Airborne Water Vapor Lidar Measurements in the Tropical Upper Troposphere during TROCCINOX and SCOUT-O3

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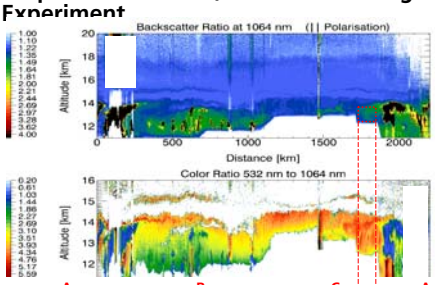
TROCCINOX, Brazil 2004+2005:

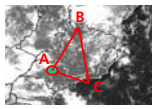
Tropical Convection, Cirrus and Nitrogen Oxides Experiment



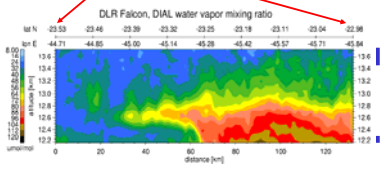
Central Brasil 3.3.04: thunderstorms in tropics

Large Lidar color ratio & low depolarisation: Small spherical particles

color ratio 1 & high depol.: anvil cirrus



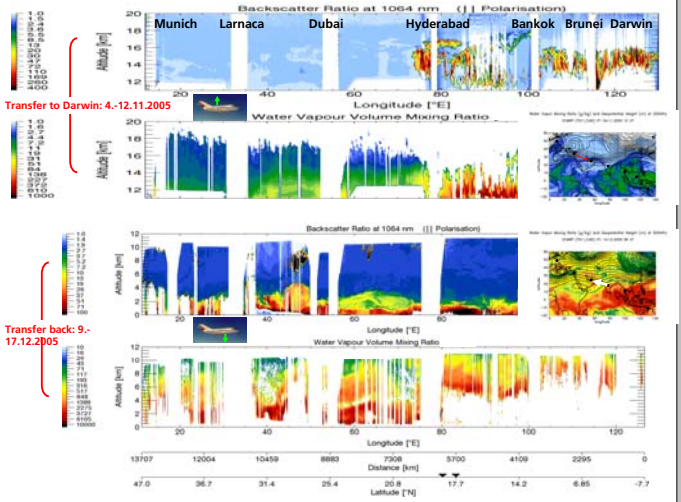
Flight route



Lidar observes H_2O outflow from anvil into TTL

DIAL resolution: 2 km horiz., 100 - 300 m vertical

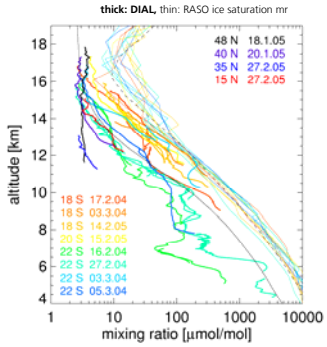
SCOUT-O3 (Stratospheric-Climate Links with Emphasis on the UT/LS), Darwin, Australia 2005: Transfer Flights



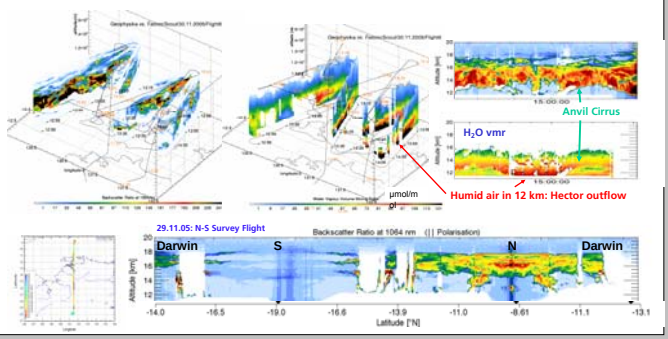
Lidar observes dynamics in the Asian Monsoon region: several STJ crossings.

TROCCINOX H_2O Profiles

- DIAL profiles in UT/LS from mid-latitudes to tropics have high resolution (see above) and accuracy (5-10%; see below).
- Good agreement with FISH and FLASH, well within the instruments' accuracies. No altitude dependent bias (see below).
- Fair agreement with MIPAS, but larger scatter due to more difficult intercomparison conditions (see below).
- Anvil outflow from tropical thunderstorms: ambient humidity is increased by factor three across 100 km (see above).
- H_2O in TTL: large scatter due to clear sky / convective outflow situations (see right).
- Hygropause at ~3 µmol/mol in 15-17 km.
- Cold point TP in 16-18 km from RASOs.



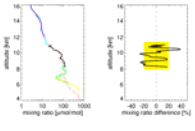
Hector Outflow and Persistent Cirrus in Northern Australia



Comparison of Water Vapour Profiles in the UT/LS

TDLAS - DIAL

onboard SF1, 16.2.04.



Reference:

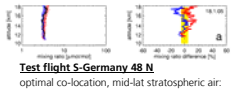
C. Kiemle, M. Wirth, A. Fix, G. Ehret, U. Schumann, T. Gardiner, C. Schiller, N. Sitnikov, and G. Stiller:

First airborne water vapor lidar measurements in the tropical upper troposphere and mid-latitudes lower stratosphere: accuracy evaluation and intercomparisons with other instruments.

Atmos. Chem. Phys. Discuss., 8, 10353–10396, 2008, TROCCINOX special issue.

FISH, FLASH - DIAL

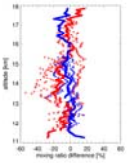
onboard Geophysika



Test flight S-Germany 48 N

optimal co-location, mid-lat stratospheric air:

FISH - DIAL: - 4.0 %, FLASH - DIAL: + 5.6 %



Overall FISH / FLASH results: 5 cases with small hor. H_2O variability, 19 S - 48 N

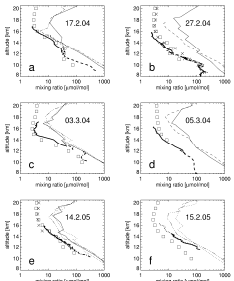
FISH-DIAL: - 3% ± 8%

FLASH-DIAL: - 8% ± 14%

Average distance betw. profiles: **130 km.**

MIPAS / ENVISAT

(boxes; DIAL thick, RASO SMR thin lines)



Results: 6 days with cloud-free MIPAS conditions

MIPAS-DIAL: -8% ± 49% (**-3%** above 12 km)

360 km average distance between probed air masses, estimated with trajectory analyses.

Airborne Differential Absorption Lidar (DIAL)

From 2009 on: HALO (High Altitude and Long Range Research Aircraft)

DIAL Advantages:

- 2-D cross sections of aerosols + H_2O,
- calibration free (lines meas. in lab),
- spatial resolution adjustable to SNR,
- large choice of T-insensitive H_2O absorption lines with appropriate σ in NIR.

Key Features:

stabilised OPO,
920 - 950 nm,
100 Hz, 1.2 W,
532 & 1064 nm,
depolarisation.

Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Institut für Physik der Atmosphäre
http://www.dlr.de/ipa

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