DICE Flight Report: June 11, 2003

Flight Type: WINDRAD Piggyback with tower flybys

Flight Objectives:

1. Continue instrument characterization studies
2. Test modified LaRC inlet
3. Examine sensitivity of APS on UNH rack by cross-sampling between UNH and UH racks
4. Perform multiple tower flybys

Flight Plan (UT)

20:51:00	Taxi
21:58:03	Takeoff
22:08:20 – 22:12:06	200’ pass by tower (#1); all isokinetic
22:14:20 – 22:18:00	500’ downwind (#1); all isokinetic; UH and UNH swapped inlets
22:21:50 – 22:25:26	200’ pass by tower (#2); all isokinetic
22:26:30	Climb to 35 kft
23:01:00	Level at 35 kft
24:20:00	Descend to 26 kft
24:28:00	Level at 26 kft
26:37:00	Descend to 800 ft; all isokinetic
26:53:30	Level at 800’; UNH and UH switch inlets
26:58:00	UNH and UH back to normal; UNH to 70% iso
27:02:20	LaRC goes to 70% iso
27:07:00	All 70% of iso
27:11:00	UH and LaRC switch inlets at 70% iso
27:15:00	UH and LaRC switched, go to 100% iso
27:19:00	UH and LaRC back to normal & 100% iso
27:20:10	Begin climb to 37 kft; LaRC at 70% iso
27:43:40	Level at 37 kft
28:18:00	Begin descent into Edwards
28:48:00	Land

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

Report

Lee went to the tower early to increase the fan speed on the ground station neph and install a Radiance Research neph to operate during the tower flybys. This work was motivated by the fact that scattering coefficients measured at the ground station were consistently lower than those recorded on the aircraft during tower flybys (see Figure 4, June 7 report). To investigate the discrepancy, Ken visited the tower the previous day and compared the data recorded by a RR neph with its inlet aligned into the wind with that measured by the TSI neph operating within the groundstation shelter and aspiring sample air from the omnidirectional inlet. He found that the TSI neph values were 10% or more lower than those from the RR neph. When he plumbed the RR neph and TSI neph to sample the same air stream, he observed excellent agreement between the two instruments. He then discovered that the flow rate on the TSI neph was set at 5% of maximum; we surmise that the low sampling velocity caused the instrument to under-sample large particles. The overall low velocity through the large diameter aerosol inlet of the ground station may have also caused the APS to record size distributions that also under-represented the coarse-mode particles.

As for the met conditions at takeoff, the skies over Edwards were clear and cloudless and the temperature ~80°F. Winds were strong, gusting up 18 m/s, and generally coming from the southwest along the tower flyby line. Billowing dust clouds were evident in a number of locations over the dry lake bed where the strong wind was picking up coarse particles; visibility was reduced throughout the valley due to transport of photochemical pollution from the LA area.

We took off at ~3 pm local and climbed briefly to 3 kft to warm-up instruments before entering a left base pattern around the airfield to perform the tower flybys. After passing over Boron, we dropped down to 200’ over the northeast edge of the lakebed and began collecting filter samples with all inlets operating 100% isokinetic. Upon reaching the end of the run, we turned left and performed a 500’ downwind leg over the bombing range during which UH and UNH switched flow from their inlets to instruments on the other group’s racks. The objective of this exercise was to investigate source of differences

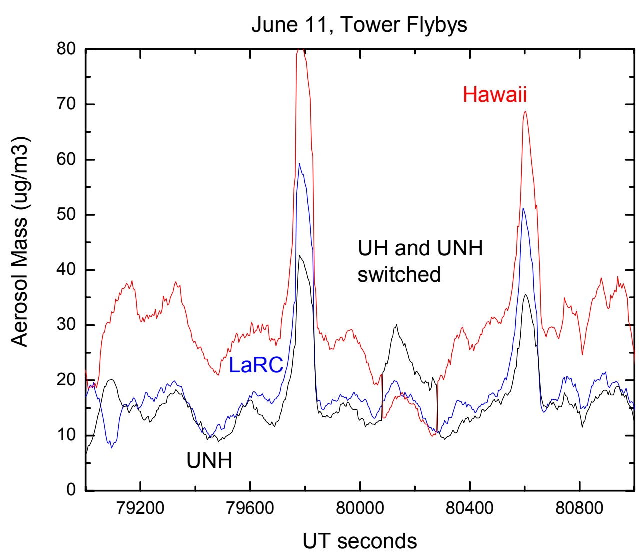

Figure 1. Aerosol mass calculated from APS data recorded during the low level passes by Eddy Tower.

