Preliminary Results from the JIRAM Observations of Jupiter Poles acquired during the first orbit of Juno

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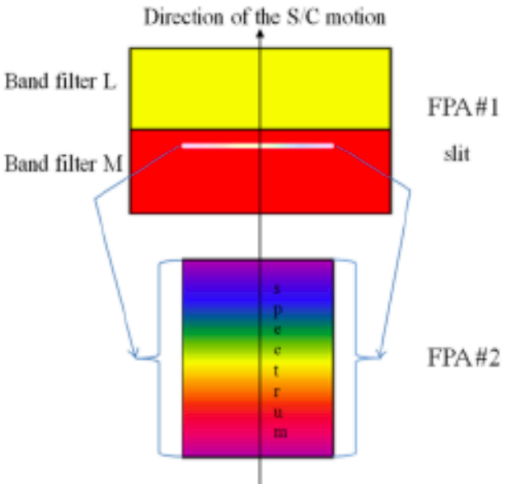
Jovian InfraRed Auroral Mapper

JIRAM Optical Head



JIRAM Scientific Objectives

- Primary Goals
  - Atmospheric Science
  - Hot spots and their chemistry
  - Aurorae
  - Clouds
- Secondary Goals (Target of Opportunity Science)
  - Satellites

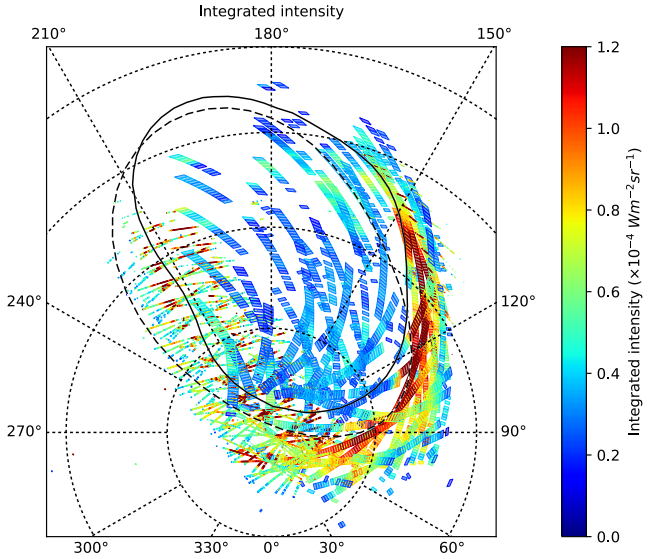
JIRAM is a camera and a spectrometer

Camera for auroral emissions, fwhm 3.32-3.60 μm
Camera for thermal emissions, fwhm 4.54-5.03 μm
Spectrometer 2-5 μm, resolution 9nm, av. fwhm 12.5 nm

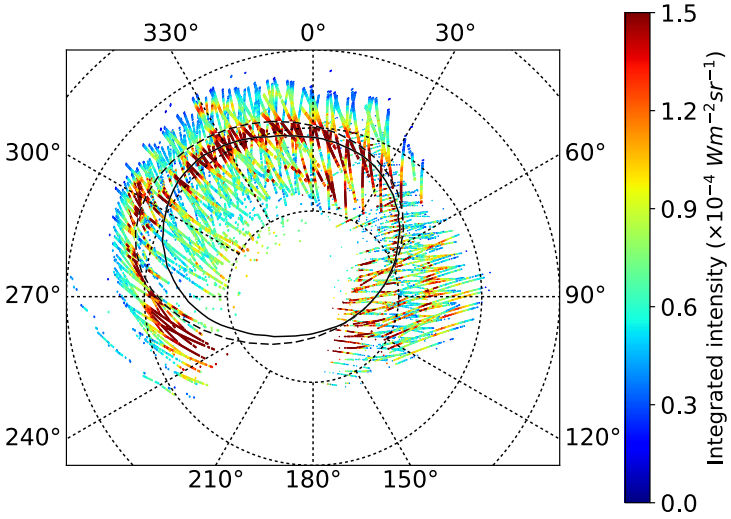
JIRAM is mounted on the spacecraft aft deck. It is equipped by a de-spinning mirror to compensate for the s/c spinning. The mirror can be set to scan the planet in the spin plane.

