DICE Flight Report: May 31, 2003

Flight Type: Dryden local to make comparative measurements in tower flybys

Flight Objectives:

1. Continue instrument, plumbing, software, communications checkout
2. Perform multiple passes by ground station tower
3. Perform vertical profiles over Aeronet Site

Flight Plan (UT)

16:53 Taxi
16:59 Takeoff
17:05 Level at 15 kft
17:29 Begin spiral descent
17:48 End descent
17:48:30 – 17:52:00 Tower Flyby #1
18:03:50 – 18:08:20 Tower Flyby #2
18:20:00 – 18:23:40 Tower Flyby #3
18:34:50 – 18:38:20 Tower Flyby #4
18:38 Begin climb to 21 kft
18:50 Level at 21 kft
19:32 Begin spiral descent
19:50 End descent
19:50:30 – 19:54:00 Tower Flyby #5
20:05:10 – 20:08:50 Tower Flyby #6
20:20:10 – 20:23:20 Tower Flyby #7
20:31 Land

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

Report

The skies over Edwards were clear and cloudless and the temperature ~85 F at takeoff. Winds were from the SW at 6 m/s. Haze was evident throughout the valley, though the winds were not strong enough to mobilize surface dust.

We took off at ~10 am local and climbed to 15 kft while warming up instruments. The APS, nephelometer, and OPC units used for the inlet comparisons powered up and behaved normally. The large vacuum pump installed aboard the aircraft on Friday was tested and could draw ~25 LPM flow through the 25 mm filter collectors, a great improvement over the 1.5 to 20 LPM that the passive pumping systems pulled on the previous flight.

While at 15 kft, two perpendicular, level runs were flown over the tower to acquire lidar aerosol scattering profiles. Then a slow spiral sounding was performed over Edwards field to collect optical parameter measurements for comparison with the Rogers Dry Lake Aeronet Aerosol Optical Thickness data.

About 50 minutes into the flight, we began the first series of tower flybys. For these runs, we maneuvered into position over the Boron, CA area, then dropped down to 200' AGL over the northeast edge of the lake bed. We maintained an altitude of 200' AGL past the tower, climbed to 500' AGL briefly over the rifle range, then dropped back down to 200' AGL and stayed there until we approached the southwest edge of the controlled area near Rosamond. There, we made a steep left turn and conducted a downwind sampling leg over the eastern side of the lake bed at 300' to 500' AGL. The upwind tower flyby legs were typically 3 to 4 minutes long and we were straight and level for 2 to 3 minutes on the downwind legs before we had to climb to avoid the hills near Boron.

Data was collected on four loops around the field, then we climbed to 21 kft to acquire additional lidar profiles and optical parameter soundings over the field. On the climb up, a number of haze layers were visually evident on the horizon and UH reported passing through high scattering layers at 4 and 5.5 km. Dave Westberg's back trajectories indicated that some of the pollution may have come from forest fires in northern China.

After descending, we made three more circuits around the tower before landing.

In terms of filter collection, for the first four flybys, we sampled only during the 200' legs and exposed the filters on two legs before changing them out. On the last three flybys, we opened the filter valves upon reaching 200' AGL on the first pass, then drew sample continuously until we completed the third 200' AGL run giving a total sampling time of 33 minutes.

Because of the LRR antenna vibrates like crazy at high air speeds, a new speed limit of 260 IAS was enforced on the DC-8 for this flight. This reduced the pumping efficiency of our venturis and we continuously struggled to maintain isokinetic flow through our inlets. New Hampshire reported being as much as 30% low on some runs and Hawaii, after the fact, calculated that they may have been low by 50% at times. Langley was still capable of going super-isokinetic, but largely by virtue of having the UNH filter system pull a large fraction of their total inlet flow into the newly installed oil pump.

Examples of the aircraft/ground station measurement intercomparisons for the flight are shown in Figures 1 and 2.

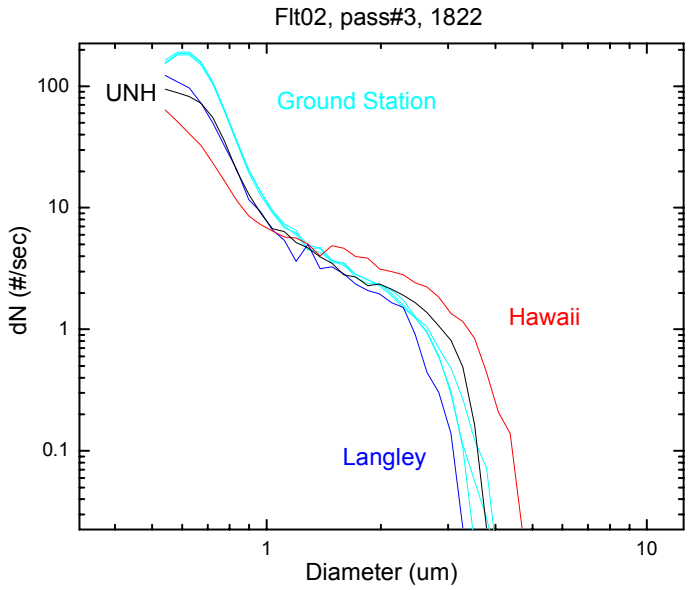

Figure 1. Aerodynamic Particle Sizer distributions from the aircraft and ground station for the third tower flyby. The ground based data are 15 minute averages for the period before, during and after the aircraft passage. The aircraft data are averages over the entire 3.5 minute time the DC-8 was at 200' AGL. These data have not been corrected for the response of the APS units; we expect that a large fraction of the differences in measurements at submicron particle sizes can be explained by differences in instrument performance.

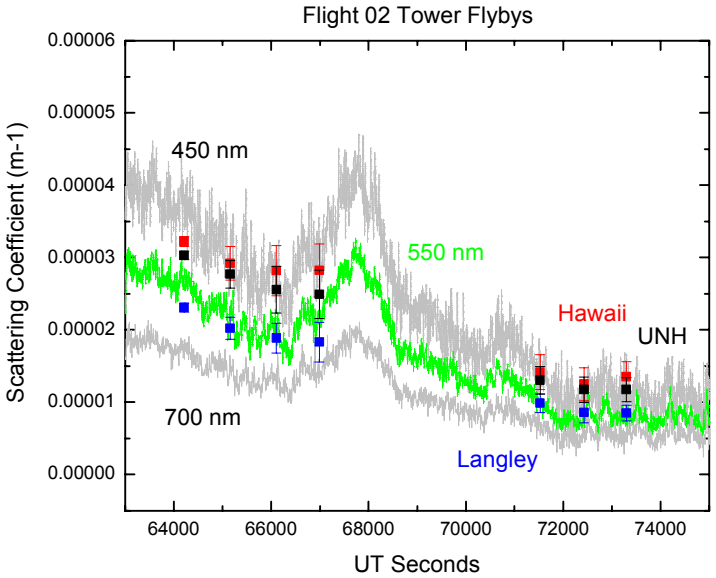

Figure 2. Comparison of the aircraft 530 nm scattering coefficients from tower flybys with ground station data. The aircraft Radiance Research nephs had been calibrated the previous day and were in good working order.