

MINI-DOAS UPDATE

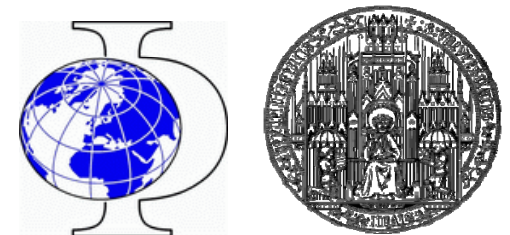
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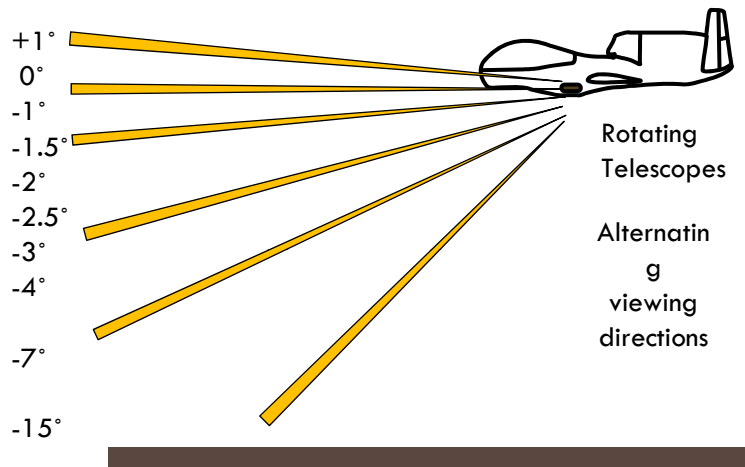
University of California Los Angeles



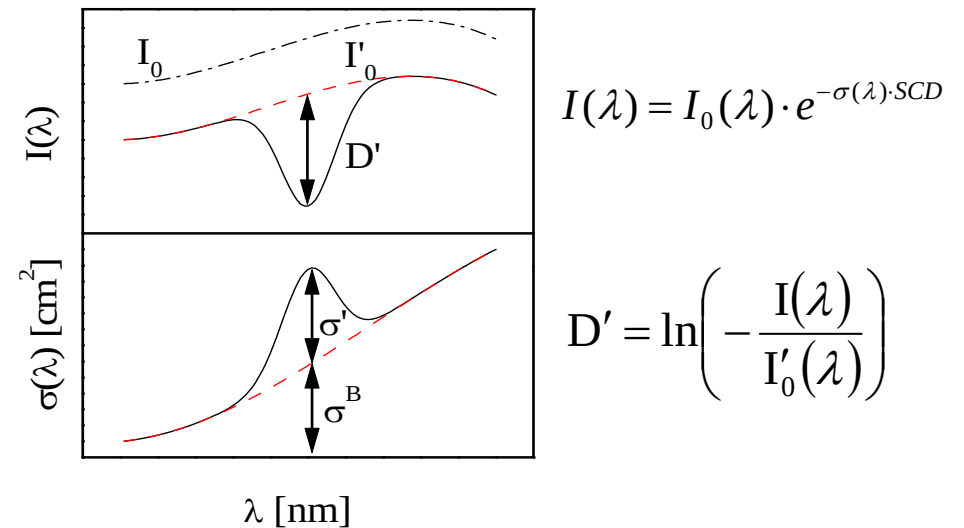
University of Heidelberg

Approach

Limb Scanner (2° off flight direction)



Differential Optical Absorption Spectroscopy



Observation of path-integrated trace gas absorptions using DOAS:

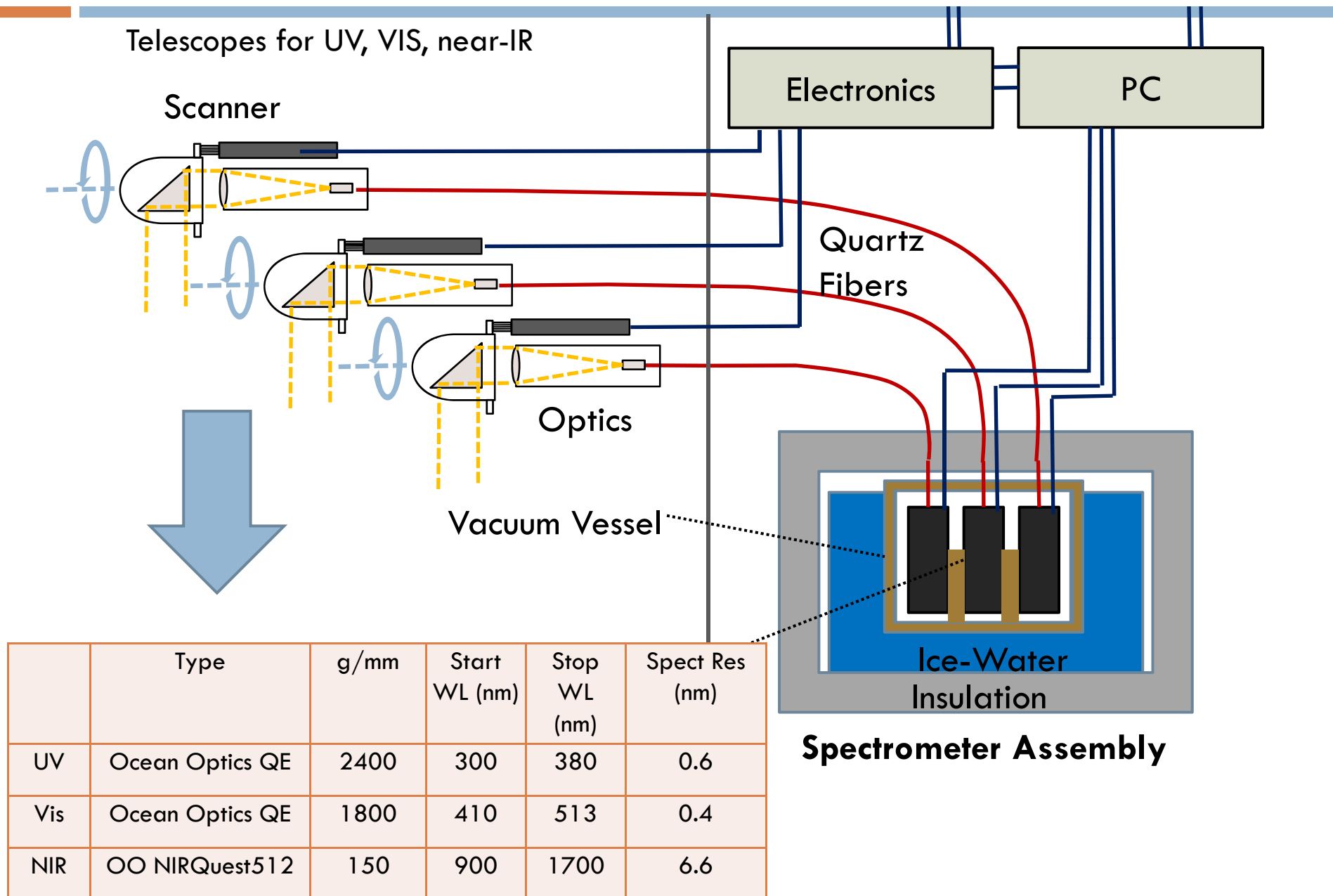
Slant Column Densities:

$$SCD = \int_0^s c(s) ds$$

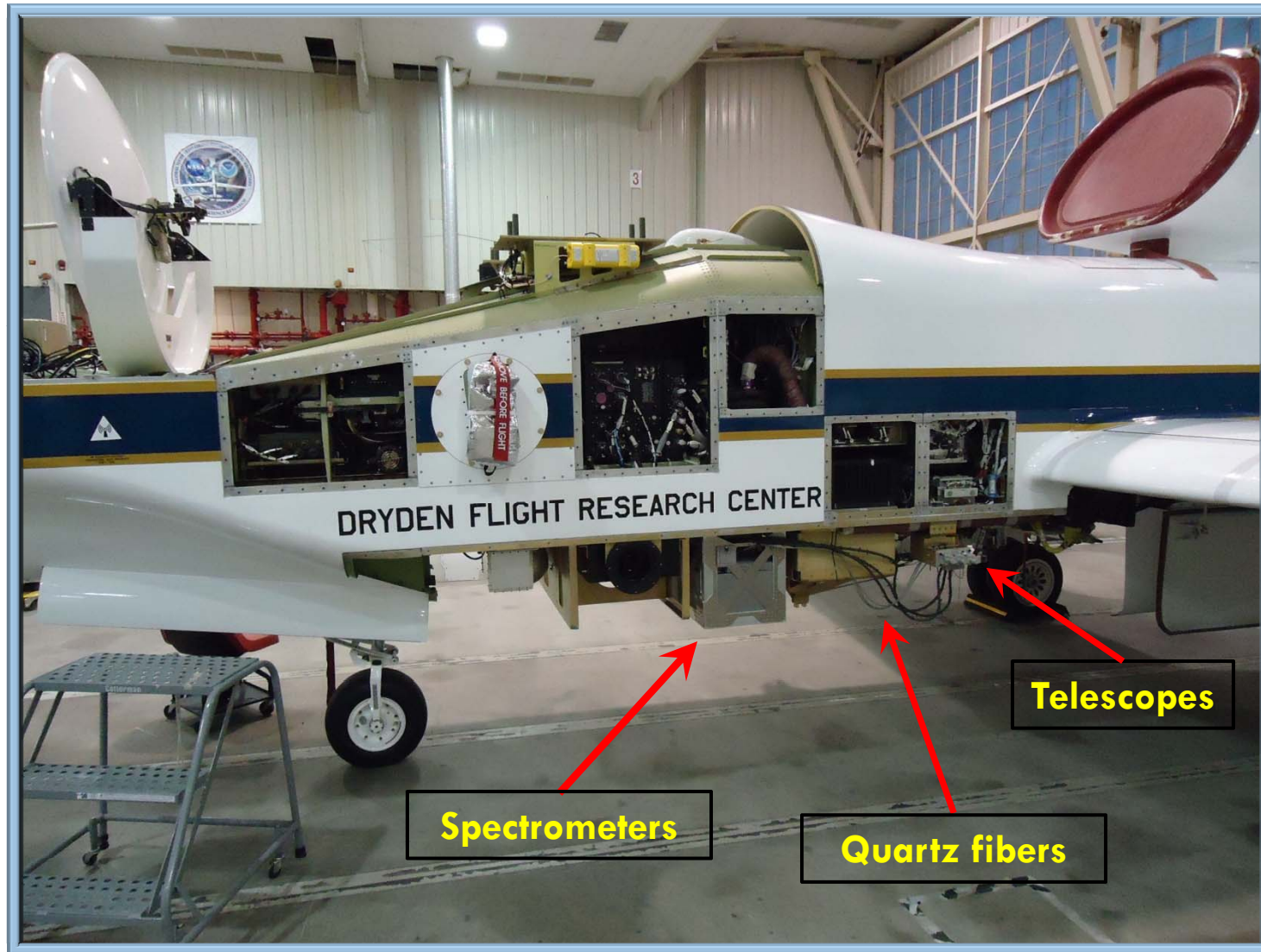
$$SCD_i = \frac{\ln(D')}{\sigma'_i(\lambda)}$$