Jiram-Spectrometer Pole coverage during PJ1

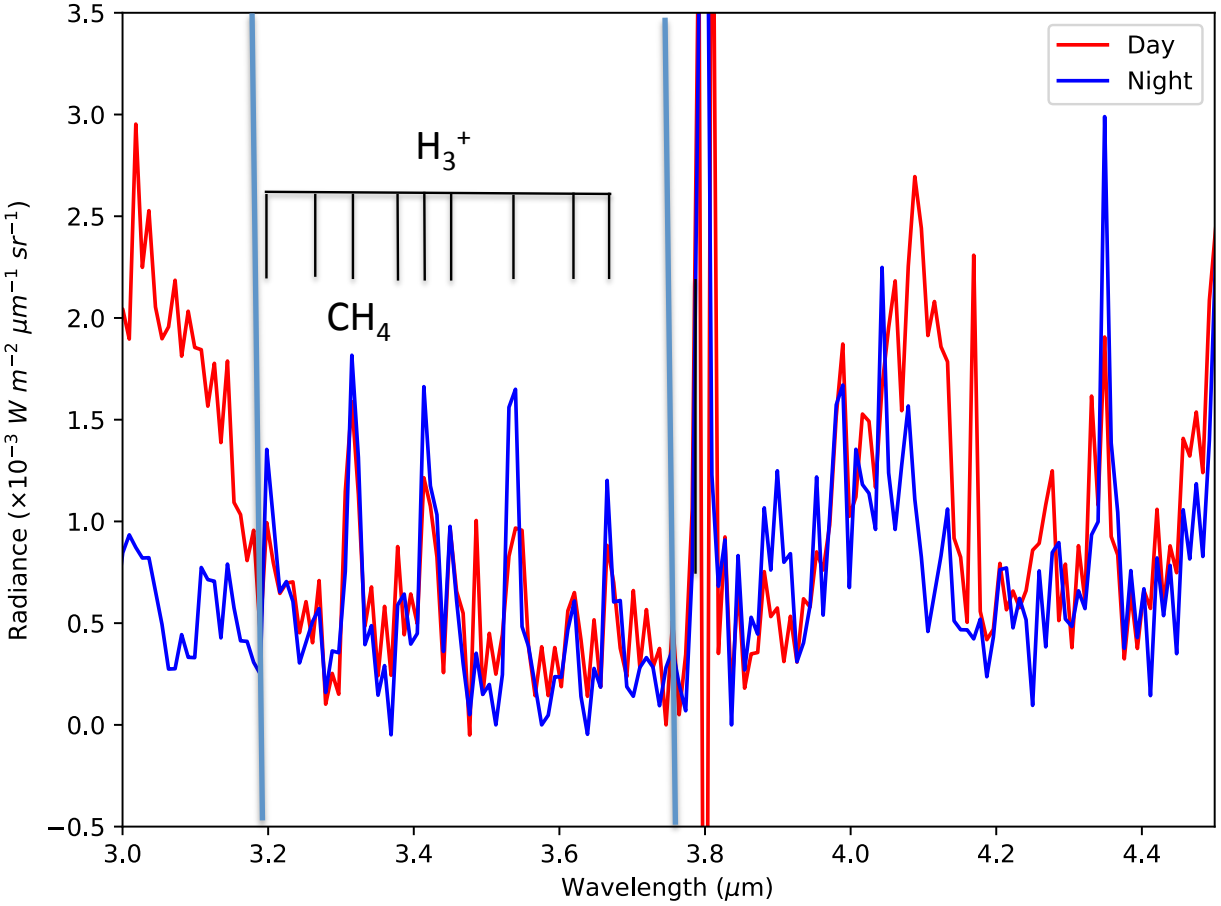
North Pole – 16000 spectra



South Pole – 30000 spectra



Auroral Spectrum in the H_3^+ window



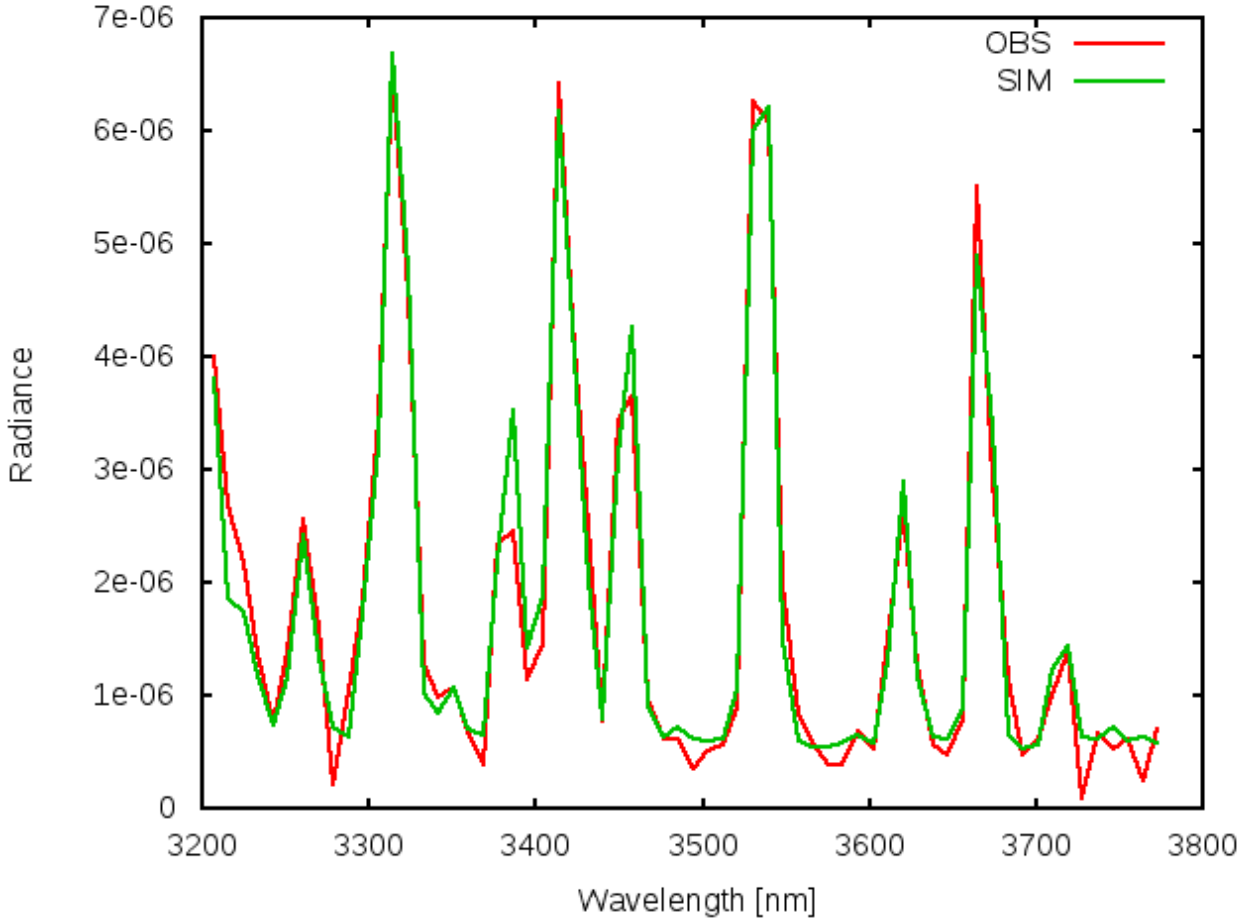
Retrieval Method

- JIRAM spectra used to infer H_3^+ temperature (T) and column density (CD) distribution in the auroral region
- The analysis makes use of **an iterative Bayesan procedure** to fit simulated spectra to observations
- The spectra are simulated assuming that the observed molecular emissions are **optically thin** and that a **single temperature** can be used for all the transitions of the same molecule (LTE)
- The intensity of each transition is computed with the

$$I_{im} = N_m(2J_{im}+1)g_{im}A_{im}hc\nu_{im}\frac{exp\left(-hcE_{im}/KT_m\right)}{4\pi Q_m(T_m)}$$

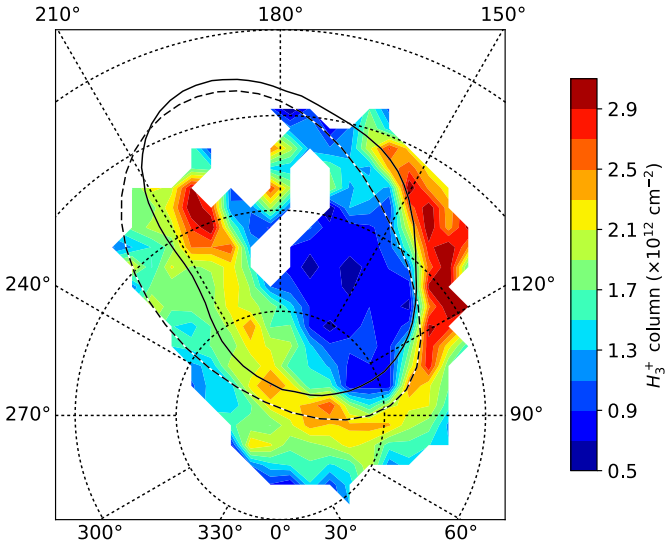
- All the computed intensities are then convolved with the instrument spectral response

