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Deflected Propagation of CMEs and Its Importance on the CME Arrival Forecasting

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As the most important driver of severe space weather, coronal mass ejections (CMEs) and their geoeffectiveness have been studied intensively. Previous statistical studies have shown that not all the front-side halo CMEs are geoeffective, and not all non-recurrent geomagnetic storms can be tracked back to a CME. These phenomena may cause some failed predictions of the geoeffectiveness of CMEs. The recent notable event exhibiting such a failure was on 2015 March 15 when a fast CME originated from the west hemisphere. Space Weather Prediction Center (SWPC) of NOAA initially forecasted that the CME would at most cause a very minor geomagnetic disturbance labeled as G1. However, the CME produced the largest geomagnetic storm so far, at G4 level with the provisional Dst value of -223 nT, in the current solar cycle 24 [e.g., Kataoka et al., 2015; Wang et al., 2016]. Such an unexpected phenomenon naturally raises the first question for the forecasting of the geoeffectiveness of a CME, i.e. whether or not a CME will hit the Earth even though we know the source location and initial kinematic properties of the CME. A full understanding of the propagation trajectory, e.g., the deflected propagation, of a CME from the Sun to 1 AU is the key. With a few cases, we show the importance of the deflection effect in the space weather forecasting. An automated CME arrival forecasting system containing a deflected propagation model is presented.