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Interplanetary magnetic field Bx component influence on ionospheric currents

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Statistical analyses have shown that the sunward component of the interplanetary magnetic field (IMF Bx), moderately but significantly affects the auroral intensity. These observations have been interpreted as signatures of a similar IMF Bx control on Birkeland currents, yet to be observed directly. Such a control, attributed to differences in magnetic tension on newly opened magnetic field lines, would lead to stronger region 1 (R1) Birkeland currents for Bx negative (positive) conditions in the northern (southern) hemisphere. We perform a detailed investigation of three different sets of magnetic field measurements, from the CHAMP and Swarm low-Earth-Orbit satellites, from the AMPERE products derived from the Iridium satellite constellation, and from the SuperMAG ground magnetometer network, each analyzed using different techniques, to test these predictions. The results show that a change in sign of Bx changes the average Birkeland currents by no more than 10%. The current patterns show little support for an inter-hemispheric asymmetry of the kind proposed to explain auroral observations. Instead we propose an alternative interpretation, which is consistent with most of the auroral observations and with the current observations in the present paper, except for those based on AMPERE: The solar wind-magnetosphere coupling is more efficient when the dipole tilt angle and Bx have the same sign than when they are different. Based on previous studies, we explain this effect in terms of a shift of the dayside reconnection region towards the subsolar point, where the solar wind magnetosphere coupling is more efficient.