Photo courtesy of Dave Moore; King's College, London

University of Wyoming
WAICO 2009

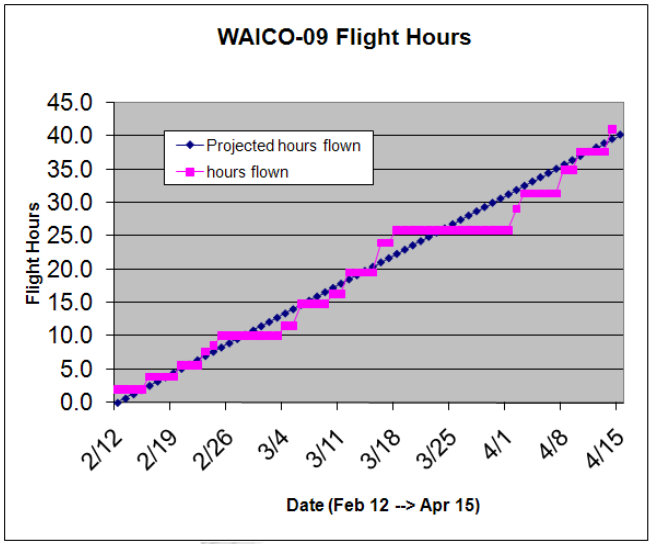
Wyoming Airborne Integrated Cloud Observations (Experiment)

February 12 2009 - April 12 2009

Coincident with WWDC09

UWKA Web Page

- Contacts
- KingAir (UWKA) Data
- Radar (WCR) Data
- Lidar (WCL) Data

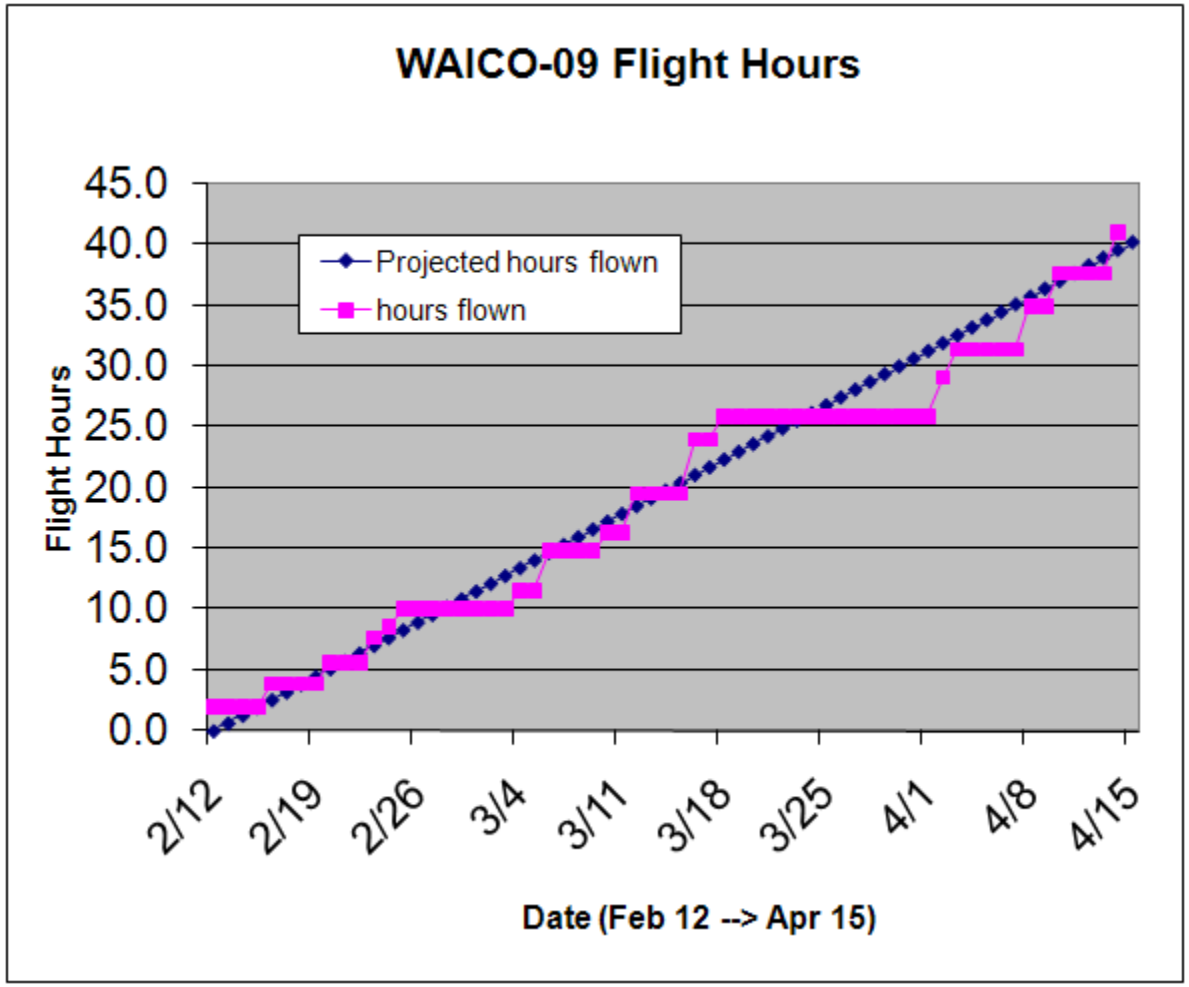


Date (*.kml)	Flight #	Status	Times (UTC)	Hours	Crew/Notes
Post project notes					
25 Apr 2009		Data reprocessed and tagged waico09_qc3. There was an error in the calculations of vertical wind.			
Research Flights					
14 Apr	RF15	Flight upwind of the Snowy Range. Some passes through our own contrails. HADS A failed in flight. Processed with HADS B.	1900-2216	3.4	B Wadsworth Z Wang

