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High altitude ammonia ice clouds observed by Juno/JIRAM at stationary positions

G. Filacchione (1), G. Sindoni (1), A. Adriani (1), A. Mura (1), F. Tosi (1), M. L. Moriconi (2), F. Altieri (1), B.M. Dinelli (2), D. Turrini (1), R. Noschese (1), A. Cicchetti (1), G. Piccioni (1), A. Migliorini (1), F. Fabiano (3), C. Plainaki (4), A. Olivieri (4), S. Bolton (5), S. Atreya (6), J. Lunine (7)

(1) INAF-IAPS, Istituto di Astrofisica e Planetologia Spaziali, Roma, Italy (gianrico.filacchione@iaps.inaf.it), (2) CNR-Istituto di Scienze dell'Atmosfera e del Clima, Bologna e Roma, Italy, (3) Dipartimento di Fisica e Astronomia, Universitá di Bologna, (4) ASI Agenzia Spaziale Italiana, Roma, Italy, (5) Southwest Research Institute, San Antonio, Texas, USA, (6) University of Michigan, Ann Arbor, Michigan, USA, (7) Cornell University, Ithaca, New York, USA

Abstract

We report the first spectroscopic identification of high altitude ammonia ice clouds observed in three discrete oval structures in the atmosphere of Jupiter by the Jovian InfraRed Auroral Mapper (JIRAM, [1]) on board the Juno spacecraft. The ovals are observed at stationary positions in 2.57 μm radiance maps derived from JIRAM's spectrometer channel data acquired on Aug 2th 2016 (observation phase #2) and Aug 25th 2016 (#3) during Juno's first perijove passage. A quantitative analysis of these three features is performed by means of an inversion technique based on Bayesian method.

1. Dataset and data projection

JIRAM spectral channel performs imaging spectroscopy in the 2-5 μm range with 336 bands (spectral sampling $\approx$ 9 nm/band) and 256 spatial pixels (IFOV=240 μrad, FOV=3.52°). In general consecutive slits are not spatially connected on Jupiter reference surface because the spectrometer can acquire only one frame per each Juno spacecraft rotation (i.e. once every 30 seconds). For this reason it is necessary to project each single frame to build a global map. The method used to build the maps shown in Fig. 1 is the same described in [2]. Each individual JIRAM pixel having incidence and emission angles $\leq 80°$ has been projected on a cilindrical grid map with a resolution of 0.25°/pixel along planetographic longitude and latitude axes. In case of redundancy above a single 0.25° ×0.25° bin, the median value is shown. For brevity we show here only the maps derived from observation phase #3.

2. High altitude ammonia clouds

High altitude ammonia clouds can be identified by means of their elevated radiance at 2.0 and 2.57 μm and by simultaneous low radiance at 2.72 μm as was done first by Galileo Near Infrared Mapping Spectrometer NIMS [3]. This is indeed the spectral behavior observed also in JIRAM's three ovals that are present in the 2.57 μm radiance map shown in Fig. 1-top panel at coordinates (lon = 345°, lat = -33.5°), (lon = 292°, lat = 41.5°) and (lon = 5.5°, lat = 41.5°) for ovals #1, #2, #3, respectively. At the same positions the ovals disappear in the 2.72 μm radiance map (Fig. 1-bottom panel). The position of the three ovals is stationary during the 23 days period encompassing JIRAM observation phases #2 (Aug 2th 2016) and #3 (Aug 25th 2016).

3. Spectral Analysis

The average radiance spectra collected in a region of lon - lat of $2° \times 2°$ centered above the position of each oval are shown in 2. These spectra are characterized by high signal at 2 μm where clouds reflected sunlight. At the same time their thermal emission in the 4.5-5 μm spectral range is very low, since the clouds have high opacity at these wavelengths. We have performed a quantitative analysis of these spectra by using an inversion technique based on a Bayesian approach. Moreover, we have compared the spectral data collected within the ovals with adjacent ones in order to contextualize the ovals properties relative to their surroundings. The same method has been applied to derive the properties of the White Ovals observed by JIRAM between $-35° \leq lat \leq -40°$ [4]. The results of the spectral inversion will be discussed at the meeting.

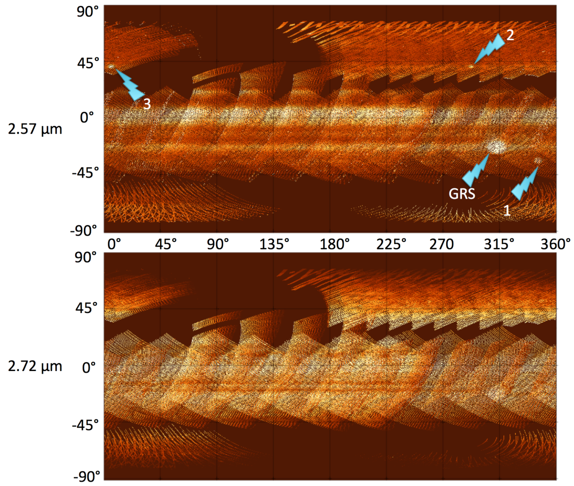

Figure 1: Top panel: Radiance map at 2.57 μm. The positions of the three ovals and Great Red Spot (GRS) are shown. Bottom panel: Radiance map at 2.72 μm.

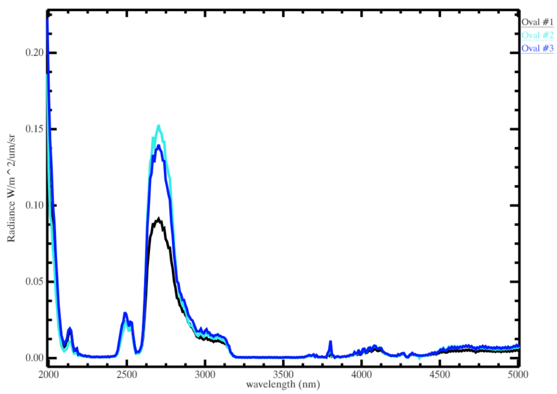

Figure 2: Average spectral radiances of the three ovals calculated within a region of lon, $\times$ lat of $2^{\circ} \times 2^{\circ}$, centered above the position of each oval.

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