### 5.2.2. LIGHTWEIGHT AIRBORNE CHROMATOGRAPH EXPERIMENT (LACE)

LACE is a three-channel gas chromatograph that operates on the NASA-sponsored Observations in the Middle Stratosphere (OMS) gondola and the NASA WB-57F aircraft. The OMS platform represents a collaboration with scientists from CMDL, Cooperative Institute for Research in Environmental Sciences (CIRES), NOAA Aeronomy Laboratory (AL), JPL, NASA Ames Research Center, Harvard University, and Penn State University. The WB-57F platform represents collaboration with scientists from CMDL, CIRES, AL, National Center for Atmospheric Research (NCAR), University of Denver, JPL, NASA, and California Institute of Technology.

OMS deployments at Fairbanks, Alaska, and Brazil were reported in *Ray et al*. [1999]. On May 18, 1998, CMDL participated in a midlatitude OMS balloon flight out of Fort Sumner, New Mexico, as a follow-up to the STRAT and POLARIS campaigns. After finalizing the data from this flight, the LACE instrument was modified for the Atmospheric Chemistry and Combustion Effects Near the Tropopause (ACCENT) campaign designed to investigate the effects of rocket and aircraft combustion in the upper troposphere and lower stratosphere and the SOLVE campaign designed to examine the processes controlling ozone levels at mid- to high latitudes.

A new chromatography channel was developed that proved advantageous for both campaigns. This channel measures molecular hydrogen, methane, and carbon monoxide once every 140 seconds. Carbon monoxide was included on the ACCENT mission to help identify rapid convection in the troposphere. Molecular hydrogen and carbon monoxide were included on the SOLVE campaign because of their strong mesospheric sources, and methane was included to help close the hydrogen budget [*Hurst et al*., 1999].

The ACCENT campaign in Houston, Texas, (September 1999) utilized an unpressurized chamber in a WB-57F aircraft. Substantial thermodynamic, mechanical, and electrical modifications of the LACE instrument were required in order to participate in the ACCENT mission. LACE operated successfully on all eight ACCENT science flights, including a tropical flight, a flight over the eye of hurricane Floyd, a flight within the commercial airline flight corridor, and a rocket plume intercept. The ACCENT data were finalized and submitted to the NASA archive. Following the ACCENT campaign, LACE was reconfigured to fly on the balloon platform as part of the OMS SOLVE campaign in Kiruna, Sweden.

The SOLVE campaign began with a balloon flight well inside the northern vortex just days after the vortex had formed (November 19, 1999). Preliminary analysis of these data revealed many interesting features of atmospheric transport such as the rate of descent of air within the vortex, the degree of entrainment of midlatitude air into the vortex, and mixing characteristics within the vortex.

Tracers such as CO, $H_2$, and $SF_6$ that have large vertical gradients in the mesosphere can also provide an estimate of the distribution of altitudes from which air originated before descending into the vortex. Estimates of the mesospheric sources and sinks for these molecules can also be made. After quantifying the mesospheric losses of $SF_6$ and $CO_2$, limits on the corrections to the age profiles calculated from these molecules can be quantified. In addition to providing information on vortex air descent, these measurements contributed to ongoing studies of transport in the lowermost stratosphere [*Ray et al.*, 1999].