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Diagnosing the impact of Alfvén waves on the energetics of magnetosphere-ionosphere coupling using Swarm

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With the advent of the Swarm mission it has become possible to resolve the details of the electrodynamics of magnetosphere-ionosphere coupling (MIC) at high cadence using E- and B-field measurements. Our recent research (Pakhotin et al., JGR, 2018) studying field-aligned currents (FACs) and Alfvén waves has indicated that rather than being two separate phenomena, they can be described by the same physical framework of incidence, ionospheric reflection and interference of Alfvén waves at different scales. This immediately leads to the conclusion that low-pass filtering methods which are often used to assess MIC energetics but which filter out non-stationary Alfvén waves will lead to a persistent under-estimation of MIC energy transfer. This study presents statistical results showing that depending on the choice of filter, between 20 and 50 percent of total Poynting flux will be eliminated by the application of filtering at 150-km scales, leading to significant underestimation of MIC energetics. Our results suggest that Alfvén waves are an essential, and potentially dominant, element of MIC which should not be neglected.