					L Oolman
10 Apr	RF14	Flight near tops of mostly decaying convection. HADS A failed again in flight. Processed with HADS B.	2304-0143	2.7	B Wadsworth Z Wang L Oolman
08 Apr	RF13	Flight trying to reach cirrus. Flew wave clouds over Shirley Basin and some convection near Medicine Bow. HADS A failed again in flight, apprears to be a cable problem. Processed with HADS B.	1654-2024	3.6	B Wadsworth Z Wang L Oolman
03 Apr	RF12	Short training flight HADS A failed in flight, processed with HADS B.	2048-2152	1.2	B Wadsworth Ling Zhi Zhong L Oolman
03 Apr	RF11	Short training flight Processed with HADS B	1915-2015	1.1	B Wadsworth Damao Zang L Oolman
02 Apr	RF10	Flight through high clouds north of Elk Mountain and lower wave clouds over Laramie.	1941-2245	3.2	B Wadsworth Z Wang L Oolman
27 Mar	RF09	Alignment flight after replacing downward window with uncoated glass. Some passes over low clouds. Calibration maneuvers start around 2002Z.	1903-2025	1.5 (WWDC)	B Wadsworth Z Wang L Oolman
18 Mar	RF08	Flight through wave clouds with embedded convection over Laramie.	2100-2248	1.9	B Wadsworth Z Wang L Oolman
16 Mar	RF07	Research flight targeting wave clouds on the Laramie Range. Last 2.5 hours of research were between -35 and -40 C. Good homogeneous freezing case. Nitrogen to defog the windows was not turned on until 1903Z.	1717-2143	4.5	B Wadsworth Z Wang L Oolman
12 Mar	RF06	Research flight targeting cold altostratus between Laramie and Cheyenne. Prior to flight colored the the up lidar manifold black and added a light trap around the columnator. Sampled clouds between -25 and -40 C, good case for homogeneous freezing. Both lidars show significant increase in depolarization with colder temperatures, but frosting was not evident from either lidar. Edgetech continues to have problems with oscillation.	2252-0155	3.2	B Wadsworth Z Wang J French

10 Mar	RF05	Research flight targeting cold, relatively shallow, cumulus/strato-cumulus. Following passage of cold front, cloud tops at ~14 kft, around -25 C. Down Lidar window became dirty at taxi/ takeoff (water on runway??)...reduced power. Up-Lidar was first WAICO flight with manifold system; show significant increase in solar background...reflection from manifold?? Edgetech dewpointer look bad, oscillating a lot, particularly at end of flight.	2134-2300	1.5	B Wadsworth Z Wang J French
06 Mar	RF04	Research flight targeting mid-level layer clouds (mostly ice) and some lower level cumuliform clouds. Target area was over the north end of the Snowy Range. Up lidar not installed (in lab for testing). Down lidar showed no frosting. No instrument problems.	2043-2356	3.3	B Wadsworth Z Wang J French
04 Mar	RF03	Flight to test solution of nitrogen flow to prevent frsoting/fogging of the glass. All clear air; following takeoff ascended to FL100, aligned WCL-II, then climbed in 2-3 steps to FL270; after S/L at FL270, descended in several steps to FL100; then RTB. Both WCL-I and WCL-II showed increased depolarization with decreasing temperature. Neither lidar glass frosted.	2350-0116	1.5	B Wadsworth Z Wang J French
23 Feb	RF02	Flew to high altitude (25 kft) to sample ice clouds. Both windows (WCL-I & WCL-II) showed evidence of frosting during the climb. Frost accumulated to the point of strongly attenuating both parallel and perpendicular channel. WAICO flights will likely be suspended until solution of problem can be found. Edgetech chilled mirror conitnues to show large oscillation in flight.	2105-2300	2.0	B Wadsworth Z Wang L Oolman
20 Feb	RF01	Test/Research flight for downward lidar (WCL-II). Began with clear air for WCL-II alignment, followed by overflight of mixed phase cloud, followed by penetration of ice cloud, then overflight of stronger mixed phase cloud and penetration of mixed phase cloud. Manual ABC of chilled mirror in flight, at time chilled mirror oscillates seeking DP.	1715 - 1857	1.8	B Wadsworth Z Wang J French
Test Flights					
25 Feb	TF05	Test to determine if flowing nitrogen over lidar window will prevent frosting of the inside of the glass at high altitudes; all data system and instruments turned off during flight		1.5	B Wadsworth B Kuestner B Glover
24 Feb	TF04	Test to determine if inside or outside of lidar window is frosting at high altitudes; All data system and instruments turned off during flight		0.9	B Wadsworth B Kuestner B Glover
16 Feb	TF03	Test flight for WCL-II. Initial portion of flight, S/L in clear air for aligning WCL-II, Several passes in cloud and above cloud between 17 and 20 kft MSL. WCL-I and WCL-II indicate large depolarization signal (window issues?). WCL-II parallel channel return too small. Edgetech Dewpoint appears to ice over early in flight. Radar ground circles (beam calibration) at end of flight.	2152 - 2337	1.9	B Wadsworth Z Wang J French
11 Feb	TF02	Instrument test flight, No WCL-II, No NetRS (died during prevous day testing); prior to fixes made to all instruments problems noted during TF01. Flight Penetrations (4) through wave cloud over Elk Mtn.; aborted attempt to do Rodi maneuvers do to presence of waves & turbulence; aborted attempt to do radar beam cals due to precip (ice) near ground.	1759 - 1800	1.1	B Wadsworth B Glover J French

