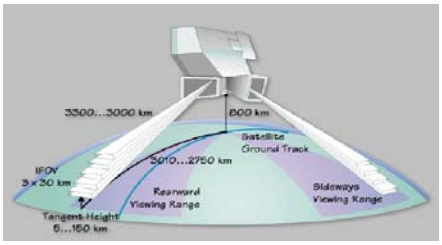
MONITORING Michelson Interferometer for Passive Atmospheric Sounding DATA

Ana-Lía Quijano, Chiara Piccolo, Vivienne Payne, Alastair Burgess and Anu Dudhia
Atmospheric Oceanic and Planetary Physics, University of Oxford

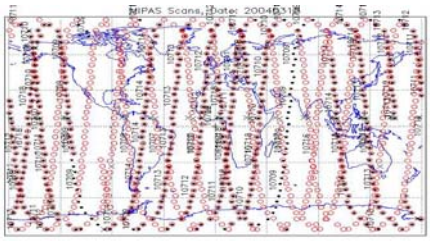
Introduction. The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) is a Fourier transform spectrometer that measures atmospheric limb emission spectra over an altitude range of 6 to 68 km. Operating in the mid infrared (4.15-14.6 μm), it detects and spectrally resolves a large number of emission features of atmospheric minor constituents. After suitable ground processing for calibration and geolocation, altitude profiles of atmospheric pressure, temperature and volume mixing ratios of six high-priority species (O3, H2O, CH4, N2O, NO2, and HNO3) are routinely retrieved operationally by the European Space Agency (ESA) and the University of Oxford, among other institutions, in near-real-time (NRT) since July 2002. In parallel, an off-line (OFL) scheme has been developed to validate the operational retrieval and to extend the altitude range of MIPAS products down to 6 km while NRT data only take into account measurements down to 12 km.

Scan Description



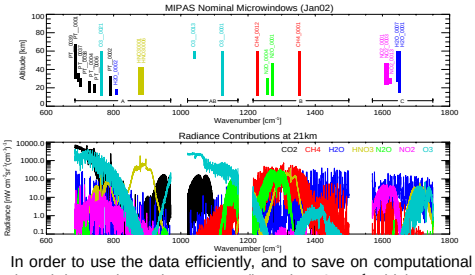
MIPAS is designed to operate in both the day and the night parts of ENVISAT's orbit with an azimuth scan geometry in the anti-flight direction. This geometry ensures a complete global coverage.

Typical Daily Coverage



This map is an example of the profile data stored at http://www.atm.ox.ac.uk/group/mipas/L2/. Black dots represent NRT profile locations with successful pressure/temperature retrievals. Red circles represent the same for OFL data. Crosses (+) represent profile locations where the pressure/temperature retrieval (and consequently all other species) was unsuccessful.

Microwindow Selection



In order to use the data efficiently, and to save on computational time, it is usual to select narrow (less than 3 cm^{-1} wide) spectral intervals, "microwindows", containing a limited number of measurements chosen specifically to target a single species These selection of microwindows depend on the altitude of the measurements.

Summary. The goal of this poster is to familiarize the reader with the monitoring of the instrument, which is partly held at the University of Oxford. An example is shown for one of the species (CH_4), although the monitoring has been performed as well for H_2O, N_2O, NO_2, O_3, HNO_3, pressure and temperature.
Figure 1 is a monthly mean residual analysis for November 2003. We choose 75 ° S latitude band to indicate the differences between spectra measured by the instrument and spectra generated by the retrieval forward model (1) for each of the CH_4 microwindows. The results of the model are then combined to obtain the monthly mean of November 2003 averaged over six different latitude bands (Figure 3).
Monthly mean time-series from July 2002 to March 2004 (Figure 5) are also discussed in the poster.
In parallel, the differences between the OFL and NRT data are plotted for the November 2003 monthly mean (Figure 4) and the residual analysis at the 75° S latitude band (Figure 2). Finally, we also compare the monthly mean time-series with climatology (Figure 6).

Monthly Mean Residual Analysis

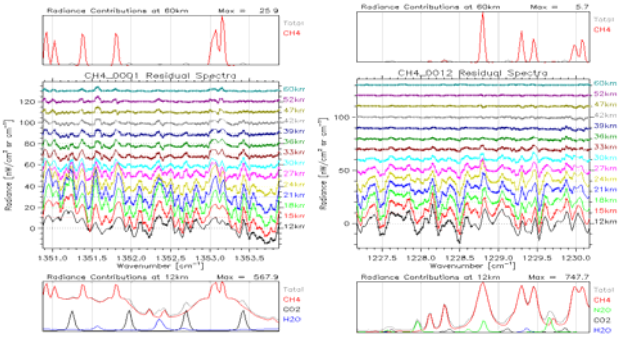


Figure 1. NRT monthly mean residual analysis (November 2003, 75°S) and radiance contibutions at 60 and 12 km for two selected microwindows (CH4_0001 and CH4_0012). Ideally, individual spectra should contain only random measurement noise but in practice a number of features are present indicating systematic errors either in the forward model or the instrument characterisation.

