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Numerical Simulation of Multiple-CME Events in 2011-2013

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The ENLIL-based heliospheric modeling system enables faster-than-real time simulations of corotating and transient disturbances. This hybrid system does not simulate origin of coronal mass ejections (CMEs) but uses appearance in coronagraphs, its geometric and kinematic parameters, and launches a CME-like structure into the solar wind computed using the Wang-Sheeley-Arge (WSA) coronal model. Propagation and interaction in the heliosphere is solved by a 3-D magnetohydrodynamic (MHD) code. In this presentation, we introduce the recent improvements that support modeling of the evolving background solar wind and modeling of multiple-CME events. These enhancements are needed especially for simulations of complex scenarios of multiple-transients interacting with each other and with corotating solar wind stream structures. We simulated over 700 CMEs in 2011-2013 to validate and calibrate new modeling system, and we will show examples of multi-CME events during August 2010. March 2012, and July 2012 periods of enhanced solar activity. We will present results of numerical simulations and compare them with remote white-light observations, with in-situ measurements of plasma parameters, and with detection of solar energetic particles (SEPs) at various spacecraft.