



University of Wyoming
Department of Atmospheric Science
NASA ROLLS Field Site

15 January 2004 - 15 February 2004

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[Contacts](#) | [Tech Notes](#) | [Flight Data](#) | [Radar Quick Looks](#) | [Plot of Flight Hours](#)

Date	Flight Number	Status	Times (UTC)	Hours
2/15/2004 (Sun)	12	RALT2 down until 1348	1333-1712	3.5
2/14/2004 (Sat)		No Flight		
2/13/2004 (Fri)		No Flight		
2/12/2004 (Thu)		No Flight		
2/11/2004 (Wed)		No Flight		
2/10/2004 (Tue)		No Flight		
2/09/2004 (Mon)	11	RALT2 down until 1433 Licor ref gas not turned on until 1510	1416-1656	2.5
2/08/2004 (Sun)		No Flight		
2/07/2004 (Sat)	10	Brent disassembled and reassembled the nose boom. No glitches in AIAS and DPR.	2134-2326	2.0
2/06/2004 (Fri)		No Flight		
2/05/2004 (Thu)		No Flight		
2/04/2004 (Wed)		No Flight		
2/03/2004 (Tue)		No Flight		
2/02/2004 (Mon)		No Flight		
2/01/2004 (Sun)		No Flight		
1/31/2004 (Sat)	9	RALT2 down until 1446 Glitches in AIAS and DPR becoming more numerous.	1357-1608	2.3
1/30/2004 (Fri)	8	Microphysics flight	1807-2025	2.6
1/30/2004 (Fri)	7	RALT2 down until 1433 Calibration Maneuvers	1257-1633	3.7

1/29/2004 (Thu)	6	RALT2 down until 1408.	1338-1558	2.4
1/28/2004 (Wed)		No Flight		
1/27/2004 (Tue)		No Flight		
1/26/2004 (Mon)		No Flight		
1/25/2004 (Sun)		No Flight		
1/24/2004 (Sat)		No Flight		
1/23/2004 (Fri)		No Flight		
1/22/2004 (Thu)	5	RALT2 down until 1848	1725-2028	3.2
1/22/2004 (Thu)	4	RALT2 down until 1319 Replace new FSSP with old.	1259-1549	2.9
1/21/2004 (Wed)		No Flight		
1/20/2004 (Tue)		No Flight		
1/19/2004 (Mon)	3	RALT2 down until 1412	1328-1648	3.4
1/18/2004 (Sun)	2	2D probes look good. RALT2 sporadic until 1536	1500-1814	3.3
1/17/2004 (Sat)		No Flight		
1/16/2004 (Fri)		No Flight		
1/15/2004 (Thu)	1	Most 2DP records incomplete. PVM has 0.05 g/m3 offset.	1603-1800	2.1
Total Research Hours as of 2/15			34.0 of 41.2	

