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Jupiter's hot spots: assessment of the retrieval capabilities of future IR spectro-imagers

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Abstract

JIRAM instrument for Juno mission will return the first high-spatial resolution IR spectro-image data of Jupiter hot spots two decades after the historical NIMS-Galileo observations. A formal retrieval scheme based on the Bayesian formalism is presented, providing a quantitative assessment of retrieval errors and vertical resolution for derived profiles of water vapour and ammonia mixing ratios. Computations are performed on the basis of JIRAM noise equivalent radiance, spectral range and resolution. An IR spectro-imager has also been included in the core payload of the EJSM mission orbiters. This instrument will provide complimentary results due to the different s/c orbits and improved spectral resolution.

Method

Bayesian formalism [1] offers a theoretical frame for the formal implementation of inverse methods. We firstly compute the partial derivatives of observed radiances at the different JIRAM sampling points with respect to gas mixing ratios at different pressure levels. These computations are performed adopting the methods described in [2]. Derivatives are computed in the neighbourhood of *a priori* mixing ratio profiles, derived from results of previous missions as summarized in [3]. Covariance matrices for *a priori* mixing ratio profiles, defining realistic ranges of variability for investigated quantities, are built *assuming* a potential *relative* variability at each layer up to 10 times the corresponding *a priori* value and imposing a correlation length equal to atmospheric scale height. Noise equivalent radiance of the instrument is also considered to evaluate the impact of random signal fluctuations on retrieval outcomes.

Results

Only few examples about ammonia for the JIRAM case are given here. Fig. 1 presents random retrieval error *relative* to *a priori* value: the decrease of uncertainty well below the initial 10 value around -70km represents the information update provided by data. Fig. 2 presents the correlations between retrieval errors at different altitudes, quantifying the vertical resolution of inverse process.

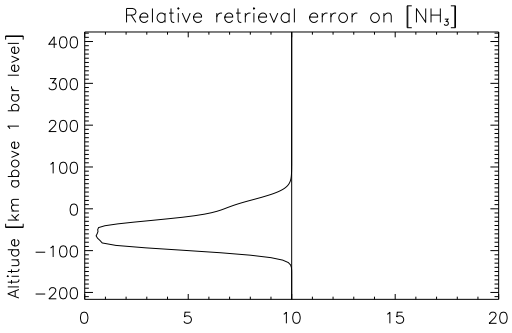

Figure 1

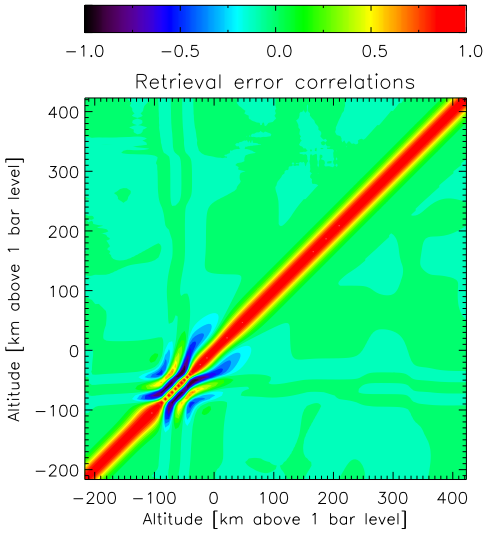

Figure 2

References

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[2] Ignatiev et al. (2005) *P&SS, 53,* 1035-1042.

[3] Atreya, S. K. (2003) *P&SS, 51 (2),* 105-112.