# Airborne Lidar Measurements of Ozone and Aerosol for the Validation of Level-2 SCIAMACHY Data Products

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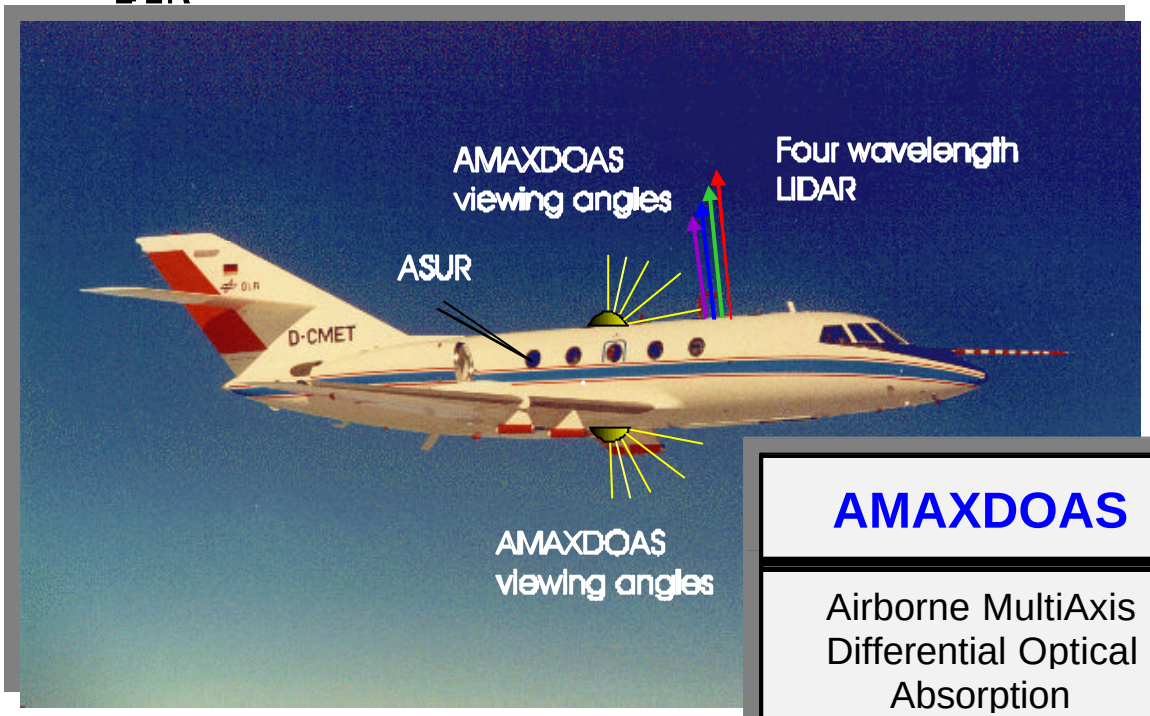
**Abteilung Lidar**

# Outline

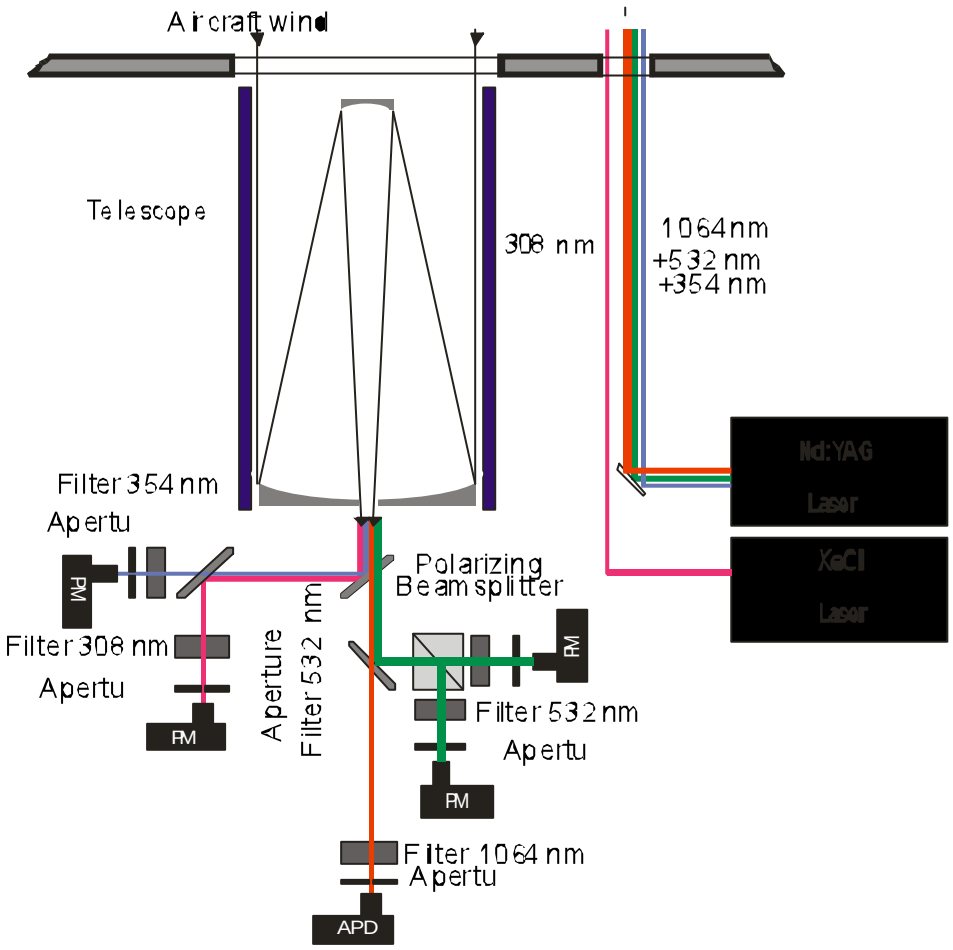
- Introduction
- The OLEX Instrument
- Data Availability
- Measurement Examples from the Arctic, Mid-Latitudes and Tropics
- Data Quality
- Conclusion