7 Feb	TF01	Combination mech test flight, first instrument test flight. No radar, No WCL-I, No WCL-II. Performed aircraft maneuvers VFR follwoing takeoff; after maneuvers flew in-cloud (mixed phase) over Snowies to test instruments. See notes for instrument checks	1617 - 1700	0.8	B Wadsworth T Drew J French
Total Flight Hours	5.0 test + 18.2 WAICO08 + 10 startup + 7 additional request = 40.2				
Total Flight Hours				41.1	


WAICO-09 Flight Hours
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flight Hours
Projected hours flown
hours flown
2/12
2/19
2/26
3/4
3/11
3/18
3/25
4/1
4/8
4/15
Date (Feb 12 --> Apr 15)

WAICO RF13

8 April 2009, 1654-2024 Z (3.6 hours)

Larry Oolman flight notes.

Crew: Brett Wadsworth, Zhien Wang, Larry Oolman

Tried to reach high cirrus. Ended up flying wave clouds over Shirley Basin. Near the end of the mission, flew through tops of convection near Medicine Bow.

1654	Take off
1720-1739	FL260, temperature -36 C, wind 230 degrees true/48 knots Cirrus are another 4000 feet above us.
1721	Increase the nitrogen flow from 5 psi to 15 psi on both windows.
1744-1751	FL250, temperature -34 C, wind 220/42 Start working wave cloud over Shirley Basin
174740	HADS-A failed
1753-1803	FL240, temperature -32 C, wind 210/37
1804-1807	FL237, temperature -31 C, wind 220/36
1809-1826	FL234, temperature -31 C, wind 220/35
1828-1836	FL231, temperature -30 C, wind 210/34
1847-1919	FL270, temperature -39 C, wind 220/54 1500 feet below cirrus. Toggled record button on WCR, no data 190214-191519
1925-1942	FL250, temperature -34 C, wind 230/53 Starting to work above tops of cumulus over Medicine Bow
1944-1957	FL240, temperature -32 C, wind 220/53
1958-2004	FL230, temperature -29 C, wind 220/51 Penetrated the tops of a couple clouds. Having trouble with toggling the WCR record button. Stopped recording WCR data at 200142.
2006-2010	FL220, temperature -27 C, wind 220/49
2024	Land

WAICO RF12

3 April 2009, 2048-2152 Z (1.2 hours)

Larry Oolman flight notes.

Crew: Brett Wadsworth, Ling Zhi Zhong, Larry Oolman

Second of two short training flights to give our students an opportunity to direct a mission. We targeted clouds northeast of Laramie. HADS-A failed. Data was processed using HADS-B.

2048	Take off
2056-2109	FL140, temperature -13 C, wind 240 degrees true/14 knots
2118-2122	FL190, temperature -23 C, wind 190/35
2124-2132	FL200, temperature -25 C, wind 200/40
2137-2143	FL140, temperature -14 C, wind 270/12
2147	HADS-A failed
1942-1951	FL140, temperature -14 C, wind 270/17
2015	Land

WAICO RF11

3 April 2009, 1915-2015 Z (1.1 hours)

Larry Oolman flight notes.

Crew: Brett Wadsworth, Damao Zang, Larry Oolman

Short training flight to give our students an opportunity to direct a mission. We targeted clouds southwest of Laramie. HADS-A failed on the second of these flights. To make processing easier, both flights were processed using HADS-B.

1915	Take off
1922-1935	FL150, temperature -17 C, wind 260 degrees true/18 knots
1942-1951	FL200, temperature -24 C, wind 220/48
1942-1951	FL140, temperature -14 C, wind 270/17
2015	Land

WAICO RF10

2 April 2009, 1941-2245 Z (3.2 hours)

Larry Oolman flight notes.

Crew: Brett Wadsworth, Zhien Wang, Larry Oolman

Flight through higher clouds north of Elk Mountain and then lower wave clouds over the Laramie Valley.

