Predicting heliospheric propagation of CMEs with probabilistic Drag-Based Ensemble Model (DBEM)

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Understanding space weather driven by the solar activity is crucial as it can affect various human technologies, health as well as it can have important implications for the space environment near the Earth and the Earth’s atmosphere. In order to better assess space weather forecasts various empirical, drag-based and MHD models have been developed to predict the arrival time of CMEs. One of them is the analytical Drag-based Model (DBM) applying the equation of CME motion which is determined by the drag force from the background solar wind acting on the CME. DBM predictions depend on various initial parameters such as CME launch speed, background solar wind speed and empirically derived drag parameter as well CME’s angular half-width and longitude of CME source region for a DBM CME cone geometry. Since many of input parameters may be inaccurate or unreliable due to limited observations, the Drag-Based Ensemble Model (DBEM) was developed that considers the variability of model input parameters by making an ensemble of a number of different input parameters to calculate a distribution and significance of DBM results. DBM has the advantage of having very short computational time (< 0.01s) and DBEM ensemble runs with many thousand members can be performed within few seconds on a normal computer. Using such approach, DBEM can determine the most likely CME arrival times and speeds, quantify the prediction uncertainties and calculate the forecast confidence intervals.

Recently, DBEM web interface was also integrated as one of the ESA Space Situational Awareness web portal space weather services (http://swe.ssa.esa.int/heliospheric-weather). We’ll present the recent DBEM developments together with the validation of its predictions using observations and other models as well as the input parameter sensitivity tests.