

Transport and Transformation of Ammonia
(TRANS²Am)
University of Wyoming King Air Research

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Summary

TRANS²Am is focused on sampling emissions (primarily methane, ethane, and ammonia) associated with intensive animal farming operations in Colorado.

This page summarizes the first phase of TRANS²Am, for flights taking place in 2021. [Click here](#) to access the facility project page for the second phase of

TRANS²Am, taking place in August-September 2022.

- [UWKA flight planning and tracking tools](#)
- [Colorado State University TRANS2Am summary page](#)
- [EOL Field Catalog](#)
- [UWKA facility project summary](#)
- [Summary of processed UWKA project dataset](#)

[Click here](#) to access the facility project page for the second phase of TRANS²Am, taking place in May-July 2022.

Date	Flight # (*kml)	Status	Times (UTC)	Hours	Crew/Notes
24 Aug 2021	RF14	Flight near Sterling. Project down to repair bird strike.	1830- 2210	3.8	Brett Wadsworth Larry Oolman Megan

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User Information

- [Planning Chart](#)
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tracking tools](#)
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Guide](#)

Facility Instruments

					McCabe
23 Aug 2021	RF13	Flight in the Greeley area near Producers and JBS feedlots	1703-2032	3.5	Brett Wadsworth Larry Oolman Julieta Juncosa Calahorrano
20 Aug 2021	RF12	Flight initially sampling sites near Greeley before moving on to the Fort Morgan area for more favorable winds.	1929-2259	3.6	Tom Drew David Plummer Megan McCabe
17 Aug 2021	RF11	Flight sampling Five Rivers and Green Plains Cattle Co. sites near Yuma, CO.	1548-1941	4.0	Tom Drew David Plummer Julieta Juncosa Calahorrano
16 Aug 2021	RF10	Flight along upslope flight profile. Winds initially mixed, but more predominantly southeasterly for latter two legs..	1831-2156	3.5	Brett Wadsworth David Plummer Emily Fischer
14 Aug 2021	RF09	Flight sampling multiple locations near Sterling, CO. Primary sites included Pinneao Feedlot and Hillrose Dairy.	1637-2019	3.8	Ed Sigel David Plummer Megan McCabe
13 Aug 2021	RF08	Flight sampling Magnum Feedyard, English Feedlot, Empire Dairy, Front Range, and Q Ranch sites.	1429-1801	3.6	Brett Wadsworth David Plummer Julieta Juncosa

-  In Situ
-  Wyoming Cloud Radar
-  Wyoming Cloud Lidar

Contact

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Facility Manager:

Jeff French



					Calahorrano
12 Aug 2021	RF07	Flight following the upslope sampling profile.	1844-2157	3.3	Ed Sigel David Plummer Amy Sullivan
11 Aug 2021	RF06	Flight sampling multiple locations near Sterling, CO. Sites included T Bar W Cattle Co., D&D Feedlot, Dinklage Feedyards (primary site), and Timmerman Feeding Corp.	1557-1923	3.5	Ed Sigel David Plummer Dana Coulton
9 Aug 2021	RF05	Flight sampling around multiple facilities near Fort Morgan, in variable winds generally centered near south- to southwesterly.	1715-2040	3.5	Ed Sigel David Plummer Megan McCabe
7 Aug 2021	RF04	Flight intending to sample multiple sites near Fort Morgan, called off due to poor visibility with wildfire smoke throughout area.	1528-1708	1.8	Brett Wadsworth David Plummer Megan McCabe
4 Aug 2021	RF03	Research flight focused around Five Rivers and Montevista sites in generally northerly winds.	2219-0109	2.9	Brett Wadsworth David Plummer Julieta Juncosa Calahorrano
4 Aug 2021	RF02	Research flight focused around multiple sites north of Greeley airport in north-northwesterly	1736-2050	3.3	Brett Wadsworth David Plummer

		winds.			Dana Caulton
2 Aug 2021	RF01	Research flight focused around Pinneao Feedlot in weak southerly winds.	1717-2005	2.9	Brett Wadsworth David Plummer Dana Caulton

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Test Flights					
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27 July 2021	TF04	Test flight along typical upslope flight profile. No PCASP.	1833-2137	3.1	Brett Wadsworth David Plummer Emily Fischer
23 July 2021	TF03	Test of PILS & air chemistry measurements with missed approach over Greeley. Picarro not operational.	1521-1609	0.9	Tom Drew David Plummer Amy Sullivan
20 July 2021	TF02	Test of Rogers aerosol inlet at levels between 8 kft and 28 kft. No time server lock.	1941-2049	1.2	Ed Sigel David Plummer Anna Robertson
9 July 2021	TF01	Systems test and calibration maneuvers for trace gas instruments.	1746-1837	1.0	Brett Wadsworth David Plummer Rob Roscioli

Flight Hours		As of Sep 02, 2021, 47.0 out of 100 research hours were flown,	Test and Ferry: 6.2		
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53.0 remain.

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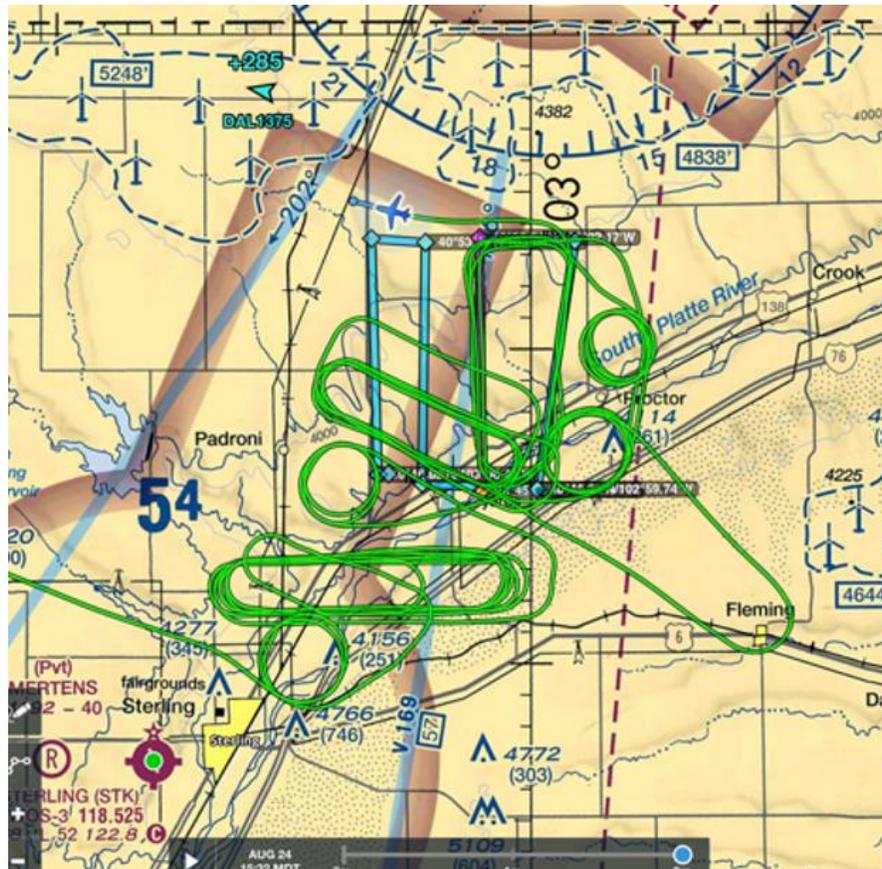
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Had a bird strike during flight. Fairly early, in the first racetrack pattern. We were eastbound, 1000' AGL, just over the green belt near the river. The bird was just below the horizon so it was not sighted. Saw it late just before hitting it. Elected to continue the flight as there was no indication of the degree of any possible damage.

Debrief:

No issues.

Actual flight below



Photos of impact point & skin damage:





TRANS²AM 24 August 2021 RF14

Crew: Brett Wadsworth, Larry Oolman, Megan McCabe, Zane Little (LOD)

Mission: study feedlots in the Sterling area. Discovered damage from a bird strike after the mission. This will down the project until the aircraft is repaired.

1831: Take off
1842: FL175, still below cloud base and what appears to be the top of the boundary layer
1853: Start down
1906: Theta drops from 319 K to 318 K at 5500 ft
1907: 1000 ft agl, around Michek
1911: Repeat at 500 ft
1915: First leg to north at 1000 ft
1924: Repeat at 500 ft
1931: Climb to FL055, still seeing plume
1934: Warmer and drier on the west end of this line
1937: Climb to FL065
1940: Into warmer, drier air
1944: Climb to FL080
1947: Still moist on east end and seeing plume
1951: Climb to FL100
1957: Small peak in water vapor and ammonia
1959: Descend and go to the TBAR ranch
2002: 1000 ft agl. Winds southeasterly, changing to 250 deg to the northeast of the feedlot
2004: Descend to 500 ft
2011: Start box to the northeast at 1000 ft
2018: Stay at 1000 ft, north leg of box closer to feedlot
2020: Descend to 500 ft on southern leg of box
2025: Climb to FL070
2032: Climb to FL085
2036: Change PILS
2039: Under nicely developing Cu, higher humidity
2042: Smoke to the north of Dinklage blowing to the west
2044: 1000 ft agl around Dinklage, winds from the east
2045: May be in the smoke plume
2046: Descend to 500 ft
2050: 1000 ft loop around D&D feed lot, winds from the east
2052: 500 ft
2055: Start 1000 ft box to the west of Dinklage and D&D
2104: 500 ft
2109: FL065
2114: 1000 ft circle around Dinklage
2117: 500 ft
2119: Head towards D&D at 1000 ft
2123: 500 ft

2125: Climb to FL080 on box west of Dinklage and D&D
2128: Winds from 250 at 4 kt
2129: Winds from 140
2130: Seem to be at the interface between the dry SW winds and moist SE winds
2133: Head home
2211: Land



8/23/21 TRANS-2AM Pilot notes (Research Flight 13)

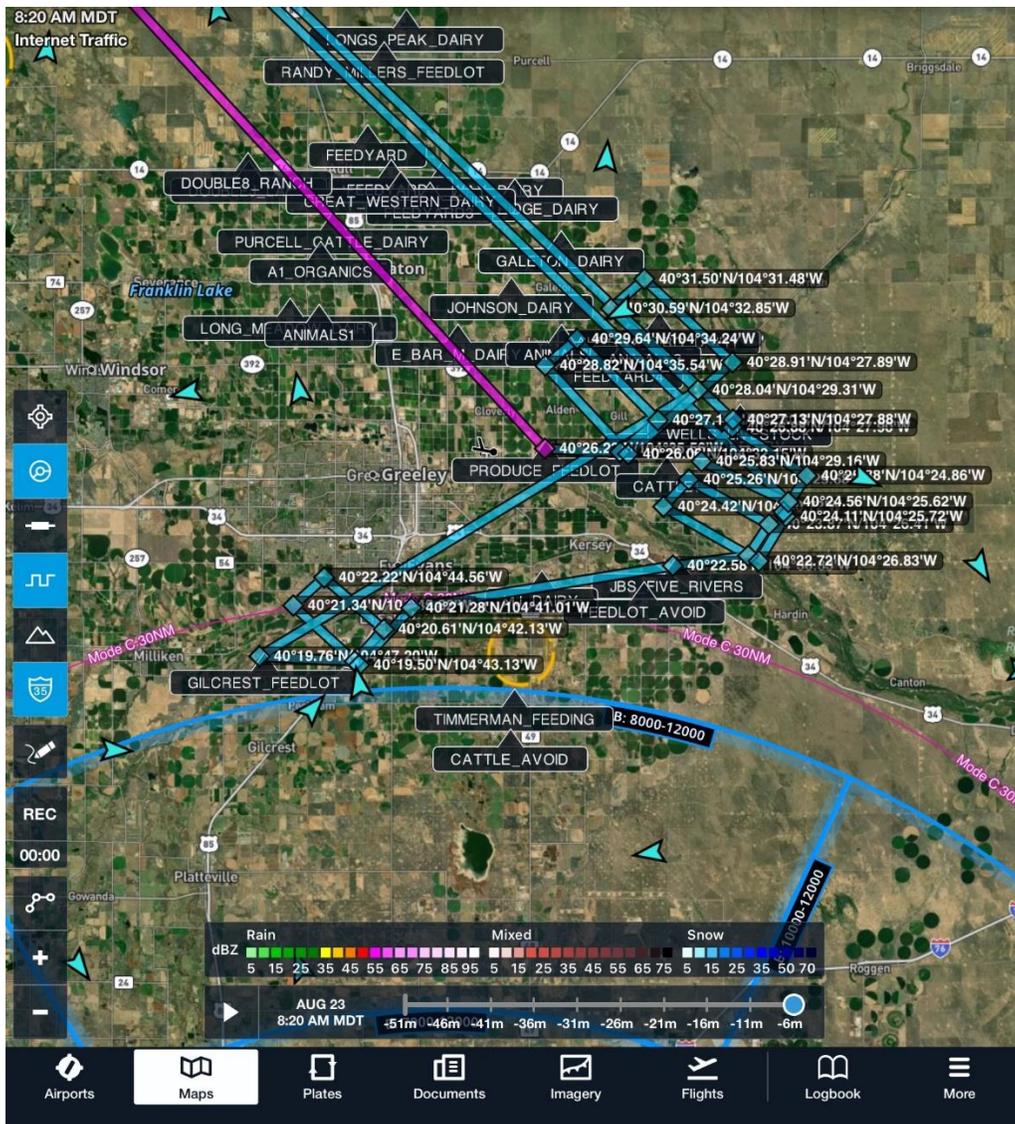
Crew: Wadsworth, Plummer, Calahorrano. LOD = Zane

Flight Time: 3.5

Planned: Targeted specific feedlots.

Foreflight VFR flightplan route.

Original plan received from the PI. Also kept the wide-area survey available in case upslope conditions developed.





Actual:

Climbed to 14,500 on the way down for the sounding.

Winds in the area were different than anticipated, so Julieta audibled some change to the pattern.

Working w/in 2 miles of KGXY got a bit busy, forcing some extra maneuvers to gain separation from other traffic. No problems encountered with traffic after moving away from Greeley.

After working the feedlots, received request via chat to fly as close to and as low as possible over Fort Collins on the way home. Eventually decided to do the 3rd leg of the upslope survey flight on the way north. Had to adjust the track further to the west to avoid some buildups.

