MIPAS retrievals of UTLS O_3 and H_2O

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Introduction

The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) provides global infrared limb measurements covering a large spectral range (685-2410 cm^{-1}) at 0.035 cm^{-1} (unapodised) spectral resolution. The nominal-mode measurements span tangent altitudes from 6 to 68 km.

A retrieval processor is being developed at RAL to complement the ESA operational processor, with particular emphasis on retrievals of ozone and water vapour in the upper troposphere/lower stratosphere (UT/LS) region.

The selection of sections of spectrum (microwindows) for use in retrievals is also being optimised for accurate retrievals at UTLS altitudes.

Microwindows

Microwindows have been selected which maximise the sensitivity to O_3 and H_2O, while minimising the contribution from errors due to unknown model and instrument parameters. The Oxford University MWMAKE code[1] has been adapted to optimise the selection for the UT/LS region by applying additional weight to errors at low altitudes.

Figure 1 shows estimated error profiles for 10 microwindows selected for low altitude joint O_3 and H_2O retrievals. For comparison, errors for the microwindows used operationally for individual O_3 and H_2O retrievals (down to 12 km) are also shown.

Spectra and O_3, H_2O Jacobians at 9 km are shown in figure 2.

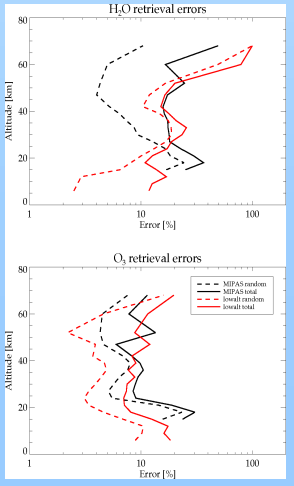

Figure 1: Random and total errors for O_3 and H_2O microwindows

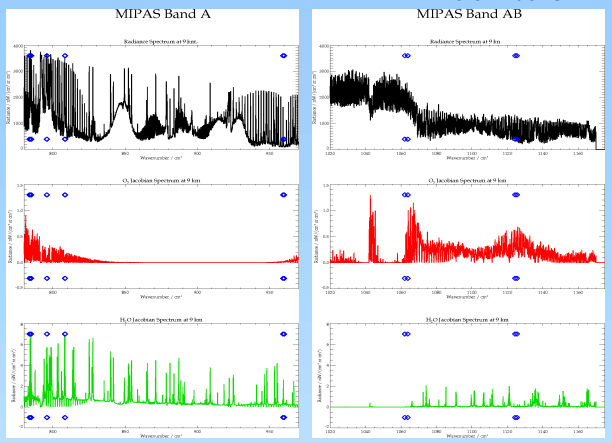

Figure 2: Spectra and Jacobian spectra for O_3 and H_2O at 9 km and positions of low altitude microwindows

The retrieval scheme

The RAL retrieval processor (RET2D) has been developed as a multi-purpose retrieval scheme for mm-wave and infrared instruments. The code can handle both 1-D (single profile) and 2-D retrievals. The forward model used is FM2D[2], originally developed at RAL for microwave applications but extended to cover infra-red wavelengths.

The retrieval scheme performs an iterative solution to the Optimal Estimation equation[3].

Retrieval Set-up and Results

State Vector: Profiles of O_3 and H_2O are retrieved simultaneously, together with the most significant interfering species. In addition, one continuum absorption profile and one radiometric offset are retrieved for each microwindow .

Pressure, Temperature and Constituents: Temperature, pressure and pointing information are obtained from MIPAS Level 2 data. At altitudes where no L2 p,T is provided (below 12 km, above 68 km) ECMWF, UKMO and MIPAS climatology[4] data are used.

First guess and *a priori* profiles, and profiles of contaminant species are extracted from climatology and ECMWF data (O_3, H_2O).

Clouds: Cloud-contaminated spectra are identified in the L1 data and excluded from retrievals.

Results: Example RET2D retrievals of O_3 and H_2O profiles are shown in figure 3. The retrieval was run in 1D-mode (one profile retrieved per scan, atmosphere assumed horizontally homogeneous). For comparison, the Level 2 product (available down to 12 km) and ECMWF data are also shown. The fourth panel shows the ratio of retrieved error / *a priori* error.

The L2 and RET2D results agree reasonably well down to 12 km, and it is clear that useful information is present from altitudes below 12 km. Some oscillatory behaviour can be seen in the results.

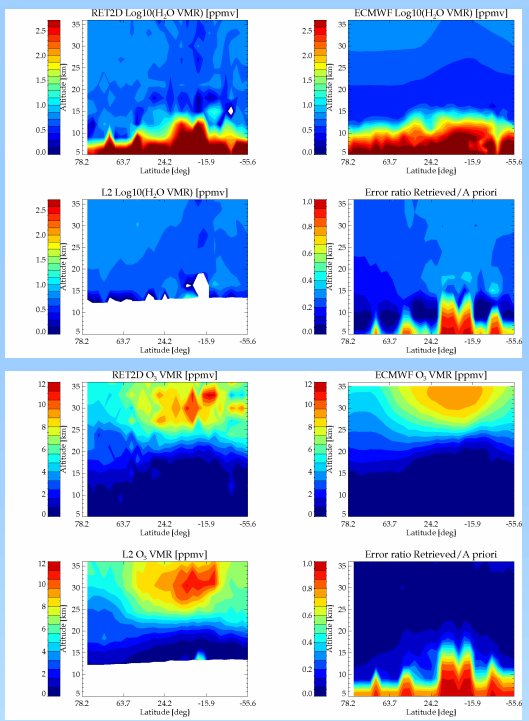

Figure 3: Orbit 2081, 24-JUL-02, RET2D, L2, ECMWF retrievals of O_3 and H_2O, and retrieved/*a priori* error

Conclusions and Future Work

Microwindows optimised for O_3 and H_2O in the UT/LS region have been selected and RAL's RET2D retrieval has successfully been applied to real data in 1D.

By addressing the most significant systematic errors it should be possible to improve retrievals at low altitudes further: additional instrumental parameters can be added to the state vector and horizontal inhomogeneities in the atmosphere can be handled by applying the retrieval scheme in 2D. This work is currently underway.

References

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