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Testing ElEvoHI on a multi-point in situ detected Coronal Mass Ejection

Tanja Amerstorfer (1), Christian Möstl (1,2), Phillip Hess (3), M. Leila Mays (4,5), and Manuela Temmer (2)
(1) Space Research Institute, Graz, Austria (tanja.amerstorfer@oeaw.ac.at), (2) IGAM-Kanzelhöhe Observatory, Institute of Physics, University of Graz, Austria, (3) Department of Physics and Astronomy, George Mason University, Fairfax, VA, USA, (4) Catholic University of America, Washington DC, USA, (5) Heliophysics Science Division, NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Solar TErrestrial RElations Observatory (STEREO) has provided us a deep insight into the interplanetary propagation of coronal mass ejections (CMEs). Especially the wide-angle heliospheric imagers (HI) enabled the development of a multitude of methods for analyzing the evolution of CMEs through interplanetary (IP) space. Methods able to forecast arrival times and speeds at Earth (or other targets) use the advantage of following a CME's path of propagation up to 1 AU. However, these methods were not able to reduce today's errors in arrival time forecasts to less than ± 6 hours, arrival speeds are mostly overestimated by some 100 km s^{-1}. One reason for that is the assumption of constant propagation speed, which is clearly incorrect for most CMEs—especially for those being faster than the ambient solar wind.

ElEvoHI, the Ellipse Evolution model (ElEvo) based on HI observations, is a new prediction tool, which uses the benefits of different methods and observations. It provides the possibility to adjust the CME frontal shape (angular width, ellipse aspect ratio) and the direction of motion for each CME event individually. This information can be gained from Graduated Cylindrical Shell (GCS) flux-rope fitting within coronagraph images. Using the Ellipse Conversion (ElCon) method, the observed HI elongation angle is converted into a unit of distance, which reveals the kinematics of the event. After fitting the time-distance profile of the CME using the drag-based equation of motion, where real-time in situ solar wind speed from 1 AU is used as additional input, we receive all input parameters needed to run a forecast using the ElEvo model and to predict arrival times and speeds at any target of interest in IP space.

Here, we present a test on a slow CME event of 3 November 2010, in situ detected by the lined-up spacecraft MESSENGER and STEREO Behind. We gain the shape of the CME front from a cut of the 3D GCS CME shape with the ecliptic plane, resulting in an almost ideal ElEvoHI forecast of arrival time and speed at 1 AU.