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# Spatially Resolved 2-cm Thermal Emission from Saturn: Ammonia Abundance in the Equatorial Zone and Relation to the Hadley Circulation

**A. P. Ingersoll** (1), S. Gulkis (2), M. A. Janssen (2), and A. Laraia (1)
(1) Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA
(2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA
(api@gps.caltech.edu / Fax +1-626-585-1917)

## Abstract

We present an analysis of spatially resolved thermal emission from Saturn at 2 cm wavelength. Opacity at this wavelength is mainly due to ammonia vapor, so high brightness temperature (high $T_B$) generally indicates low ammonia abundance and vice versa. The data were obtained by the Cassini radar instrument in passive mode, in which the signal is microwave thermal emission from the planet. The atmospheric model was developed for the Juno mission to Jupiter, and includes forward calculation of microwave radiances and inversions of radiances to get physical parameters of the atmosphere. The 2-cm map of Saturn provides a test of the model and reveals significant features of Saturn's atmosphere.

## 1. Features of the 2-cm map

First, there is considerable structure in the ammonia abundance at all latitudes (Fig. 1). Diagonal features running from northwest to southeast (NW-SE) in the northern hemisphere and SW-NE in the southern hemisphere could be related to the shear in the zonal velocity at latitudes from 10-30° in both hemispheres. Figure 2 shows the velocity profile in the southern hemisphere only. The northern hemisphere profile is nearly a mirror image of the one shown. Second, there is a band within ±10° of the equator that shows high $T_B$, indicating low ammonia abundance, somewhat like the low water vapor abundance in the sub-tropics of Earth's atmosphere. Third, closer to the equator there is a band of low $T_B$, with contributions from emission by the cold rings and emission by the elevated ammonia at the equator, somewhat like the inter-tropical convergence zone of Earth's atmosphere. With further analysis we should be able to separate the two contributions.

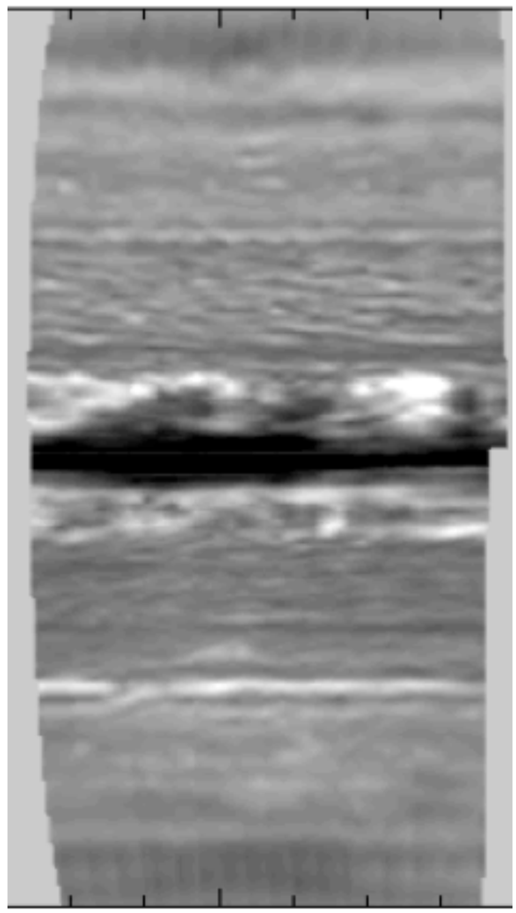

Figure 1: Portion of the 2-cm map of Saturn. The map covers ± 60° in latitude. The equator is a dark horizontal line at the centre.

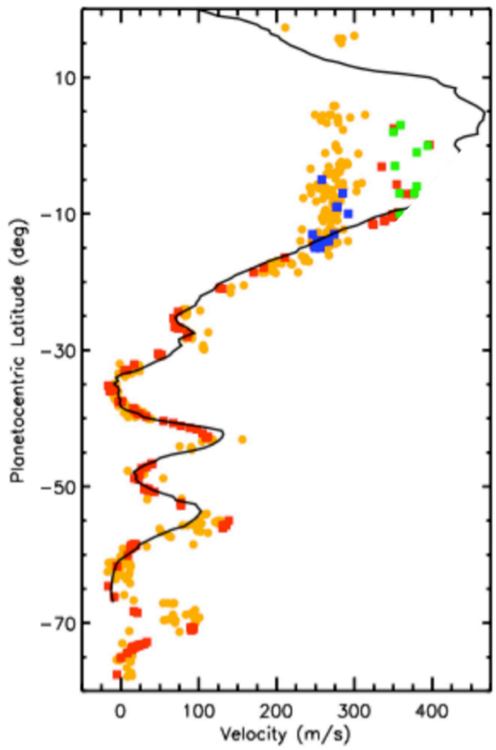


Figure 2: Saturn's zonal velocity profile inferred by tracking clouds in sequences of images. The solid line is from Voyager in 1980-81 [2]. The lighter points, which span the entire range of latitudes, are from HST in 1996-2004 [3] and from Cassini in 2004 [1]. The darker points are also from Cassini [1], but they use a filter that only sees clouds at high altitudes.

## 2. Discussion

The equatorial zone (±10° from the equator) is anomalous in several respects. The zone is bounded by zonal jet maxima (Fig. 2). The ammonia abundance (Fig. 1) is consistent with upwelling at the equator and downwelling out to ±10°. The 5-micron thermal emission (Fig. 3) is consistent with generally uniform high cloud cover. We will try to tie these observations together and speculate on what controls the width of the Hadley cells on giant planets.

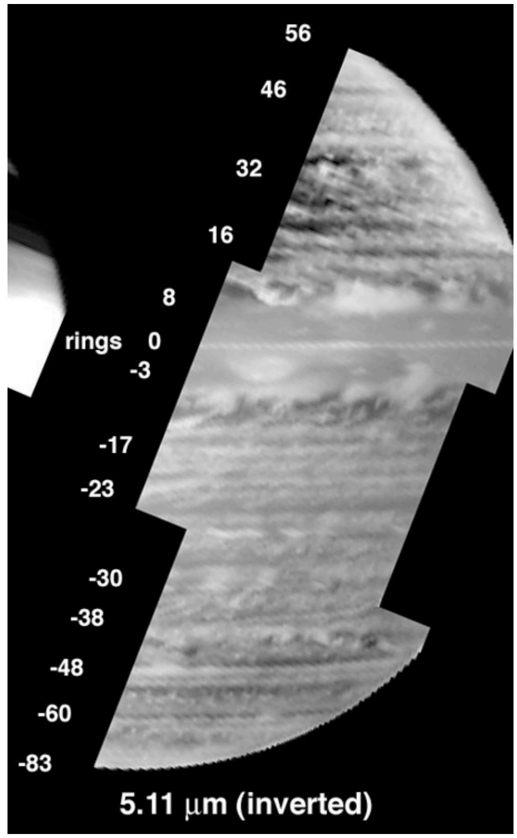


Figure 3: Image PIA03558 taken by the Cassini VIMS instrument showing thermal emission at 5 microns wavelength, inverted so that low $T_B$ areas (high clouds) appear white and high $T_B$ areas (holes in the clouds) appear dark.

## References


[1] Porco, C. P., and 34 colleagues. Science 307, 1243-1247, 2005.

[2] Sanchez-Lavega, A., Rojas, J. F., and Sada, P. V. Icarus 147, 405-420 , 2000.

[3] Sanchez-Lavega, A., Hueso, R., Perez-Hoyos, S., Rojas, J. F., and French, R. G. Icarus 170, 519-523, 2004.