	Pre-flight check of nadir lidar alignment looks good.
1941	Take off
1947	Set nitrogen flow on both windows to 10 psi
1949-1954	FL160, temperature -17 C, wind 290 degrees true/42 knots
2002-2007	FL220, temperature -28 C, wind 280/59
2002-2007	FL230, temperature -31 C, wind 280/64
2015-2020	FL220, temperature -30 C, wind 280/63
2023-2028	FL250, temperature -35 C, wind 280/63 Between layers.
2032-2035	FL260, temperature -37 C, wind 280/61
2039-2055	FL270, temperature -40 C, wind 280/66 Uniform 200 μm particles seen on 2D-C. Increased nitrogen flow to 20 psi on both windows.
2057-2104	FL260, temperature -37 C, wind 280/63
2115-2121	FL190, temperature -25 C, wind 290/41 Flying through wave over the Laramie Valley. May be south of main wave cloud.
2124-2134	FL200, temperature -26 C, wind 280/40 Vertical wind speeds +/- 3 m/s
2135-2146	FL205, temperature -26 C, wind 280/41
2147-2208	FL210, temperature -27 C, wind 280/44
2210-2214	FL190, temperature -24 C, wind 280/31
2221-2223	FL170, temperature -20 C, wind 280/24
2226-2234	FL150, temperature -16 C, wind 280/30
2245	Land

WAICO RF09

27 March 2009, 1903-2025 Z (1.5 hours - charged to WWDC)

Larry Oolman flight notes.

Crew: Brett Wadsworth, Zhien Wang, Larry Oolman

The purpose of this flight was to check the alignment of the nadir lidar after replacing the coated glass with uncoated. The alignment looked good. We did some passes above low clouds and ended the flight with calibration maneuvers. Post flight analysis showed that the air wasn't quiescent enough for a good calibration.

Parts of this flight were over northern Colorado. The area south of Laramie in Colorado is an approach corridor for DEN and difficult to work.

1903	Take off
1909-1916	FL150, temperature -17 C, wind 270 degrees true/13 knots Zhien checked the alignment on the nadir lidar. It looked good.
1915	Manual autobalance on Edgetech dewpoint hygrometer. Signal still oscillates after calibration.
1922-1925	FL200, temperature -27 C, wind 290/15 Climb to colder temperatures to check the depolarization.
1928-1939	FL150, temperature -17 C, wind westerly and variable Passes over low clouds in mountains.
1929	Manual autobalance on Edgetech dewpoint hygrometer. Signal looks resonable for several minutes but still with a 6 C offset.
1940-1953	FL153, temperature -17 C, wind 280/15
2002-2007	FL170, temperature -21 C, wind 275/18 Maneuvers, too much atmospheric variation to be used.
2025	Land

WAICO RF08

18 March 2009, 2100-2248 Z (1.9 hours)

Larry Oolman flight notes.

Crew: Brett Wadsworth, Zhien Wang, Larry Oolman

This flight was through wave clouds with embedded convection over the Laramie Valley. At the end of the flight we tried to sample a stronger wave cloud that formed off the north end of the Snowy Range.

Near the end of the flight the SatPhone reported "Antenna not found". Reseating the phone and cycling power didn't fix the message. By the end of the flight, the SatPhone was back to normal.

2100	Take off
2111-2139	FL190, temperature -22 C, wind 280 degrees true/38 knots
2122	Zhien reported that the WNL had a low signal. Increased the nitrogen flow pressure from 5 psi to 10 psi.
2152	Increased the nitrogen flow pressure to the lower window to 15 psi. No frost was visible on the window.
2141-2216	FL200, temperature -24 C, wind 280/41
2215	Head toward larger wave cloud near Elk Mountain
2224-2226	FL230, temperature -30 C, wind 280/42
2229-2234	FL240, temperature -33 C, wind 280/46
	Descend and head home, making an additional pass over a wave clound on the way.
2248	Land

WAICO RF07

16 March 2009, 1717-2143 Z (4.5 hours)

Larry Oolman flight notes.

Crew: Brett Wadsworth, Zhien Wang, Larry Oolman

This flight was through wave clouds east of the Laramie Range. The best areas were difficult to work. The wave off of Laramie Peak was over the active military area at Guernsey which went up to FL230. Another good cloud between Laramie and Cheyenne was in the Denver departure route. I forgot to turn on the nitrogen until 1903Z so there was some frost on the lidar windows during the first part of the flight. We flew for about 2.5 hours through wave clouds near Wheatland at temperatures between -35 and -40 C. This may be a good homogeneous nucleation flight. The Edgetech dew point hygrometer starts oscillating within minutes of an autocalibraton.

1717	Take off
1725-1738	FL160, temperature -11 C, wind 285 degrees true/32 knots Ferry to near Wheatland
172605- 173028	Autobalance Edgetech dew point hygrometer Start oscillating within minutes
1745-1751	FL210, temperature -25 C, wind 280/29 Single pass just below wave clouds. Needed to work south of best cloud to avoid military area.
1754-1812	FL220, temperature -27 C, wind 275/32 Three passes
1812-1836	Ferry to area between Laramie and Cheyenne. Unable to work here because it was in the Denver departure route. Ferry back to the Wheatland area.
1853-1912	FL250, temperature -35 C, wind 265/43 Above military area, two passes.
1903	Open nitrogen valves, set pressure to 20 psi.
1916-2002	FL260, temperature -37 C, wind 265/45
1952	Adjusted nitrogen flow to 5 psi.
1958	May be seeing some depolarization on downward lidar. Increased flow for lower window to 10 psi.
2004-2051	FL270, temperature -39 C, wind 265/48
2051-2058	Slow descent
2058-2125	FL250, temperature -34 C, wind 270/45
2125	End of research, ferry back to Laramie
2143	Land

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: RF06
File: 20090312a

Crew:
B. Wadsworth
Z. Wang
J. French
LOD:
B. Glover

Preflight:
Late afternoon/evening flight; prior to flight pulled up lidar (WCL-I) to pain manifold black and install light trap around columnator.