# OLEX as part of the Falcon payload




| AMAXDOAS | ASUR | OLEX |
|---|---|---|
| Airborne MultiAxis Differential Optical Absorption Spectrometer | Airborne SUbmillimeter wave Radiometer (604-662 GHz) | Ozone Lidar Experiment |
| U of Bremen<br>U of Heidelberg | U of Bremen | DLR |
| stratospheric and tropospheric **columns** of $O_3$, $NO_2$, BrO, and OClO | **profiles** of $O_3$, $N_2O$,H2O, ClO, BrO, ($HNO_3$, ...) | **profiles** of $O_3$, stratospheric aerosol extinction, aerosol/molecular backscatter ratios, particle depolarisation |

# The OLEX Instrument




# OLEX: Horizontal and Vertical Resolution

| Species | Parameter | Resolution (typical) | |
|---|---|---|---|
| | | Horizontal | Vertical |
| Ozone | Number density | | |
| (Range: 12-19km) | | < 50 km | 0.38 km |
| (Range: 19-24km) | | < 50 km | 0.75 km |
| (Range: 24-30km) | | < 50 km | 1.50 km |
| Aerosols/PSCs | Backscatter ratio | 30 km | 150 m |
| | Optical depth (OD) | | |
| Clouds (i.e. high cirrus) | Geometric distribution | 100 m | 50 m |
| Polar Stratospheric Clouds | Geometric distribution | 100 m | 50 m |
| | Type classification | | |

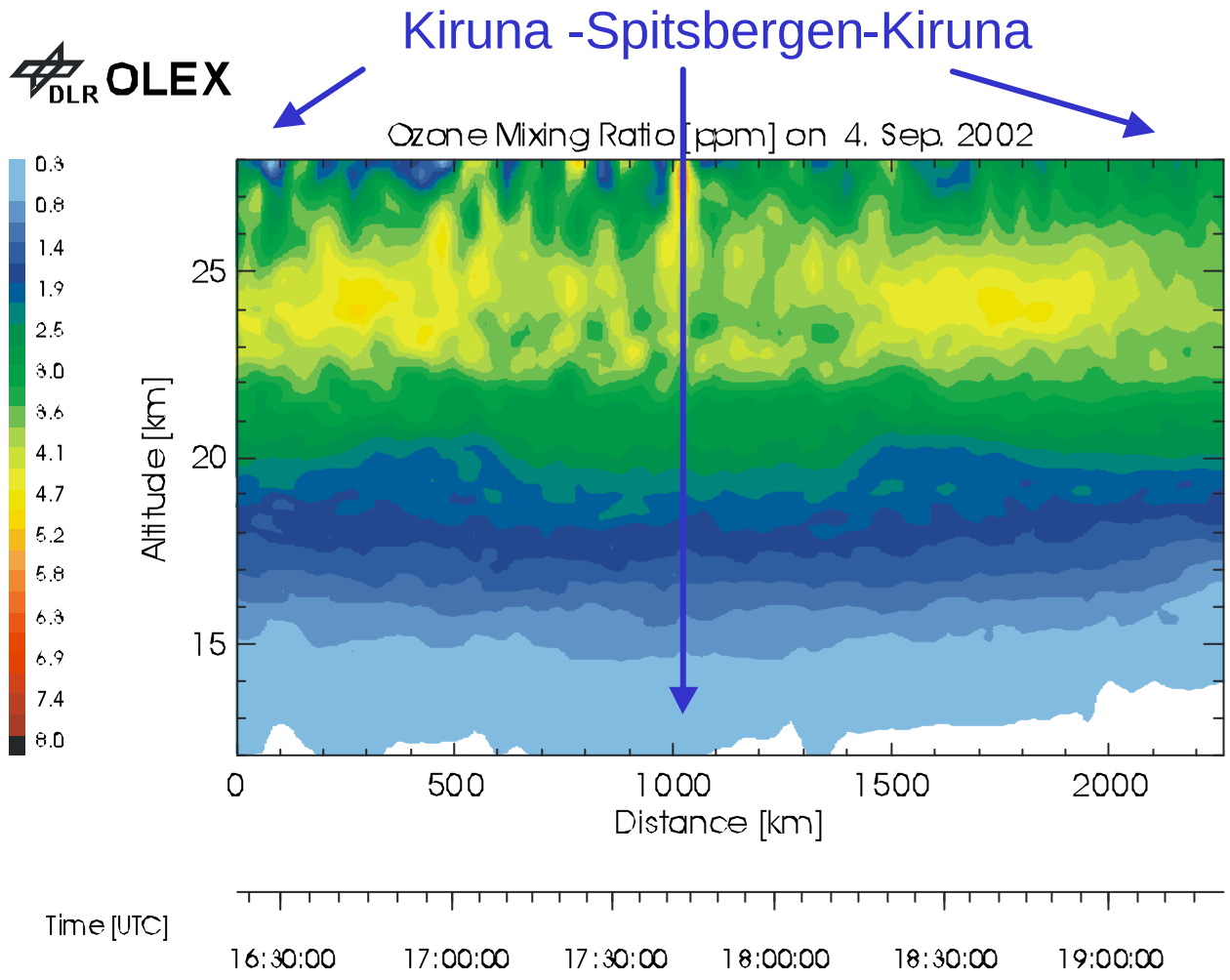
# Data Availability

- No instrument failure (during 113 hours of operation)
- OLEX practically measured all the time
- Minor gaps over the Sahara due to overheating
- Minor gaps over the Equator due to direct sunlight
- Range ~28km in the North and ~26km in the South

