Space Physics Seminar

Thursday, November 2, 2017

Sandra Chapman

CFSA, University of Warwick

Fulbright-Lloyd's of London 2017/18 Scholar, Boston University

Dynamical Networks Approach to Multi-point Solar Terrestrial Physics Observations

The plasma and magnetic field of earths near-space environment is highly dynamic, with its own space weather. Space weather and solar terrestrial physics observations are increasingly becoming a data analytics challenge. Constellations of satellites observe the solar corona, the upstream solar wind and throughout earth's magnetosphere. Space weather effects on the ground are monitored by 100+ magnetometer stations in the auroral region. Ionospheric currents can be detected by magnetometers on (for example the 60+ Iridium) polar orbiting satellites in low earth orbit. These data are multipoint in space and ex-tended in time, so in principle are ideal for study using dynamical networks. Whilst networks are in widespread use in the data analytics of societal and commercial data, there are additional challenges in their application to physical timeseries. Determining whether two nodes (here, ground based magnetometer stations) are connected in a network (seeing related dynamics) requires normalization w.r.t. the detailed sensitivities and dynamical responses of specific observing stations which also have seasonal variations. The spatial sampling points are not uniformly spatially distributed and are moving w.r.t. the plasma-current system under observation, and the plasma-current system itself is non-linear and highly dynamic. This talk will present a dynamical network study of the auroral current system which is observed by the SuperMAG set of over a hundred ground based magnetometers. The dynamics of this current system reflect the dynamical response of the earth's magnetosphere to solar wind driving where energy is stored and then released in a bursty manner (substorms). Spatio-temporal patterns of correlation between the magnetometer time series can be used to form a dynamical network [1], the properties of the network can then be captured by (time dependent) network parameters. This offers the possibility of characterizing detailed spatio-temporal pattern by a few parameters, so that many events can then be compared [2] with each other and with theoretical pre-dictions.

[1] Dods et al, J. Geophys. Res 120, doi:10.1002/2015JA02 (2015).
[2] Dods et al, J. Geophys. Res. 122, doi:10.1002/2016JA02 (2017).

4:00pm in CAS 502. *Refreshments served at 3:45pm in CAS 500.*

BOSTON UNIVERSITY

C·S·P

Next Week

Ryan McGranaghan

JPL