

Chequamegon Heterogeneous Ecosystem Energy-balance Study Enabled by a High-density Extensive Array of Detectors (CHEESEHEAD)  
University of Wyoming King Air Research

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## Summary

CHEESEHEAD is a three-month experiment to intensively sample and scale surface energy balance, Planetary Boundary Layer response, and Large Eddy Simulation model parameterizations in a 10x10 km heterogeneous vegetated region (Chequamegon Forest) in Northern Wisconsin. The experiment will be held from summer through early fall 2019, as the region switches from homogenous transpiration-dominated to heterogeneous, sensible heat-dominated surface energy forcing. The UW King Air will be deployed in three short intensive operations periods spaced throughout this three month period.

## Links

- [UW-Madison CHEESEHEAD project website](#)
- [EOL project website](#)
- [Quicklooks of zenith lidar measurements](#)
- [Articles and interviews - Wisconsin Public Radio](#)
- [CHEESEHEAD domain and obstacles KMZ](#)
-  [UWKA flight planning and tracking tools](#)
- [Convert Google Earth points to way points](#)

Date	Flight # (*.kml)	Status	Times (UTC)	Hours	Crew/Notes
		Second flight of the day. WE1 pattern.			B Wadsworth

## Order CHEESEHEAD Data

- [King Air 1 Hz files](#)
- [King Air high rate 25 Hz files](#)
- [Zenith Cloud Lidar L0 initial processed files](#)
- [Zenith Cloud Lidar L1 files](#)

## User Information

- [Planning Chart](#)
- [EOL Facilities](#)
- [Software Repository](#)
- [Projects & Data Requests](#)
- [Planning and](#)

28 Sep 2019	RF24	Decreasing shallow cumulus field with some high clouds early in flight.	1850-2151	3.1	J Thom D Plummer M Deng
28 Sep 2019	RF23	First flight of the day. WE1 pattern with extra pass at 4500' and descent along leg for CRL. Scattered cumulus with bases to intended flight level, higher-altitude passes moved to 2500' MSL.	1413-1731	3.3	B Wadsworth J Thom D Plummer M Deng
26 Sep 2019	RF22	Second flight of the day. SE1 pattern with two subsequent passes at 4600' MSL over central domain. Widespread cumulus field with bases above flight level, increasing high-level clouds.	1831-2140	3.3	B Wadsworth B Butterworth D Plummer
26 Sep 2019	RF21	First flight of the day. SE1 pattern.	1352-1646	3.0	B Wadsworth B Butterworth D Plummer M Deng
25 Sep 2019	RF20	Second flight of the day. SW1 pattern with legs 17 and 19 ended early to avoid precipitation.	1912-2206	3.0	B Wadsworth A Desai D Plummer
25 Sep 2019	RF19	First flight of the day. SW1 pattern.	1420-1722	3.1	B Wadsworth A Desai D Plummer M Deng
		Second flight of the day. SE1 pattern.			B Wadsworth

#### tracking tools

-  Facility User's Guide

## Facility Instruments

-  In Situ
-  Wyoming Cloud Radar
-  Wyoming Cloud Lidar

## Contact

Mailing Address:

**Atmospheric Science  
University of Wyoming  
College of Engineering  
1000 E. University Ave.  
Laramie, WY 82071  
Phone:(307)766-3245  
Fax: (307)766-2635**

Facility Manager:

**Jeff French**



24 Sep 2019	RF18	Deepened boundary layer and high cloud cover compared to morning flight.	1858-2149	3.0	A Desai D Plummer M Deng
24 Sep 2019	RF17	First flight of the day. SE1 pattern. SSE winds at 300' AGL becoming more westerly at 1300'. Flew an extra leg at 4500' MSL and descent to minimum for CRL following pattern.	1338-1701	3.4	B Wadsworth A Desai D Plummer M Deng
23 Aug 2019	RF16	Second flight of the day. WE2 pattern. Light winds from the east and clear. <b>Edgetech chilled mirror hygrometer did not work for this or subsequent research flights.</b>	1906-2203	3.1	T Drew A Desai L Oolman S Onkley
23 Aug 2019	RF15	First flight of the day. WE2 pattern. Light winds from the east and clear	1356-1657	3.1	T Drew A Desai L Oolman J Mineau
22 Aug 2019	RF14	Second flight of the day. SW2 pattern. NE winds and overcast.	1900-2200	3.1	T Drew J Thom L Oolman L Mikula
22 Aug 2019	RF13	First flight of the day. SW2 pattern. NE winds and overcast.	1357-1714	3.3	T Drew J Thom L Oolman L Mikula
21 Aug 2019	RF12	Second flight of the day. SW1 pattern.	1855-2150	3.1	T Drew B Butterworth L Oolman

21 Aug 2019	RF11	First flight of the day. SW1 pattern.	1912-2222	3.0	T Drew B Butterworth L Oolman Z Wang
20 Aug 2019	RF10	Second flight of the day. SE1 pattern. The flight was delayed slightly to give the showers time to move out of the area. Did a couple higher legs at the end of the mission to better characterize the CRL overlap function.	1912-2222	3.2	T Drew A Desai L Oolman Z Wang
20 Aug 2019	RF09	First flight of the day. SE1 pattern. A couple of the lines were shortened to avoid rain showers.	1340-1623	2.8	T Drew A Desai L Oolman Z Wang
13 Jul 2019	RF08	Second flight of day, SW01 pattern.	1856-2130	2.8	E Sigel A Desai D Plummer S Baleri
13 Jul 2019	RF07	First flight of day, SE012 pattern.	1405-1655	2.9	E Sigel J Thom D Plummer S Baleri
12 Jul 2019	RF06	Second flight of day, WE012 pattern.	1752-2100	3.2	E Sigel B Butterworth D Plummer Z Little
12 Jul 2019	RF05	First flight of day, WE012 pattern, stacked legs at 4, 4.5, 5 kft MSL for CRL following pattern.	1340-1644	3.1	E Sigel B Butterworth D Plummer Z Wang

11 Jul 2019	RF04	Second flight of day, WE01 pattern.	1859-2144	2.6	E Sigel S Metzger D Plummer Z Wang
11 Jul 2019	RF03	First flight of day, WE01 pattern. Spiral to 8 kft MSL for CRL profile following pattern.	1405-1655	3.0	E Sigel S Metzger D Plummer Z Wang
9 Jul 2019	RF02	Second flight of day, WE012 pattern.	1902-2132	2.5	E Sigel A Desai D Plummer Z Wang
9 Jul 2019	RF01	First flight of day, WE012 pattern plus stacked passes for CRL.	1356-1647	3.0	E Sigel A Desai D Plummer Z Wang

### **Test Flights**

29 Sep 2019	FF07	Ferry flight from RHI to LAR. Collected most standard in-flight measurements; PCASP showed high counts in lowest size bins, increasingly consistent during climb and constantly at ferry altitudes.	1330-~1710	3.8	B Wadsworth D Plummer M Deng
23 Sep 2019	TF06	Short flight for pilot familiarization and instrument testing. EdgeTech chilled mirror showed invalid response for dewpoint and other derived	1710-1827	1.4	B Wadsworth D Plummer M Deng