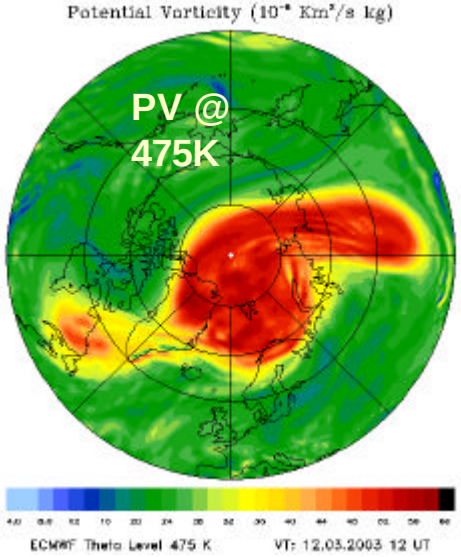
# Selected Examples

| | Date | Orbits | $O_3$ | Clouds |
|---|---|---|---|---|
| Arctic | 04.09.2002 | 2685-86 | x | |
| | 12.03.2003 | 5386-87 | x | |
| | 14.03.2003 | 5417-18 | x | |
| Mid-Latitudes | 28.09.2002 | 3025 | x | |
| Tropics | 18.09.2002 | 2880 | | x |
| | 19.09.2002 | 2894 | x | x |
| | 01.03.2003 | 5229 | | x |

