Probabilistic model for heliospheric propagation of CMEs: Drag-Based Ensemble Model (DBEM)

Authors:

Čalogović, J. (jcalogovic@geof.hr), Hvar Observatory, Faculty of Geodesy, Kačićeva 26, HR-10000 Zagreb, Croatia; Institute of Physics, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria
Dumbović, M. (mdumbovic@geof.hr), Institute of Physics, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria
Vršnak, B. (bvrsnak@geof.hr), Hvar Observatory, Faculty of Geodesy, Kačićeva 26, HR-10000 Zagreb, Croatia
Temmer, M. (manuela.temmer@uni-graz.at), Institute of Physics, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria
Mays, L. M. Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD, USA
Veronig, A. (astrid.veronig@uni-graz.at), Institute of Physics, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria

Abstract:

The Drag-based Model (DBM) is a simple empirical model for heliospheric propagation of Coronal Mass Ejections (CMEs). It is based on the equation of motion that depends on the CME launch speed, background solar wind speed and CME mass and density (gamma parameter). The model predicts the CME arrival time and speed at Earth or any other targets in the solar system. However, the main problem of empirical and numerical models (e.g. ENLIL) is the lack of reliable observations that are needed for the model input. This can induce a large error in the CME arrival time (−1.7 ± 18.3 h; Vršnak et al., 2014) when observations and DBM forecasts are compared. The main advantage of DBM is its very fast computational time (<< 1s). This allows an ensemble modeling approach to provide a probabilistic forecasting of CME arrival time and speed within several minutes compared to numerical models that would need several hours (e.g., ENLIL). The Drag-Based Ensemble Model (DBEM) takes into account the variability of model input parameters by making an ensemble of *n* different input parameters to calculate a distribution and significance of DBM results. Using such approach DBEM can determine most likely CME arrival times and speeds, quantify the prediction uncertainties and calculate the forecast confidence intervals.