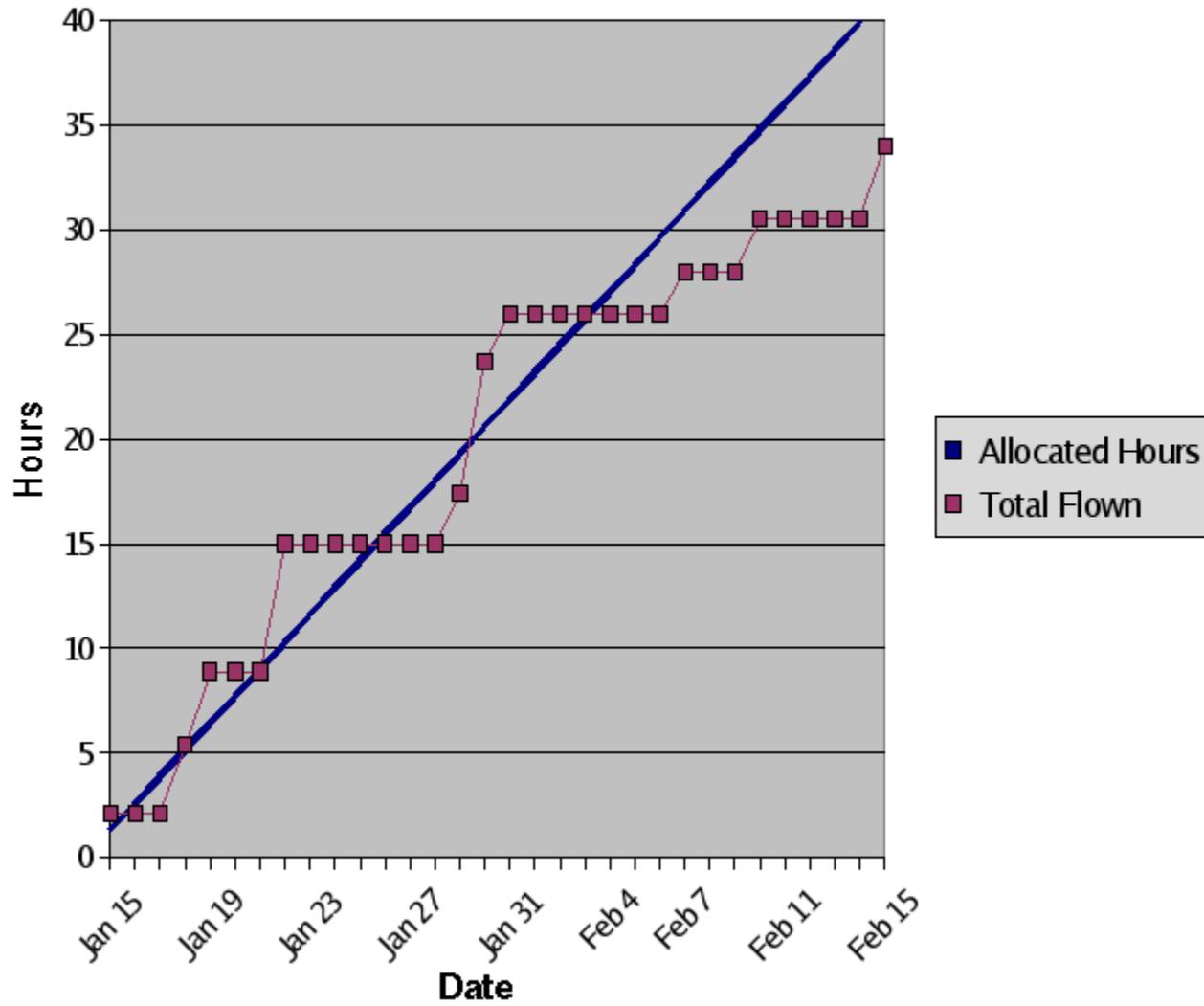


Technical Support Notes for NASA-ROLLS 2004

Flight Date	Flight Number	Crew	Items Done For This Flight
1/22/2003 (Thursday)	4 & 5	BG, MB	<p>Old FSSP was removed.</p> <p>New FSSP was added.</p> <p>1D was removed and optics/contacts were cleaned. No signs of dirt or corrosion.</p> <p>PVM calibration was checked. Disk read correctly and very little (0.002) drift in offset. Probe was recalibrated.</p> <p>After the second flight (high LW as reported by Brent who flew 4th Seat), nose boom was cleaned and blown out. Visible water in boom when disassembled. Desiccant was replaced.</p> <p>Between the two flights the set screw holding one of the switching handles on the radar cam loose and had to be tightened. Socket head is being rounded out so replacement screw are needed.</p> <p>GPS data via the Ashtech was recorded for both flights.</p> <p>APN-159 Comments: The long delay times after switching to "on" and the inability to calculate height above ground are reminiscent of the problems experienced before it finally failed three years ago. A good test would be a missed approach to see if it works over land but not over water (no data was provided during 500' passes over the Lake but data resumed on climb out). Stewart Warner said they most likely cannot fix it this time around.</p> <p>Avionics databases for the GPS, MFD and FMS were updated.</p>
1/19/2003 (Monday)	3	BG, MB	<p>4th Seat Display program was updated to display new variables.</p> <p>Ashtech GPS was installed (6 lbs.. in front display cabinet) with 4th Seat PC (N2UWOBS) will be logging the data. Faster CPU than the laptop seems to show fewer missed data sentences.</p> <p>Noseboom was inspected . . . no visible water.</p> <p>External GPS antenna for the SVeeSix was installed to help Larry install time server software on Tigger.</p>
			Cables and Bus-to-Bus adapter card on the radar computer WASP were reseated at the

1/18/2003 (Sunday)	2	BG, MB	<p>request of Sam Haimov.</p> <p>Reference gas bottle for the Li-Cor was left on after the previous flight and lost half of the gas. Pressure now at ~500psi. Crew was reminded to please turn off the bottle.</p>
1/15/2003 (Thursday)	1	BG, MB	<p>After the flight, the 2D-P was removed, boards reseated, optics cleaned and cables checked due to missing portions of the data records. Nothing unusual was found. The "spinner" and a slow moving wire through the beam were used to check operation. All looks OK.</p> <p>Dew points were checked.</p> <p>Li-Cor was "zeroed" and the span checked before the flight.</p>

NASA ROLLS Flight Hours



NASARolls 20040215

Crew: Fagerstrom, Kelly, Gordon, Glover

1331 Start engines.

Small cold pool with surface high centered over NW Wisconsin. Radar shows rolls over L. Superior, and some lake-effect stcu over northern 1/3 of Lake Michigan. Land breeze convergence has a band of snow going onshore over Chicago. Winds probably too light for rolls over L. Michigan, but the temperatures are cold enough, so we'll try.

Takeoff delayed over an hour by glitch in the power system relay (re: power cart, data system power, etc.). Diagnosed as probable overload on the cart (radar+DAS+avionics+cold start on all the above+charging KingAir batteries cause the plane has been sitting for nearly a week?).

Racine conditions: clear to the west, stcu to the east, occasional light snowfall (unrimed dendrites up to 3 mm). Winds NWly at the surface, NEly at cloud top (re: local flags, power plant plume): classic land breeze signature.

1344 takeoff. Ran WCR down dual in transit, with echo strength varying along the line from Racine to P45.

Waypoints for crosswind line at about 045-225 heading:

P45: 86d 47' 44d 29'

P45-1 86d 23' 44d 43'

1426 P45 to P45-1 at 6500 ft MSL with radar down dual. Echoes not strong, but fairly continuous. Approximate cloud top 5400 ft, base 3800 ft.

1437 Setting up for P45-1 to P45 at 4000 ft, side dual. No obvious signs of linear echo structure. Winds at this level light, 2.5 - 4 m/s. Echoes stronger a north end of line. Echo pattern cellular, perhaps Benard? Noting quite a bit of changes in wind direction. Cell-related?

