

## Using Interplanetary Scintillation Data to Improve Ensemble Modeling of Coronal Mass Ejections

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The impact of the coronal mass ejections (CMEs) on the Earth's magnetosphere-ionosphere system can cause widespread anomalies for satellites from geosynchronous to low-Earth orbit and produce effects such as geomagnetically induced currents. At the NASA/GSFC Community Coordinated Modeling Center we have been using ensemble modeling of CMEs since 2012. In this work we use interplanetary scintillation (IPS) observations from the Ooty Radio Telescope facility in India to track CMEs and compare to an ensemble of CME forecasts. This allows downselection of the ensemble members and helps to improve forecasting of CME arrival times. The inclusion of observations of the solar wind density and velocity using IPS from hundreds of distant sources in ensemble modeling of CMEs can be a game-changing improvement of the current state of the art in CME forecasting. Moreover, the same method can be applied to ensemble simulations of the magnetosphere that suffer from the same scarcity of input data with similar degree of uncertainty.

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