University of Colorado Total Water Instrument: Closed-path Laser Hygrometer 2 (CLH2)

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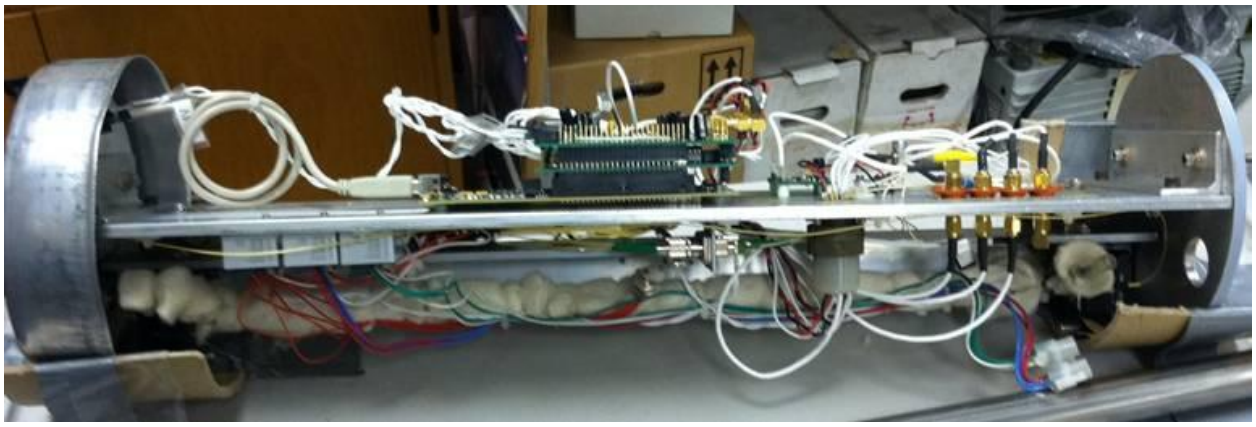
Instrument description:

The University of Colorado Closed-path Laser Hygrometer, version 2 (CLH2) is an infrared absorption instrument designed to measure so-called "total water", the sum of water vapor and particulate water. It is a second-generation sensor that derives from the original CLH, which has been flown on the NASA DC-8 and WB-57F and the NSF/NCAR G-V and C-130 [Hallar et al., 2004; Davis et al., 2007a; 2007b]. This version of the instrument uses a fiber-coupled tunable diode laser at 1.37 µm to measure by absorption the water vapor resulting from the evaporation of cloud particles. The spectrometer will be housed in a modified PMS canister and coupled to a heated forward-facing inlet. Sampling of particles is deliberately sub-isokinetic, which results in enhancements of particle mass relative to ambient by factors ranging between 30 and 70. Therefore, condensed water even in very thin clouds can be measured with high precision and accuracy.

Since this will be the first mission for the CLH2, we do not yet know exactly its accuracy and precision characteristics. Based on laboratory calibrations and ground-based field testing, the CLH2 can measure water vapor at a rate of 1 Hz with an accuracy of about 7% (2-sigma), over a range of mixing ratio from about 700 to 30,000 ppm [Dorsi et al., 2011]. Accuracy of deduced ice water content (IWC) will depend on the performance of the instrument inlet; IWC data from the CLH1 flying on the NASA WB-57F are accurate to about 22% for values greater than 5 mg m^{-3}. We anticipate similar performance for this instrument.



CLH2 in prototype configuration.

Data Products:

During the CLH2 will provide a quantity we call enhanced total water (eTW) at a rate of 1 Hz with an accuracy of approximately 10%. Rough estimates of IWC (good to no better than 50%) can be produced in the field upon request.

Following instrument calibration and data post-processing, IWC values will be provided at a rate of 1 Hz. In dense clouds, which provide larger signal to noise ratios, higher sampling rates (up to 8 Hz) may be possible. Precision and accuracy are currently unknown.

References:

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