

## DC-8 Flight 16, 26 June

This flight was primarily a transit from Palmdale to Cold Lake to start the second phase of ARCTAS. Canadian Immigration and Customs required that we land in Edmonton to check into the country, and then do a short (30 minute) flight on to Cold Lake. All instruments worked well from shortly after takeoff until landing at Edmonton. None of the DC-8 instruments came back on for the second part of the transit.

Multiple objectives were planned enroute. During climb out of Palmdale we headed over the LA basin to Catalina Island then turned back to fly one last DIAL curtain at 17.5 kft over the city to characterize the early morning BL. DIAL came on line soon enough to take some data on the south bound leg and was fully on line on the return. Turning north into the SJV, we remained at 17.5 kft long enough for DIAL to report 2 distinct aerosol layers beneath us (assumed to be smoke from all the CA fires). Upper layer near 11 kft was separated from the stronger layer between 3 and 6 kft in the southern end of the valley. Descent to 10 kft allowed in situ instruments to confirm that the upper layer was fire smoke, and that strongest scattering was close to 11.5 kft, so we returned to that level for 5 minute leg. Descent to 5 kft found top of lower layer just above 6 kft, but thicker smoke at 5 kft. Subsequent descent to 1 kft AGL confirmed that the thickest smoke was not extending all the way to the surface (i.e., it was hazy at our lowest flight level, but less so than in the layer from 3-5 kft). Final level leg in the central valley was flown at 3 kft in very thick smoke ( $\text{CO} > 2 \text{ ppm}$ , extinction  $> 1000 \text{ Mm}^{-1}$ ). All biomass burning tracers showed extremely large enhancements in this layer, including organic aerosols. However, many urban pollution tracers were also enhanced.

Heading east, we climbed back to 17.5 kft to clear the Sierra Mountains and set up for a lidar curtain above the P3 over Lake Tahoe. DIAL observed strong scattering layer (presumed to be the CA smoke) from about 13 kft down to surface. We descended and sampled the smoke east of the mountains at 13 kft. As terrain dropped beneath so did the smoke, and we passed out of it. DIAL and visible observations showed smoke filling the valleys in Basin and Range region, but the fact that our flight path was nearly perpendicular to the ranges prevented us from getting down to sample it again. We continued eastward about 1 kft above the regional peaks, then ascended to 17.5 kft to make better time enroute to southern Utah and the Four Corners region. Shortly after crossing Bryce Canyon we returned to 1 kft AGL and toured Monument Valley, passing very near Ship Rock enroute to the large coal-fired power plant at Four Corners. As expected, large enhancements in  $\text{SO}_2$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{NO}_x$ , and  $\text{CO}_2$  (among others), but not CO, were observed in each of our two low level transects of the power plant plume.

After the power plant tour we ascended to 33 kft to rendezvous with HIAPER over the Colorado Rocky Mountains. We arrived at the scheduled time (despite taking off 26 minutes late). Unfortunately, chat between experimenters on the DC-8 and their colleagues on the GV had caused NCAR to believe we would be late, so they had delayed takeoff. We loitered about 15 minutes waiting for HIAPER to arrive in the region. Formation was established at 34 kft at approximately 19:00. Platform scientists on the 2 airplanes then chatted and decided to cut each of the 3 level legs back to 15 minutes

rather than the 20 minute legs planned. DIAL reported that the scattered clouds in the region had bases near 11 kft, so the intermediate leg was flown at cloud base, followed by 15 minutes at 1 kft AGL nominal altitude. Restricted areas required that we deviate westward of the planned track (which was along a TES ground track). (After the flight we learned that Aura performed some unscheduled maneuver, so TES was not looking along the track anyway.) At the end of the 11 kft leg the DC-8 dropped behind the GV to sample its exhaust for several minutes.

In situ observations on the DC-8 suggest that there was a lot of fine scale structure along the 34 kft leg. Run at 11 kft was very near to the top of mixed layer, so passing in and out of that layer also created significant variations in many tracers. Extremely high  $\text{H}_2\text{SO}_4$  and  $\text{CO}_2$  was measured in GV exhaust, with more modest enhancements in  $\text{SO}_2$ . Small or no enhancements in CO and black carbon suggest very efficient combustion.

At conclusion of the intercomparison the DC-8 was turned over to the pilots. In order to save fuel (to avoid needing to refuel in Edmonton) and beat the P3 to the line at Customs we ascended into the stratosphere at 40 kft for most of the final leg.