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Magnetic structure of Earth-directed events in the HELCATS LINKCAT catalog during 2011–2013

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Coronal mass ejections (CMEs) are the main drivers of intense magnetic storms and various subsequent space weather phenomena at Earth. The parameter that defines the ability of a CME to drive geomagnetic storms is the north-south magnetic field component. One of the most significant problems in current long-term space weather forecasts is that there is no practical method to measure the magnetic structure of CMEs routinely in the outer corona. The magnetic structure of CME flux ropes can however be inferred based on the properties of the CME's source region characteristics, such as filament details, coronal EUV arcades, X-ray sigmoids, taking into account nearby coronal and photospheric features.

The linked catalogue (LINKCAT) of solar CMEs during the STEREO era is part of the HELCATS project. It aims at connecting CME observations at the Sun and in interplanetary space, using heliospheric imager observations from the HI1 cameras onboard the two STEREO spacecraft to connect the different datasets. The HELCATS LINKCAT catalogue contains 45 Earth-directed events in the period 2011–2013 (https://www.helcats-fp7.eu/catalogues/wp4_cat.html).

Here we present a statistical study based on the LINKCAT Earth-directed events during 2011–2013 in which we determine the magnetic properties of the erupting CMEs, i.e. their magnetic helicity sign, flux rope tilt, and flux rope axial field direction, by using a synthesis of indirect proxies based on multi-wavelength remote sensing observations from the STEREO, SOHO, Hinode, and SDO satellites. These parameters define the "intrinsic" flux rope configuration at the time of the eruption which is compared with the magnetic structures detected in situ near Earth.