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Local time resolved FAC behaviors

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The empirical model MFACE [*He et al.,* 2012] and ten years of CHAMP magnetic measurements are used to study the local time resoluted behaviors of field-aligned currents (FACs), including the level of FAC predictability, latitudinal distribution, FAC intensity, and delay time to solar wind. Results indicate that the FACs respond quicker to solar wind changes on the dayside than on the nightside: 15–20 min vs. 55–95 min delays for the FAC intensity referring to solar wind conditions at the bow shock nose, and 20–30 min vs. 35–65 min for the FAC latitude. The predictability of dayside FACs is higher than on the nightside: the determination coefficient R^2 reaches values >0.3 for FAC intensity and >0.7 for FAC latitude whereas the corresponding values for the nightside are <0.1 and <0.25, respectively. These results can be understood in terms of the two principal solar wind-magnetosphere coupling modes, namely, directly driven processes acting primarily on the dayside and unloading processes responsible for the dynamics on the nightside. Furthermore, standardized regression coefficients are employed to assess the relative importance of the independent variables. The variance of FAC latitude could be explained most efficiently by the variations of season, solar activity reflected in the F10.7 index and the empirical potential, and substorm evolution stages reflected through AU and a substorm onset relaxation index. For FAC intensity, the empirical conductance G and IMF By give important contribution to both the EOF1 and EOF2 regressions. In particular, the EOF1 component correlates notably with AU and the relaxation index, while EOF2 correlates with the square and cross term, G^2 and G*By, suggesting the intensity of R1/R2 structure varies regularly with substorm evolution and the dependence of the cusp currents on conductance is not linear. The important coefficients identified in the present study have been integrated into the most recent version of MFACE.

References

He, M., J. Vogt, H. Lühr, E. Sorbalo, A. Blagau, G. Le, and G. Lu (2012), A high-resolution model of field-aligned currents through empirical orthogonal functions analysis (MFACE), Geophys. Res. Lett., 39(18), L18105.