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Field-aligned current morphology and multipoint observations: Comparisons between low altitude spacecraft, global simulations and ground-based radars

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The morphology of field-aligned currents (FACs) in the polar ionosphere is investigated using space-based and ground-based data and global simulations. Magnetic field data from the low altitude FAST and DMSP spacecraft are used to derive local field-aligned current structure. Particle data acquired by these spacecraft provides some context for the FACS, e.g., polar cap versus auroral zone, and by using multiple spacecraft we can obtain some sense of the large-scale structure of the currents. An even better picture of the large-scale structure can be obtained through comparisons with ground-based data from the SuperDARN radars, which provide large-scale convection patterns for the polar ionosphere. This comparison also provides a consistency check between the inferred FAC pattern and the corresponding flows. An even larger global context is provided by comparing the data with global simulations. When there is consistency between the data and the model we can use the simulations to address the global magnetic field topology, and in particular the relationship between FACs as observed at low altitude and the magnetospheric drivers of FACs, such as reconnection and vorticity. Global MHD codes tend to underestimate FACs driven by pressure gradients, such as Region-2 currents, so we concentrate on the Region-1 and polar cap FACs. Specific areas to be addressed include the dependence of FAC morphology in the dayside cusp-region as a function of the Interplanetary Magnetic Field (IMF), and changes in FAC structure associated with solar wind dynamic pressure pulses.