Observed and Simulated spectrum

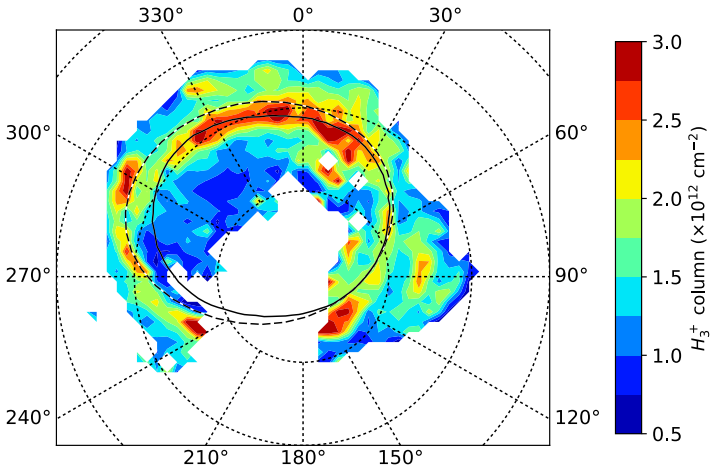


Retrieval results: H_3^+ Column Densities

North Pole

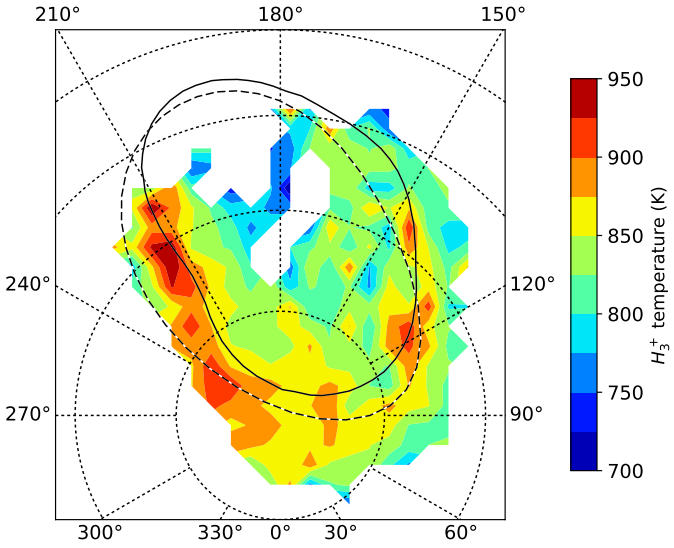


South Pole

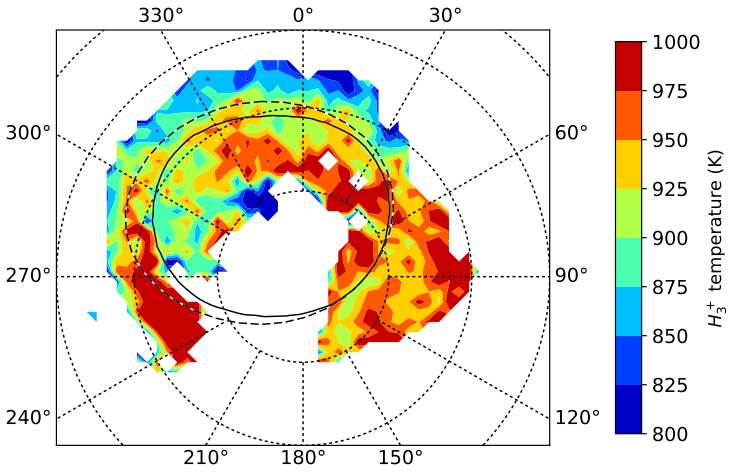


Retrieval results: H_3^+ Temperature

North Pole

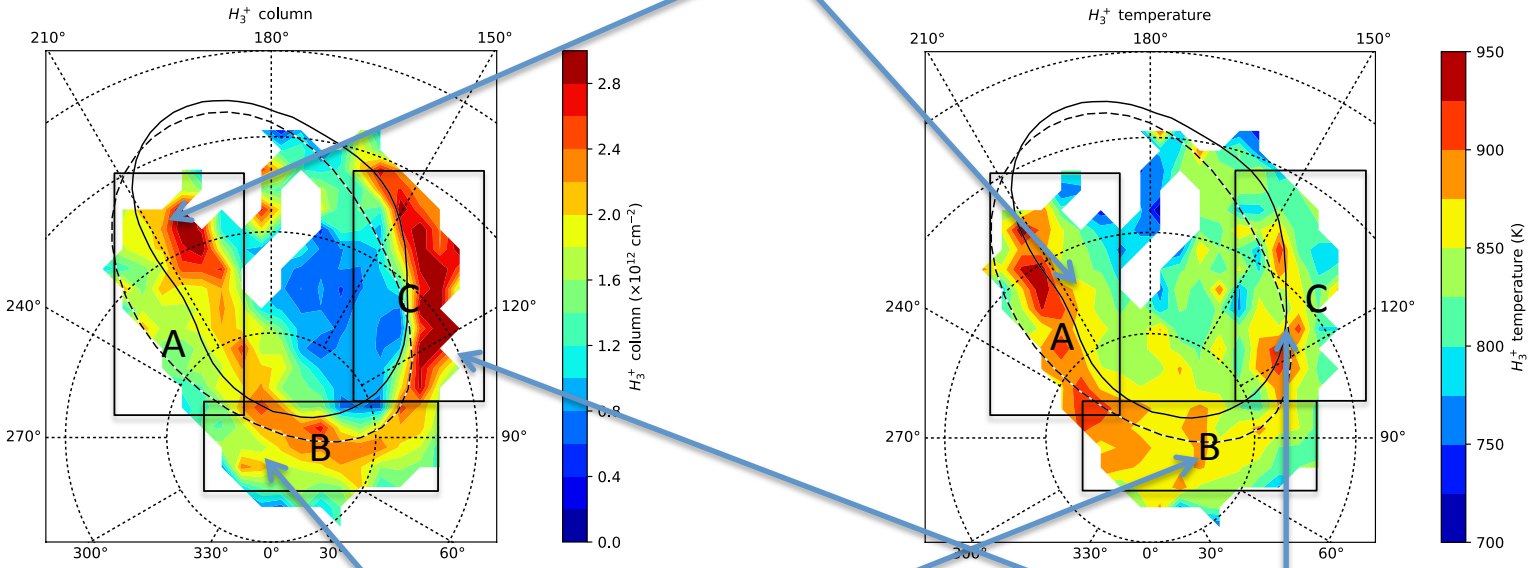


