



Role of inductive electric fields and currents in dynamical ionospheric situations

H. Vanhamäki, O. Amm and A. Viljanen

Space Research Unit, Finnish Meteorological Institute (heikki.vanhamaki@fmi.fi)

Inductive electric fields and currents have an important role in ionospheric electro-dynamics and ionosphere-magnetosphere coupling. Traditionally it has been assumed that the ionospheric electric field is a potential field, and it is well established that on large scales this is a valid assumption. This is understandable, since the temporal variations of large scale current systems are generally quite slow, in the timescales of several minutes, so inductive effects should be small. However, small scale and mesoscale current systems may exhibit much faster temporal variations, especially during substorm onsets. In this presentation we use a westward travelling surge and ionospheric omega bands as examples of rapidly varying and commonly observed ionospheric phenomena.

Using a new scheme that solves the ionospheric induction problem for arbitrary geometries and allows for non-uniform conductances, we demonstrate that in a localized area around the head of the WTS, the induced currents in the ionosphere can be of the same order of magnitude as those due to the potential electric field. In the case of omega bands, the induced currents are less strong than in the WTS case, but still locally not negligible. These induced currents are associated with strong field-aligned currents (FAC), that in the WTS can locally reach about 1/3 of the magnitude of the FAC due to the non-inductive currents. Thus induced FAC are not negligible and may play a significant role in the dynamical ionosphere-magnetosphere coupling.