# Arctic: 04.09.02, Orbits 2685-86

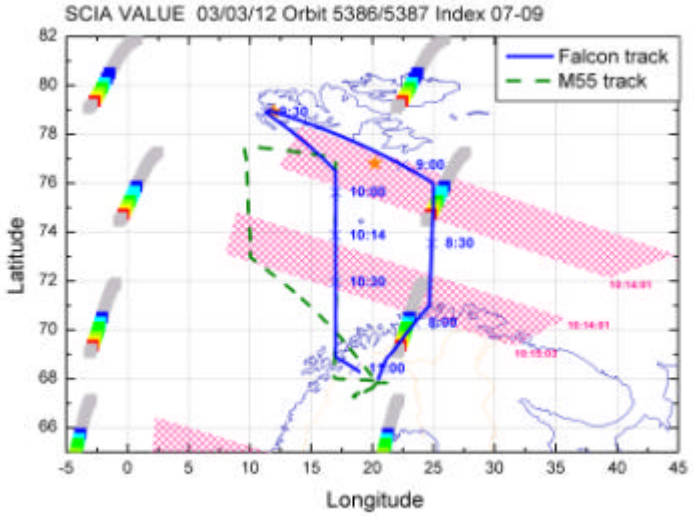


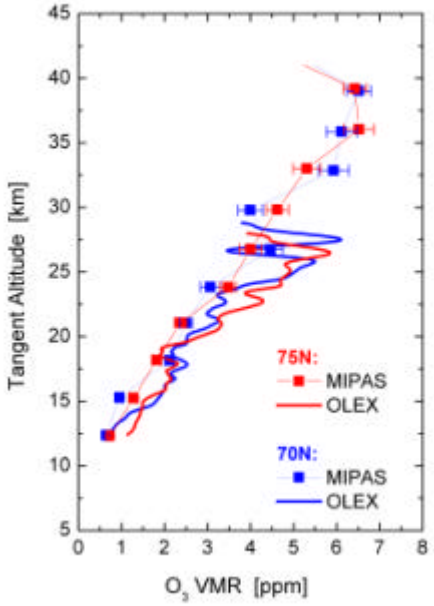
# Arctic: 12.03.03, Orbits 5386-87




**Co-ordinated Flight with Geophysika**

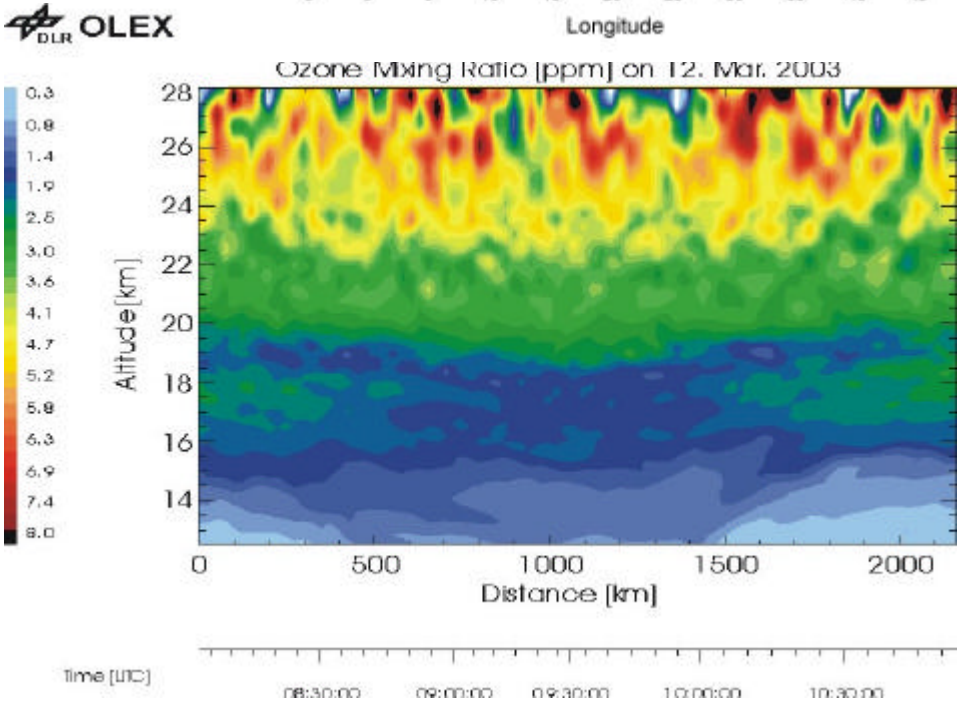
**Inside polar vortex**



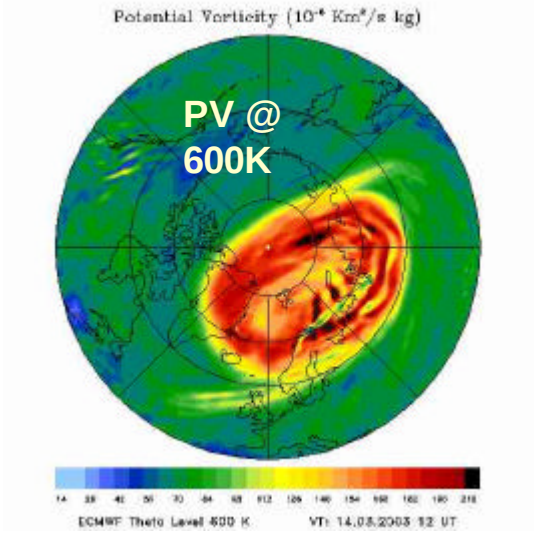



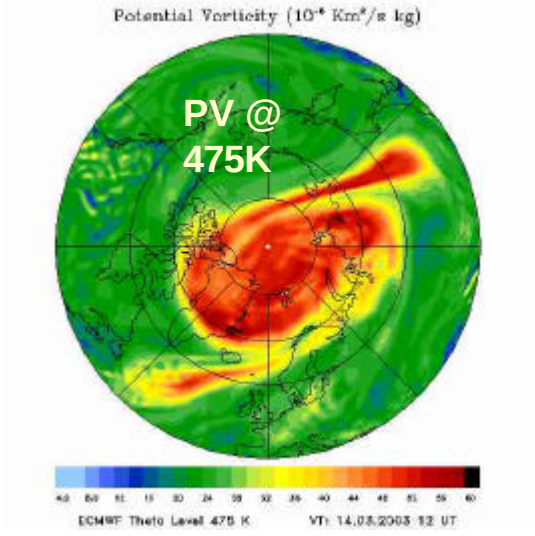

**Comparison to MIPAS/ENVISAT**

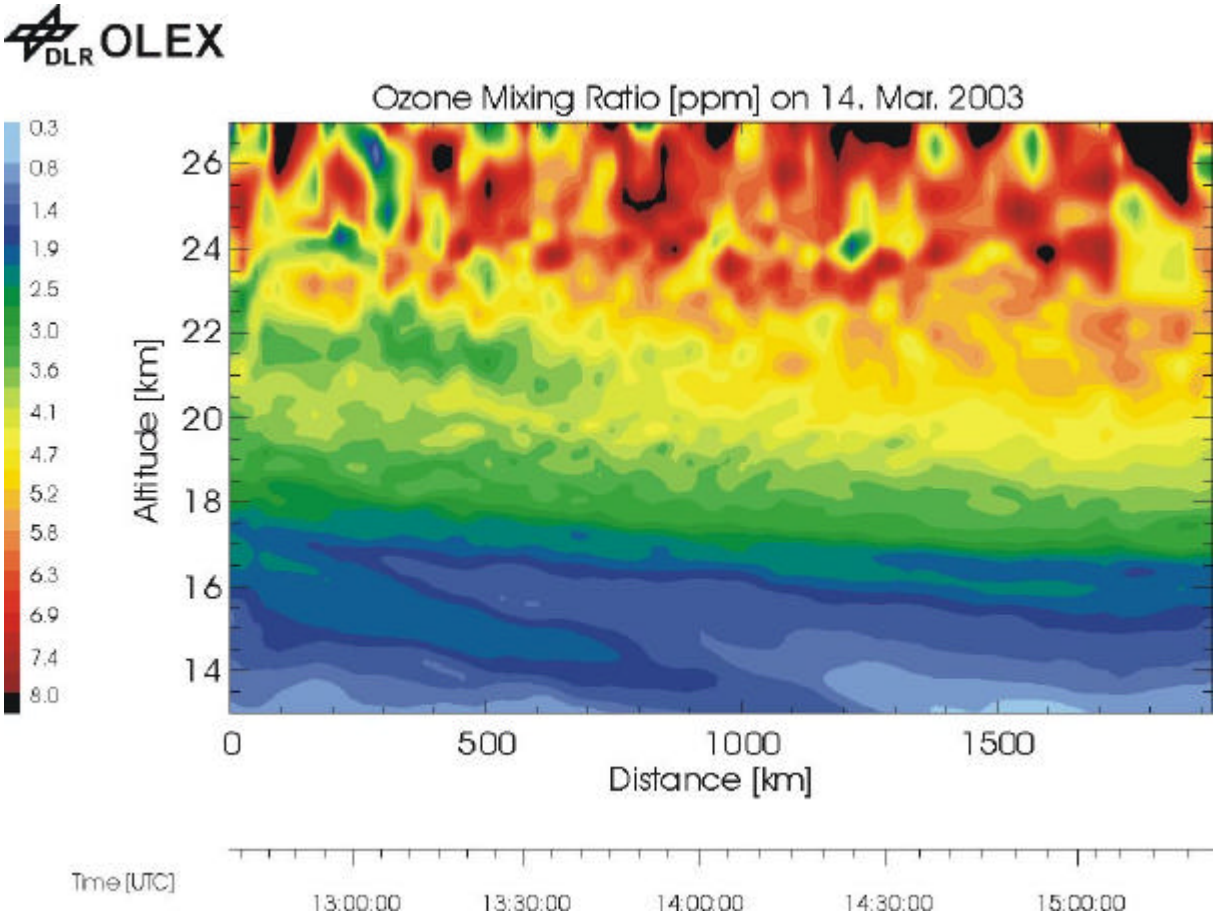
**Deviation [(MIPAS-OLEX)/OLEX]:**
**70N: -(19±14)%**
**75N: -(17±11)%**



