

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 is the second phase of the project, comprised of flights taking place from August-September 2022. [Click here](#) to access the facility webpage for the 2021 phase of the project.

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

| Date | Flight # (*kml) | Status | Times (UTC) | Hours | Crew/Notes |
|----------------|--------------------|--|----------------|-------|--|
| 02 Sep 2022 | RF23 | Research flight sampling sites south of Greeley. | 1537- 1821 | 2.9 | Ed Sigel Anna Robertson Megan McCabe |
| 30 Aug 2022 | RF22 | Research flight sampling Yuma facilities. Dewpoint measurements and derived moisture | 1740- 2117 | 3.7 | Ed Sigel Coltin Grasmick Megan |

Order
TRANS²Am
Data

User Information

- [Planning Chart](#)
- [EOL Facilities](#)
- [Software
Repository](#)
- [Projects & Data
Requests](#)
- [Planning and
tracking tools](#)
- [Facility User's
Guide](#)

Facility
Instruments

| | | | | | |
|-------------|------|--|-----------|-----|---|
| | | parameters operational again. | | | McCabe |
| 29 Aug 2022 | RF21 | Research flight along upslope profile. Dewpoint hygrometer measurements and derived moisture-related parameters invalid. | 1909-2223 | 3.3 | Ed Sigel Coltin Grasmick En Li |
| 23 Aug 2022 | RF20 | Research flight along satellite underpass profile. Air temperature and related derived parameters unavailable prior to ~1856 UTC. Note: this is a USDA flight using 2.1 out of 13 research hours from USDA allotment, 10.9 flight hours remaining. | 1849-2103 | 0.0 | Tom Drew Anna Robertson Megan McCabe |
| 21 Aug 2022 | RF19 | Research flight sampling Yuma facilities. KT1585 sensor returned to operation. | 1802-2141 | 3.6 | Tom Drew Coltin Grasmick Julieta Juncosa Calahorrano |
| 19 Aug 2022 | RF18 | Research flight using upslope profile. No KT1585 data available. | 1735-2057 | 3.3 | Tom Drew Coltin Grasmick Amy Sullivan |
| 18 Aug 2022 | RF17 | Research flight targeting facilities near Fort Morgan. No KT1585 | 1801-2138 | 3.7 | Tom Drew Anna Robertson Megan |

- In Situ
- Wyoming Cloud Radar
- Wyoming Cloud Lidar

Contact

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Jeff French



| | | | | | |
|---------------------|------|--|-----------|-----|---|
| | | data available. | | | McCabe |
| 17 Aug 2022 | RF16 | Research flight on upslope profile. No KT1585 data available. | 1917-2240 | 3.5 | Tom Drew Anna Robertson Amy Sullivan |
| 16 Aug 2022 | RF15 | Research flight sampling facilities near Sterling. KT1585 sensor lost connection - no data available. HADS A&B static pressure reporting erroneous values. Note: the Weston pressure measurements will be used as the primary static pressure measurement used for all dependent parameters from this flight onward. | 1819-2143 | 3.5 | Tom Drew Anna Robertson Julieta Juncosa Calahorrano |
| | | | | | |
| Test Flights | | | | | |
| 12 August 2022 | TF06 | Test flight over Laramie Valley, wind calibration maneuvers completed. | 1540-1607 | 0.6 | Tom Drew Coltin Grasmick Anna Robertson |
| 10 August | | Test flight over Laramie Valley. Serial connection issues for CPT-6140/9000 and | 2009- | | Ed Sigel Anna |

| | | | | | |
|--------------|------|--|---------------------|-----|-------------------------------|
| 2022 | TF05 | radiometric measurements, no cabin pressure or Rogers inlet flow measurements. | 2053 | 0.7 | Robertson Ilana Pollack |
| Flight Hours | | As of Sep 02, 2022, 27.5 out of 53 research hours were flown, 25.5 remain. | Test and Ferry: 1.3 | | |

TRANS²-Am 2022 project summary

The Transport and Transformation of Ammonia (TRANS²-Am) campaign was focused on sampling emissions (primarily methane, ethane, and ammonia) associated with intensive animal farming operations in Colorado. In addition to instrumentation supported by the King Air facility, many of the air chemistry and aerosol measurements for this campaign were designed around multiple user-supplied instruments, including an Aerodyne Ethane Trace Gas Monitor, a Picarro G2401-m gas analyzer, Aerodyne nitric acid and ammonia analyzers, and a Particle-into-Liquid Sampler.

The project took place in both 2021 and 2022. The 2022 portion continued with the same general locations and procedures as TRANS²Am-21. The project was based out of Laramie, WY, with 9 research flights taking place from 16 August - 2 September 2022. The flights took place over north-central to northeastern Colorado, with two primary types of research flight profiles used. Most flights profiled emissions sampling directly around agricultural sites in this area. Several flights followed an alternate profile, performing vertically stacked north-south legs spaced from west to east to track emissions transport in upslope wind conditions.

The UWKA facility webpage for the project, including general flight summaries and detailed flight notes, can be found here: <http://flights.uwyo.edu/projects/trans2am22/>

Instrumentation:

Facility instrumentation:

Data from the following University of Wyoming instruments are included in this dataset.

- Applanix AV 410 GPS/Inertial Measurement Unit

- Reverse-flow static air temperature

- Rosemount 102 static air temperature

- Heitronics KT1585 IR temperature

- EdgeTech Vigilant model 137 chilled mirror hygrometer

- Rosemount 1501 HADS static air pressure (*see data quality note below*)

- Weston static air pressure

- CPT-6140 static air pressure

- CPT-9000 static air pressure

- Rosemount 1332 cabin air pressure

- Rosemount 0858 for indicated airspeed, angle of attack, and sideslip angle to derive winds

- Co-pilot indicated airspeed

- King KRA 405 Radar Altitude (to 2000 ft)

- DMT Passive Cavity Aerosol Spectrometer Probe (PCASP-100X)

Further information on the King Air instrumentation, along with a summary list of variables in processed UWKA flight-level data, can be found at: <https://www.uwyo.edu/atsc/uwka/in-situ-instrumentation.html>

Instrument Notes:

Applanix: The Applanix IMU/GPS measurements and associated parameters (aircraft location and attitude, three-dimensional winds) were post-processed following the project using updated values for the instrument's installed location within the cabin, and using reference measurements obtained during calibration maneuvers during the CHACHA-22 field deployment.

Static pressure: The HADS static pressure sensor is typically used for the base measurement pressure measurement and for all dependent parameters. However, this sensor module failed at the start of the 2022 research operations, so the Mensor CPT 6140 static pressure sensor is used as the base measurement for these flights.

Radiation: The Heitronics KT 15.85 surface temperature probe was not functioning correctly for several flights; measurements are unavailable for 17, 18, and 19 August 2022.

Moisture: The chilled mirror hygrometer was not functioning correctly during one flight; dewpoint and derived moisture parameters are unavailable for 29 August 2022.

