# Long-term behaviour of the morphology and dynamics of Venus's middle clouds with Akatsuki/IR1.

*Javier Peralta[1], Naomoto Iwagami[2], Sánchez-Lavega Agustín[3], Yeon Joo Lee[4], Ricardo Hueso[3], Minori Narita[4], Takeshi Imamura[4], Phil Miles[5], Anthony Wesley[6], Emmanuel Kardasis[7], Seiko Takagi[8]

1. Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency (JAXA), Sagamihara, Japan, 2. Tokyo 156-0044, Japan, 3. Escuela de Ingeniería de Bilbao, University of the Basque Country (UPV/EHU), Bilbao, Spain, 4. Graduate School of Frontier Sciences, The University of Tokyo, Japan, 5. Rubyvale QLD, Australia, 6. Astronomical Society of Australia, Australia, 7. Hellenic Amateur Astronomy Association, Greece, 8. Research and Information Center, Tokai University, Japan

The Venusian atmosphere is covered by clouds with super-rotating winds whose accelerating mechanism is still not well understood. Fastest wind speeds occur at the top of the clouds (about 70 km height), and they have been studied for decades thanks to their visual contrast in dayside ultraviolet images caused by the presence of a yet unknown absorber. The middle clouds (at about 50-55 km) can be observed using near-infrared wavelengths (800-950 nm) and they exhibit much weaker contrasts. Here we present the first long-term study of the dayside middle clouds of Venus at middle to low latitudes thanks to the combination of the full dataset of Akatsuki/IR1 images acquired at 900 nm during the year 2016 (A-I), complemented with observations of Venus with small telescopes and band-pass filters 1.0-1.1 $\mu$m and 884-900 nm (J-L). Thanks to the analysis of more than 1,000 images, we report the discovery of new cloud morphologies, like fast sharp discontinuities (C), elongated "hook-like" stripes (B,J) and a single case of mesoscale wave packet (I). Surprisingly, the albedo of Venus at 900 nm exhibit periodical hemispherical asymmetry (E-F), and clouds' contrasts varying from 3% to 21%. These contrasts are larger than reported in previous missions, and they are suggestive of important changes in the optical thickness of the clouds or they might imply the presence of a new atmospheric absorber at near-infrared wavelengths. Finally, we also present more than 500 wind measurements from IR1 images and —for the first time— with ground-based observations. The mean zonal winds are observed to peak at the equator, while the combination with data from Venus Express reveals long-term variations in the zonal winds of ˜20 m/s along 10 years.

Keywords: Venus, Atmosphere, Clouds, Atmospheric dynamics, Remote sensing