Comparison of calculated and observed IMF near magnetic cloud start times

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The solar source of magnetic clouds (MCs) is considered to be either coronal mass ejections (CMEs) or prominence eruptions [Bothmer et al., 1994, 1998]. We suppose that the coronal magnetic fields above CME or prominence eruption sites move outward and are then convected into interplanetary space to arrive at the Earth a short time before the MC start time. We extract the magnetic field close to the solar surface at different heights using the PFSS model [Hakamada, 1998] and propagate this field outward to 1 AU using 3D-reconstructed solar wind velocity [Jackson et al., 2010]. The purpose of our work is to examine whether the direction of interplanetary magnetic field (IMF) agrees with the observed vector field prior to a MC arrival at the Earth. We compare the sign of each component of modeled IMF (in RTN coordinates) with that of IMF observed by ACE three hours before the MC start time (pre MC time) and at the MC start time (MC time). These comparisons are made for six MC events during 2006 - 2007. We find that the sign of B_n, the normal component of IMF in RTN coordinates, extracted from 1.4 R_s (1.2 R_s) agrees best with ACE observations at the pre MC time (at the MC time) for all MC events analyzed here. However, the other two components B_r and B_t , the radial and tangential components of IMF in RTN coordinates, extracted from 1.4 R_s (1.2 R_s) do not agree as well with ACE observations at the pre MC time (at the MC time). We conclude that B_n observed by ACE at the pre MC time (at the MC time) is related to that at 1.4 R_s (1.2 R_s) at the location of the sub-Earth point on the Sun. This result shows that we can infer the sign of B_n at the MC time (pre MC time) from the value present at 1.2 R_s (1.4 R_s) at the location of the sub-Earth point, and thus this is an important finding for space weather forecasts. Future work will extend this result to additional MC events.

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