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Modeling solar wind background for CME propagation using the Alfven Wave Solar atmosphere Model (AWSoM)

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The first step towards reliable prediction of the impact of solar transients that drive space weather is to accurately model the background solar wind into which these transients propagate. Uncertainties in the plasma environment into which CMEs propagate can lead to significant errors in time of arrival and impact prediction which is important for technology that humans are routinely dependent on as well as space-based explorations.

We use the physics-based 3D extended MHD Alfven Wave Solar atmosphere Model (AWSoM) within the Space Weather Modeling Framework (SWMF) developed at the University of Michigan to model the solar wind conditions during periods of high activity that include many strong solar transient events. These modeling efforts are validated by both in-situ and remote observations including EUV observations in the low corona from STEREO-A/B and SDO-AIA as well as plasma parameters at L1 from the OMNI database. AWSoM is driven by observations of the photospheric magnetic field. We use the ADAPT magnetic field maps that model the evolution of the observed magnetic field on the solar surface using physical processes like flux-transport, supergranulation and meridional flows. Our results show how our solar corona model behaves when driven by different data products like GONG and HMI observations.

In addition to the input magnetograms, the results also depend on model parameters. AWSoM is a self-consistent physics-based model with only a few free parameters. In our NSF funded Space Weather with Quantified Uncertainty (SWQU) project we systematically study the uncertainty quantification associated with various model inputs and parameters. We find that during periods of higher solar activity the Poynting flux parameter at the inner boundary needs to be adjusted to match the observations well to provide correct initial conditions for CME propagation. This work is in preparation for simulating CMEs launched from the Sun and propagating into correct solar wind background in order to achieve accurate and reliable space weather modeling and prediction.