		moisture variables.			
22 Sep 2019	FF05	Ferry flight from LAR to RHI.	1501-1750	x.x	B Wadsworth A Morgan D Plummer M Deng
18 Sep 2019	TF05	Shakedown flight in clear air ahead of IOP3.	1644-1800	1.4	B Wadsworth S Chu D Plummer S Fuller
19 Aug 2019	TF04	Survey flight to start IOP2. PCASP looked fine.	1459-1617	1.4	T Drew A Desai L Oolman Z Wang
18 Aug 2019	FF04	Ferry from Laramie to Rhinelander. Single PCASP with the UWYO PCASP in the OBR can. It also exhibited high counts in the lower channels at higher altitudes. No lidar data collected.	1449-1740	3.1	T Drew B Glover L Oolman Z Wang
14 Aug 2019	TF03	Test flight from Laramie. Dual-PCASP. The NOAA PCASP in the OBR pod had high counts in a number of channels.	1744-1847	1.1	T Drew T Mazzetti L Oolman M Deng
14 Jul 2019	FF03	Ferry flight from FSD to LAR, no data collected.	1515-1717	2.1	E Sigel Z Little D Plummer Z Wang
14 Jul 2019	FF02	Ferry flight from RHI to FSD, no data collected.	1250-1425	1.7	E Sigel Z Little D Plummer Z Wang

8 Jul 2019	TF02	Pilot familiarization flight along WE012 pattern- lidar and standard research data collected.	1403-1653	2.9	E Sigel D Plummer Z Wang
7 Jul 2019	FF01	Ferry flight from LAR to RHI, no data collected	1409-1707	3.0	E Sigel D Plummer Z Wang
27 Jun 2019	TF01	Alignment of CRL and general data collection	1951-2219	2.6	E Sigel D Plummer Z Wang
Flight Hours		As of Jul 15, 2020, 73.0 out of 84 research hours were flown, 11.0 remain.		Test and Ferry: 0.0	

## References to the data [Digital Object Identifiers (DOI)]

University of Wyoming - Reseach Flight Center, 2019: University of Wyoming King Air (UWKA) Low Rate Flight Level Data. University of Wyoming, College of Engineering, Department of Atmospheric Science, [doi:10.26023/NX8K-N6EQ-SM00](https://doi.org/10.26023/NX8K-N6EQ-SM00).

University of Wyoming - Reseach Flight Center, 2019: University of Wyoming King Air (UWKA) High Rate Flight Level Data. University of Wyoming, College of Engineering, Department of Atmospheric Science, [doi:10.26023/5B70-4VP5-XY0V](https://doi.org/10.26023/5B70-4VP5-XY0V).

**Project:** CHEESEHEAD-19

28 Sep 2019

**Flight:** RF24

*Notes:*

Second flight of day, continuing on pattern WE1. Cloud field had cleared enough from the morning flight to fly the standard 2900' MSL flight legs. Some high clouds in vicinity, especially early on. Winds centered near 25 degrees and 10-15 kt at 1300' AGL, and 350 degrees ~10 kt at 300' AGL, though with substantial variability.

Crew: Wadsworth, Thom, Plummer, Wang; LOD: Morgan

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*Flight Summary:*

UTC Comment

1850 Wheels up.

1907 Starting pattern.

1907-1913 Leg 1, waypoints 1-2 at 1300' AGL.

1915-1921 Leg 2, waypoints 2-1 at 300' AGL.

1922-1928 Leg 3, waypoints 1-4 at 1300' AGL.

1930-1936 Leg 4, waypoints 4-1 at 300' AGL.

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1937-1943 Leg 5, waypoints 3-4 at 1300' AGL.

1945-1951 Leg 6, waypoints 4-3 at 300' AGL.

1952-1958 Leg 7, waypoints 3-6 at 1300' AGL.

2000-2007 Leg 8, waypoints 6-3 at 300' AGL.

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2007-2013 Leg 9, waypoints 5-6 at 1300' AGL.

2015-2021 Leg 10, waypoints 6-5 at 300' AGL.

2022-2028 Leg 11, waypoints 7-8 at 1300' AGL.

2029-2035 Leg 12, waypoints 8-7 at 300' AGL.

2037-2043-----

2045-2050 Leg 13, waypoints 7-10 at 1300' AGL.

2051-2057 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

2059-2105 Leg 15, waypoints 9-10 at 1300' AGL.

2107-2113 Leg 16, waypoints 10-9 at 300' AGL.

