Transmission Of Solar Wind-Driven Electric Fields To The Low Latitude Ionosphere And Inner Magnetosphere

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Southward solar wind magnetic field causes the dawn-to-dusk convection electric field in the outer magnetosphere, which propagates to the polar ionosphere accompanying the Region-1 field-aligned currents (R1 FACs) and is transmitted to the equatorial ionosphere near-instantaneously by the TM0 mode wave in the Earth-ionosphere waveguide. The convection electric field drives DP2 currents in the global ionosphere, intensifying the eastward electrojet (EEJ) at the dayside equator. Thus, the equatorial EEJ and low latitude ionospheric disturbances occur near-instantaneously during the substorm growth phase and storm main phase. The electric field is further transmitted into the inner magnetosphere, generating ring current and the R2 FACs responsible for the dusk-to-dawn shielding/overshielding electric field at low latitude. Ground magnetometers detect the counterelectrojet (CEJ) caused by the overshielding electric field during substorm expansion phase and storm recovery phase. The quasi-periodic DP2 fluctuations are found to be caused by alternating contribution of the convection and overshielding electric fields. The Earth-ionosphere waveguide model is applied to explain the near-instantaneous transmission of the convection electric field to the equatorial ionosphere and upward transmission from the ionosphere to the inner magnetosphere.

Key words: DP2 currents, convection electric field, overshielding, Instantaneous penetration, Earth-ionosphere waveguide, geomagnetic storm