Target clouds over Laramie range, east of Laramie, west of Cheyenne. Depending on performance of lidars, flight may last between 1 and 3 hours.

Planned takeoff time: 2300 Z (or earlier, if possible)

Flight Profile:
1. Takeoff from LAR headed north to FL100
2. In clear air, check alignment of WCL-II
3. Following alignment check, turn E/SE towards clouds, initial FL150
4. Following first pass, align along clouds if "rows" are not along wind direction

2237 Z: 010/08 T03/TD-11, SCT 030

Flight:

2252 WHEELS UP

2258 all instruments operational; alignment on WCL-II looks good

22-57-29 WCR new file; Up/DD

2300 Level at 148, started manual ABC on Edgetech

2308 pass through top of cloud at FL170, need to climb to FL185 to get completely on top of clouds

231230 end of Leg1; FL185 ~500-1000 ft above tops

231530 start leg 2, hdg 80deg, in middle of leg climb to FL188 to clear cloud tops
2318 end leg, turn 90deg to S and continue with a box pattern

231845 begin leg 3, FL188, ~1kft above tops
231945 end leg (short leg) turn to west

232030 begin leg 4, FL188, cloud below us, and as we continue further west an ice deck develops above us
232615 end leg 4, end the box pattern, turn back to the east

2329 begin leg 5
2335 end leg 5, descend to FL170

233850 begin leg 6 at FL170, tracking west, passing through tops of clouds around 2342; at 2345 descend further into clouds to FL160
234540 end leg 6

???? begin leg 7
2351 end leg 7

2353 begin leg 8 at FL150, tops getting lower (~2 kft above us)
235845 end leg 8

Break off from lower clouds, climb to FL200 to focus on upper clouds

000515 at FL200, setup for next leg, clouds at 24 kft, T~-30

000615 begin leg 9, tracking east, slowly climb to FL210, will likely need to go higher on next leg, continue climb to FL220
001230 end leg, setup for return leg at FL220

001540 begin leg 10, FL220, small ice, T~-32C
001850 during leg start climb to FL230 to try to get into thicker part of clouds
0022 end leg

00-22-52 WCR new file, Up/DD

0025 begin leg 11; 002815 start climb to FL240
002930 end leg 11

0032 begin leg 12
0038 end leg 12

0041 begin leg 13; may need to adjust heading somewhat
004230 adjust heading to get into clouds

0046 end leg, climb to FL250

0049 begin leg 14, above clouds at FL250
005230 tweak heading to stay over the ice cloud
0059 tweak heading again
005930 end leg, descend to FL248 for next leg

01-00-11 WCR new file, Up/DD

0102 begin leg 15
010540 begin slow descent to FL240 to stay in clouds
0107 end leg

010845 begin leg 16 at FL240
011445 end leg, mover further south to try to get into cloud

Move anchor point for clearance to the south to be able to stay inclouds

012330 begin leg 17 in ice cloud
0127 begin climb to FL245
012715 end leg

012920 begin leg 18
013420 end leg 18

01-34-23 WCR new file, Up/DD

0136(??) begin leg 19
013930 end leg

RTB

0155 WHEELS DOWN

Postflight:

Identified aircraft issues:

1. *None*
2. NOTE: ATC was very accommodating to let us work where we did, for entire flight working with 2-3 kft increments of block clearance in a very busy airspace that was dealing with arrivals/departures out of Denver

Identified ground issues:

1. *none*

Identified science instrument issues:

1. Edgetech issues, oscillations, also noted that it was in ABC hold mode; confirmed that this was switched before flight….all this means is that during the manual ABC, instead of outputting actual temperature, it outputs a constant temperature.
2. WCL-I painting the manifold and adding light trap seemed to work
3. No frosting on either of the windows despite we were flying at -40C and all fuselage windows had frost
4. Both lidars showed significant depolarization at colder temperature…to the point that perpendicular channel is saturated…seems to be T-dependent issue only??
5. *No other known issues*

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: RF05
File: 20090310b

Crew:
B. Wadsworth
Z. Wang
J. French
LOD:
B. Glover

Preflight:
Second flight of day; first flight was WWDC in the morning.
Both lidars are now installed, this AM's flight was first flight with manifold solution for the up lidar (WCL-I).

Noticed on AM flight that there was a very large increase/decrease of the perpendicular channel that depended on heading of the aircraft (relationship to sun angle??). Will test this on afternoon flight.

Set to targe cumuliform clouds north of Laramie.

Planned takeoff: 2130 Z; ~1-3 hour flight

Upon boarding aircraft, turned nitrogen flow to 4 LPM

2124 Z: 250/24G35, FEW042, SCT050, T 07/ TD -14, 29.87

Flight:

2134 WHEELS UP

2139 all equipment is turned on

21-37-58 radar file, Up/DD

2140 force manual ABC for Edgetech

2146 Zhien notices the alignment for WCL-II looks bad, to the back to align lidar

2150 Can't get alignment right…appears to have offset in perpendicular channel for down…looking at downward window there appears some grime/dirt on window

2155 upped flow rate, WCL-II appears to have dirt specs all over window, does not appear to be ice. For most part WCL-I depolarization looks good, but ~20 minutes into flight we change heading and depolarization increases instantly.

