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Detailed look at energy dynamics in Earth's magnetosphere using simulation

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Energy transport into and throughout Earth's magnetosphere has direct consequences for human infrastructure in orbit and on the planets surface but studying the entire system in a comprehensive and quantifiable way has many challenges. In this work we use the Space Weather Modeling Framework (SWMF) in the Geospace configuration with the addition of the Conductance Model for Extreme Events (CMEE) to simulate a real storm event and take a thorough look at the energy content within regions of the magnetosphere. The magnetosphere outer boundary is defined using techniques published in Brenner et al. 2021 and is represented in the simulation domain as an iso-surface. Additional boundaries between the lobes and the closed field line plasma sheet are then determined in order to study the transport of energy between the different plasma regimes from the magnetosheath to the inner magnetosphere. The results are shown as time-series of integrated energy content within each region volume, and integrated energy flux between the regional interfaces. These volume energies and surface fluxes are compared with input solar wind conditions, storm phases, and empirical solar wind - magnetosphere coupling functions. Finally, the results are quantitatively assessed in terms of statistical parameters of the integrated quantities during each storm phase as well as statistical relationships such as correlation coefficients between energy from the sheath to the lobes and lobes to the closed field line region.