Probabilistic prediction of solar wind speed variation with solar cycle activity

*Hotaka Tsujimura[1], Shinsuke Imada[2], Haruhisa Iijima[1], Yoshizumi Miyoshi[1]

1. Institute for Space-Earth Environmental Research, Nagoya University, 2. Department of Earth and Planetary Science, Graduate School of Science, University of Tokyo

There are concerns about the impact of the solar wind on satellite communications and power transmission equipment. Predicting the solar wind is important to avoid these risks. It is empirically known that the speed of the solar wind is determined by the strength ratio of the magnetic field on the surface of the sun to the magnetic field in the solar wind. The Wang-Sheeley-Arge model (WSA model) is an empirical expression of this relationship. Therefore, if we can predict the magnetic fields at these two locations, we can predict the velocity of the solar wind. We used two physical models to estimate the magnetic fields in the two location: the surface flux transport model (SFT model) and the potential-magnetic field source-surface model (PFSS model). The SFT model consists of an advection term, a magnetic diffusion term, and a magnetic flux appearance term. The magnetic flux appearance term requires information about the number of sunspots that appear, the latitude, the area, and the angle of inclination. However, these parameters that characterize sunspots are generally statistically uncertain, and it is not yet well understood how this statistical variation affects the solar surface magnetic field and solar wind velocity.

In this study, the solar wind speed was predicted using the SFT model, PFSS model, and WSA model. Among them, the input parameters of the SFT model such as the number of sunspots, inclination angle, appearance latitude, and appearance longitude were changed stochastically. As a result, long-term fluctuations in solar wind speed over 15 years were obtained. We also obtained changes in the solar wind speed when each parameter was changed stochastically. This time, based on the result, I will show a comparison of the magnetic field and magnetic field lines on the surface of the sun.

Keywords: solar wind, sunspot, simulation

