Data-driven Interlocked Modeling of the Sun-Earth System: Formation Dynamics of Coronal Mass Ejections

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We have developed a new interlocked MHD model of the Sun-Earth System, for the research of the relations between solar activities and the terrestrial environment and the space weather forecast. The new interlocked model consists of several different MHD models which are specialized for different physical processes, such as triggering of flares, coronal mass ejection (CME) acceleration and propagation, and solar wind interaction with the magnetosphere. In this paper, we introduce our new MHD code with HLLD non-linear Riemann solver (Miyoshi & Kusano 2005) and Yin-Yang grid (Kageyama & Sato 2004) for the comprehensive MHD simulation of the solar corona.

Using the new code, we performed MHD simulation of the evolution of a twisted flux rope ejected from an active region under global magnetic field structure, in order to investigate the condition for CME formation and its dynamics. According to the numerical results with different global field, it is found the flux rope can be ejected when the global field is moderately strong and parallel to the poloidal field of the flux rope. This tendency of the evolution is contrastive to other old 2D view. Furthermore, the ejecting flux rope shows tilt rotation, which is important process for space weather forecasting. These results show that the interaction between ejecting structure and ambient field is a significant process for formation of a CME. In this paper, we summarize analysis of the numerical results concentrating in the direction of the magnetic field. Furthermore, using synthetic coronagraph of the numerical results, we discuss the probability of discernment of dynamics inside a CME.