

An Effect of Anomalous Cooling of the Dynamo Layer Electrons for Under FB-threshold Electron Drifts

E.E. Timofeev (Physical Institute, Univ. of the S-Petersburg);
P. Pollari, J. Kangas, T. Bosinger (Department of Physics, University
of Oulu, Finland);

The EISCAT measurements of the E-layer ionospheric parameters near the Tromso zenith coordinated with measurements of the F-layer plasma drifts carried out during the ERRRIS campaign are analyzed. The data statistics contains almost 2000 measurements with a mean altitude and temporal resolution equal of about 3 km and 90 s, respectively. To derive the systematical trends the electron (T_e) and ion (T_i) temperatures are averaged through 10 and 20-km dynamo layer width whereas the E-field strengths are averaged over 10-mV/m bins and the E-field vector azimuths over 30-degree bins.

It is found that: 1) The T_e and T_i averages are practically equal to each other for electron drifts approximately equal to ion-sound velocity (close to the FB-threshold). For greater electric fields (above the threshold) well known effect of the electron-to-ion overheating take place; 2) For smaller electron drifts (under the threshold) the bin average T_i keeps approximate constancy independently on the strength of the ionospheric E-field. However, the bin average T_e decreases monotonically following the E-field decrease and achieving its minimum for minimum (0-5 mV/m) E-field bin. For this bin the temperature difference ($T_e - T_i$) achieves its maximum equal to about 100, 50 Kelvin for 10 and 20-km dynamo layer width, respectively. 3) The difference depends also on the E-field azimuth achieving its minimum for the E-fields belonging to the plane of the local magnetic meridian and maximizing in the approximately perpendicular directions.

The results are discussed in terms of the thermoelectric and turbulent cooling processes similar to the Peltier and Ranque-Hilsche effects.