PCASP: Two PCASPs were operated during TRANS²Am-22, installed on the inboard right and outboard right instrument pylon positions. Variable names in the processed data files are appended with `_IBR` and `_OBR`, respectively. The primary PCASP for the project was the inboard right, serial no. 1013-0502-29, with the secondary being the outboard right, serial no. 39798-0200-26.

Based on post-project analysis, the 5th size channel was removed from the primary PCASP size distribution in the processed dataset. This is because of an overlap between the high- and mid-gain amplifier stages, causing double-counting of particles. The overlap is discussed in Section 3.4 of Cai et al. (2013). This reduces the number of channels from 30 to 29. Removal of the 5th versus the 6th channel was arbitrary, the number concentration between the two bins was within 3%. The particle sizing table for this instrument following post-project analysis is included as separate documentation.

Additionally, analysis of the secondary PCASP indicated undersizing by up to two channels in the post-project calibrations as compared to the pre-project calibrations. With inadequate certainty regarding this instrument's sizing of aerosol particles during TRANS²Am-22, only total particle number concentrations are included in the processed dataset for this instrument.

Reference: Cai, Y., J.R.Snyder and P. Wechsler, 2013: Calibration of the passive cavity aerosol spectrometer probe for airborne determination of the size distribution, *Atmos. Meas. Tech.*, **6**, 2349-2358.

| Category | Instrument | Description, units | Variable name |
|---|--|---|---------------------------|
| Atmospheric State | | | |
| <i>Air Temperature</i> | Reverse-flow temperature sensor | Reference static air temperature, °C | trf |
| | Rosemount 102 temperature sensor | Secondary static air temperature, °C | trose |
| | <i>Derived parameter</i> | Potential temperature, K | thetad |
| <i>Atmospheric Moisture (Water Vapor)</i> | EdgeTech Vigilant model 137 chilled mirror hygrometer | Dewpoint temperature, °C | tdp |
| | <i>Derived parameters</i> | EdgeTech relative humidity, % | rh |
| | | EdgeTech equivalent potential temperature, K | thetae |
| | | EdgeTech water vapor mixing ratio, g/kg | mr |
| <i>Atmospheric Pressure</i> | Rosemount 1501 HADS static pressure sensor | Primary static air pressure (module A), hPa | ps_hads_a |
| | | Static air pressure (module B), hPa | ps_hads_b |
| | Weston static pressure sensor | Static air pressure, hPa | ps_weston |
| | CPT 6140 static pressure sensor | Static air pressure, hPa | ps_CPT6140 |
| | CPT 9000 static pressure sensor | Static air pressure, hPa | ps_CPT9000 |
| | <i>Diagnostic parameter</i> | CPT 9000 sensor temperature, °C | temp_CPT9000 |
| | Noseboom pitot | Static pressure correction calculation | dpa, dpb, dpr |
| <i>Wind Components</i> | Applanix AV 410 GPS/Inertial Measurement Unit (<i>see additional notes for Applanix parameters below under Aircraft State</i>) | u/v/w wind components (using AIAS), m/s | avuwind, avvwind, avwwind |
| | | Wind direction/magnitude (using AIAS), deg; m/s | avwinddir, avwindmag |

| | | | |
|--|--|---|-------------------------------|
| | | Longitudinal/lateral horizontal wind components, m/s | avux, avvy |
| <i>Photographic Imagery</i> | Forward and downward cameras | Photo imagery at 1-Hz, imagery may be stitched to flight track in .kml files upon request | |
| Aircraft state | | | |
| <i>Aircraft Position and Orientation</i> | Applanix AV 410 GPS/Inertial Measurement Unit | Ground velocity in E-W/N-S/up components, m/s | avewvel, avnsvel, avzvel |
| | | Ground speed, m/s | avgs |
| | | Roll/pitch/heading, deg | avroll, avpitch, avthead |
| | | Latitude/longitude, deg | avlat, avlon |
| | | Orthometric/ellipsoid altitude, m | avzmsl, avzell |
| | | Track angle, deg | avtrack |
| | | Roll/pitch/yaw angle rate, rad/s | avrollr, avpitchr, avyawr |
| | Body-axis longitudinal/lateral/vertical acceleration component, m/s ² | avlonga, avlata, avnorma | |
| | <i>Initial diagnostic parameters (realtime Applanix output)</i> | North/east/down position RMS, m | avnposrms/aveposrms/avdposrms |
| | | North/east/down velocity RMS, m/s | avnvelrms/avevelrms/avdvelrms |
| Roll/pitch/heading angle RMS, deg | | avrollrms/avpitchrms/avtheadrms | |
| <i>Post-processed measurements and diagnostic parameters</i> | Flight data are typically post-processed to incorporate high-precision satellite data available several days subsequent to each flight. With the exception of removing the real-time dilution of precision, the parameters above are replaced with a | | |

| | | | |
|-------------------------------|---|---|---------|
| | | higher-accuracy with the parameter names beginning with capitalized 'AV', for example <i>AVlat</i> rather than the original <i>avlat</i> . | |
| | | Attack angle (corrected), deg | alpha |
| | | Sideslip angle (corrected), deg | beta |
| <i>Airspeed</i> | | Reference indicated airspeed, m/s | aias |
| | Co-pilot pitot | Secondary indicated airspeed, m/s | bias |
| | | True airspeed, m/s | tas |
| | | Reference true airspeed, m/s | TASX |
| <i>Cabin Air Pressure</i> | Cabin air pressure sensor | Ambient cabin air pressure, hPa | cabinp |
| <i>Timekeeping Parameters</i> | | Seconds since start of project year | time |
| | | UTC time in HHMMSS | TIME |
| | | Date in YYYYMMDD | DATE |
| | | Hours from midnight (UTC) | HOUR |
| | | Minutes from beginning of HOUR | MINUTE |
| | | Seconds from beginning of MINUTE | SECONDS |
| <i>Radiation</i> | | | |
| | Heitronics KT 15.85 surface temperature probe | Surface temperature, °C | rstb2 |
| <i>Aerosols</i> | | | |
| | DMT Passive Cavity Aerosol Spectrometer Probe (PCASP-100X; two available) | <i>Aerosol Hydrometeor size distribution (0.1 – 3.0 μm diameter), total concentration; parameter names are appended with <u>_IBR</u> if the instrument was installed in the inboard right wing-tip canister and <u>_OBR</u> if in the outboard canister</i> | |

| | | | |
|---|------------------------------|---|-------|
| | | Particle count per size bin | AS200 |
| | | Particle concentration per size bin, #/cm ³ | CS200 |
| | | Total particle count | TCNTP |
| | | Total particle number concentration, #/ cm ³ | CONCP |
| | <i>Derived parameters</i> | Mean particle diameter, μm | DBARP |
| | | Particle surface area concentration, μm ² /cm ³ | PSFCP |
| | | Particle volume concentration, μm ³ /cm ³ | PVOLP |
| | | Particle size dispersion, unitless | DISPP |
| | <i>Diagnostic parameters</i> | Sample flow rate, cm ³ /s | PFLW |
| | | Sample volume, cm ³ /s | PFLWC |
| Sheath flow rate, cm ³ /s PFLWS | | | |

Title: University of Wyoming King Air (UWKA) Low-Rate Flight Level Data from the 2022 Transport and Transformation of Ammonia (TRANS2Am) Project

Authors:

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Description:

The Transport and Transformation of Ammonia (TRANS2Am) campaign was focused on sampling emissions (primarily methane, ethane, and ammonia) associated with intensive animal farming operations in Colorado. This dataset contains the navigation and state parameter data measured by the UWKA during the research phase of TRANS2Am in August-September 2022.