Debrief:

No issues.

The external antenna for the Stratus is apparently for the ADS-B jack. I'll contact them about getting the right antenna.

Actual flight below.

TRANS²AM 23 August 2021 RF13

Crew: Brett Wadsworth, Larry Oolman, Julieta Juncosa Calahorrano, Zane Little (LOD)

Mission: fly at missed approach at Greeley and then study feedlots in the area

1703: Takeoff
1709: FL145, boundary layer and scattered cloud base still above us. Stopped climb for traffic.
1715: Start descent
1725: Low approach at GXY
1726: Circle feedlot 2 miles east of airport at 1000 ft
1730: Circle at 500 ft
1732: Break off for traffic
1736: Repeat 500 ft circle
1741: Westbound on northern leg of racetrack at 1000 ft
1748: Didn't see plume, descend to 500 ft for eastbound leg further south
1802: Intercept a smoke plume
1806: Climb to 1500 ft agl
1812: Climb to 2500 ft
1814: Did not see plume
1818: Circle Producers at 500 ft
1822: 1000 ft
1825: 1500 ft
1830: Head to JBS Five River
1832: 1000 ft agl around JBS Five River
1835: 500 ft
1838: 1000 ft
1840: Climb to 1500 ft agl on racetrack to the NNE
1843: 1000 ft
1845: 500 ft
1850: 1500 ft
1858: 1000 ft, 6 and 4 nmi downwind
1903: 500 ft
1908: Climb to 1800 ft agl to change PILS
1913: Done
1921: Racetrack another 6 nmi further out at 1000 ft
1926: Repeat 1000 ft
1933: 500 ft
1940: Head back to JBS at 1000 ft
1944: Start circle at 1000 ft
1947: 500 ft
1950: Done here
2006: Try upslope leg 3 that passes to the west of Fort Collins
2014: Head to NW to avoid possible precipitation
2032: Land

08/20/21 Pilot notes (TRANS2AM RF 12)

Crew: Drew, McCabe, Plummer

Flight Time: 3.6

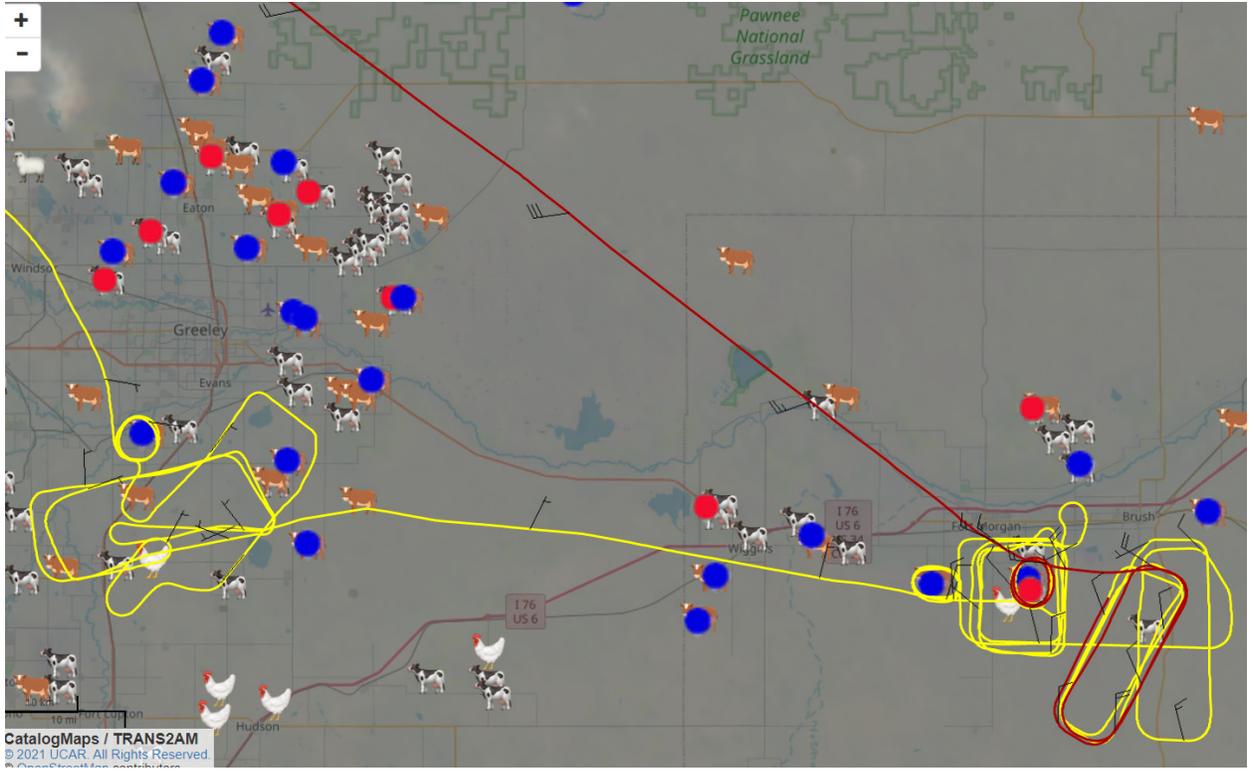
Planned: Ferry to feedlot near Greeley, CO. Fly 1000 ft. and 500 ft. circles around facility. Then fly one box pattern at 1000 ft. and 500 ft. then move to feedlot just east of Greeley airport and repeat the same with two box patterns. (See Foreflight image below.)

Actual: Climbed to 13,500 ft. MSL leaving Laramie, descended ~1000 fpm to 1000 ft. AGL before first facility. Orbited facility at 1000 ft. and then 500 ft. Then set up first box pattern (W Wind plan). However, changed to the Northwest wind plan because of shifting wind midway through first box.

Decided to head east to Teague Enterprises and circled it but continued to Dinklage feedyards and circled at 1000 ft., 500 ft., and then made several boxes around the facility followed by a N-S box just to the east. Because the wind was turning offset the box to NE-SW. Flew the box at 1000, 500, 7000 ft. MSL, and 9000 ft. MSL. (See map image below).

Returned to circle the facilities again at 1000 ft., 500 ft., Returned to Laramie at 14,500, but descended to 12,500 for clouds.





Project: TRANS²Am-21
20 Aug 2021

Flight: RF12

Notes:

Flight initially targeting Fiver Rivers Gilcrest and Producers Feedlot sites, before moving on to Teague Enterprises/Dinklage Feedyards sites near Fort Morgan due to unfavorable winds in the initial location.

Crew: Drew, Plummer, McCabe; LOD: Morgan.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1929 Wheels up. Transit at 13.5 kft. Used noseboom heat here and during transit back, as the day was cooler than normal.

1939 Initial descent.

1950 Circling Gilcrest Five Rivers site, 1000' AGL then 500' AGL.

1956 To first box, circling clockwise.

2001 At north end of box, turning southeast.

2005 At south end, turning northwest.

2014 Turning eastbound at northwest end, 1000' AGL.

2018 Turning west at southeast end.

2022 Turning at southwest end and descending to 500' AGL.

2031 Switching plans - targeting Teague Enterprises/Dinklage Feedyard due to unfavorable winds locally.

2046 Circling Teague site at 1000' AGL, then 500' AGL.

2054 At 1000' then 500' AGL for circle around Dinklage. Clearer plume here, will focus on this site.

2101 To 1000' AGL for box circuit.

2108 Turning east at southwest end.

2110 Turning north and descending to 500' AGL.

2112 Turning west at NE end.

2115 Turning east at SW end, ascending to 7 kft.

2116 Turning north.

2118 Turning west at NE end.

2121 Turning east and ascending to 9 kft.

2129 Maneuvering for PILS sampler swap.

2133 Descending to 1000' for second box.

2136 Southbound on west side.

2139 Turning east at SW end.

2143 Turning west at NE end. Will tilt the S leg more SW.

2144 Turning southwest.

2149 Turning northeast at S end.

2153 Turning at north end and descending to 500' AGL.

2156 Turning southeast at SW end.

2200 Turning northwest and ascending to 7 kft.

2204 Turning southeast at SW end.

2208 Turning at NE end, ascending to 9 kft.

2210 Heading southwest at NW end.

2213 Turning northeast at SW end.

2216 Turning at NE end and descending to 1000' to repeat circles around Dinklage.

2219 Circling at 1000', then 500' AGL.

2224 Heading home. Boom heat on 14.5 kft with temperatures < 0C. Eventually head to 12.5 kft for clouds.

2259 On the ground.

08/17/21 Pilot notes (TRANS2AM RF 11)

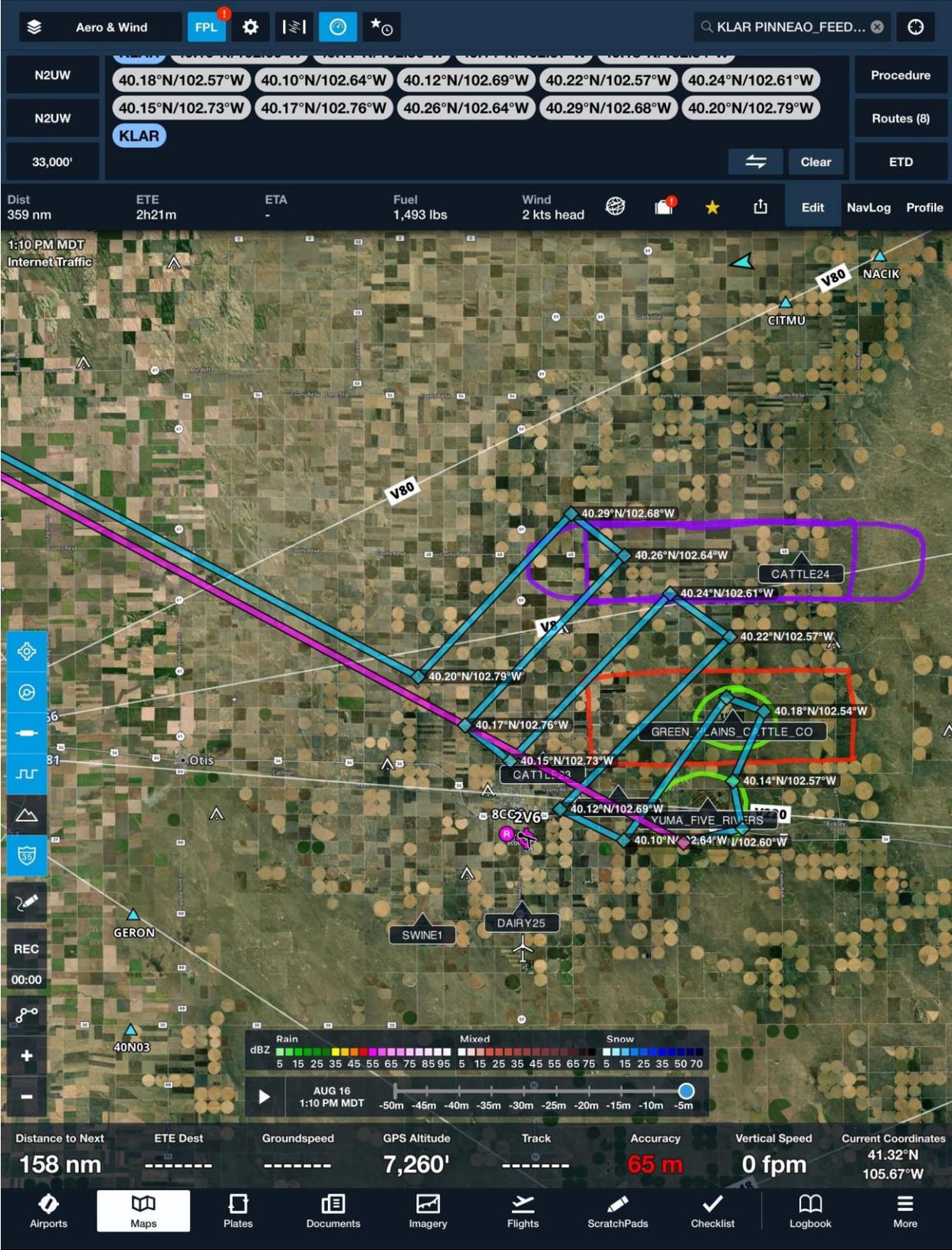
Crew: Drew, Juncosa Calahorrano, Plummer

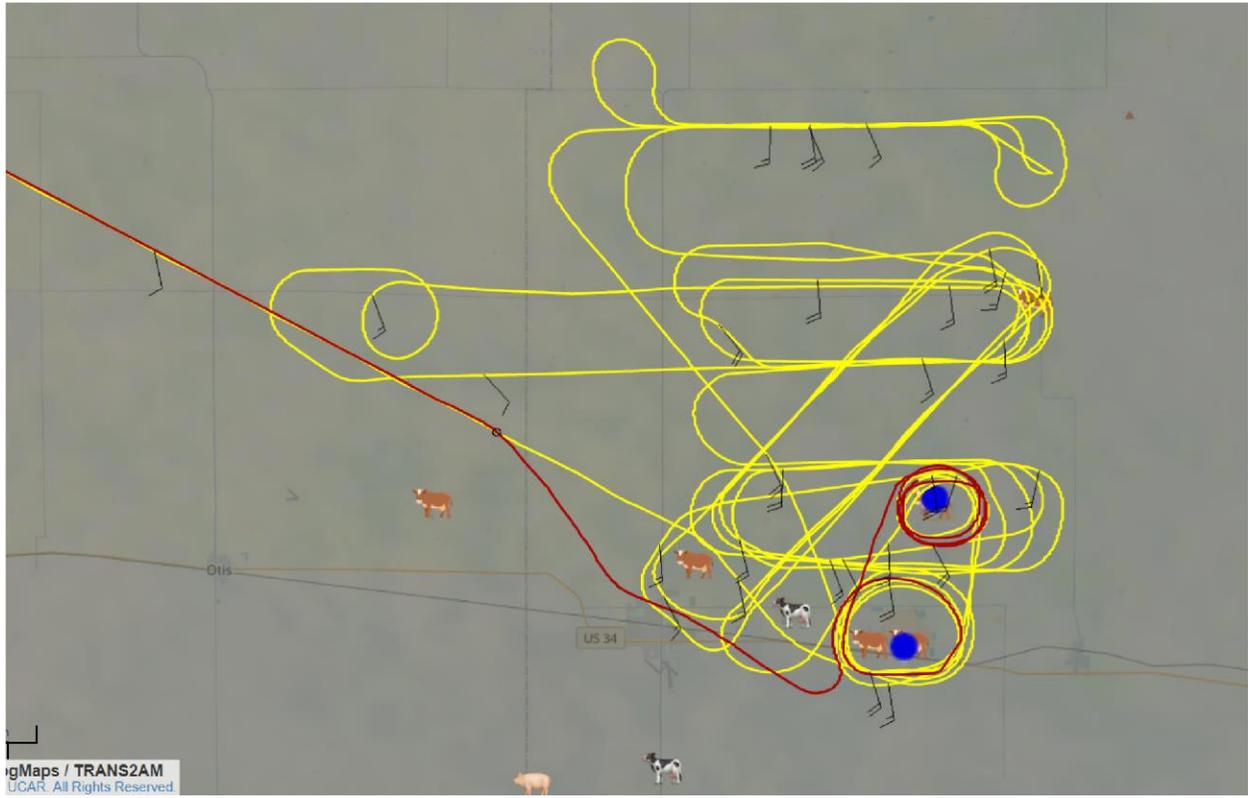
Flight Time: 4.0

Planned: Ferry to feedlot near Yuma, CO. Fly 1000 ft. and 500 ft. circles around facility. Then fly two box patterns northeasterly at 1000 ft. and 500 ft. ferry back. (See Foreflight image below.)

