

Multi-institutional Collaborative Student Experience in Airborne Research in the Mid-Atlantic Region (SEAR-MAR - 2017)

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Summary

Multi-institutional Collaborative Student Experience in Airborne Research in the Mid-Atlantic Region (SEAR-MAR) will study atmospheric phenomena in the mid-Atlantic region, with a focus on student involvement in association with Millersville University, Pennsylvania State University, Rutgers, and the University of Maryland, Baltimore County.

Links

- Planning Chart
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- Planning and tracking tools
- Plot of flight hours
- Lidar Quicklooks

Field Notes

- S. Kleinert

Date	Flight # (*.kml)	Status	Times (UTC)	Hours	Crew/Notes
17 Nov 2017	RF14	Clear air profiling near Rutgers' PAM site and Millersville's ground site.	1751-1932	1.8	T Drew E Jones D Plummer J Parker B Knight
16 Nov 2017	RF13b	Second of two paired flights, sampling emissions downwind of Philadelphia.	2113-2254	1.8	T Drew J Hane L Oolman P Ghosh M Dellandre
16 Nov 2017	RF13a	First of two paired flights, sampling background emissions upwind of Philadelphia.	1845-2001	1.3	T Drew P Roelant L Oolman M McGee N Wellington
16 Nov 2017	RF12	Sampling boundary layer across coastal transition (UMBC cold-frontal track).	1349-1601	2.3	T Drew B Carroll D Plummer C Sasser B Rinaldi
15 Nov 2017	RF11	Rutgers PAM site overflight & coastal boundary layer sampling.	1803-2006	2.2	T Drew M Drows L Oolman C Barns S Housseal

Guide

Facility Instruments

- In Situ
- Wyoming Cloud Radar
- Wyoming Cloud Lidar

Contact

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Jeff French



14 Nov 2017	RF10	Calibration maneuvers - static pressure profile.	1750-1854	1.1	T Drew T Keebler D Plummer A Fritz S Fuller
11 Nov 2017	RF09	Ocean-bay-land boundary layer characterization.	1245-2004	2.5	T Drew B Carroll L Oolman Z Yang A Flores
11 Nov 2017	RF08	Cold air damming	1209-1514	3.1	T Drew D Casale D Plummer A Cannistraci R Lees
10 Nov 2017	RF07	Mountain Waves	1424-1625	2.1	T Drew D Harp L Oolman A Weiner B Benjamin
9 Nov 2017	RF06	Emissions profiles around Enlow & Cumberland coal mines.	1759-2150	3.9	T Drew A Tomhoff D Plummer A Moffitt S Hallett
8 Nov 2017	RF05	Emissions profile, Sugar Run-Salt Springs track.	1656-2008	3.3	T Drew A Liggett L Oolman G Himmele C Wiley
7 Nov 2017	RF04	Mid-level frontogenesis.	1656-2022	3.6	T Drew R Fleming D Plummer A Dobrowski D Gibson
					T Drew

6 Nov 2017	RF03	Fine structure of fronts.	1935-2228	3.0	B Thompson D Plummer M Richardson A Cotispoti
6 Nov 2017	RF02	Fine structure of fronts.	1400-1753	3.9	T Drew R Capella L Oolman E Morehead J van der Veken
4 Nov 2017	RF01	Cold air damming flight profile.	1155-1551	4.1	T Drew G Carlton D Plummer B Molyneux D Karppala

Test Flights

3 Nov 2017	TF03	Familiarization flight following CAD profile outline	1822-1938	1.3	T Drew L Oolman D Plummer
2 Nov 2017	FF02	Ferry leg 2, MLI to LNS	1913-2138	2.5	T Drew N Mahon L Oolman D Plummer B Heesen
2 Nov 2017	FF01	Ferry leg 1, LAR to MLI	1454-1712	2.4	T Drew N Mahon L Oolman D Plummer B Heesen
1 Nov 2017	TF02	Test flight focused on clear air for nadir & zenith lidar	1837-2002	1.6	T Drew M Hatt D Plummer M Zhang
					T Drew

27 Oct 2017	TF01	Test flight focused on clear air for nadir & zenith lidar	2029-2228	2.0	K Smith D Plummer M Deng L Lin
Flight Hours		As of Jul 13, 2018, 40.0 out of 40 research hours were flown, 0.0 remain.		Test and Ferry: 9.8	

Although I did not fly during the duration of the SEAR-MAR research project, I helped with some of the groundwork. Many people were needed to forecast which was very important during this project. Each flight required different weather conditions since each one studied something different. I was present during the forecast most mornings, so we could create forecasts for the crew flying the flight pattern. I was also very active in the hands-on data collection we did at the landfill. The instruments that we had out there at the site were the SODAR, LIDAR, flux tower, and radiosondes. I was most active in the radiosonde launches. I helped prepare the balloon for launch and helped tie the radiosonde to the spool which would unravel during the launch. I learned how to calibrate the radiosonde before the launch and how to track the data it was collecting and the GPS during flight. The data collected by the radiosonde during these launches was important because it was used to supplement the data that was collected on the flight that was flown that day. All in all, much of the data and research from the SEAR-MAR project was collected via the aircraft but there was important groundwork to do such as launching radiosondes and I was so happy to learn how to do it and be a part of it.

11/17/17 SEAR-MAR17 Pilot notes (Research Flight 14)

Crew: Drew, Plummer, Erin Jones, Jon Parker, and Bryan Knight

Flight Time: 1.8

Objective: PAM-Site overflight/spiral

Planned: Fly at 1000 ft. AGL to spiral location about 7 nm west of PAM site. Spiral over site to 5000 ft. MSL and down. Overfly the PAM site at 1000 ft. AGL climbing to 2000 ft. MSL over the site. Ferry to the Lancaster landfill location and spiral over site to 10,000 ft. MSL if time allows. Return to Lancaster.

Actual: Ferried to spiral location at 1000 ft. AGL. Spiraled over site to 5,500 ft. MSL and back down to 1000 ft. AGL. Ferried to PAM site at 1000 ft. AGL and climbed to 2,500 while in the turn. Descended back down to 1000 ft. AGL for ferry to the Lancaster landfill. Spiraled over landfill site to 8000 ft. MSL and back down to 1000 ft. AGL, breaking off twice for traffic in the area. Overflew the University on return flight to Lancaster.

Project: SEAR-MAR17

17 Nov 2017

Flight: RF14

Notes:

Spirals near Rutgers' PAM site, and over Millersville's landfill site, in clear air.

Crew: Tom Drew, Erin Jones (MU), Dave Plummer, Jon Parker (MU), Bryan Knight(MU); LOD: Ben Heesen

Flight Summary:

UTC Comment

1751 Wheels up

Transiting near 1500', +4/-8C.

1821 Main spiral ascent to ~5000' upwind of PAM site. T to -4C at 4000', inversion above 4000'.

1825-1830 Descent.

1830 Returning to track for short spiral near/over PAM site.

1833-~1835 Shallower spiral through ~2300 ft, close to PAM site. T from ~+5C to +1C, TDP near -9C.

1835 Returning westbound to profile over MU's ground site.

1913-1919 Profile upward to ~8200' over ground site, temperature ~0C below inversion, +7C maximum in inversion, +1.5C at top.

1924 Main descent complete, temperature maximum +9C in inversion. Return to base.

1932 Wheels down

Clear air profiling near Rutgers' PAM site and Millersville's ground site

Flight # RF14

November 17, 2017

Bryan Knight – Millersville University

Crew:

Tom Drew

Dave Plummer

Erin Jones

Jon Parker

Bryan Knight

We took off at approximately 12:50 pm headed towards Rutgers PAM site at 1000 ft AGL. We ferried to the site at 1000 ft and preformed a spiral to 5500 ft MSL at the PAM site. We climbed 2500 ft while in the turn by the PAM site. We then proceeded at 1000 ft AGL to the Creswell Landfill. On our way there we passed over the university. Once at the landfill, we spiraled to 8000 ft MSL and then back down to 1000 ft AGL. Air traffic interrupted our spiral over the landfill, forcing us to break off twice. We then proceeded back to Lancaster airport, flying over the university again on our way back. The flight was about 1.8 hours total. We were supported by a balloon launch from the landfill after we completed our spiral.

11/16/17 SEAR-MAR17 Pilot notes (Research Flight 13b)

Crew: Drew, Jennifer Hane-MU, Larry Oolman, Poushali Ghosh-MU, Mark Dellondre-MU

Flight Time: 1.8

Objective: Split Triangle Flight b

Planned: Make a very shallow climb to 5000 ft. MSL to NE waypoint of second triangle, spiral down over the waypoint and then fly 1000 ft. AGL to SE waypoint. Spiral up to 5000 ft. MSL over second waypoint and then make a shallow descent back to 1000 ft. AGL while returning to LNS.

Actual: Departed to the NE and tried to keep a very shallow climb going to 5500 ft. MSL. We had one interruption for traffic along the way. Reaching the point, spiraled down to 1000 ft. AGL and then flew to the SE point, side-stepping slightly east for a taller antenna along the way. Spiraled up to 5,500 ft. MSL. at the second waypoint and started a slow descent to 1000 ft. with one interruption for traffic while returning to LNS.

