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On the solar wind-magnetosphere energy coupling function

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One of the fundamental questions in space physics is to understand how the flow of energy is transported and distributed in the solar wind-magnetospheric-ionospheric system. There is no direct method of measuring the energy transfer from the solar wind to the magnetosphere, but it is well accepted that the transfer is strongly coupled to the southward component of the Interplanetary Magnetic Field (IMF). During such conditions some of the solar wind energy will enter the magnetosphere, due to large-scale reconnection processes and deposit energy in the ionosphere and ring current. The three major sinks in the Magnetosphere-Ionosphere (MI) system is Ring Current Injection, Joule Heating and Particle Precipitation. The deposited energy by these sinks can be estimated using ground based magnetometer data. Over the years several coupling parameters have been suggested, but still the epsilon parameter from Perrault and Akasofu (1978) based on the Poynting flux is the most widely used. The epsilon parameter indicates how the solar wind couples its energy to the magnetosphere. More recent studies have also included other plasma parameters, e.g. pressure and density, to better balance the system. Using consistent magnetometer and solar wind data over several months in the period 1997-2010, we can estimate input (energy coupling function) and ouput (energy sinks) and assess the validity of various energy coupling functions.