- Version: 1.0 (2022-05-19) processing release tag trans2am22_qc1
- Status: Final
- Time period: 2022-08-16 18:19 to 2022-09-02 18:21
- Physical location: 40.0 to 41.3 degrees North latitude, -105.8 to -102.4 degrees East longitude
- Data frequency: 1 Hz
- Project web site: <http://flights.uwyo.edu/projects/trans2am22/>
- Data restrictions: none

Instruments:

- Aircraft position and attitude - Applanix AV-410
- Static Pressure - Rosemount HADS, Weston, CPT-6140, CPT-9000
- Air Temperature - Reverse Flow, Rosemount 102
- Air Flow - Rosemount 0858
- Water Vapor - Edgetech Vigilant 137

- Radar Altitude - King KRA 405B
- Cabin Pressure - Rosemount 1332
- Aerosol Sizes - PCASP SPP-100

Data Format:

- NCAR-RAF netCDF Conventions: <https://archive.eol.ucar.edu/raf/software/netCDF.html>

Remarks:

- Summary of each flight including instrument issues:
<http://flights.uwyo.edu/projects/trans2am22/>

The project consisted of nine research flights. As the project was a continuation of the 2021 phase of TRANS2Am, flight numbers continue sequentially from that phase and begin at RF15. Flight numbers are included in the file metadata. Files are named by UTC date, as YYYYMMDD.cX.nc, where X corresponds to the processed data rate in Hz.

GCMD Keywords:

Atmosphere, Aerosols, Aerosol Particle Properties, Air Quality, Emissions, Altitude, Barometric Altitude, Atmospheric Chemistry, Atmospheric Pressure, Static Pressure, Atmospheric Temperature, Upper Air Temperature, Atmospheric Water Vapor, Dew Point Temperature, Humidity, Atmospheric Winds, Upper Level Winds, Flight Level Winds

Primary Contact Information:

- UWKA Project Management: atsc-kapm@uwyo.edu

PCASP-1 (aka, the UWYO/IBR PCASP)

Cai et al. (2013) and Snider et al. (2017) explain how a PCASP is challenged with laboratory-generated monodisperse test particles. This was done before and after the TRANS²AM22 deployment. The Table has sizing derived using polystyrene latex test particles (refractive index = 1.59).

The table has upper-bound particle sizes for 29 channels. The lower bound for channel 1 is 0.09 micrometer. The aerosol sample flow rate calibration did not change significantly before-to-after the TRANS²AM-22 deployment.

Cai, Y., J.R.Snider and P. Wechsler, Calibration of the passive cavity aerosol spectrometer probe for airborne determination of the size distribution, *Atmos. Meas. Tech.*, 6, 2349-2358, 2013

Snider, J.R., D.Leon and Z.Wang, Droplet Concentration and Spectral Broadening in Southeast Pacific Stratocumulus, *J. Atmos. Sci.*, 74, 719-749, 2017

| Channel Number | Size Calibration |
|----------------|----------------------|
| | Diameter, micrometer |
| 1 | 0.10 |
| 2 | 0.11 |
| 3 | 0.12 |
| 4 | 0.13 |
| 6 | 0.14 |
| 7 | 0.15 |
| 8 | 0.16 |
| 9 | 0.17 |
| 10 | 0.19 |
| 11 | 0.21 |
| 12 | 0.23 |
| 13 | 0.25 |
| 14 | 0.27 |
| 15 | 0.29 |
| 16 | 0.45 |
| 17 | 0.55 |
| 18 | 0.65 |
| 19 | 0.75 |
| 20 | 0.85 |
| 21 | 0.95 |
| 22 | 1.05 |
| 23 | 1.25 |
| 24 | 1.45 |
| 25 | 1.65 |
| 26 | 1.85 |
| 27 | 2.05 |
| 28 | 2.35 |
| 29 | 2.65 |
| 30 | 3.05 |

 Channel 5 removed

08/29/2022

Pilot notes (Trans2 AM RF21)

Crew: Sigel, Grasmick and Li

Time: 3.3

Planned:

Take off From PABR, at 1300 Lc. Fly the up slope pattern at 1000agl on first legs and on the return leg fly at 1500agl. Repeat the third leg once.

Actual:

Departed at 13:10 this was my fault due to I was taking things slowly. Climbed to 11,500 and proceeded to the first way point. Descended to 1000 feet agl and flew the leg. Made a turn before crossing the way point and needed to reset the GPS. Denver had a few call outs for traffic. Rest of the legs went well until the last leg. We had traffic at our alt and it was not called out. I did not see the traffic and decided to turn since we were at the end of the leg anyway. Last leg was flown at 10,500 there is no way to terrain follow due to the height of the mountains. Came home

Aircraft:

The aircraft worked well. No wright ups. Apparently the Hobbs meter does not work.

Things Learned:

- **It was hot and got hotter as we went through the day.**



They



08/23/22 Pilot notes (TRANS2AM RF 20)

Crew: Drew, McCade, Robertson

Flight Time: 2.1 (Hobbs 1.6)

Planned: Stay low and ferry to first set of transects. Fly them at 1000 ft. AGL. Ferry to second set NW of Greeley and fly those transects at 1000 ft. AGL. Ferry to third set of transects south of Greeley and fly those transects at 1300 ft. AGL. Do a spiral sounding NW of Greeley and ferry to Laramie. Do a spiral sounding down SE of Laramie.

Actual: Climbed to 3000 AGL leaving Laramie to the SE and at the summit maintained 1000 ft. AGL. to first set of transects SW of Cheyenne. Flew those at approximately 1000 ft. AGL (slight slope up to the west). Maintained 1000 ft. AGL to next set of transects. Flew them at 1000 ft. AGL. Then climbed to 1300 ft. AGL for last set of transects (south of Greeley). Flew just east of Eaton and starting at 500 ft. AGL climbed in a spiral to 13,500 ft. MSL. Then descended to 12,500 for transit to Laramie. Deviated around a storm southeast of Laramie. Climbed to 13,500 ft. MSL and spiraled down at 1000 fpm to 500 ft. AGL. and returned to Laramie.