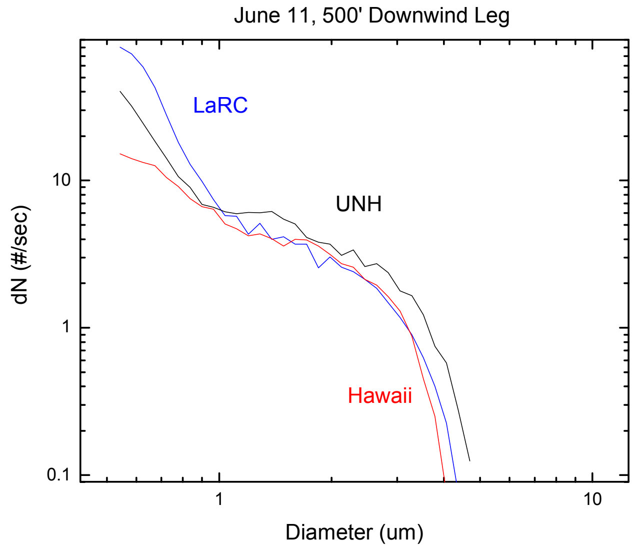

Figure 1b. Aerosol size distributions from period when UNH and UH inlets were sampled by instruments on the each other's racks.

in mass measured by APS units operating behind the UH and UNH inlets. As illustrated in Figures 1 and 1b, it appears that the discrepancies are due to differences in instrument calibration, not to differential particle transmission by the two inlets. Earlier tests had established that the APS units in the LaRC and UH rack performed similarly, thus it appeared that the modifications made to the LaRC inlet tip did little to improve its performance (see Figures 1 and 2).

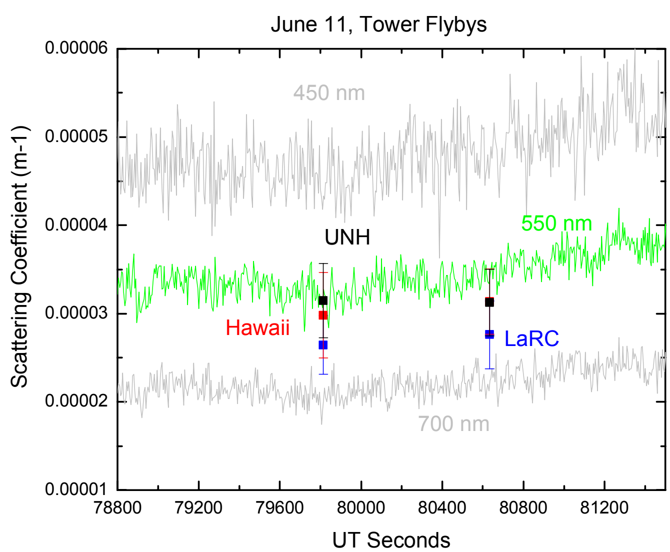

Figure 2. Scattering coefficients measured aboard the aircraft during the 200' runs compared to those recorded at Eddy Tower.

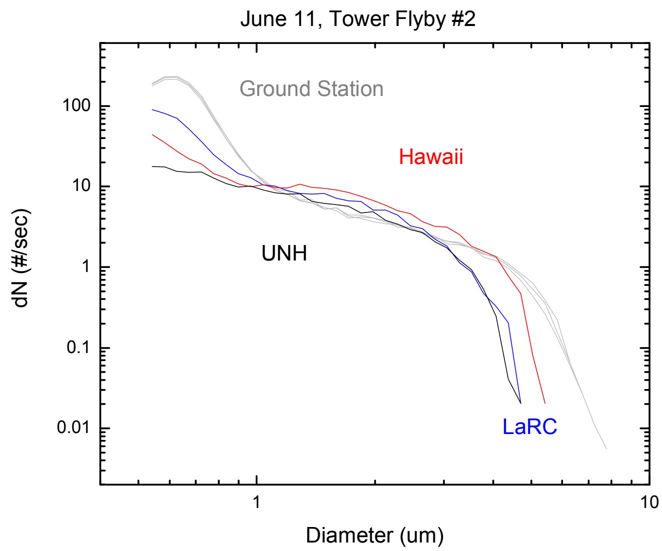

Figure 3. Airborne particle size distributions recorded during the second 200’ pass by Eddy Tower compared to 15 minute averages of ground station data.

