SCIAMACHY

Newsletter Nr. 7

Information from the German SCIAMACHY Validation Team

Airborne Lidar measurements during the TROCCINOX field campaign for the Validation of MIPAS and SCIAMACHY

Figure 1. *Photograph out of the Falcon cockpit: pilots view on convective clouds on 17 Feb. 2003 near Gaviao Peixoto, Brazil*

With the Differential-Absorption Lidar (DIAL) instrument of the DLR Institute for Atmospheric Physics water vapour, aerosols and cirrus clouds have been successfully measured during the Tropical Convection, Cirrus and Nitrogen Oxides Experiment TROCCINOX which took place in Brazil from 31 January – 15 March 2004. During two transfer flights and 14 local flights around Gaviao Peixoto near Araraquara (48°W, 22°S) which is about 300 km north-west of Sao Paulo, two-dimensional distributions of upper tropospheric water vapour water and particle backscatter inside and outside the ITCZ (Intertropical Convergence Zone) have been measured.

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A main focus of TROCCINOX (see http://www.pa.op.dlr.de/troccinox/index. html for further information) was put on convection and the corresponding modification of the humidity field at upper tropospheric levels and on the improvement of the knowledge about lightning-produced NO_x in tropical thunderstorms. Therefore, anvils of deep convective Cumulonimbus (Cb) clouds were investigated, particularly with respect to the outflow of cloud-processed air masses at the top, transported upward from the lower or middle troposphere. The DIAL measurements were co-ordinated with balloon soundings from HIBISCUS partner projects and ENVISAT overpasses for comparison with MIPAS and SCIAMACHY data products such as water vapour, aerosols and clouds.

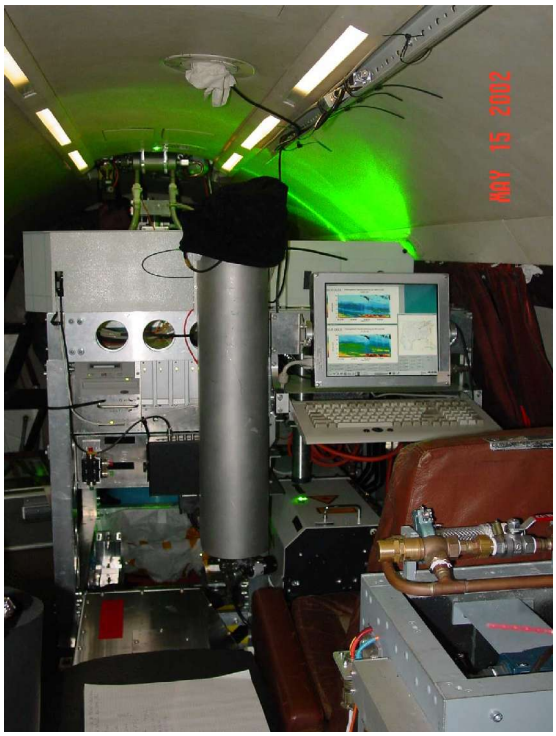

Figure 2. *Photograph of the H_2O-DIAL system aboard DLR' s Falcon 20E.*

For these measurements the DIAL system was operated in zenith-looking mode. Information on aerosol and cirrus clouds were obtained from backscatter and depolarisation measurements at the two wavelengths 1.06 µm and 0.53 µm. The water vapour distribution along the flight path was obtained from DIAL measurements in the near infrared around 0.935 nm. To cover the large dynamic range of tropospheric water vapour differently strong water vapour absorption lines could be selected. The wavelength change can be managed quickly during data recording in the Falcon and without significant data losses. Further details on the DIAL instrument can be found in *Poberaj et al., 2002*.

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Figure 3 shows a measurement example from flight number 4 on 17 February 2004. The backscatter cross sections clearly indicate convective outflow associated to the formation of cirrus clouds at tropopause level. The water vapour mixing ratio between 10 km and the tropopause at 16 km is surprisingly constant while a very humid layer with large vertical gradient at 10 km height occurs in the north.

