Ionospheric currents in the two hemispheres during low and high magnetic activity by the Swarm satellite

A. Workayehu, H. Vanhamäki and A. Aikio

Ionospheric Research Unit, University of Oulu, Finland

We present statistical investigation of the high-latitude ionospheric current systems in the Northern and Southern hemispheres during low (Kp < 2) and high (Kp ≥ 2) geomagnetic activity levels. We analyse nearly four years of vector magnetic field measurements from the two parallel flying Swarm satellites using the spherical elementary current system (SECS) method [Amm et al., 2015], and determine the ionospheric horizontal and field-aligned currents (FAC) for each auroral oval crossing separately. We bin the FAC as well as the horizontal curl-free (CF) and divergence-free (DF) currents in magnetic latitude and local time grid for each hemisphere and activity level separately. Bootstrap resampling is used to estimate the statistical significance, and to remove seasonal bias in the data distribution.

We find that overall the currents are stronger in the Northern hemisphere than in the Southern hemisphere, but the difference depends on the geomagnetic activity level. Large hemispheric asymmetry is observed during low magnetic activity, with larger magnitudes of FACs and horizontal currents in the Northern hemisphere. In contrast, the interhemispheric difference is very small during high magnetic activity, which suggests that the local ionospheric conditions may be important, playing a larger role during quiet than disturbed periods. The local conditions may be related to factors such as variations in solar illumination or magnetic field strength due to different offsets between the geographical and magnetic poles, and dynamics of neutral atmosphere. We plan to study these factors in the future.