SOFIE (Solar-wind with Field-lines and Energetic-particles): A data-driven and self-consistent SEP modeling and forecasting tool

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Abstract

We present a data-driven and self-consistent SEP model, SOFIE, to simulate the acceleration and transport processes of energetic particles using the Space Weather Modeling Framework (SWMF). In this model, the background solar wind plasma in the solar corona and interplanetary space are modeled by the Alfven Wave Solar-atmosphere Model(-Realtime) (AWSoM(-R)) driven by the near-real-time hourly updated GONG (bihourly ADAPT-GONG) magnetograms. In the background solar wind, the CMEs are launched employing the Eruptive Event Generator using Gibson-Low configuration (EEGGL), by inserting a flux rope estimated from the free magnetic energy in the active region. The acceleration and transport processes are then modeled self-consistently by the multiple magnetic field line tracker (M-FLAMPA) and the Adaptive Mesh Particle Simulator (AMPS). We will demonstrate the capability of SOFIE to demystify the acceleration processes by the CME-driven shock in the low corona and the modulation of energetic particles by the solar wind structures. Besides, using selected historical SEP events, e.g. 2013 Apr 11 event, we will illustrate the progresses toward a faster-than-real-time prediction of SEPs.

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