2211 video tape stops and rewinds automatically, start a new tape

22-11-57 WCR new file, up/DD

2212 start new WCL-I file

2217 climb to FL170

2220 leg, all above cumulus clouds

222245 adjust heading to line up on clouds

223215 end leg, reverse heading to target clouds further to south of last track

223615 begin leg, FL170

224130 end leg, Return to base

2247 begin shutdown, Edgetech looks bad near landing (oscillating)

2300 WHEELS DOWN

Postflight:

Identified aircraft issues:

1. *none*

Identified ground issues:

1. *none*

Identified science instrument issues:

1. Edgetech issues, oscillations, offset at colder temperatures??
2. WCL-II (down)…dirt specs on window…was very clean right before we boarded the plane, Zhien noticed the dirt shortly after takeoff…possibly due to dirt/water being kicked up on taxi and/or takeoff…also Brett S. lubed the nadir door prior to flight and is likely when the door was opened excess lube was blown onto window.
3. WCL-I (up)…showed heading dependence on depolarization….like “turning a switch”, likely related to sun angle dependence. Checking data with Zhien on next day, large increase in the solar background, due to reflection of sun off of manifold? Prior to next flight will paint manifold black and add light trap.

4. *No other known issues*

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: RF04
File: 20090306a

Crew:
B. Wadsworth
Z. Wang
J. French
LOD:
D. Lukens

Preflight:
At time of briefing there are cumuliform clouds over the valley and Snowy Range; there seem to be more clouds on north/northwest side of Snowies with some layering over the Range. Will target these clouds, beginning at altitude of around FL150.

Planned takeoff: 2045 Z; ~3 hour flight

Flight Profile:
1. Takeoff to point near Elk Mountain
2. Enroute, verify alignment of down lidar (WCL-II)
3. Work clouds

Upon boarding aircraft, turned nitrogen flow to 4 LPM

After engine start and began recording data, noticed that date and time was incorrect on *realtime* display. All other computer times were correct (wasp, tigger, WCL-II computer). Restarted data system. Time is OK.

2029 Z: 230/22G33, CLR, 29.80

Flight:
Wheels up 2043

2046 open nadir port, WCL-II on, re-adjust flow to 2 LPM

20-47-35 Up/DD

2053 started ABC on EdgeTech

2055 Edgetech finished ABC, ~10C lower than LICOR

2100 end of first leg; in/out of cloud, climb to FL170 for 2nd leg

2103 begin leg 2, FL170
210745 end leg 2, climb to FL180; 90/270

2111 begin leg 3, T~ -24C; between 2 layers, upper layer is very thin, ~100 ft thick at about 2 kft above our altitude; lower layer is 3-5 kft thick with lots of structure
212330 end leg, climb to FL185

21-23-50 Up/DD, new WCR file

2125 begin leg 4 @ FL185, bit further south, no upper cloud on this leg, lower cloud shows lots of structure at top
213020 end leg 4; move further north anc climb to FL195; try to target upper cloud

2134 begin leg 5, in upper ice cloud; T ~ -28C, at FL200, cloud extends to 500 ft above and below us
2143 end leg 5

Climb to FL210, fly back over same track

214530 begin leg 6, FL210; in the top of ~3 layers, uppermost layer ~4 kft above us. We are in very top of middle layer, thicker bottom layer with tops ~4 kft below us
2149 end leg 6

2152 begin leg 7, FL210
220130 end leg 7; 90/270 descend to FL200

22-01-51 new WCR file; Up/DD

220450 begin leg 8, FL200, our contrail from last leg is very visible; above us at ~11:00
220820 end leg 8, descend to FL180, focus on lower level for next set of legs

221145 begin leg 9, FL179, descend to FL177 to sample cloud; *break off leg to try to sample contrail*, climb to level of contrail from last leg.

2229 took picture of up window, lot of frost on window
2229 *contrail hunting---futile!* Give up on contrail, set up for pass at FL180

2235 begin leg 10; very top of lower cloud deck, numerous small water drops on FSSP and 2DC particles to 200 microns
224145 end leg 10; 90/270, descend to FL175

224415 begin leg 11, FL175; a little bit further down into the cloud
224845 end leg 11; descend to FL170

225150 begin leg 12, FL170; ~1 kft below tops of lower deck
2256 end leg, move further south, look for more cumuliform clouds

230330 begin leg 13, FL180, right at top of embedded cu
230945 end leg, 90/270, climb to FL190, should put us above cloud tops

2313 leg 14, FL190, TD about 10C lower, completely above cloud field
231740 end leg, setup for repeat of last leg

232040 leg 15, FL190, 1-2 kft above cloud tops
233230 end leg, clouds getting deeper with time

Fly to LAR VOR at 190, above cu in valley

234340 descend to FL110 and setup for approach

2356 Wheels down

Postflight:

Identified aircraft issues:

1. *none*

Identified ground issues:

1. *none*

Identified science instrument issues:

1. Edgetech issues, oscillations, offset at colder temperatures??
2. No up lidar for flight
3. *No other known issues*

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: RF03
File: 20090304a

Crew:
B. Wadsworth
Z. Wang
J. French
LOD:
D. Lukens

Preflight:
Clear air flight; over the last couple of days manifold was build for the WCL-II and installed nitrogen tanks to flow nitrogen to reduce fogging/frosting of the lidar windows. WCL-I (up) is using the tubing built by Bill during WAICO-08.