SEAR-MAR RF13b – 16 November 2017

Tom Drew, Jennifer Hane-MU, Larry Oolman, Poushali Ghosh-MU, Mark Dellondre-MU, Ben Heesen (LOD)

Second of two paired flights, sampling emissions downwind of Philadelphia.

2113 Take off
2129 FL040, T=0 C, DP=-5 C, winds=290 true @ 31 kt, CH4=1.98 ppm, cloud base 7000 ft
2137 FL055, T=-2, DP=-9, winds=290 @ 37, CH4=1.97, CLR
2140 Starting spiral down
2144 FL011, T=8, DP=-1, winds=300@30, CH4=1.98, CLR
2208 T=11, DP=-3, winds=300 @ 33, CH4=1.98
2216 FL055, T=0, DP=-5, winds=280@32, CH4=1.98
2223 Boundary height around 6000 ft MSL
2243 FL020, T=5, DP=-3, winds=300@32, CH4=2.00
2254 Land

11/16/17 SEAR-MAR17 Pilot notes (Research Flight 13a)

Crew: Drew, Patrick Roelant-MU, Larry Oolman, Nathan Wellington-MU, Megan McGee-MU

Flight Time: 1.3

Objective: Split Triangle flight a

Planned: Make a very shallow climb to 5000 ft. MSL to NE waypoint on first triangle, spiral down and fly 1000 ft. AGL to SE waypoint, spiral up to 5000 ft. MSL and then make a shallow descent back to 1000 ft. returning to LNS.

Actual: Departed to the NE and tried to keep a very shallow climb going to 5500 ft. MSL. Reaching the point, spiraled down to 1000 ft. AGL and flew to the SE point. Spiraled up to 5,500 ft. MSL. over the SE point and started a slow descent to 1000 ft. while returning to LNS.

SEAR-MAR RF13a – 16 November 2017

Tom Drew, Patrick Roelant-MU, Larry Oolman, Nathan Wellington-MU, Megan McGee-MU, Ben Heesen (LOD)

First of two paired flights, sampling background emissions upwind of Philadelphia.

1846 Take off
1856 FL040, T=2 C, DP=-3 C, winds=280 true @ 26 kt. Shower off to our left. CH4=2.00 ppm. Cloud base is about at 8000 ft
1901 FL050, T=0, DP=-7, winds=290@37, showers to our right,
1909 Start descent from FL055, T=-2, DP=-8, winds=290@39, CH4=1.97
1914 FL013, T=6, DP=2, winds=270@24
1919 Climb to FL017 for rising terrain
1935 FL014, T=10, DP=0, winds=280@22, CH4=1.99
1945 FL016, T=9, DP=-3, winds=280@24, CH4=1.98
1946 Start spiral up
1950 FL055, T=-2, DP=-6, winds=290@24, CH4=1.97
1951 Start slow ramp down towards Lancaster
2002 Land

11/16/17 SEAR-MAR17 Pilot notes (Research Flight 12)

Crew: Drew, Brian Carroll (UMBC), Dave Plummer, Christiana Sasser (UMBC), Brian Rinaldi

Flight Time: 2.3

Objective: Weak Frontal Flight

Planned: VFR planned flight to line three of the modified weak frontal flight track. Line three was picked so we could extend to the east further without interfering with Atlantic City. Fly Line three four times starting at 1000 ft. AGL, 2500 ft. MSL, 4500 ft. MSL, and 5,500 ft. MSL and return.

Actual: The weather had rapidly improved in the vicinity of the line prior to takeoff. Departed LNS and ferried to new west end of line three VFR. Flew line three extending out to the edge of the warning area. Reversed course and returned at 1000 ft. AGL. Reversed course and climbed to 2500 ft. MSL, however, changed back to 1000 ft. AGL in first $\frac{1}{4}$ of the line. Reversed course about 20 miles east of the west endpoint climbing to 5500 ft. MSL. Descended to 3,500 ft. MSL in the last 20 miles to the east. Extended out to the warning area again, and descended to 1000 ft. AGL in the turn. Did two sawtooth profiles from 1000 ft. AGL to 4500 ft. MSL on return leg. Conducted an additional sawtooth on the way back to LNS.

During & post-flight notes, RF12, 2017/11/16: Coastal morning transition (UMBC)

Take-off ~1400Z, land ~1610Z (9000-1110 local). Very hazy out over southern NJ. Cloud cover 30 min before takeoff had cloud base ~5000ft with scattered clouds ~1500ft closer to ocean. The scattered low clouds were expected to dissipate for our flight, which did happen, allowing planned flight path, but plans changed mid-flight because no cold front was observed. The flight was changed to focus on the coastal morning transition period. The cloud deck over southern NJ mostly cleared out mid-flight.

4 legs were flown along the “W3” and “E3” line, with some legs extending or stopping short of W3/E3

Leg 1, constant altitude eastbound: Flying from W3 towards E3 at approx. 850-1100ft. Expecting to fly out of the cold front, but neither a significant temperature rise nor wind change was ever observed. The aircraft skimmed the top of the PBL during the leg; dipping into the PBL caused some fluctuation in atmospheric parameters, but we did not spend enough time in the BL to determine if the cold front was present along the track. Wind direction along the whole leg (~250deg) met expectations for the forecasted post-front environment. We flew beyond E3 hoping to see the front, but reached our limit of 10mi offshore with no clear signs.

Leg 2, constant altitude westbound: Flew straight back towards W3, ending the leg ~20mi short (barely reaching the Delaware River, where PBLH dropped immediately). Same altitude as Leg 1, hoping to stay in PBL and see cold front. Once it became evident we wouldn't see the front on this flight, we finished the leg while devising a new plan to direct our measurements at the coastal morning transition period.

Leg 3, constant altitude eastbound: Headed towards E3, flying at 5500ft to measure PBLH with lidar. Raw lidar data looked good, seeing PBL ~400-600m thick. Ended the leg ~10mi beyond shore, as with Leg 1. Decreased flight altitude to ~4000ft offshore to avoid the lower marine cloud deck.

Leg 4, sawtooth westbound: Two “teeth” ranging from 1000ft to 4500ft, then 1000ft for a stretch turning from W3 towards Lancaster. On ferry home, did one more sawtooth to ~4500ft, which seemed to almost skim PBL top (via lidar raw data). We did not go higher as we were about to fly into a cloud wall, the base of which matched ~4500ft PBLH estimation.

- Prevailing winds were northwesterly and weaker than 15 m/s. Daily high of 60degF.
- MU sonde support from landfill site at 11, 14, & 17 Z. UMBC/Beltsville planned to launch 1 or 2 sondes; need to confirm.

Composed by Brian Carroll, brian.carroll@umbc.edu

More notes at: <http://flights.uwyo.edu/projects/searmar17/>

Project: SEAR-MAR17

16 Nov 2017

Flight: RF12

Flight following UMBC's cold-frontal profile; no strong frontal gradients encountered, so the flight refocused on sampling the boundary layer and its transition across the coast.

Only issue, "Nav degraded" on Applanix - map position looks good, may be holdover from going offshore. Regained nav alignment but took a while to get accuracy on Attitude/Heading/Velocity.

Crew: Tom Drew, Brian Carroll (UMBC), Dave Plummer, Christiana Sasser (UMBC), Brian Rinaldi (MU); LOD: Ben Heesen

Flight Summary:

UTC Comment

Will head immediately to line 3, attempt to do vertically stacked passes, transiting at low altitude.

1349 Wheels up.

1407 Turning onto line at 1 kft AGL. T/Tdp are near +10.5/3.5. Occasional bumps, gradual warming to east along track.

1415 Thin and scattered clouds above, zenith lidar has bases 1.5-2 km above FL. Broader decrease in T after 1414-15Z, from +11-12 to +7C.

1424 Warming temperatures again, minimum was about +7.5C, up near +10C now. Dewpoint dropoff as we went offshore, not much wind change. Looks more like boundary layer differences than any notable frontal gradient.

1430 Turning back west, to 2500 ft.

1435 Descending back to 1000 ft to look at lower structure again, as no strong frontal structure apparent.

Main difference looks like drier air near BL (or lowest mixed layer).

New plan for final two legs: transit east at 5500 to look down at BL with nadir lidar, then final leg at 2500 ft. Focus more on BL transition over coast since there's not a strong frontal signature evident.

1452 Turn early, ascend to 5500.

Very clear BL signature on nadir lidar, lowest 3-400 m AGL. T/Tdp +1.5/-1C.

1507 Just in cloud bases at 1.5-2C, descending to 3500 prior to turn.

1509 In turn at east end while descending to 1000. Will do sawtooths on west leg.

1519 Sawtooth pattern.

1548 One more sawtooth to 4500 on track back to LNS.

1601 On the ground.

11/15/17 SEAR-MAR17 Pilot notes (Research Flight 11)

Crew: Drew, Oolman, Matthew Drews, Christopher Barns, Sara Housseal

Flight Time: 2.2

Objective: Pam-coastal Flight

Planned: Overfly elementary school at 1000 ft. AGL, fly to 39N and then on to the PAM-site at 1000 ft. AGL. Over PAM-site, climb to 2000 ft. AGL. Reverse course back to 39N, and fly south to first spiral location on west side, spiral up to the cloud deck, then resume course to south at 1000 ft. AGL. At southwest point turn east to southeast point. Turn north towards spiral location of east side and spiral up to cloud deck. Resume course back to 39N and LNS at 1000 ft. AGL.