1447 Setting up for updown, radar software/display glitched. Ended up having to do full reboot.

1503 P45 to P45-1, 4000 ft, updown. Echoes still strongest at north end.

1513 P45-1 to P45, 500 ft agl, radar up+sideslant. Cloud base about 3200 ft. Winds stronger below cloud base than in cloud, and stronger at north end than south.

1523 Sounding 500 ft agl to 6000 ft msl in spiral climb. Cloud top 4400 ft.

1532 P45 to P45-1, 6000 ft, down dual.

1542 P45-1 to P45, 4000 ft , side dual. Echoes weakening along entire track.

1552 Again had to reboot radar computer after trying to switch to updown.

1600 P45 to P45-1, 4000 ft, updown.

1610 P45-1 to P45, 500 ft agl, radar up+sidedown. Echo now VERY spotty as seen in side beam.

1620 climbout sounding enroute Racine.

1706 land.

Should be interesting to look at the first few passes (down dual, side dual) plus aircraft and see if it's obvious how the dynamics of this case differ from the strong roll cases, re: w, v_{nat} quadratures and so on.

LAST FLIGHT OF PROJECT. FOR THE FIRST TIME IN MY FLYING, FINISHING WITH A SIGNIFICANT FRACTION OF UNUSED HOURS!!!

NASARolls

Crew: Fagerstrom, Kelly, Leon, Gordon

1415 start engines. Plan for today is some radar-related maneuvers in some nimbostratus, if available, up in the Green Bay - Traverse City area.

1428 takeoff.

1522 Start descent from 17 kft in right turn with radar updown. Most of the spiral was at about 30 degree bank angle, with one full turn at 45 degree bank. Descended to 10 kft.

1530 Climb at constant heading (270 deg, upwind) to 16 kft with radar in down dual most of the climb.

1535 Spiral descent from 16 kft to 7 kft, radar updown.

1542 Climb at constant heading, downwind, to 16 kft. Initially in updown mode, then switched to down dual.

Sequence of pictures here of optical effects: sun dogs, undersuns, and at one point the circumzenith arc passing through the sundogs. Also got clear shot of our own contrail.

1550 Spiral descent, radar updown, from 16 kft to 7 kft. First four complete turns at 45 degree bank.

1555 Climb at constant heading, upwind, to 8 kft.

1557 Constant-altitude left turn circles with radar up+sideslant.

1602 start back to Racine, at constant altitude above cloud, radar down dual. Initially could see echo, but warmer temperatures and thinning cloud (altocu) put the echo below threshold.

1651 land.

NASA rolls 20040207

Crew: Fagerstrom, Kelly, Leon, Oolman

2120 start engines.

Conditions here at Racine are overcast, with WCR from the apron showing cloud tops about 4300 ft MSL. This morning there were no stcu over the lake, and we had called the day down. But in the early afternoon Larry noticed rolls in the satellite images over the north end of the lake, apparently in a brief surge of cold air. The northern boundary of the roll-aligned stcu moved slowly south, but rolls were still visible in the satellite images (visible) at least until 2200 UTC (1600 LT, about 1/2 hour after takeoff). The rolls were never visible from NEXRAD, on either side of the lake. Roll alignment was essentially north-south.

2133 takeoff, with cloud tops at 4300' MSL on climbout.

2155 Line P-P1 at 6000 ft MSL with radar down dual. Seeing distinct undulations in echo top height and even in Heimann temperature (lake visible through gaps in cloud) at a period of about 60-75 sec (5-6+ km).

2204 P1-P at 3700 ft MSL with radar in updown. Height chosen to stay just below the low spots in the undulating echo tops. Cloud too thin vertically to try horizontal dual Doppler. Staying as close to cloud top as reasonable to see if can document upper limb of roll circulation. At 3700 ft we are in and out of liquid cloud base. Maximum cloud top is 4700 ft or higher.

2216 P-P1 at 500 ft agl with radar up+sideslant.

222515+ climbout fairly rapid sounding in transition to line at 45 degrees to rolls axes. Cloud bases about 3400 ft, cloud tops about 4300 ft MSL.

2232 P45-1 to P45 at 6000 ft MSL with radar down dual, but now seeing marginal echoes, without continuous enough area coverage for very much dual Doppler analysis. Still seeing undulations in echo top height.

2242 P45 to P45-1 at 3700 ft MSL with radar updown. Echoes stronger at SW end of line.

2252+ P45-1 to P45 at 500 ft agl with radar up+sideslant.

Down dual in transit back to Racine.

2325 land.

This certainly will not be our most spectacular case for Doppler analysis, but

it should be good for analysis of the in-situ winds, and especially to compare the cross-wind and at-45-degrees-to-the-wind dynamics, to see how much of the 2-D appearance holds up along the P45 line as compared to the P line.

Waypoints used:

P 87d 20' 43d 30'
P1 86d 50' 43d 30'
P45 87d 16' 43d 23'
p45-1 86d 54' 43d 37'

Note: Need to re-calculate theta-e using the Licor mixing ratio, for all the flights. Otherwise, will see artifacts at cloud top when entering and leaving cloud due to slow response of the EG&G.