South Pole



Discussion - North Aurora

Region A
High CD inside statistical oval
High T outside statistical oval



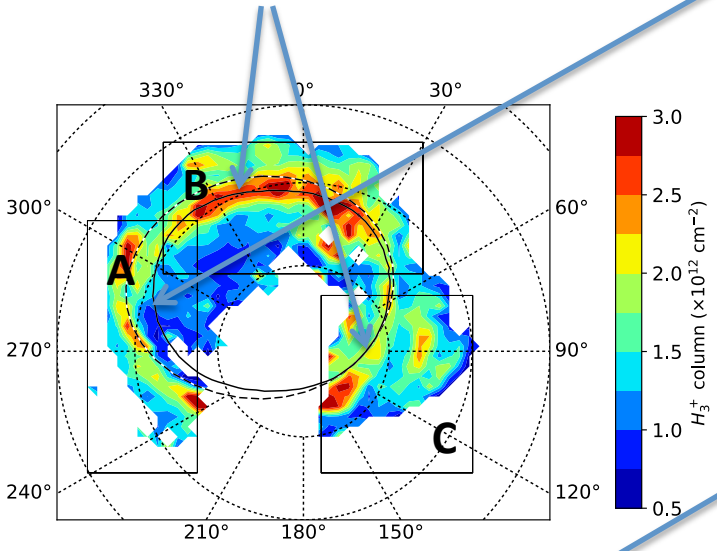
Region B
High CD and T on the statistical oval

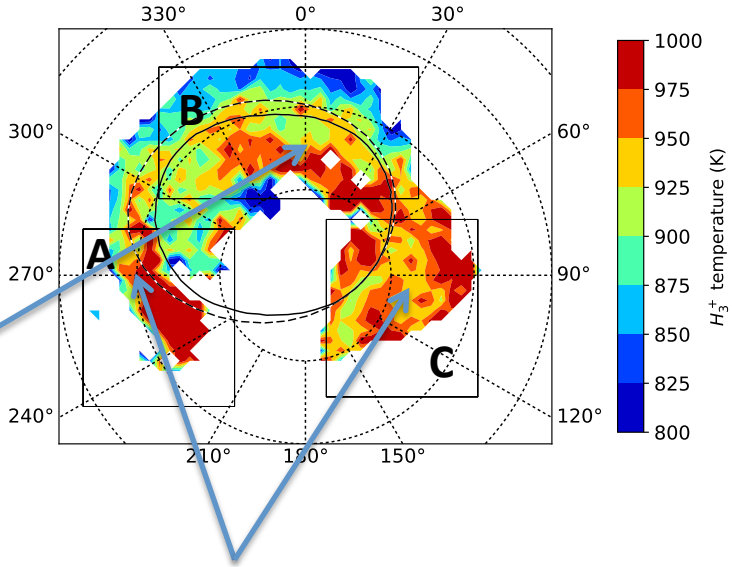
Region C
High CD outside the statistical oval
High T on the statistical oval