Actual: Overflew elementary school at 1000 ft. AGL, and then turned to the east to 39N. 39N had traffic in the pattern, so side stepped to the south of the airport. Crossing the PAM-site at 1000 ft. climbed to 2000 ft. AGL, and reversed course back to 39N, again side stepping the pattern to the south. Flew south to first spiral location on west side, spiraled up to about 2000 ft. AGL, then resumed course to south at 1000 ft. AGL. At southwest point did a spiral to 3000 ft. MSL and back to 1000 ft. AGL. Turned east to southeast point. At southeast point, climbed to 2000 ft. MSL and back down to 1000 ft. AGL in the turn to the northwest. Reaching the spiral location on the east side spiraled up to 3000 ft. MSL. and back to 1000 ft. AGL and resumed course back to 39N. Over 39N, climbed to 3000 ft. MSL, and made turn towards LNS. Descended to 1000 ft. AGL and returned to LNS.

SEAR-MAR RF11 – 15 November 2017

Tom Drew, Matthew Drew, Larry Oolman, Sara Housseal, Christopher Barns, Ben Heesen (LOD)

1802 Take off
1828 FL020, T=4 C, DP=-3, winds light
1838 FL012, near Princeton Airport, SCT038, T=6,DP=0
1842 Over PAM station
1844 CH4 exceeds 2.3 ppm
1848 FL011 heading SSE from Princeton, T=7, DP=0, winds=120 true 7 knots
1856 FL015, T=6, DP=1,winds=100@10 kt, clouds OVC032
1902 Spiral to FLO30 and back down again to F010 and then head east
1910 Over the coastline, FL012, T=7, DP=3, winds 50@12, OVC024
1915 At eastern point, climbing from FL012 to FL020 and down to FL012.
1916 Heading NW
1924 Spiral to FL030 near Lakehurst
1934 Starting climb near Princeton
1935 FL034, T=1, DP=0, winds 165@6
1936 Heading back to Lancaster
2005 Land

SEAR-MAR Flight – Static Pressure

The static pressure flight was designed to independently vary aircraft parameters to measure static pressure defect fluctuations. The flight was to begin at 1000 ft and vary pitch through porpoising, yaw, and airspeed on three legs with 270° turns in between to vary roll. The same pattern would be repeated at higher altitudes before spiraling down and returning to LNS. Specific care was taken to limit flight time to one hour or less, saving allocated flight time for other missions.

I sat in the copilot seat to direct Tom through the maneuvers. I had been working with Dr. Clark to alter the flight plan the night before and morning of the flight, and so was familiar with the maneuver patterns and stack structure.

We took off a little before 1:00 PM and climbed quickly to 1000 ft.

Flew SE to MARAF ground site at Frey Landfill and did sharp clockwise turn; we could see the ground instruments and Dr. Clark's Instrumentation class. The aircraft was photographed by students and faculty on the ground.

Proceeded southeast and began varying aircraft parameters.

Second stack was originally planned for 5,000 ft. After first set, decided that cloud base was too low (<4,000 ft) and completed second set of maneuvers at 3,000 ft.

Halfway through the second stack, we discovered Tom and I had different flight plans (he never got the new set). We began modifying the plans to account for current position and flight duration, made more difficult by heavy traffic.

Watching the clock, decided to do third set of maneuvers. Got IFR clearance to ascend to 7,000 ft. Completed third set of maneuvers. Third set was the opposite direction (and correspondingly opposite maneuvers) to the flight plan. We then had a complete set of maneuvers at three altitudes.

Ended third set over the landfill; obtained IFR clearance and did a tight counterclockwise spiral down over the wind turbines and MARAF site.

Returned to airport, total flight slightly over an hour. Landed around 2:00 PM.

Flight was observed by Millersville students both at the Frey Landfill ground site at the beginning and end of the flight and several times on the Millersville University campus, even noted and photographed by non-meteorology students.

Preliminary data looks good; Min noted unusual signatures in the lidar resulting from our maneuvers that warrant investigation.

Project: SEAR-MAR17

14 Nov 2017

Flight: RF10

Notes:

Short flight following Millersville's static pressure profile, varying aircraft parameters over short times at three altitudes.

Crew: Tom Drew, Tim Keebler (MU), Dave Plummer, Shelby Fuller (MU), Amanda Fritz (MU); LOD: Ben Heesen

Flight Summary:

UTC Comment

1750 Wheels up

1756-1758 First line - yaw maneuvers

Down lidar not displaying - looks like files being written ok, toggle data recording to start new file.

Lidar cloud bases 1-1.2 km above flight track (~1500 ft).

180030 pitch maneuvers

180430 Airspeed maneuvers

Second set of maneuvers - Looks like scattered and broken layers merging, will bias lower for 2nd set - 3000 kft.

1811 - Maneuvering for traffic on intended line.

181420-181610 Yaw maneuvers - ending over river.

181845-182045 Pitch maneuvers - coming close to bases but haven't seen any noise on CDP (TRF near 0 to -1C).

1821 Left turn for airspeed maneuvers.

182310-182545 Airspeed maneuvers.

Third set, above cloud deck

1829 In cloud passing through 5 kft (-6C); Tops 6 kft and pretty uniform. Looking at 7 kft for maneuvers.

183345-183645 Speed maneuvers first.

183645 Turn into pitch leg.

183820-184030 Pitch maneuvers.

184215-184415 Yaw maneuvers.

184415 Spiral descent near landfill site.

1849 lidars off for return.

1854 On the ground.

Static Pressure Flight

18Z – 19Z on November 14, 2017

Amanda Fritz, Millersville University

Flight:

We left the airport at 18Z, and we flew to the Susquehanna River. Once there, we varied air speed for two minutes on one leg, pitch for two minutes on one leg, and yaw for two minutes on one leg. Then, we ascended to 3000 feet and repeated the same three maneuvers for the same amount of time. Following this, we ascended above the cloud layers and boundary layer. At 7000 feet, we repeated the air speed, pitch, and yaw maneuvers for the three legs and the two-minute time frames. We spiraled down to 1000 feet through the cloud layer and over the landfill, which is where Millersville has its ground site. Then, we headed back to the airport and landed. This flight lasted a little over an hour.

Experience:

This static pressure flight was a once in a lifetime opportunity. I learned so much about the instruments from all the members of the crew. This experience inspires me to go to graduate school and get more involved with airborne research. I really enjoyed seeing the data coming in and plotting the different data types. The skew-T was really interesting because I have learned in class about how to tell where the cloud layers are based on the temperature and dew point lines. While flying, I got to see this for myself by looking at the areas on the skew-T where the lines were close together and seeing the corresponding clouds outside of the plane. I learned a lot of valuable information from this experience!

Static Pressure Flight

November 14th, 2017; 1750Z – 1854Z

Shelby Fuller, Millersville University

Crew: Tom Drew, Timothy Keebler, Dave Plummer, Amanda Fritz, Shelby Fuller

Flight Time: 1.1 hours

Flight:

The morning of the flight Dr. Clark briefed Tim, Amanda and I with directions on where to fly, how high to fly, and what maneuvers to do for how long. The plan was to take off and ferry over to the landfill site where the Meteorological Instrumentation class would be to watch us do some of the maneuvers. The maneuvers done would test the pitch, yaw, and air speed of the aircraft and each maneuver would be done for 2 minutes at a time. We would do these maneuvers at 1,000 feet, 5,000 feet, and 10,000 feet to create a static pressure profile.

It took approximately 5 minutes to fly over to the landfill and once there we got right into our maneuvers at 1,000 feet. On the first leg we varied the yaw of the aircraft and started to time the length of each leg. Next, we did a 270 degree turn to vary the roll and went into testing the pitch. For this we did porpoising movements and would quickly climb about 1,000 feet and then descend 1,000 feet. After that, we did another turn and went into varying air speeds.

The second stack of maneuvers was then done at 3,000 feet instead of 5,000 feet due to the presence of a cloud layer between 4,000 and 6,000 feet. Because of this we had to slightly modify the original flight plans. We completed the same maneuvers in the same order, although this stack took slightly longer than the first due to the presence of air traffic.

Before punching through the clouds to get to our final stack, we requested IFR clearance. Clouds seemed pretty thick as we flew through them but was perfectly clear once we got above the layer. Final maneuvers were done at 7,000 feet in the order of varying air speed, pitch, and then yaw. After completing the maneuvers we did a tight spiral down from 7,000 feet to 1,000 feet over the landfill site. From here we returned back to LNS, completing the flight at slightly over an hour.

11/11/17 SEAR-MAR17 Pilot notes (Research Flight 9)

Crew: Drew, Oolman, Brian Carroll-UMBC, Zhifeng Yang-UMBC, Adrian Flores-UMBC.

Flight Time: 2.5

Objective: UMBC Boundary Layer

Planned: Ferry to inland waypoint. Fly sawtooth from 1000 ft. AGL to 8000 ft. MSL. Fly level at 12,500 MSL back to inland waypoint, reverse course and fly sawtooth again. Repeat level leg at 12,500 ft. MSL. and return to LNS.