Actual: Climbed to 13,500 ft. MSL leaving Laramie, descended ~1000 fpm to 1000 ft. AGL before first facility. Orbited both facilities at 1000 ft. and then 500 ft. Then set up first box pattern (SE Wind plan). However, changed to the South wind plan because of slightly shifting wind. Flew each box at 1000 ft., 500 ft., 2000 ft. AGL. Added an addition crosswind leg approximately 3 nm downwind of last box and just reversed course several times for 500 ft., 1000 ft. and 1500 ft. (See map image below).

Returned to circle the facilities again at 1000 ft., 500 ft., and 1500 ft. Returned to Laramie at 14,500, but descended to 12,500 for research.





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Project: TRANS²Am-21
17 Aug 2021

Flight: RF11

Notes:

Flight sampling Five Rivers and Green Plains Cattle Co. sites near Yuma, CO.

Crew: Drew, Plummer, Juncosa Calahorrano; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1548 Wheels up. Transiting at 13.5 kft, just over top of mixed layer.

1618 Begin descent, initially to 5.2 kft.

1630 On site for Five Rivers, beginning circle at 1000' AGL. Winds generally S/SE.

1634 Circle at 500' AGL.

1638 Alongside Green Plains site, beginning 1000' AGL circle.

1641 Circle at 500' AGL.

Box 1

1647 Heading northeast from S end at 1000' AGL.

1649 Turn after extending further NE.

1651 Headed southwest from N end. Winds more southerly.

1654 Turning southeast, will descend to 500' AGL for next circuit.

1655 At south end, turning northeast.

1703 At west end. Will rotate box somewhat clockwise for next circuit.

Box 2

1704 Heading east at SW end, 1000' AGL.

Box 1 continued

1709 Back to box 1 at 2000' AGL.

1711 At southern end, heading NE.

1718 Finishing box 1, descending to 1000' and do box 3 along initially-planned southerly wind track.

Box 3

1724 Turning south at NW end, ascending to 2000' AGL.

1725 Heading eastbound at SW end.

1730 Turning south and ascending to 3000' AGL at NW end, to finish up box 3.

Box 4

Descend to 2000' AGL and step north.

1738 Eastbound at SW end.

1744 Turning south and descending to 1000' AGL at NW end.

1745 Eastbound at SW end.

1750 Turning south and descending to 500' AGL.

1757 Ascending for PILS swap.

1803 PILS swap complete, descending to 3000' AGL and returning to measurement area.

1806 Heading into SW end.

Stacked passes and site circuits

1812 Descending to 1000' AGL to do stacked east-west passes north of box 4.

1813 Eastbound along leg.

1816 Descending to 500' AGL at east end for westbound leg.

1820 Ascending to 2000' AGL for eastbound leg.

1825 Ascending to 3000' AGL for final westbound leg.

1836 Circling Five Rivers site at 1000' then 500' AGL.

1842 Circling Green Plains site at 1000', 500', and 1500' AGL.

1852 Circling Five Rivers site at 1500' AGL.

1856 Heading home.

1941 On the ground.



8/16/21 TRANS-2AM Pilot notes (Research Flight 10)

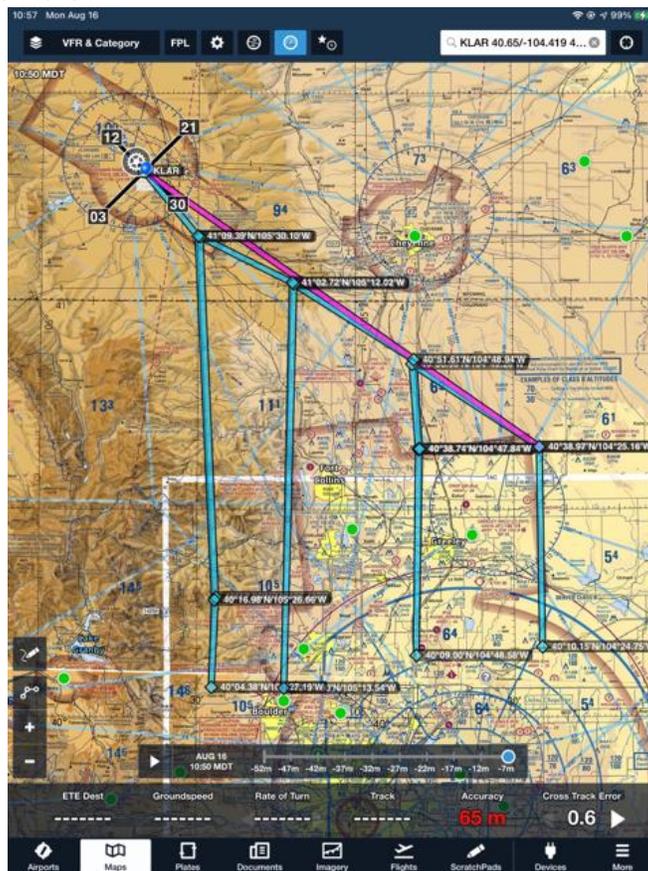
Crew: Wadsworth, Plummer, Fisher. LOD = Zane

Flight Time: 3.5

Planned: Wide-area survey flight, shown below. Each leg initially at ~1000' AGL. Second at ~2000' AGL.

Foreflight VFR flightplan route.

Original plan received from the PI.



Actual:

Climbed to 15,500 on the way down for the sounding. Nearly to the base of a scattered – broken layer. Denver Approach gave good assistance today for traffic calls. Asking me as I approached the north end of each track what I was doing next and which leg was I going to be working, so clearly they have the set of graphics generated by Bill Dunn.



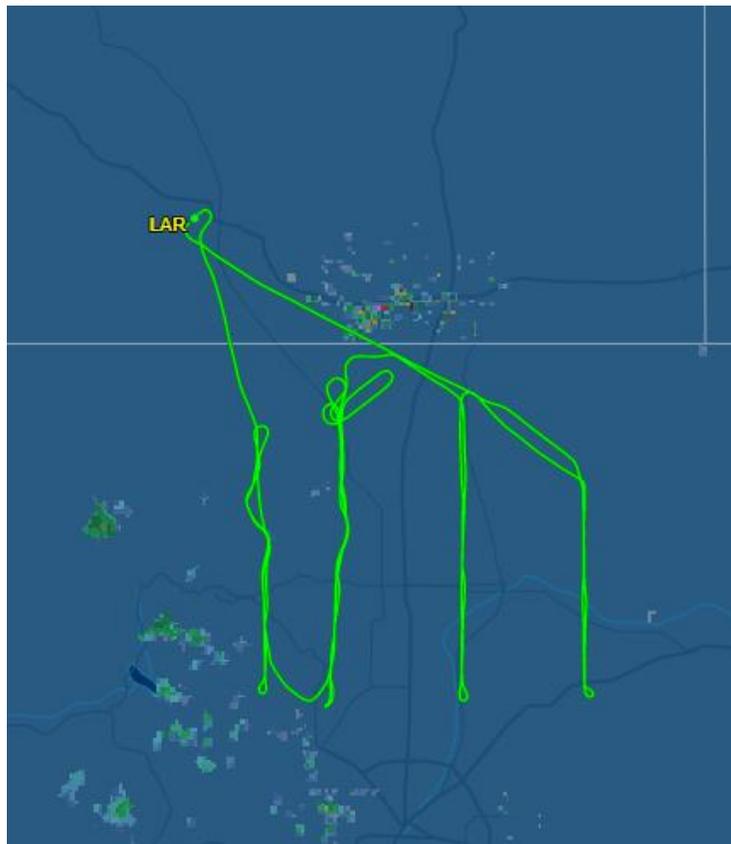
The 3rd track, just west of Longmont is pretty reasonable for terrain. Some small amount of wandering L/R of the planned track to avoid crossing the highest terrain. Found a plume of Ammonia in the valley NW of Longmont.

The 4th track is more of a challenge. Did a version of the “bowtie” as we got onto this track near the south end after 3 iterations of track 3. As headed north, climbed immediately to 11,000’ MSL due to the high ridgeline just north of Estes Park. After clearing this ridge, was able to start a fairly aggressive descent along the falling terrain. Flew to the west side of the 10,305’ peak just south of the Poudre River, then corrected back onto the planned track. Heading south on this track, again climbed immediately to 11,000’ MSL until across this ridge again, then started descending. Able to descend right away to about 9000’ MSL before flying to the east of Estes Park. This altitude was comfortable for the rest of the track to the south.

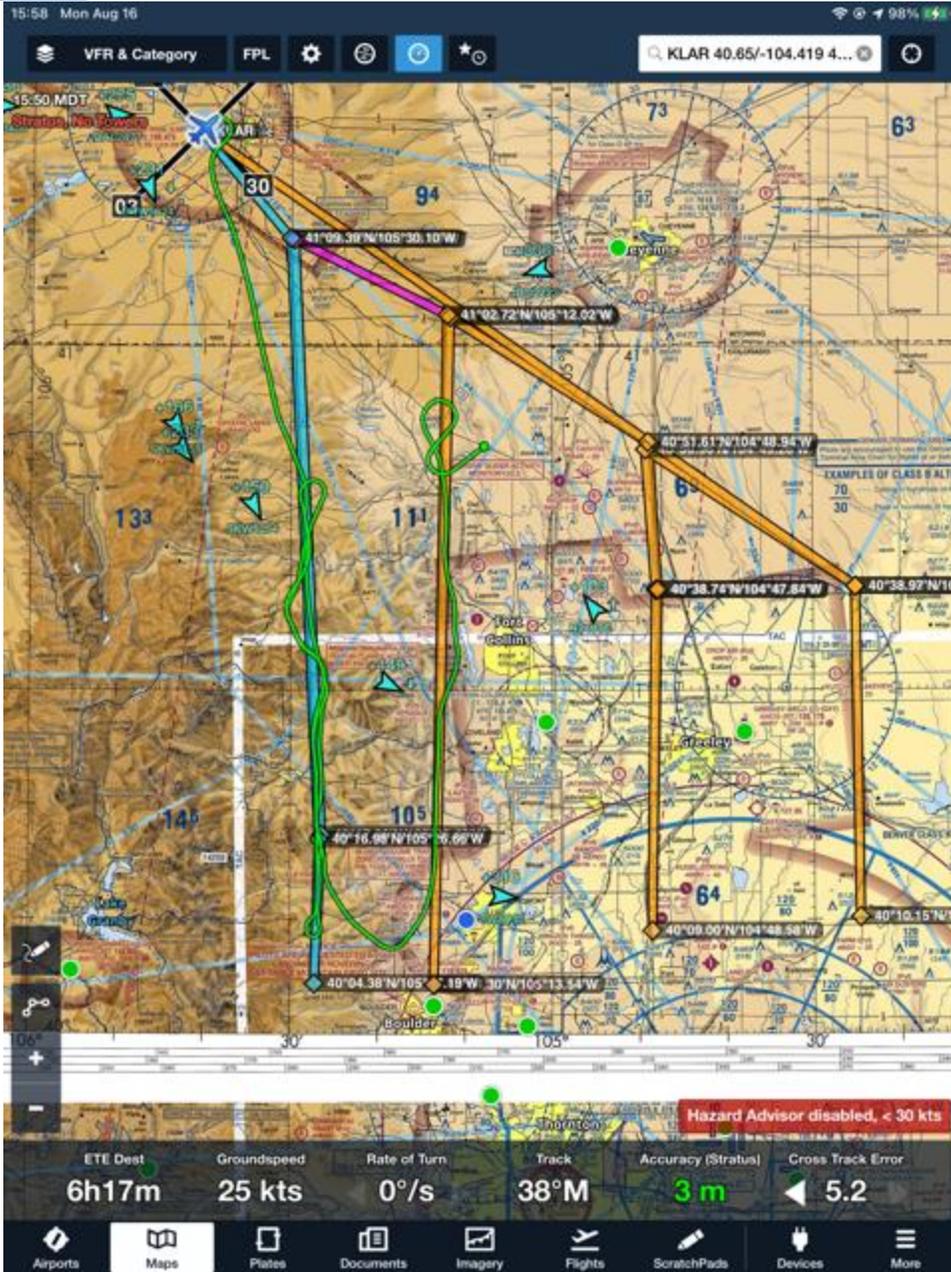
Stratus 2S worked on the glareshield. The new 3 only worked as we were approaching Laramie. An external antenna should be getting delivered to the hangar tomorrow..

Debrief:

More consideration of how to better work that track #4 will be done by the PI.
Actual flight path below.



Foreflight re-started breadcrumbs as shown in the image below.



Project: TRANS²Am-21
16 Aug 2021

Flight: RF10

Notes:

Flight sampling along upslope profile. Winds initially mixed, with general southeasterly component at 1000' AGL but northwesterly at 2000' AGL for first two tracks, but became more generally southeasterly subsequently.

