

The JPL Laser Hygrometer in CAMEX-4

The JPL Laser Hygrometer is a tunable diode laser (TDL) spectrometer for rapid, *in situ* measurements of water vapor. During NASA's fourth Convection and Moisture Experiment (CAMEX-4), the instrument will be mounted on the NASA DC-8 aircraft to measure water vapor as the airplane is flown through tropical hurricanes off the coast of Florida. Dr. Robert L. Herman, principal investigator, will participate in this field campaign, utilizing meteorological data to determine supersaturations and latent heating rates in the upper levels of tropical cyclones. The analysis of these data should provide a better understanding of the processes that regulate upper tropospheric water, the atmospheric water cycle, and tropical storms. This will lead to improved hurricane forecasting.

As shown in figure 1, the JPL Laser Hygrometer is an open-path instrument that measures water vapor in the free-stream air flow external to the aircraft. This configuration ensures that measurements are not subject to contamination by vaporization of condensed phases of water (i.e. liquid or ice) in clouds. The instrument incorporates near-infrared room-temperature TDLs that were developed and fabricated at the JPL Microdevices Laboratory. The JPL Laser Hygrometer was developed at JPL in the late 1990's with funding from the NASA Upper Atmosphere Research Program. Previously, the JPL Laser Hygrometer measured water on 18 DC-8 flights during the third Convection and Moisture Experiment (CAMEX-3) in 1998, and on 25 flights during the SAGE III Ozone Loss and Validation Experiment (SOLVE) in November 1999 through March 2000. Slightly different versions of this instrument with multipass optical paths (11 meters) have measured water on the NASA ER-2 and WB-57F high-altitude aircraft during several recent field missions including: the WB-57F Aerosol Mission (WAM), Atmospheric Chemistry of Combustion Emissions Near the Tropopause (ACCENT), Photochemistry of Ozone Loss in the Arctic Region in Summer (POLARIS), and SOLVE.



Figure 1. During CAMEX-4, the JLH will be mounted on a DC-8 window port at fuselage station 490 right. To ensure measurements in “clean” air, the optical path is outside the aircraft boundary layer. The laser, detector, and collimating optics are located in the upper housing, with a return mirror on the lower housing. The foreoptics can be evacuated or purged with dry nitrogen to eliminate water vapor absorption inside the optical head. This spectrometer features a simple “there and back” open path between the two external housings, for a total optical pathlength of 50 cm.



Figure 2. View of the JPL Laser Hygrometer from inside the NASA DC-8 passenger cabin. The box on the right contains the power supplies, and the black box on the left houses the control electronics and instrument computer. A hermetic connector provides the single-cable connection to the optical head. This instrument is autonomous, so an operator is not required to fly on the aircraft.