Actual: Departed LNS climbed to 7,500 ft. MSL and then descended to 1000 ft. AGL for inland waypoint. At inland waypoint, started 2 sawtooth profiles to 5000 ft. MSL. At ocean waypoint made turn and climbed for a level leg at 6500 ft. MSL. After arriving back at the inland waypoint climbed to 7500 ft. MSL and flew another level leg back to ocean waypoint dropping to 5500 ft. MSL the last 17 nm. Descended to 1000 ft. AGL over the ocean waypoint and started the return sawtooth profiles to 7000 ft. MSL. Reaching the inland waypoint, turned toward LNS and did another climb and decent to 6500 ft. MSL.

During & post-flight notes, RF09, 2017/11/11: PBL/PBLH variability over land and water (UMBC)

No clouds, very clear day. Take-off 1745Z, land around 2000Z (1245-1500 local) Flew the 4 legs between “Land” & “Ocean” mostly as planned, but with changes from planned altitudes:

Leg 1, sawtooth eastbound: Two “teeth” ranging from 1000ft to 5000ft; lower than the planned 8500 because BLH was observed ~2500ft. Rough estimates of BLH had it sloping downwards from land to ocean, approx. 3200ft to 2500ft.

Leg 2, constant altitude westbound: Flew at 4500ft. Good lidar data of PBLH! This leg was at a lower altitude than planned because we thought the lidar wasn’t seeing anything during Leg 1, but during Leg 2 we changed the lidar data color scale, revealing good measurements. Near “Land” point, BLH had risen close enough to flight altitude to be indiscernible by raw lidar data. This may clear up with processed data.

Leg 3, constant altitude eastbound: Flew at 7500ft to remain above PBLH but not so far away as to lose signal. Needed to drop raw lidar backscatter color scale by about 1.5dB from the previous leg. Upon reaching the ocean shore, we dropped to 5500ft to try to improve on dwindling signal.

Leg 4, sawtooth westbound: Two “teeth” ranging from 1000ft to 7500ft; higher than Leg 1 because of observed rising PBLH. PBLH rough estimates between 2500ft and 3100ft, no clear land-ocean sloping.

- Prevailing winds were northerly and weaker than 10 m/s. Daily high of 40degF.
- MU sonde support from landfill site at 13 & 15 local. UMBC/Beltsville site sonde launch was planned for 14 local, but need confirmation of launch.

Composed by Brian Carroll, brian.carroll@umbc.edu

More notes at: <http://flights.uwyo.edu/projects/searmar17/>

SEAR-MAR RF09 – 11 November 2017, flight B

Tom Drew, Brian Carroll-UMBC, Larry Oolman, Zhifeng Yang-UMBC, Adrian Flores-UMBC, Ben Heesen (LOD)

Boundary layer mission

1745 Take off
1759 Starting up on sawtooth, near MD/DE border
1801 Top of boundary layer near 3200 ft. Was 2800 ft on first climb
1804 Top of climb, FL050, T=-2, DP=-50, winds=330@10 kt, CH4=1.93
1805 Starting down
1809 Bottom of descent, T=0, DP=-16, wind=300@5, CH4=1.97
1817 Top of sawtooth, lidars aren't showing much
1823 End of line at FL010, reversing to west
1826 At FL045 for constant altitude leg
1842 Able to tease out boundary layer height by zooming nadir lidar color scale to -18:-16.5
1853 At end of line over NE MD, turn east and climb to FL075
1857 FL075, T=1.5, DP=-38, winds=280@11, CH4=1.93. WCL-NADIR show top of boundary layer 1.1 km below using a color scale -19:-17
1907 PBL around 1.4 km below us
1913 Nadir lidar signal getting weaker, descend to FL055
1919 East end of line, descend to FL010 and reverse course
1921 FL010, T=-1, DP=-14, winds variable, CH4=1.96, Starting sawtooth between FL010 and FL070
1922 Lost satcom. Reasons unknown.
1949 At western point, head back to LNS
2004 Land

11/11/17 SEAR-MAR17 Pilot notes (Research Flight 8)

Crew: Drew, Plummer, Alyssa Cannistraci, Drew Casale, Ryan Lees

Flight Time: 3.1

Objective: Millersville Cold Pool

Planned: Ferry to SE point and fly pattern at 1000 ft. MSL. with a low approach at N68. Repeat the pattern at 1,300 ft. AGL and again at 1,600 ft. AGL. Make another low approach at N68 and climb to 7000 ft. on ferry to north point. Make a low approach into ZER and N49. Return to LNS.

Actual: Departed LNS and ferried to SE point and flew pattern at 1000 ft. MSL making 270 turns on each corner. Three fairly high ridges crossed the pattern area, so I had to ramp up to maintain the appropriate AGL height (1000, 1300, 1600 AGL) over each. Made the low approach at N68 north to south. Repeated the pattern at 1,300 ft. AGL and then again at 1,600 ft. AGL. Made another low approach at N68 after the crossing the final SW point. Did a sounding climb to 10,000 ft. MSL while ferrying to the north. Descended to 1000 ft. AGL over the north waypoint and proceeded to KZER for the low approach (east to west). Then proceeded to 74N for a low approach (NE-SW). Climbed out and returned to LNS.

Project: SEAR-MAR17

11 Nov 2017

Flight: RF08

Notes:

Flight following a modified version of Millersville's cold air damming profile, stacked hourglass pattern with two missed approaches at Franklin Co. airport, an ascent to 10 kft to profile through main inversion layer, and missed approaches at Schuylkill (ZER) and Bendingo(74N). Delayed startup after system data disk check timed out after flagging free disk space. Restarted lidar recording midway through flight. KACAMS software locked up twice, recorded camera images otherwise.

Crew: Tom Drew, Drew Casale (MU), Dave Plummer, Alyssa Cannistraci (MU), Rya Lees (MU); LOD: Ben Heesen

Flight Summary:

UTC Comment

1209 Wheels up

1209 Licor pump already on prior to takeoff.

First hourglass pattern will be roughly terrain following, ostensibly 1000 ft AGL but tracking with terrain over mountains.

1226 On first line heading from waypoints E1 to NW2, inversion close to our altitude.

1239 On track from NW2 to E3.

1245 Turning at E3.

1248 On line for point E3 to missed approach at Franklin Co. T/Tdp near -7C/-17C at flight level.

1253 Missed approach, T near -6.5C during approach, -8C at flight level at ~1000 ft AGL.

1257 Final leg of 1000 ft AGL hourglass, from point SW4 back to E1. -8C/-17C near ~1800 ft IMU alt, in upper level of cold layer. -9C at 2600 ft over terrain.

Second hourglass, 1300 ft AGL

1308 Ascending from point E1. Less pronounced inversion heading through 2500 ft IMU alt, pretty distinct at 2600 ft.

1313 Profile through inversion layer up through ~3100 ft alt, temperature up to -5C, very dry.

1319 Turning at NW end, near -8C at 3.1-3.2 kft (IMU).

1321 At NW2 heading to E3, 3300 kft IMU, -10C/-17C. Cold air to about 3000 ft IMU alt, coldest -11C.

1322 Had toggled both lidars, displays stopped updating; status updates still showing on screen, so likely display issue. Both good on disk space. In turn at SW end.

Error -1074360308 occurred at IMAQdx Get Image2.vi Possible reason(s): NI-IMAQdx: (Hex 0xBFF6900C) Camera has been removed. Reconnected with cameras pretty quickly but doesn't want to record. Tried reconnecting a couple times, then rebooted computer, after which software worked again.

1348 Turning out of second hourglass.

Third hourglass, 1600 ft AGL

1351 Heading from points E1 to NW2, T/Tdp near -8C/-16C at 2200 ft (IMU). Still ascending into inversion when ascending over higher terrain.

1401 In turn at NW end.

1404 Eastbound from NW2 to E3, T near -6 to -7C with dewpoint near -30C at 3200 ft, well into inversion/drier air.

1413 SWbound from E3 to SW4, will do missed approach when returning NE on this leg.

1420 In turn at SW4. Will return for missed approach at Franklin Co, then ramp up through 10 kft. Then rest of ferry leg NE near minimum alt

1426 At minimum on approach. T/Tdp near -4C/-14C at minimum.

1431 Camera error again. Rebooted to reconnect.

1437 Inversion capped out close to 7000 ft, near 0C.

1455 Missed approach at Schuylkill/ZER.

1500 Missed at Bendingo/74N, max temperature near -3C.

1514 On the ground

SEAR-MAR Research Flight Eight | 11 November 2017

In the eighth SEAR-MAR research flight, students and scientists studied the formation of a cold pool over south-eastern Pennsylvania. On the morning of 11 November 2017, three Millersville University students boarded the UWKA and completed a pre-flight safety briefing. Through this briefing, students located the fire extinguisher as well as learned proper techniques to open/close the cabin door. Students were then introduced to UWKA instruments such as the upward and downward pointing LiDARs and Picarro which was used to monitor atmospheric methane.

Casale served as Drew's copilot while Lees sat in the second row adjacent to Plummer. Cannistraci sat in the very back seat and was nauseous. The flight was delayed approximately five minutes due to miscommunications between the UWKA's main meteorological instrument data collector and ground computers. A reboot to the system resolved all error messages, and the airplane took off at approximately 7:05am.

The UWKA flew at levels of 1000, 1300, and 1600 feet AGL. The region studied included airspace over Cumberland Valley. In addition, the UWKA completed four missed approaches at three regional airports. This allowed SEAR-MAR researchers to obtain data below 1000 feet AGL. The airplane then ascended to approximately 10,000 feet AGL prior to returning to Lancaster Airport.