Crew: Wadsworth, Plummer, Fischer; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1831 Wheels up. Transiting at 15.5 kft, just barely below cloud base at top of mixed layer.

1843 Descending, initially to 7.5 kft.

Track 1

1855 Southbound at north end of track 1, 1000' AGL. Southeasterly component of wind increasing as we head south.

1904 Turning north at southern end, ascending to 2000' AGL.

1906 On track, heading north. Winds generally in the NW quadrant now.

1916 End of line, transiting to track 2.

Track 2

1925 On track at north end of the line, 1000' AGL. Winds behaving similarly to track 1.

1939 Turning at southern end, ascending to 2000' AGL.

1941 On line, heading north at 2000' AGL. Winds again have a NW component.

1954 End of line, turning to transit to track 3.

Track 3

2001 Heading south, cut west to track early, eliminating some of the northern extent. Headed south at 1000' AGL, but more variable terrain here.

2019 Turning back north, will aim for 1500' AGL heading north.

2033 North of plume, ascending for PILS sampler swap.

2036 Swapping PILS.

2044 Finished with PILS, returning southbound along track 3 at 1500' AGL again.

Track 4

2101 Ascending to 11 kft and heading to southern end of track 4.

2117 Turning back south along track 4, heading to 11 kft initially.

2123 Start descending into Estes Park area.

2130 At southern end, return north along track 4 then head home.

2156 On the ground.

8/14/21 TRANS-2AM Pilot notes (Research Flight 9)

Crew: Sigel, Plummer, McCabe . LOD = Little.

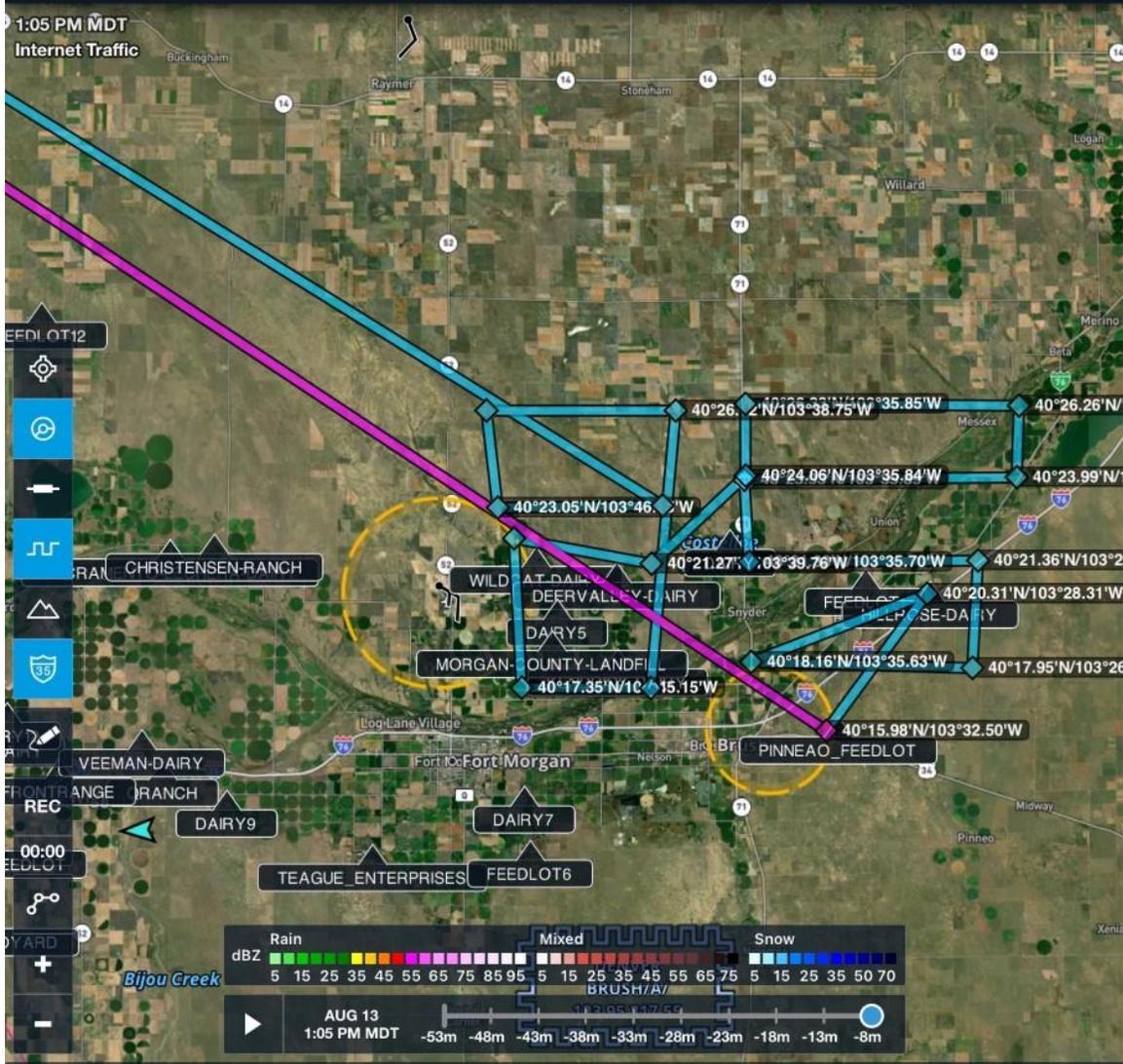
Flight Time: 3.8

First image is what we planned to do and the second is what we did. Picked up a VFR flight Following. Used Brush (7V5) Co. to navigate to the study area. We went out at 13500 and back at 12500. I had good visibility the whole time. There were no towers close to the rout. There was really no Traffic. Diverted once for traffic in bound to Fort Morgan. The aircraft worked well the heading bug had a small red x though it for about 10 seconds and then it went away. It worked well after that. I used the Stratus3 to start off with and it didn't work. I switched to the Stratus2 and it worked well. I placed it just left of the center of the pilots window.

Aero & Wind **FPL**

N2UW	KLAR	40°15.98'N/103°32.50'W	40°20.31'N/103°28.31'W	Procedure
N2Uw		40°18.16'N/103°35.63'W	40°17.95'N/103°26.43'W	Routes (8)
		40°21.36'N/103°26.18'W	40°21.33'N/103°35.70'W	
33,000'		40°23.93'N/103°35.89'W	40°23.99'N/103°24.56'W	ETD

Dist 317 nm ETE 2h05m ETA - Fuel 1,333 lbs Wind 2 kts head **Edit** NavLog Profile



Distance to Next	ETE Dest	Groundspeed	GPS Altitude	Track	Accuracy
116 nm	-----	-----	7,264'	-----	79 m

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Project: TRANS²Am-21

14 Aug 2021

Flight: RF09

Notes:

Flight sampling multiple locations initially near Brush, CO, then near Sterling. Primary sites included Pinneao Feedlot and Hillrose Dairy, before maneuvering to new sites near Sterling due to less-favorable winds.

Crew: Sigel, Plummer, McCabe; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1637 Wheels up. Transiting at 13.5 kft - lower developing boundary layer topping out near 8.5 kft, deeper mixed layer to 13 kft.

1702 Beginning descent, initially to 5.3 kft.

1709 Circling Pinneao Feedlot at 1000' AGL, then 500' AGL.

1716 Circling Hillrose Dairy at same altitudes.

First box circuit

1721 Westbound at NE end at 1000' AGL, box will encompass Hillrose but stay north of Pinneao.

1731 Turning at NW end, descending to 500' AGL.

1735 Turning north at SE end.

1740 Turning west at NW end and ascending to 7 kft.

1745 Turning east at SE end.

1749 Turning south at NW end, ascending to 8 kft.

1759 First box circuit complete, heading to SW end of second box at 1000' AGL.

Second box circuit

1805 Turning north at SE end.

1809 Turning south at NW end.

1813 Turning north at SE end, descending to 500' AGL.

1817 Turning south at NW end.

1811 Turning north at SE end, ascending to 7 kft.

1826 Turning south at NW end.

1830 Turning north at SE end, ascending to 8 kft.

1835 Turning north at SW end.

Transiting towards Sterling for new circuits.

1848 Turning into SW corner of new box, to 1000' AGL.

1855 Turning south at NW end.

1858 Turning east and descending to 500' AGL at SW end.

1904 Turning south at NW end, 500' AGL.

1908 Turning north at SE end and ascending to 1000' AGL.

1913 Turning south at NW end.

1917 Turning north at SE end, continuing north for next box.

1922 Turning south at NW end of second box.

1924 Second box abbreviated, heading north for third circuit.

1927 Eastbound starting from center of planned southern leg of box.

1928 Turn north at SE end.

1929 Turn west at NE end.

1933 Short on flight time, returning eastbound along same leg at 500' AGL.

1939 Returning west along same leg enroute home at 7.5 kft.

1945 At west end, heading home. Transit up to 16.5 kft to get through full boundary layer, then descend for clouds.

2019 On the ground.



8/13/21 TRANS-2AM Pilot notes (Research Flight 8)

Crew: Wadsworth, Plummer, Colohorrano. LOD = Austin.

Flight Time: 3.6

Planned: Work SW of Fort Morgan. Points shown below.

Foreflight VFR flightplan route.

This was the original plan received from the PI.



Actual:

Visibility much better today. Routing down at 13.5K, back at 14.5 K. Approach control sent me on my way with a code of 1200 once I got below about 9000 feet or so. Traffic wasn't bad when operating. Winds shifted during the flight, so once we had completed the orbits of the feedlots, Julieta gave me audible guidance to establish new boxes. Actual flight track with original plan below.

Stratus 2S worked on the glareshield. The new 3 only worked a couple of times. I'll order an external antenna.

Debrief:

All good.

Actual flight path below.

Project: TRANS²Am-21
13 Aug 2021

Flight: RF08

Notes:

Flight sampling around multiple sites near Wiggins, CO. Sites are: Magnum Feedyard, English Feedlot, Empire Dairy, Front Range, and Q Ranch. PCASP started a few minutes into the flight, otherwise good.

Crew: Sigel, Plummer, Juncosa-Calahorrano; LOD: Morgan.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1429 Wheels up. Transiting at 13.5 kft, just above top of remnant boundary layer. PCASP had issues starting up.

1440 PCASP up.

1451 Descend, initially to 5.5 kft.

Initial circuit of individual sites

1502 Magnum Feedyard at 1000' AGL, descend to 500' AGL at 1505.

1509 English Feedlot at 1000' AGL, descend to 500' AGL at 1512.

1516 Empire Dairy at 1000' AGL, descend to 500' AGL at 1518.

1522 Front Range at 1000' AGL, descend to 500' AGL at 1523. Lower passes had to work around Wiggins.

1528 Q Ranch at 1000' AGL, descend to 500' AGL at 1532.

First box circuit

1535 Setting up for first box at 1000' AGL. Will be north-south oriented, with narrower east-west legs.

1536 Turning westbound at NE end.

1538 Turning east at SW end.

1540 Descending to 500' AGL for next lap.

1542 At NE end.

1544 At SW end.

1546 Ascending to 1500' AGL for next lap.

1548 Turning south at NW end.

1551 Turning north at SE end.

1552 Ascending to 2000' AGL for next circuit. Just clear of a few small clouds near 6.5 kft.

1553 Turning south at NW end.

1555 Turning east at SW end.

1558 Ending first box circuit and transiting west to set up next one encompassing the first three sites.

Second box circuit

1601 At northwest end, heading to 1000' AGL.

1605 Turning north at SE end.

1608 Turning west at NE end. Will repeat 1000' AGL circuit, but closer in from the west for the two northerly sites.

1613 Turning north at SE end.

1616 End 1000' AGL box circuits, descending to 500' AGL at NE end.

1621 Turning north at SE end.

1624 Starting next circuit, ascending to 1500' AGL from NE end.

1627 Turning east at SW end.

1632 Ending circuit, maneuvering to change PILS sampler.

Third box circuit

1641 Starting southbound leg from NW end at 1000' AGL, after some maneuvering to get on correct transect.

1645 Turning north at SE end.

1649 Turning south at NW end.

1654 Turning north at SE end.

1659 Extended circuit on the north side, turning west at the NE end.

1704 Descending to 500' AGL at the SW end.

1710 Turning west at NE end.

1715 Turning east and ascending to 1500' AGL at SW end.

1721 Turning west at NE end, for final complete circuit.

1726 Ascending to 2000' AGL at SW end, returning north for final transect before heading to Laramie.

1732 Heading home.

1801 On the ground.

8/12/21 TRANS-2AM Pilot notes (Research Flight 6)

Crew: Sigel, Plummer, Sullivan . LOD = Little.