NASArolls 20040131

Crew: Fagerstrom, Kelly, Leon, Oolman

1346 start engines. Have classic lake effect situation with NWly winds, and temperatures along the Wisconsin shore at -5 to -10F. The stcu starts well offshore now as there is more ice at the surface.

The flight plan is to work three lines over near the Michigan shore, oriented along, across, and at 45 degrees to the wind (calling it 310 degrees from the GRR radar). GRR radar indicates the clouds are quite shallow and mostly cellular, with occasional indications of roll alignments.

1356 takeoff

Over first few miles of cloud, along the upwind edge, many of the cu tops that are bulging upward (updraft obviously) appear to have wave-like features concentric to the center of the bulge. An analogous appearance would be to drop a beach ball into the water and look at it from below, with ripples moving away from the ball. We were going to try to fly through them at the end of the flight, but the convection had weakened so much they were no longer there.

1412 F1-F2 at 4000 ft msl, radar down dual. This is the cross-wind line.

1423 F2-F1 at 2200 ft msl, side dual, cloud tops about 3100 ft msl.

1424 move down to 1800 ft msl to minimize the times when aircraft roll tilts the side beams out of cloud top. Can occasionally see the lake surface, which is relatively calm compare with other days. Also see occasional patches of sunlight reaching the surface.

1424 F1-F2, 500 ft agl, radar up+side-slant. Cloud bases relatively well defined. Several different evidences of light snowfall: 2DC buffer updating, sunlight shafts visible between cloud base and lake.

Mini-sounding in the transition to G2.

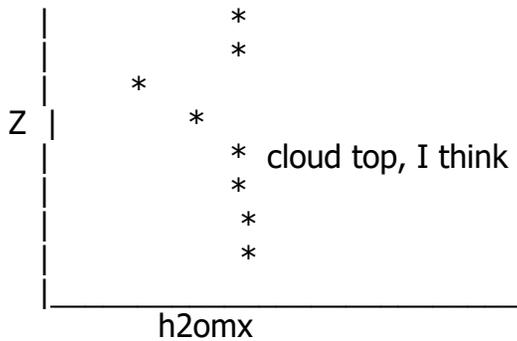
1447 G2-G1 4000 ft, down dual. This line is oriented at 45 degrees to the wind.

1457 G1-G2 1800 ft msl, side dual.

150007 and 150336: sizable holes in cloud.

1507 G2-G1, 500 ft agl, up+side-slant.

Mini sounding in transition to H1. On this and subsequent soundings, see interesting and VERY puzzling profile of water vapor mixing ratio. The thetaE profile is classic: nearly constant from cloud top down, sharp inversion layer from cloud top up. However the water vapor was about 0.25 g/kg both in the BL and above cloud (to a few hundred feet below 4000 ft msl), with a sharp decrease to about half that value just above (I think) cloud top:



1518 H1-H2 4000 ft, down dual

1530 H2-H1, 18000 ft, side dual. Several changes occurring now, including decreasing wind speed, decreasing echo strength, decreasing horizontal echo coverage, higher cloud bases, etc.

1538 H1-H2 500 ft agl, up+side-slant.

Climb back up to 4000 ft msl for return to Racine.

1608 land

Flight: 2004_01_30b

On board: Kevin Fagerstrom, Sarah Walters, Larry Oolman, Brent Glover

Take-off: 1806 UTC - Landing: 2034 UTC -total duration 2 hrs 28 min

Author: Sarah

1. Synopsis: Time: 17:53 UTC

	Sky Cover	Temp(C)	DewPnt (C)	Wind Spd(m/s)	Wind Dir
Racine:	clear	-1	-14	15	W
Sheboygan:	clear	-5	-15	17	W
Green Bay:	partly cloudy	-2	-12	15	W

Green Bay Sounding: Stable, very cold conditions up to 700mb

Winds through all layers throughout flight from 280-320 (mostly from 310-315) at 15-25 (units of hwsdpd unknown m/s or knots?)

Cloud free area larger than previous flights on 01/18, 01/19, 01/22.

Approximately the same as the 01/29 flight

Ice extending off shore much farther than on 01/22.

Steam rising from lake. Most prominent on west side where steam continuous from lake surface to cloud base. On east side steam fog on lake but not connecting to cloud base.

RALT2 not working until approximately 18:30 UTC (between points S and P)

No roll organization visible in radar data.

Lake visible through breaks in clouds.

Cloud tops around 2800-3000ft from Racine to point S. Cloud tops increasing heights from West to East.

Eastern end of track cloud tops around 3800-4000ft

Flight Tracks:

18:06-1821 UTC: Racine to point S: up to 5000 ft MSL

18:22-18:36: Point S to Point P: wait for VFR on top clearance

18:36: Point P too far east, move west 5 miles to avoid traffic to Muskegon.

18:41-19:03: Microphysics study between point P and point Q: Beginning @ 5000ft MSL down to 1200 ft MSL. Complete circle around 10 mile diameter circle for each 500ft interval in altitude 180o of data collection and 180o for 500ft AGL drop in altitude.

19:03-19:03: Climb to 5000ft MSL to point Q

19:08-19:30: Microphysics study at point Q: Beginning @ 5000ft MSL down to 1200ft MSL. Complete circle around 10 mile diameter circle for each 500ft interval in altitude 180o of data collection and 180o for 500ft AGL drop in altitude.

