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Detection of organic compound signatures in infra-red, limb emission spectra observed by the MIPAS-B2 balloon instrument

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Abstract. Organic compounds play a central role in troposphere chemistry and increasingly are a viable target for remote sensing observations. In this paper, infra-red spectral features of three organic compounds are investigated in thermal emission spectra recorded on a flight on 8 May 1998 near Aire sur l'Adour by a balloon-borne instrument, MIPAS-B2, operating at high spectral resolution. It is demonstrated, for the first time, that PAN and acetone can be detected in infra-red remote sensing spectra of the upper troposphere; detection results are presented at tangent altitudes of 10.4 km and 7.5 km (not acetone). In addition, the results provide the first observation of spectral features of formic acid in thermal emission, as opposed to solar occultation, and confirm that concentrations of this gas are measurable in the mid-latitude upper troposphere, given accurate spectroscopic data. For PAN, two bands are observed centred at 794 cm^{-1} and 1163 cm^{-1} . For acetone and formic acid, one band has been detected for each so far with band centres at 1218 cm^{-1} and 1105 cm^{-1} respectively. Mixing ratios inferred at 10.4 km tangent altitude are 180 pptv and 530 pptv for PAN and acetone respectively, and 200 pptv for formic acid with HITRAN 2000 spectroscopy. Accuracies are on the order of 15 to 40%. The detection technique applied here is verified by examining weak but known signatures of CFC-12 and HCFC-22 in the same spectral regions as those of the organic compounds, with results confirming the quality of both the instrument and the radiative transfer model. The results suggest the possibility of global sensing of the organic compounds studied here which would be a major step forward in verifying and interpreting global tropospheric model calculations.

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