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Field-aligned current and auroral Hall current characteristics derived from the Swarm constellation

Tao Huang (1,2), Hui Wang (1), and Luehr Hermann (2)

(1) Dept. of Space Physics, School of Electronic Information, Wuhan University, China, (2) GFZ, German Research Centre for Geosciences, Section 2.3 “Earth’s Magnetic Field”

On the basis of field-aligned currents (FACs) and Hall currents derived from high-resolution magnetic field data of the Swarm constellation the average characteristics of these two current systems in the auroral regions are comprehensively investigated by statistical methods. This is the first study considering both current types simultaneously and for both hemispheres. The FAC distribution, derived from the Swarm dual-spacecraft approach, reveals the well-known features of Region 1 (R1) and Region 2 (R2) FACs. At high latitudes, Region 0 (R0) FACs appear on the dayside. Their direction depends on the orientation of the interplanetary magnetic field (IMF) By component. Of particular interest is the distribution of auroral Hall currents. The most prominent auroral electrojets are found to be closely controlled by the solar wind input. But there is no dependence on the IMF By orientation. The eastward electrojet is about twice as strong in summer as in winter. Conversely, the westward electrojet shows less dependence on season. Part of the electrojet current is closed over the polar cap. Here the seasonal variation of conductivity mainly controls the current density. There is a clear channeling of return currents over the polar cap. Depending on IMF By orientation most of the current is flowing either on the dawn or dusk side. The direction of Hall currents in the noon sector depends directly on the orientation of the IMF By. This is true for both signs of the IMF Bz component. But largest differences between summer and winter seasons are found for northward IMF Bz. Around the midnight sector the westward substorm electrojet is dominating. As expected, it is highly dependent on magnetic activity, but shows only little response to the IMF By polarity.