# Arctic: 14.03.03, Orbits 5417-18

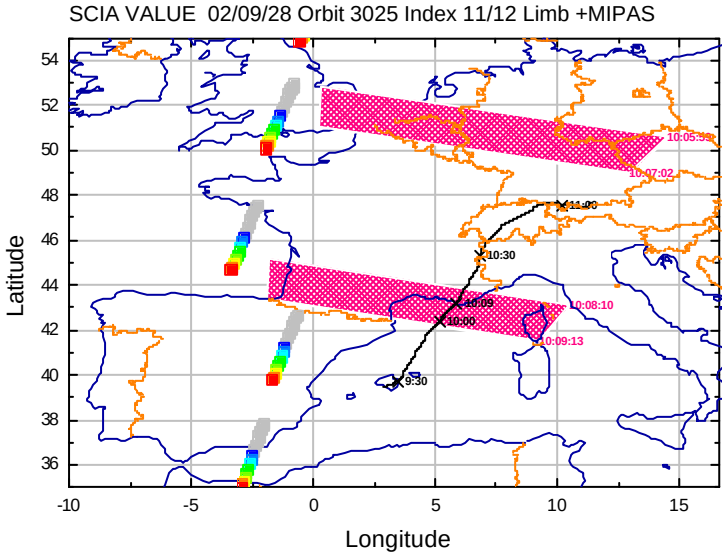


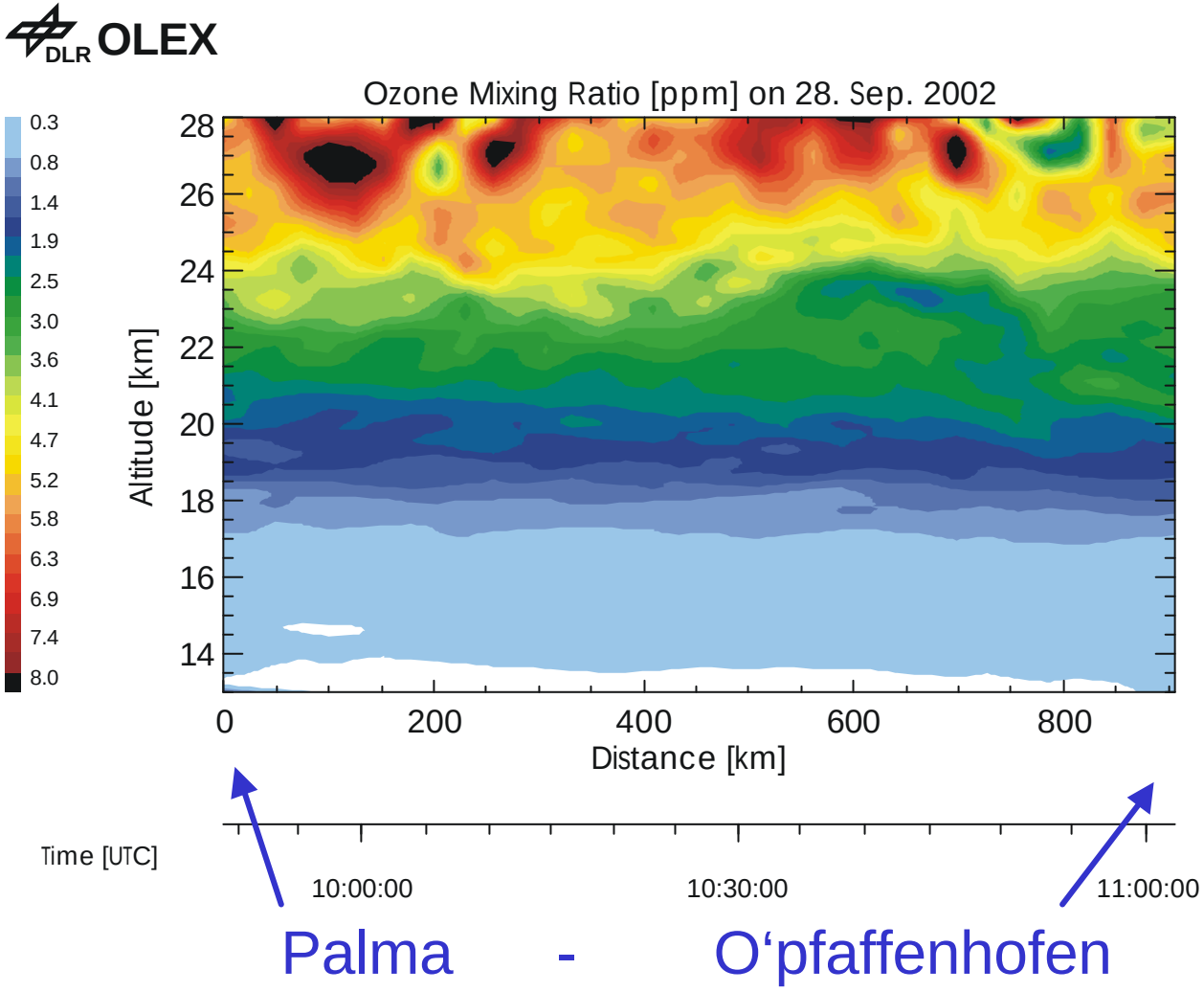




Iceland - Greenland

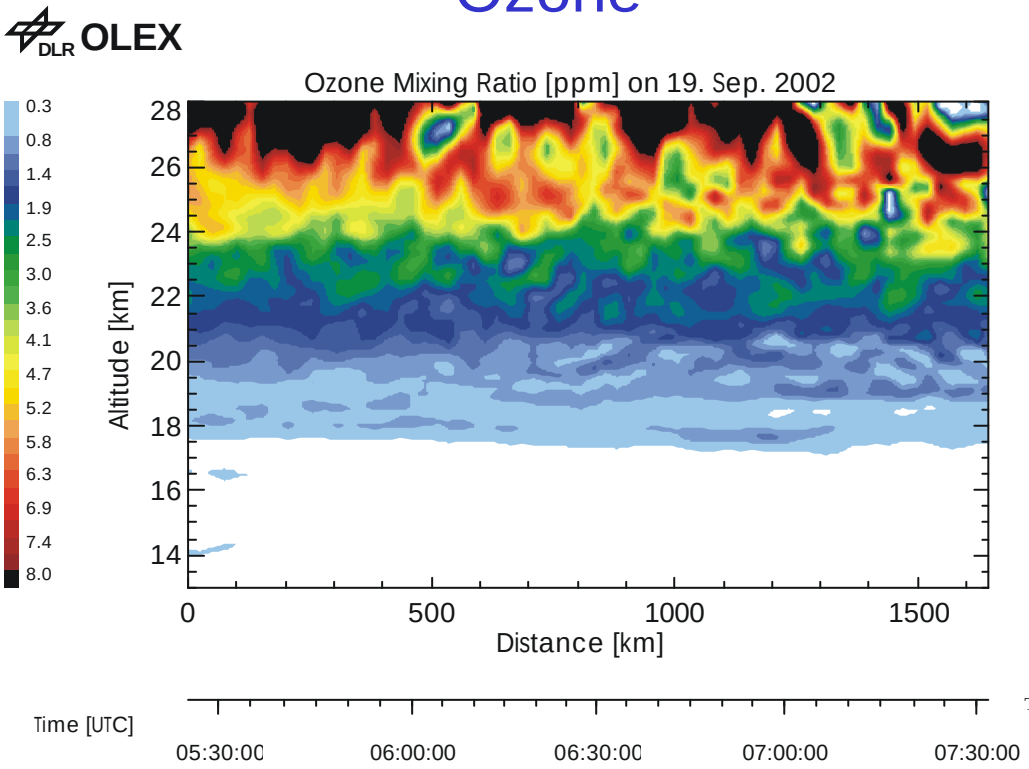
# Mid-Latitudes: 28.09.2002, Orbit 3025



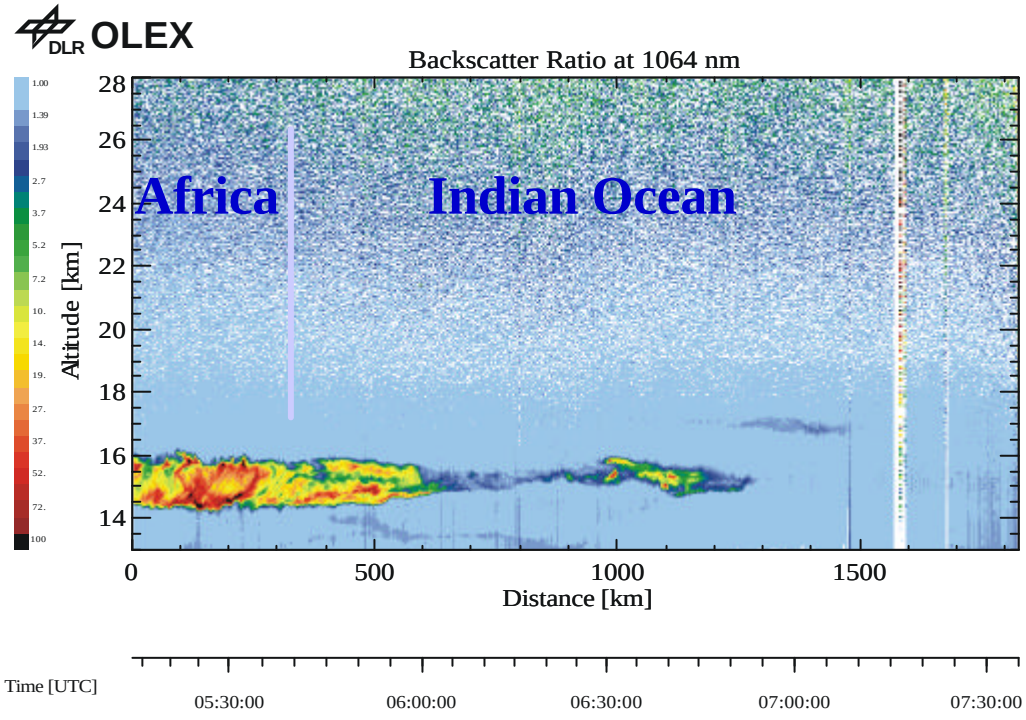



# Tropics: 19.09.02, Orbit 2894

## Ozone



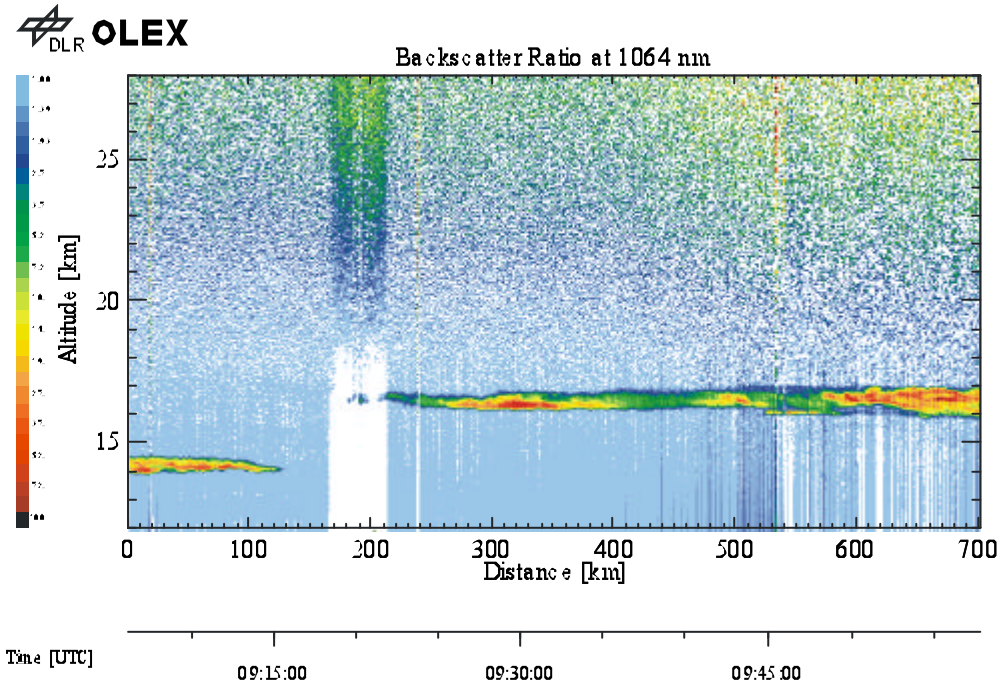

