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SEP modeling and forecasts based on the ENLIL global heliospheric model

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Understanding gradual SEP events (often driven by CMEs) well enough to forecast their properties at a given location requires a realistic picture of the global background solar wind through which the shocks and SEPs propagate. The global 3D MHD WSA-ENLIL model (Odstrcil et al., 2004) provides a time-dependent background heliospheric description, into which a cone-shaped CME can be inserted. It is clear from our preliminary runs that the CMEs sometimes generate multiple shocks, some of which fade while others merge and/or strengthen as they propagate. In order to completely characterize the SEP profiles observed at various locations with the aid of these simulations it is essential to include all of the relevant CMEs and allow enough time for the events to propagate and interact. From ENLIL v2.8 simulations 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. Accurate descriptions of the heliosphere, and hence modeled SEPs, are achieved by ENLIL only when the background solar wind is well-reproduced and CME parameters are accurate. ENLIL derived information is also useful to drive SEP models such as the Solar Energetic Particle Model (SEPMOD) which calculates the time series of $\sim$10-100 MeV protons at a specific observer location using a passive test particle population (Luhmann et al. 2007, 2010). In this presentation we demonstrate SEP event modeling which utilizes routine ENLIL runs important for space weather forecasting and research.

Making SEP models available for research and operational users is one of Community Coordinated Modeling Center's (CCMC) top priorities. Heliospheric model outputs are a necessary ingredient for SEP simulations. The CCMC is making steps towards offering a system to run SEP models driven by a variety of heliospheric models available at CCMC such as the ones described in this presentation.