How Reliable are CME speeds derived from single viewpoint observations?

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Images of Coronal Mass Ejections (CMEs) are primarily acquired by space-based coronagraphs. Such images capture the outward flow of density structures from the Sun by observing Thompson-scattered sunlight from the free electrons entrained in these structures. Because the emission is optically thin, CMEs images are projections of their real 3D structure on the field of view (FOV) of the coronagraph. As a result, the CME characteristics (e.g. linear speed, angular width) calculated from these images, suffer from projection effects and their reliability needs to be quantified. In this work we apply a geometrical method for the de-projection of the linear CME speeds of 4009 CMEs from the CDAW catalog, associated with solar flares (3225 C-class, 736 M-class and 48 X-class solar flares). Our aim is to provide a robust quantification of the reliability of the CME properties from L1 (SOHO/LASCO) single viewpoint measurements.

In addition, we compare the intensity and location of solar flares with the CME kinematic characteristics. In particular, 482 M-class solar flares associated with CMEs with an angular width $30° < w < 120°$, show a dependence of the mean CME linear speed with the longitude of the parent solar flare, indicating that projection effects of CMEs should be reduced near the solar limb. However, such deprojections tend to overcorrect the CME speed for sources near the solar meridian. They result in speeds of the order of 5000-7000 km/s, which seem physically unreasonable. By considering the 3D extent of the CMEs, we provide a novel geometrical correction of the deprojected CME linear speed. The resulting speeds range from a few 100 km/s up to almost 2600 km/s, a much more physically acceptable correction. This study has important implications for Space Weather applications since the reliable estimation of the CME linear speed has a direct effect on the time of arrival of CMEs at Earth and the quantification of the expected peak flux of solar radiation storms.

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