23 August 2022

RF20 System Scientist Notes

Crew: Tom Drew, Anna Robertson, Megan McCabe

Objective:

Satellite overpass flight with two spirals to characterize boundary layer

Instrument notes:

TRF and TROSE breakers were pulled so values are wrong for first ~8 minutes of flight

Flight notes:

1849 Wheels up

1903 starting first set of zig zags, 1000 ft agl

1912 Sat com down again

1914 end set

1919 starting second set of zig zags, 1000 ft agl

1932 end second set

1940 starting 3rd set of zig zags, 1300 ft

2020 end 3rd set

2025 descending to 500 ft agl for spiral

2026 starting spiral

- BL hgt around 13000 ft amsl

2034 descending back to 12500 ft amsl for the transit back

2048 a few drops of rain on windshield

2049 climbing for spiral down. Climbed just below cloud base ~ 14.4k ft amsl

2051 starting spiral down

2057 end spiral at 500 ft agl (7.8k ft amsl)

08/21/22 Pilot notes (TRANS2AM RF 19)

Crew: Drew, Calahorrano, Grasmick

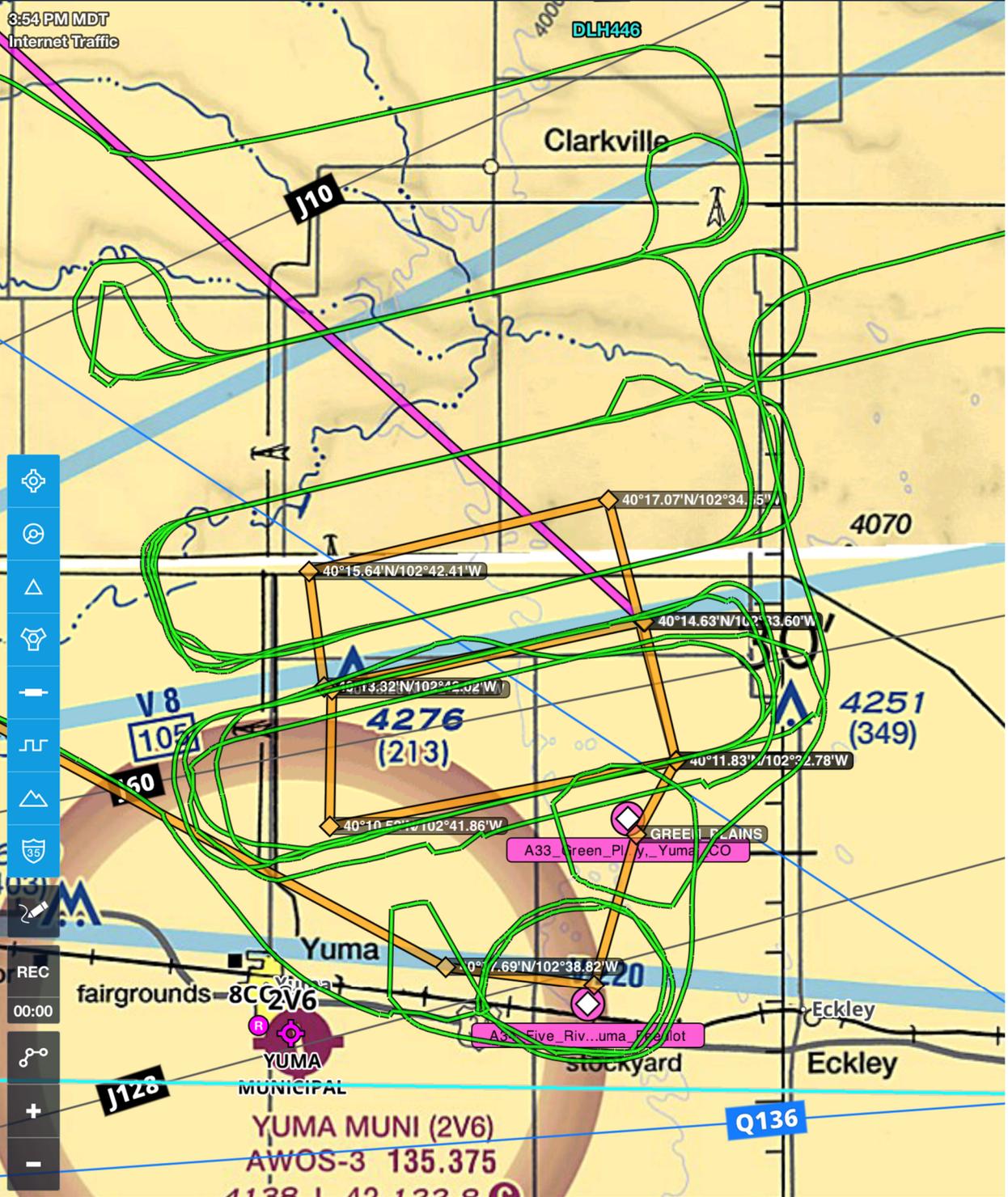
Flight Time: 3.6

Planned: Ferry to Dairy, and the feedlots (A34, A33, and Dairy) west of Yuma, CO. Fly 1000 ft. and 500 ft. circles around each facility. Then fly one box pattern at (4.5, 8 nm) 600, 1200 ft., 2400 ft. 5000 ft. AGL then the second box pattern further downwind at (8, 10 nm) 600, 1200, 1800, 2600 ft. AGL.

Actual: Climbed to 13,500 ft. MSL leaving Laramie, but then climbed to 15,500 ft. MSL enroute to clear cloud tops. Descended ~1000 fpm to 1000 ft. AGL before first facility. Approached the facility (Dairy Farm) from the southeast (windward side) Orbited facility at 1000 ft. and then 500 ft. Then orbited A34 (Five Rivers) at 1000/500 ft. then A33 (Green Plains) at 1000/500. Set up first box pattern for left turns. Did not need to adjust the box pattern for wind, it was good at 340/160 wind axis with legs 070/250 at 4, 7.5 nm, but because it was a little close moved it ½ nm to 4.5 and 8 nm. Made the other box at 9, and 11 nm. Flew the boxes at constant MSL Altitudes approximately 600, 1200, 2400, and 5000 ft. AGL.

Did Pills change on NE side before starting second box. Flew second box at 9, and 12 nm. Flew the boxes at constant MSL Altitudes approximately 5000, 2400, 1200, 600 ft. AGL.

Added another single line at 14 nm. and made 90/270 and altitude changes on each end 600, 1200, 2400, 5000. Because we were not far below the clouds at 9100 MSL (5000 AGL) and couldn't really go up much more, decided to make the last line at 16 nm and stayed at 9100 MSL. Started toward Laramie, after finding a break in the clouds made the sounding to 12,000 MSL and descended to 10,500 MSL for the remainder of the ferry. Made small deviation around weather near Cheyenne.



- Home
- Layers
- Waypoints
- Planes
- Routes
- Map Style
- Map Scale
- Map Orientation
- REC 00:00
- Waypoints
- Map Scale
- Map Orientation

08/19/22 Pilot notes (TRANS2AM RF 18)

Crew: Drew, Sullivan, Grasmick

Flight Time: 3.3

Planned: Upslope flight plan. Four N-S legs flown east to west at 1000 ft. AGL Southbound and 1500 ft. Northbound. Average MSL altitudes especially on Legs 3 and 4.