Flight Time: 3.3

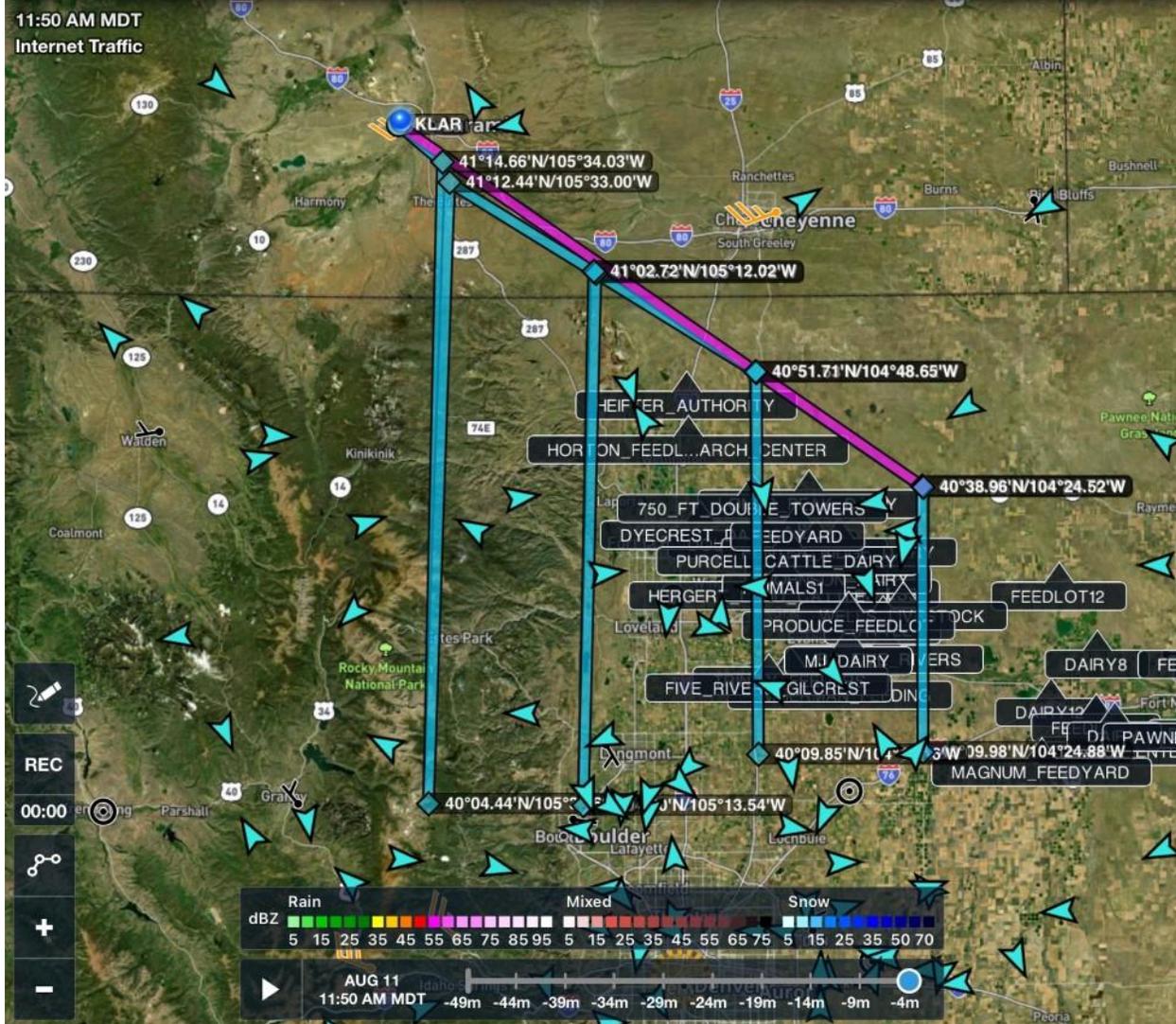
First image is what we planned to do and the second is what we did. Picked up an VFR flight Following. Used the iPad to follow the rout down to first leg. The first controller had no idea what I was up to and tried to give me a clearance for 200uw. I had good visibility the whole time. There were towers fairly close to the rout. Traffic was our main concern. Diverted once for traffic and had many call outs from Denver once we were with Approach. The aircraft worked well and there was no problems. I used the Stratus3 the whole time and it worked well. I placed it low and center of the window I would lose contact with it in steep turns.

Aerial & Wind **FPL** 1 ⚙️ 📏 🕒 🌟 🔍 KLAR 40.59/-103.308 4... 🔄

N2UW	40°51.71'N/104°48.65'W	41°02.53'N/105°11.72'W	40°04.30'N/105°13.54'W	Procedure
Unnamed profile	41°02.72'N/105°12.02'W	41°12.44'N/105°33.00'W	40°04.44'N/105°35.66'W	Routes (8)
33,000'	41°14.66'N/105°34.03'W	KLAR		ETD

↔️ Clear

Dist 534 nm ETE 3h24m ETA - Fuel 2,118 lbs Wind 1 kts tail 🌐 📄 🌟 📶 Edit NavLog Profile



Distance to Next **70 nm** ETE Dest **---** Groundspeed **---** GPS Altitude **7,261'** Track **---** Accuracy **65 m**

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Project: TRANS²Am-21
12 Aug 2021

Flight: RF07

Notes:

Flight sampling along upslope profile, four north-south legs working from east to west.

Crew: Sigel, Plummer, Sullivan; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1844 Wheels up. Transiting 11.5 kft, just above top of boundary layer.

1857 Starting descent, to 6.2 kft for 1000' AGL at start of leg.

Leg 1

1906 At north end of leg 1, 1000' AGL.

1916 Turning at southern end and ascending to 2000' AGL.

1917 Northbound at 6.8 kft/~2000' AGL.

1926 Turning west and descending to 1000' AGL for transit to second leg.

Leg 2

1933 Turning into leg 2 at north end.

1945 Turning north, then ascending to 2000' AGL.

1947 On track.

1959 Turning at north end for transit to leg 3.

Leg 3

2004 Turning for leg 3, a bit short due to a wind farm not shown on the charts. Starting a bit higher, ~2000' AGL due to rising terrain.

2022 Turning at southern end.

2027 Descending a bit, may be above plume.

2037 Returning south, will try to follow terrain at lower altitudes.

2048 Returning north, 1000' AGL where possible.

2100 Ascending to 11.5 kft for PILS sampler swap.

2105 PILS changeover complete.

2107 Turning for transit to leg 4.

Leg 4

2112 Turning into north end of leg. Initially 11 kft, climbed to 12.5 kft for terrain.

2132 Turning at southern end, returning to Laramie after completing leg.

2157 On the ground.

8/11/21 TRANS-2AM Pilot notes (Research Flight 6)

Crew: Sigel, Plummer, Caulton. LOD = Morgan.

Flight Time: 3.5

First image is what we planned to do and the second is what we did. Picked up an IFR flight plan down to Haxtun (17V) at 13000. I had a hard time getting the clearance on the ground in LAR due to someone flying practice approaches and carrying an IFR clearance. Started down about 50 miles out of Haxtun and found the first feed lot no problem. After. Visibility was not bad I would estimate at least 10 miles. Once again it was a large work load. There was a bit of traffic and a few birds nothing to exciting. We had to maneuver and keep in sight a crop-duster. Denver canceled our VFR flight following once we went below 7000 MSL. We picked up Flight Following on the way home and came back at 14500. The Aircraft worked well and there were no problems. The Stratus 3 did not work at all and the Stratus 2 started to overheat on the front widow. Other than that all went well.



Project: TRANS²Am-21

11 Aug 2021

Flight: RF06

Notes:

Flight sampling multiple locations near Sterling, CO. Sites included T Bar W Cattle Co., D&D Feedlot, Dinklage Feedyards (primary site), and Timmerman Feeding Corp.

Crew: Sigel, Plummer, Caulton; LOD: Morgan.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1557 Wheels up, transiting at 13 kft. Highest boundary layer top ~12.5 kft, with sublayers below.

1618 Descend to 8 kft.

T Bar W Cattle Co.

1625 Terrain is ~4 kft here, descending to 5 kft for 1000' AGL maneuvers.

Descend to 500' AGL, continue circle.

Dinklage Feedyards

1634 Ascend to 1000' and move to Dinklage site.

1641 Descend to 500' in circle.

D&D Feedlot

1643 To D&D site at 1000' AGL for circle.

1646 Descend to 500' in circle.

Box circuits focused around Dinklage Feedyards

1648 Ascend to 1000' for box circuit, starting from NE end.

1655 Westbound in box at 1000' AGL.

1659 Eastbound at SW end.

1703 Turn north and descend to 500' AGL.

1704 Westbound at NE end.

1710 Eastbound at SW end.

1714 Ascend to 6 kft for next box.

1718 Westbound at NE end, at 6 kft.

1723 Eastbound at SW end.

1728 Turning north at SE end and ascending to 7 kft.

1730 Westbound at NE end.

1736 Eastbound, finishing this box.

1740 Maneuver to swap PILS sampler.

1746 Returning westbound at 7 kft to start box displaced further south.

1758 Turning south and descending to 6 kft.

1759 Heading eastbound at 6 kft, at SW end.

1803 Westbound at NE end, 6 kft.

1805 Turning south and descending to 5 kft, heading east coming out of turn.

1809 Westbound at NE end, at 5 kft.

1813 Turning south and descending to 4.5 kft.

1818 Westbound, finishing box.

Timmerman Feeding Corp.

1822 Ascending to 1000' AGL and transiting south.

1825 On site.

1828 To 500' AGL in circle.

1830 Ascending to 1000' AGL for box circuit.

1833 Southbound at NW end.

1836 Eastbound at SW end, descending to 500' AGL.

1837 Turning northbound.

1840 Turning west.

1841 Turning south.

1844 Ascending to 6.5 kft and returning north for final transect.

1849 Ascending to 14.5 kft and returning to Laramie.

1923 On the ground.

8/09/21 TRANS-2AM Pilot notes (Research Flight 5)

Crew: Sigel, Plummer, McCabe. LOD = Morgan.

Flight Time: 3.5

First image is what we planned to do and the second is what we did. Picked up an IFR flight plan down to GLL VOR at 14500. No problems just confused the controllers a bit. I explained that I was just going down there IFR and would cancel due to the smoke around here. Got down to the first feed lot and it was a bit disorientating due to the smoke once we found the feed lot all went well. After that finding the next feed lots was easy. Visibility was not the greatest and towers seem to emerge from the smoke. It defiantly was a large work load. I monitored the frequencies of the parachute jumpers and local airports. Not much going on. There was a bit of traffic and a few birds nothing to exciting. It was hot and turbulent. The Aircraft worked well and there were no problems.



4:22 PM Mon Aug 9



VFR & User Pts

FPL



4:15 PM MDT
Internet Traffic



Project: TRANS²Am-21

9 Aug 2021

Flight: RF05

Notes:

Flight sampling multiple locations near Fort Morgan - Heifer Authority/Horton Feedlot, Dyecrest Dairy, and Miller Cattle Feeders/Longs Peak Dairy/Miller Feedlot. Winds were somewhat variable, tending towards SSE at very low levels and more SW further aloft.

Crew: Sigel, Plummer, McCabe; LOD: Morgan.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1715 Wheels up, transiting at 15 kft.

1727 Descending initially to 8 kft.

Horton Feedlot/Heifer Authority sites

1732 Horton Feedlot in sight, circling at 1000' then 500' AGL.

1734 To Heifer Authority for similar circuits.

1746 Extended east, turning north for box circuit.

1747 Turning westbound.

1750 At NW end, turning south.

1752 Eastbound, track is north of Horton Feedlot and south of Heifer Authority.

1756 Turning west at NE corner of box circuit.

1758 Turning south and descending to 500' AGL.

1800 Turning eastbound along southern leg.

1805 Turning westbound at NE corner.

1808 Turning south and ascending to 7.6 kft.

1810 Turning eastbound to start southern leg.

1814 Turning west at NE corner.

1817 Ascending to 8.4 kft and returning along same leg, eastbound.

1821 Turning north at SE end of new box, shifted further downwind from first.

1826 Turn south, descend to 7.6 kft.

1828 Turning east at SW end.

1834 Turning north at SE end.

1840 Turning south at NW end.

1848 Turning north at SE end, descend to 7 kft.

Dyecrest Dairy site

1854 Ascending to 8 kft for transit to Dyecrest.

1859 Descending to 1000' AGL for circuit around site.

1902 In circle at 1000' AGL.

1912 Turning for westbound leg at NE end of box circuit, 500' AGL.

1918 At SE end, turning north and ascending to 1000' AGL.

1920 Turning for westbound leg at NE end.

1925 Diverting to change PILS sampler.

1931 PILS sampler swap complete, heading back to research lines and descending to 7.3 kft.

1937 Turning north at SE end.

1940 Turning west at NE end and ascending to 8 kft.

Miller Cattle Feeders/Longs Peak Dairy/Miller Feedlot

Diverting further east to next sites as a convective shower is building near Dyecrest site.

1950 At 1000' AGL circuiting sites.

1959 Continuing on and ascending to 6.5 kft (7 kft intended, but impacted by traffic).

Heifer Authority, second profile

2003 Transit back to Heifer Authority site for second set of measurements following afternoon heating.

2007 Descending to 1000' AGL for circle.

2011 Ascending to 6.6 kft in circle.

2014 Ascending to 7.2 kft in circle, then head for tracks NE of site.

2020 Descending to 6.8 kft and heading eastbound.

2023 Descending to 6.2 kft for westbound leg.

2028 Research operations complete, heading home.

2040 On the ground.



the PI was considering cancelling as satellite images showed a big mass of smoke moving into the area. We elected to try.

Filed an IFR flightplan to KFMM & back. Planned to proceed VFR if the viz was decent then pickup an IFR for the return.

On the way down, it became apparent that the viz was dropping around KFMM. Also in KAKO. Changed the routing enroute with Center to go over the Akron VOR. AWOS was reported at 4nm. Got a descent to 9000' MSL and it looked poor. Eventually asked to do the RNAV 29 at KAKO. Viz didn't get any better and elected to bag it for the day. Flew the RNAV 30 to land back in KLAR.

Debrief:

Had problems with both Stratus receivers. The new one (STRATUS 3) finally got a good GPS signal when we landed back in Laramie after placing it on the dash beside the old one for the last 30 minutes of flight. The old one (STRATUS 2S) initially gave me a message that it needed a software update, so I deselected it and just ran on the internal GPS in the iPad. Megan was able to get good GPS from the STRATUS 2S which was mounted on the front dash in the new rubber mount. On the return to Laramie, I tried the old one again and it connected just fine with my iPad. Keep trying. Bring both along.

Actual flight path below.