Removal of solar Fraunhofer lines: $DSCD = SCD_{Elev.Angle} - SCD_{solar}$

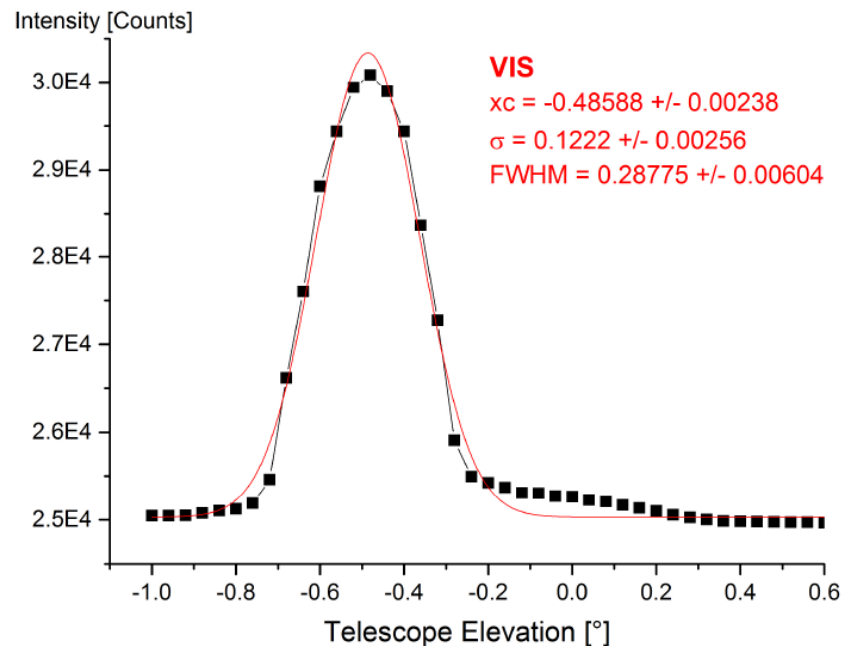
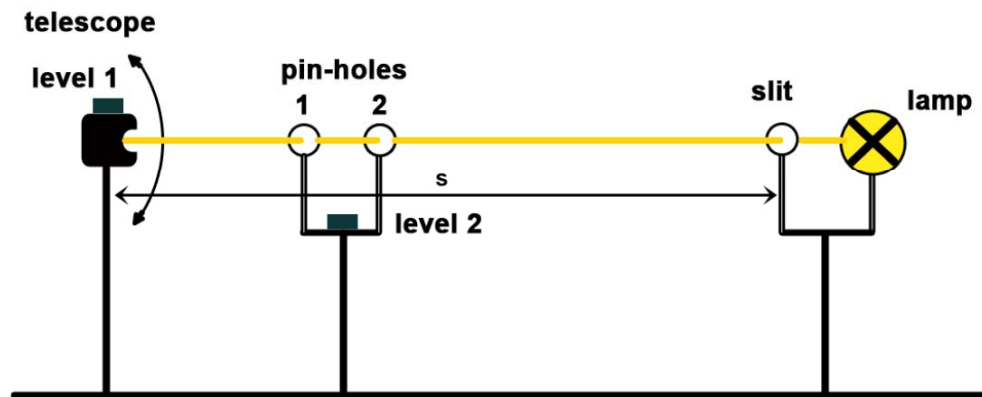
Mini-DOAS Setup



... we are here:

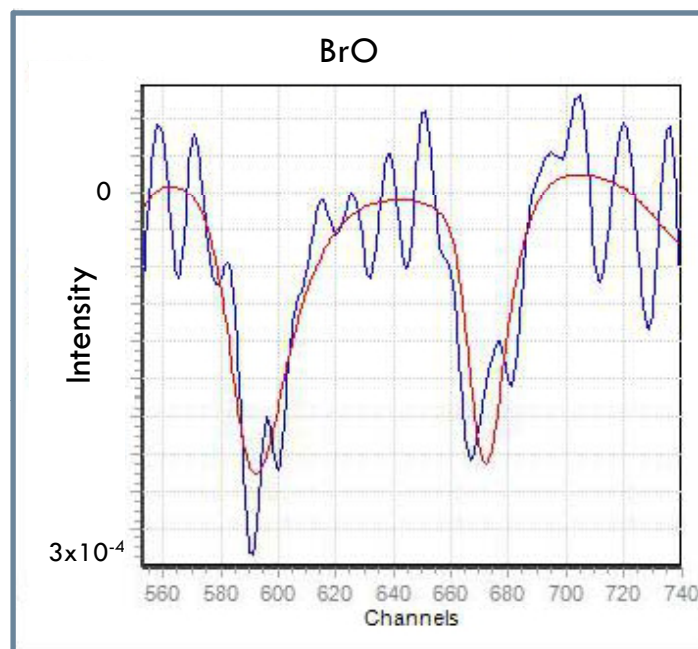


2013 Telescope Characterization

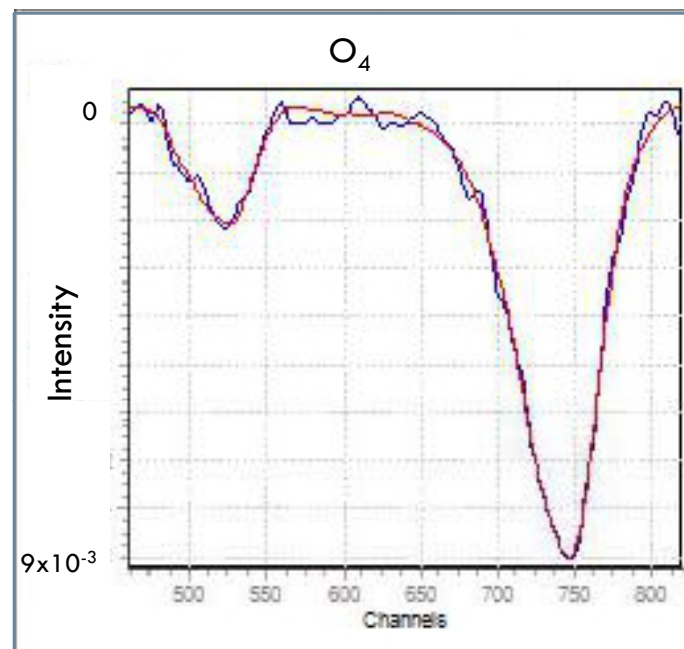


- Three high accuracy elevation scanner.
- Aligned relative to aircraft pitch to within $\pm 0.1^\circ$
- Active, in-flight, pitch correction at 1 Hz with an accuracy of $\pm 0.1^\circ$ (checked using in-flight data)
- Opening angle in limb
 - UV = $0.265^\circ \pm 0.005^\circ$
 - VIS = $0.288^\circ \pm 0.006^\circ$
 - IR = $0.254^\circ \pm 0.004^\circ$

UV Analysis



BrO fit range: 345 – 360nm



O₄ fit range: 338-347nm 352-360nm

References: Solar, O₄, NO₂,
O₃, BrO, Ring

BrO DL: 4×10^{13} molec./cm²
O₄ DL: 2×10^{43} molec.²/cm⁵

- BrO: Fleischmann et al. 2000
- O₄: Hermans et al. (2003) (dSCD corrected for temp effect)
- O₃: 203 K and 223 K (Bogumil et al., 2002)
- NO₂ 223 K (Bogumil et al., 2002)