19:30-19:33: Climb to 5000ft MSL to point R

19:33-19:57: Microphysics study at point R: Beginning @ 4500ft MSL down to 1200ft MSL. Complete circle around 10 mile diameter circle for each 500ft interval in altitude 180o of data collection and 180o

for 500ft AGL drop in altitude.

19:59-20:07: Climb to 5000ft MSL to point S

20:08-20:24: Microphysics study at point S: Beginning @ 3000ft MSL down to 1200ft MSL. Complete circle around 10 mile diameter circle for each 500ft interval in altitude 180o of data collection and 180o for 500ft AGL drop in altitude.

20:24: Turn to head cross wind at 500ft AGL, cloud tops above, climb to 1900 ft MSL. Remain at 1900ft MSL for 4 miles, just below cloud top.

20:26: Climb to 2800ft MSL head back to Racine

20:34: Land

Flight: 2004_01_30a

On board: Kevin, Bart, Dave, Larry

Take-off: 12:57 UTC - Landing: 16:34 UTC - total duration 3 hrs 37 min

Author: Bart

1. Synopsis:

The surface temperatures in Racine and Sheboygan at take-off are about -23C to -24C. This is colder than any other flight so far. The entire region of flight remains cloud-free at all levels above the CBL. Surface winds at Racine from the NW (310-320) at 10 kts. Large sheets of new ice, not broken by waves, cover the first few km from shore, and pancake ice floes drift further offshore, with perhaps 90% ice and 10% water. As soon as we reach open water some 10 km offshore, clouds occur. Streamers of steam fog are seen everywhere, but mainly between the ice floes near the upwind shore. Some ice piles up near Muskegon but it remains east of our easternmost point on the flight.

During the flight the winds are 10-12 m/s at all levels (more like 10 m/s above the CBL and 12 m/s within); directions vary between 305 (above the CBL) and 325 (low levels). The Green Bay sounding suggests stable conditions up to 700 mb, and generally a NW flow. Well-developed cumuliform clouds are visible, everywhere. Clear breaks are found only towards the west: near the eastern shore cloudiness is pervasive. That is confirmed by the GRR WSR-88D radar. The latter suggests that these cumuli are marginally aligned in streets oriented about 315-135. Bob Kelly, looking at GRR WSR-88D animations, notes that sometimes lines are visible, sometimes not; the dominant mode is cellular, closely-spaced cells with thin, barely resolvable breaks in between. Never any clearly defined echo lines with clear break lines in between though, as we observed on 1/22. Near the western cloud edge, some cloud lines oriented 300 spacing about 500 m.

2. Instruments

No problems that I am aware of. Dave encountered two VXI problems upon switching mode (one at 15:36), resulting in very little data loss. Start of radar operations was delayed a bit, presumably because the radar was quite cold. Apparently the systems wants to auto-shut down.

3. Flight tracks: a 320 track roughly along the A section (endpoints are SW=42 deg 45'N and 86 deg 43'W; NE=43 deg 00'N and 86 deg 20'N). This track was flown 15 times, as follows:

- Racine to 320B: to 5000 ft MSL,
- 320B to 320B1: sounding down to 500 ft, U/D

- 13:26:00- 13:33:35: NE to SW, 5500 ft MSL, VPDD
- 13:36:05- 13:45:00: SW to NE, 2900 ft MSL, U/D
- 13:47:18- 13:56:00: NE to SW, 3500 ft MSL, HPDD (forced by ATC up to 4000 ft at 13:49)
- 13:57:35- 14:05:20: SW to NE, 5500 ft MSL, VPDD
- 14:07:40- 14:17:00: NE to SW, 2500 ft MSL, U/D
- 14:19:50- 14:29:00: SW to NE, 500 ft AGL, slant-side & UP (track readjusted at 14:20:40)
- 14:31:00- 14:39:10: NE to SW: ramp sounding, 280 ft AGL to 6000 ft MSL, U/D (VPDD starts at 14:36:40)
- 14:42:10- 14:50:10: SW to NE, 5300 ft MSL, VPDD
- 14:52:20- 15:00:30: NE to SW, 3000 ft MSL, HPDD
- 15:03:00- 15:11:15: SW to NE, 2500 ft MSL, U/D
- 15:14:20- 15:22:10: NE to SW, 5500 ft MSL, VPDD
- 15:25:00- 15:33:20: SW to NE, 3000 ft MSL, HPDD
- 15:36:00- 15:45:20: NE to SW, 500 ft AGL, slant-side & UP
- 15:47:30- 15:55:10: SW to NE, 2500 ft MSL, U/D
- 15:58:00- 16:06:00: NE to SW: ramp sounding, 280 ft AGL to 6000 ft MSL, U/D
- 16:06:50- radar shut-off at 16:25:00: continue on towards Racine (WCR in VPDD)
- 16:07-16:15: Rodi manoeuvres at 6000 ft: air seems to be very quiet

Flight: 2004_01_29

On board: Kevin Fagerstrom, Sarah Walters, Dave Leon, Larry Oolman

Take-off: 1337 UTC - Landing: 1557 UTC -total duration 2 hrs 20 min

Author: Sarah

1. Synopsis:

Time: 12:53	Sky Cover	Temp(C)	DewPnt (C)	Wind Spd(m/s)	Wind Dir
Racine:	mostly cloudy	-4	-16	9	NW
Sheboygan:	high clouds	-10	-19	13	W
Green Bay:	high clouds	-12	-21	8	W

Green Bay Sounding: Stable, very cold conditions up to 650mb

Winds through all layers throughout flight from 280-345 (mostly from 280-300) at 9-18 (mostly 11-13) (units of hwsprd unknown m/s or knots?)

