Mission Scientist Report, RICO, RF10 January 5th, 2005
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Figure 1: Images showing cloud field early, gravity wave patterning of upper cirrus deck (left), and structure of clouds close up, when shaded by upper level cirrus (right).

**General cloud characteristics:** With the exception of the overlying cirrus deck related to the upper level jet-stream, this was a classical tradewind layer, with a deep layer of North Easterlies and a distinct trade inversion near 800 hPa (Fig. ??). There was a very dry layer (Dew points of -40 degC) above the trade inversion and below the upper level cloud deck and little evidence of the upper deck precipitating into the lower level cloud fields. The upper level cloud deck cleared somewhat during the middle period of cloud work, but re-established itself over the flight area later one. Clouds grouped in bands, with bands of clear air several tens of kilometers in between. Within bands evidence of lines, or linear grouping of cells, made cloud work very easy as we tended to work upwind and then downwind at fixed levels along these bands. This is somewhat evident from the 0.5deg surveillance scan from SPoL which is included in Fig. 3. That said, the lack of direct solar radiation at times made the assessment of cloud targets more difficult. Early cloud base was somewhat higher than in the past, although it seemed to lower through the flight. Clouds seemed to develop more strongly through the course of our cloud work, with a few topping 6000ft, there was evidence of some tops closer to 9000ft from lidar/dropsonde circle at the end of the mission. At the beginning and end of the mission there was evidence of a more stratiform layer at the base of the inversion, perhaps being fed by cumuli, although no such systems were penetrated. Droplet concentrations tended to be about 100 cm$^{-3}$ (Fig. ??) and updrafts of 5 ms$^{-1}$ were common. On the first 15,000 ft circle the gravity wave modulation of the upper level cloud field (see Fig 1) was evident in the temperature and humidity fields at flight level. Drizzle seemed to be more prevalent as the flight progressed, and this was interpreted as the advection into the flight area of more active cloud fields.

**General Comments:** Take off was delayed by nearly an hour because of fueling delays. Another very nice case for statistical studies, with cloud fields perhaps showing less range in altitudes than in previous studies. Another case where relatively shallow clouds produced remarkable amounts of precip. The cloud field we sampled was also worked by the KingAir, leading to a potentially well coordinated data set.
Overview of Flight Pattern: The flight pattern was a standard one with bookend circles flown at 15000 ft (with dropsondes), sub-cloud legs at 1700ft (first) and 1500ft (last), and surface legs at 300ft (Figs. ?? and ??). The surface leg was flown after sunset, and the last 15000ft leg was flown in the dark. We worked cloud base twice for 30 minutes once at the beginning of our cloud work interval and once again at the end. In addition a series of four other levels through the cloud were stepped through, leading to nice and systematic vertical probing. Each 30 minute interval on level corresponded to roughly 3 passes through a linearly organized cluster of clouds.

Flight Notes:

14:45 Taxi (altimeter 3005)
14:52 Takeoff, Cloud base near 2500 ft. Humid inversion base near 2000m
   Considerable shear through cloud layer, vary dry aloft.
   Moist layer above 5km
15:17 Start of circle
15:27 Slight turbulence. Wavy humidity field (15:20-15:30), with 2min (20km) period: gravity waves?
15:39 Blip on 260X, Precip from Stratiform Layer at 6km?
15:40 More significant turbulence.
15:47 Descent sounding, Cloud base 940-950 hPa from dropsondes.
16:00 Cloud base at 2200ft.
16:02 Altimeter at 3017
16:05 Start 300 ft, CCM circle, PALT 260ft, GGALT 90m.
16:09 Winds 7-8 ms$^{-1}$, CONCN $\approx$ 400 cm$^{-3}$
16:15 Ship track, both cargo and tanker visible down wind.
   Lidar cloud base between 700 and 750m.
16:35 Finished circle, climbing to 1700 ft.
16:41 Starting 1700 ft, CW circle.
16:48 Nice cloud features in NE quadrant (of circle).
16:53 Ship plume, with double peak structure
17:12 Finish 1700’ circle, ascending
17:15 At 2500 ft, Precip
17:20 Precip on window.
17:46 Ascend to 3000 ft, many penetrations with precip at this altitude.
18:10 Small cloud with plenty of precip penetrated.
18:23 Clear air pH calibration
18:24 Climbing to 4000 ft (penetrations all have precip).
19:40 Sounding, up to 900 ft, descend to 300ft, back to 2500 ft.
19:55 Ascent through cloud (seemed to miss base and clip side).
19:56 Working cloud at 3500 ft.
20:16 Pass through detached thermal.
21:33 1500 ft circle finished.
21:38 starting 300 ft circle.
22:09 Finished 300 ft circle.
22:21 Starting 15000 ft circle (CW).
22:52 Finished circle, returning home.
23:18 Landing.

Figure 2: Dropsondes from first (blue) and second (red) legs. Left panel shows $\theta_e$ and $\theta_{e,s}$, right panel shows $u$ and $v$ winds.
Figure 3: SPOL surveillance scan (0.5deg) reflectivity with superimposed C130Q and KingAir flight tracks.
Figure 4: Flight altitudes.

RICO, Flight #rf10
01/05/2005, 14:50:04-23:20:00

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Figure 5: Flight tracks.
Figure 6: FSSP Droplet Concentrations.