Vis NO₂ Analysis

- O₄: 459.89 - 488.82 nm
- NO₂: 425.29 - 446.82 nm
- O₃: 437.22 - 485.54 nm
- H₂O: 438.29 - 476.85 nm

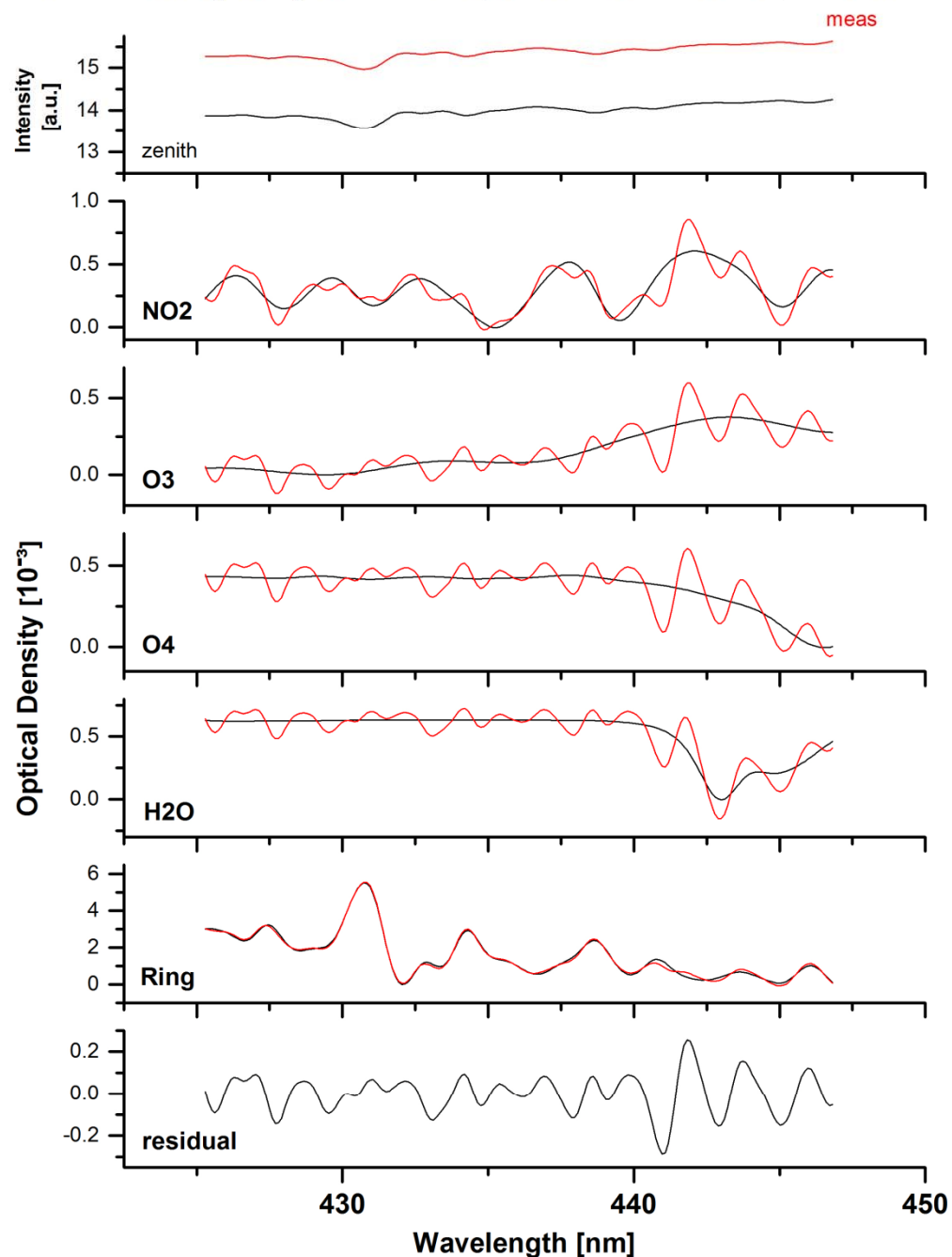
- Low temperature, vacuum trace gas references:

- O₄: Hermans et al. (2003) (dSCD corrected for temp effect)
- O₃: 203 K and 223 K (Bogumil et al., 2002)
- NO₂ 223 K (Bogumil et al., 2002)
- H₂O HITRAN 203 K and 100 mbar (Rothman et al., 2003)
- Ring calculated by DOASIS (Busemer et al.)

- DL:

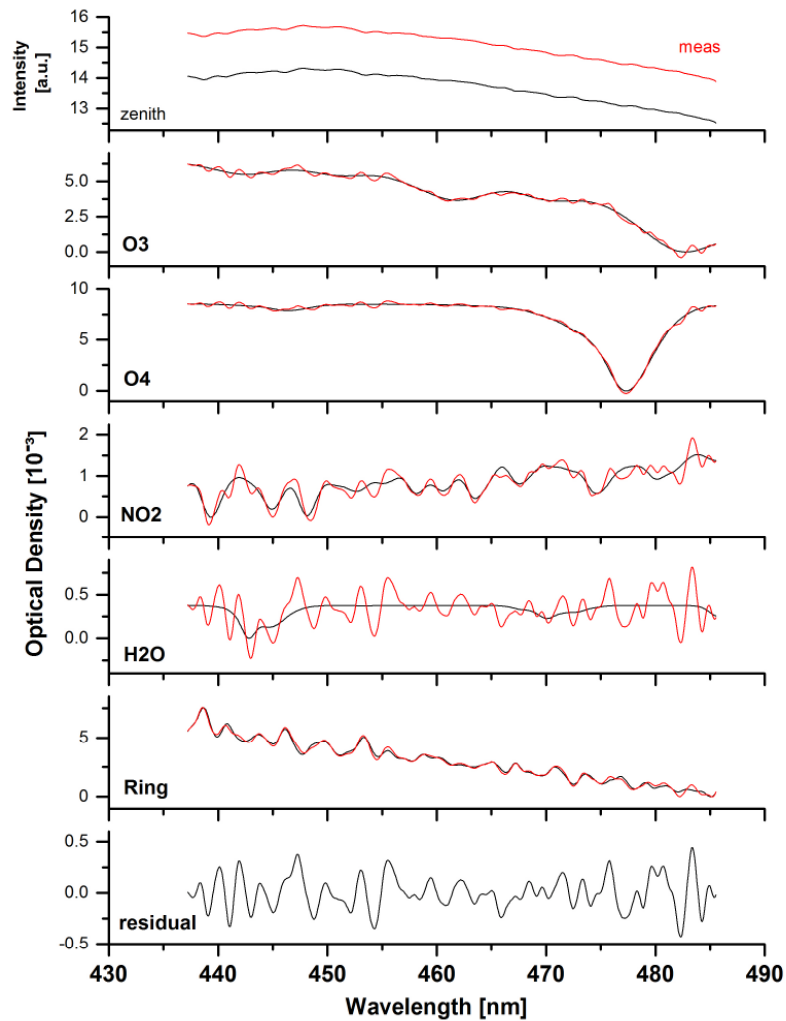
- O₄: 1.5×10^{42} molec.² cm⁻⁵
- O₃: 1.1×10^{18} molec. cm⁻²
- NO₂: 4.2×10^{14} molec. cm⁻²
- H₂O: 1.5×10^{22} molec. cm⁻²

