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Three-dimensional MHD simulation of interplanetary solar wind

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The prediction of solar wind parameters near the Earth has important scientific research significance and practical application value. Three-dimensional magnetohydrodynamics (MHD) numerical simulation is an important tool in the prediction of solar wind parameters. This work presents a three-dimensional MHD numerical model, which can be used to simulate the background solar wind in the interplanetary space. The inner boundary of the model is set at 0.1 astronomical unit (AU) and six-component grid system is employed in the computational domain. The ideal MHD equations are solved by using the total variation diminution (TVD) Lax-Friedrich scheme, and the divergence of the magnetic field is eliminated by a diffusion method. This model uses magnetogram synoptic map images from the Global Oscillation Network Group (GONG) observation as input data. The empirical WSA relation is used to assign solar wind speed at the inner boundary, while density and temperature are specified according to the characteristics of satellite observation. There are six free parameters in the boundary conditions, which can be tuned to simulate the solar wind for different phases of solar cycle. This model is used to simulate the background solar wind in 2007 and 2016 respectively, and the simulated solar wind parameters (including speed, density, temperature, and the magnetic field strength) are in good agreement with the ACE/WIND satellite observations.