Numerical Simulation on the Propagation and Deflection of Fast Coronal Mass Ejections (CMEs) Interacting with a Corotating Interaction Region in Interplanetary Space

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Previous research has shown that the deflection of coronal mass ejections (CMEs) in interplanetary space, especially fast CMEs, is a common phenomenon. The deflection caused by the interaction with background solar wind is an important factor to determine whether CMEs could hit Earth or not. As the Sun rotates, there will be interactions between solar wind flows with different speeds. When faster solar wind runs into slower solar wind ahead, it will form a compressive area corotating with the Sun, which is called a corotating interaction region (CIR). These compression regions always have a higher density than the common background solar wind. When interacting with CME, will this make a difference in the deflection process of CME? In this research, first, a three-dimensional (3D) flux-rope CME initialization model is established based on the graduated cylindrical shell (GCS) model. Then this CME model is introduced into the background solar wind, which is obtained using a 3D IN (INterplanetary) -TVD-MHD model. The Carrington Rotation (CR) 2154 is selected as an example to simulate the propagation and deflection of fast CME when it interacts with background solar wind, especially with the CIR structure.

The simulation results show that: (1) the fast CME will deflect eastward when it propagates into the background solar wind without the CIR; (2) when the fast CME hits the CIR on its west side, it will also deflect eastward, and the deflection angle will increase compared with the situation without CIR.