Geophysical Research Abstracts
Vol. 21, EGU2019-1465-3, 2019
EGU General Assembly 2019

Validating the Alfven Wave Solar Model (AWSoM) from the lower corona to 1 AU

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We examine the steady state three-dimensional MHD simulations of the solar corona carried out with the new version of the Alfven Wave Solar Model (AWSoM) within the Space Weather Modeling framework (SWMF). AWSoM addresses the acceleration and heating of the solar corona via the interaction between counter-propagating Alfven waves. This non-linear interaction between the outward propagating low-frequency Alfven waves and those partially reflected by the speed gradients results in a turbulent energy cascade. The model uses physics-based partitioning of wave-dissipated heat between isotropic electron and anisotropic proton temperatures.

To validate the AWSoM model, we select rotations representative of the solar minimum and maximum conditions and compare our simulation results with a comprehensive suite of observations. We use three-dimensional tomographic reconstructions of the electron temperature and density in the inner corona ($r < 1.25$ Rsun) based on multi-wavelength extreme ultraviolet images from STEREO/EUVI and SDO/AIA. For comparison with observations made near the Earth, we compare the model with OMNI data. At different radial distances between 20 Rsun and 1 AU, we compare the model with reconstructions made with Interplanetary Scintillation (IPS) observations. Observations are compared with the simulated model results of plasma mass density, velocity, and magnetic fields, temperature anisotropy, and wave turbulence.
Our results at solar minimum show that the improved AWSoM model performs well in agreement with the observations between inner corona and 1 AU. In the lower corona the model and the tomographic reconstructions match within a 20 % accuracy. Near the Earth, our model shows good agreement with observations of solar wind velocity, electron temperature and magnetic field. However, the electron density at 1 AU is overpredicted by the model for the solar minimum simulations. While this model version is already an improvement over previous predictions, we plan to validate our model using more Carrington rotations. The AWSoM model presents an extensive application to study the solar corona and larger heliosphere in concert with current and future solar missions.