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When and where is the process of restoring symmetry important?

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We define the process of restoring symmetry as the gradual relaxation of a flux-tube participating in the Dyngey-type convection from nightside to dayside, starting out with asymmetric footpoints. The first observations linked to this penomenon was presented by Grocott et al. 2004 (Annales), observing fast ($\sim$1000 m/s) east/west ionospheric convection across midnight, later shown to be simultaneous present in the opposite hemisphere, and oppositely directed for +/- IMF By. More recently, Tenfjord et al. 2015 (JGR) presented a framework for how the stress stored in a magnetic flux-tube around midnight having asymmetric footpoints, can dissipate preferentially into one hemisphere. In this model, the asymmetric dissipation of stress is communicated as Alfven waves, providing Birkeland currents and the jxB force needed to move the footpoint of the field-line toward a more symmetric configuration.

Until recently, observations supporting this scenario has mainly been made during northward, but By dominated IMF. Reistad et al. 2016 (JGR) presented statistical maps of Birkeland currents during conditions favorable for large hemispheric asymmetry in footpoint locations during southward IMF. Significant differences in Birkeland current strength was seen between the two hemispheres, where the hemisphere having footpoints "lagging behind" (i.e. strongest expected return flow) having largest current densities. Reistad et al. 2016 suggested that the process of restoring symmetry was a likely explanation of at least some of these asymmetries. If that is the case, it indicates that the importance of the restoring symmetry process is more general, not only restricted to the northward and By dominating IMF. One way to test this is to look at corresponding differences in convection speed during conditions other than northward IMF. By looking at the average properties of the ionospheric return flow during periods associated with asymmetric footpoints, we seek to investigate the importance of the restoring symmetry process also outside the northward IMF domain reported on earlier.

This study is utilizing the Doppler-shift of backscatter from decametre-scale density irregularities in the E- and F- region ionosphere to infer the line-of-sight component of the ionospheric plasma drift using the Super Dual Auroral Radar Network (SuperDARN). We produce average maps of ionospheric convection based solely on observations during carefully selected periods, to search for conditions favoring the restoring symmetry process. The outcome of this study is expected to enhance our understanding of when and where this process is important, and put further constraints on the framework put forward by Tenfjord et al. 2015 for when and where the stress is transmitted asymmetrically. This is important to get a better understanding of the influence on Birkeland currents from this mechanism, and during which conditions they can be considered important.