MIPAS as a mesosoheric instrument

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Introduction

The mesosphere has not attracted much attention from the science community mainly due to a lack of instruments capable of sounding this region. MIPAS sensitivity allows the observation of several atmospheric parameters from the upper troposphere to the thermosphere. Figure 1 summarizes three of the MIPAS viewing modes that measure part or all the mesosphere.

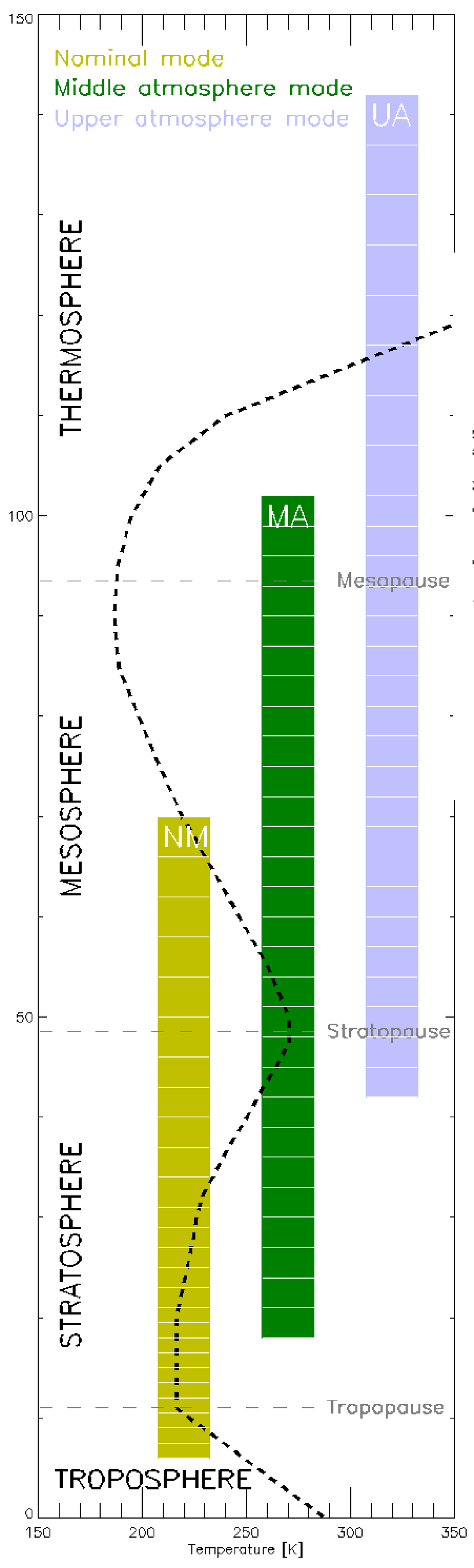

Fig.1

At these high altitudes, the emission lines from most gases are sparse and reduced in amplitude, the S/N ratio decreases and also, non LTE effects become significant.

All of which makes use of the standard microwindow approach (as used for the operational retrievals) impractical.

Mesospheric spectra can be used for checking the calibration. After masking the remaining atmospheric emission lines, the residual spectra or the "zero" background can be used to detect instrument artefacts (such as the forward and reverse offset) or to verify the radiometric noise estimates. A large number of spectra can be averaged to improve the S/N ratio.

