High-time resolution plasma drift observations with EISCAT and KAIRA

Ilkka Virtanen[(1)], Yasunobu Ogawa [(2)], Keisuke Hosokawa[(3)] , Toru Takahashi [(2)] , Anita Aikio [(1)] , and Thomas Ulich [(4)]

(1) Ionospheric Physics Research Unit, University of Oulu, Finland
(2) National Institute of Polar Research, Tokyo, Japan
(3) Department of Communication Engineering and Informatics, University of Electro-Communications, Tokyo, Japan
(4) Sodankylä Geophysical Observatory, University of Oulu, Sodankylä, Finland

Commonly used techniques for ion drift observations with the EISCAT radars are tristatic observation and scanning a monostatic radar. In tristatic observations, the observed plasma volume is rather small and arbitrary time resolutions are technically possible. However, signal-to-noise ratio at the remote sites usually limits the time resolution to about a minute. Due to its better signal-to-noise ratio and larger coverage in height, the scanning technique provides more accurate velocity estimates than the tristatic measurements, but limited steering speed of the large antennas restricts the time resolution. The Kilpisjärvi Atmospheric Imaging Array (KAIRA) [McKay-Bukowski et al., 2015], located about 80 km from the EISCAT Tromsø site in Kilpisjärvi, Finland, can be used as an additional, multibeam, remote receiver for the EISCAT VHF. By means of combining data from the EISCAT mainland radars and KAIRA with the multistatic incoherent scatter analysis [Virtanen et al., 2014], we have observed F region plasma drifts and electric fields with time resolutions down to a few seconds. Like in the scanning technique, a drawback of our multiradar technique is that we are combining data from spatially separated plasma volumes, which are not on the same geomagnetic field-line. Despite its limitations, the multiradar technique enables electric field estimation with unprecedented time resolution. It also gives us a glimpse of the kind of observations the EISCAT_3D system will provide in future. We present the experimental setup and data processing, together with some examples of the results, and compare statistical accuracies of the different techniques.

References

D. McKay-Bukowski et al., KAIRA: the Kilpisjärvi Atmospheric Imaging Receiver Array -- system overview and first results, IEEE Transactions on Geoscience and Remote Sensing, 53 (3), 1440-1451, doi:10.1109/TGRS.2014.2342252, 2015.

I.I. Virtanen, D. McKay-Bukowski, J. Vierinen, A.T. Aikio, R. Fallows, and L. Roininen, Plasma parameter estimation from multistatic, multibeam incoherent scatter data, Journal of Geophysical Research: Space Physics, 119 (12), 10528-10543, doi:10.1002/2014JA020540, 2014.