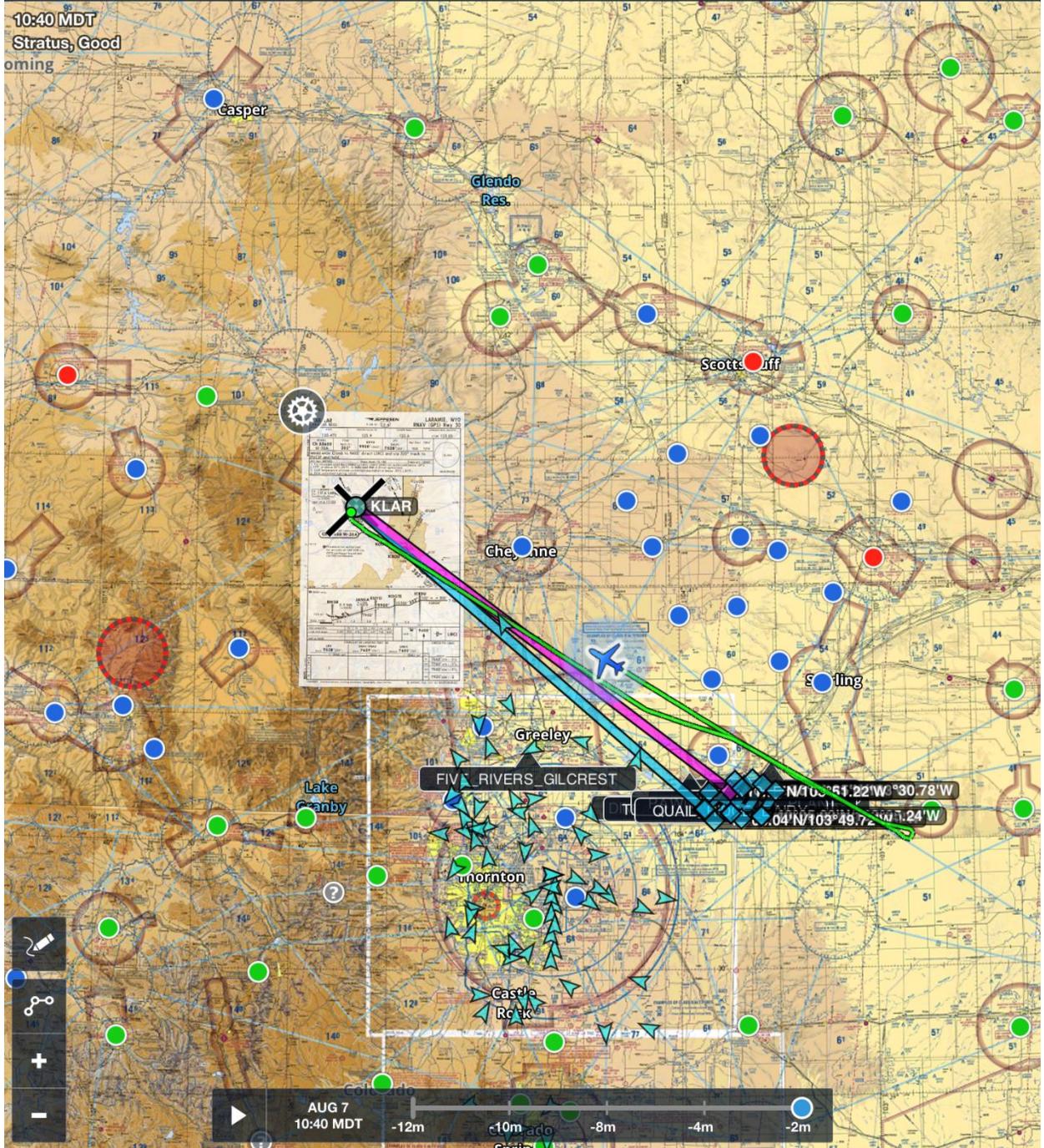
10:42 Sat Aug 7

100%

VFR & Category FPL

KLAR 40.201/-103.745...

10:40 MDT
Stratus, Good
oming



KLAR

LAZARUS WFO
REV 03/17

KLAR
10.201
-103.745

KLAR
10.201
-103.745

KLAR
10.201
-103.745

AUG 7 10:40 MDT

ETE Dest 1h17m

Groundspeed 192 kts

Rate of Turn 0°/s

Track 294°M

Accuracy (Stratus) 6 m

Cross Track Error 6.9

Blue Mesa

Airports Maps Plates Documents Imagery Flights ScratchPads Devices More

Project: TRANS²Am-21

7 Aug 2021

Flight: RF04

Notes:

Short flight intended to sample sites near Fort Morgan if visibility allowed. Visual survey and missed approach at Akron found visibility too poor to operate, so the flight was called off. Applanix would not connect/write to thumbdrive; verified that data system was ingesting IMU data (confirmed after the flight). Cabin pressure sensor out, not mission critical.

Crew: Wadsworth, Plummer, McCabe; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1528 Wheels up. Poor visibility locally so using IFR departure, transiting at 15 kft.

1543 Beginning descent into operations area.

1600 Stated visibility 4 nmi locally, visually not looking good. Will shoot approach at Akron (CO Plains) to check lower altitude.

1607 Descend to 8 kft for airport circuit.

1612 Left turn, coming into approach.

1621 1600' AGL, descending.

1623 Out of approach, consensus is visibility is too poor for low altitude operations. Transiting back, initially at 14 kft.

1708 On the ground.



8/04/21 TRANS-2AM Pilot notes (Research Flight 3)

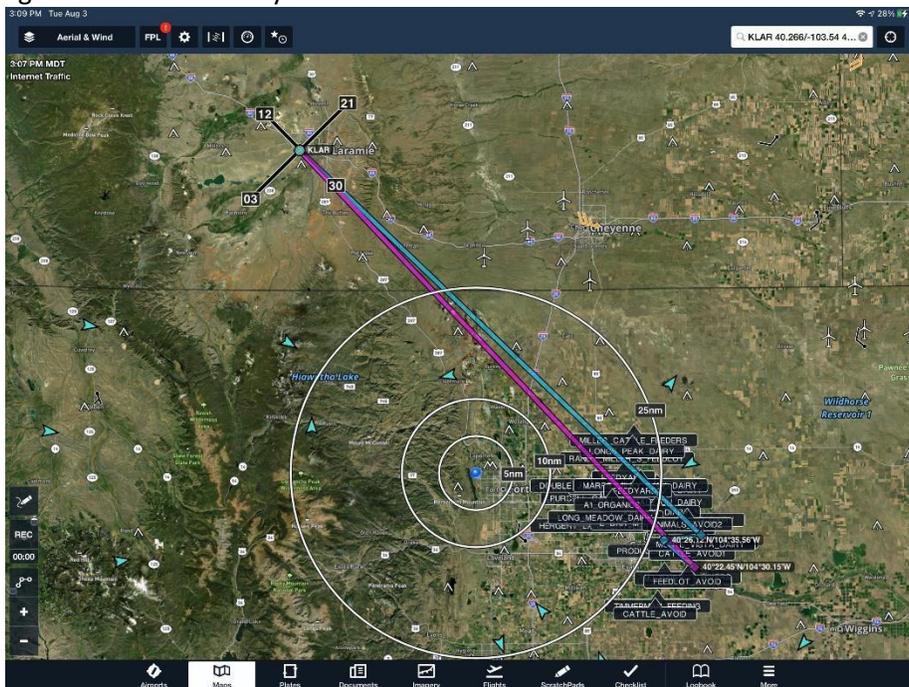
Crew: Wadsworth, Plummer, Calahorrano. LOD = Little.

Flight Time: 2.9

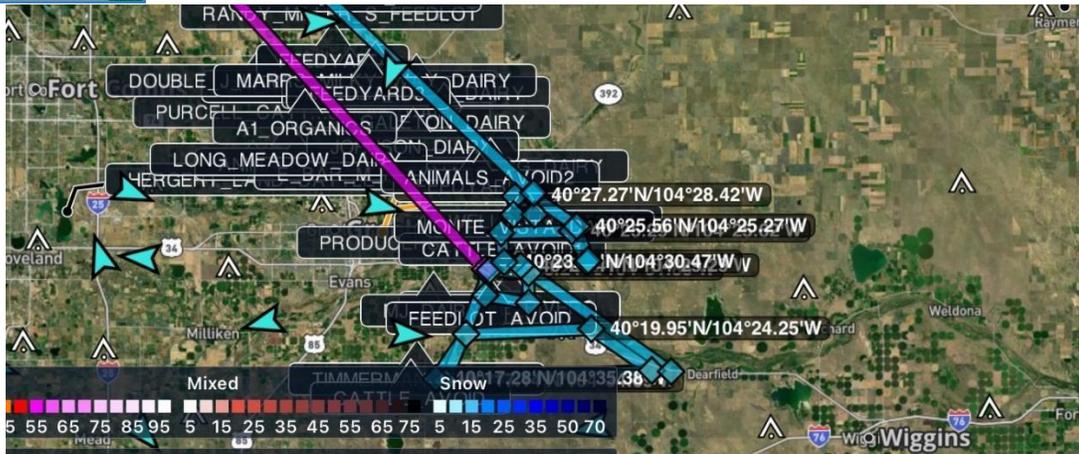
Planned: Fly closer to Denver, SE of Greely, but partly under Class B airspace. I promised to put the Stratus back into the aircraft to at least give intermittent GPS to the PI. PI was Julieta.

Foreflight VFR flightplan route.

This was the original one and basically what I used to format the email to the FAA on Tuesday.



Details from the flight brief.



Actual:

This was a quick turn. From the earlier flight, we had transferred the aircraft over to ground power to keep the data system going. Called for fuel & after doing some admin from the previous flight, jumped into the flight brief. Saw the above intended flight pattern above. Note that the grad students have found how to import names of the various feedlots into Foreflight.

The old Stratus finally worked for this flight, and worked pretty well. It displayed a green light for GPS almost immediately on start & continued to give good information for the entire flight, both for me and the PI. I have no idea why it finally started working. But a new one is in the mail.

A big & re-learned lesson from this quickturn. When Emily gave me the name of the first feedlot (southernmost one), I went into the Google spreadsheet that she had shared with us to get the lat/long to put into the FMS. Unfortunately, there are two "Five Rivers" feedlots in the spreadsheet & I grabbed the location for the wrong one. This had me initially heading for a location much further to the west of the desired feedlot & about made my head explode when flying down & the FMS destination did not agree with what Foreflight was showing me. I tried getting updated lat/long from the PI but the format given to me was in dd.mmm and again led to a head explosion. I basically ignored the FMS from that point on & followed the yellow brick road on the iPad.

Again, the plan was to get to the first feedlot (more southern one), do an orbit at 1000' AGL, then drop down to 500' AGL, then move to the larger box south of it and do it at multiple altitudes (1000' AGL, 500' AGL, 7500' MSL). Had a bit of traffic on the west side of this box as a pipeline inspection aircraft went through & landed at Greeley. Later in the flight, the PI asked if we could do any part of this box at a higher altitude. Gave her the north, westbound leg at 8500' as it was outside the class B airspace and then the southernmost leg (eastbound) at 7500' MSL as it was under the class B. The Approach Controller for the first part of this flight was good & gave traffic calls. Sometime during the flight, there was a turnover & the second guy basically never even spoke to me except when I headed home.

Project: TRANS²Am-21
4 Aug 2021

Flight: RF03

Notes:

Short turnaround from RF02. Flight targeted Five Rivers and Montevista sites in generally northerly winds. Profiles similar to previous flight, except more abbreviated - circling each site, and one box track downwind of each. No flight data sent to the ground initially, see the pilot report for the entire flight track summary. Front display froze during the transit home (after research measurements were complete); it eventually returned to being responsive without a loss of data from any of the connected systems.

Crew: Wadsworth, Plummer, Calahorrano; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

2219 Wheels up. Transiting at 15.5 kft, boundary layer top near 15 kft.

2229 Beginning profile descent to avoid clouds.

First site, Five Rivers.

2245 In initial circle around site. Northerly winds and southerly plume identified.

2248 Descend on north side.

2251 Ascending to 1000' AGL for box track south of site.

2254 Turning east to start box track at SW end.

2258 Turning north at SE end.

2300 Westbound on north side.

2302 Turning south for eastbound leg.

2306 Turning north and descending to 500' AGL.

2307 Westbound at NE end.

2312 Getting back on track after diverting for traffic.

2314 Eastbound on southern side.

2317 Turning north for westbound leg, maintaining 500' AGL.

2321 Ascending to 7.5 kft at west end before turning south for eastbound transect.

2323 At 7.5 kft, heading east at SW end.

2325 Turning north at SE end.

2329 At NW end, descend to 6.5 kft and turn south to east.

2334 At SE end and turning north.

2339 Ascending to 7.5 kft at NW end for eastbound transect.

2344 Ascending to 8.5 kft at SE end for westbound transect on north side, further away from limited airspace.

2346 Westbound on 8.5 kft transect.

2349 Box track complete, proceeding to next site.

Second site, Montevista.

2355 At SE end, no plume along transect at 1000' AGL.

2357 At NW end and turning south, descend to 500' AGL.

0000 At SE end, turning north.

0003 Turning south and ascending to 1500' AGL at NW end.

0006 Turning north at SE end.

0008 Turning south and descending to 1000' AGL.

0011 Turning north at SE end.

0013 Turning south for eastbound leg, then change PILS sampler.

0015-0020 Changing PILS sampler.