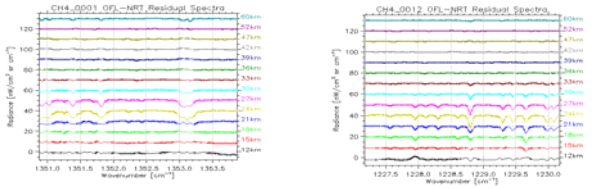


Figure 2. Differences between the OFL and NRT monthly mean residual analysis.

Monthly Means

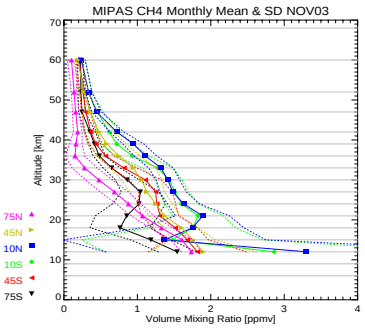


Figure 3. Monthly average of the MIPAS NRT CH_4 product. The vertical axis is the nominal tangent altitude. Each color represents a different latitude. Dotted lines indicate one standard deviation scatter in the averaged data.

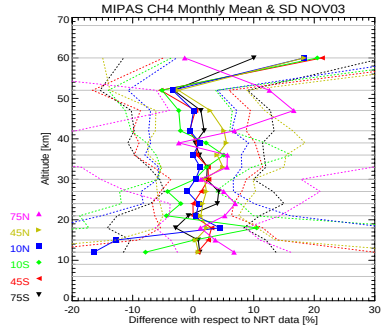


Figure 4. Mean of the differences between NRT and OFL CH_4 data for November 2003 (approx. 30 days - 25,000 profiles). The difference taken was OFL - NRT.

Monthly Mean Time-Series

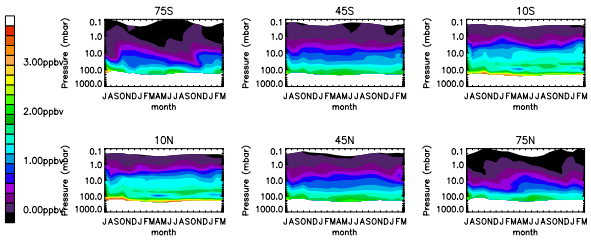


Figure 5. Time-series of the MIPAS monthly mean CH_4 profiles from July 2002 to March 2004. A strong seasonal cycle can be seen in polar regions, due to the general descending motion of the air at certain times of the year. CH_4 is produced at the surface, well-mixed in the troposphere and broken down in the stratosphere by oxidation and photolysis. It is therefore expected that the CH4 profiles should decrease monotonically with height. This is not the case for some of the equatorial monthly mean profiles. The MIPAS CH_4 in the equatorial latitude bands for some of the months shows a local minimum at around 15-18 km. The reason for this is not known, but it is thought that it may be due to the 3 km vertical resolution of MIPAS being unable to resolve temperature features around the tropopause region.

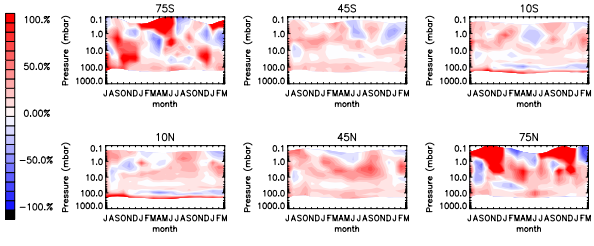


Figure 6. Percentage difference between the MIPAS monthly mean of CH_4 and the IG2 climatology profiles (used in the construction of the initial guess for the MIPAS retrievals) (2). As with other gases, the MIPAS CH_4 at the lowest retrieval altitude seems unrealistically high when compared with climatological profiles. The problem with the local minimum in the equatorial tropopause region can be seen as blue regions in the equatorial plots. In general, MIPAS CH_4 is around 20% higher than would be expected over most of the stratosphere for all latitude bands.

References

(1) Ridolfi, M. et al., Optimized forward model and retrieval scheme for MIPAS near-real-time data processing, Applied Optics, Vo. 39, No 8, 2000.
(2) Remedios, J. J., Extreme atmospheric constituent profiles for MIPAS, Proceedings of the European Symposium on Atmospheric Measurements from Space, ESTEC, Nordwijk, Netherlands, 20-22 January, Vol. 2, 779-783, 1999.