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2107-2113 Leg 17, waypoints 9-12 at 1300' AGL.

2114-2120 Leg 18, waypoints 12-9 at 300' AGL.

2121-2127 Leg 19, waypoints 11-12 at 1300' AGL.

2128-2134 Leg 20, waypoints 12-11 at 300' AGL.

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2151 On the ground.

## 9/28/19 Pilot notes (RF23)

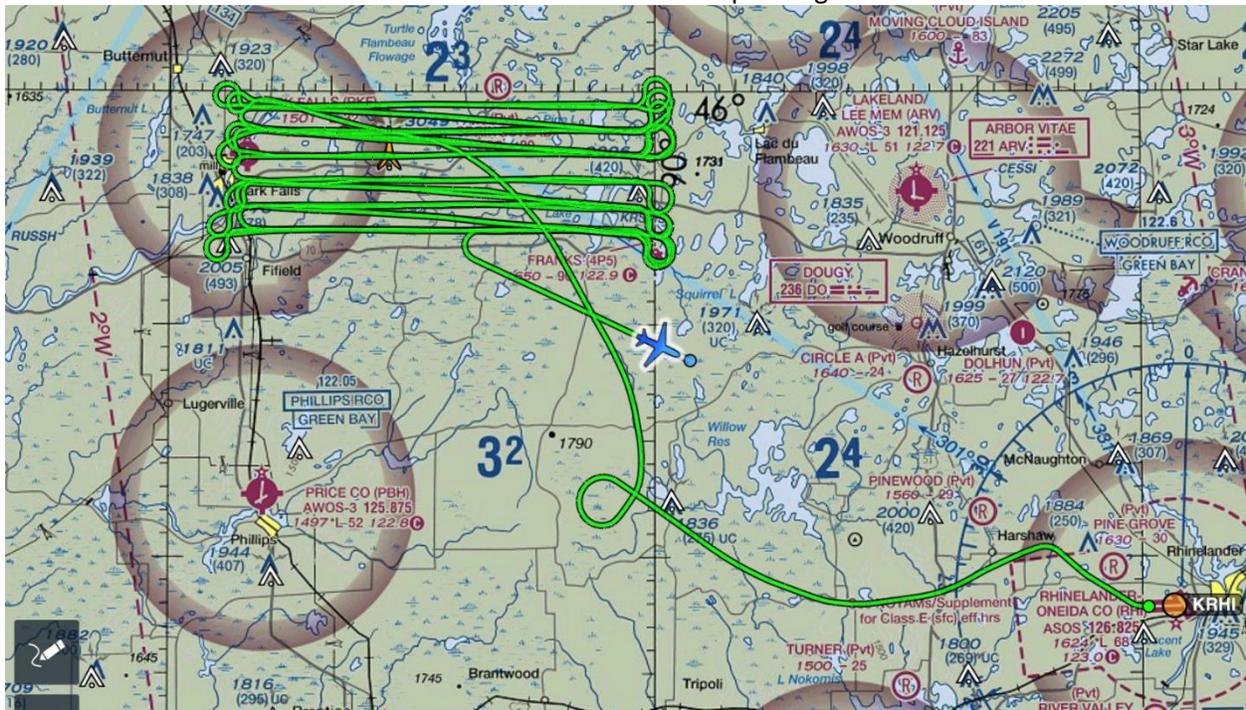
Crew: Wadsworth, Thom, Plummer, Deng

Flight Time: 3.3

Planned: Track WE01.

Actual:

As depicted below. Had some traffic to avoid on the transit out to the start point. Did a left 360 to delay a bit. Flew an additional lap of the last leg at 4500' MSL eastbound and then a wings-level descent to the west for LIDAR calibration at the end. There was a Bald Eagle that nearly got morted at the east end of the two northernmost tracks. No feathers located on N2UW post-flight.