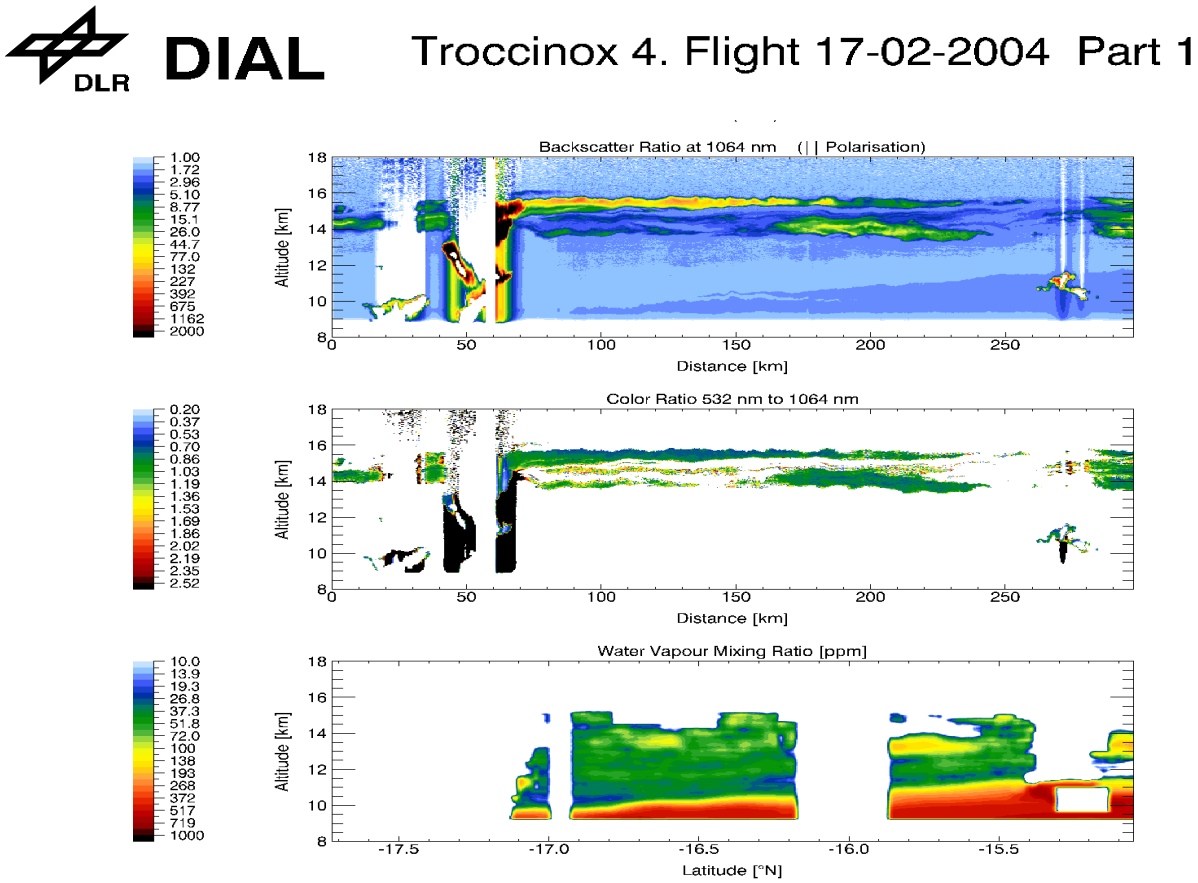

Figure 3 *. Cross sections of the backscatter ratio β at 1.06 µm (upper panel), colour ratio* $\beta_{0.53\,\mu m}/\beta_{1.06\mu m}$ *(centre panel) and water vapour (lower panel) from TROCCINOX flight mission number 4.*

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On 7 March 2004 cloud free conditions were favourable for a MIPAS and SCIAMACHY validation flight which was performed as shown in Figure 4. The flight route included a step-wise descent after the turn at the southernmost point in order to measure water vapour at different altitudes.