NO2-Fit example: Spec. #B015463, Reference: #B015462, Elevation: +1°

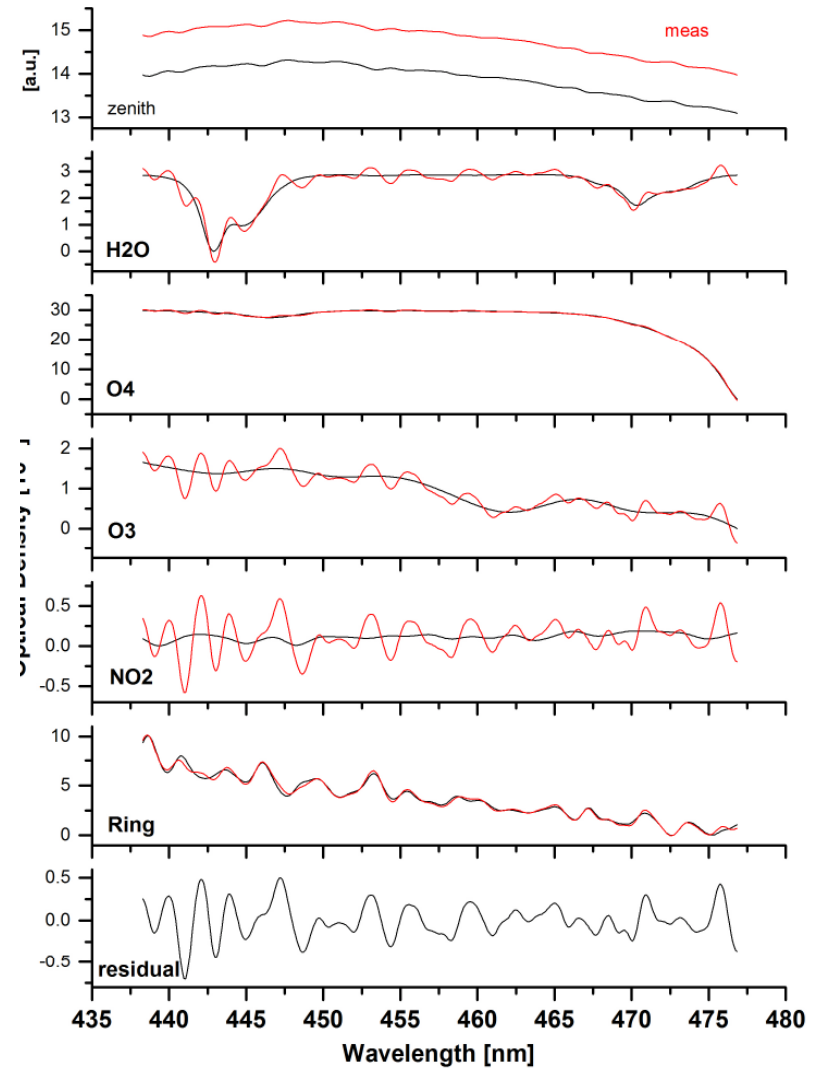


Vis O₃ and H₂O Analysis

O3-Fit example: Spec. #B015464, Reference: #B015462, Elevation: 0°



H2O-Fit example: Spec. #B015473, Reference: #B015462, Elevation: -5°



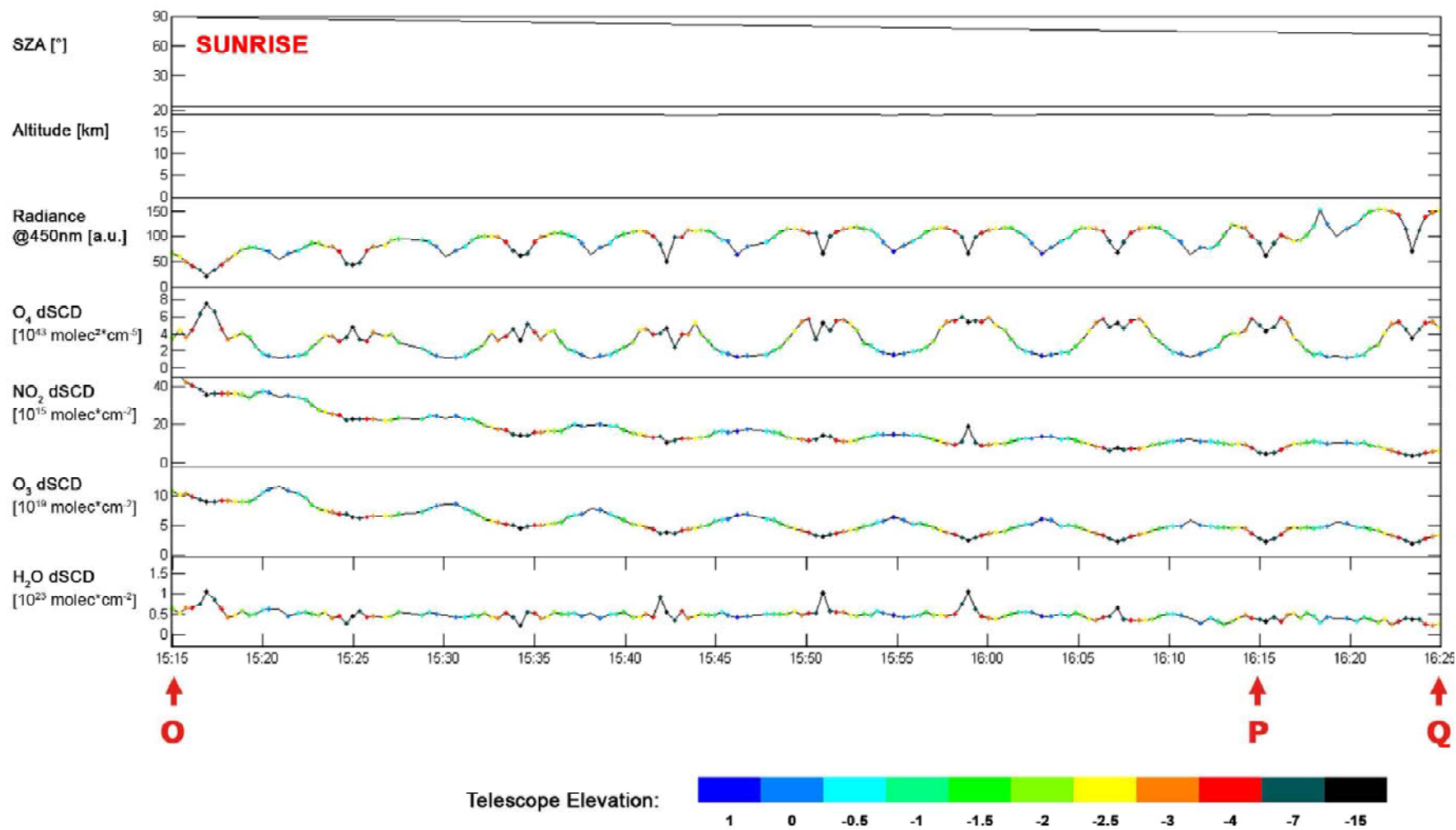
Data Collected in 2013

	UV spectra	Visible spectra	IR spectra