Actual: Climbed to 13,500 ft. MSL leaving Laramie to north point on line 1. Flew line 1, but on the north leg of line 2 encountered traffic and had to break off the line. Returned to the line once traffic was clear. Tried to follow the terrain a little closer. Repeated line 3 three times due to weather over line 4. Delayed for 5 minutes for Pills Change at north end of line 3.

Revised MSL altitudes from last time are below:

Line 1 – 1000/1500

North end: 6000/6500 MSL,

Middle: 5700/6200, (5 Rivers)

South end 6100/6600

Line 2 – 1000/1500

North end – 6600/7000 MSL,

6400/6900

6300/6800

6000/6500

5900/6400

South end 5900/6400

Line 3 - 1000/1500

North end – 7400/8000 MSL,

7100/

7600/

7000

6600/7100

6800/7300 (over lake)

7000/

6800/

6400/6900

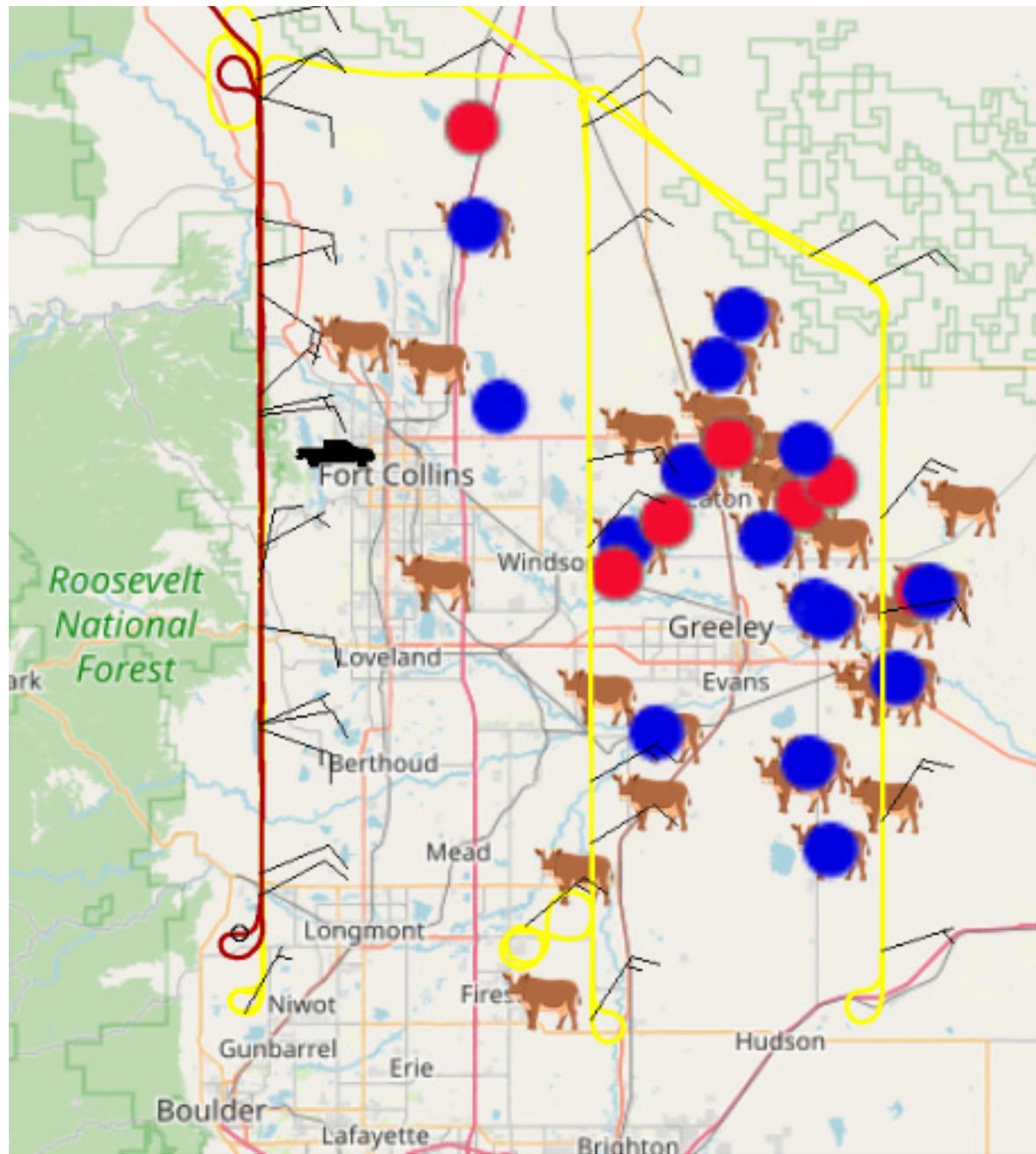
6200/6700 South end

Notes for lines:

Line 1 – watch Greeley pattern traffic and Skydivers south, lots of student training

Line 2 – Watch Greeley and Northern Co airport, Skydivers and big towers on the west side of south end

Line 3 Higher terrain on north end, lower on south end opens up to Boulder area. It is just behind horse tooth peak over the lakes. Lots of traffic in Longmont and north of Boulder. Skydive ops in Longmont. Glider ops along ridges on south end.



08/18/22 Pilot notes (TRANS2AM RF 17)