Discussion - South Aurora

Region B and C
High CD along statistical oval

Region A
High CD along model oval

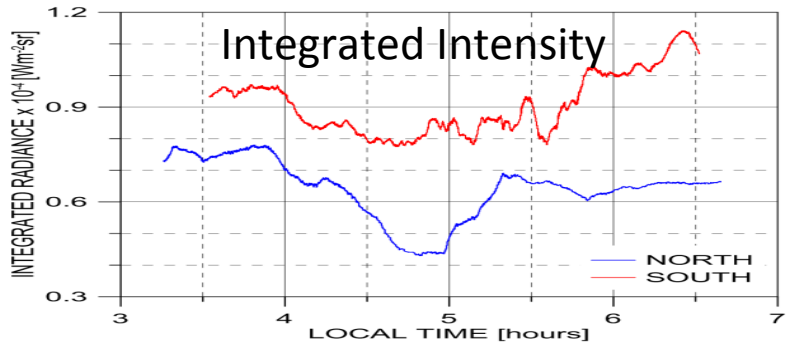


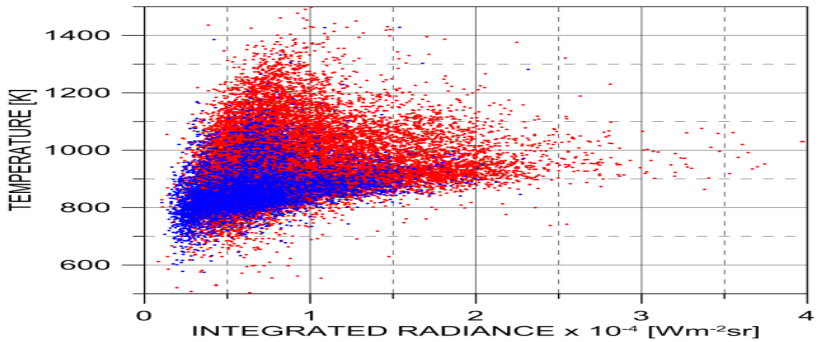


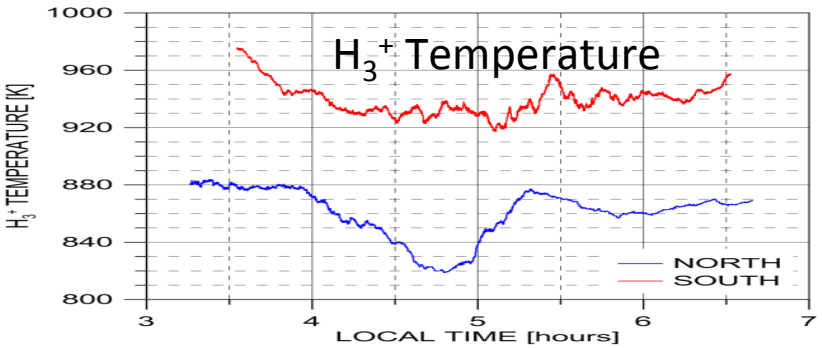
Region B
High T internal to the oval

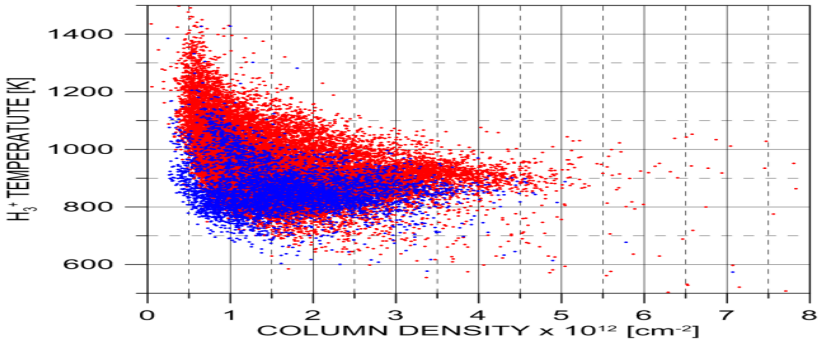
Regions A and C
Diffuse regions of high T

