

Coronal radio sounding using Akatsuki spacecraft: variation in the solar cycle

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Radio occultation observation is one of the limited means to approach the dark and hot coronal region. Quasi-periodic density fluctuations that are considered to be acoustic waves were detected by radio occultation observations in 2011 using radio waves transmitted from the Japanese Venus explorer Akatsuki and received at the ground station during the superior conjunction period. The acoustic waves were considered to have been generated from the nonlinearity of Alfvén waves that originate from the photosphere. However, since the observation was limited to a certain period of the 11-year solar activity cycle, to what extent the suggested features are typical and the variability in the solar cycle are uncertain. In this research, we analyze radio occultation observations carried out during the superior conjunction periods from 30 May 2016 to 15 June 2016 and from 29 December 2017 to 20 January 2018 as well as the observations in 2011. Solar offset distances of about 2 to 10 solar radii were probed intermittently 11 times in the former period and 10 times in the latter period. The time series data of frequency and intensity of radio waves received at the ground station are analyzed. Radial velocities of the solar wind are estimated from intensity spectra, and wavelet analysis is applied to the frequency time series to detect quasi-periodic density fluctuations that are thought to be manifestations of acoustic waves. The solar wind velocities near the Sun obtained by the radio occultation observations and those at far distances measured by IPS (Interplanetary Scintillation) observations are compared. We also aim to clarify the dependence on the solar activity by analyzing all observational data from 2011 to 2018.

Keywords: radio sounding observation, solar corona, solar wind acceleration