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The contribution to the variability of polar ionospheric equivalent currents from different components of the interplanetary magnetic field – an EOF approach

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Shore et al. (2017) 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 the interplanetary magnetic field (IMF) time series in order to obtain covariance maps in magnetic latitude and magnetic local time of the contributions to the ionospheric equivalent current variability from given IMF components. Specifically, whilst Shore et al. (2017) 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 IMF component. We compute these covariance maps as a function of the time lag between the IMF perturbation and the terrestrial response, demonstrating that larger covariances are exhibited at longer lags for the nightside and auroral regions. 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:

Shore R.M., M.P. Freeman, and J.W. Gjerloev (2017), An empirical orthogonal function reanalysis of the northern polar external and induced magnetic field during solar cycle 23, J. Geophys. Res. Space Physics, 121, doi:10.1002/2017JA024420.