11/10/17 SEAR-MAR17 Pilot notes (Research Flight 7)

Crew: Drew, Daniel Harp-MU, Larry Oolman, Adam Weiner-MU, Benjamin Fellman-MU

Flight Time: 2.1

Objective: Millersville Mountain Wave Flight

Planned: TO, climb to 6250 ft. Fly to 3SE Fly to 3NE at 6250 ft. Repeat line 3SE-3NE making 180s at standard rate, stepping down 1500 ft. each turn. Fly to 3F at 1750 ft. Fly to 3G climbing to 3250 ft. Fly to 3H climbing to 4750 ft. Fly to 3I climbing to 6250 ft. Fly to 3J descending to 4750 ft. Fly to 3K descending to 3250 ft. Fly to 3NW descending to 1750 ft. Climb to 6250 ft. Fly to 3SW (detour Gettysburg if needed). Fly to 3SE at 6250 ft. Repeat line 3SW-3SE making 180s at standard rate, stepping down 1500 ft. each turn. Return to LNS at 3250 ft.

Right before takeoff decided to fly east-west track first then the stair-step pattern and ending with the north-south track.

Actual: Departed LNS climbed to 6250 ft. MSL for first east-west leg. Stepped down to 4750 and 3250 and 1750 ft. MSL. Climbed in the 270 turns for each of the stair-stepped legs at 1750, 3250, 4750, and 6250 ft. MSL, arriving back at the SE waypoint. Decided to add an additional N-S leg at 7500 ft. MSL and step down 1500 ft. on each SE-NE leg down to 3250 ft. MSL eliminating the last 1750 ft. MSL leg. Returned to LNS.

SEAR-MAR RF07 – 10 November 2017

Tom Drew, Daniel Harp-MU, Larry Oolman, Adam Weiner-MU, Benjamin Fellman-MU, Ben Heesen (LOD)

Mountain waves mission

1424 Take off
1435 FL065, T=-6 C, DP=-50 C, winds=310 true @ 38 kt. From climb out sounding the inversion starts at 840 hPa. Clouds at 5 km above us.
1439 Starting leg to west. FL062, T=-10, DP=-35, winds=315@37
1441 Climb to FL065 to get over clouds. Vertical velocity +/- 3 m/s, period 2 minutes (3 nmi)
1443 End of line
1446 Eastbound FL048, T=-11, DP=-16, winds 330 @ 20.
1450 Done with line
1453 Westbound FL032, T=-6, DP=-17, winds=330 @ 22
1458 Done
1500 Eastbound, FL018, T=-2, DP=-14, winds=340@22
1507 Northbound FL030, T=-6, DP=-15, winds=330 @ 22
1509 Done
1510 Westbound, climbing to FL045
1512 270 degree turn
1514 Northbound, climbing to FL062.
1516 FL062, T=-6, DP=-50, winds=315@36
1518 Done, turn 180
1519 Southbound, FL062
1521 270 degree turn
1522 NE bound FL062
1524 270 degree turn
1526 S bound FL062, T=-10, DP=-32, winds=320@28
1528 270 degree turn to right
1531 Eastbound, FL062, waves +/- 3 m/s,
1532 Just above cloud top
1533 Right turn
1534 Northbound, FL075, T=-4, DP=-54, winds=310@40
1542 Done
1544 Southbound, FL063, T=-10, DP=-36, winds=320@29
1549 Done
1551 Northbound, FL047, T=-11, DP=-16, winds=320@18
1600 Done
1602 Southbound, FL032, T=-7, DP=-17, winds=330@23
1608 Done with mission, head back
1626 Land

11/8/17 SEAR-MAR17 Pilot notes (Research Flight 6)

Crew: Drew, Plummer, Alex Tomhoff, Stephen Hallett, and Andy Moffitt.

Flight Time: 3.9

Objective: PSU's Coal-Cumberland-Enlow

Planned: Ferry to spiral coordinates starting at 1000 ft. cross over the site and perform a 2 nm spiral to about 6500 ft. Ferry to second coordinates and repeat making a similar but smaller spiral above it to 6500 ft. MSL.

Actual: Departed LNS IFR climbed to 14,000 ft. MSL. Arriving at coordinates, canceled IFR and descended to 1000 ft. AGL. Flew over site at 1000 ft. MSL and then made a ~2 nm circle around the point at 1000 ft. Set up a very slow climb to 6500 and back down with a spiral of about 2 nm. Then set up a crosswind pass over the point and offset downwind about ½ nm for 3 more passes. Ferried to the second point and repeated the same, with the exception that we used about a 1 nm radius circle (at 1000 ft. AGL) and spiral up and a 2 nm radius down. After the final pass, picked up the IFR and ferried back to LNS at 14,000 ft. MSL.

Project: SEAR-MAR17

9 Nov 2017

Flight: RF06

Notes:

Flight studying methane emissions based on PSU's Coal-Cumberland-Enlow profile. Initially called for spiral ascents around Cumberland and Enlow mines, modified for ascending & descending profiles, and four sets of cross-wind passes at minimum altitude starting over the mine and staggering downwind.

Crew: Tom Drew, Alex Tomhoff (PSU), Dave Plummer, Andrew Moffitt (PSU), Stephen Hallett (PSU); LOD: Ben Heesen

Flight Summary:

UTC Comment

1759 Wheels up Lidars used through ~1830, transiting in clear air with predominant cloud deck well below.

1840 Very dry (TDP down to -50C), can see edge of cloud field ahead. Western spiral (Enlow site) should be clear, do southern spiral (Cumberland site) second to give more time to clear.

~1850 Water display frozen on Picarro, data look fine. Was able to start it updating again by changing display zoom settings around.

1902 Descending for Enlow site, will try to do ~800 ft ascent per spiral.

1907 Looks like BL up to about 5000', turbulence, methane from 1.9-2.2.

1910 Broad CH₄ peak of 2.1-2.2 ppm around site.

CH₄ 2.6 ppm on NE side at 2500ft, winds 220-240 at 10-15 kt.

"Background" CH₄ is 2.1-2.2 ppm heading to 4000 ft, peak on NE is 2.35 ppm here.

~1942 Spike to 2.5 ppm on the N side of the circle.

1946 Spike to 2.4 near 3000 ft, a bit more to the east.

1951 First cross leg, will stagger legs downwind starting at site at ~1000 ft AGL.

1955 Second cross leg, 3.5 ppm straight downwind of site.

1959 Third cross leg, ~2.4 ppm downwind.

2003 Final cross leg, no big plume, probably overhead by this point.

Enroute to Cumberland site.

2013 In spiral near 2400 ft, winds more SSW, background CH₄ 2.15 ppm.

Spikes in methane not nearly as pronounced visually, upwind sides look pretty similar.

2025 Starting descending profiles, expanding to 2 nm.

2037 Crosswind passes starting over site and stepping downwind. Winds generally centered around 220, CH₄ background values ~2.15 ppm.

2040 On second leg with 0.5 nm spacing. Some "spikes" but all small and to side of line. 2.2 ppm +/- 0.1 along second leg, variations away from site have been as large as anything downwind.

Diverting for traffic avoidance before last leg.

2053 Heading back to base

2122 Both lidars up and recording, above lower cloud deck again.

2126 Heading into clouds near -3C on descent.

2150 On the ground

11/8/17 SEAR-MAR17 Pilot notes (Research Flight 5)

Crew: Drew, Oolman, Amber Liggett, Chad Wiley, Gabriella Himmele.

Flight Time: 3.3

Objective: PSU Sugar Run Salt Springs

Planned: Ferry to first grid area with a sounding to the top of the boundary layer. Fly the outer grid at 1000 ft. AGL (east-west). Then fly the inner grid at 1000 ft. AGL (east-west). Ferry to the second grid to the northeast and fly the small grid. Return to LNS.

Actual: Departed LNS VFR and climbed to 2500 ft. MSL to remain below the overcast. Descended to 2000 ft. on the ferry to remain VFR. Skies cleared arriving at the first grid site. Beginning at the southwest corner and made the first pass on line 14. Turned to line 12 and then returned back to line 13. However, we then continued the lines in order from 12 to line 1 at approximately 1000 ft. AGL. Started the inner grid at the NW corner and did the lines in the following order: 1, 3, 5, 2, 4. Maintained approximately 1000 ft. AGL although the terrain was fairly variable.

Departed the first grid area and climbed to 6500 ft. MSL for the transit (sounding). Descended to the second grid and started at the southwest corner. Did lines in order: 3, 1, 2 at 1000 ft. AGL. Departed the grid area towards Lancaster, picking up IFR for the return flight.