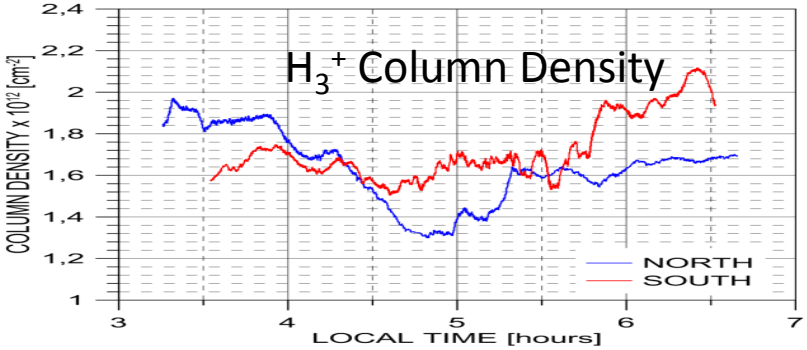
North (blue)/South (red) comparison

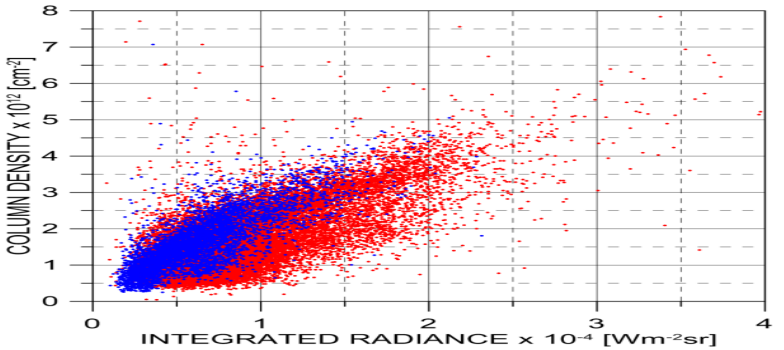












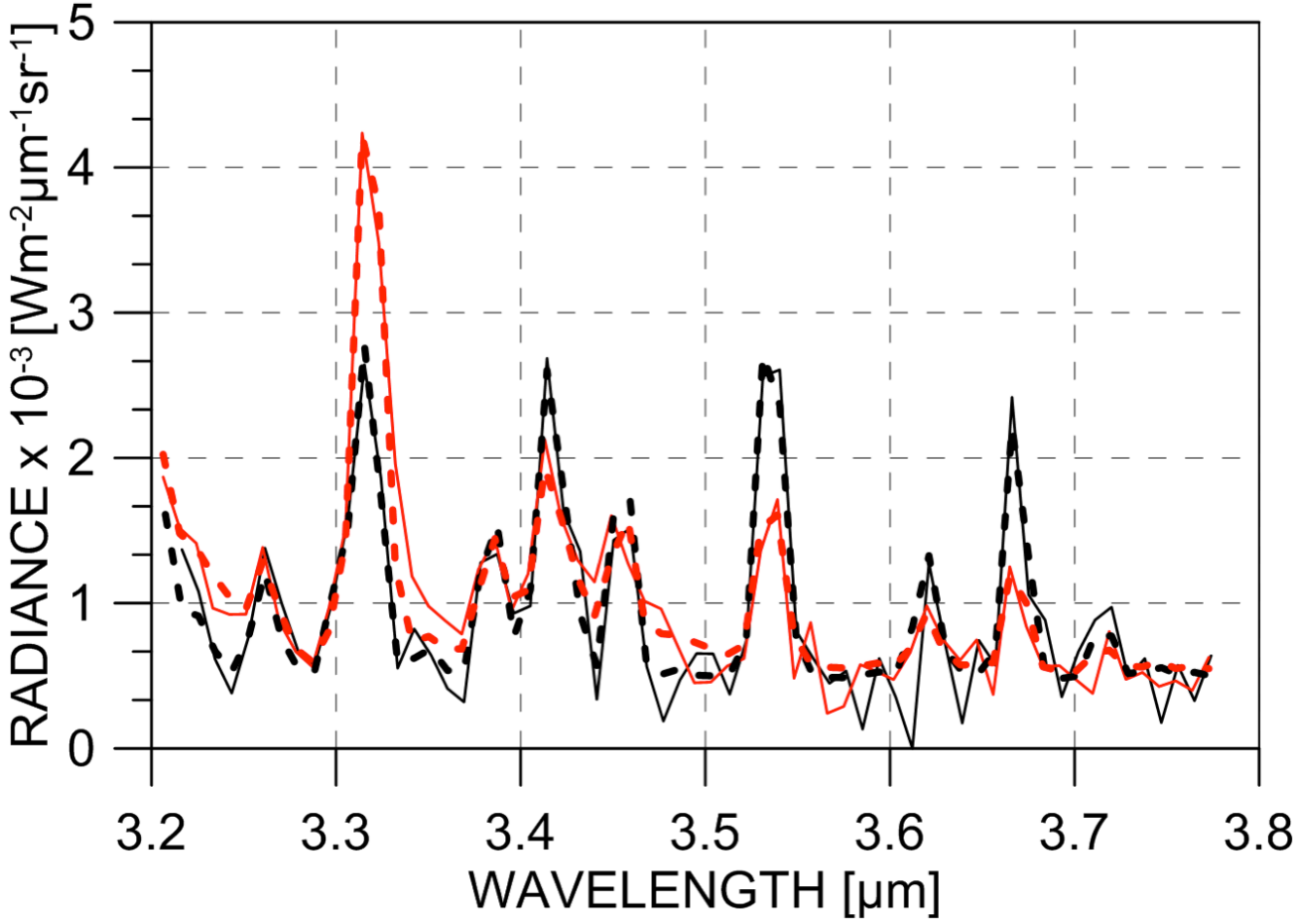
Discussion

- North and South Auroral regions quite different
- In general the H_3^+ emission in the South Aurora is more intense than the North Aurora
- H_3^+ CD peak follows oval pattern in both Auroras
- H_3^+ T peak shows oval pattern in the North Pole, oval pattern less pronounced in the South Pole
- North Aurora H_3^+ CD oval not superimposed to the T oval
- South Aurora widespread regions of high H_3^+ T (higher than in the North)
