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Determination of CME orientation and consequences for their propagation

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The configuration of the interplanetary magnetic field and features of the related ambient solar wind in the ecliptic and meridional plane are different. Therefore, one can expect that the orientation of the flux rope axis of a coronal mass ejection (CME) influences the propagation of the CME itself. However, the determination of the CME orientation remains a challenging task to perform. This study aims to provide a reference to different CME orientation determination methods in the near-Sun environment. Also, it aims to investigate the non-radial flow in the sheath region of the interplanetary CME (ICME) in order to provide the first proxy to relate the ICME orientation with its propagation. We investigated 22 isolated CME-ICME events in the period 2008-2015. We first determined the CME orientation in the near-Sun environment using a 3D reconstruction of the CME with the graduated cylindrical shell (GCS) model applied to coronagraphic images provided by the STEREO and SOHO missions. The CME orientation in the near-Sun environment was determined using an ellipse fitting technique to the CME outer front as determined from the SOHO/LASCO coronagraph. In the near-Earth environment, we obtained the orientation of the corresponding ICME using in-situ plasma and field data and also investigated the non-radial flow in its sheath region. The ability of GCS and ellipse fitting to determine the CME orientation is found to be limited to only distinguishing between the high or low inclination of the events. Most of the CME-ICME pairs under investigation were found to be characterized by a low inclination, and regardless of whether their inclination was high or low, the CME-ICME pairs maintained their inclination during interplanetary propagation. The observed non-radial flows in the sheath region show a greater y-direction to z-direction flow ratio for low-inclination events which suggests that there is a connection between the orientation and propagation of the observed CME-ICME pairs.