Amateur observations of a planetary-scale wave in the middle clouds of Venus

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Abstract

We present the detection and evolution of a planet-scale Cloud Discontinuity on Venus for the first time from amateur data sensing the middle clouds of Venus during March/April 2020. The Cloud Discontinuity was observed mainly as a long vertical dark streak on the dayside hemisphere of Venus in amateur near-infrared images (NIR). Observations were obtained by small telescopes mainly from Greece and Ukraine. Amateur observations will continue in support of professional earth-based and spacecraft observations.

Introduction

The dayside upper clouds of Venus (56.5–70 km above the surface) can be observed in UV wavelengths and they drift to the west with velocities 60 times faster than the planet surface, a phenomenon known as superrotation. Imaging the dayside of Venus in the NIR spectrum (~750-1000nm) reveals the morphology and dynamics of the middle clouds (50.5–56.5 km), while longer certain windows at longer infrared wavelengths allow to sense the lower clouds (47.5–50.5 km) on nightside images. Lower-middle and upper clouds comprise the main cloud deck in the atmosphere of Venus. The middle and lower clouds move slower than the upper ones and they were poorly studied until JAXA’s Akatsuki mission. During the year 2016, Akatsuki revealed the presence of a giant discontinuity propagating on the middle and lower clouds. Mysteriously, this discontinuity (interpreted to be a new atmospheric wave), has not been observed on the middle clouds since December 2016.

Methodology

This preliminary analysis is based on measurements on the first available dayside images by authors, 3 by EK and 2 by YN, made in 5-day steps (the period needed for the same feature of middle atmosphere to be visible again) from 11 March to 31 March 2020. At that epoch (~21/3/2020) Venus presented solar elongation of 46°East, 23 arcsec in diameter, and 52% of illuminated disk. The amateur technique is based on the “lucky imaging” technique combined with special processing to increase contrast. The application WinJupos, was used for feature measurements and analysis.
**Analysis**

During March 2020, we detected and followed the re-apparition of the Cloud Discontinuity (hereafter CD). It was observed mainly as a long vertical dark streak on the dayside hemisphere of Venus (see Figure 1).

![Figure 1](image)

**Figure 1:** The first image of the March Cloud Discontinuity. It can be seen as dark vertical streak in the centre of the illuminated disc in the right image (E.Kardasis 11/3/2020 16:45-55 UT, 355mm SCT,ZWO 290MM, Right image 884-900 nm & left image UVenus filter, Glyfada-Athens, Greece)

On the 11th of March EK captured a long dark vertical feature (followed by a brighter streak), suspected to be a CD. We confirmed that it still existed 10 days later when the specific longitude was again observable. An alert was sent to worldwide observers. Previous observations presented not obvious signs of the event. The CD was observed until April 25th.

The CD spanned between ~30° S and ~30° N, with a total length ranging from ~4500-6500 km and 350-700km width. The CD drifted to the west at an approximate rate of -69° per day. Speed measurements were made between pair of images (March 11 & 16, March 16 & 21, March 21 & 26) separated by 5-day period. The average speed calculated with the three combination of images confirms that the CD seems to propagate with the same speed during March. The velocity gradually peaks at the equator, reaching ~84 ± 0,5 m/s. When comparing the CD speed with wind speeds of the middle clouds from past reports, we observe that the CD propagates faster than the the average zonal speed of the middle clouds. Finally, we report that the CD is not visible in simultaneous UV images of the upper clouds, confirming previous findings from Akatsuki.

**Acknowledgements**
We acknowledge the contribution of ALPO-Japan database, Grischa Hahn for providing support on WinJupos, and Iakovos-Marios Strikis for the technical support.