

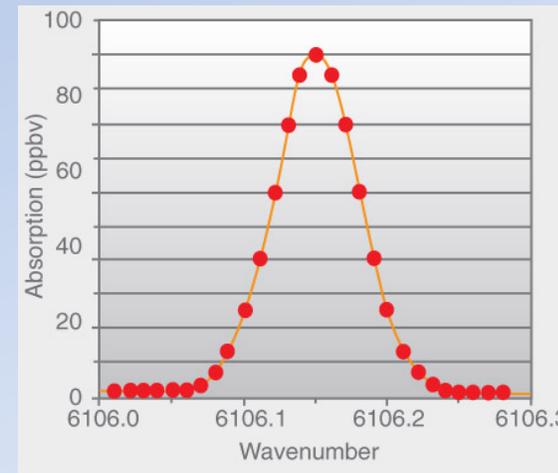
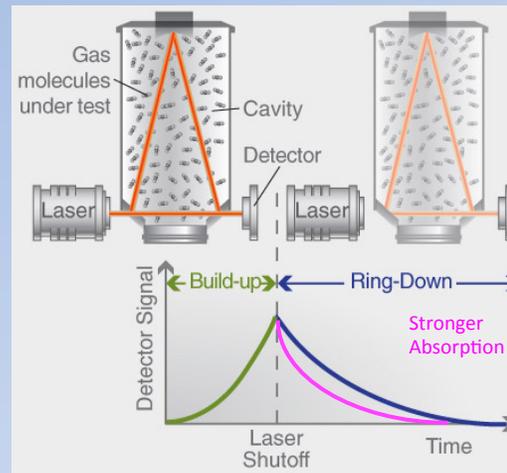
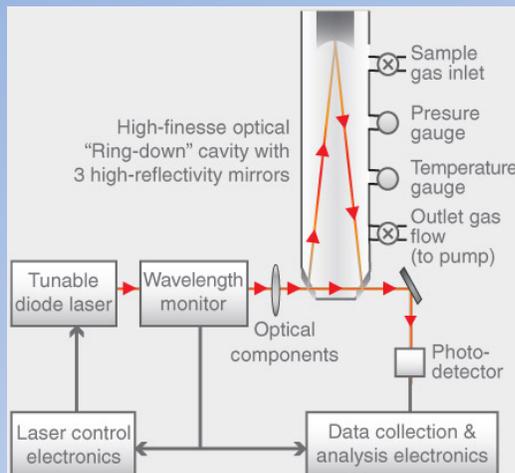
Harvard University Picarro Cavity Ringdown Spectrometer (HUPCRS)

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Data Collection

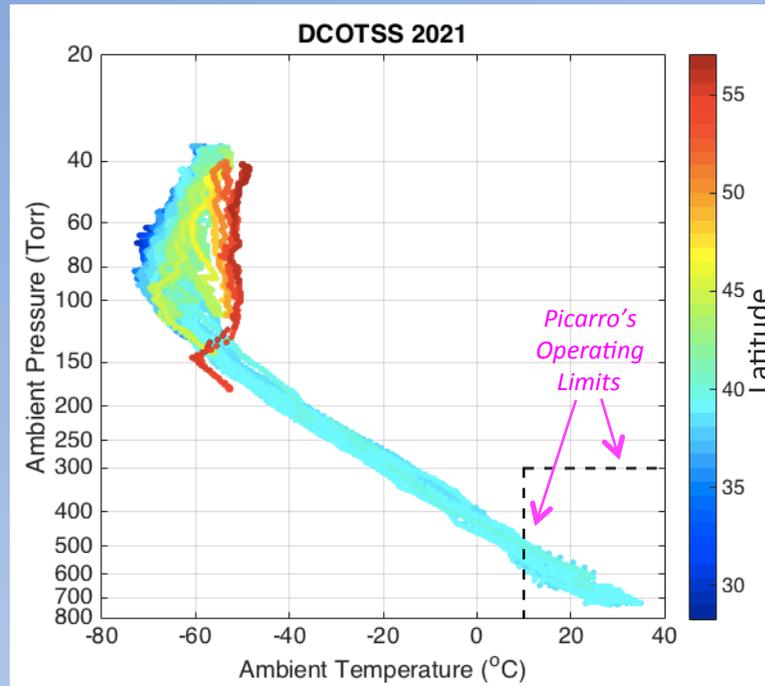
- HUPCRS provides *in situ* measurements of Greenhouse Gases (GHG): CO₂, CH₄, CO, and H₂O (not reported) at ~2.2 sec intervals.
 - 0.2 sec for CO₂, 0.4 sec for CH₄, 0.9 sec for CO, 0.7 sec for H₂O
- Molecule detection is done by a G2401-m Picarro analyzer (picarro.com), which uses the Wavelength-Scanned Cavity Ringdown Spectroscopy technique in the Near-IR.



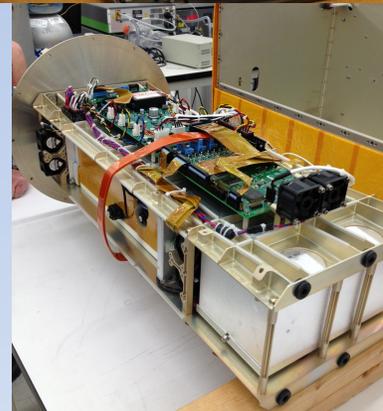
Data Collection

- HUPCRS was designed to perform:

- Airborne measurements over a large range of ambient conditions (e.g., pressures from sea level to 70,000 ft; temperatures down to -90 °C) with the use of specialized engineering components
- In-flight stability checks with the use of a custom-made calibration system, which periodically replaces ambient air with air from two standards (NOAA tanks as sources, pre-determined concentrations).



Ambient and Instrument Operating Conditions



Picarro: original and modified



ER-2 Installation of HUPCRS

File Structure & Content

- HUPCRS archived files consist of time series of dry mixing ratios of CO₂ (ppm), CH₄ (ppb), and CO (ppb) throughout the flight.
- CO₂ and CH₄ data are reported at the default rate of ~ 2.2 sec, to the nearest second.
- CO is averaged to 10 sec, with the timestamp at the midpoint of the interval.
- Data exclusions:
 - Approximately the first 45 minutes after take-off due to instrument warm-up.
 - Approximately 7 minutes at the top of every hour due to in-flight calibrations.

Data Limitations & Considerations

- *On-going assessments* on data quality and control.
- Accuracy is determined by NOAA's uncertainties in tank calibrations. For the tanks we used during DCOTSS, these were as follows: ± 0.20 ppm for CO_2 , ± 3.60 ppb for CH_4 , and ± 1.25 ppb CO.
- In-flight precision from preliminary analysis suggests ± 0.02 ppm for CO_2 and ± 0.30 ppb for CH_4 at 2.2 sec, and ± 3.22 ppb for CO at 10 sec.
- Recommendations: consult with the HUPCRS team prior to using the data.

Tentative Archival Timeline

- HUPCRS has submitted preliminary files to the ESPO archive for all science flights out of Salina, KS.
- Latest versions contain pre- and post-deployment initial analysis (e.g., flight and laboratory calibrations, time delay adjustment on flight data).
- Final data (“R0”) delivered to archive by March 2022 (or earlier).