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Possible hysteresis in solar wind power input to the magnetosphere

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We examine the clock angle dependence of the solar wind power input into the magnetosphere using the Grand Unified Magnetosphere Ionosphere Coupling Simulation (GUMICS-4). We compute the power input through the magnetopause systematically in four events where the solar wind parameters are otherwise kept constant, but the interplanetary magnetic field (IMF) clock angle θ is rotated from 0° to 360°. We find that when the clock angle rotates from north to south, the power input is well represented by $\sin^2(\theta/2)$. However, during the return rotation from south to north, the power input in the simulation remains enhanced longer than a $\sin^2(\theta/2)$ dependence would indicate. This suggests that the energy transfer may be hysteretic such that after strong energy input the energy transfer remains active, which contradicts the earlier view that the energy transfer is a linear function of solar wind parameters. We investigate the time delay associated with the power input as a function of solar wind parameters. Furthermore, we characterize the spatial extent of the hysteresis at the magnetopause. We suggest that the hysteretic energy input may be a consequence of the nature of reconnection process at the magnetopause.