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First hints on tropospheric composition at Jupiter's polar regions from JIRAM-Juno data

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Abstract

1. Introduction

The Jupiter InfraRed Auroral Mapper (JIRAM) instrument on the NASA Juno spacecraft hosts an imager operating around 5 μm and a spectrometer operating between 2 and 5 μm, with a spectral resolution of about 15 nm. The imager and the spectrometer have a spatial resolution of 250 μrad and are operated simultaneously. While most regions of Jupiter are usually affected by a thick cloud coverage, clearance areas (with cloud total opacities < 1 in the 5 μm range) exist at specific locations, notably the hot spots frequently observed between the equatorial zone and the north equatorial belt [4]. In these conditions, JIRAM spectra are sensitive to the contents of ammonia, water vapour, phosphine and – in lesser degree – germane, at the approximate levels between 2 and 3 bar [5], well below the Jupiter tropopause.

2. Materials

While tropospheric composition in hot spots and in extended regions at Jupiter's low and intermediate latitudes has been investigated by a number of authors on the basis of spacecraft and ground telescope data (e.g. [2], [3]), no study has yet covered polar regions. However, during the Juno's fourth periapsis (February 2nd 2017) the JIRAM instrument has eventually acquired extensive observations over both poles. The JIRAM imager revealed a surprisingly regular pattern of nine large cyclones on the north pole and – similarly surprising - six more cyclones on the south pole [1].

In this work, we present a first attempt to map tropospheric composition at Jupiter's polar regions from JIRAM spectral data. Analysis was performed according the methods presented in [5] and limited to spectra with lower emission angle (to limit retrieval uncertainties) and higher signal (retrievals are not possible in regions with thick cloud coverage).

3. Results

Example maps are presented in figures 1 and 2.

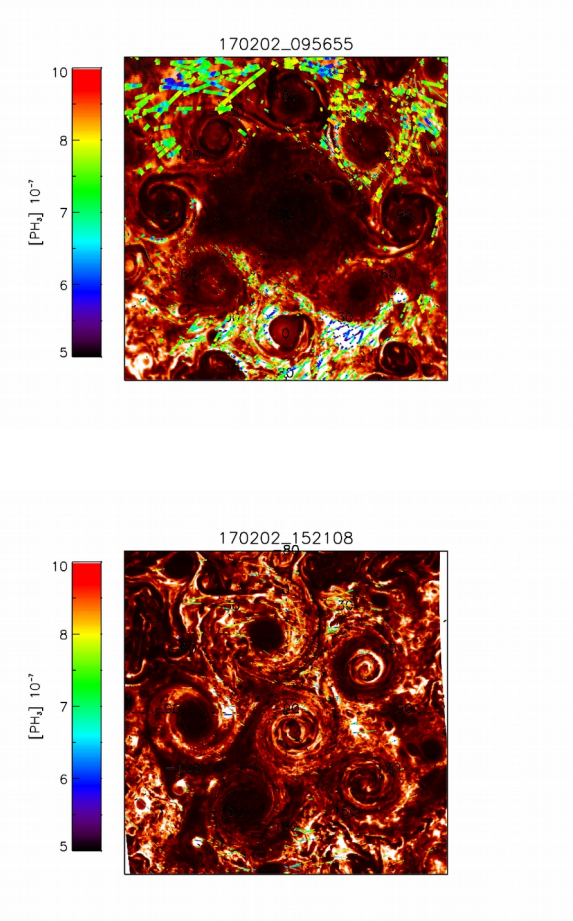

Figure 1: Phosphine content over the two polar regions

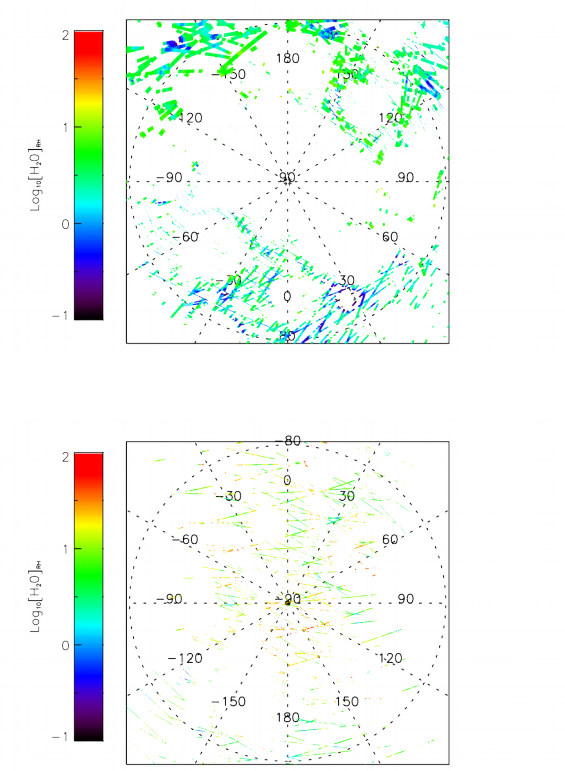

Figure 2: Comparison of water content over the two poles.

Brighter (clear) regions are found to be considerably depleted in disequilibrium species (PH_3 and GeH_4) once compared against darker (moderately cloudy) ones, suggesting effective suppression of vertical upwelling. Concentration contrasts between bright and dark area appear stronger over the northern pole. Contents of condensible species (H_2O and NH_3) are enhanced over the south pole, possibly associated with smaller overall opacity of cyclones there.

Acknowledgements

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References

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