MINI-DOAS

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What is Mini-DOAS?

- Identify and quantify trace gases using their narrow band absorptions.
- Airborne remote sensing
- Slant Column Density (SCD) \[ SCD = \int_0^s c(s) \, ds \]
How does Mini-DOAS work?

- Power consumption: 29VDC at 1.4A = 41W
- Size and Weight: 11.8x9.84x8.0 inches; 75 pounds including 9L ice-water
Spectrometers, Telescopes, and Quartz fibers... on NASA's Global Hawk.
**DOAS**

Differential Optical Absorption Spectroscopy

**Identification and quantification of trace gases by their unique narrow band absorption in the open atmosphere**
BrO and O4 data analysis

BrO fit range: 345 – 360nm

Species to be measured & DL:

- NO₂  50 ppt
- HONO  20 ppt
- BrO   0.75 ppt
- HCHO  150 ppt
- SO₂   200 ppt
- glyoxal: ?
- aerosol extinction (via O₄)

O4 fit range: 338-347nm 352-360nm
ATTREX Data Example

- Relative Radiance [counts/ms*scans]
- Altitude [10^5 m]
- BrO DSCD [10^14 molec./cm^2]
- O4 DSCD [10^3 molec./cm^2]

Universal Time [5th November 2011]
From SCDs to trace gas concentration

$$\text{SCD}(\text{El. Ang.}) = \sum \text{BAMF}(\text{El. Ang.}) \times c(h) \times dh$$

- BAMFs derived via radiative transfer calculations
- Optimal Estimation Inversion to derive concentration profile $c(h)$

Detector at 4km

Box Airmass Factor (DBAMF)

Altitude (km)

0 20 40 60 80 100

-90.0°
-45.0°
-30.0°
-4.0°
-3.0°
-2.5°
-2.0°
-1.5°
-1.0°
-0.5°
0.5°
1.0°
1.5°
2.0°
2.5°
3.0°
4.0°
5.0°
BrO vertical concentration profile retrieval

Science flight 2 on 11/05, 18:00 UTC

Retrieved BrO profile

Modeled SCDs fit well

BrO at flight altitude:

\( \sim (1.8 \pm 0.25) \times 10^7 \text{ molec/cm}^3 \)

\( = (5.0 \pm 0.75) \text{ ppt} \)
BrO vertical profiles

Science flight 2 on 11/05

Consecutively retrieved BrO profiles

BrO at flight altitude
Questions / Issues

- Telescope fairing (pressure seal).
  - Calibration of telescope geometry after installation
- Meeting NSF specs for instrument
  - Instrument has undergone environmental testing at NASA
- Fast information on pitch, roll, acceleration?
  - Addition of sensor to instrument of from aircraft?
- Data archive on C130 server (~5000 spectra each 10kbyte)?
- Change of measurement strategy depending on flight status
  - Profiling through elevation scanning vs limb during ascent/decent