

Variation of open magnetic field distribution and its connection to the global structure of the solar wind

*Ken'ichi Fujiki¹, Munetoshi Tokumaru¹, Kazumasa Iwai¹

1. Institute for Space-Earth Environmental Research

The solar wind is accelerated in the low plasma-beta corona; it is confined along a magnetic field open to the interplanetary space. The origin of the solar wind closely relates to the photospheric magnetic field distribution. Therefore, the solar wind origin can be estimated by calculating the coronal magnetic field. We extrapolate the coronal magnetic field applying the potential-field-source-surface (PFSS) model to the Kitt-Peak (KP) and ADAPT (generated from KP and GONG) synoptic magnetograms. The ADAPT data (model 0) are averaged over each Carrington rotation to derive a global magnetic field distribution. We compare PFSS spherical harmonics coefficients obtained from KP, GONG, and ADAPT. Then, footpoint distributions of the open magnetic field are also compared among them. As a result, we confirm that the PFSS extrapolations using ADAPT are greatly improved, especially for the recent weak solar activity cycle. Next, we examine the simple Wang-Sheeley relationship between the flux tube expansion rate (f) and the solar wind velocity (v) using the interplanetary scintillation (IPS) observation and the new PFSS results. The f -distributions mapping on the source surface and photosphere are averaged over longitude, and the latitudinal structure is stacked in the same manner as a butterfly diagram. Then, we compare v and f obtained from those 'butterfly' diagrams. We also update the estimation technique to reproduce a latitudinal solar wind structure using PFSS spherical harmonics coefficient and several coronal magnetic field parameters (Fujiki JpGU 2021, Fujiki SGEPS 2021).

In this presentation, we report the updated technique and the difference in the PFSS calculations using different magnetic field data.

References:

Fujiki et al., Simple Estimation of the Global Solar Wind Structure, JpGU 2021 (poster)

Fujiki et al., Distribution of Solar Wind Sources at the solar surface from 1985 to 2016 (online oral)

Keywords: solar wind, long-term variation, magnetic field