Geophysical Research Abstracts
Vol. 18, EGU2016-8969, 2016
EGU General Assembly 2016

Solar wind - magnetosphere coupling efficiency during ejecta and sheath region driven geomagnetic storms

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We have investigated the effect of key solar wind driving parameters on solar wind- magnetosphere coupling efficiency during sheath and magnetic cloud driven storms. The particular focus of the study was on the coupling efficiency dependence with Alfven Mach number (M_A). The efficiency has been estimated using the dawn-dusk component of the interplanetary electric field (E_Y), Newell and Borovsky functions as a proxy for the energy inflow and the polar cap potential (PCN), auroral electrojet (AE) and SYM-H indices as the measure of the energy output. We have also performed a time delay analysis between the input parameters and the geomagnetic indices.

We demonstrate that the PCN index distinctively shows both a M_A dependent saturation and a M_A-independent saturation, pointing to the existence of at least two underlying physical mechanisms for the saturation of the index. By contrast, we show that the AE index saturates, but that the saturation of this index is independent of the solar wind M_A. Finally we find that the SYM-H index does not seem to saturate and that the absence of saturation is independent of the M_A regime.