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Field Line Eigenfrequencies During Storms and Substorms

Jasmine Sandhu (1), Jonathan Rae (1), Colin Forsyth (1), Tim Yeoman (2), Matthew James (2), Alexander Luff (1), Maria-Theresia Walach (3), and Marina Georgiou (1)

(1) Mullard Space Science Laboratory, University College London, Dorking, UK, (2) University of Leicester, Leicester, UK, (3) Lancaster University, Lancaster, UK

The eigenfrequencies of geomagnetic field lines provide a useful diagnostic for the large scale magnetic field configuration and the mass density distribution of plasma within the magnetosphere. By applying the cross phase technique [Waters et al., 1991, 1995] to ground magnetometer observations, the eigenfrequencies of field lines can be directly measured. We illustrate the capability of using measured eigenfrequencies to observe large scale structure and variability of the terrestrial magnetosphere during highly dynamic and not fully understood magnetospheric conditions, specifically during storm and substorm processes. Magnetic field observations from the CARISMA ground magnetometer array are analysed, providing simultaneous coverage over a large range of L shells. We present large scale statistical studies, which provide insight into how the magnetic field and mass density vary globally throughout storms and substorms. Furthermore, case studies have been identified that allow us to measure the Alfvén continuum prior to substorm onset. The results of this work offer further insight into the mechanics of these processes and the varied response of the magnetosphere, as well as highlighting the ability to probe large scale magnetospheric structure through measurements of field line eigenfrequencies.