- H_3^+ CD of similar magnitude in both Auroras

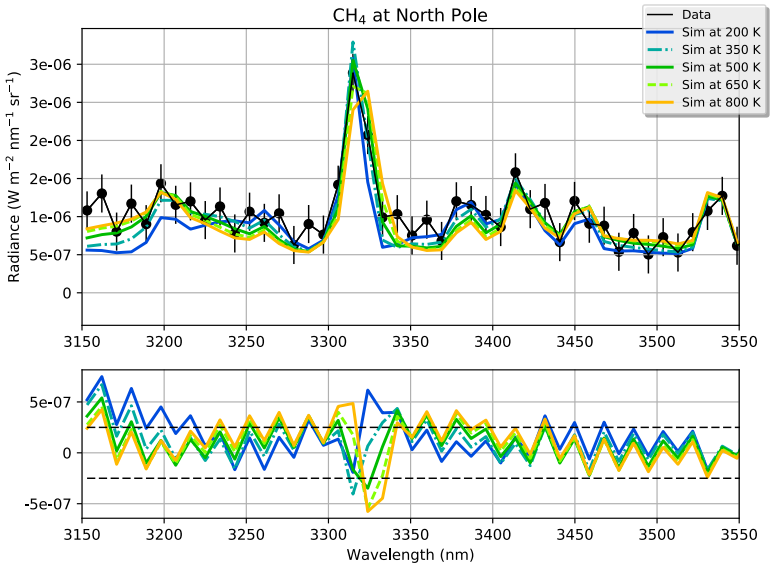
Methane

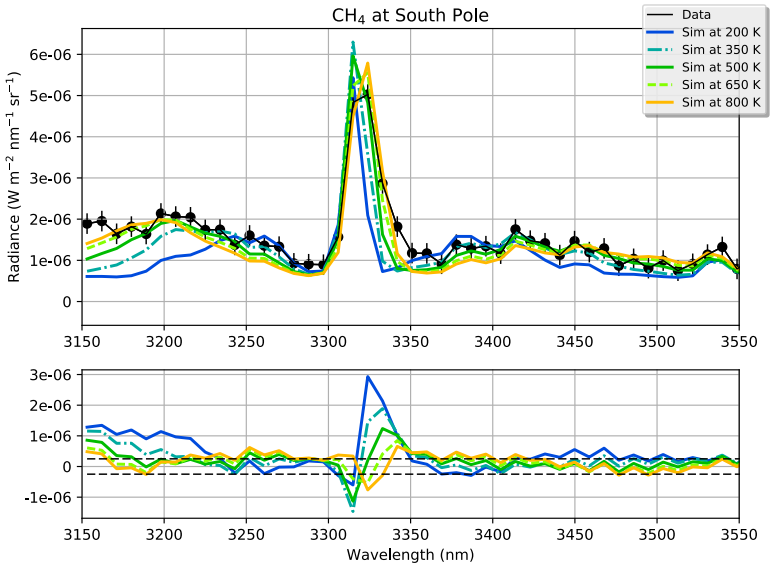
- A first run of the retrieval code highlighted that the spectral contribution of methane was not negligible
- Therefore among the free parameters of the retrievals we introduced methane CD (T was fixed to 500 K)
- The spectra of the regions where CH_4 CD was highest have been used to estimate CH_4 average temperature
- The results of the CD retrieval used to evaluate CH_4 spatial distribution at the Poles

