

A three-dimensional ionospheric electrodynamics model

*Astrid I Maute¹, Arthur D Richmond¹

1. High Altitude Observatory, National Center for Atmospheric Research, Boulder CO, USA.

Ionospheric electric fields and currents are driven by collisional interaction between thermospheric winds and ions, by magnetospherically driven convection and field-aligned currents at high latitudes, by gravitational and pressure-gradient forces on the ionospheric plasma, and by weak currents from the lower atmosphere. The electrodynamics of the ionospheric E and F regions are strongly coupled. For time scales longer than a few minutes the electric field is electrostatic. The electric potential is nearly constant along geomagnetic-field lines, and can be represented in two dimensions in a coordinate system aligned with the magnetic field. The current density, however, varies in all three dimensions. Knowing the ionospheric current flow in three dimension is important for determining the magnetic perturbations at Low Earth Orbit (LEO) satellite height.

We are developing a model of ionospheric electrodynamics that takes into account all of the sources and calculates the three-dimensional structure of currents and their associated magnetic perturbation fields. This model will be used to simulate ionospheric drifts, currents, and ground and LEO geomagnetic perturbations. In this presentation we discuss the modeling principles and present results relevant to the electrodynamics of the middle and low latitude ionosphere, including the effects of coupling with F-region electrodynamics and the expected observable effects at low Earth orbit satellites.

Keywords: Ionospheric electrodynamics, ionospheric current, magnetic perturbations