A Statistical Study of the Radial and North-South Component Values of Heliospheric Magnetic Field

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Determination of interplanetary magnetic field (IMF) north-south component of magnetic field (B_z) is important from the space weather perspective because this field interacts with Earth's magnetic field causing geomagnetic storms. Lyatsky et al. (2003) and Youssef et al. (2011) show that there is a correlation between IMF B_z (south is positive) and the absolute value of the radial field B_x ($|B_x|$) during solar minima. They find a positive correlation when the dominant solar field has a positive polarity and negative for a dominant negative field polarity. The negative and positive polarities correspond to whether the Sun's magnetic field in the northern hemisphere is directed toward or away from the Sun, respectively. We calculate the correlation between IMF B_z and $|B_x|$ using the OMNI dataset from 1965 - 2015, and Helios in-situ measurement data from 1975 - 1977. In a similar study, we find that the correlation between B_z and $|B_x|$ shows a sinusoidal variation associated with ~11 year solar cycle, and also that an even more significant correlation between B_z and $|B_x|$ exists for solar distances between 0.3 and 0.4 AU in the Helios measurements. In an ongoing study, we extrapolate the Potential Field Source Surface (PFSS) model [Hakamada, 1998] to the Earth's location by using the UCSD 3D tomography model [Jackson et al. 2010] and compare the radial component (B_r) of modeled magnetic field with the normal (north-south) component (B_n) observed by ACE spacecraft. This study finds a significant positive correlation between B_r and B_n (north is positive). Thus, this study strongly suggests that the IMF B_z is generated, not in interplanetary space, but at the corona. In the future, we will study why this correlation between B_z and $|B_x|$ exists.

Keywords: solar wind, interplanetary magnetic field, space weather, heliosphere

