Auroral Spirals Paper

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1 Abstract

In this case study, we investigate a close conjunction between auroral spirals observed by multi-wavelength all-sky auroral imagers on the ground (from the TREx-RGB array) and the overflight of the Swarm B satellite in the local morning sector. Due to an extended period of low magnitude southward interplanetary magnetic field (IMF) , a strong global convection pattern arises because of solar wind-magnetosphere coupling. We find during the interval of the conjunction, small-scale auroral spirals (100km length) form coincident with a latitudinally narrow shear flow boundary measured by Swarm B. Additionally, measurements of the phase speed of optical elements of the evolving auroral vortices are consistent with the shear-flows seen by Swarm-B when mapped into the field of view of the all-sky imager. We further contextualize the conditions leading to the auroral vortices by integrating a variety of local electrodynamic and magnetic measurements into a meso-scale electrodynamics model. We find that the location of the shear flow in the return convective flow in the global pattern is coincident with the latitude of the auroral vortices. These factors strongly suggest that a magnetic Kelvin-Helmholtz instability occurs on the inner edge of the dawnside convection cell, and that this shear-flow boundary provides the mechanism that drives the local auroral vortices seen in the ionosphere. Additionally, morphological arguments are preliminarily explained to explain folds coincident with auroral spirals.