

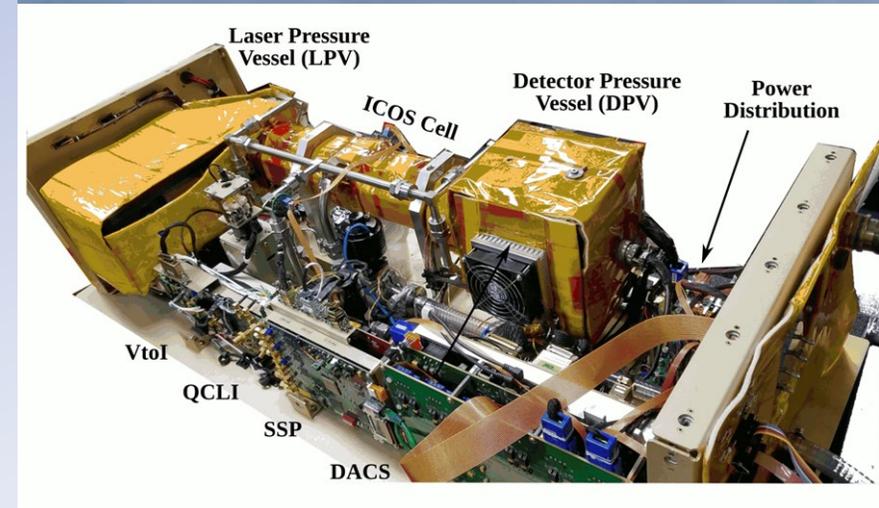
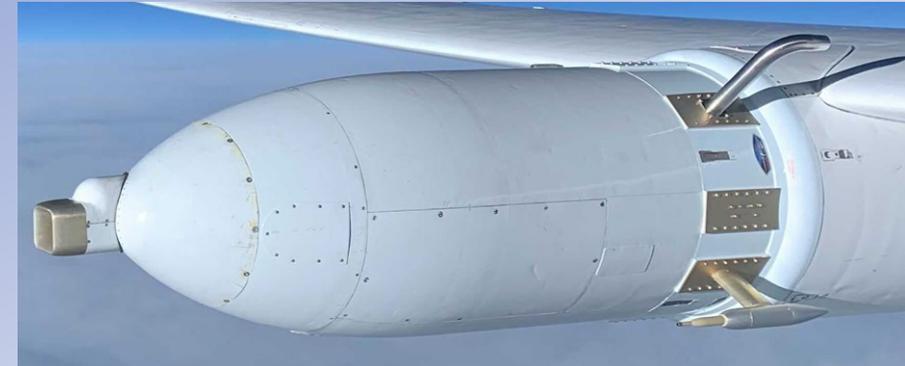
Water Isotopologue – Integrated Cavity Output Spectrometer

WI-ICOS

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Data Collection/Creation Process

- Uses a cavity enhanced technique, ICOS, to measure the absorption of water vapor and its isotopologues near $2.65 \mu\text{m}$.
- Uses an isokinetic inlet with heaters to measure total water (water vapor + ice).
- Ambient air is pulled through an isokinetic inlet with a venturi exhaust and a portion of this air is pulled into the absorption cell using a scroll pump.
- A laser is used to scan across absorption features and the depth of those absorptions are proportional to concentration.