## Backscatter Ratio




Nairobi - Mahé

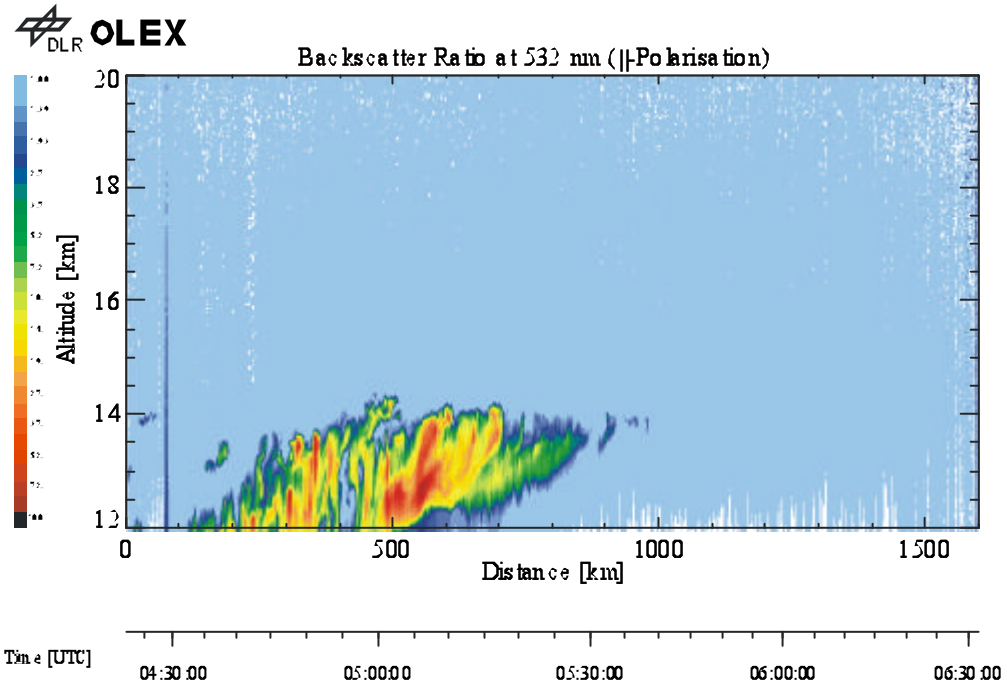
# Tropics: Cirrus clouds

## 18.09.02: Yaounde-Nairobi
## Orbit 2880



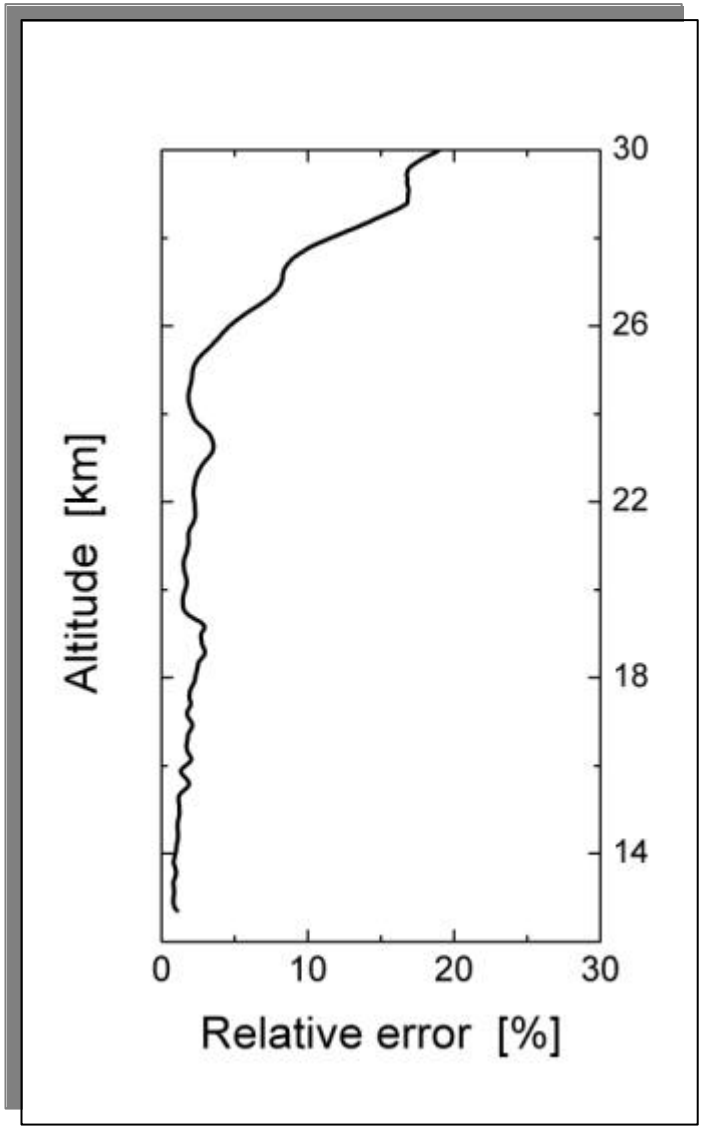

? = 1064 nm

## 01.03.03: Douala-Niamey
## Orbit 5229




? = 532 nm

# Data Quality: Statistical Error Analysis




## Cross