



Saturn's atmospheric winds between 2021 and 2024

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Saturn's zonal wind profile at cloud level has been measured at different epochs since the first spacecraft visits from Voyager 1 and 2 in 1980-81 [1-2]. Saturn's wind measurements available in the literature include zonal wind profiles obtained from HST before Cassini, from 1996 to 2002 [3], Cassini ISS images and VIMS data from 2004 to 2017 [4-6], and zonal wind profiles from Hubble Space Telescope (HST) images in 2015 [7] and 2018-2020 [8]. In most latitudes, there is a very close agreement among those zonal wind profiles. However, the equatorial region, between the planetographic latitudes of 10°N and 10°S, presents a complex vertical structure and significant variability [e.g. 7]. In this work, we track and characterize several discrete features in Saturn's atmosphere and measure the zonal winds along four years from 2021 to 2024. We used ground-based images from amateur observers (available in the PVOL database and similarly to refs. [9-10]) to track individual meteorological systems, and HST images obtained by the OPAL program [8] to obtain zonal wind profiles. The ground-based images have lower spatial resolution than HST, but the tracked features are followed over long timescales, reducing uncertainty in wind speed measurements. HST images in different filters were used to retrieve zonal wind profiles by correlating pairs of images taken one planetary rotation apart. The results in filters F631N and F763M show an intensification and strong variability in the equatorial jet when compared to Cassini measurements. In the methane absorbing bands (FQ727N and FQ889N) we also observed changes with respect to previous measurements. Given Saturn's yearly illumination cycle due to its tilt and ring shadows, images from 2021 to 2024 provide the first measurements of the southern hemisphere since the end of the Cassini mission.

REFERENCES:

[1] Sromovsky et al. *Journal of Geophysical Research* (1983). [2] Sánchez-Lavega et al. *Saturn's Zonal Winds at Cloud Level*, *Icarus* (2000). [3] Sánchez-Lavega et al. *Nature* (2003). [4] García-Melendo et al. *Geophys. Res. Lett.* (2010). [5] García-Melendo et al. *Icarus* (2011). [6] Studwell et al. *Geophys. Res. Lett.* (2018). [7] Sánchez-Lavega et al. *Nature Communications* (2016). [8] Simon et al. *Planet. Sci. Journal* (2021). [9] Sánchez-Lavega et al. *Nature Comm.* (2019). [10] Hueso et al. *Icarus* (2020).