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MEASUREMENTS OF WATER VAPOR DURING THE VORTEX SPLIT IN SEPTEMBER/OCTOBER 2002 WITH MIPAS/ENVISAT

Objectives

In September and October 2002 a major stratospheric warming in the antarctic region led to an unusual split of the south polar vortex. MIPAS measurements in the polar vortex are available for the period from September 18 to 27 and October 11 to 13.

MIPAS/Envisat

Envisat was launched on March 1, 2002.
Michelson Interferometer for Passive Atmospheric Sounding (MIPAS):

- IR-Fourier-Transform Interferometer
- spectral range: 685 cm^{-1} to 2410 cm^{-1}
- spectral resolution (unapodized): 0.035 cm^{-1}
- altitude range (standard–mode): 6 to 68 km
- standard measurement grid: 3 km steps, 6 to 42 km, wider above
- data taken in the commissioning phase, preliminary.

H_2O retrieval

- 14 microwindows, height dependent, covered wavenumber range: 795 - 1654 cm^{-1}
- Retrieval grid: 1 km spacing up to 42 km, 2 km spacing from 44 to 70 km
- Regularisation: height dependent Tikhonov-Phillips 1. order; Regularisation strength $\sim \frac{1}{vmr^2}$

H_2O on different Θ-Levels

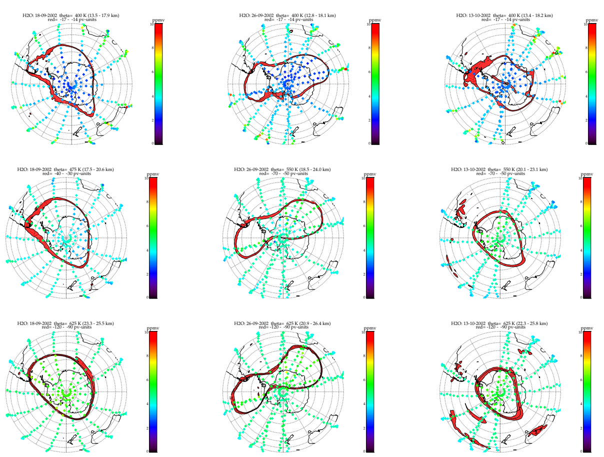


Fig. 1: Water vapor results on Θ-levels 400 K, 550 K, 625 K for three days (18 and 26 September and 13 October 2002). Additionally ECMWF-potential vorticities providing the vortex edge given by PV definition are shown with red contours. For low altitudes (Θ=400 K) small H_2O vmr values indicate dehydration inside the vortex. At high altitudes (Θ=550 K, 625 K) large values inside the vortex compared to values outside indicate subsidence inside the vortex.

Orbit 2882

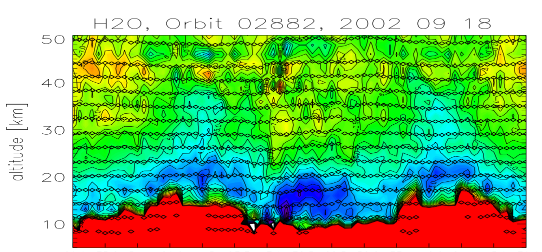
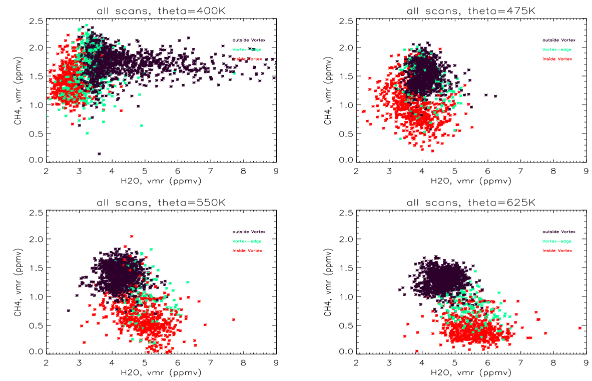


Fig. 2: H_2O distribution along MIPAS orbit 2882 on september 18, 2002. The contour plot shows H_2O volume mixing ratios along the flight track. The numbers on the abscissa show latitudes for selected scans. Black diamonds indicate the available tangent altitudes for each scan.

Correlation H_2O and CH_4



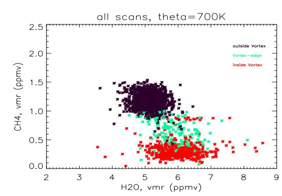


Fig. 3: Scatter plots H_2O vs. CH_4, for Θ-levels 400, 475, 550, 625, and 700 K. Crosses show values outside the vortex (black), inside the vortex (red), and on the edge (green). Separated clusters for values inside and outside the vortex hint on processes altering air masses inside the vortex during Antarctic winter.

Validation

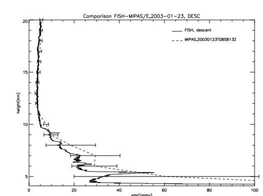


Fig. 4: Collocated measurements from FISH (C. Schiller, priv. comm., 2003) and MIPAS, January 23, 2003, arctic winter conditions. Error bars show the total error budget for MIPAS retrievals, including contributions from systematic and model errors.

Error assessment

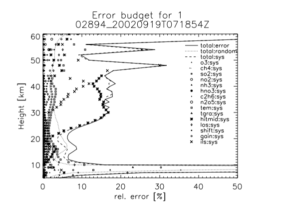


Fig. 5: Error budget for a selected scan, H_2O measurement outside the vortex. Displayed are random error, model error, total systematic error and major contributing systematic error sources.

Conclusions

- In the lower stratosphere H_2O measurements inside the vortex show significantly decreased vmrs indicating dehydration during polar winter.
- In the middle stratosphere inside the vortex observed H_2O values are larger than outside showing subsidence of air masses inside the vortex.
- The correlation of H_2O and CH_4 vmrs shows different properties for air masses inside and outside the vortex, as well as for lower and middle stratosphere, respectively.
- Error assessment yields total errors below 10 % for the lower stratosphere and total errors below 20 % for the middle stratosphere. Main error sources are the accuracy of the spectroscopic database and ILS knowledge in the stratosphere, and T and LOS uncertainties in the troposphere.
- MIPAS measurements in polar regions show good agreement with in situ measurements from FISH (C. Schiller, priv. comm., 2003).

Acknowledgements

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