Crew: Drew, McCabe, Robertson

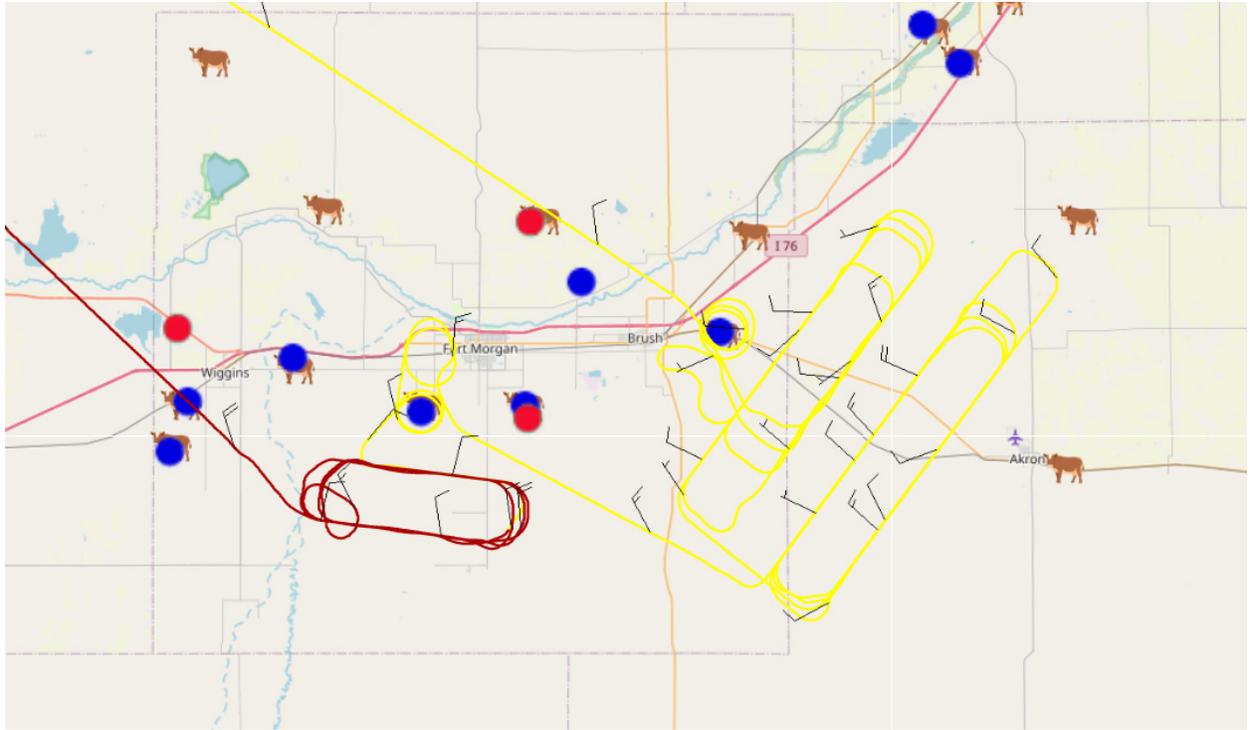
Flight Time: 3.7

Planned: Ferry to feedlots (A26, A23) south of Ft. Morgan, CO. Fly 1000 ft. and 500 ft. circles around each facility. Then fly one box pattern at 500, 1000 ft., 1800 ft. 2600 ft. AGL then the second box pattern further downwind at 500, 1000, 1800, 2600 ft. AGL.

Actual: Climbed to 15,500 ft. MSL leaving Laramie, but then climbed to 16,500 ft. MSL enroute to clear the boundary layer. Descended ~1000 fpm to 1000 ft. AGL before first facility. Approached the facility from the northwest (windward side) Orbited facility at 1000 ft. and then 500 ft. Then set up first box pattern. We adjusted the box pattern 90 degrees to the wind. Settled on 120 wind axis with legs 030/210 at 3, 6, and another box at 9, and 12 nm. Flew the boxes at constant MSL Altitudes approximately 600, 1200, 2400, and 5000 ft. AGL.

Flew second box at 9, and 12 nm. Flew the boxes at constant MSL Altitudes approximately 5000, 2400, 1200, 600 ft. AGL.

Did Pills Change before orbiting north of second facility then approached the facility from the north (windward side) Orbited facility at 1000 ft. and then 500 ft. Then set up first box pattern. We adjusted the box pattern 90 degrees to the wind. Settled on 180 wind axis with legs 090/270 at 3. Flew the boxes at constant MSL Altitudes approximately 600, 1200, 2400, and 5000 ft. AGL. Climbed up to 16,500 MSL for the transit back.



08/17/22 Pilot notes (TRANS2AM RF 16)

Crew: Drew, Sullivan, Robertson

Flight Time: 3.5

Planned: Upslope flight plan. Four N-S legs flown east to west at 1000 ft. AGL Southbound and 2000 ft. Northbound. Average MSL altitudes especially on Legs 3 and 4.

Actual: Climbed to 13,500 ft. MSL leaving Laramie to north point on line 1. Flew the pattern but repeated line 3. Delayed for 10 minutes for Pills Change at north end of line 3.

The terrain is surprisingly bowl shaped to the river bottom in the middle for first two legs. Terrain on 2nd two. My flight written notes are a little hard to read so the altitudes below need to be verified and adjusted.

Line 1 – 1000/2000 is North end – 5800/6800 MSL, Middle: 5000/6000, south end 5700/6700

Line 2 – 1000/1500 is North end – 5700/6700 MSL, Middle: 5000/5700, south end 5700/6300

Line 3 - 1000/1500 is North end – 7600/8100 MSL, Middle 8000/8500, South end 6600/7000

Line 4 – Lowest practical (1000/1500) is North end – 9000/9500 MSL, 11,000 MSL, 10,400 MSL and south end 10000 MSL

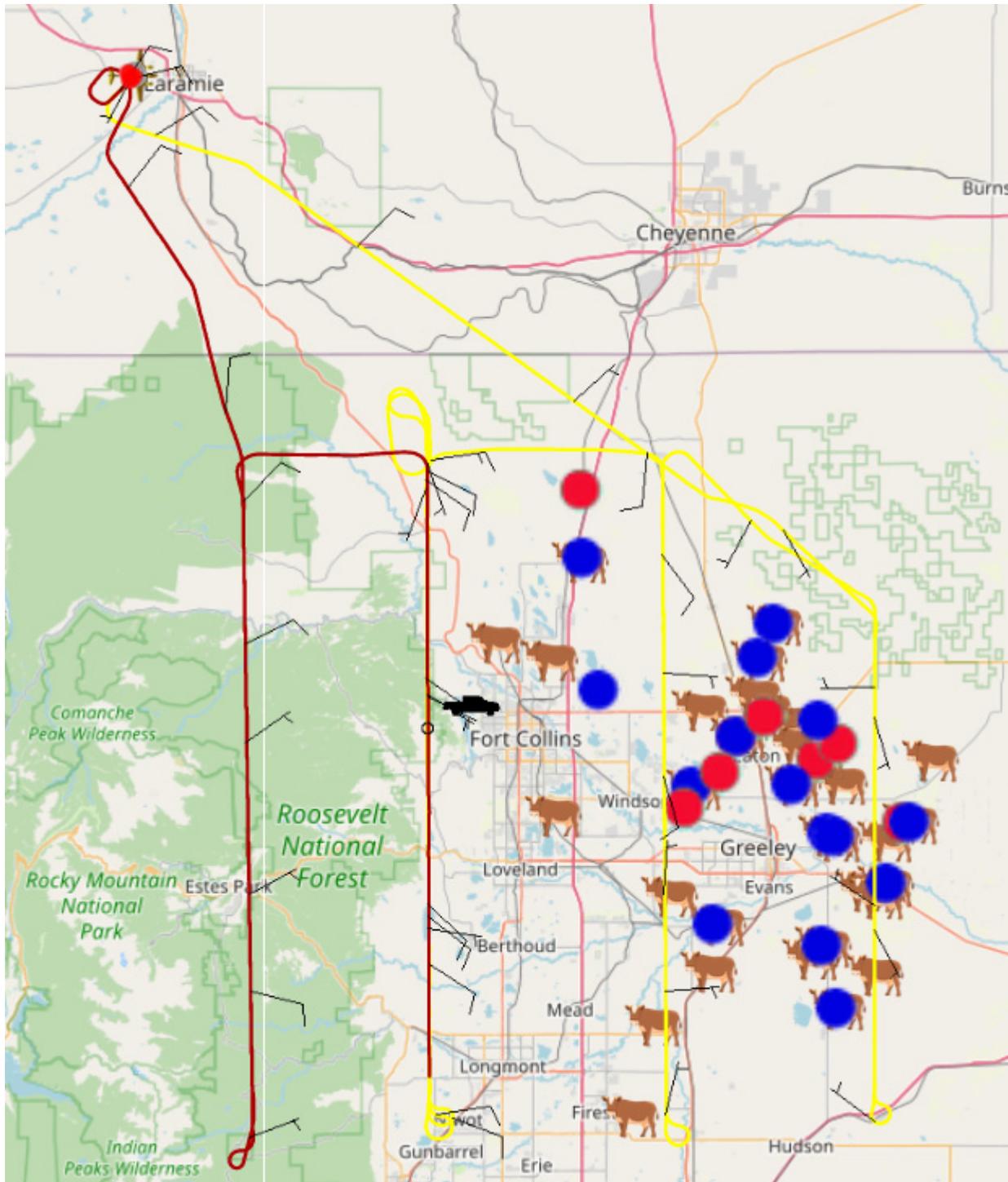
Notes for lines:

Line 1 – watch Greeley pattern traffic and Skydivers south, lots of student training

Line 2 – Watch Greeley and Northern Co airport, Skydivers and big towers on the west side of south end

Line 3 Higher terrain on north end, lower on south end opens up to boulder area. It is just behind horse tooth peak over the lakes. Lots of traffic in Longmont on south end

Line 4: Southbound on north end climbing into rising terrain, so have to climb early on the north end. 11000 ft. MSL clears the saddle and can descend over Estes Park down to about 10400 MSL. Crossing next ridge can descend to 10,000. Northbound 10,000 ft. MSL is fine until about Estes Park when you need to start climbing early for the ridge to the north at 11,000 ft. MSL. Once crossing that ridge can descend to 9000 ft. MSL for the north end.



08/16/22 Pilot notes (TRANS2AM RF 15)

Crew: Drew, Calahorrano, Robertson

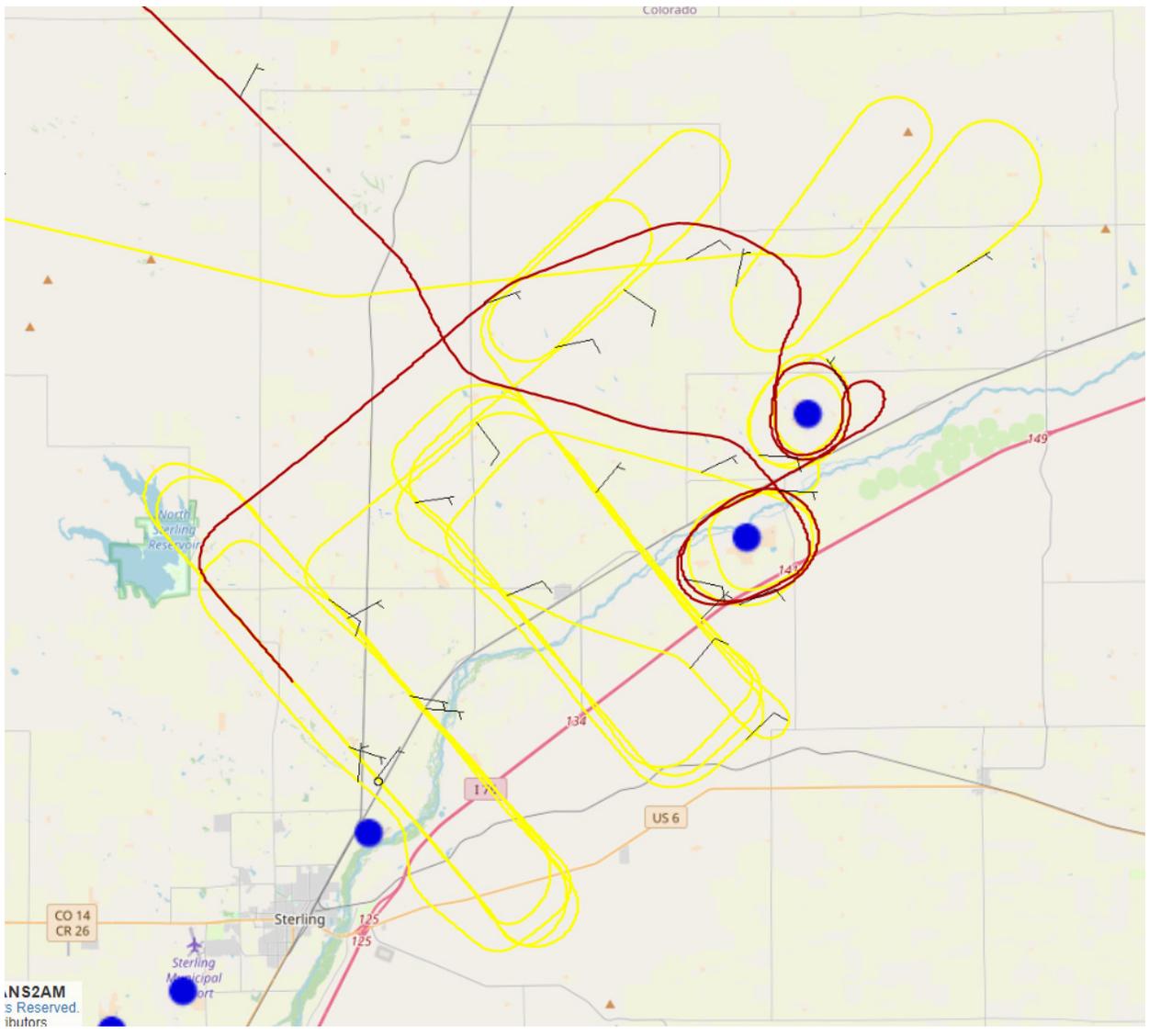
Flight Time: 3.5

Planned: Ferry to feedlots (A30, A31) north of Sterling, CO. Fly 1000 ft. and 500 ft. circles around each facility. Then fly one box pattern at 500, 1000 ft., 1800 ft. 2600 ft. AGL then the second box pattern further downwind at 500, 1000, 1800, 2600 ft. AGL.

Actual: Climbed to 13,500 ft. MSL leaving Laramie, but then climbed to 15,500 ft. MSL enroute to clear clouds. Descended ~1000 fpm to 1000 ft. AGL before first facility. Delayed in holding pattern to make sure data system was working for two turns. Approached the facility from the northeast (windward side) Orbited facility at 1000 ft. and then 500 ft. A small feedlot was just SW of main lot, so extended to include the smaller lot. However, we did go between them on one pass. Approached the second larger feedlot (A31) from NE and flew 1000 ft. and 500 ft. circles around it. It also had a smaller feedlot on the SW side so included that lot in the circle. However, later on we did pass between the lots.

Then set up first box pattern. We adjusted the box pattern 90 degrees to the wind after a little bit of trial and error. Settled on 222 wind axis with legs 312/132 at 3, 6, and another box at 9, and 12 nm. Flew the boxes at constant MSL Altitudes approximately 500, 1000, 1800, and 2600 ft. AGL. Surprising variation in terrain. SW leg of second box was directly over Mitchek Cattle (A40) so we moved the line 1 nm NE (11 nm from lot). Flew second box at 500, 1000, 1800, 2600 ft. AGL. Extended west on a few legs over the reservoir before turning.

