

DC-8 Flight 22, 9 July, 2008

Thule local mission. Originally, this sortie was supposed to be a transit back to Cold Lake, starting with formation flight with the Falcon over Summit. Because changes to Flight 21 prevented reaching the northern branch of the Siberian plume on the way to Thule, that target became one of the priorities for this flight. However, the chemical forecasts indicated that the plume would be pretty far north of Thule, perhaps near 87 N.

Logistical constraints (primarily the short work day at Thule) made timing a key issue throughout the flight. We shortened preflight warm up to 2.5 hours in order to have an 8:30 local (11:30 Z)takeoff, and planned a 7 hour mission in order to have some loiter time on returning, in case the thick fog that enveloped Thule from afternoon 8 July (and through takeoff time) had not burned off by mid-afternoon as forecasted by the Thule Met office. Hitting all the objectives within this time line meant we had to include several long legs at high altitude and high speeds, in order to reach 87 N before heading back to base.

Fog was very thick at takeoff, and there was some last minute negotiating with ATC, so we were not off deck until 11:51 Z. Transit to Summit for the spiral under MOPPET prior to Falcon rendezvous was made at 28 kft and 450 knots true air speed. This got us back on schedule, but caused some difficulties for DFGAS and TOGA. Clouds for most of this leg were limited to a low deck just above the ice sheet, and as we neared Summit there were large breaks even in the low clouds. MOPPET was able to make retrievals over much of the central part of the ice sheet, north and east of Summit and all DC-8 instruments were operating normally during the spiral. The only minor disappointment was that we were not able to spiral all the way down to the boundary layer for comparison with ground measurements at Summit, since there were clouds over the station. Ground observers reported cloud base at 1200 feet, but there were no breaks in the immediate area that might have allowed us to get below the clouds. The Falcon had arrived at rendezvous point by this time so we could not search for breaks, but we did form up with the other airplane very close to scheduled time.

First intercomparison leg at 14 kft was flown as planned, but we were held at 19 kft for more than 5 minutes during the climb to our second planned level leg at 24 kft. Almost as soon as we leveled off at 24 kft, ATC directed that we return to 19 kft. Intecomparison leg was extended along the same south westerly heading over Davis Strait and flown at 19 kft for the full 15 minutes, but this put us behind schedule by about 20 minutes again.

Turning northward toward the Siberian/Asian plumes that were our next objective, we climbed back to 28 kft and cruised at 440 knots to make up as much time as possible without jeopardizing instrument performance. The TES ground track for Step and Stare special observations was joined and followed to 78 N, where we turned to NNW to intercept the forecast Asian plumes. At 28 kft we entered the lower stratosphere (or crossed a trop fold) near our turning point, providing a nice gradient in O₃ and CO for both in situ measurements on the DC-8 and TES. Small enhancements in CO and biomass burning tracers were observed at 28 kft near 79 N. At this point in the flight, we

learned that fog had cleared at Thule, and that the airport would stay open until 17:00 local time if necessary, so our requirement to stay high and fly fast in order to reach 87 N before descending to sample in the plumes (if DIAL confirmed where they were) on the return leg was relaxed. We profiled between 10 and 30 kft with 9 short level legs and enroute ascents/descents between 80 and 87 N on both north bound and south bound tracks. North of 86 the plume seemed to be thinner and weaker (as seen by DIAL, unfortunately, ATC was slow to grant our request to descend out of 28 kft before we made our turn back to the south). Several chemically distinct layers were sampled, largest CO enhancement and highest abundance of BB tracers were found between 4 and 6 km. This layer also had some absorbing aerosol and modest enhancements in scattering, CO remained elevated (near 150 ppb) to 28 kft, but most other tracers decreased markedly above 6 km.

Final leg back to Thule was flown at 25 kft. Crossing over Ellsmere near cloud tops, DFGAS reported HCHO oscillations from near detection limit to as much as 500 ppt over several minute time scales. It is hypothesized that cloud processing, perhaps modulated by mild mountain waves, was responsible.

Landing back at Thule was at 15:47 local time, within their standard work day. Despite the multiple objectives and constraints, this flight was successful at meeting all goals. All instruments reported that good data were obtained for most of the flight, and all expected to be ready to operate for the transit back to Cold Lake the next day. Several groups mentioned concerns that expendables might run out late in Flight 24, but they would operate as long as they could.