Notes for Emissions profile, PSU Sugar Run-Salt Springs track

Notes by: Amber Liggett

Time: 1656 – 2008 UTC (3.3 hours)

Date: 8 Nov 2017

Flight #: RF05

Weather:

- Cloudy transit (to and from main area of study)
- Clear skies and calm Northerly winds over study region

Flight path:

- Travel ~58 miles north near Salt Springs using VFR (30 minutes)
- Collect methane measurements at 1200 feet over Salt Springs grid site (~ 1.25 hours)
- Travel 50 miles north/northeast near Wilkes Barre (~ 25 minutes)
 - Ascend into boundary layer at this time – boundary layer was at 5600 feet
- Collect methane measurements at 1000 feet over second grid site (5 minutes)
- Travel 108 miles back to Lancaster Airport using VFR (~ 45 minutes)

Instruments:

- LIDAR
- Skew-T
- Gust probe
- Radiometers
- GPS

Measurements:

- Methane
- Wind speed
- Turbulent flux
- Temperature
- Pressure
- Humidity

SEAR-MAR RF02 – 06 November 2017

Tom Drew, Amber Liggett-MU, Larry Oolman, Gabriella Himmele-MU, Chad Wiley-MU, Ben Heesen (LOD)

Sugar Run Methane mission

1656 Take off
1709 FL023, T=0 C, DP=-1 C, winds variable < 4 knots, overcast
1715 Maneuver for traffic
1716 Breaking out from clouds. FL024, T=0, DP=-2, winds light. CH4=1.95 ppm
1722 Eastbound on first line, FL017, T=3, DP=-4, winds light, CH4=1.98
1725 Climb to FL023 to clear ridge
1726 End of line, T=1, DP=2, CH4=1.95
1728 Westbound on the 3rd line
1733 End of line
1734 Eastbound on the 2nd line, FL019, T=3, DP=-6, CH4=1.97
1736 Climb to FL021
1738 Climb to FL023
1739 End of line, T=2, DP=-3, CH4=1.96
1741 Westbound on the 4th line
1743 Descend to FL021
1746 Done with line
1747 Eastbound on the 5th line, T=3, DP=-6, CH4=1.99
1753 Done with line
1754 Westbound on the 6th line, FL021, T=3, DP=-4, winds light, CH4=1.98
1758 Done with line
1759 Eastbound on the 7th line, T=3, DP=-6, CH4=2.01
1803 Climb to FL025
1804 Done with line
1805 Westbound on the 8th line, FL023, T=3, DP=-5, CH4=1.97
1810 Done with line
1811 Eastbound on the 9th line.
1815 Done with line
1816 Westbound on the 10th line. FL024, T=3, DP=-6, CH4=1.97
1821 Done with line, DP varying between -10 and -5
1822 Eastbound on the 11th line. CH4=1.95
1826 Turning a bit early instead of climbing over ridge.
1826 Westbound on the 12th line. FL024, T=4, DP=-9, winds northerly at 5 kts, CH4=1.96
1830 Done with line
1831 Eastbound on the 13th line.
1835 Done with line
1836 Start of last line, FL025, T=4, DP=-11, winds NNE at 4 kts, CH4=1.95
1839 Done with outer grid.
1845 Heading east on north most line of inner grid. FL022, T=3, DP=-5, CH4=1.98
1847 Westbound line 3
1849 Eastbound line 5

1851 Westbound line 2
1853 Eastbound line 4
1856 Done with inner grid
1857 Starting sounding climb
1859 Top of boundary layer around FL061, 820 hPa
1908 Heading back down.
1909 Top of boundary layer, 830 hPa, FL056
1915 Start of northern grid. FL026, T=3, DP=-11, winds light, CH4=1.95
1917 Westbound on northern line
1919 Eastbound on center line
1920 Done. Climb to FL065 and head home.
1924 FL065, T=-2, DP=-45, winds 300 true at 14 knots, CH4=1.92 ppm
1944 Cloud tops FL040
1957 Cloud tops down to FL036 near Lancaster
2004 Cloud base FL028
2008 Land

11/7/17 SEAR-MAR17 Pilot notes (Research Flight 4)

Crew: Drew, Plummer, Rhiannon Fleming, Amanda Dobrowski, David Gibson.

Flight Time: 3.6

Objective: Extended NW Frontal Pattern at Mid-level (10,000 MSL)

Planned: Fly the Extended NW Frontal Pattern (complete) at 10,000 ft. MSL.

Actual: Departed LNS IFR, climbed to 10,000 ft. MSL. Remained IMC most of the flight. Aircraft OAT temperature was around zero most of the flight and we occasionally picked up a trace of ice. Coordinated with New York and Cleveland Centers, however, Cleveland handled us for the majority of the flight. Flew the pattern as originally prescribed, except made all turns with 270 degree turns and returned to LNS.

Project: SEAR-MAR17

7 Nov 2017

Flight: RF04

Notes:

Flight studying frontogenesis at mid-levels, using the abbreviated version of Millersville's frontal structure (NW) profile, but flown at 10 kft. Note, lower time series display on Picarro was frozen again. Left software running after verifying that data were still being recorded. Licor reference gas was not enabled before flight, opened cylinder ~1706. No other notable instrumentation issues.

Crew: Tom Drew, Rhiannon Fleming (MU), Dave Plummer, Amanda Dobrowski (MU), David Gibson (MU); LOD: Ben Heesen

Flight Summary:

UTC Comment

1656 Wheels up

1700 Lidars running.

1715 At 10 kft, consistently in cloud. TRF near -1C but only sporadic liquid.

1742 At north corner of box, TRF -3 to -4C in cloud, still only sporadic liquid.

1749 On track for 2nd leg, heading NW to SE. TRF -3.5C, TDP -4.5C.

1802 Turning at southern end of NW-SE leg. Radar indicative of frontogenesis within operations area. Theta-E broadly increasing along leg heading SE, from ~309 to 313K.

1810 Starting third leg, heading from SE to NW. Warmer, -1C sporadic LWC.

1824 At NW end of leg, beginning turn. Consistently near -4C out at this end, -1C at SE end.

1837 In first SW-NE cross leg, at NW end of box.

1846 Turning at NE end of leg, TRF -4C here, some liquid on CDP and LWC probes.

1853 On track for second cross leg, headed NE to SW. TRF near -3.5C, continued similar cloud structure.

1904 In turns at SW end. Warming towards southwest, TRF up to -1C, similar trends on TDP/Theta-E.

1909 Between cloud layers.

1920 Ending SW-NE leg, TRF decreased to -3C and Theta-E to 309K over last few minutes in northeast side of box.

1928 On track for NE-SW leg, near -2C at end.

1939 Turn out of penultimate leg, temperatures close to freezing here.

1946 On track for final SW-NE leg, -1.5C at this end.

1955 Returning to base.

2022 On the ground.

Notes for Mid-Level Frontogenesis

Written by Amanda Dobrowski, Rhiannon Fleming, and David G Gibson

Date: 7 November 2017

Time: 1656-2022 UTC (3.6 hrs)

Flight #: RF04

Weather Observations:

- Flight began with overcast skies with a relatively low cloud ceiling and no precipitation reaching the ground.
- Proceeded to climb to an altitude of 10,000 feet to fly through frontogenesis at 700mb.
- Entered a region of light precipitation which alternated between snow and rain precip throughout the flight.
- Alternating instances of clouds above and below separating in the range in which we flew (10000').
- Winds were Northwest (310).
- Mild turbulence was experienced throughout the flight; turbulence experienced occurred during turns.
- Experienced a break in the clouds for ~5 mins in a valley region west of State College.
- Tower based warnings of precipitation and winds during flight back to Lancaster Airport.
- Completed mission and arrived back to the airport around 2022UTC with light rain conditions.

Flight Path:

- Flew the flight plan grid at 10,000 ft altitude MSL
- Starting point was at point ZEE at the lower right on grid
- The SE-NW legs were done first followed by the SW-NE legs
- NW legs were flown in ~40 minutes and the SE legs took 30-35 minutes.

Instruments:

- Skew-T- multiple parameters were observed and recorded
- LiDAR- the LiDAR reading above the aircraft yielded interesting data based on the trends of cloud densities.
- Radar Reflectivity

Noted:

- The wing tip ice sensors did have ice accumulation and then melted.

11/6/17 SEAR-MAR17 Pilot notes (Research Flight 3)

Crew: Drew, Plummer, Blaik Thompson (MU), Mark Richardson (MU), Anthony Cotispoti (MU)

Flight Time: 3.0

Objective: NW Fine Frontal Pattern at 5,000 MSL

Planned: Fly the original NW Fine Frontal Pattern at MIA, eliminating the extended legs to the NW.

Actual: Departed LNS and climbed to 4,000 ft. MSL. Harrisburg handled the flight and were able to offer 4000 ft. MSL. Did the first four NW-SE legs (eliminating the two to the southwest), then starting on SW-NE legs from the SW corner working northwest. After completing three cross legs, diverted off the pattern to the southwest corner which required a climb to 5000 ft. MSL to avoid the restricted area. Once clear descended back to 4000 ft. MSL. Then flew to the Lancaster landfill site and returned to the southeast corner of the pattern. Harrisburg assigned 5000 ft. MSL after reaching the landfill. Returned to LNS

Flight RF03 Notes: Blaik Thompson

The flight described is a flight to record the fine structure of fronts which is the second flight of this subject on November 6th, 2017. This is the second part of the Fine Structure of Fronts objective to record airborne data of a front that has passed the study area in the early morning and the mid-afternoon. The flight path changed, where we had to remove a leg from our west to make sure we can record information on the front ahead of us. Takeoff began around 1935z and flew our respective flight path with a bit of a shortening near the end due to time constraints, since the aircraft had a 7 hour limit of air time for every possible flight day, and landed at 2228z. By looking at our x-y plot, there was definite changes between air masses over the flight. By looking at Nadir Lidar, there was cloud cover at around 0.2 km by 1939z and rose to 1.2 km by 2150z. Zenith Lidar picked up activity around 1.5-2.0 km.