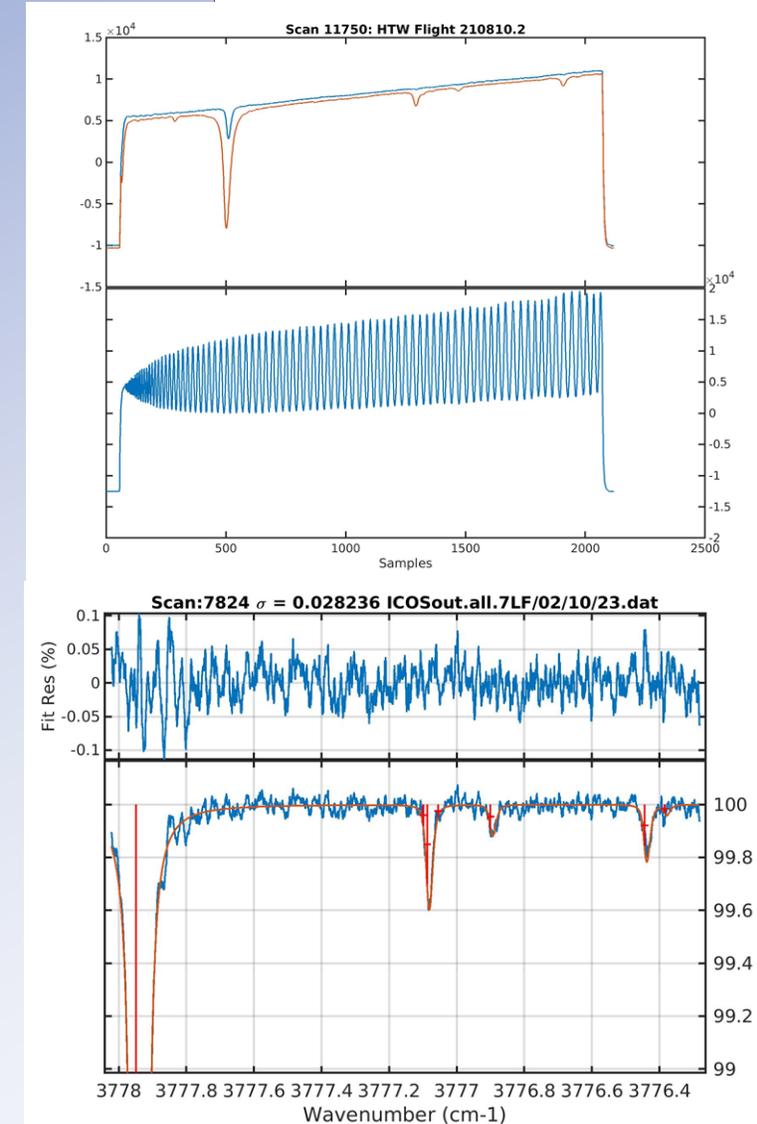


Sayres, D. S., E. J. Moyer, T. F. Hanisco, J. M. St. Clair, F. N. Keutsch, A. O'Brien, N. T. Allen, L. Lapson, J. N. Demusz, M. Rivero, T. Martin, M. Greenberg, C. Tuozzolo, G. S. Engel, J. H. Kroll, J. Paul, and J. G. Anderson, A new cavity based absorption instrument for detection of water isotopologues in the upper troposphere and lower stratosphere, *Rev. Sci. Instrum.*, **80**, 044102, 2009.

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File Structure & Content

- Two files for each flight are archived
- Total Water Vapor files
 - ICARTT format files
 - Flight data recorded at 1 Hz
 - Columns: Total Water Vapor (ppmv), Uncertainty in Total Water (ppmv), Ice Water Content* (ppmv), Uncertainty in Ice Water Content (ppmv)

*Ice Water Content uses data from the Harvard Water Vapor (HWV) instrument.
- Water Vapor Isotopologue files
 - ICARTT format files
 - Flight data averaged to 30 seconds or 2 minutes depending on water vapor mixing ratio
 - Columns: H₂O(ppmv), HDO (ppbv), δD (permil), Uncertainty for each column

Data Limitations & Considerations

- Accuracy is tied to both the uncertainties of the spectroscopic parameters from the HITRAN database and from laboratory and in-flight calibrations using a bubbler system.
 - Typical accuracy for total water is 5%; precision is 0.13 ppmv (1σ , 1s)
 - Typical precision for δD is 200‰@5 ppmv; <100‰@>10ppmv (1σ , 30s)
 - Calculated uncertainties (accuracy + precision) are given for each archived value
 - Please check header of each flight day for any flight specific limitations
- For isotopologue ratios the precision is a function of the water vapor concentration. Please pay attention to the uncertainty column. Due to some signal to noise problems at the lowest water vapor mixing ratios, the isotopologue data are heavily averaged. This can cause some issues if the aircraft is changing altitude rapidly.
- We can produce different averages from the raw high frequency data upon request

Tentative Archival Timeline

- Final data for total water product will be archived by end of December, 2021. IWC product will be archived by end of February, 2022.
- Final isotopologue ratio products will be archived by February, 2022.