Science Flight #1	2,471	2,461	1,398
Science Flight #2	2,614	2,620	1,607
Science Flight #3	2,729	2,772	1,588
Science Flight #4	2,453	2,494	1,437
Science Flight #5	2,497	2,520	1,401
Science Flight #6	2,195	2,214	1,330
Total	14,959	15,081	8,761

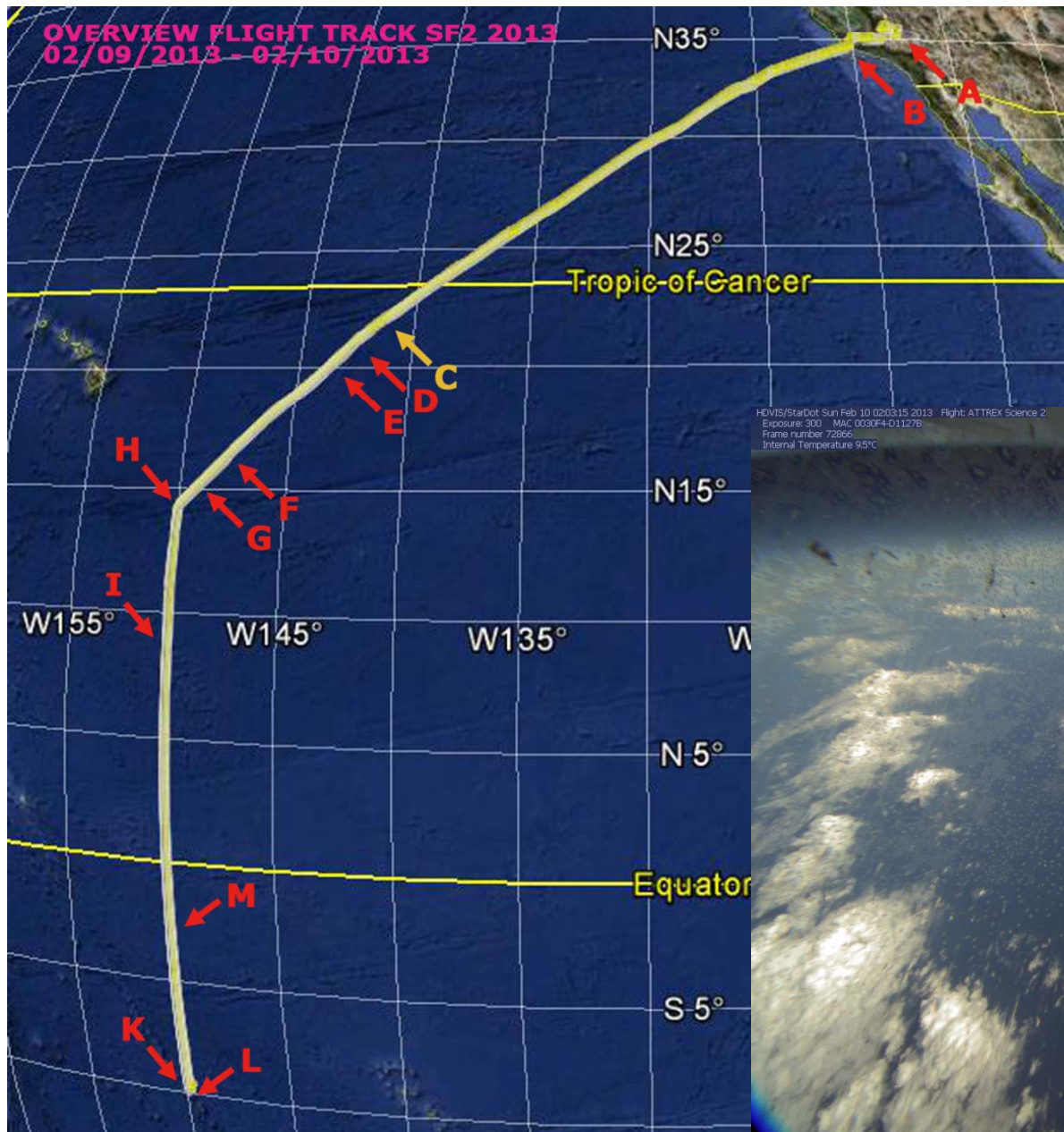
- UV and vis spectra have been analyzed to determine trace gas SCDs.
- Working on interpretation of IR spectra

