

Introduction to Ionosphere and E-region electrodynamics

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Abstract:

The ionosphere, extending from approximately 60 to 1000 km in altitude, constitutes a partially ionized region of Earth's upper atmosphere formed by the interaction of solar radiation with neutral gases. Rich in free electrons and ions, the ionosphere plays a significant role in radio wave propagation and space weather dynamics.

Within the altitude range of 85 to 200 km lies the ionospheric dynamo region, where tidal winds—driven by solar heating and lunar gravitational forces—move ionized plasma across geomagnetic field lines, generating electric fields and large-scale current systems. This process, known as the E-region Dynamo, primarily operates within the E-layer (90–150 km), historically referred to as the Kennelly-Heaviside layer.

The resulting electric currents produce geomagnetic field variations observable at the Earth's surface, particularly under geomagnetically quiet conditions. These diurnal variations are collectively termed Solar Quiet (Sq) variations. The Sq current system is a global-scale phenomenon, with currents forming closed loops directing towards dusk from dawn in the both hemisphere. A prominent equatorial feature of this system is the Equatorial Electrojet (EEJ)—a strong eastward current formed by the convergence and intensification of Sq currents near the geomagnetic equator.