Spectra with high (red) and low (black) methane contribution



Average CH_4 spectra and simulations

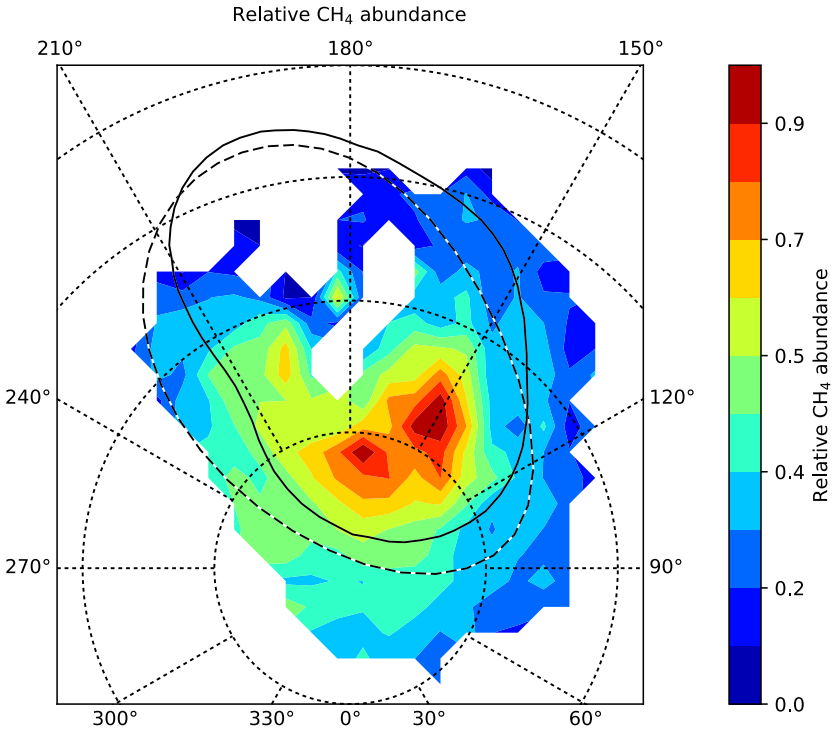




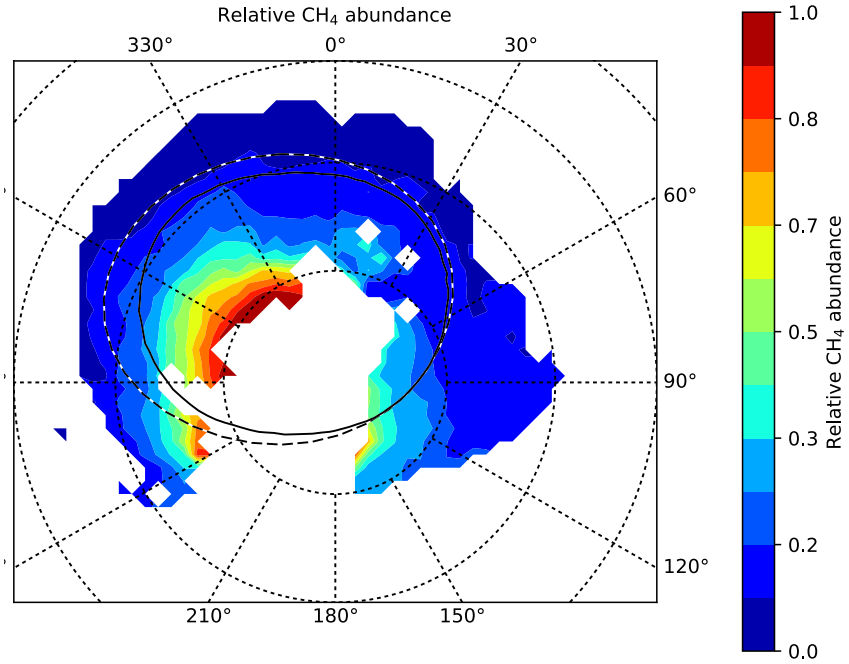
Temperature	χ^2 North	χ^2 South
200	2.5	17.4
350	1.9	9.6
500	**1.7**	4.5
650	1.9	**2.9**
800	2.2	3.3

CH_4 distribution

North Pole



South Pole



Conclusions

- JIRAM observed both Jupiter Poles during PJ1
- Detailed analysis of H_3^+ emission in the 3 microns region enabled to retrieve the spatial distribution of its CD and T
- North and South aurorae different in both intensity and geographycal distribution
- Hot methane emission has been identified both at North and South Pole
- The CH_4 temperature (500 North, 650 South) suggests hot methane altitude different in North and South Poles
- The analysis of next PJs will help in understanding auroral behaviour
- JIRAM limb observations of the auroral regions will help in characterising the vertical distribution of H_3^+ and possibly methane