Cloud free area larger than previous flights on 01/18, 01/19, and 01/22.

Ice extending off shore much farther than on 01/22. Lake surface smoother than 01/22.

Very little steam rising from lake surface throughout flight. Most prominent on west side of lake.

Cloud tops around 2800-3000ft from Racine to point B. Cloud tops increasing heights from South to North.

Northern end of track A cloud tops around 3500-4000ft

RALT2 not working until well into flight

On western edge of clouds very few breaks visible. Along tracks A and B breaks become more regular.

Deck of altostratus above. Dissipating to the north.

After 8th pass (5th pass on track A, A to A1) no roll organization visible in radar data. Decided to do one more in cloud pass to focus on structure. When no roll structure was visible decided to head back to Racine.

Radar crash ~15:27 Restart computer component

Flight Tracks:

13:37-13:52 UTC: Racine to point B: up to 4000 ft MSL

13:52-13:59: Descend from B to B1

14:00-14:08: B1 to B sounding from ztrue 923 (~1100 MSL) climbing to 6000ft MSL at 500ft/min

14:09-14:12: B to A @6000ft MSL descending to 5000ft RALT2 working (WCR in up/down)

14:12-14:19: A to A1 @5000ft MSL (ztrue = 4553) (WCR in VPDD)

14:23-14:33: A1 to A @5000ft MSL (ztrue=4545) (WCR in VPDD)

14:34-14:42: A to A1 @2800ft MSL (ztrue=2543) (WCR in HPDD)

14:45-14:53: A1 to A @1500ft MSL (ztrue=1378) (WCR in up/down)

14:55-15:04: A to A1 @1200ft MSL (ztrue=1041) (WCR in up side slant)

15:06-15:15: A1 to A sounding from 1100ft MSL climbing to 6000ft MSL at 500ft/min. Cloud top around 4100ft MSL

15:17-15:26: A to A1 @2800ft MSL (WCR in HPDD) No roll structure visible in data, climb back up to 6000ft MSL

15:29-15:36: A1 to A @6000ft MSL (WCR in up/down)

15:36-15:57: A to Racine

15:57: Land

Flight: 2004_01_22b

On board: Kevin, Bart, Larry, Brent

Take-off: 17:24 UTC - Landing: 20:28 UTC - total duration 3 hrs 4 min

Author: Bart

1. Synopsis:

The surface temperatures in Racine and Sheboygan at take-off are about -18C. Racine and Sheboygan are cloud-free at all levels. Surface winds from the NW (310-320) at 15 kts. Pancake ice drifts in large floes towards the SE from the Racine Lighthouse, I guess the ice zone is several km wide because it can be seen on visible satellite imagery. The lake persistently shows some whitecaps (small breaking waves) and streamers of steam fog are seen everywhere, suggesting a large temperature differential between water and air.

During the flight the winds are 12-17 m/s at all levels, directions vary between 310 and 320. The Green Bay sounding suggests stable conditions up to 620 mb, and generally a NW flow. Well-developed cumuliform clouds are visible, especially on the eastern end of the track, with clear breaks in between. That is confirmed by the GRR WSR-88D radar. The latter suggests that these cumuli are aligned in streets oriented about 315-135. Visible observations from the plane, and the WCR HP and VP reflectivity fields, confirm that the cloud streets are more clearly defined than on 1/1/9 and on 1/18. This is especially so on the eastern ends of the tracks. Very little liquid water, and no icing on the airframe. Flight was deemed rather bumpy, bumpier than 1/18 and 1/19, but smoother than the 1/22 morning flight. The most turbulent sections are just below cloud top (in the vertical) and in the snow showers towards the NE end of the legs.

2. Instruments

No problems that I am aware of. Larry once encountered a WCR problem upon switching mode, resulting in no data between 19:22-19:26 UTC.

3. Flight tracks: a 310 track roughly along the A section (endpoints are SW=43 deg 11'N and 86 deg 58'W; NE=43 deg 30'N and 86 deg 35'W).

This track was flown 12 times, as follows:

- Racine to SW: to 5000 ft MSL, VPDD
- 17:41:10- 17:51:00: SW to NE, 5000 ft MSL, VPDD
- 17:53:00- 18:04:30: NE to SW, 3300 ft MSL, U/D
- 18:06:10- 18:16:20: SW to NE, 2700 ft MSL, U/D
- 18:18:34- 18:28:00: NE to SW, 2100 ft MSL, U/D
- 18:31:20- 18:42:20: SW to NE, 500 ft AGL, slant-side & UP
- 18:45:00- 18:55:00: NE to SW: ramp sounding, 280 ft AGL to 6000 ft MSL, U/D
- 18:57:20- 19:07:00: SW to NE, 5700 ft MSL, VPDD

- 19:10:00- 19:20:10: NE to SW, 3000 ft MSL, HPDD
- 19:22:30- 19:32:30: SW to NE, 2500 ft MSL, U/D
- 19:35:20- 19:45:40: NE to SW, 1900 ft MSL, U/D
- 19:48:15- 19:58:40: SW to NE, 500 ft AGL, slant-side & UP
- 20:01:00- 20:07:00: NE to SW: ramp sounding, 210 ft AGL to 6000 ft MSL, U/D
- 20:07:50- 20:22:00: continue on roughly the same track towards Racine (WCR in VPDD)