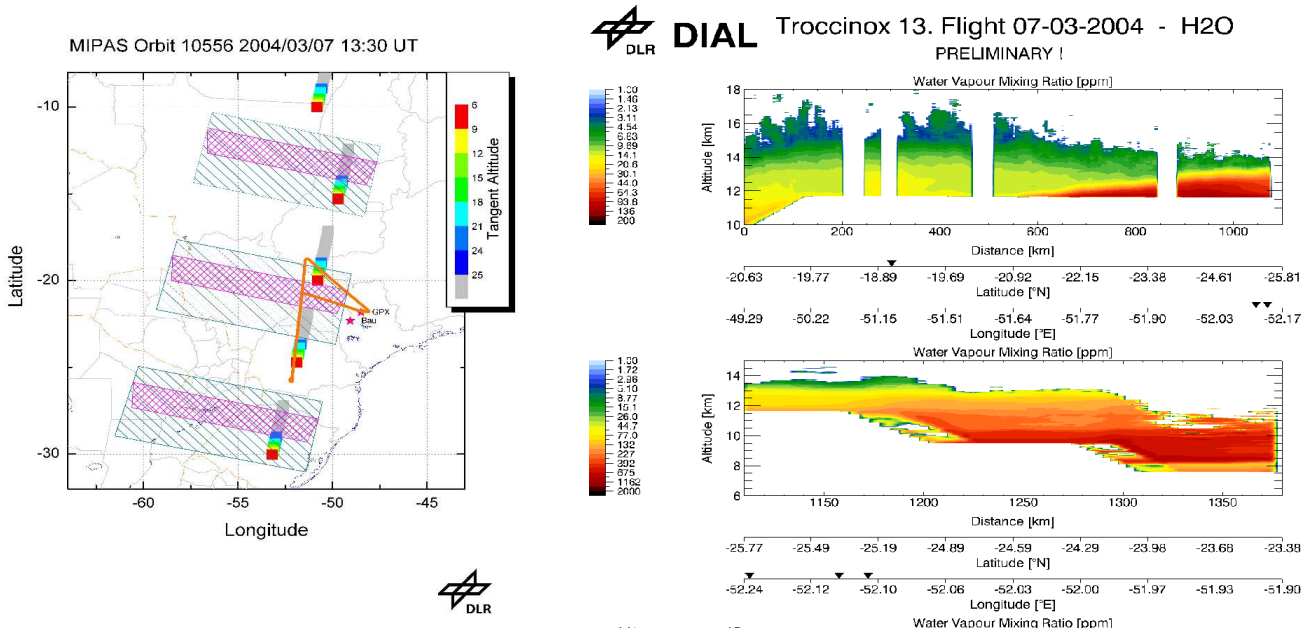

Figure 4: Flight pattern from 7 March 2004 (left panel) and preliminary water vapour distribution as measured by the DLR H_2O DIAL (right panels). The flight pattern was specifically designed for ENVISAT validation. The footprints of SCIAMACHY (nadir: blue, limb: magenta) and the MIPAS limb scans (tangent altitude colour coded) are depicted in the left panel.

The horizontal and vertical variability of water vapour is evident from this figure. A humid air mass reaching up to 13 km is entered near the southern part of the flight leg. The descent reveals a humid layer which is confined to altitudes between 8-12 km, depending on latitude. During this descent, the Falcon in-situ payload also recorded profiles of NO, NO_x, O_3, CO, CO_2, and aerosol properties.

References

Poberaj, G., Fix, A., Assion, A., Wirth, M., Kiemle, C., Ehret, G.: Airborne All-Solid-State DIAL for Water Vapour Measurements in the Tropopause Region: System Description and Assessment of Accuracy, *Applied Physics B 75*, 165-172, 2002.