Simple Estimation of the Global Solar Wind Structure

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The solar wind is composed of a slow wind (~450 km/s) and a fast wind (~800 km/s), which is known as the bimodal signature of the solar-wind velocity. These slow and fast wind are the main components of the solar wind in the low-mid and high latitudes of the heliosphere, respectively. The solar wind structure is stratified by latitude. For example, the slow wind is confined in a narrow band around the solar equator (or heliospheric current sheet with a small tilt angle) during the solar minimum. The width of the narrow slow wind band increases in rising and declining phases then the tilt angle of HCS becomes larger. During solar maxima, the latitude structure is lost, and the heliosphere is dominated by slow solar wind and frequent CMEs.

In this study, we focus a variation of boundary latitudes of the slow-fast solar wind through three solar cycles by using the interplanetary scintillation (IPS) observation at the Institute for Space-Earth Environmental Research (ISEE). The latitudinal structure of the bimodal solar wind is derived from the solar wind synoptic map for each Carrington rotation and compared with the maximum tilt angle of the HCS derived from observations by the Wilcox Solar Observatory (WSO). The results show that the HCS tilt angle correlates well with the latitudinal average of the solar wind speed of 600 km/s (correlation coefficient of 0.8). The empirical results allow us to estimate the latitudinal structure of the solar wind by the bimodal solar wind velocity after the 1970s when continuous magnetic field observations of the Sun began.

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