Geophysical Research Abstracts
Vol. 19, EGU2017-7396, 2017
EGU General Assembly 2017

EUHFORIA: a solar wind and CME evolution model

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We present the latest results of the new physics-based forecasting-targeted inner heliosphere model EUHFORIA ('EUropean Heliospheric FORecasting Information Asset') that we are developing.

EUHFORIA consists of a coronal model and a magnetohydrodynamic (MHD) heliosphere model with CMEs. The aim of the baseline coronal model is to produce realistic plasma conditions at the interface radius r = 0.1 AU between the two models thus providing the necessary input to the time-dependent, three-dimensional MHD heliosphere model. It uses GONG synoptic line-of-sight magnetograms as input for a potential (PFSS) field extrapolation of the low-coronal magnetic field coupled to a current sheet (CS) model of the extended coronal magnetic field. The plasma variables at the interface radius are determined by employing semi-empirical considerations based on the properties of the PFSS+CS field such as the flux tube expansion factor and distance to nearest coronal hole. The heliosphere model computes the time-dependent evolution of the MHD variables from the interface radius typically up to 2 AU. Coronal mass ejections (CMEs) are injected at the interface radius using a hydrodynamic cone-like model using parameters constrained from fits to coronal imaging observations. In order to account for the modification of the heliosphere due to the presence of earlier CMEs, the standard run scenario includes CMEs launched five days prior to the start of the forecast, while the duration of the forecast extends up to seven days.

In addition to presenting results of the modeling, we will highlight our on-going efforts to advance beyond the baseline in the forecasting pipeline. In particular we discuss our path towards using magnetized CMEs, the application of a time-dependent coronal model as well as modeling the transport of solar energetic particles (SEPs) in the heliosphere. We also discuss the tests with solution AMR (Adaptive Mesh Refinement) for the background wind and the evolution of magnetized CME clouds and shock waves.