Geophysical Research Abstracts
Vol. 21, EGU2019-10062, 2019
EGU General Assembly 2019

The predictability of the geomagnetic variation and its dependence on solar wind driver, time lag, and ionospheric conductance

Robert Shore (1), Mervyn Freeman (1), John Coxon (2), Evan Thomas (3), Jesper Gjerloev (4,5), and Nils Olsen (6)

(1) British Antarctic Survey, High Cross, Madingley Road, CAMBRIDGE, CB3 0ET, UK (robore@bas.ac.uk), (2) Space Environment Physics (SEP) Group, University of Southampton, Southampton, SO17 1BJ, UK (J.Coxon@soton.ac.uk), (3) Thayer School of Engineering, Dartmouth College, Hanover, NH, USA (Evan.G.Thomas@dartmouth.edu), (4) Johns Hopkins University, Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, Maryland, 20723, USA (Jesper.Gjerloev@jhuapl.edu), (5) Birkeland Center of Excellence, Department of Physics and Technology, University of Bergen, Norway (Jesper.Gjerloev@jhuapl.edu), (6) DTU Space, Technical University of Denmark, Elektrovej 327, 2800 Kongens Lyngby, Denmark (nio@space.dtu.dk)

Shore et al. (2018) have used empirical orthogonal function (EOF) analysis to decompose the northern polar surface magnetic field variability into a small set of characteristic patterns – basis vectors defined in space and time – which collectively describe the majority of the variance. The resulting magnetic field model completely describes the surface magnetic field variation above 50 degrees North between 1997.0—2009.0, and represents the complex interactions of local time, season, ionospheric conductivity, and solar and geomagnetic activity. Using this model, we regress the surface magnetic field variation against time series of solar wind parameters in order to obtain covariance maps in magnetic latitude and magnetic local time of the contributions to the ionospheric equivalent current variability from specific solar wind inputs. The following parameters are considered: Perreault and Akasofu's ε parameter, interplanetary magnetic field (IMF) Bz and By components, dipole tilt angle and F10.7. We also investigated the contributions from solar wind speed and proton density, though these were not important stand-alone predictors.

Specifically, whilst Shore et al. (2018) computed the orthogonal set of equivalent current patterns of maximal variance which describe the data, here we extract from the combined EOF patterns the spatial patterns due to forcing by each solar wind direct-driving component. We compute these covariance maps as a function of the time lag between the solar wind perturbation and the terrestrial response, demonstrating (with the best fidelity to date) the reconfiguration timescale of the ionospheric equivalent currents to perturbations in different solar wind parameters. Our study is the first to resolve the contributions to the ionospheric equivalent current variability from given IMF components. This new information will improve estimates of the geoeffectiveness of a given solar wind perturbation.

References:
- Perreault, P., and S.-I. Akasofu (1978), A study of geomagnetic storms, Geophys. J. R. Astron. Soc., 54, 547–573, doi:10.1111/j.1365-246X.1978.tb05494.x.
- Shore, R. M., Freeman, M. P., & Gjerloev, J. W. (2018). An empirical orthogonal function reanalysis of the northern polar external and induced magnetic field during solar cycle 23. Journal of Geophysical Research: Space Physics, 123, 781–795. https://doi.org/10.1002/2017JA024420