Flight: 2004_01_22

On board: Kevin Fagerstrom, Sarah Walters, Dave Leon, Larry Oolman

Take-off: 1257 UTC - Landing: 1549 UTC -total duration 2 hrs 52 min

Author: Sarah

1. Synopsis:

NWS data:

Time: 12:53	Sky Cover	Temp(C)	DewPnt (C)	Wind Spd(m/s)	Wind Dir
Racine:	clear	-3	-17	16	NW
Sheboygan:	clear	-9	-20	20	NW
Green Bay:	clear	-12	-24	16	NW

Green Bay Sounding: Stable, very cold conditions up to 700mb

Winds through all layers throughout flight from 300-325 (mostly from 310-315) at 20-25 (units of hwspd unknown m/s or knots?)

Cloud free area smaller than previous flights on 01/18 and 01/19, closer by probably 2 km.

On western edge cloud base around 900 to 1000 ft (274 - 304m), Cloud tops around 3000ft from Racine to point C cloud depth approximately 1700 ft (518 m). clear slope in the cloud top height, increasing the east

Steam rising from lake surface visible during entire flight, most prominent along tracks B and A

Along Tracks B and A Roll structure visible from plane and the WCR reflectivity fields. Structure most prominent along track A. Roll structure more defined in the SE portions of tracks A and B.

Visibility below clouds limited along tracks B and A lowest passes around 700 ft (213 m) above lake surface.

Throughout flight breaks in clouds allow clear view of lake surface.

RALT2 had some difficulty until about 13:18

Flight Tracks:

Racine to point C: up to 6000 ft MSL

Ordered up to 7000ft by Chicago for other flight traffic

13:19-13:27 UTC: C to C1 @ 7000 ft MSL (WCR in VPDD)

Ordered to stay at 4000ft by Chicago for C1 to C

13:31-13:42: C1 to C @ 4000 ft MSL (WCR in VPDD)

13:43-13:50: C to C1 @1500 ft MSL (WCR in up/down)

1354-14:02: C1 to C sounding from 1500 ft MSL up to 6000 ft MSL (WCR in up/down)

14:02-14:05: C to B @ 6000 ft MSL (WCR in VPDD)

14:05-14:12: B to B1 @ 6000 ft MSL (WCR in VPDD) cloud tops~ 3100 ft

14:16-14:24: B1 to B @ 2800 ft MSL (WCR in HPDD)

14:27-14:36: B-B1 @ 1000 ft MSL (WCR in up/down)

14:38-14:46: B1 to B sounding from 1000 ft to 5500 ft (WCR in up/down)

14:47-14:50: B to A (WCR in VPDD)

14:50-14:58: A to A1 @5000 ft cloud tops higher ~3500 ft-4000 ft (WCR in VPDD)

15:02-15:09: A1 to A @2600 ft MSL roll structure visible from plane and on radar reflectivities (WCR in HPDD)

15:12-15:20: A to A1 @700 ft MSL (WCR in up/down)

15:23-15:30: A1 to A sounding from 500 ft MSL to 5000 ft (WCR in VPDD)

15:30-15:54: A1 toward Racine (WCR in VPDD) licor off @15:45

15:49: Land

Flight: 2004_01_19

On board: Kevin, Bart, Dave, Larry

Take-off: 13:28 UTC - Landing: 16:48 UTC - total duration 3 hrs 20 min

Author: Bart

1. Synopsis:

The surface temperatures in Racine and Sheboygan at take-off are about -17C. Racine and Sheboygan are cloud-free at all levels. The near-surface air is remarkably dry, drier in Racine. Surface winds from the NW at 10 kts. The lake persistently shows some whitecaps (small breaking waves). On the 500 ft (165 m AGL) level legs, the Heiman IR regularly generally shows temps between 2-4C. A cloud-free stretch of lake 0-10 km wide allows us to see nice streamers of condensate, suggesting a large temperature differential between water and air. Some pancake ice floes, out to about 1 km from shore.

During the flight the winds are 10-15 m/s at all levels, directions vary between 340 and 360 (occasionally up to 10 degrees). The Green Bay sounding suggests stable conditions up to 600 mb, considerable cooling at mid-levels compared to 1/18, and generally a NW flow. Well-developed cloud streets are apparent on GOES visible, and that is confirmed by the GRR WSR-88D radar. They are oriented about 350-170. Visible observations from the plane, and the WCR HP and VP reflectivity fields, confirm that the cloud streets are more clearly defined on 1/19 than on 1/18. This is especially so on the eastern ends of the tracks, and more on the southern tracks than the northern tracks (also evident in GOES images). Clearly in the oldest region, located towards the SE (point A2), the CBL and the circulations are the deepest, the cloud base the highest, the LWC the lowest (needs to be confirmed), and the cloud streets best defined. Near A2 or B1 the clouds topped at about 2000 m MSL (1800 m above the lake). There was a little icing just below the cloud tops, mainly in the western streaks. Altogether the CB 'feels' smoother on 1/19 than on 1/18. The most turbulent sections are just below cloud top (in the vertical) and in the snow showers towards the SE (point A2).

2. Instruments

No problems I am aware of. Dave once encountered a WCR problem upon switching mode, around 15:27 UTC, and the restart implied a loss of perhaps 1 min of data.

