DICE Flight Report: June 5, 2003

Flight Type: WINDRAD Piggyback Flight

Flight Objectives:

1. Continue instrument and inlet characterization studies
2. Perform sounding and multiple passes by ground station
3. Perform level run within MBL

Flight Plan (UT)

21:48 Taxi
21:55 Takeoff
21:58 Level at 5 kft
22:09:50 Start DICE Tower Flyby #1
22:25:00 Start DICE Tower Flyby #2
22:28 Start climb to 20 kft
22:45 Level at 20 kft
23:18 Climb to 26 kft for WINDRAD/LRR maneuvers
23:23 Level at 26 kft
23:44 Climb to 35 kft for WINDRAD/LRR maneuvers
23:56 Level at 35 kft
24:11 Descend to 26 kft for WINDRAD/LRR maneuvers
24:19 Level at 26 kft
26:37 Decend to 1 kft for Beacon/Bouy flyby
26:54 Level at 1 kft: conduct inlet comparisons in sea salt
27:01 Langley and UH switch valves to sample each others inlets
27:09 Valves switched back to regular configuration
27:16 Leave 1 kft and climb to 37 kft
27:41 Level at 37 kft enroute to EAFB
28:15 Begin descent into EAFB
28:51:35 Landed

Participating DICE Groups: Langley In Situ, Langley Lidar, PILS, Hawaii, UNH

Report

The skies over Edwards were clear and cloudless and the temperature ~97 F at takeoff. Winds were from the SW at 5m/s. Haze was evident throughout the valley, and a few dust devels were evident over the dry lake bed. Lee Thornhill went to the tower an hour before takeoff to deliver cookies, flirt with the blonde ATC officer, and begin pulling filter samples.

We took off at ~3 pm local and climbed to 5 kft to warm-up instruments and prepare for the tower flybys. All instruments appeared to work normally. We descended to the surface at 22:05 UT and began pulling samples into our small filter collectors at 500' altitude. For these passes, all inlets were maintained as close as possible to isokinetic flow and the filter valves were left open for the duration of the low altitude work, about 20 minutes, which allowed us to sample a volume of 0.6 m3 of air. We made the first tower pass at 3:10 pm local time, turned a left base, passed over the east side of Rogers Dry Lake at 500' AGL and completed another left base to realign ourselves on the tower flyby line after passing over the Boron area. After completing the second tower flyby, we performed a spiral climb over Edwards, then turned west to fly out to offshore buoys to conduct maneuvers aimed at testing/characterizing the WINDRAD system.

During the tower flybys, we paid close attention to the scattering coefficients and size distributions measured behind each inlet. Consistent with previous flights, it appeared that the LaRC inlet was not transmitting large particles very efficiently. The UH inlet also seemed to be slightly less efficient (a few percent according to scattering coefficient measurements shown in Figure 1) than the UNH inlet, though some of the differences may have been due to instrument calibration/sensitivity.

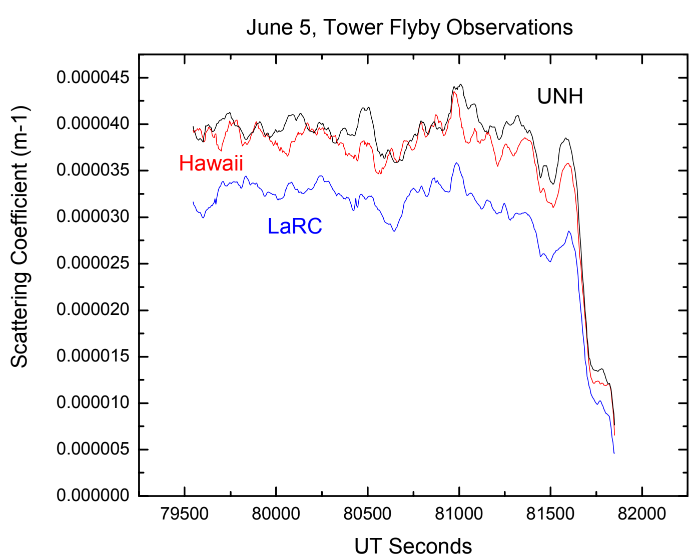

Figure 1. Pressure and temperature corrected aerosol scattering data from the Radiance Research Nephelometers operating on each of the test inlets collected during the tower flyby portion of the flight. All inlets were operating isokinetically.

