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Reliability Assessment of Solar Wind Speeds Derived from IPS Observations

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Radio waves from distant sources are scattered by solar wind plasma, producing intensity fluctuations observed on the ground. This phenomenon, known as interplanetary scintillation (IPS), offers an effective means for remotely sensing the solar wind. Although IPS data contain line-of-sight (LOS)-integrated information on the solar wind, tomographic analysis applied to a large number of observations can mitigate this integration effect and reconstruct the global solar wind distribution.

Since the early 1970s, Nagoya University has been conducting continuous IPS observations, revealing long-term variations in the large-scale solar wind structure. These variations exhibit a strong correlation with solar activity. On shorter timescales, however, comparisons between IPS-derived solar wind structures and in situ measurements from spacecraft show alternating periods of high and low correlation.

In recent years, the worsening radio-frequency interference (RFI) environment in Japan has seriously affected IPS observations, leading to increasing discrepancies between IPS-derived solar wind speeds and in situ measurements. The aim of this study is to evaluate the reliability of IPS-derived solar wind speeds under such conditions.

To address this issue, we used IPS data from 1995 to 2010, a period with high-quality data acquisition, and compared short-term variations in solar wind speed with those in the OMNI database. To simulate the current RFI environment, we randomly thinned LOSs, reproducing the effects of reduced observational density and increased interference. We then quantitatively assessed the consistency between IPS-derived and in situ solar wind speeds. Furthermore, we investigated how this consistency depends on several key parameters, such as the number of LOS and the level of RFI, thereby providing a basis for future improvements in IPS observations and ensuring the continued utility of IPS for solar wind monitoring.