

Quantifying space weather turbulence and extremes and risk at earth

Fully funded project

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Centre for Fusion, Space and Astrophysics

Research at the Centre for Fusion, Space and Astrophysics (CFSa) focuses on plasma physics applied to the grand challenges of fusion power, space physics, solar physics, and astrophysics. Our work spans fundamental theory, observation, and the analysis of experimental data, combined with high performance computing. For more details of the CFSa see <http://www.warwick.ac.uk/go/cfsa/>

The near-earth space plasma environment, its magnetosphere and ionosphere, exhibit a rich range of non-linear phenomena, from turbulence to large-scale reorganization, leading to geomagnetic substorms with system-scale phenomenology such as the aurora. Direct driving by solar activity, such as coronal mass ejections, precipitates geomagnetic storms, but the magnetosphere responds to solar driving in a complex manner. This space weather, and its impacts on power grids, communications and satellite performance, is thus challenging to quantify.

Turbulent fluctuations are ubiquitous in space plasmas, from the high Reynolds number solar wind, to shear-driven ionospheric flows. There is now a rich set of data available for their study. Single-point observations in-situ in the solar wind and at earth span multiple solar cycles, and multipoint observations of ground level magnetic disturbances, and fluctuations in ionospheric plasma density, are available from an extensive system of 100+ ground based magnetometers, and by using the ground signals from the Global Navigation Satellite System (GNSS). This project will use these data both to advance our fundamental understanding of turbulence, and to quantify the pattern and likelihood of extreme fluctuations which in the ionosphere can impact on communications and GNSS timing and positioning. It will require combining nonlinear plasma physics with a careful understanding of the varied nature of the observations and their uncertainties.

The project is part of an ongoing collaboration with lead experimenter sites NASA-JPL and JHU/APL, and will require visits to the USA.

We plan to interview in person at Warwick University in late February. We welcome informal enquiries and can discuss online before then.