太陽観測データに基づく太陽風・コロナ質量放出の磁気流体シミュレーション

塩田大幸 [1]、片岡龍峰 [2]
[1] 名古屋大学
[2] 国立極地研究所

Magnetohydrodynamic Modeling of Solar Wind and Coronal Mass Ejections on the Basis of Solar Observations

Daikou Shiota[1] and Ryuho Kataoka[2]
[1]*Nagoya University*
[2]*National Institute of Polar Research*

Solar wind including coronal mass ejections (CMEs) is a main driver of various space weather disturbances, some of which affect the environment of the upper atmosphere of the Polar Regions. 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].
We also have been developing a CME model [Kataoka et al. 2009] to inject each CME as a twisted magnetic flux rope accompanying with a velocity pulse through the inner boundary of the simulation. We will show a test case: the propagation and interaction process of multiple CMEs associated with high active regions NOAA 10486 in October to November 2003. As a result, we succeeded to reproduce the arrival to the Earth position of a large amount of southward magnetic flux, which is capable of causing an intense magnetic storm.

References

Kataoka, R.; Ebisuzaki, T.; Kusano, K.; Shiota, D.; Inoue, S.; Yamamoto, T.; Tokumaru, M., Three-dimensional magnetohydrodynamic (MHD) modeling of the solar wind structures associated with 13 December 2006 coronal mass ejection Journal of Geophysical Research - Space Physics, Volume 114, Issue A10, CiteID A10102, 2009
Miyoshi, Y. S.; Jordanova, V. K.; Morioka, A.; Evans, D. S., Solar cycle variations of the electron radiation belts: Observations and radial diffusion simulation, Space Weather, Volume 2, 10, 2004
Shiota, D.; Kataoka, R.; Miyoshi, Y.; Hara, T.; Tao, C.; Masunaga, K.; Futaana, Y.; Terada, N., Inner heliosphere MHD modeling system applicable to space weather forecasting for the other planets, Space Weather, Volume 12, 187, doi:10.1002/2013SW000989, 2014