3. Flight tracks:

- Racine to Sheboygan, and sounding over Sheboygan airport (min altitude ~100 m AGL)
- Sheboygan to point C: up to 6000 ft MSL
- 14:12-14:21 UTC: C to C2 @ 6000 ft MSL (WCR in VPDD)

- 14:23-14:31: C2 to C @ 3200 ft MSL (WCR up/down) clear slope in the cloud top height, increasing the east
- 14:35-14:43: C to C2 @ 500 ft AGL (WCR up/down)
- 14:45-14:52: sounding from 200 ft AGL up to 6500 ft MSL
- 14:56-15:07: B1 to B @6500 ft MSL: an extra long leg (58 km) (WCR in VPDD)
- 15:09-15:24: B to B1 @3000 ft MSL: 66 km long leg! WCR side/down
- 15:28-15:37: B1 to B @ 500 ft AGL (WCR up/down)
- 15:38-15:47: sounding to 7000 ft AGL (lowest level 400 ft AGL)
- 15:47-15:55: A to A2 @6500 ft MSL (WCR in VPDD)
- 15:58-16:06: A2 to A @3500 ft MSL (WCR in HPDD)
- 16:08-16:17: A to A2 @2300 ft MSL (WCR up/down)
- 16:19-16:28: A2 to A @ 500 ft AGL (WCR up/down)
- 16:30-16:40: continue on same track towards Racine (WCR in VPDD and then up/down)

NASARolls

20040118

Crew: Fagerstrom, Kelly, Leon, Oolman

1447 start engines. In post cold frontal situation with northwesterly winds and clear skies on Wisconsin side of lake. Filed flight plans calling for flight lines based on winds from 330 degrees.

1500 takeoff

Various problems with ralt2 until well into the flight.

1533 sounding via missed approach at Sheboygan.

ca 1545 Line 330D to D1 at 500 ft agl. Very small, not well-defined cloud elements. Steam fog visible on lake surface. Occasional steam devils, especially as got closer to 330D1.

Restart WCR after seeing weak signal in V channel.

1604 WCR back up and appears o.k.

Flew transition from line D to C above cloud top, down-dual WCR.

161450 Line 330C1 to C at 5000 ft MSL, radar down dual, no breaks in cloud top. At C1 find cloud tops about 3900 ft MSL.

162430 Line 330C to C1 at 3100 ft, radar side down. Had to reset radar. Same weak signal showed up in the V channel.

163630 Line 330C1 to C at 3100 ft, radar side dual. Winds appear to be shifting to more northerly direction since time of sounding at Sheboygan.

ca 1644 Line 330C to C1 at 500 ft AGL, radar updown. Cloud base about 2000 ft. Still steam fog at surface. Winds about 13-15 m/s from 330-340.

Note: there will be directional shear in the BL, with more northerly winds at the BL top.

After finished C-C1, climbed out for sounding (but faster than 1000 fpm), finding cloud tops at about 4400 ft.

1700 transition from line C to B at 5000 ft, radar down dual.

170630 Line 330B1-B at 5000 ft, radar down dual. Cloud tops were higher near C1 than C. Same true between B1 and B. Near B, cloud tops about

4100 ft.

1717 Line 330B to B1 at 2900 ft, radar side down. Near B find occasional glimpses of lake surface.

1728 Line330B1 to B at 2900 ft, radar side dual. Definitely more turbulent near B than B1.

1738 Line 330B to B1 at 500 ft AGL, rdar updown.

1748 Sounding back along 330B1 to B, climbing at 1000 fpm to 5000 ft MSL.

Direct Racine with radar in down dual.

1815 Land.

NASARolls flight notes 20040115 (kelly)

Crew: Fagerstrom, Kelly, Leon, Oolman

Purpose: shakedown and check out aircraft, radar, communication with FAA centers, etc.

1547 start engines. Mostly clear skies over Racine (RAC), with mid level clouds to east. Also some lower level shallow visible out over the lake.

1603 takeoff. No ice visible on lake at RAC. Heimann lake temperature in range 2.0-2.4C. Further north, e.g., near Sheboygan, see ice against shore, perhaps extending 1/4 - 1 mile off shore. It is loose ice, e.g., rafts of pancake ice.

1641 missed approach sounding at Sheboygan.

1657 nearing waypoint 320B to start above-cloud run on line 320B-320B1.

165830 start along 320B-320B1 at 4500 ft altimeter, radar in down dual. Initially over clear air, then above cloud top, and finally skimming through cloud tops.

ca 1709 B1 to B at 4000 ft, initially in cloud, radar up-down

ca 1720 B to B1 at 4000 ft, radar dual side

ca 1730 B1 to B at 4000 ft, radar down dual.

Between 320B and Racine saw tug and barge headed east on lake!!!

1800 land.

To-do and to check:

Add new variable to front display that is sum of channels 2-4 for 1DC, as a check for bad icing conditions.

Change default for XY1 plot: thetae (250-300), hwoml (0-10), vs. ralt2 (0-6000 ft)

For one-d spectra change fssp axis default to 1000, and 1dc default to 10. Why does the double grid show up on the xy plots after a certain amount of time has elapsed?

The 2DP display alternated between good (images separated by timer words) and garbage, while the 2DC looked good throughout.

A good choice for default track parameters: center at (60,90)km and the x-y scale at 150 km.