Instrument: MayComm Instruments G-V open path hygrometer (RAF_H2O)
PI Team: Teresa Campos, Cliff Heizer, Ilana Pollack, Wengang Zheng, Deedee Montzka, and Frank Flocke, Community Airborne Research Instrumentation Group, Atmospheric Chemistry Division, Earth and Sun Systems Laboratory, National Center for Atmospheric Research, Boulder, CO.
Contact: campos@ucar.edu, 303-407-1048 (v), 303-497-1092 (f)
Precision: Variable (see table below)
Resolution: 10-Hz

Principle of Operation: The MayComm open-path hygrometer quantifies water vapor in the range of 1-20,000 ppmv. The instrument is a wavelength modulated diode laser absorption spectrometer. The optical source is a 1.368 um fiber-coupled DFB diode laser. In its standard configuration, the laser beam is split to provide dual channel operation. The two absorption cells have very different path lengths (10 cm and 130 cm) and the two source beams have different laser powers in order to cover the large dynamic range of ambient atmospheric humidities. The stratospheric humidity channel optical absorption cavity has as its main component a multi-pass Herriott cell. Second harmonic detection of the modulated signal provides quantitation down to the lower detection limit. Lower tropospheric humidities are detectable by the short-path channel.

Performance during START-08: During the ICE-L experiment (November 1-December 17, 2007) and the HEFT-08 test project (February, 2008), one of the Herriott cell mirrors was damaged by ice impaction. The initial damage created a vulnerability to delamination of the gold IR-reflective mirror coating. The subsequent loss in photon throughput led to a degradation of the lower detection limit of the instrument. Given the UT/LS focus of the START-08 experiment the decision was made to sacrifice the tropospheric channel of the MayComm hygrometer to increase the incident laser power and slightly reduce the effect of lost mirror reflectivity. An additional problem developed between the second and third research flights due to optical noise introduced in the fiber optic feedthroughs at two bulkhead connections. The lower detection limit of data from RF03 was 200 ppmv. The instrument was removed and modified to minimize and in some cases eliminate the sources of optical noise. The instrument did not collect data during RF04 and RF05 during this process. The table below documents the lower detection limit on a per flight basis.

Flight Number	Lower Detection Limit	Upper Detection Limit
RF01	15 ppmv	2000 ppmv
RF02	15 ppmv	2000 ppmv
RF03	200 ppmv	2000 ppmv
RF04	Not installed	Not installed
RF05	Not installed	Not installed
RF06	4 ppmv	2000 ppmv
RF07	5 ppmv	2000 ppmv
RF08	5 ppmv	2000 ppmv
RF09	7 ppmv	2000 ppmv
RF10	8 ppmv	2000 ppmv
RF11	7 ppmv	2000 ppmv
RF12	9 ppmv	2000 ppmv

RF13	7 ppmv	2000 ppmv
RF14	10 ppmv	2000 ppmv
RF15	7 ppmv	2000 ppmv
RF16	10 ppmv	2000 ppmv
RF17	8 ppmv	2000 ppmv
RF18	8 ppmv	2000 ppmv

Data format: Final data files have been archived in comma-delimited ascii format and include a timestamp synchronized to RAF data system network time. The data have been edited to remove measurements below the detection limit.