ELECTRODYNAMIC STRUCTURE OF THE MORNING HIGH-LATITUDE TROUGH REGION

H. Vanhamäki[1,3], A. Aikio[1], M. Voiculescu[2], L. Juusola[3], T. Nygrén[1], and R. Kuula[1]

1: University of Oulu, Oulu, Finland.
2: "Dunărea de Jos" University of Galati, Galati, Romania.
3: Finnish Meteorological Institute, Helsinki, Finland.
email: heikki.vanhamaki@oulu.fi

We study electrodynamics of the morning trough region, seen as depletion of the F-region electron density. This trough was observed with the EISCAT radar in northern Scandinavia near summer soltice on 24-25 June 2003, around 23-04 magnetic local time. The UHF radar made meridian scans, giving 9 cross-sections of ionospheric electron density and ion temperature with 30 minute cadence. Also the F-region electric field was determined with the tristatic system.

Ionospheric equivalent currents, calculated from IMAGE magnetometer data, mostly show an electrojet-like current that is reasonably uniform in the longitudinal direction. This allows us to longitudinally extrapolate the Pedersen and Hall conductances, estimated from EISCAT data. Combined analysis of the conductances and equivalent currents with a local KRM method yields the ionospheric electric field and FAC in a 2D (latitude-longitude) area around the radar site.

The KRM results and EISCAT data offer a unique view into trough development, combining electrodynamic and plasma parameters. We conclude that the most likely scenario is one where the trough is initially created poleward of the auroral oval by downward FAC that evacuates the F-region, but as the trough moves to lower latitudes during the early morning hours it becomes co-located with the westward electrojet. There the electron density further decreases due to increased recombination caused by ion temperature increase brought about by a larger convection speed. Later in the morning the convection speed decreases and the trough is filled by increasing photo-ionization.

[1] Vanhamäki H., A. Aikio, M. Voiculescu, L. Juusola, T. Nygrén, and R. Kuula, Electrodynamic structure of the morning high-latitude trough region, *Submitted to Journal of Geophysical Research*, 2016.