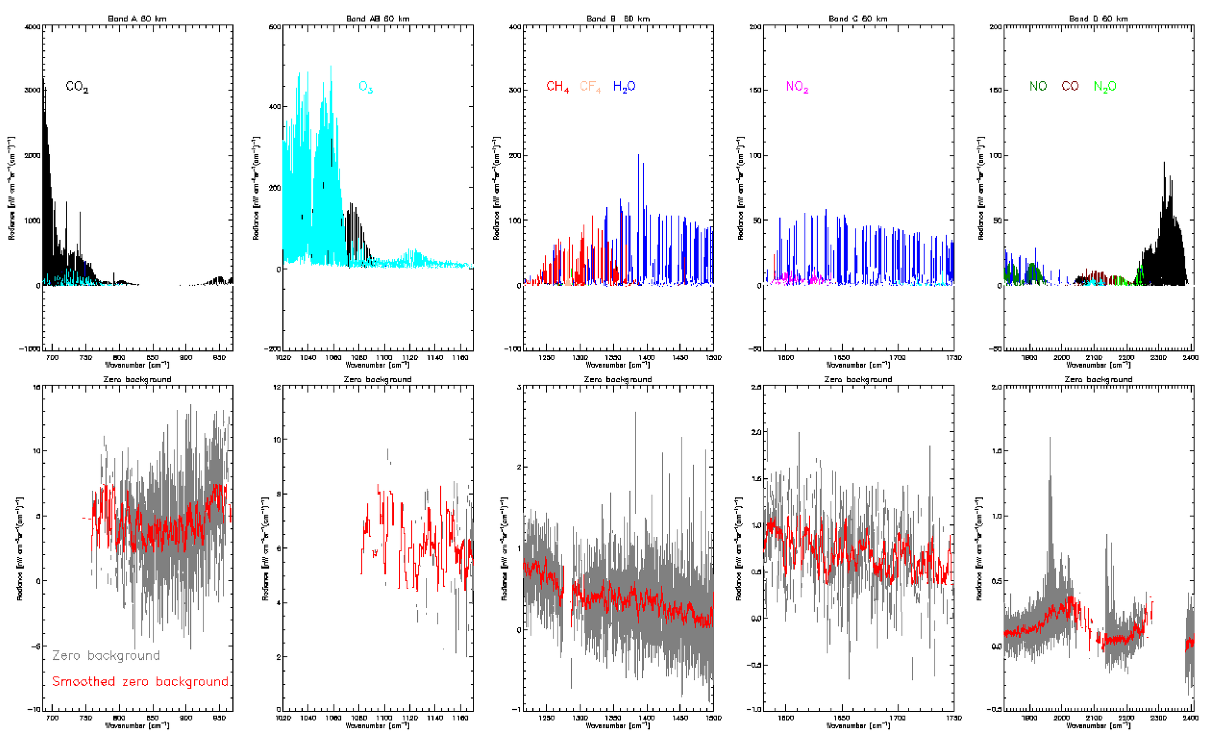

Fig.2

Figure 2 displays the averaged emission lines encountered for 07 June 2003 as well as the "zero" background remaining after the application of spectral mask.

An unexpected emission feature remains in the D band at 1920 cm^{-1}. Further research should be done to identify this molecule and apply the appropriate spectral mask.

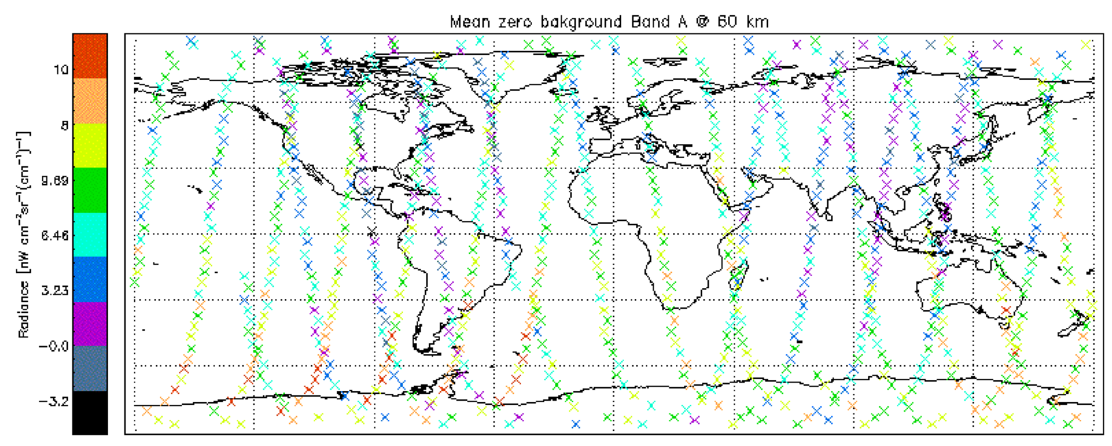

Fig.3

Figure 3 shows the distribution of the mean of the smoothed "zero" background for the A band at the tangent height of 60 kilometres. The highest offsets are encountered at the south east of South America; more investigation need to be done to understand this feature.