After departing Edwards air space, we climbed to high altitude and flew to the Monterrey area to perform WINDRAD maneuvers over various ocean buoys in coordination with a satellite overpass. During this time, we investigated the cause for pressure differences between the inlets. With flow valved off, pressures measured inside the three inlets were essentially the same and roughly equivalent to the impact pressure recorded on the aircraft pitot-static system. As sample flow was gradually increased toward achieving isokinetic conditions on each of the inlets, the inlet pressures began to drop relative to the measured impact pressure, with UNH's dropping the least and LaRC's dropping the most. However, in most cases, both the UH and UNH inlet pressures for isokinetic sampling were only a few 10's of mb lower than the aircraft total pressure while the LaRC value was often >100 mb lower.

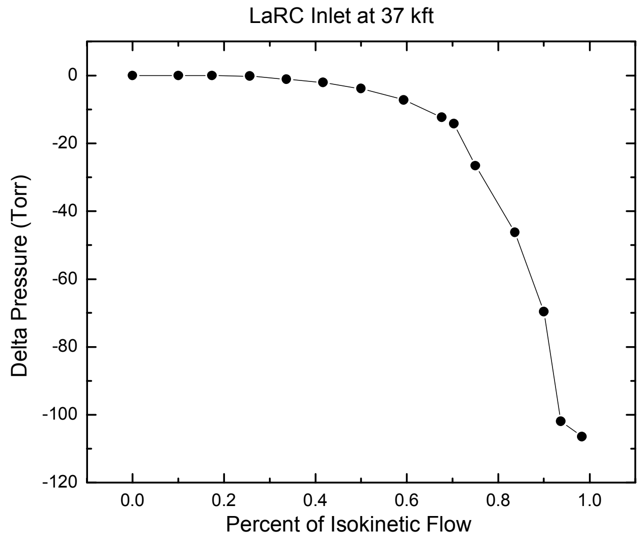

Figure 1. Pressure drop within the LaRC inlet as a function of normalized flow.

To see if the inlets would have the same particle transmission efficiencies if operated at the same pressure, we carefully controlled the LaRC inlet pressure to be the same as that measured within the UH inlet during the spiral descent over the ocean. As shown in

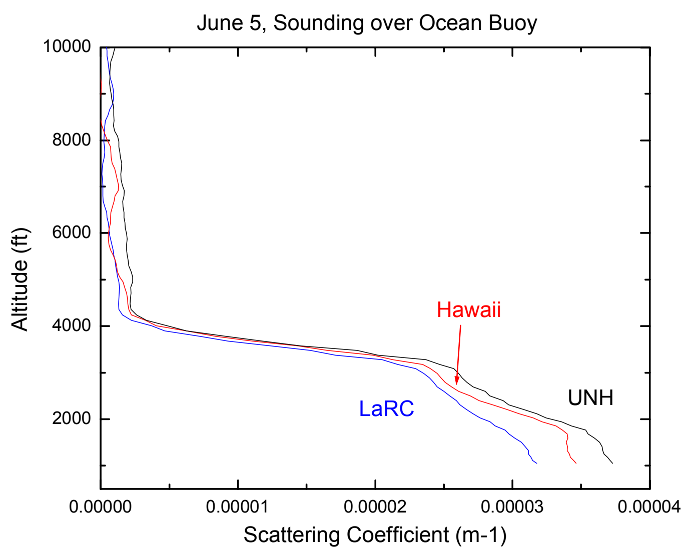

Figure 2. Pressure and temperature corrected scattering coefficients measured during the spiral decent into the marine boundary layer. The Hawaii and UNH inlets were isokinetic in this case whereas the LaRC inlet was operated 40% subisokinetic.

Figure 2, aerosol losses within the LaRC inlet were lessened but not eliminated by increasing the inlet pressure. Tests that involved switching flow between the instruments on the LaRC and the UH inlet and visa versa confirmed that the apparent lower concentrations and scattering coefficients measured behind the LaRC inlet were real and not an instrument artifact. Aerosol size distributions recorded by the APS instruments suggest a majority of the losses are occurring at sizes >2 um.

While within the MBL, we performed additional tests to examine the impact of subisokinetic flow upon the measured composition and aerosol characteristics. For the first half of the 20 minute MBL run, UNH operated their common inlet at 100% of isokinetic flow and their filter inlet at 85%. In the second half, both inlets were at 85%.

Total aerosol scattering profiles recorded during the climb back to altitude and on the ramp descent into Edwards confirmed the lower efficiency of the LaRC inlet and further suggested a slight difference exists between the UH and UNH inlets.