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Induction Effects on Ionospheric Electromagnetic Fields

H. Vanhamäki, A. Viljanen and O. Amm
Finnish Meteorological Institute, Space Research Unit

Rapid changes in the ionospheric current system give rise to inductive electric fields and currents both in the ionospheric plasma and in the conducting ground. These fields and currents can significantly contribute to magnetic and electric fields at the ionosphere. Previous studies have concentrated on the ground induction and the effects it has on the fields at the ground's surface, as these effects are important in e.g. interpreting magnetometer measurements or in the studies of the earth's conductivity structure.

In this presentation we investigate the effects of induction fields at the ionospheric altitudes using several realistic ionospheric current models (Westward Travelling Surge, Omega-band, Giant Pulsation). We discuss both the ionospheric self-induction and the secondary effect of ground induction on ionospheric electromagnetic fields.

Our main conclusions are: 1) The secondary electric field caused by earth induction is relatively small at the ionospheric altitude, at most few % of the total electric field. 2) Under very dynamic situations the primary induced field due to ionospheric self-induction may be locally important in some "hot spots", where the ionospheric conductivity is high and the total electric field is low. In these areas inductive electric fields may modify the ionospheric current system and field aligned currents. 3) The secondary magnetic field caused by earth induction may significantly affect the magnetic measurements of low orbiting satellites. The secondary contribution from earth currents is largest in the vertical component of the magnetic field, where it may be several tens of % of the field caused by ionospheric currents.