**Project:** CHEESEHEAD-19

28 Sep 2019

**Flight:** RF23

*Notes:*

First flight of day, on pattern WE1 with subsequent higher pass and descent for CRL as in RF17. Scattered to broken Cu field with bases initially just above intended higher flight level, so 2900' MSL legs will be at 2500' MSL. Smooth early on, without much variability between flight levels - winds centered around 15 degrees near 10 kt at 900' AGL, but with substantial variability in weak winds. Similarly weak winds centered ~10 degrees further west and closer to 5 kt at 300' AGL.

Takeoff was delayed due to error flag on the data system and no response on the Li-7500; eventually a full reset of research power was required before we could proceed with the flight.

Crew: Wadsworth, Thom, Plummer, Wang; LOD: Morgan

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*Flight Summary:*

UTC Comment

1413 Wheels up.

1436 On pattern, were delayed a bit for traffic enroute.

1436-1442 Leg 1, waypoints 1-2 at 1300' AGL.

1444-1450 Leg 2, waypoints 2-1 at 300' AGL.

1451-1457 Leg 3, waypoints 1-4 at 1300' AGL.

1459-1505 Leg 4, waypoints 4-1 at 300' AGL.

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1506-1512 Leg 5, waypoints 3-4 at 1300' AGL.

1514-1520 Leg 6, waypoints 4-3 at 300' AGL.

1522-1528 Leg 7, waypoints 3-6 at 1300' AGL.

1530-1536 Leg 8, waypoints 6-3 at 300' AGL.

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1537-1543 Leg 9, waypoints 5-6 at 1300' AGL.

1545-1551 Leg 10, waypoints 6-5 at 300' AGL.

1552-1558 Leg 11, waypoints 7-8 at 1300' AGL.

1559-1605 Leg 12, waypoints 8-7 at 300' AGL.

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1607-1613 Leg 13, waypoints 7-10 at 1300' AGL.

1615-1621 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

1622-1627 Leg 15, waypoints 9-10 at 1300' AGL.

1629-1635 Leg 16, waypoints 10-9 at 300' AGL.

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1637-1643 Leg 17, waypoints 9-12 at 1300' AGL.

1645-1651 Leg 18, waypoints 12-9 at 300' AGL.

1651-1657 Leg 19, waypoints 11-12 at 1300' AGL.

1659-1705 Leg 20, waypoints 12-11 at 300' AGL.

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1707-1713 Return along same leg at 4500' MSL.

1714-1717 Return along same leg, gradually descending to 300' AGL.