0022 Turning south at NE end, transiting NE to circle around site.

0025 Circling site at 1000' AGL.

0027 Descend to 500' and continue to circle.

0030 Ascend to 1000' AGL, continuing circle.

0033 Ascending to 1500' AGL, continuing circle.

0036 Descend to 500' AGL, continuing circle.

0040 Ascending to 1000' AGL, continuing circle.

0043 Profile complete, heading home.

0109 On the ground.



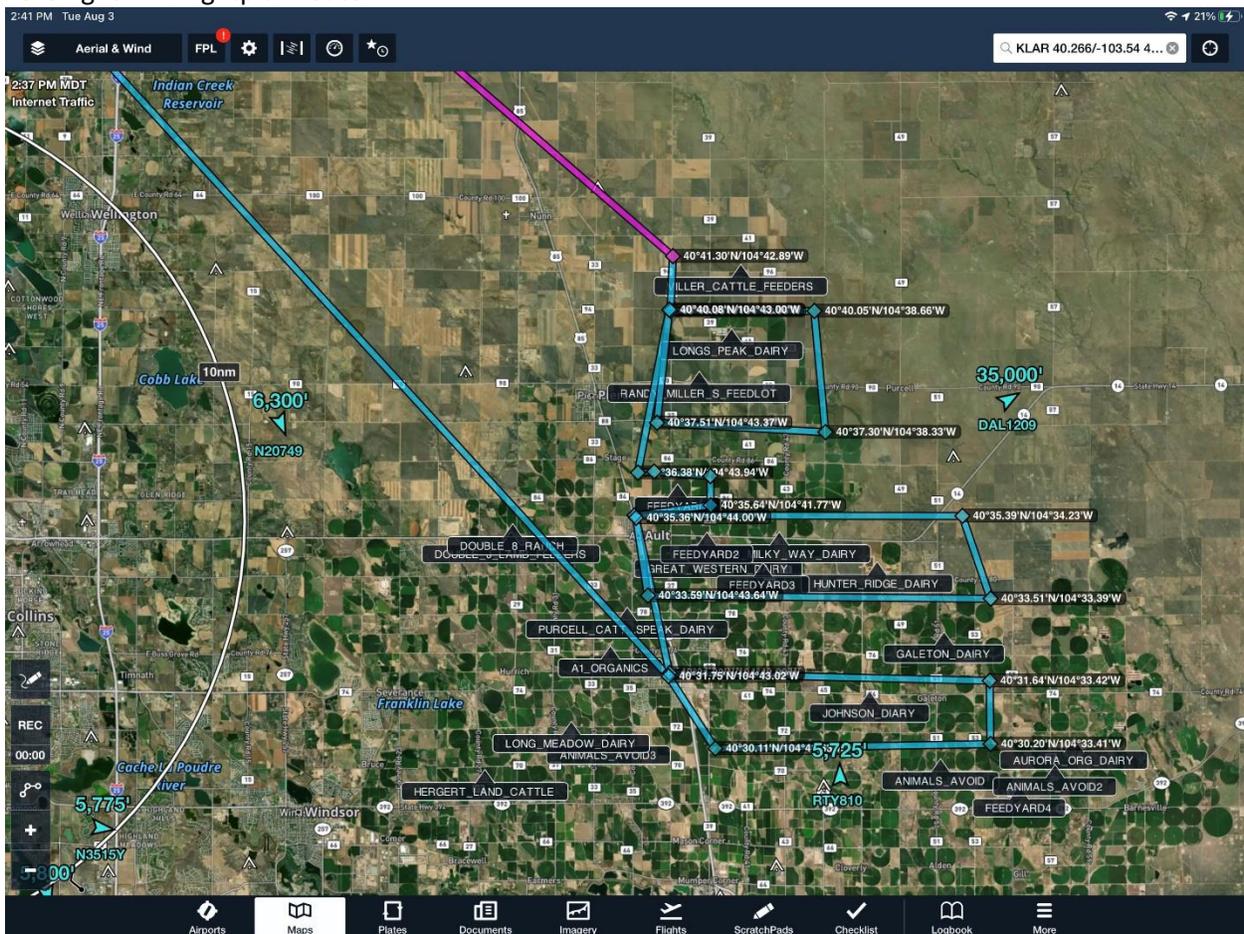
8/04/21 TRANS-2AM Pilot notes (Research Flight 2)

Crew: Wadsworth, Plummer, Caulton. LOD = Little.

Flight Time: 3.3

Planned: Fly north of Greeley. Use the Low-Alt Waiver. Work around the densest area of feedlots in entire region.

Foreflight VFR flightplan route.



Actual: We stumbled in the brief a bit. We were out of sequence & not completely organized. The aircraft was already on the ramp, so some people were already out working on it, getting things ready. By the time I stepped into the conference room, the PI jumped right into talking about the details of the research pattern. This was brought up in the debrief, that the full brief happens first, then the aircraft



gets pulled out. Helps to have everyone focused on what we are planning & to include details of the startup. Reminder here, that prior to starting engines, ensure the PI is ready for it.

Departed VFR. For some reason, even after filing a VFR flight plan on Foreflight, Denver Center says they have nothing on file. Still getting flight following from them. Visibility was terrible. Climbed to 14,500 MSL on the way down, then started the descent about 10 minutes prior to the northernmost point.

The PIs had made a much more efficient pattern than the prior flight (RF1). We talked about it before flight, and basically flew it as planned. It was a sequence of three boxes. They were all very narrow, and moreso than I was expecting before starting them. At the ends of the legs, it was basically a constant turn to get back onto the leg heading the opposite direction. Very dense feedlots here. Even being off the intended Foreflight track by $\frac{1}{2}$ mile could put you right over a feedlot.

Dana asked to extend the eastbound legs further to the east than planned to get back into clear air. We also had to maneuver a bit on the east side to avoid some traffic. Lower right series of 3 circles were to allow Dana to change the Pils.

The last & most southern leg was not pre-planned. When we were finishing the 3rd box, Dana asked if we could do one more leg, about $1\frac{1}{2}$ mile closer to Greeley airport. There had been quite a bit of traffic going into Greeley, most of it simply landing. Not much taking off. Some staying in the pattern. Made a bunch of position & intent reports on CTAF & no real problems there. There was a crop-dusting aircraft working on the west end of the 3rd box which was a distraction. For our 500' AGL lap on this box we turned tightly to not get close to him. There were also parachute jumping ops going on to the south of Greeley nearly the entire flight.

I did not even bring the Stratus on the plane for this flight. The iPad internal GPS worked far better than the Stratus had. Unfortunately, Dana then had little SA of where we were.

Overall, a high workload in the flight. The patterns were efficient & we had plenty of fuel for what we wanted to do, but tight maneuvering, requires a lot of focus on where the feedlots are to try to not overfly them. Staying aware of traffic. Monitoring Approach & CTAF; communicating on both these frequencies; watching for birds (we hit one, left a blood smear on the nose); identifying which TCAS tracks are which aircraft that are talking on which radio; maneuvering to avoid TCAS tracks, etc. That plus a warm cockpit, poor visibility, makes for a handful.

Actual flight path below.

Project: TRANS²Am-21

4 Aug 2021

Flight: RF02

Notes:

Flight targeting multiple ground sites near Greeley, in very active dairy/feedlot area. Profile includes a box track encompassing several sites, then stepping south for additional boxes at stacked altitudes tracking plumes downwind.

Crew: Wadsworth, Plummer, Caulton; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1736 Wheels up. Will transit above boundary layer top prior to descending profile enroute.

1746 Begin descent down to 6.5 kft.

1752 1000' AGL.

First box track, encompassing target sites.

1754 Entered box track around target sites a bit close, at 1000' AGL. Peak ID'd to the south, will extend eastbound end of leg a bit.

1757 Northwestbound at SE end of initial box track.

1759 Westbound at NE side.

1801 Turn S and descend to 500' AGL for next box.

1802 Eastbound at SW side.

1805 Extended leg, turning NW.

1806 Westbound along north side.

1808 Turning south, ascending to 7.5 kft for next set.

1809 Turning eastbound.

1811 Turning northwest at SE end.

1812 Turning west, maintain 7.5 kft.

1814 Turning southbound at NW end.

1815 Turning for eastbound leg, additional 7.5 kft pass.

1818 Ascending to 8.5 kft, 9.5 was initial plan but cloud bases are too low. No plume on north side.

1821 Turning south.

1822 Turning eastbound for southern end. No plume to south at this altitude.

1824 Heading to second box track.

Second box track, south of initial target sites.

1829 Westbound at 1000' AGL along northern end, extended a bit for traffic.

1835 Traffic was too large a factor, resetting initial 1000' AGL box.

1837 Westbound at NE end. Extend west end a bit.

1840 Turning south, east for southern leg.

1844 Extended east end of leg, turning north and descending to 500' AGL.

1849 Turning south, east.

1850 Eastbound on southern leg.

1853 At SE end, ascending to 7.5 kft for next set.

1855 Westbound at 7.5 kft.

1858 At west end, turning south, east.

1859 Eastbound at SW end.

1902 At SE end, ascending to 8.5 kft.

1904 Westbound at 8.5 kft.

1907 At west end, turning south, east.

1908 Eastbound at SW end.

1911 Ending 2nd box track, descending to 1000' AGL.

Third box track, continuing further south of targets.

1915 Westbound at NE end, 1000' AGL.

1919 Eastbound at SW end, cropduster activity below will not allow the full planned 500' AGL track here.

1924 At SE end, will descend to 500' AGL.

1926 Westbound at NE end.

1929 Reverse track early due to traffic activity, heading eastbound.

1932 Turning north at SE end, one more 500' AGL transit.

1936 At west end, ascending to 7.5 kft.

1942 Turning at SE end.

1943 Westbound at 7.5 kft.

1945 At NW side. Will do one more pass, then swap PILS sampler.

1949 Transiting east of tracks to swap PILS sampler.

1957 Swap complete, heading back to try sampling one track further south. Traffic coming off Greeley airport will be main concern here.

Final southernmost track.

1959 Westbound on new transit leg, 7.5 kft.

2003 At west end, descending to 1000' AGL for eastbound transect.

2010 At east end, descending to 500' AGL.

2012 Westbound at 500' AGL.

2018 Turning north and ascending to 1000' AGL for final background transect north of initial sites.

2023 Eastbound at 1000' AGL on final transect.

2026 Ascending initially to 14.5 kft enroute to Laramie. Boundary layer top is approximately 13 kft. Descend to 12.5 kft subsequently to avoid clouds.

2050 On the ground.



8/02/21 TRANS-2AM Pilot notes (Research Flight 1)

Crew: Wadsworth, Plummer, Caulton. LOD = Little.

Flight Time: 2.9

Planned: Utilized the waiver today. Coordinates of route here:

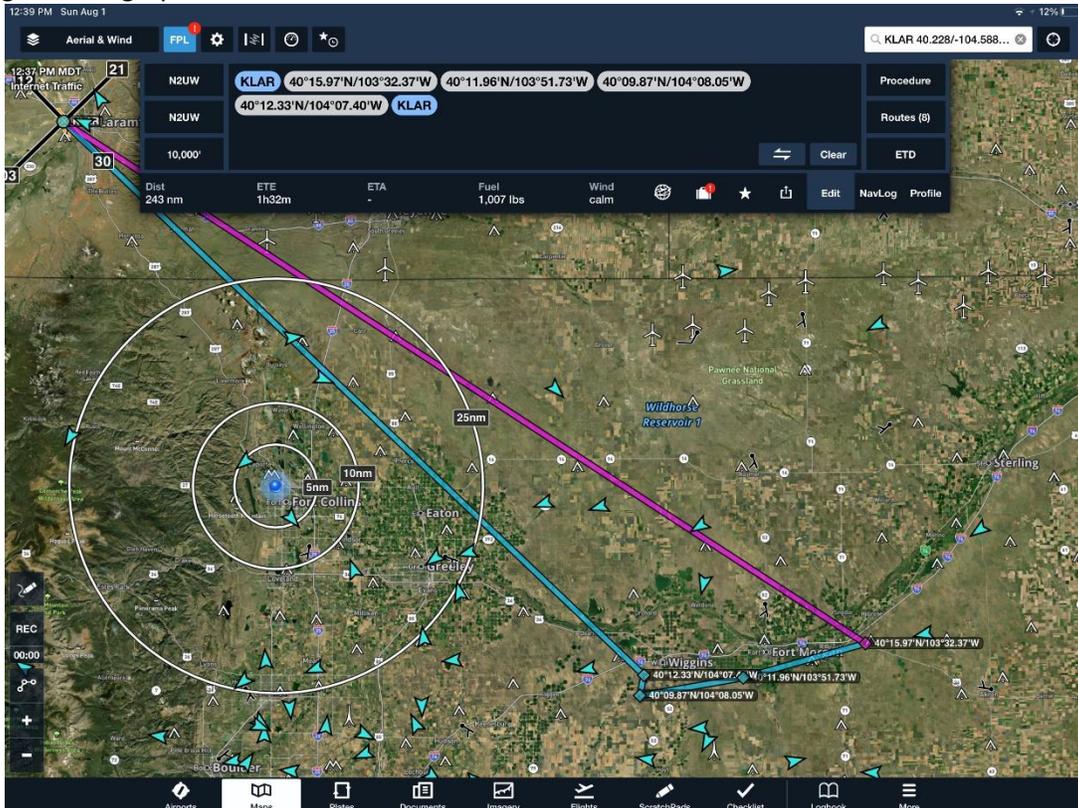
40 16N / 103 33W Pinneao: TA2PN

40 12N / 103 53W Teague: TA2TG

40 10N/ 104 08W Magnum: TA2MG

40 12N/ 104 07W English / Timmerman: TA2EN

Foreflight VFR flightplan route.



Actual:



We will be starting the briefing 2.5 hours before planned takeoff for the next flight. Had some problems on data system startup that set up behind.

Ensure you let the PI know that you are about to start the engines. They need to push a button / turn something on or off before the engines coming on-line.

On departure, found that there was a 250 pound fuel split, with the left side that much lower than the right. Double check the fuel unload from Cowboy.

Probably won't do a spiral descent in the research area due to need to improve efficiency and to improve the pilot comfort with simply doing a straight-ahead descent with all the traffic in the area. Essentially only had enough time to fully work the first area – the Pinneao Feedlot. We talked about how to improve our efficiency during the debrief. I related that in these kind of conditions, I prefer to make left turns both around the feedlot and in the racetrack pattern downwind, due to a better FOV for the pilot.

There were five different aircraft which I had to maneuver away from during the flight. The last two had RA's from the TCAS. Was under Denver Center control, and they gave some great advisories throughout the flight. After the second RA, it was enough for me, and we came home. At least one of the RA's was from an aircraft that was below us when we were at 1000' AGL.

Lastly, with the fuel issue, it was time to go home.

The visibility was poor with smoke. AWOS reports varied from 5 nm up to 10 nm throughout the area. Parachute jumps were ongoing at Fort Morgan.



During the debrief, we talked about how to follow VFR cruising altitude rules in the racetrack pattern. It will require a lot of altitude changes, from eastbound to westbound legs, but with the traffic that was encountered down there, we need to do this.

This is the second flight where the Stratus Receiver performed poorly. It never got a good GPS signal, so I did not have a good display of the aircraft position on Foreflight. I'm ordering a new one.

That's about it.

Project: TRANS²Am-21

2 Aug 2021

Flight: RF01

Notes:

The first research flight, targeting sites near Fort Morgan in weak southerly flow. The general profile was to circle a site at 1000', then 500' AGL to identify a plume, then set up a racetrack profile oriented E-W downwind of the site, doing stacked vertical passes to sample the plume at an array of altitudes and ranges.

First site (Pinneao Feedlot) completed successfully; the flight was aborted early into sampling the second site (Teague Enterprises), due to a combination of safety factors including low visibility and active close traffic.

Crew: Wadsworth, Plummer, Caulton; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1717 Wheels up.

1721 Boundary layer top near 12.5 kft, transiting just above top before making a descending profile enroute to first site.

1744 Beginning descending profile down to 5.5 kft.

1752 At 1000' AGL, heading towards Pinneao.

1753 In circle to identify plume, were essentially in plume as we entered - for future flights, the plan will be to enter circle from upstream to simplify this.

