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ENLIL Global Heliospheric Modeling as a Context For Multipoint Observations

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We present heliospheric simulation case studies using recent enhancements to WSA–ENLIL+Cone (version 2.8) at the Community Coordinated Modeling Center (CCMC). The global 3D MHD ENLIL model provides a time-dependent description of the background solar wind plasma and magnetic field using a sequence of WSA coronal model maps as input at the inner boundary of 21.5 Rs. A homogeneous, over-pressured hydrodynamic plasma cloud is launched through the inner boundary of the heliospheric computational domain and into the background solar wind. Multipoint observations help constrain simulations and this modeling system provides global context and arrival times of the solar wind streams and CMEs at Earth, planets, and spacecraft. Additionally, one can extract the magnetic topologies of observer-connected magnetic field lines and all plasma and shock properties along those field lines. ENLIL "likelihood/all-clear" forecasting maps provide expected intensity, timing/duration of events at locations throughout the heliosphere with "possible SEP affected areas" color-coded based on shock strength. ENLIL simulations are also useful to drive SEP models such as the Solar Energetic Particle Model (SEPMOD) (Luhmann et al. 2007, 2010) and Energetic Particle Radiation Environment Module (EPREM) (Schwadron et al., 2010). SEPMOD injects protons onto a sequence observer field lines at intensities dependent on the connected shock source strength which are then integrated at the observer to approximate the proton flux. EPREM couples with MHD models such as ENLIL and computes energetic particle distributions based on the focused transport equation along a Lagrangian grid of nodes that propagate out with the solar wind. Studies have shown that accurate descriptions of the heliosphere, and hence modeled CME arrival times and SEPs, are achieved by ENLIL only when the background solar wind is well-reproduced and CME parameters are accurate. It is essential to include all of the relevant CMEs and allow enough time for the events to propagate and interact. In this presentation we demonstrate several event case studies of ENLIL simulations compared with multipoint observations, exploring the background solar wind and CME pre-conditioning, and including comparisons between ENLIL synthetic j-maps with observed STEREO/HI j-maps using catalogues from the HELCATS FP7 project.