Flew upwind of the facilities and again circled both at 1000 ft. and 500 ft. Then returned to Laramie deviating slightly north to clear clouds on the climb to 14,500 ft. MSL. Dropped back below cloud deck to 10,500 ft. MSL and then descended for Laramie.



16 August 2022

RF15 System Scientist notes

Crew: Tom Drew, Anna Robertson, Julieta Juncosa Calahorrano

Objective: Sample D&D and Dinklage feedlots. Do 2 large boxes around area at various heights (but below cloud).

Instruments: Static pressure not good (hadsa, hadsb), Temp9000 reading 44C, Kt1585 lost its serial connection again. NTP on ammonia, both zero air bottles will need to be replaced.

Flight Notes:

1819 wheels up

1821 running manual balance on hygrometer, dewpoint was erroneously high

- seems more accurate after the balance

1831 ascending to 15.5k ft to stay out of cloud

1843 starting descent

1905 1000 ft spiral around D&D

- winds light and variable, but seeing good plume signature

1908 descending to 500 ft

1912 heading to Dinklage, ascending to 1000 ft

1916 descending to 500 ft, flying between dinklage and nearby facility for next downwind transect

1919 setting up for first box at 500 ft

1923 turned boom heat off, was up to 70C

1929 ascending to 1000 for 2nd rectangle

1938 climbing to 1800 ft

1947 climbing to 2600 ft (approx)

2003 descending to 500 ft, setting up for 2nd box

2022 climbing to 1000 ft

2027 climbing to 1800 ft

2037 climbing to 2600 ft

2040-2042 adjusting altitude - radar alt only goes up to about 2300 ft and our first height approximation was too high

2046 descending to 1000 ft, heading back to D&D to resample

2055 descending to 500 ft

2057 ascending to 1000 ft, heading to dinklage to resample

2101 descending to 500 ft

2104 starting transect home

2121 descending to dip below clouds

2141 Gast pump off

2143 wheels down

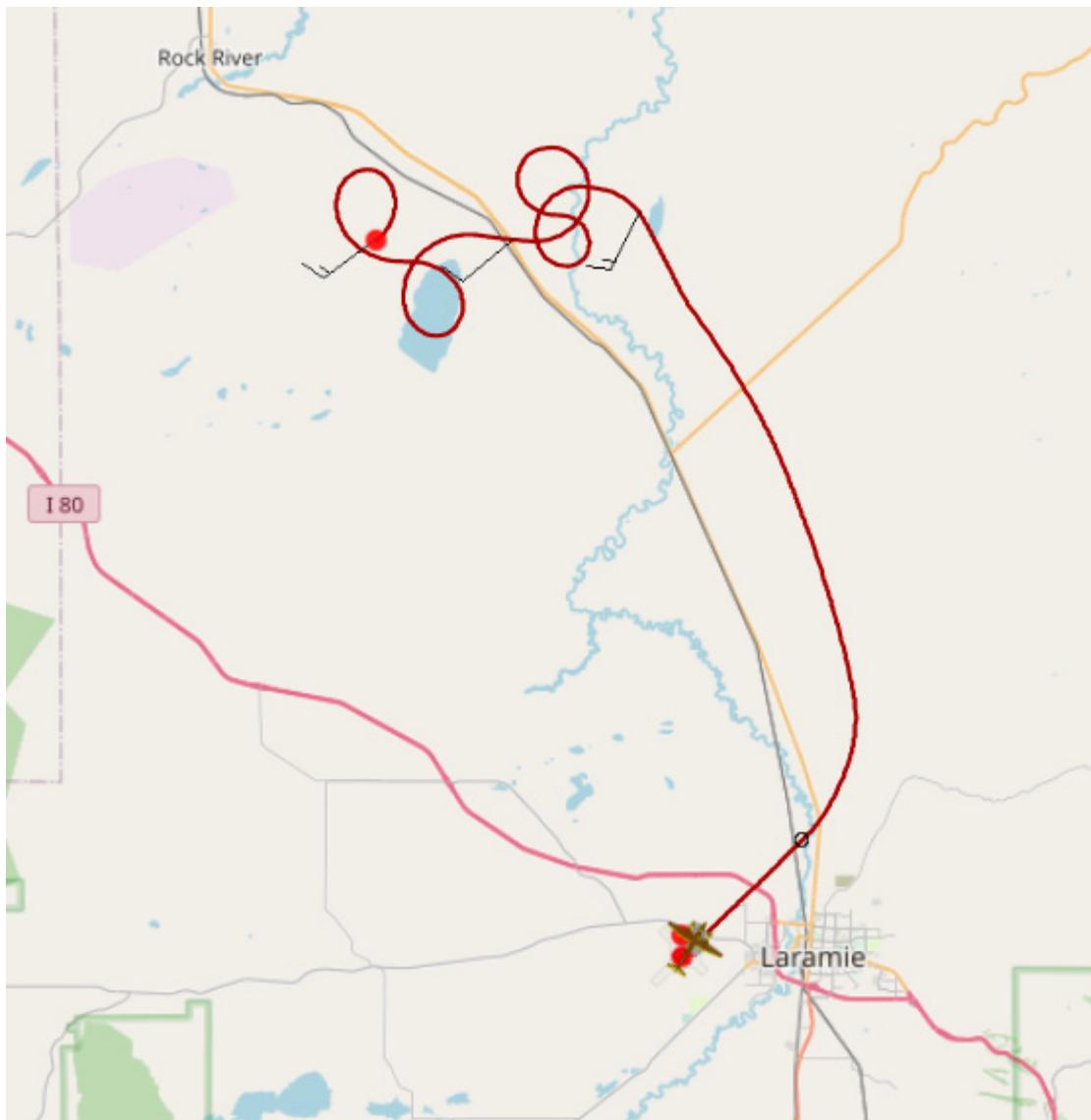
08/12/22 Pilot notes (TRANS2AM TF 6)

Crew: Drew, Grasmick, Robertson

Flight Time: .6

Planned: Climb to smooth air, do wind calibration maneuvers and return, keeping flight time minimal.

Actual: Climbed to 16,500 ft. MSL to about 18 nm NW of Laramie. Did the maneuvers and returned on RW 21.



08/10/2022 Pilot notes (Trans Am test flight 5)

Crew: Sigel, Robertson, Pollack Flight Time: .7

Planned: Depart to the west climb to 5000 then 1 min strait and then 10,000 strait and then to 17,500 strait. Spiral down to 12,500 for maneuvers. Do a 90/270 and then accelerate and decelerate and porpoise. Find boundary layer and return.

Actual: Departed Laramie to west off 21. Climbed to 10,000 then 12,000 for a minute and the 13,000 for a minute turned north to find clear skies and climbed to 16,000. 17,500 would not get us out of the cloud layer. We descended down to 12,500 preformed the 90/270 the excel and decel maneuvers and porpoise. Went back to Laramie and landed on Rwy 12. It was HOT and bumpy!

Aircraft flew well no problems or squawks.