In-flight instrument performance

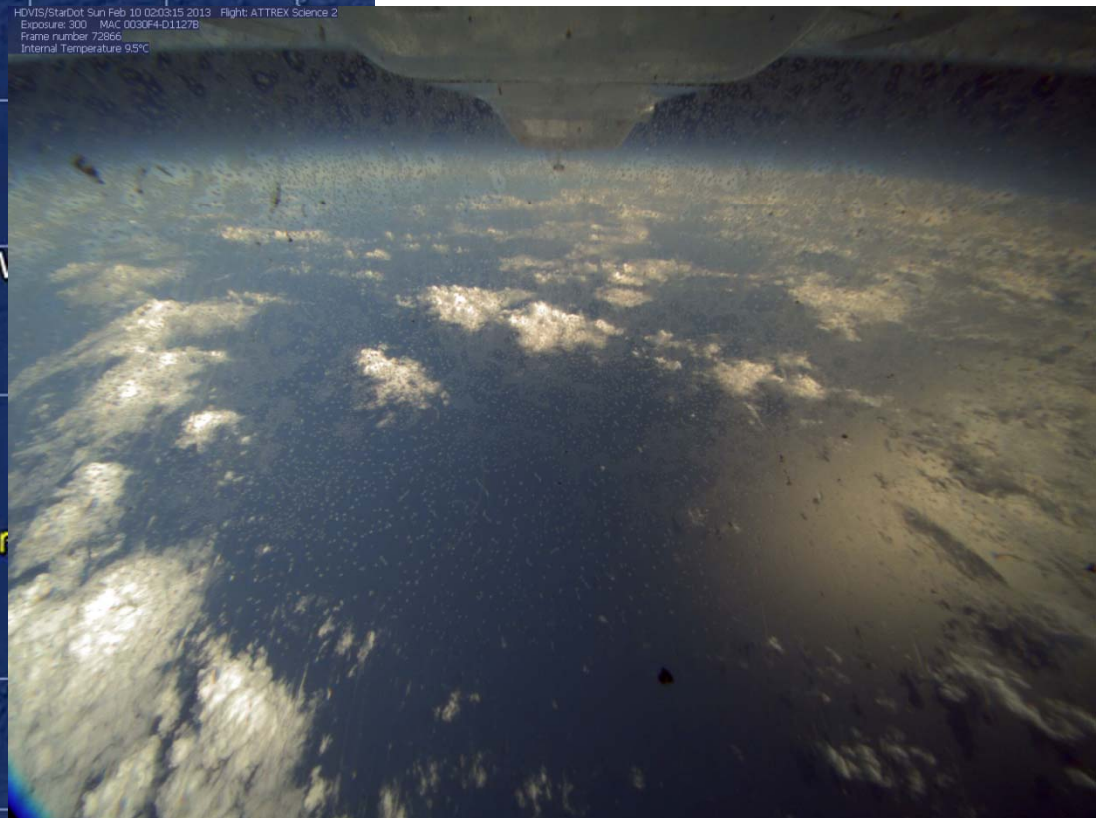
GH mini-DOAS Visible Spectrometer: results DOAS-retrieval SF3 02/14/2013 - 02/15/2013



