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Penetration of Magnetospheric Electric Fields to Low Latitude Ionosphere, Observations and Modeling

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The magnetospheric convection electric field produced by the solar wind magnetosphere interaction with southward IMF is transmitted to the polar ionosphere along the magnetic field lines, and further penetrates deep into the low latitude ionosphere and to the inner magnetosphere. The penetrated electric field drives DP2 ionospheric currents with an enhanced amplitude at the dayside geomagnetic equator, which also enhances the TEC in the low latitude ionosphere. On the other hand, the low latitude ionosphere tends to be shielded from the convection electric field, and the electric field often reverses its direction when the IMF turns northward. From the electric current point of view, the Region-1 and -2 field-aligned currents flow into the equatorial ionosphere through the polar ionosphere, resulting in DP2 (intensification of the EEJ) or reversed DP2 (CEJ) when the R1 or R2 FACs are dominant. During a geomagnetic storm, DP2 currents dominate during the main phase, while CEJ tends to occur in the beginning of the recovery phase. The convection electric field is often observed in the inner magnetosphere during major geomagnetic storms, which suggests a tight electromagnetic coupling between the low latitude ionosphere and the inner magnetosphere. The reversed electric field associated with the equatorial CEJ may play a role in reducing the ring current during the recovery phase. The magnetosphere-ionosphere current circuit is analogous to a transmission line that transports electromagnetic energies to the low latitude ionosphere and to the inner magnetosphere. It should be stressed that the electromagnetic waves in the vacuum region below the ionosphere play a crucial role in transporting the electromagnetic energies. This talk will review the observations and theoretical model for the electromagnetic coupling between the magnetosphere and the ionosphere, with an emphasis on the low latitude ionosphere and the inner magnetosphere.