance of these disturbed ionospheric drivers and their combined effects are evaluated and studied. Based on the model results, we further examine the GPS-TEC observations of magnetic storms occurred during ten-year period of 1999-2009 to study the ionospheric disturbances under various storm conditions.

Keywords: Ionospheric storm effect