Science Flight 2, 2013

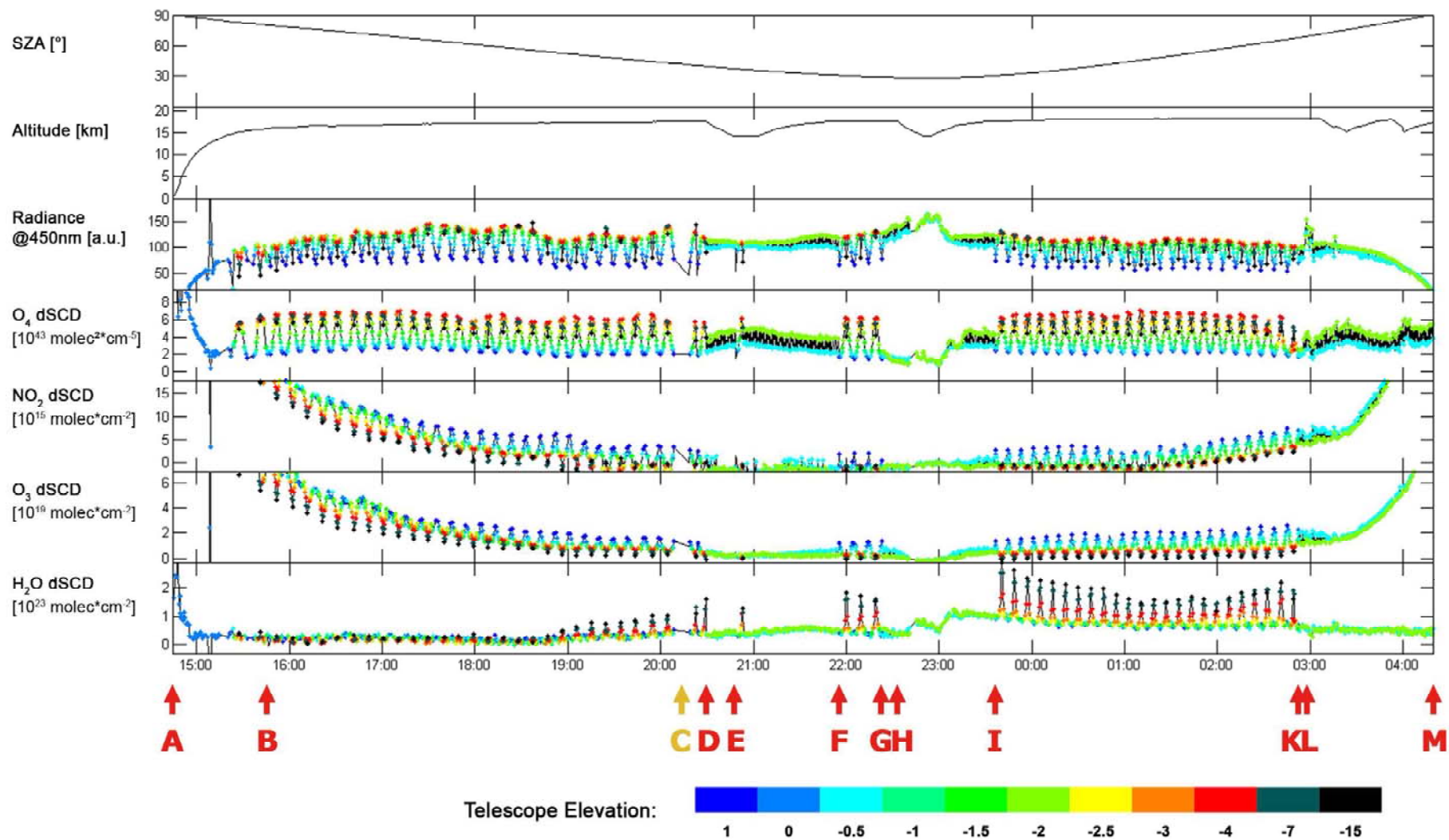


- Takeoff:
02/09/2013 14:45 UT
- Sunset:
02/09/2013 04:17 UT

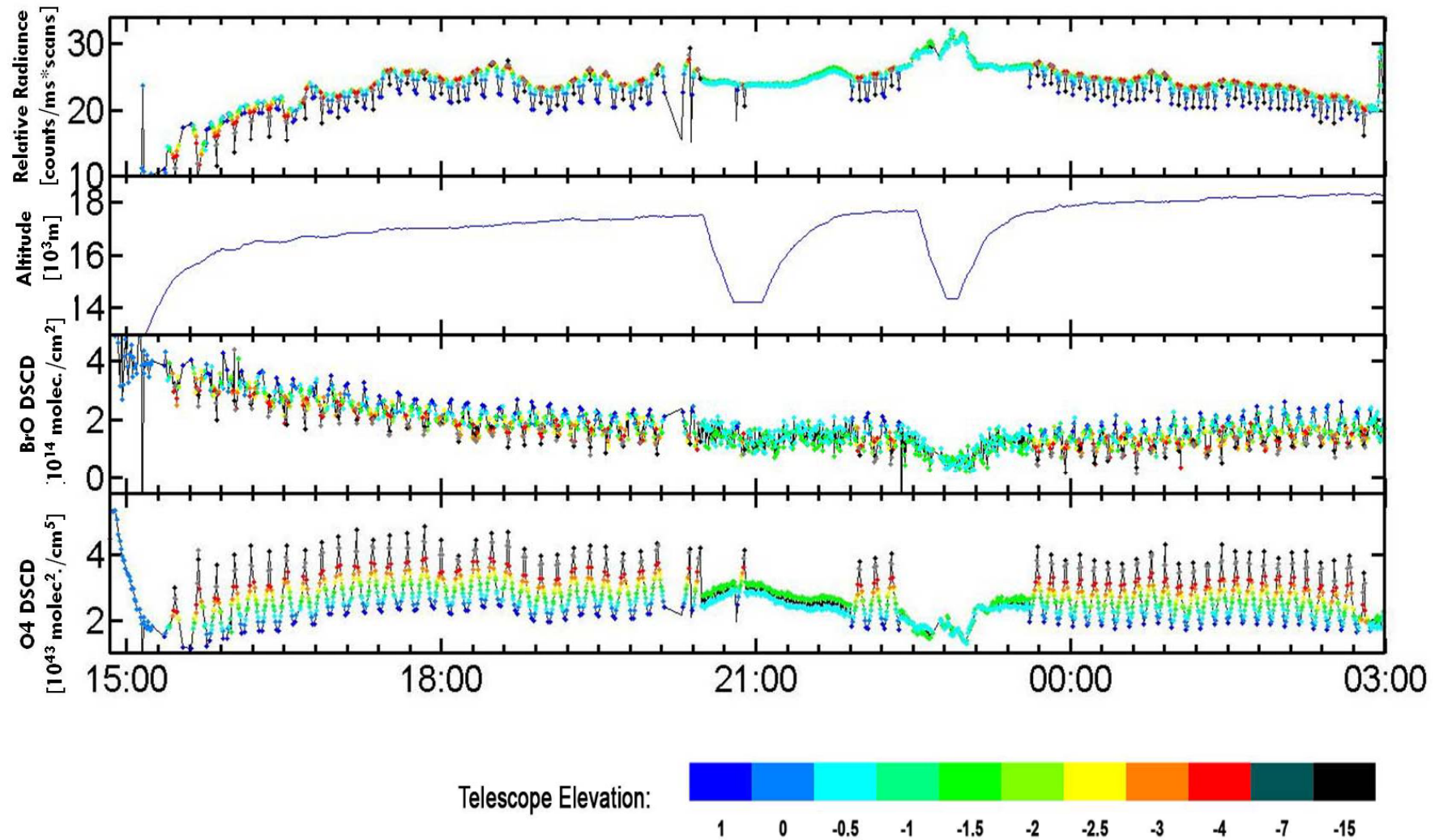


Science Flight 2

GH mini-DOAS Visible Spectrometer: results DOAS-retrieval SF2 02/09/2013 - 02/10/2013



Science Flight 2



Conclusion and Status

- All UV & VIS 2013 spectra have been analyzed.
- Software for fast retrieval has been set finalized
- Radiative transfer calculations to determine mixing ratios in progress:
 - ▣ First results during Friday's talk
 - ▣ Method for fast conversion of “flight-altitude” NO_2 and BrO mixing ratios has been developed (testing still under way) Goal: Have preliminary M.R. while in field.
- Instrument was tested under Guam-like conditions (high R.H. , rain, bugs, etc.) over Summer in Nashville.
- No major changes to instrument
- Instrument currently under maintenance (update cables, heaters, and plugs).
- Should be ready by Nov 12.