Covariance Analysis:

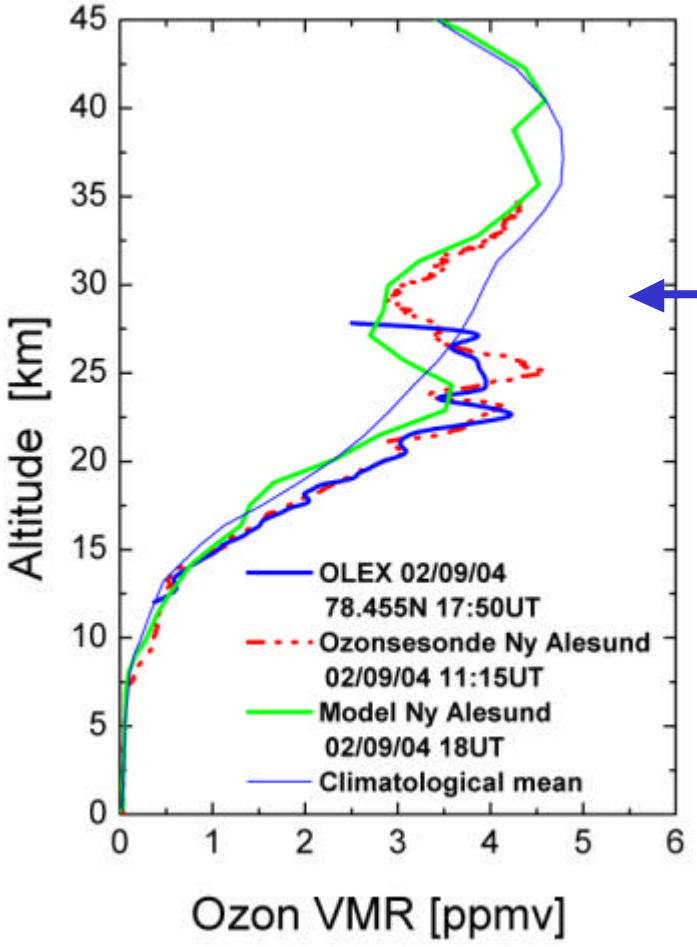
Arctic error profile

<10% (up to 25 km)
<20% (up to 28 km)

Tropics:

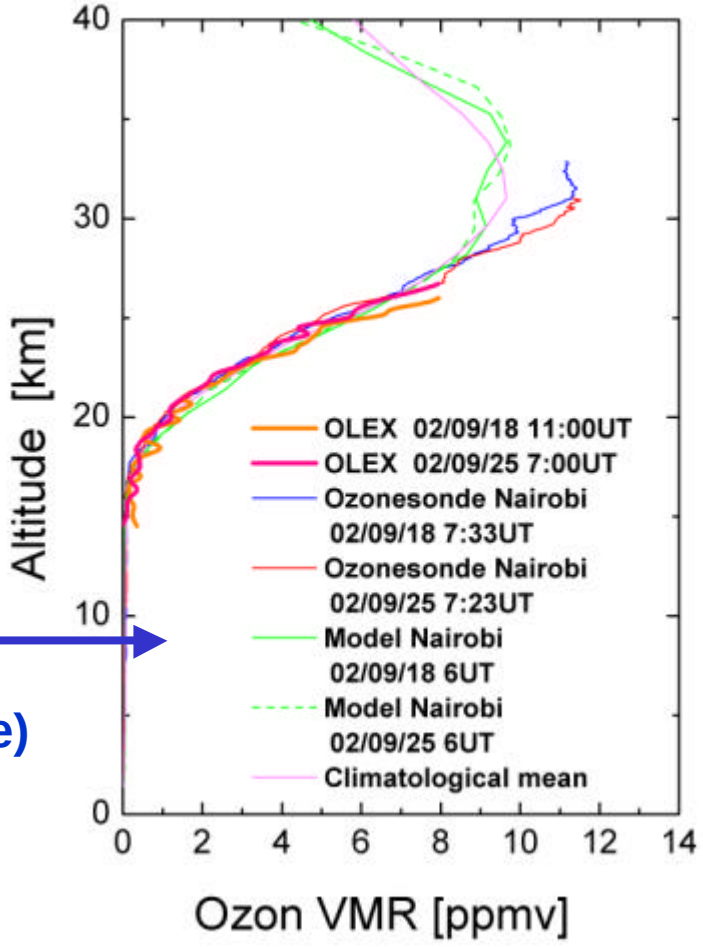
< 10% (up to 22 km)
increasing to ~25% at 26km.

# Data Quality:
# Comparison to Ozonesondes




**Ny Ålesund**
**(courtesy: AWI)**

**Nairobi**
**(courtesy:**
**KMI/MeteoSuisse)**



# Conclusion

- Both campaigns: 113 flight hours, 49 SCIA pixels, 1 occultation
- Excellent measurements under various conditions
- High latitudes to equator
- TBD:
  - Comparison to SCIAMACHY profiles
  - Detailed meteorological analysis
  - Exploration of synergy
  - Publications
  - Long-term validation activities