

Pathway and conversion of solar wind energy to ionosphere: Global MHD simulation result

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A large amount of energy is consumed in the auroral ionosphere during the substorms. An immediate question is where the energy comes from. We analyzed the results of the global magnetohydrodynamics (MHD) simulation that is capable of reproducing sudden intensification of the Region 1-sense field-aligned current and subsequent auroral electrojet. The solar wind energy is converted to the electromagnetic energy in the cusp/mantle region when the interplanetary magnetic field is southward. The electromagnetic energy is transported to the ionosphere. We introduced an integral curve of the Poynting flux (S-curve) to show a pathway of the electromagnetic energy. The S-curve shows a spiral moving toward the ionosphere. Just before the expansion onset, the near-Earth reconnection initiates 3-dimensional redistribution of the magnetosphere. Flow shear in the near-Earth region results in the generation of the near-Earth dynamo and the onset FACs as well. In the near-Earth dynamo, the electromagnetic energy is converted to the thermal energy and the kinetic energy (known as bursty bulk flow), followed by the electromagnetic energy. About 1% of solar wind energy is converted to the electromagnetic energy in the cusp/mantle dynamo. About 25-33% of the electromagnetic energy generated in the cusp/mantle dynamo is consumed in the ionosphere.

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