Planned takeoff: 2245 Z; ~2 hour flight

Flight Profile:
1. Takeoff to N/NW of Laramie
2. Level at 10 kft for alignment of WCL-II
3. Increase altitude moderately slowly to ~FL250, leveling off a couple of times
4. After S/L at ~FL250, decrease altitude down to FL100

Takeoff delayed ~1 hour, Mechanics need to fix "go-around" switch

2334 Z: 210/27G35, CLR, T 13/ TD -17, 29.71

Flight:
Wheels up 235045

2353 Open nadir port, turned on N2 for WCL-I & WCL-II; Flow ~1 LPM

2355 FL100, Zhien up to do alignment, complete at 0003; Edgetech→start manual ABC, complete at 2400

0005 Begin climb to FL240

0008 noticed increased depolarization, upped flow rate of both lidars to 2 LPM

0018 WCL-I continues large increase in depol; increased flow rate to 4 LPM, WCL-II looks OK

0032 FL270

00-35-57 Up/DD, weak clouds well below us

003830 descending to FL200 to get closer to clouds

0033 →0043 Edgetech goes “out to lunch”, however, on screen display reads “servo-lock” indicating should have good signal????

0045 From now on, Edgetech looks good

0051 descending to FL140

0109 turn gas flow off

0116 Wheels down

Postflight:

Identified aircraft issues:

1. Go-around switch fixed before flight
2. *No other known issues*

Identified ground issues:

1. *none*

Identified science instrument issues:

1. Edgetech still acting funny at times, need to do in-flight ABC; it looks like it operates pretty well at Td> -30 C (??)
2. *No other known issues*

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: RF01
File: 20090220a

Crew:
B. Wadsworth
Z. Wang
J. French
LOD:
D. Lukens

Preflight:
Test/Research flight for the down lidar (WCL-II). Expect short 1.5-2 hour flight, include laser alignment and test in ice and water clouds

New procedure to force manual auto balance control of Edgetech in flight.

Scheduled takeoff time of 1730 Z

Wx: 1703Z: 240/21G29, 1.0 vis, Sct 075, -01C/-16C

Flight:

~1715 wheels up

17-18-48 WCR new file, up/DD

1722 both lidars and radar are operational and collecting data, @ FL100, climbing to FL145 to stay under clouds and setup for alignment

1727 manual ABC on chilled mirror

~1730 appears that ABC is complete? And seeking dewpoint??

1733 Zhien completes WCL-II alignment

1734 Edgetech—seeking dewpoint

1735 Edgetech looks OK

1738 Edgetech display reads ‘seeking dewpoint’

1740 pick up IFR clearance, try to get on top of clouds, climb to FL170, flying over top of layered clouds

17-50-34 WCR new file, up/DD

1752 turning back to south, climb to FL210, try to sample ice clouds above us

1755 Edgetech display reads: -39 (servolock), realtime -45 (difference between frost and dew point??); DPlicor -34

1802 new WCL-I file

1806 into ice cloud

1808 reverse heading to stay in clearance area

18-21-38 WCR new file, up/DD

1821 descend to FL190 to try to sample lower cloud

1824 still too high, descend to FL180, ~2 kft above lower cloud at this location

1834 dscend to FL150 to fly through clouds

1835 @FL150, in cloud, TDP oscillating

1840 setup WCL-II for perpendicular channel to full range of 1 volt (perpend. Channel saturates in strong cloud)

1843 finished with data collection, RTB

1857 Wheels down

Postflight
Aircraft issues: NONE

Ground Ops/preflight: NONE

Instrument/DAS issues:

WCL-II appeared to operate well, Perpendicular channel saturated in strong cloud, needed to change full scale range

WCL-I still appeared to have high deplolarization when window got cold, even before entering any cloud

Radiometers covered in ice at landing, likely bad data from middle to late in flight

TDP (Edgetech) operated better, but appeared to oscillate even during straight and level flight like is was searching for dewpoint.

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: TF03
File: 20090216a

Crew:
B. Wadsworth
Z. Wang
J. French
LOD:
D. Lukens

Preflight:
Test flight for down lidar (WCL-II). Will fly clear air early in flight to align lidar, followed by cloud penetrations and above cloud legs to test response/signal of the down lidar. Weather conditions permitting, last portion of flight will be radar ground circles to calibrate beam pointing angles.

First flight with WCL-II

Scheduled takeoff time: 2145 Z

Wx: 2137Z: 230/22G29, 1.0 vis, Sct 070, 04C/-07C

Timeserver not apparently running on Tigger, **WCL-I and WCL-II not synced exactly** (synced by hand, likely within 1 second)

Flight:

2152 wheels up

~2200 climbing out of LAR, pass through cloud; turn on WCR, WCL-I, WCL-II; heading to point NW looking for clear air.