Project: SEAR-MAR17

Date: 06 Nov 2017 (2nd flight of day)

Flight: RF03

Notes:

Second flight across frontal boundary, based off of Millersville's fine frontal structure (NW) with abbreviated along/cross-frontal pattern.

Crew: Tom Drew, Blaik Thompson (MU), Dave Plummer, Mark Richardson (MU), Anthony Cotispoti (MU); LOD: Ben Heesen

Flight Summary:

UTC Comment

1935 Wheels up

At 19Z leading edge was near waypoint Carlisle (near start of grid maneuvers), so we will be focusing on post-frontal gradients.

1953 On line near Carlisle/AAS.

1954 In cloud, just starting at turn. 4 kft, +9C.

2000 Lidars working, lots of liquid cloud.

2015 Turning along short axis for next perpendicular leg. Fair amount of turbulence/mixing as well.

2019 Starting 2nd perpendicular leg.

2024 Oscillations in cloud.

2041 In cross legs.

2042 Strongest along-track temperature gradient while heading to NE.

2050 Second cross leg, NE to SW. Not noting a strong gradient, more differences in vs. out of cloud.

2058 In turn.

2108 In next turn.

2113 Continuing next NE-SW cross leg.

2130 Updated end to flight: starting from A6W, go to LNS to A6E to LNS.

2139 Slight update, use MU landfill site as next waypoint on triangle, instead of returning to LNS first. Otherwise as planned.

2151 Turning to A6E from landfill. Any post-frontal characteristics seem smaller than variations in/between cloud.

2209 At A6E, will return to base.

2228 On the ground.

11/6/17 SEAR-MAR17 Pilot notes (Research Flight 2)

Crew: Drew, Bob Capella-MU, Larry Oolman, Liz Morehead-MU, Jan van der Veken-MU

Flight Time: 3.9

Objective: Extended NW Fine Frontal Pattern at 5,000 MSL

Planned: Fly the Extended NW Fine Frontal Pattern at MIA.

Actual: Departed LNS and climbed to 5,000 ft. MSL. Coordinated with both New York and Cleveland Centers, and was handed off several times as we crossed back and forth between the two areas. After reaching the far northeast end of the pattern decided to modify the pattern to concentrate primarily on the northwest end of the pattern. Flew most frontal parallel legs in order, however, repeating one and skipping another. Made most turns with 270 degree turns vs. 90 degree turns. Then returned to LNS

Flight Notes Summary

Students:

Elizabeth Morehead

Jan van der Veken

Robert Capella

Flight: RF02 – Fine Structure of Fronts

Date: 06 Nov 2017

Time: 1400-1753

The objective of this flight was to explore the fine structure of a cold frontal boundary and the effects of the Appalachians on its associated flow. We planned to utilize a lattice pattern that would interrogate the along-front and cross-front features. We departed at 1400Z and stayed true to track until approximately 1500Z. The initial plan was to fly north northwest through the frontal boundary, fly a cold-side along-front leg, then cut back across the boundary. Since we did not encounter the front during our first leg, we cut the planned southerly return leg short. Resuming a northerly track, we finally penetrated the front at 1515Z as indicated by an 8 K decrease in theta-E. We initiated a cold-side along-front leg, then a cross-front leg, and used a full length warm-side along-front leg.

Instead of heading south and using the planned warm-side lattice pattern, we decided to cross back into the cold sector and complete a full cold-side along-front leg to allow the front to continue propagating southeastward. From here, we continued to explore both sides of the boundary with both cold and warm along-front flight legs.

Overall, the flight was an excellent experience in teamwork and attention to detail. We were able to make on-the-fly flight path changes thanks to strong communication between the students, Dr. Larry Oolman and our pilot, Tom Drew. Our on-the-ground crew, led by Dr. Brian Billings, was also a strong asset, providing guidance for major changes.

14:10 UTC

In the first leg of the flight, heading out to where we hope to see the front.

Lidar data shows ice in clouds above us

14:20

Continuing on leg one, just past first waypoint

14:30

Continuing on the first leg

Ground support says front is still located about 35 miles NW of waypoint 7 near DuBois

Visually: Between cloud layers

14:40

Just past Penn State

Cloud bases rapidly descending to our level, as seen on LIDAR

Visually: In cloud

14:50

Completing the first leg, turning into second

Nearing front?

Visually: Still locked in cloud

15:00

Decided to cut 2nd leg short

Turning to try and find front

Visually: Skies brightening, but still in clouds

15:10

Turned NW to start 2nd across leg at 15:05, still searching for front

Finishing leg, going to repeat path in attempt to locate front

Visually: Still in cloud deck, light precip

15:20

Believe we've crossed front

Winds have changed to 290 degrees

Temperatures and dewpoints have dropped

Returning to Northern route once more before going back on track

15:30

As of 15:23 back on warm side of front

At 15:24 turning onto next leg of the track

Breaks in clouds

Remain on the warm side

15:40

Hit the front again

Visually: In clouds, moderate precip

15:50

Executing along front leg

Warm air, really low dewpoint

Visually: Broken clouds below, some clearing ahead. Visual of ground.

16:00

Continuing along front

Visually: Between lower and upper level clouds

16:10

Going to continue on current track, then return to original plan

16:20

Returning to continue original waypoint pattern

16:30

Believe to be in the transition zone of the front

16:40

Back into cold side of the front

Visually: See blue clouds, still quite a few clouds around us

16:50

Going to adjust to go south east

Continue to be on warm side of the front

17:00

Heading into transition zone

Visually: Back into full clouds

17:10

On warm side

Finishing final leg

17:20

Heading back into colder air

Turning to start last leg, back into warmer air

17:30

On the way back to KLNS

Time	TRF C	TDP (C)	HWDIR (Degrees)
14:10	14.4	7.95	251.78
14:20	11.08	6.35	265
14:30	11.26	4.95	251.81
14:40	8.6	7.53	263.21
14:50	8.21	8.52	255
15:00	8.6	8.53	273.5
15:10	8.12	8.7	263.7
15:20	6.88	6.93	300
15:30	8.46	8	277.57
15:40	6.27	7.39	303
15:50	8.71	3.67	302
16:00	9.88	5.5	292
16:10	10.12	2.73	300.44
16:20	7.44	6.55	297.76
16:30	9.44	5.6	291.22
16:40	8.65	4.81	294.92
16:50	10.2	3.74	287
17:00	7.76	7.85	300

17:10	8.11	7.85	273.3
17:20	8.67	7.63	284.21
17:30	9.45	7.41	294

SEAR-MAR RF02 – 06 November 2017

Tom Drew, Bob Capella-MU, Larry Oolman, Liz Morehead-MU, Jan van der Veken-MU, Ben Heesen (LOD)

Frontal boundary flight near College Park

1400 Take off
1419 Heading NW from the south most way point. FL050, T=11 C, DP=6 C, winds 260 true @ 34 kt
1436 Over College Park, T=9, DP=8, winds=260@30. From the nadir lidar, the cloud bases are descending.
1445 CH4 increased slightly from 1.87 to 1.95 ppm
1449 At N corner of box, FL050, T=8, DP=8, wind=260@23. In light rain. From the lidar, the melting layer is 1.2 km above us.
1455 Heading back to the SE
1459 About at cloud top of the lower layer
1501 Turning. T=8, DP=8, winds=270@33
1507 Heading back NW
1513 Winds=300@17, Θ_e dropped 4 K to 316. Probably passed through front.
1515 In turn toward SW. FL050, T=5, DP=5, winds=310@23.
1519 Heading SE again. T=7, DP=7, winds=300@18
1522 Back on warm side of front. T=8, DP=8, winds=290@16
1524 270 degree turn to the NE
1536 In 270 degree turn at NE end of line, T=8, DP=8, winds=270@18, Θ_e =319 K
1539 Starting to intersect front
1542 At northern end of box. T=6, DP=6, winds=290@39, Θ_e =316
1545 Along front leg towards the SW. T=7, DP=7, winds=295@39, Θ_e =315, Light rain. BKN lines of clouds aligned with the front below us.
1557 At SW end, T=11, DP=3, winds=300@28, Θ_e =315. Turning to SE.
1559 Heading into warm side of front, Θ_e =319
1602 Heading to NE
1603 Back in cold air, Θ_e =315
1612 Turn 270 towards the SE, T=9, DP=4, winds=300@39, Θ_e =314
1619 Left 270 towards the SW. Still on the cold side, T=8, DP=7, winds=300@30, Θ_e =316
1631 Left 270 to NW, T=9, DP=6, wind=310@20, Θ_e =316
1638 Left 270 to NE, T=9, DP=5, winds=290@27, Θ_e =315
1649 Right 90 to SE, T=11, DP=4, winds=290@27, Θ_e =316, Skipping the 3rd NE-SW line and proceeding the the 4th.
1657 Θ_e increased to 318 K
1700 Left 270 to end up to the SW. T=8, DP=8, winds=300@15, Θ_e =319
1711 Passing into the cold air. T=10, DP=3, winds=300@25, Θ_e =315
1713 Right 270 to the SE
1717 Right 270 near Altoona to end up on the 5th line. T=9, DP=9, winds=290@29, Θ_e =319. In the warm air.
1719 In cold air briefly.
1728 At the end of the line, return to LNS. T=10, DP=7, wind=300@24, Θ_e =319
1753 Land

11/4/17 SEAR-MAR17 Pilot notes (Research Flight 1)

Crew: Drew, Grant Carlton, David Karpala, Brandon Molyneaux

Flight Time: 4.1

Objective: Cold Dam Flight

Planned: Low approach at KDMW then four legs on east N-S line, transit to west side, 4 legs on west N-S line including a low approach at N68. Return to KDMW for another low approach and return to KLNS.