Forward and reverse offset

MIPAS instrument design is based on the classical Michelson interferometer. Each spectrum is obtained either by a forward or a reverse sweep of the mirror, and forward and reverse spectra are calibrated independently. Ideally the zero background should be zero for both directions.
Figure 4 compares the radiometric forward and reverse "zero" background or offset averaged over one day, for high and low resolution data. The high resolution data shows small differences in the residual values while the low resolution shows mainly no difference between the two directions.

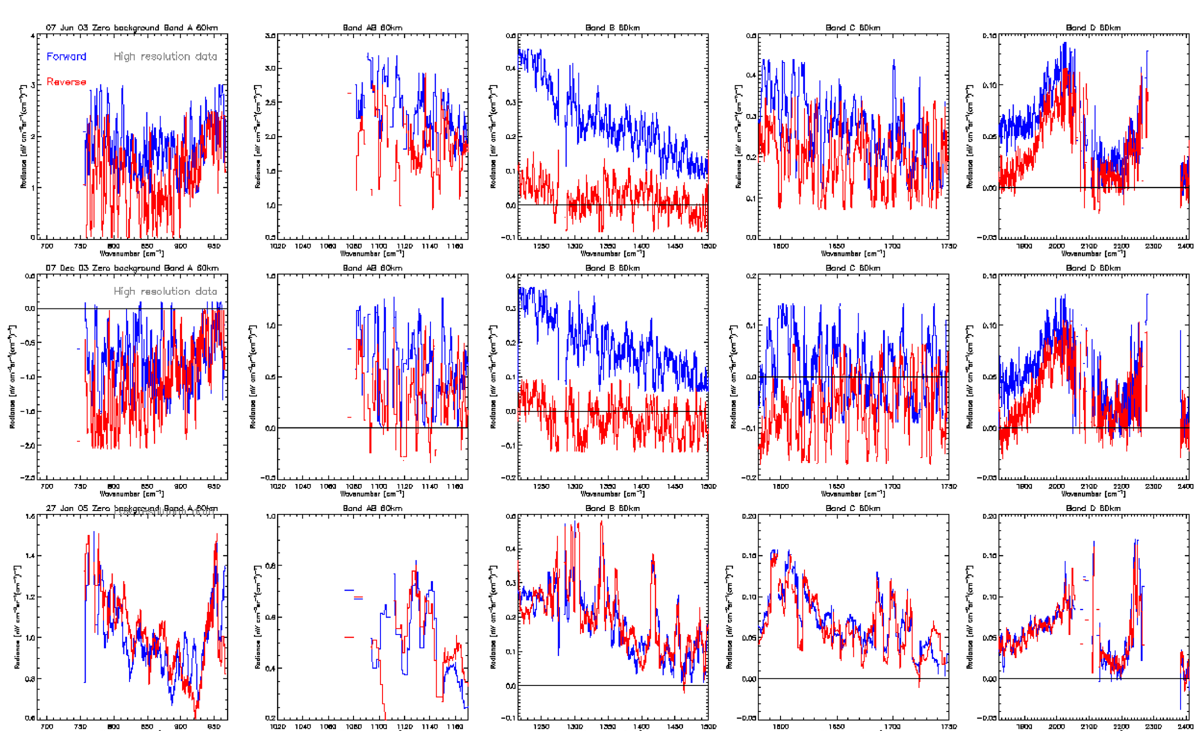

Fig.4

Noise estimates

MIPAS estimates the noise (the thermal instrument self emission) from deep space measurements several times per orbit and these can be found in the L1B data. Using a simple standard deviation approach the "zero" background at mesospheric altitudes can be used to derivate the noise estimate.

