Analysis of water vapour and methane from the MIPAS satellite intstrument

V. Payne, A. Dudhia, C. Piccolo

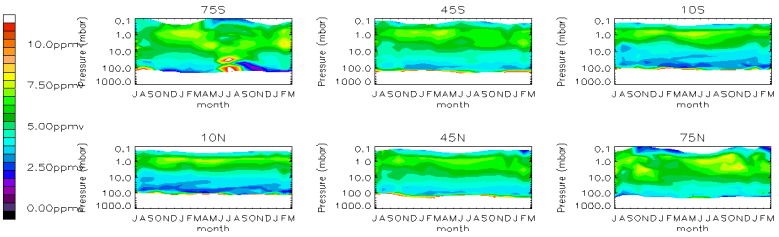
Atmospheric, Oceanic and Planetary Physics, Department of Physics, Oxford University, Oxford, UK

payne@atm.ox.ac.uk

Introduction

The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) is one of the core experiments on the European Space Agency's polar-orbiting Envisat satellite. MIPAS measures infrared atmospheric limb emission spectra from 685-2410cm^{-1} with a resolution of 0.025cm^{-1}, over an altitude range of 6-68km. After suitable ground processing, the spectra allow retrieval of concentration profiles of many atmospheric constituents. Water vapour and methane are two of the species retrieved operationally from the MIPAS data. Here we assess the quality of water vapour and methane profiles from the European Space Agency's near-real-time operational retrieval, based on data from July 2002 until March 2004.

Monthly mean profiles have been calculated for six latitude bands (90-65S, 65-20S, 20S-EQU, EQU-20N, 20N-65N, 65N-90N). These monthly means are plotted here as time series. The monthly means have also been compared with climatological profiles (*Remedios 1999*) in order to give an overview of the quality of the MIPAS data over the timescale of almost two years.

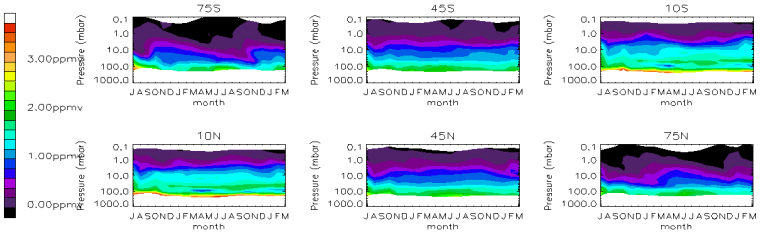


H_2O: Monthly mean profiles from July 2002 until March 2004.

The anomalously high values in the southern polar region in the winter months are thought to be due to polar stratospheric clouds affecting the retrieval. 'Tongues' of drier air can be seen propogating upwards with time in the equatorial plots, consistent with the 'tropical tape recorder' effect (*Mote et al., 1996*)

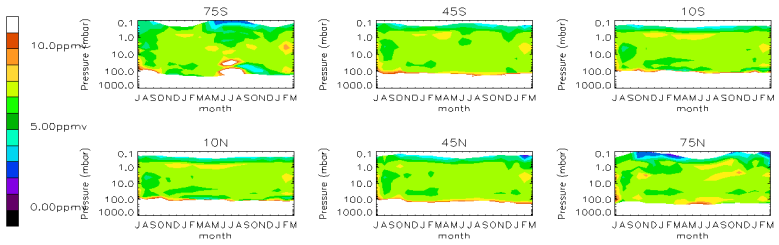
CH_4: Monthly mean profiles from July 2002 until March 2004.

Descent of air from higher altitudes can be seen in polar latitudes in winter. A local minimum can be seen at around 18km in the equatorial profiles from March 2003 onwards. The reason for this is not known, but may be related to a temperature feature that the 3km vertical resolution of MIPAS is unable to resolve.



Total Hydrogen

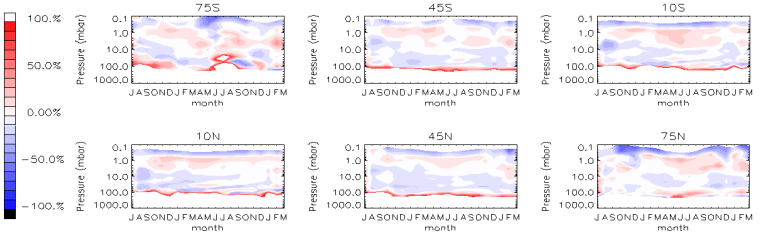
The oxidation of methane produces water vapour and molecular hydrogen such that the sum $H_2 + H_2O + 2CH_4$ is approximately constant with altitude. Assuming that the mixing ratio of molecular hydrogen is approximately constant in the lower stratosphere, we would also expect the quantity $H_2O + 2CH_4$ to be constant in this region, providing a useful internal validation test. Apart from in the polar latitudes, where this assumption is not expected to hold, this quantity is reasonably constant with height in the lower stratosphere for the MIPAS data.

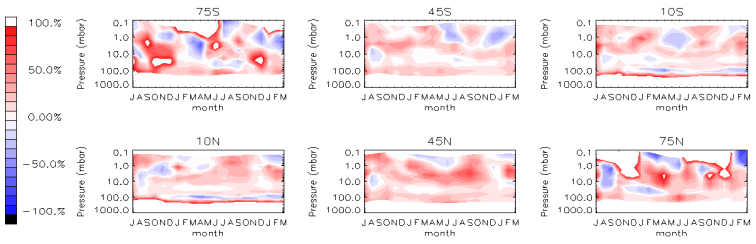


H_2O: Percentage difference from IG2 climatology (Remedios, 1999)

(MIPAS – IG2) / IG2

It can be seen from these plots that the MIPAS H_2O is a lot higher than would be expected at the lowest altitudes. This is thought to be attributable to problems with the implementation of the cloud detection scheme. MIPAS H2O is around 20% lower than climatology in the lower stratosphere. There are some problems with the MIPAS H_2O at the highest altitudes.





CH4: Percentage difference from IG2 climatology (Remedios, 1999)

(MIPAS – IG2) / IG2

The MIPAS methane seems to be around 20% higher throughout most of the stratosphere than would be expected from climatology. MIPAS values at the lowest altitudes in the tropics are much higher than would be expected. Differences from climatology are very large in polar regions, but only because the climatology cannot be expected to capture real seasonal variations.

References:

http://www.atm.ox.ac.uk/group/mipas

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