Solar cycle variation of solar wind global structure of proton density

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The solar system is located in a low-density interstellar cloud. The heliosphere formed via the interaction of the expanding solar wind and the interstellar wind plasma. Neutral hydrogen and helium atoms of the interstellar medium can penetrate deep into the heliosphere without being interrupted by the solar wind plasma. Consequently, there is uniform flow of interplanetary hydrogen and helium in the solar system. The distribution of interplanetary neutral hydrogen is sensitive to solar wind proton flux because interplanetary neutral hydrogen atoms are ionized mainly via a charge exchange process with solar wind protons, contributing to 80% of the total ionization rate. A potential technique for determining the latitudinal distribution of interplanetary hydrogen in the heliosphere is observation of resonant backscatter of solar Lyman alpha emission at 121.6 nm.

Previous studies demonstrate a clear relationship between the distribution of interplanetary Lyman alpha emission and solar wind flux behavior associated with the tilt of the heliospheric current sheet [Bertaux et al., 1995; Summanen, 2000; Pryor et al., 2003; Nakagawa et al., 2003].

We present a remote sensing method for continuously monitoring the ionization rate of interplanetary hydrogen atoms and solar wind density in the heliospheric polar region using interplanetary Lyman alpha data. In this study we use hydrogen Lyman alpha data obtained during 1999-2002 by the Ultraviolet Imaging Spectrometer (UVS) aboard the Nozomi spacecraft. To investigate the daily latitudinal dependence of the ionization rate, 8 latitudinal distributions of ionization rate were fitted to observational data by the least mean squares method and the distribution with the minimum value selected. The latitudinal anisotropy of ionization rate given as the pole/equator ratio has a value of 0.6 during the solar minimum phase prior to January 1999, and decreases to 1.0 (isotropic distribution) in the middle of 1999. Excess ionization with ratios of 1.1-1.4 in the polar region is identified in UVS data for the solar maximum phase between January 2000 and April 2002, while simultaneous SWAN observation shows keeping isotropy of total ionization rate at the same phase [Bertaux, private communications].

Modification of input paremeters is future work.

Using observational data obtained from WIND, SOHO/EIT, SOHO/SEM instruments,we estimated the charge exchange ionization rate at the ecliptic plane and photoionization rate.

Next step is to input the practical solar Lyman alpha flux distributions and radiation pressure using UARS/SEE Lyman alpha data. Furthermore, we will calibrate the sensitivity of instrument and derive the absolute value of ionization rate for each latitudes to investigate the north-south asymmetry of solar wind.