

# Forschungszentrum Karlsruhe in der Helmholtz-Gemeinschaft

Forschungszentrum Karlsruhe, Institut für Meteorologie und Klimaforschung  
Postfach 3640, 76021 Karlsruhe, Germany  
N. Glathor, T. v. Clarmann, H. Fischer, B. Funke, U. Grabowski, M. Höpfner, S. Kellmann,  
M. Kiefer, A. Linden, M. Milz, T. Steck, G. P. Stiller, G. Mengistu Tsidu, and D.-Y. Wang

## OBSERVATION OF CLO BY MIPAS/ENVISAT DURING THE ANTARCTIC VORTEX SPLIT IN SEPTEMBER/OCTOBER 2002

### Introduction

During end of September 2002 the Antarctic polar vortex encountered an unusual major warming, which led to a vortex-split at September 25/26. We present first CIO measurements by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) on board of the European research satellite ENVISAT (ENVironmental SATellite) before and during this event.

### Data

Data were retrieved at IMK from MIPAS/ENVISAT level-1B spectra, which were recorded by limb sounding on 17 tangent altitudes between 6 and 68 km. The dataset consists of about 6500 MIPAS scans from 100 orbits of the periods September 8-28 and October 11-13.

### CIO Signatures

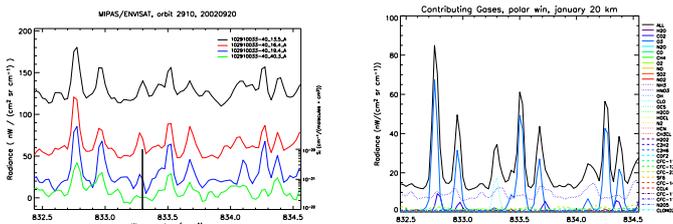


Fig.1: Coadded MIPAS spectra, consisting of 8 single spectra of the high-CIO region of orbit 2910 (September 20, 2002, cf. Figure 2) for tangent heights 13.5 km (black), 16.4 km (red), 19.4 km (blue) and 40.3 km (green) (left panel), and simulation with all potentially contributing species for 20 km tangent height (right panel). The CIO line at  $833.297 \text{ cm}^{-1}$  (indicated by vertical line) is clearly visible in the coadded lower stratospheric spectra, but not in the spectrum at 40.3 km.

### CIO Observations

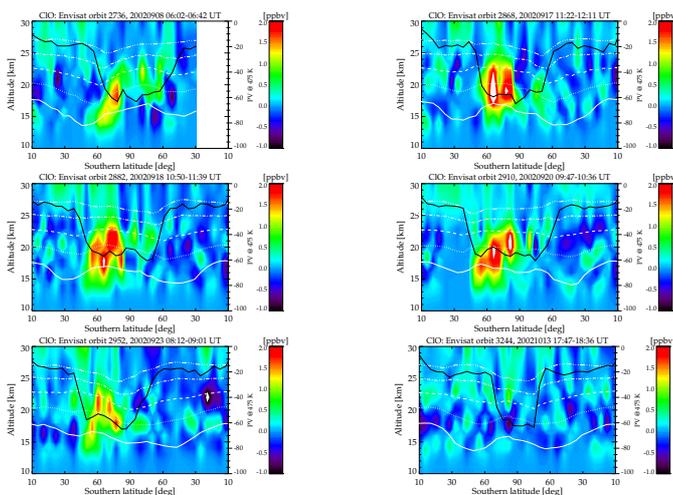


Fig.2: CIO vmrs measured by MIPAS/ENVISAT along selected orbits between September 8 and October 13, 2002, (top left to bottom right) versus relative latitude and altitude. Only the southern hemispheric part south of  $10^\circ \text{ S}$  of the

orbits is shown, the right side of the plots ( $90^\circ$  to  $10^\circ$ ) is the nightside part of the orbits. The terminator is around  $-90^\circ$ . The black curves show potential vorticity on the 475 K level of potential temperature, interpolated to time and location of the measurements. White lines indicate potential temperature levels of 400, 475, 550, 625 and 700 K (bottom to top).

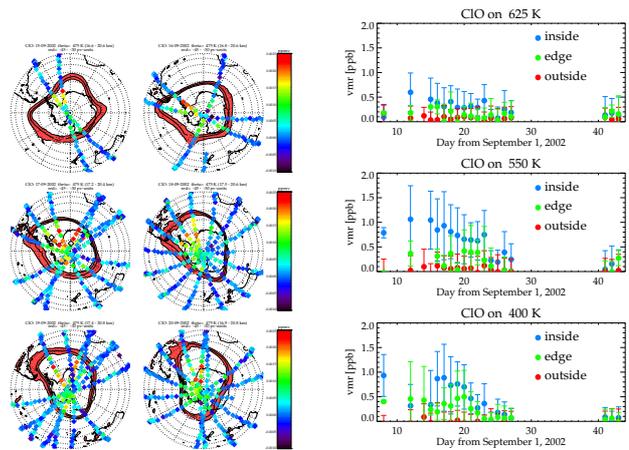


Fig.3: Left: CIO vmrs observed between September 15 and 20, 2002, on the 475 K level of potential temperature. The vortex boundary region is indicated as red oval. Right: Daily averages of CIO vmrs between September 8 and October 13, 2002, on the 625 K, 550 K and 400 K level of potential temperature (top to bottom), separated into measurements inside the antarctic vortex (blue points), in the vortex edge region (green points) and outside the vortex (red points). Only daytime measurements are taken into account. The error bars indicate the standard deviation of the measurements.

### Error Budget

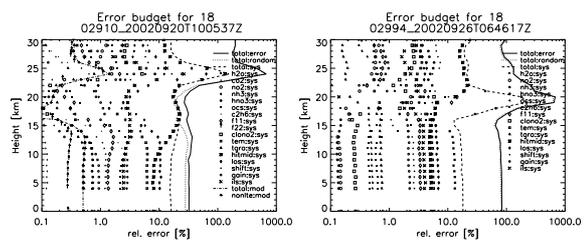


Fig.4: Total CIO retrieval errors and contributions of various error sources for a high-CIO scan of orbit 2910 (left) and a midlatitude scan of orbit 2994 (right).

### Conclusions

- MIPAS measured high CIO vmrs of up to 2.5 ppbv between September 8 and September 23, 2002, inside the dayside Antarctic vortex in the altitude region 15-25 km (400-625 K).
- Daily averages of inside-vortex daytime CIO were around 1 ppbv between 400 K and 550 K until September 20. Thereafter, the PSCs disappeared due to the major warming, and CIO rapidly decreased to values below 0.5 ppbv on September 25-27. No significant amounts of CIO were measured in October.
- The total CIO retrieval error for a high-CIO scan of orbit 2910 is around 30% in the lower stratosphere. For a midlatitude scan of orbit 2994 the total retrieval error is around 100%.