Overview

- Tunable Diode Laser Measurements
  Sampling, Zeroing, Calibration, Selectivity

- Past Comparisons

- INTEX-A Comparisons

- Convective Outflow at High Altitudes

- Measurements in the MBL
Airborne Tunable Diode Laser System
Airborne Inlet & Sampling Sequence

Typical Sampling Seq.

Ambient
30 - 60 s

Bkg
10 - 15 s

Bkg
10 - 15 s
CH$_2$O Permeation Cal System

Glass Capillaries
(0.127 mm ID, 5 cm long)

Permeation Devices

Heater Block

RTD

Critical Orifice

Pressure Controller

Hopcolite Trap

Standard Out (to inlet)

Scrubbed Standard Out (dumped)

Zero Air In
Fitting & Response Calibration Factors

\[ RCF = \frac{(\text{Sig})_{\text{CAL}} \text{ Peak-to-Peak}}{(LP) \text{ (Cal Conc)}} \]

1) Electronic gain entire sys.
2) Cal stds output
3) Cal system and inlet sys surface effects
4) Pathlength
5) Mode fraction and scattered light
INTEX-A Daily Flight Calibrations

INTEX-NA Flight Calibration Factors
(Stdev of Cal for each fit ranges between 1.1% to 4.7% with avg value of 2.7%)
Absorption Features Near CH$_2$O Line

CH$_2$O Feature Use 2831.6417 cm$^{-1}$

Fit Window

Freq cm$^{-1}$

2831.4  2831.5  2831.6  2831.7  2831.8  2831.9
Results of Interference Tests

• $\text{H}_2\text{O} (\text{HDO})$ Line yields 0 to 4% interference for $[\text{H}_2\text{O}] = 0.02$ to 0.03

• Methanol yields a 0.3 to 0.4% interference for equiv. $\text{CH}_2\text{O}$ concentrations.

• No additional interference with: ethanol, 2-propanol, acetaldehyde, propanal, butanal, i-butanal, acetone, MEK, n-butane, isoprene, benzene, i-butane, methacrolein, pentanal, hexanal
Results of Fitting Out Methanol

Methanol Comparisons July 20, 2004  Flt 10

- NCAR MeOH ppbv (uncert ~ ± 2 ppbv)
- Singh MeOH ppbv
TDLAS-DOAS Comparisons Over LaPorte, Texas

TDLAS: On Electra
DOAS: Ground-Based

\[ Y = 0.95 \pm 0.15 \times - 0.70 \pm 0.65, \]
\[ \chi^2 = 5.5, n = 6, r^2 = 0.97 \]
Comparison of NCAR TDLAS & UCLA DOAS CH₂O Measurements (Cornelia Fort During SOS 99)
TDL Performance Characteristics

1) Data on all but 1 science flight

2) Accuracy: Better than 12%

3) Upper limit to LOD (30 second meas)
   a) Before 7/31/04: ~ 70 to 80 pptv
   b) After 7/31/03 ~ 50 to 60 pptv

4) Response Time: 1-2 seconds
URI vs NCAR Linear Regression (normal) on 1-Min. Merged Data

**Graph Details:**
- **Y-Axis:** [CH2O] URI pptv
- **X-Axis:** [CH2O] NCAR pptv
- **Legend:**
  - Individual comparison points
  - Fit of orig points
  - Med of Bins
  - Avg of Bins ± 1 std
  - fit_Avg_URI_Bin
  - Fits 13 to 20

**Linear Regression Statistics:**
- **Std Linear Reg of All Points**
  - \( a = 50 \pm 6 \text{ pptv} \)
  - \( b = 0.64 \pm 0.005 \)
  - \( r^2 = 0.89 \)
  - \( N = 2615 \)

- **Std Linear Reg of Bin Avg**
  - \( a = 67 \pm 32 \text{ pptv} \)
  - \( b = 0.62 \pm 0.02 \)
  - \( r^2 = 0.99 \)
  - \( N = 18 \)
Time Dependence of Regression Slopes
CH$_2$O During INTEX-NA 2004

- CH$_2$O in the UT & Convective Outflow
- CH$_2$O in the MBL & Transport
Continental CH2O Distributions 1-Min TDLAS

**Pressure Altitude > 6K**

- Average = 190 ± 188 pptv
- Median = 154 pptv
- N = 1603

**Radar Altitude < 1K**

- Average = 2283 ± 1346 pptv
- Median = 2063 pptv
- N = 778
Marine CH2O Distributions 1-Min TDLAS

Marine Data: Pressure Altitude > 6K

Alaska Fire Plume
July 18

Average = 135 ± 180 pptv (98 ± 108)
Median = 90 pptv (79)
N = 369 (336)
Topics for Papers

- CH$_2$O in the UT & Convective Outflow
- CH$_2$O in the MBL & Transport
- CH$_2$O Distributions Over the U.S.
- Effects of Fires
- Measurement-Model Relationships
- CH$_2$O & Tracer Correlations
- Relationship of CH$_2$O with methanol and clouds/aerosols (Alaska fire plume)