Actual: Departed KLNS flew to KDMW for low approach and then completed four N-S legs on east side (2500, 1750, and climbing, and descending between the two). At south end climbed to 3200 to transit to the west side. Conducted first leg at 2500 and then made a low approach at N68. Repeated west side line at 1750, 2500, 3200 and climbing/descending between. Transited back to east side at 3200 ft. MSL. and repeated N-S line at 3200 and 2500 ft. MSL with climbs and descents. However, there were numerous disruptions to the last few legs due to VFR traffic conflicts. Returned to KDMW and made a low approach before returning to KLNS.

11/04/17

King Air CAD Flight: Project Notes

Grant Carlton

Summary:

Ultimately the King Air Cold Air Damming Research flight was a success and provided us with data that we feel will assist our group moving forward. The extra time that we had on the aircraft allowed us to perform two additional vertical profiles with a higher altitude that allowed us to capture the apparent Cold Air Damming inversion. From the safety and weather brief before the flight, to our time on the aircraft, the first day of King Air's time here in Lancaster was a success.

The rest of the CAD research group was on the ground launching a windsound at two different locations. According to Kyle Wilner, a member of our research group who was in the MU Weather Center, the King Air was only a few miles away collecting data from the group's first windsound launch in Antietam, MD at approximately 12:41 Z. With King Air collecting data, and having two separate windsound launches will allow us to continue with our research project. The CAD research group hopes to take this data and perform a WRF simulation. Moving forward we will compare our data to a past CAD scenario in the same region and will begin our case study.

After approximately 4 hours co-piloting the King Air research aircraft, I can confidently say that I am proud of the work that everyone has done, and have learned so much from the incredible crew of King Air. For this being my first time on any aircraft, I am so pleased of the outcome and look forward to the research ahead.

Notes:

Time (Z):

11:50

- King Air Crew and student researchers boarded the aircraft.
- Customized co-pilot computer to show custom meteorological variables.
- Opened up KA Display.
- Entered Runway

11:56

- Flight departed KLNS.

11/04/17

12:03

- On route to Carrol County Regional Airport for missed approach.
 - o Constant altitude of 3000 ft.

12:10

- Missed Approach KDMW
 - o 500 ft.

12:15

- Finished missed approach, on route to waypoint, 1SE.
 - o Constant altitude of 1800 ft.

12:20

- Arrived at waypoint 1SE starting vertical profile between 1SE and 1NE.
 - o Constant altitude of 1800 ft.

12:28

- 1NE to 1SE
 - o Gradually descending to 1550 ft.

12:31

- 1SE to 1NE
 - o Constant altitude of 1550 ft.

12:41

- 1NE to 1SE
 - o Gradually ascending to 1800 ft.
- We notice that the temperature variation between 1550 ft. and 1800 ft. is miniscule and does not match the data we are looking for with our CAD project.

12:46

- Arrived at 1SE on route to 1SW toward Chambersburg.
 - o Constant altitude of 3000 ft.

12:52

- We notice that as we ascended to 3000 ft. the temperature spiked from 5 C to 9 C
- We decide that we will have extra time to perform two additional vertical profiles at higher altitudes to capture the CAD inversion.

12:57

- King Air approaches 1SW and we begin first designated vertical profile.
- 1SW to 1NW

11/04/17

- Constant altitude of 2500 ft.
 - 5 degrees C

13:08

- Arrive at 1 NW and decide to do our missed approach at Chambersburg airport.
- 1 NW to Chambersburg airport.
 - Constant altitude of 2500 ft.

13:10

- Missed approach at Chambersburg Airport.
 - 500 ft.

13:15

- 1NW to 1 SW
 - Gradually descending from 2500 ft. to 1750 ft.

13:23

- 1SW to 1 NW
 - Constant altitude of 1750 ft.

13:35

- 1NW to 1SW
 - Ascending to 2500 ft.

13:50

- We decide to do another vertical profile between 1SW and 1NW with higher altitude to capture CAD inversion.
- 1SW to 1NW
 - Ascending to 3500 ft.

13:58

- CAD Inversion suspected around 3000 ft.

14:05

- 1NW to 1SW
 - Constant altitude of 3500 ft.

14:20

- 1SW to 1NW
 - Descending to 2500 ft.

14:31

11/04/17

- 1NW to 1SW
 - o Constant altitude of 2500 ft.
- Noticed turbulence that could be caused by a wave signature.

14:44

- We arrive at 1SW and are finished with the third vertical profile of the day.
- 1SW heading east on route to waypoint 1SE.
 - o Constant altitude of 3500 ft.

14:54

- We arrive at 1SE and decide we have enough time to do another (partial) vertical profile.
- 1 SE to 1 NE
 - o Constant altitude of 2500 ft.

15:04

- 1NE to 1SE
 - o Ascending from 2500 ft. to 3500 ft.

15:10

- 1SE to 1NE
 - o Constant altitude of 3500 ft.

15:18

- 1NE to 1SE
 - o Descending to 2500ft.

15:24

- 1SE to Westminster Airport for another missed approach

15:34

- Encountered high volume of air traffic which led to a weak missed approach at KDMW.
 - o Unable to fly at 500 ft.

15:38

- On route to KLNS from KDMW
 - o Inversion found again

16:00

- King Air touches down at KLNS concluding flight path for Cold Air Damming.

16:10

- Debrief with the King Air crew.

Project: SEAR-MAR17

Date: 04 Nov 2017

Flight: RF01

Notes:

Based off of Millersville's cold air damming flight plan, modified later in flight. Initial profiles were at or below 2500 ft, found inversion near 3000 ft and added 2500-3500 ft profiles above original flight to adequately sample through transition and in air mass aloft. The lidars were only used early in the flight as this plan primarily exists outside of the lidar operations area. No notable instrumentation issues otherwise.

Crew: Tom Drew, Grant Carlton (MU), Dave Plummer, Brandon Molyneaux (MU), David Karppala (MU); LOD: Ben Heesen.

Flight Summary:

UTC Comment

1156 Wheels up

1208 Enroute to first missed approach at Westminster, +4-5C at 2.5 kft.

Operating lidars just for first leg of flight.

1210 Lidars shut down, heading to missed approach.

1213 Missed approach at Westminster, TRF +5-6C, not a big change, no significant turbulence.

1220 On line headed N for SE/NE profile, to 1.8 kft. TRF +5C, TDP near 0C

1225 Turn S from NE end, descend along track from 1800' to 1550'.

1227 On line, descend to 1550' along track. T from 4.5 to 5.5C, dewpoint variable at 0-1C. Light winds, no sig turbulence.

1232 Turning back to N, will return at 1550' on track.

1234 On line, a bit more turbulence now. +5-6C at 1500 ft, 0.3C dewpoint.

1239 Final turn at NE end.

1241 On line, gradual ascent to 1800', +5.5C, dewpoint slightly negative to -.5C.

1248 Enroute to SW/NW waypoints, passed out of shallow layer near 3000 ft, with TRF ~9C, dewpoint drop to -30C(!).

1300 On west line at 2500', heading from SW-NE. Back below inversion, TRF +5C, TDP -3C. Slight turbulence but not significant.

1308 At NW waypoint, heading to Chambersburg missed approach.

1310 On approach, T to +6C, Tdp to +0-1C.

1312 Ascending back to 2500 for next leg on NW-SW.

1313 On line at waypoint NW, start at 2500' and descend to 1750' along line. +3.5C/-1.3C at north end to +5.5C/0.5C at south end.

1324 Turning at SW point.

1326 On line at 1750', heading from SW-NW. Plan to finish two legs on original profile, then do a new stack profiling the transition between layers: 2500-3200', 3200', 3200-2500'?

1337 Turning at NW, ascend from 1750-2500' on final original leg.

1340 On the line, ascending. 4.5C/~0C, not much change but more variability to south end.

1350 Turning for new profile, ascending from SW to NW.

1354, At SW and ascending on leg - transition layer from ~3000-3200', continuing to 3600' instead.

1404 Turning back south, will stay at 3600'.

1406 On line at 3600'. Some wave signatures in w, T?

1420 on the line, descending from 3600-2500' from SW to NW. Near +8C/-37C at SW point. Transition about 3000' again.

1431 Turning at NW, heading from NW-SW at constant 2500'. Some turbulence now, less wavelike than earlier.

1434 Heading south to SW on last western leg at 2500', +3-4C/-1C.

1445 Enroute to SE at 3500'.

1448 Climb for traffic.

1504 Heading from NE to SE, ascending from 2500-3500'. Note, smoke/steam plume to east of track, capping at inversion just above us.

1510 Turning for last pair of legs.

1512 On track, from SE-NE at 3500'.

1517 Turning for final leg.

1519 On track, heading from NE to SE descending from 3500-2500'.

1524 Done with profile. 2500' to Westminster for approach.

1533 "Moderately" low approach at Westminster, RTB.

1551 On the ground.