Figure 5 shows the difference between the L1B noise estimates and the derived noise. Generally these are in good agreement, the larger variability of the values derived here being due to the averaging over spectral regions containing emission lines, therefore masked out.

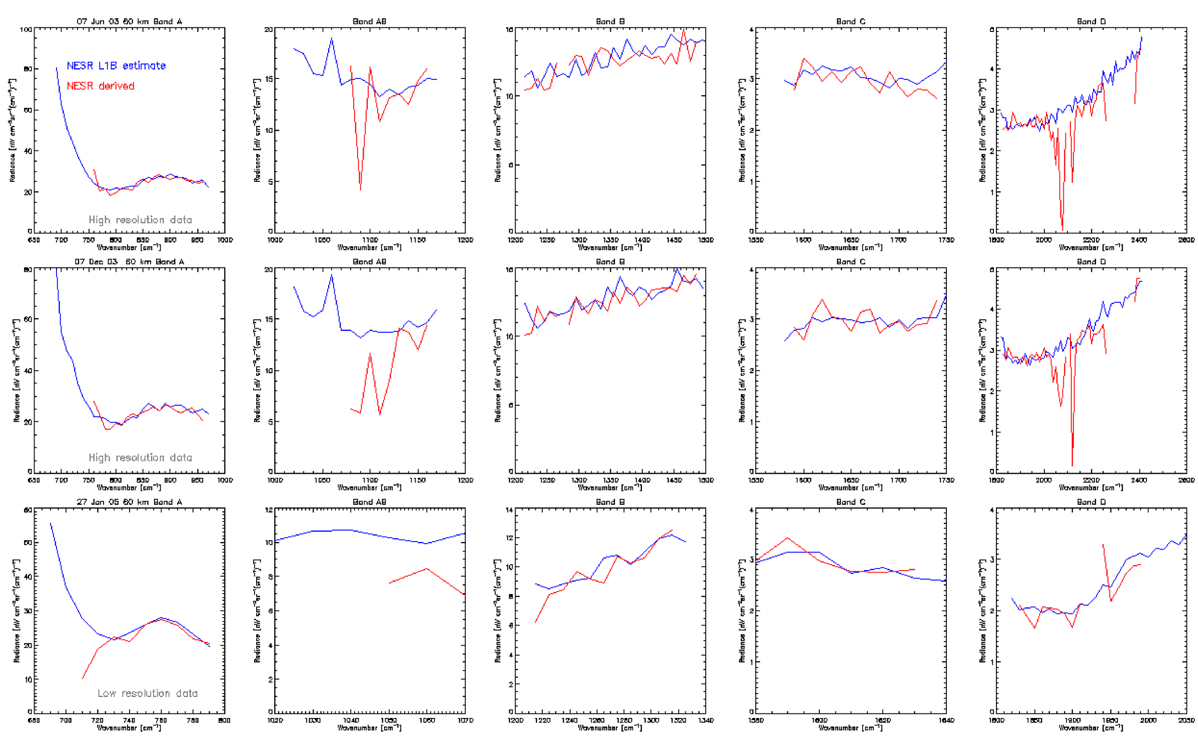

Fig. 5

Future work

Assuming that the tangent paths are optically thin, the mesospheric spectra can be used to retrieve mesospheric temperature using a simple linear retrieval. This should allow the full spectral signature of the target molecules to be used, rather than just microwindows, and provide retrievals of improved precision, if not accuracy, compared to the operational products at altitudes above 50km.

Also, further research needs to be done in order to apply similar techniques as the described here to detect real atmospheric features such as noctilucent clouds or unexpected molecular emissions.

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