New Species retrieved from Envisat/MIPAS

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C2H2 (acetylene)

HDO (deuterated water)

SF6 (sulphur hexafluoride)

SO2 (sulphur dioxide)

INFRARED SPECTRUM

Above is a simulated MIPAS spectrum for a tangent height of 12km showing the spectral features associated with the atmosphere’s main infrared emitting species in the 5 µm window. The original list of ESA L2 products retrieved from MIPAS consisted of profiles of Temperature, H2O, O3, HNO3, CH4, N2O and NO2. This was later extended to include C3NO2, N2O5, CFC-11 and CFC-12 and, more recently, CO, HCN, HCFc-22, CF4, CC14 and C02.

For the ESA processor it is desirable to find species which are not achievable, limited primarily by ozone interference and spectroscopic uncertainties (SPECDB). C2H2 has only a relatively weak emission feature between 800-860 cm⁻¹. Even so, retrieval accuracy is limited by ozone interference rather than NESR. It is unlikely that this can be retrieved using the standard set-up.

OCS (carbonyl sulfide)

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OCS has spectral features between 840-870 cm⁻¹ and (not shown) 2040-2080 cm⁻¹. It should be possible to retrieve profiles to an accuracy of 100 pptv (25%) in the UTLS, limited by random noise.

In these error analyses it is assumed that the a priori (random) uncertainty is 100%, indicated by the ‘Profile’ curves. Where the NESR error curve converges to this 100% value, essentially no information is available from the measurements.

STANDARD RETRIEVAL

For the ESA processor it is desirable to find species which can be retrieved with essentially the same algorithm and code as the major species. This means

• An independent profile retrieved from every limb-scan (i.e. no averaging of spectra)
• Single target species retrieval (i.e. no joint retrievals with interfering species)
• Use of up to 5 microwindows of max 3cm⁻¹ width
• Spectrally flat atmospheric continuum term fitted within each microwindow.

With future updates to the ESA software, particularly relaxing the first two requirements, it should be possible to retrieve additional species.

The following panels show results of a microwindow selection based on modelling instrument noise (NERS) as well as a variety of instrument and forward modelling errors through the ‘standard retrieval’, aiming to obtain the best accuracy, or minimum ‘Total’ error curve, shown in the lower right plots in each panel.

C2H2 has a spectral signature which exceeds the MIPAS noise in the 820-840 cm⁻¹ region. A retrieval accuracy of around 0.1 ppbv (40% of the assumed profile) seems achievable, limited primarily by ozone interference and spectroscopic uncertainties (SPECDB).

HDO has strong spectral features in the MIPAS B-band, distinct from the main isotopologue. Accuracies of around 10% in the UTLS seem achievable, limited by instrument noise (thus improved by spatial averaging).

Based on these simulations it should be possible to obtain meaningful profiles of C2H2, OCS, SF6 and HDO using the standard ESA retrieval. It may also be possible to retrieve C2H2, SO2 and PAN (results not shown), but only in enhanced conditions.

CONCLUSIONS