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Estimation of solar wind speed by the photospheric magnetic field

Kazuyuki Hakamada[1*], Munetoshi Tokumaru[2], Ken'ichi Fujiki[2]

[1]Chubu University, [2]Solar-Terrestrial Environment Laboratory

In this study, we visualize three-dimensional structure of the coronal magneic field by using the Radial-Field model for the coronal magnetic field devised by myself with the synoptic maps of the photospheric magnetic field observed by the

NSO/Kitt Peak, USA. According to our previous analysis on the Carrignton rotation base, the photospheric magnetic field (Log10|Br_pho|), the coronal magnetic field (Log10|Br_sou|) shows good correlation with the solar wind speed (SWS) for the data of (-1.0 <= Log10|Br_pho| <= 1.5, (0.1 G <= |Br_pho| <= 31.6 G), -1.5 <= Log10|Br_sou| <= 0.0, (0.0316 G <= |Br_sou| <= 1.0 G)). We use rotation averages for these SWS, Log10|Br_pho|, and Log10|Br_sou| in this study. We found good multiple correlaion (r = 0.855) among them by using the regression equation in the form of SWS = a + b $*$ log10|Br_sou| + c $*$ log10|Br_pho|. We obtained the empirical equation, SWS = 1027.7 + 181.6$*$log10|Br_sou| - 346.6$*$log10|Br_pho|, by wich we can estimate SWS from the magnetic data Log10|Br_pho| and Log10|Br_sou|. Since the SWS observed by the IPS method and the SWS estimated by the empirical equation show good agreement, we can estimate SWSs during no IPS observation period. The SWS thus estimated shows solar cycle variations with three peaks during the year 1975 and the year 2012 with the amplitude of 300 km/s (between 400 km/s and 700 km/s). The shape of log-term variation of the SWS estimated by the IPS observation is somewhat different from the SWS observed by the Earth orbit satellites, because the IPS observation covers from the north pole to the south pole of the heliospher in contrast to the lower latitude coverage of the satellite. This result is important for the study of space weather and space climate.

Keywords: solar wind, photoshpheric magnetic field, solar cycle variation, estimation