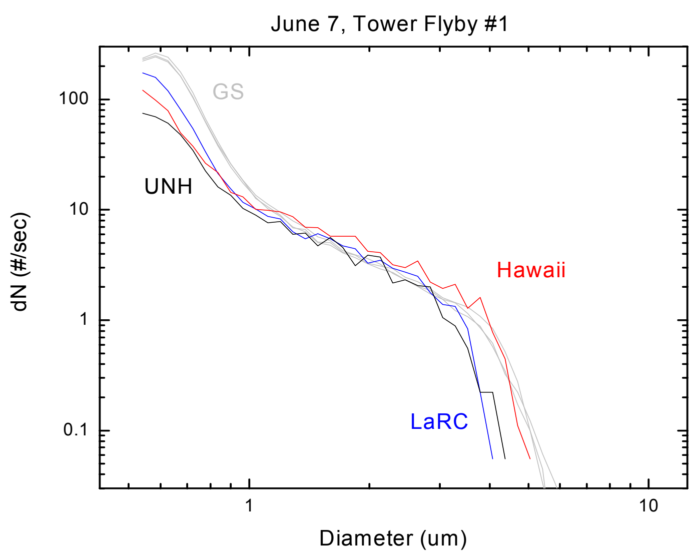

Figure 4. Particle size distributions recorded during the first 200’ pass by Eddy Tower on June 7 (before sample flow increased to TSI neph) compared to 15 minute averages of ground station data.

After the second tower flyby, we spiraled up to 18 kft over EAFB, then departed the area to the northwest and climbed to 35 kft enroute to perform LRR and WINDRAD maneuvers over buoys located just off the California coast.

Examining data from the tower flybys, we found that the aircraft scattering coefficients were lower than those recorded at the ground station, more in line with our expectations (Figure 2). We also noted that size distributions recorded by the ground-based APS extended to larger sizes (8 um as opposed to 5 um) than on previous days (contrast Figures 3 and 4) when similar meteorological conditions and aerosol loadings were prevalent within Antelope Valley. Thus we conclude that the low inlet velocity maintained at the ground station on previous flights had caused it to poorly sample coarse aerosol particles.

After the WINDRAD/LRR maneuvers were complete, we descended into the MBL and performed a 25 minute sampling run during which UH cross sampled both the LaRC and UNH inlets (and visa versa) to accumulate further data for defining the relative passing efficiency of the three inlets. During the descent, we noted a very strong scattering layer

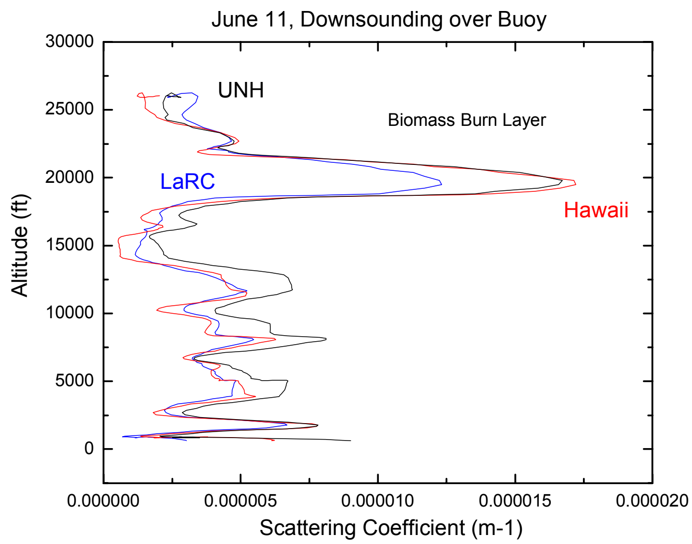

Figure 5. Vertical profiles of scattering coefficient recorded about 300 km offshore west of Monterrey. All inlets were operating at isokinetic flow velocity.

centered at ~20 kft and containing high concentrations of refractory particles. According to Lidar profiles, this layer was horizontally extensive, a dominant feature stretching the entire length of our flight path. Trajectory forcasts suggest it may have arisen from fires or pollution in Asia/Russia.

Data recorded during the MBL run further substantiated that the differences in size distributions recorded behind the UH and UNH inlets were more related to instrument performance than differences in inlet transmission efficiencies. The LaRC inlet, bored out to be similar in dimensions to the UH inlet tip, exhibited improved performance in transmitting large sea-salt particles, but was still appeared to be less efficient than either the UNH or UH inlets.