

# MESOSPHERIC RETRIEVALS WITH MIPAS

L. F. MILLÁN-VALLE AND A. DUDHIA

ATMOSPHERIC, OCEANIC AND PLANETARY PHYSICS, UNIVERSITY OF OXFORD

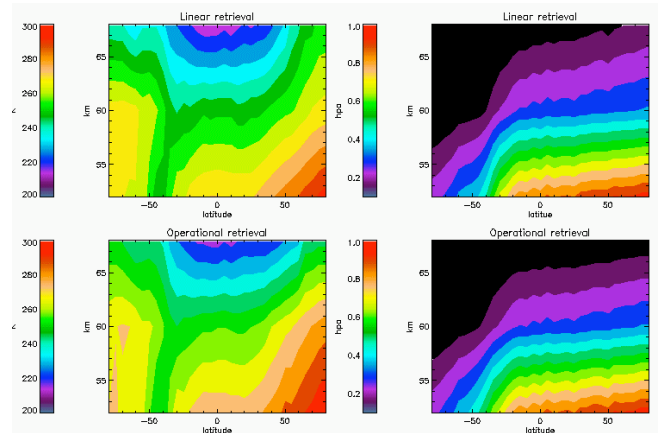


## INTRODUCTION

MIPAS normally scans from 6 to 68 km but, under special viewing modes, its altitude coverage can be extended to tangent heights above 100 km, capturing the entire mesosphere. Currently, the middle atmosphere mode, which covers the altitudes from 18 to 102 km in 29 steps, is used every ten days.

The operational MIPAS L2 retrieval uses an iterative microwindow approach which implies re-running the radiative transfer model. When trying to extend this into the mesosphere, the low signal to noise ratio requires many more spectral points to be used and hence a much longer processing time.

A linear algorithm has been developed to retrieve temperature, pressure and volume mixing ratio at lower mesospheric altitudes. The retrieval exploits the linearity of an optically thin path and uses pre-computed spectra.



Zonal average temperature and pressure retrieved for 07 June 2003

## GAS CONCENTRATION RETRIEVAL

1. Chose a spectral range where most lines from the molecule to retrieve are found

MOLECULE	SPECTRAL RANGE
O <sub>3</sub>	1020-1170 cm <sup>-1</sup> (AB)
H <sub>2</sub> O	1215-1500 cm <sup>-1</sup> (B)

2. Again, screen out lines affected by non-LTE effects and lines from other gases rather than the gas to retrieve.

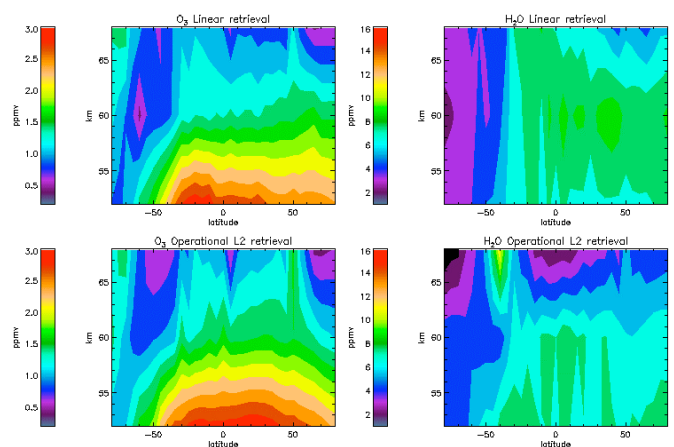
3. Assuming the measured radiance is,

$$y = y_o + K_B(B - B_o) + K_p(p - p_o) + K_v(v - v_o)$$

the volume mixing ratio can be retrieved following,

$$v = v_o + (K_v^T K_v)^{-1} K_v^T [y - y_o - K_B(B - B_o) - K_p(p - p_o)]$$

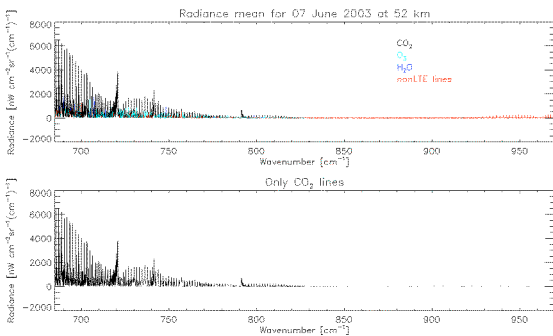
B: correspondent Planck function (at a fixed wavenumber) for the temperature retrieved  
 B<sub>o</sub>, p<sub>o</sub>, v<sub>o</sub>: Planck function, pressure and volume mixing ratio values of the initial guess.  
 p: pressure retrieved  
 K<sub>B</sub>, K<sub>v</sub>, K<sub>p</sub>: Planck function, vmr and pressure Jacobian



Zonal average O<sub>3</sub> and H<sub>2</sub>O retrieved for 07 June 2003

## PRESSURE - TEMPERATURE (PT) RETRIEVAL

1. Spectral range from 685-970 cm<sup>-1</sup> (A band)
2. Screen out lines affected by non-LTE effects and lines from other gases rather than CO<sub>2</sub>.



3. Retrieve temperature and pressure by a linear least squares fit of the form:

$$x = x_o + (K^T K)^{-1} K^T (y - f(x_o))$$

y: measurement vector (limb radiances)  
 x: state vector (parameters to retrieve)  
 f(x<sub>o</sub>): precomputed reference spectra (the result of the radiative transfer model using x<sub>o</sub>)  
 K: precomputed Jacobian  $K_{ij} = \frac{\partial y_i}{\partial x_j}$

More linearity is obtained retrieving linear pressure rather than log(pressure) and retrieving Planck function (at a fixed wavenumber) rather than temperature. After the retrieval, the Planck function is converted into temperature.

Three initial guesses are used to improve the retrieval accuracy. In the three cases, the retrieval scheme is carried out and the one that most closely predicts the observed spectra is used.

- Mid latitude day
- Polar summer
- Polar winter

4. Add the hydrostatic balance constraint (using the standard optimal estimation approach described by Rodgers 2000)

## REFERENCES

Rodgers, Inverse Methods for Atmospheric Sounding: Theory and Practice, world Scientific, 2000

EMAIL: millanvalle@atm.ox.ac.uk