2209 Zhien into back of plane to align WCL-II

2236 flying at ~19 kft, depolarization on WCL-I very high

2258 noticed CR taped stopped and rewound during last five minutes, put in new tape for remainder of flight

2300 finished flying in cloud, above cloud for testing down lidar, now proceed to point north of LAR for radar circles

230940 – 231200 radar circle right (side/dualdown)
231610 – 231839 radar circle left (side/dualdown)

2320 RTB

2337 Wheels down

Postflight
Aircraft issues: NONE

Instrument/DAS issues:

Front display for operating WCL-II virtually unusable with touchscreen…needed to use Bluetooth keyboard from 3rd seat.

Timestamps on WCL-I quicklooks incorrect…software display issue, will fix before next flight

WCL-I & WCL-II depolarization too high, ice on windows??

WCL-II parallel channel too low; will need to remove WCL-II and test on bench prior to next flight.

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: TF02
File: 20090211a

Crew:
B. Wadsworth
B. Glover
J. French

LOD:
P. Wechsler

Preflight:
Test science instruments for WAICO & WWDC; radar power calibration in cloud, radar beam calibration (ground target), Rodi maneuvers for wind calibration

First flight with WCR
First flight with WCL-I
No WCL-II
No NetRS, it died during GPS diagnosis and fix prior to flight, Ashtech GPS appears to be fixed

Flight profile:
1. IFR section over northern end of Snowies for radar power calibration and testing of cloud physics instruments
2. VFR section for Rodi maneuvers NW of LAR in clear air between 10 and 14 kft
3. VFR section for radar beam calibrations N of LAR in clear air at 3000 ft AGL

Scheduled takeoff time: 18Z (11 AM Local)

1747Z: 240/25 G 35, SCT 110, 3C/-13C, 29.83

Flight:
Wheels up 175830

1808 @ FL140, the radar is up, WCL is up, both look good, target cloud tops are actually below us, will aim for deeper wave cloud further to the NW centered around Elk Mountain

1812 flying roughly into wind (heading ~280) at FL140, pen wave cloud P1

1815 90/270 on upwind side of cloud, climb to FL150 (previous pen had us between layers)

1818 on track, hdg 105, P2, see liquid water on upwind edge of cloud

1822 start new radar file 18-22-53 up/DD

1823 90/270 on downwind side, setup for another penetration

1825 on track for next penetration; set LICOR flow (FLOWM)

1830 P3, incloud, water content comparisons look reasonable

183130 out of cloud

1832 90/270 on upwind side of cloud, setup for next pen

1835 P4, LWC ~0.2 g/m3; FSSP ~100 /cm3

1838 done with cloud work, return towards LAR, will not do Rodis due to turbulence and wave motion

1840 big bump while descending, following bump, DMT looks noisy

1847 at location for radar beam calib, radar is seeing come precip reaching near ground (although can't see anything visually), decide to abort beam cals and RTB.

Postflight:
Identified aircraft issues: *none*

Identified science instrument issues:

1. DMT looked noisy last 1/3 flight after hitting turbulence on descent back towards LAR area.
2. *No other known issues*

Flight and Debrief Notes:
JF

Project: WAICO-09
Flight: TF01
File: 20090207a

Crew:
B. Wadsworth
T. Drew
J. French
LOD:
P. Wechsler

Preflight:
Post Maintenance Calibration Flight; test science instruments for WAICO & WWDC

No WCR (no known issues); No WCL-I (no LOD); No WCL-II (not installed); no timestamp on video

Flight profile:
1. Pilots maneuvers for aircraft shakedown, pre-project
2. In-cloud; s/l for 1-2 minutes test cloud physics probes

1558Z: 320/04, clr, 0C/-5C, 30.08

Flight:
Wheels up 1617

In-cloud second portion of flight
Wheels down 1700

Postflight:
Identified aircraft issues:
1. No terrain awareness, (could be out-of-date database??) will fix or MEL prior to next flight

Identified science instrument issues:
1. no GPS???? (I had to turn off GPS to get it to process...did not look into this further).
2. FLOWM (inlet main flow for LICOR): signal wire was not hooked up, fixed following flight (??)
3. DMT LWC: raw power looks incorrect entire flight, essentially flat-lined, no response to episodes of liquid water or change in airspeed

4. FSSP/PVM: LWC comparison between two probes look reasonable. PVM shows baseline drift following takeoff and returns to zero baseline at landing (drift small, 0.02 g/m3).
5. FSSP: quick look at DOF fraction looks good to me, AL will look at closer with JLB processing. (closer inspection, DOF probably OK, Vrej looks a bit odd; activity vs. resets does not look right, but concentration is very low…)
6. No 2DP data at all...is it set up properly in header??? (not in header….)
7. ~1 m/s difference in AIAS/BIAS
8. trf/trose comparison: looks good, trf greater ~0.4 C through flight
9. tdp/dplicor comparison: looks bad, in general licorDP is greater by ~13 C. licor is closer to what I expect is the correct dew point. In/around cloud the licorDP within a few degrees of trf/trose; the chilled mirror begins ~15C too low and drifts to near trf/trose over 15 minute period. (calibration issue; may be able to fix in post processing???)
10. ralt3: looks good
11. winds look reasonable
12. radiometers look reasonable
13. no time on video/no down look camera: control issue from computer to camera, will be looked at monday.
14. Onboard issues:
    - 3rd seat display did not show FSSP histogram (but front seat display did)
    - skewt disabled on front display??