

# In Situ Measurements of CO, CH<sub>4</sub>, and H<sub>2</sub>O from the NASA P-3B in support of DISCOVER-AQ

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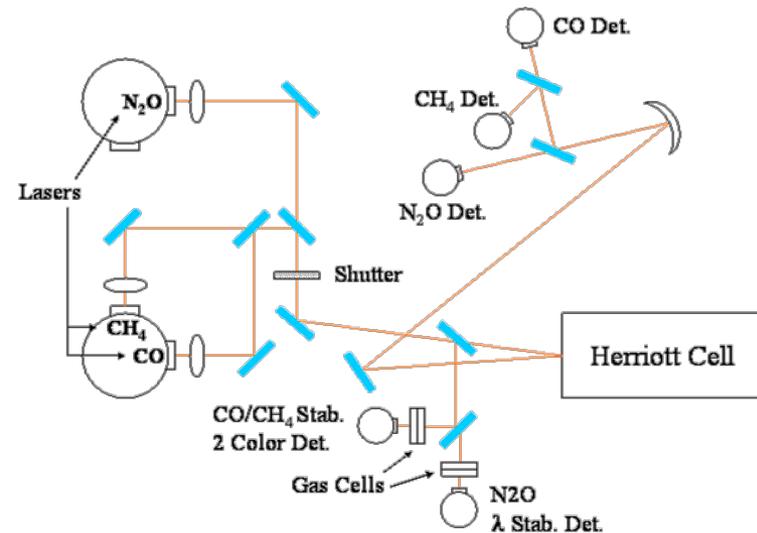
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# DACOM: Differential Absorption CO Measurement

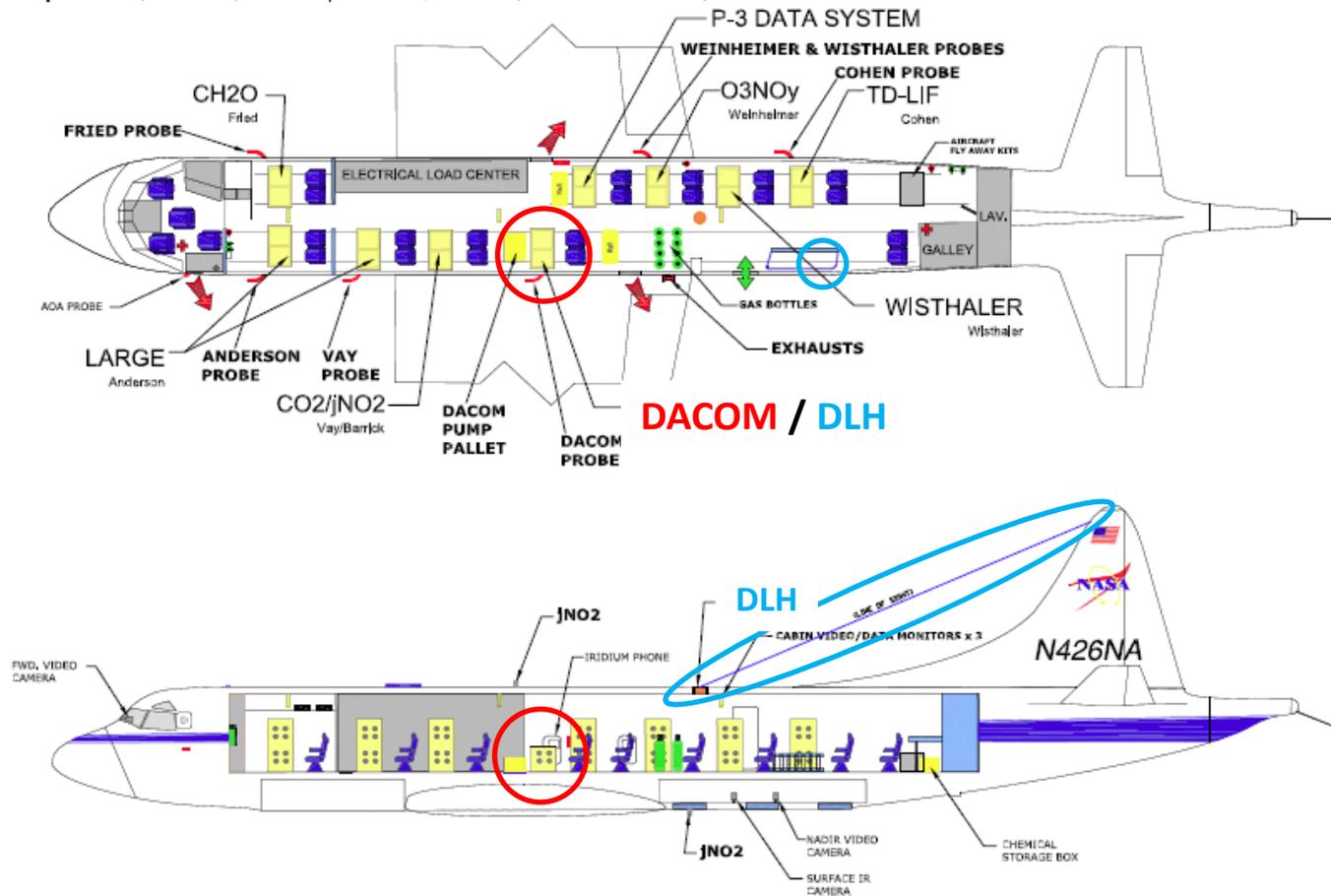
- Three channel (CO, CH<sub>4</sub>, N<sub>2</sub>O) tunable diode laser spectrometer operating in mid-IR (4.7, 3.3, 4.5 μm)
- Wavelength modulation at ~1 kHz; multi-harmonic detection
- Line-locked to absorption lines in low-pressure reference cells
- Three beams combined using dichroic mirrors, and focused into a small volume (~0.3 l) Herriott cell; l=36m
- Outside air collected in forward-facing inlet, dried, pumped through Herriott cell, at reduced pressure
- Flow through cell (~5 slpm) limits frequency response to ~1/s
- Optical table enclosed in temperature-stabilized container (after Fried, et al.)
- Accuracy tied to calibration standards (NOAA)



# Diode Laser Hygrometer (DLH)

- Tunable diode laser spectrometer operating in the 1.4  $\mu\text{m}$  spectral region
- Wavelength modulation at  $\sim 2$  kHz
  - data analysis based on 2F, 4F demodulation, normalized by signal power
- Line-locked to absorption line in low-pressure reference cell
- Uses one of three absorption lines, depending on conditions (primarily altitude)
- Double-pass external path configuration
  - “mirror” is panel of retroreflecting roadsign material
  - sample volume is primarily outside of aircraft boundary layer
  - Internal optical path is purged with dry air or  $\text{N}_2$
  - no inlet effects, such as condensation, evaporation, hysteresis, etc.
  - long path-length, combined with line-locked, harmonic detection allow excellent sensitivity and rapid time response
  - normalization by return power allows measurements to be made within clouds
  - Cloud extinction can be assessed from return power signal
- Realtime mixing ratio determination using onboard pressure, temperature

# Instruments: DACOM: CO, CH<sub>4</sub> (and N<sub>2</sub>O); DLH: H<sub>2</sub>O(v)



Acronym	Measurement Quantity	Sampling Rate	Precision (1 $\sigma$ )	Accuracy
DACOM	CO	1/sec	<1% or 1 ppbv	2%
	CH <sub>4</sub>	1/sec	<1%	1%
DLH	H <sub>2</sub> O vapor	100/sec	<1%	5%

# Data Example from ARCTAS / CARB Flight, 2008

