Global rates of Alfvénic energy deposition, electron precipitation, and ion outflow during geomagnetic storms

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During the past decade magnetospheric and ionospheric research communities have made notable advances in our collective understanding of geomagnetic storms as periods of the strongest coupling between the solar wind and the magnetosphere, and between several magnetospheric and ionospheric subsystems. Of three broad classes of aurora (diffuse, monoenergetic, and broadband) several studies have demonstrated that broadband aurora are the most susceptible to the influence of solar wind driving, geomagnetic storms, and substorms, but there have been no studies to determine the relative contribution of each geomagnetic storm phase to the total broadband energy budget in the auroral ionosphere. Using a large database of FAST satellite observations of inertial Alfvén waves we present evidence that storm main and recovery phases were responsible for ∼70% of the total Alfvénic energy input to the auroral ionosphere between October 1996 and November 1999, even though storm phases comprised only 31% of the three-year study period. We furthermore find that storm main phase, while comprising less than 15% of this period, was responsible for almost 40% of the total Alfvénic energy input to the auroral ionosphere, and 50% of the associated ion outflow. Using two methods for storm identification we compare overall geomagnetic storm frequency and strength, as well as the frequency of each storm phase, during the portion of the 23$^{\text{rd}}$ solar cycle covered in this study with corresponding statistics over a contiguous 55-year period from 1957 to 2012. Measures of geomagnetic activity during the study period fall near corresponding 55-year median values; on this basis we conclude that storm main and recovery phases are the dominant contributors to the total Alfvénic energy budget in the auroral ionosphere for all periods except possibly those when geomagnetic activity is protractedly weak, such as solar minimum.