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Alfvénic field-aligned currents, ion upflow and electron precipitation during large geomagnetic storms

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We present four years of FAST observations of Alfvénic field-aligned currents (FACs) in the Northern Hemisphere coincident with 40 moderate (Dst < -50 nT) to very large geomagnetic storms. Superposed epoch analysis of Alfvénic activity of storm periods demonstrate a sharp increase in the probability of Alfvén wave occurrence just after storm commencement, and analysis based on storm phase shows that the probability of Alfvén wave occurrence increases by more than a factor of 5 on both dayside and nightside. Additionally, recently reported Van Allen Probes measurements in the magnetosphere imply a region (∼60–68 degrees invariant latitude) in the nightside ionosphere where Alfvén waves are statistically likely to be observed during storm main phase; we report statistical observations during main phase showing that this region instead corresponds to both intense electron precipitation (>10 mW m^{-2}) and strong upflowing ion number flux (> 10^8 cm^{-2} s^{-1}), while observed Alfvénic FAC occurrence rates are diminished relative to Van Allen Probes measurements. FAST observations also indicate that the most intense electron precipitation associated with Alfvénic FACs occurs pre-midnight during storm recovery phase.