Geophysical Research Abstracts, Vol. 8, 05123, 2006
SRef-ID:

Heliospheric flux and CMEs

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To test for magnetic flux build-up in the heliosphere from coronal mass ejections (CMEs), we simulate heliospheric flux as a constant background open flux with a time-varying interplanetary CME (ICME) contribution. As flux carried by ejecta can only contribute to the heliospheric flux budget while it remains closed, the ICME flux opening rate is an important factor. Two separate forms for the ICME flux opening rate are considered: constant and exponentially decaying with time. Coronagraph observations are used to determine the CME occurrence rates, while in situ observations are used to estimate the magnetic flux content of a typical ICME. Both static equilibrium and dynamic simulations, using the constant and exponential ICME flux opening models, require flux opening time-scales $\sim$100 days in order to match the observed doubling in the magnetic field intensity at 1 AU over the solar cycle. Such time-scales are equivalent to a change in the ICME closed flux of $\sim$5% between 1 and 5 AU, in close agreement with CSE signatures; no flux catastrophe results. The dynamic simulation yields a solar cycle flux variation with high variability that matches the overall variability of the observed magnetic field intensity remarkably well, including the double peak forming the Gnevyshev gap.