Development of coronal mass ejection arrival time forecasting system using interplanetary scintillation observations

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Coronal mass ejections (CMEs) sometimes cause disturbances in the environment of the Earth. However, prediction of the arrival of CMEs still remains a challenge. We have developed a data assimilation forecasting system of the CME arrival time by combining radio interplanetary scintillation (IPS) observations and a global magnetohydrodynamic (MHD) simulation of the inner heliosphere. In this system, the initial speed of a CME is roughly derived from the white light coronagraph observations. Then, the propagation of the CME is calculated by global MHD simulation (Shiota et al. submitted in this session). The IPS is estimated by the three-dimensional density distribution of the inner heliosphere derived from the MHD simulation. The estimated IPS is compared with the actual IPS observation made by the Institute for Space-Earth Environmental Research, Nagoya University. The estimated IPS shows good agreement with the observed IPS. We demonstrated the working of the simulation system using a typical halo CME event generated by a X9.3 flare observed on September 5, 2017. We found that the CME simulation that estimates IPS most similar to the observation can most accurately predict the time of arrival of the CME to the Earth. These results suggest that the accuracy of the CME arrival time will be improved if the current MHD simulations include IPS data.

Keywords: coronal mass ejection (CME), space weather forecasting, interplanetary scintillation (IPS), data assimilation

