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Evolution of asymmetrically displaced footpoints during substorms

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It is well established that a transverse (y) component in the Interplanetary Magnetic Field (IMF) induces a By component in the closed magnetosphere through asymmetric loading and/or redistribution of magnetic flux. Simultaneous images of the aurora in the two hemispheres have revealed that conjugate auroral features are displaced longitudinally during such conditions, indicating that the field-lines are displaced from their symmetric configuration. Although the direction and magnitude of this displacement show correlations with IMF clock angle and dipole tilt, events show large temporal and spatial variability of this displacement. For instance, it is currently unknown how substorms affect the displacement.
In a previous case study it has been demonstrated that displaced auroral forms, associated with the prevailing IMF orientation, returned to a more symmetric configuration during the expansion phase of two substorms. Using IMAGE and Polar, we have identified multiple events where conjugate auroral images during substorms are available. By visual inspection and by applying a correlation analysis, we identify conjugate auroral features and investigate how the asymmetry evolves during the expansion phase. We find that the system returns to a more symmetric state, in agreement with the earlier published case study. This is also true for the events where the solar wind driving is stable, indicating that the asymmetric displacement is indeed reduced or removed by the substorm. This can be interpreted as the result of increased reconnection rate in the magnetotail during the expansion phase, which reduces the asymmetric lobe pressure.