Latitudinal cloud characteristics in the Venusian northern high-latitude region evaluated from VEX/VIRTIS-H observations

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Abstract

This paper presents the characteristics of Venusian northern high-latitude clouds, i.e. its opacity, cloud top temperature and altitude, evaluated from Venus Express (VEX) observation. We try to compare these characteristics to those in the southern hemisphere.

1. Introduction

Venusian clouds mainly consist of sulphuric acid droplets in the altitude of 40-70 km. Recent long-term observations by Venus Monitoring Camera (VMC) and Visible and Infrared Thermal Imaging Spectrometer - M channel (VIRTIS-M) aboard VEX have investigated the polar vortex in the southern hemisphere. There is a bright 'dipole' feature surrounded by a cold 'collar' [*Piccioni et al.*, 2007]. It is also found that the cloud top altitude is located at 74 ± 1 km in low and middle latitudes, and it decreases poleward and reaches 63–69 km in the polar region [*Ignatiev et al.*, 2008].

We try to compare the characteristics in the northern polar region with these previous southern studies. Since the past observations by Galileo Near-Infrared Mapping Spectrometer indicated that cloud mean particle size in the Northern hemisphere is more than that in the Southern [*Carson et al.*, 1993], we pay attention to confirm whether differences between the both hemispheres are evident or not in other aspects.

2. Data Selection

We investigated the latitudinal variations of cloud opacity, cloud top temperature and altitude in the northern hemisphere by the data observed by VIRTIS - High spectral resolution channel (VIRTIS-H). This instrument can provide the information of the northern hemisphere which has not been well reported yet in past VEX studies. We picked up the all open data in ESA/PSA (see **Fig. 1**) which observed the northern hemisphere by nadir mode.

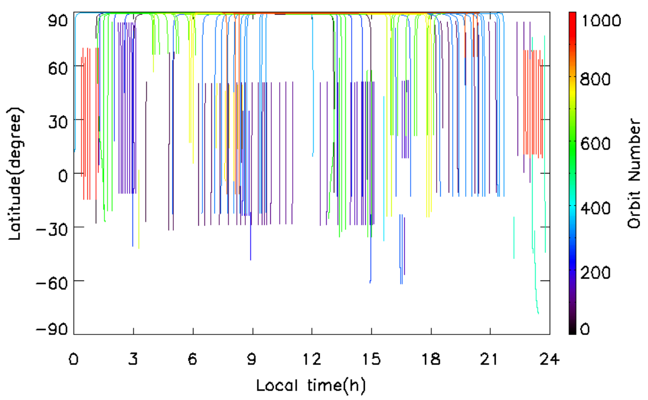

Figure 1. Local time and latitude coverage of the VIRTIS-H selected data in the nadir mode.

3. Results and Discussions

In this paper, we show three results, (A) cloud opacity, (B) cloud top temperature and altitude, and (C) their relationships.

(A) In the 2.3 um thermal radiation in the night side, we could not find enough flux from lower altitude regions in the latitude more than 70 degN (see **Fig. 2**, red line). With the combination of a radiation transfer analysis based on standard aerosol models, we conclude that the cloud optical thickness in high latitude region (> 70 degN) is constantly about twice of that in lower latitudes (< 70 degN). This tendency is consistent with the past southern hemispheric result [*Wilson et al.*, 2008].

(B) We retrieved the cloud top temperature from 5 um radiation and the dayside cloud top altitude by 2.2 um CO_2 absorption band. The averaged cloud top temperature increased from 223 K at 65 degN (cold collar region) to 234 K at 80 degN (bright dipole region) (see **Fig. 2**, black line). On the other hand, the averaged cloud top altitude at 80 degN (65.4±0.9km) was lower than that at 65 degN (68.1±0.5km) (see **Fig. 3**, black line). These are consistent with the characteristics in the southern hemisphere [*Ignatiev et al.*, 2008].

(C) We compared the averaged latitudinal distributions of cloud opacity (from A), cloud top temperature and altitude (from B) from all selected data with the resolution of 1 deg. in latitude. Although there was a negative correlation between the cloud top temperature and its altitude (see **Fig. 4**), there were no remarkable characteristics between other two (see **Fig. 2** and **Fig. 3**). It suggests the temperature of the Venusian polar structure (bright 'dipole' and cold "collar') is affected by cloud top altitude.

4. Summary

We investigated the latitudinal variations of Venusian cloud opacity, cloud top temperature and altitude in the northern hemisphere by VEX/VIRTIS-H nadir data.

As a result, cloud optical depth in polar region is always thick compared with in mid-latitude, and cloud top altitude decreases toward poleward. These are consistent with the characteristics in the southern hemisphere. Furthermore, there is a negative correlation between the cloud top temperature and its altitude. It suggests the temperature of the Venusian polar structure (bright 'dipole' and cold "collar') is affected by cloud top altitude.

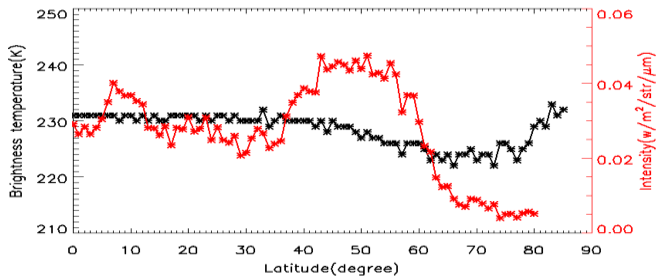

Figure 2. Correlations of cloud top temperature (black) with cloud opacity at 2.3um radiations (red) in the northern hemisphere.

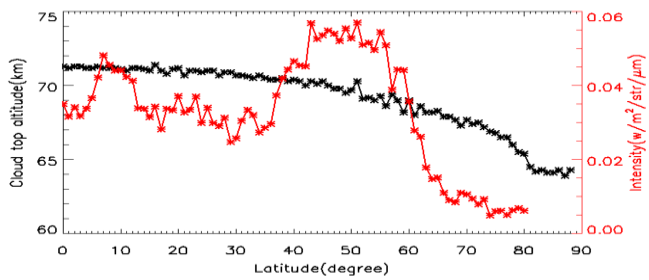

Figure 3. Correlations of cloud top altitude (black) with cloud opacity (red) in the northern hemisphere.

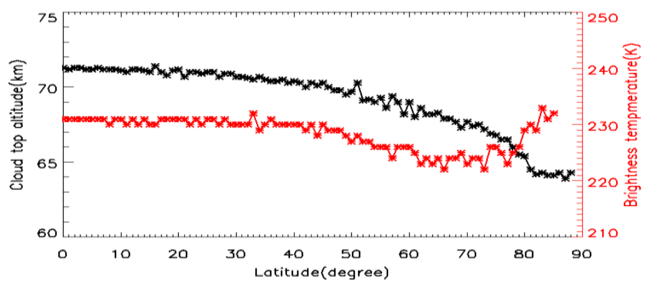

Figure 4. Correlations of cloud top altitude (black) with cloud top temperature (red) in the northern hemisphere.

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