1757 At 500' AGL, similar signal.

1802 E-W transect approximately 2 nmi north of site, setting up southern end of stacked racetrack pattern.

1804 Turned to return eastbound along same transect, continuing further east at end to exit plume.

1808 Descending to 500' AGL, stepping north along east end of track.

1812 Westbound along northern E-W leg.

1816 Turning south along western end of track.

1819 Repeating first transect headed east.

1823 Turning north and ascending to 2000' AGL.

1826 Diverting for traffic.

1827 Westbound on track.

1832 Turning south at west end.

1834 Heading eastbound, continuing at 2000' AGL.

1838 Turning north and ascending to 3000' AGL.

1841 At altitude, heading westbound.

1845 Turning south at west end of track.

1847 Turning eastbound.

1852 Turning north at east end of track, ascending to 4500' AGL.

1856 Westbound along north end of track.

1900 Turning south at west end.

1902 Eastbound for final transect.

1907 Sampling completed for first site, ascending and loitering to change PILS sampler, then head to second site.

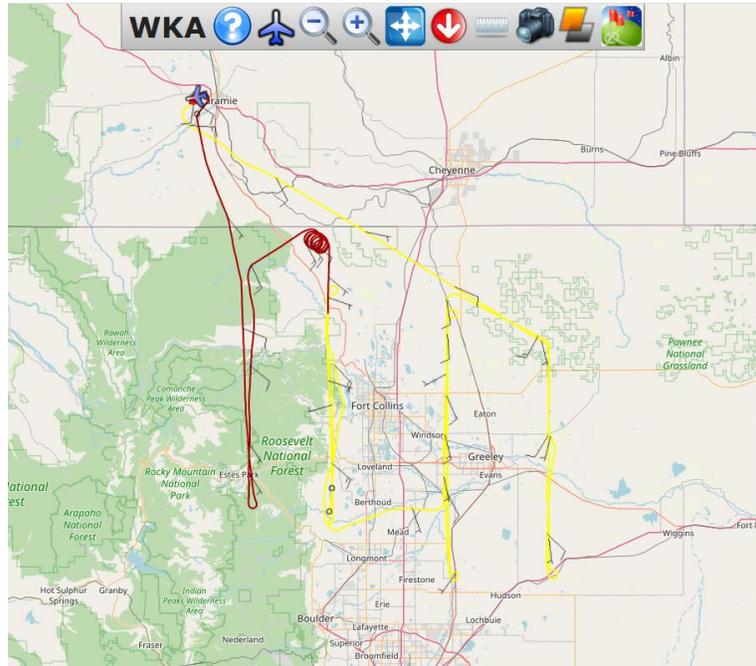
1923 In RH circle at 1000' AGL.

Flight called off subsequently after several diversions and close events involving busy air traffic with poor visibility. Transit home starting at 14.5 kft.

2005 On the ground.



Actual:



Flew each of the N-S legs (numbered from 1 – 4, east to west). Generally attempted to fly the southbound leg at 1000' AGL. Northbound was about 1000 – 1500' higher. Flew the 2nd leg a 3rd time, N-S, then bailed-off just before reaching Class B airspace and picked up the 3rd leg going north. Flew this 3rd leg three times. Then delayed for about 8 orbits while the pils collector was changed out. Flew the 4th leg down to just south of Estes Park, then came home. This last leg flew at 11000' MSL and cleared all terrain comfortably.

Project: TRANS²Am-21
27 Jul 2021

Flight: TF04

Notes:

Flight testing measurements and crew coordination along a typical upslope flight track consisting of four N-S legs spaced from east to west, starting east of Greeley. Winds were generally from the southeast so the sampled plumes were cutting more diagonally across the profile legs compared to more ideal easterly winds. No PCASP data.

Crew: Wadsworth, Plummer, Fischer; LOD: Little.

Flight Summary:

UTC Comment (all altitudes in MSL unless specified AGL)

1833 Wheels up. Transiting at 11.5 kft.

1848 Beginning descent to 6.5 kft.

1855 On north end of leg 1, 1000' AGL.

~1906 Reversing course to head north on leg 1 at 2500' AGL.

1908 Northbound at 7 kft.

1919 Finished northbound leg 1, transiting to north end of leg 2.

1923 Descending to 1000' AGL.

1925 Southbound on leg 2.

1936 Exiting Greeley plume.

1940 Northbound at 7 kft (~2500' AGL again).

1944 Feedlot just upwind.

1952 Returning south at 8 kft.

2003 End leg 2 and transit to southern end of leg 3.

2008 Beginning northbound transit of leg 3 at 7 kft.

2019 Reversing to go southbound at same altitude.

2021 On track.

2033 Northbound on leg 3 at 7.5 kft.

2047 Holding at north end over lower terrain to swap PILS sampler. Zeroing instruments in the meantime at 9.5 kft.

2102 PILS sampler changed out, transiting to northern end of leg 4.

2105 Southbound on leg 4, starting at 8.5 kft and ascending to 11 kft enroute for terrain.

2116 Northbound return leg, beginning at 11 kft and gradually descending with terrain.

2127 Returning to base.

2137 On the ground.

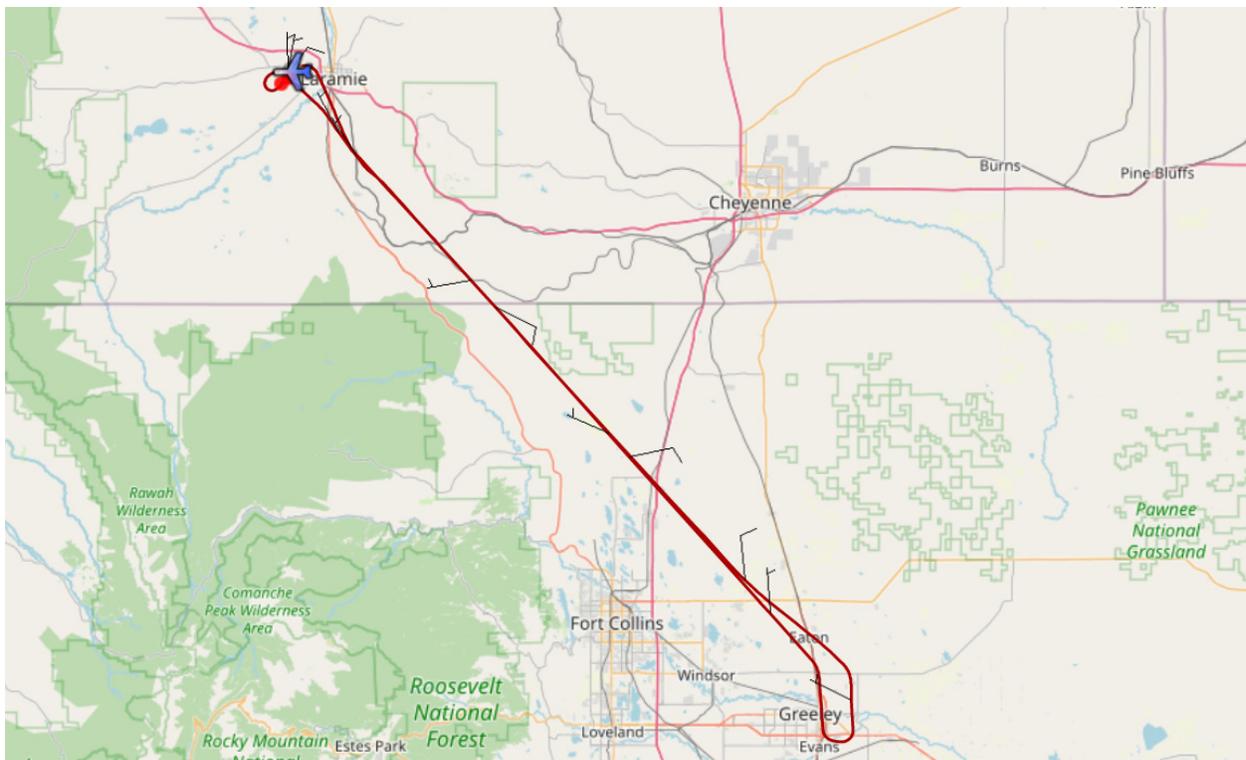
07/23/21 Pilot notes (TRANS2AM TF 3)

Crew: Drew, Sullivan, Plummer

Flight Time: .9

Planned: Fly straight and level to Greeley, fly low approach, fly straight and level back.

Actual: Climbed to 11,500 ft. MSL leaving Laramie, flew low approach on runway 35 in Greeley. Climbed to 10,500 ft. MSL returning to Laramie.



Project: TRANS²Am-21

23 Jul 2021

Flight: TF03

Notes:

Short flight focused on PILS & air chemistry measurements, transiting to Greeley for a missed approach and returning to Laramie. Secondary PCASP continued to have low flow. The Picarro pump had issues so the instrument was not operated for this flight.

Crew: Drew, Plummer, Sullivan; LOD: Glover.

Flight Summary:

UTC Comment

1521 Wheels up.

1525 Transiting to Greeley at 11.5 kft.

1534 Beginning descent.

1540 Brief altitude diversion due to traffic.

1544 In approach.

1550 At 10.5 kft for transit back to Laramie.

1601 Beginning descent.

1609 On the ground.

Project: TRANS²Am-21
20 Jul 2021

Flight: TF02

Notes:

Flight focused around characterizing Rogers inlet (not attached to PILS) via an ascending profile to 28 kft, then descending with constant-altitude legs every 4k feet. No time server lock. Both PCASPs were operated (power cycled several times early on to get them to respond), so deice was off for the Rosemount temperature element for the entire flight.

Crew: Sigel, Plummer, Robinson; LOD: Little.

Flight Summary:

UTC Comment

1941 Wheels up. Heading out at ~8400'.

1945 IBR PCASP responding, but very spikey.

1946-2008 Ascending to 28 kft.

2011 Begin descent, will step down in 4000' increments.

201530 Beginning two minute pass at 24 kft, then descending to 20 kft.

202110 Beginning two minute pass at 20 kft, then descending to 16 kft.

2024 Cloud base is near 16 kft, so this pass will be 1000' lower.

203100 Two minute pass at 15 kft, then descending to 12 kft.

203730 Two minute pass at 12 kft, then turn and descend to 8 kft.

204410 Two minute pass at 8 kft, then head home.

2049 On the ground.



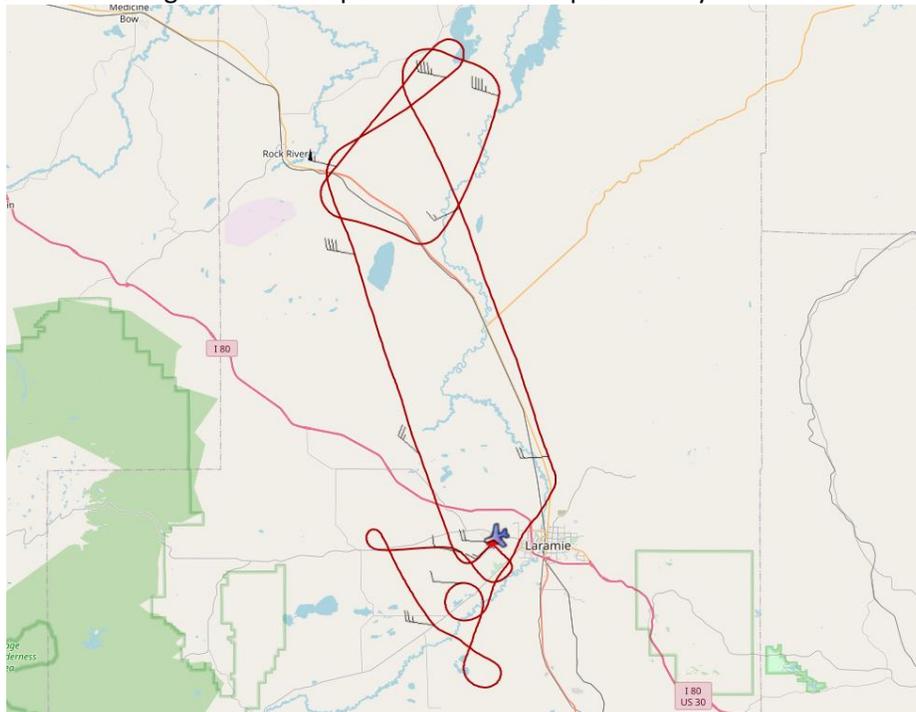
7/9/21 TRANS-2AM Pilot notes (Test Flight 1)

Crew: Wadsworth, Plummer, Roscioli. LOD = Glover.

Flight Time: 1.0

Planned: From KLAR to MBW. Climb to FL280, with delays for 30 seconds every 5k'. At FL280, S&L for 1 minute. Spiral down to middle of BL. Climb to 16,000' MSL. Do pitch, yaw & speed changes. RTB.

Actual: Flew as-planned although could not spiral down as planned. Clouds were building up around us and there was traffic below, so we descended on a heading. Otherwise, went well. Shorter flight than PI's anticipated which was good as the airport was unable to provide any fuel.



Project: TRANS²Am-21

9 Jul 2021

Flight: TF01

Notes:

Flight focused around general testing for facility systems and calibration for trace gas instruments during a series of vertical profiles and maneuvers to vary pitch, yaw, and acceleration separately. Performed a test of the Rosemount temperature sensor with and without deice power midway through the flight, and operated both PCASPs side-by-side for the latter half of the flight.

Crew: Wadsworth, Plummer, Roscioli; LOD: Glover.

Flight Summary:

UTC Comment

1743 Short pressurization test on the ground.

1746 Wheels up, profiling up to 28 kft interspersed with 30-second straight-and-level steps along the way. Rosemount temperature deice off initially.

1748 Rosemount deice heat on.

1751 Short level leg at 12 kft.

1755 Short level leg at 17 kft.

175930 Short level leg at 23 kft.

180545 Beginning one minute of straight-and-level at 28 kft, followed by descent to 16 kft for boundary layer sampling.

1810 Beginning more of a spiral descent, maneuvering was initially limited due to clouds in the vicinity.

181330 In straight-and-level at 16 kft, deice off for Rosemount temperature.

181430 PCASPs turned on, beginning two sets of porpoising maneuvers.

1817 Pulling throttles back for two sets of acceleration maneuvers.

1821 Beginning two sets of yaw maneuvers.

1823 Spiral descending profile.

183115 Beginning a short straight-and-level leg at 1000' AGL.

1837 On the ground.