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ElEvoHI—Improving CME arrival predictions using heliospheric imaging

Tanja Rollett (1), Christian Möstl (1,2), Alexey Isavnin (3), Manuel Kubicka (1), Ute Amerstorfer (1), Jackie Davies (4), and Richard Harrison (4)

(1) Space Research Institute, Austrian Academy of Sciences, Graz, Austria (tanja.rollett@oeaw.ac.at), (2) IGAM-Kanzelhöhe Observatory, Institute of Physics, University of Graz, Austria, (3) Department of Physics, University of Helsinki, Helsinki, Finland, (4) RAL Space, Rutherford Appleton Laboratory, Harwell Oxford, UK

The STEREO mission has sampled a tremendous amount of data, which have served as a basis to develop a lot of new methods to analyze the dynamics of coronal mass ejections (CMEs) during their journey through interplanetary space. The STEREO heliospheric imagers (HI) in particular are unsurpassed in their contribution to a deeper understanding of how CMEs are influenced by interaction with the solar wind and other CMEs and how they evolve in the inner heliosphere. Although STEREO is currently not well observing the space between the Sun and Earth, the large data repository of HI observations enables us to further improve the prediction of CME arrival times and speeds using HI observations—particularly with regard to a potential future L5 mission.

We present a new method for predicting arrival times and speeds of CMEs at any location in the inner heliosphere: ElEvoHI. This new approach uses HI observations as input and assumes an elliptic CME front shape. The solar wind influence is taken into account by fitting the observations using the drag-based model. In this way, it is possible to gain all parameters needed as input for the Ellipse Evolution model (ElEvo), which is then used to predict the CME arrival. To demonstrate the applicability of ElEvoHI we present the forecasts for 20 CMEs remotely observed by STEREO/HI and compare the forecasts to their in situ arrival times and speeds at 1 AU. Compared to the widely used Fixed-ϕ fitting method, ElEvoHI improves the arrival time forecast by 2.2 hours to ± 6.5 hours and the arrival speed forecast by 260 km s^{-1} to ± 55 km s^{-1}. In particular, the remarkable improvement of the arrival speed prediction is crucial for predicting geomagnetic storm strength on Earth.