"Characterization of Coronal Mass Ejection Deflection using Coronagraph Image Sequences"

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When analyzing CMEs in real time for space weather forecasting, a lack of sufficient coronagraph images can make it difficult to determine the CME's longitude. In these cases, usually the location of strong disk signatures (for example, an associated flare) is used to estimate the CME's propagation direction. Although not an unreasonable assumption, observational and numerical studies have shown that CMEs can deflect by ten or more degrees from the source location. Results from CME ensemble modeling by the NASA/GSFC Space Weather Research Center show that variation of the CME's direction by more than ten degrees can change the arrival time at 1 AU by more than eight hours. However, to date there has not been a statistical analysis of observed near-Sun CME deflection. In this work, we present a study that includes more than 20 events during 2010-2014 with a range of CME speeds, widths, and source locations. We use the CCMC's Space Weather Database Of Notifications, Knowledge, and Information (DONKI) to select events, and use the CCMC's StereoCAT analysis tool to fit a CME to a cone shape in the SOHO/LASCO and STEREO/SECCHI coronagraph images. We find a range of deflections from less than 5 degrees to more than 15 degrees. It has been proposed that CMEs deflect due to interactions with structures such as coronal holes, streamers, current sheets, and other CMEs. We use SDO/AIA and STEREO/EUVI images to locate coronal holes near the CME source locations. We present the calculated CME deflection angles as a function of average speed, average width, and coronal hole properties (including the Coronal Hole Influence Parameter). Finally, we developed an uncertainty parameter for the calculated deflection based on the position of the CME with respect to the observing spacecraft. It is our goal that the results of this study will be used to select appropriate ranges of latitudes and longitudes in CME ensemble modeling studies, and that coronal hole observations will be incorporated more systematically in real time CME analysis for space weather forecasting.