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GEMSIS-Sun: Numerical Modeling of Sun-Earth System on the Basis of Solar Observations (SUSANOO)

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Solar wind including coronal mass ejections (CMEs) is a main driver of various space weather disturbances. MHD modeling of the solar wind is a powerful tool to understand the solar-terrestrial environment and to forecast space weather accurately. Recently, we have developed an MHD model of the inner heliosphere on the basis of minimal input, namely, time series of daily synoptic observation of the photospheric magnetic field [Shiota et al. 2014]. The time series of MHD parameters at the Earth position is passed to a radiation belt model [Miyoshi et al. 2004] for forecasting of the radiation belt energetic electron flux. These programs are executed everyday on a server in STEL, Nagoya University and the results are uploaded on the web site (http://st4a.stelab.nagoya-u.ac.jp/susanoo/). This system is named as Space-weather-forecast-Usable System Anchored by Numerical Operations and Observations (SUSANOO). The calculated time profiles of solar wind velocity and magnetic field at positions of planets agreed with in situ measurements around solar minimum (2007 -2009) [Shiota et al. 2014].

The MHD simulation of solar wind does not include CMEs and therefore this is a possible source of error of the forecast in active period in solar cycle. We have been developing a CME model including magnetic flux ropes [Kataoka et al. 2009]. In the model, each CME is injected as a twisted magnetic flux rope accompanying with a velocity pulse through the inner boundary of the simulation and propagate into the solar winds. Thanks to the including flux ropes, the model is capable for a model of Dst index variation. We attempted to model the solar wind profile when multiple CMEs came from associated recent large-scale active regions: NOAA 10486 in October to November 2003 (Halloween event). As a result, the strength of compressed magnetic field becomes as high as about four times of background IMF when a fast CME interacts with the background solar wind. However, successive CMEs interact with each other to form much stronger magnetic filed due to compression of the magnetic cloud of the preceding CME by shock associated the following CME.

キーワード: 太陽風, MHD, 放射線帯, 宇宙天気, コロナ質量放出
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