1731 On the ground.

## 9/26/19 Pilot notes (RF22)

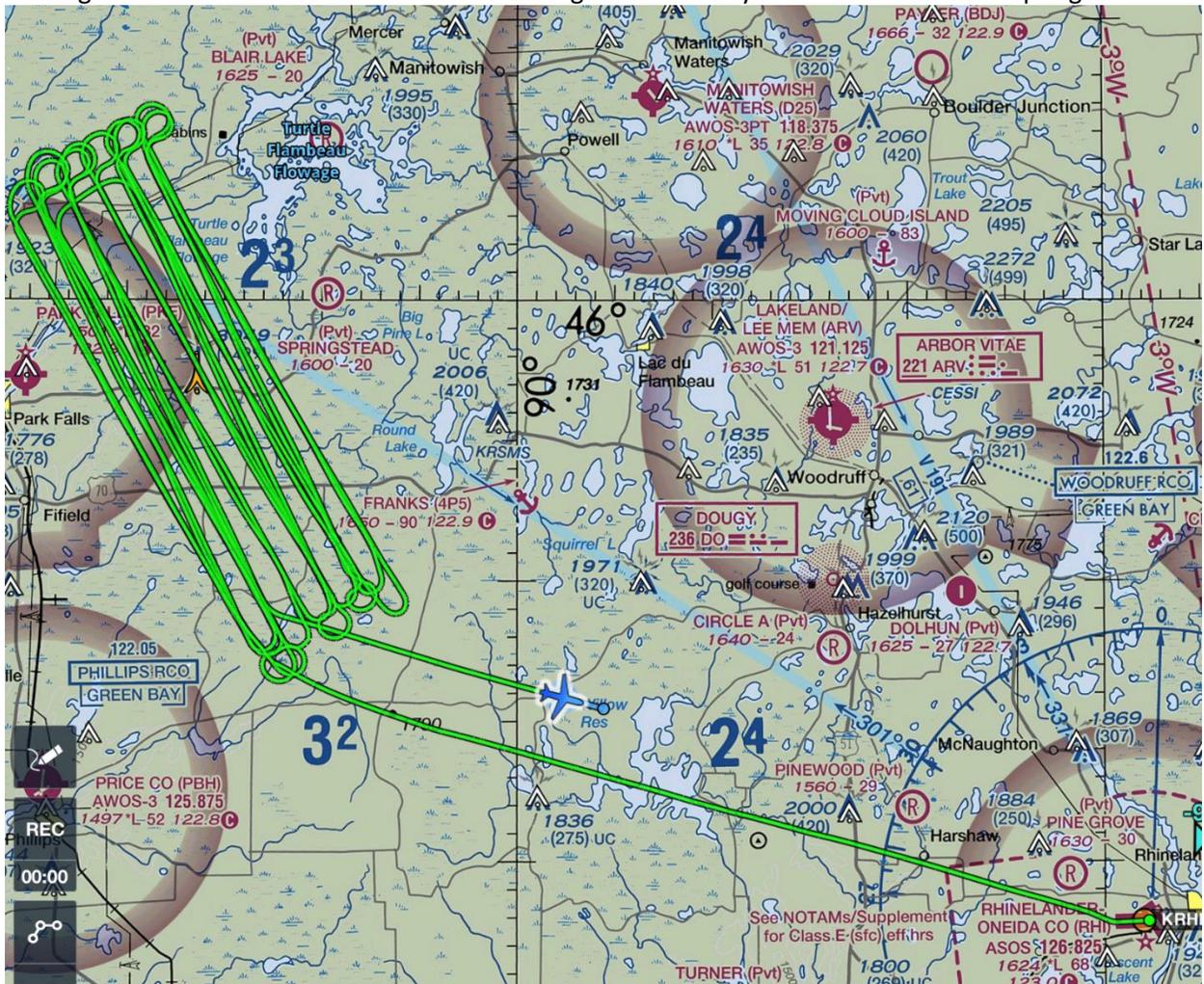
Crew: Wadsworth, Butterworth, Plummer

Flight Time: 3.3

Planned: Track SE01.

Actual:

As depicted below. Flew an additional lap of the tracks at ~3000' AGL. Brian wanted to see if the imagery from our downward camera might help him to correlate visual foliage changes with instrument readings. Turns out that our camera FOV is 27 degrees. Probably won't do these extra laps again.



**Project:** CHEESEHEAD-19

26 Sep 2019

**Flight:** RF22

*Notes:*

Second flight of day, on pattern SE1. We also made two extra passes at 4600' MSL after the pattern to test the field of view of the down camera, for identifying vegetation/ground characteristics along flight legs.

Widespread cumulus field this afternoon with bases ~1.1 km above higher FL, from zenith WCL. High clouds moved into region over the course of the flight. Winds were centered at approximately 260 degrees, 20 kt at 1300' AGL, and 250 degrees, 15 kt at 300' AGL, though with substantial variability.

EdgeTech chilled mirror deactivated. CRL computer ran out of disk space despite clearing it yesterday, but this was during the later high-altitude passes. The zenith WCL also locked up again at approximately the same time, though not in turbulence this time.

Crew: Wadsworth, Butterworth, Plummer; LOD: Morgan

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*Flight Summary:*

UTC Comment

1831 Wheels up.

1844 On pattern, cumulus bases are well above and should not be an issue for the standard flight levels.

1844-1850 Leg 1, waypoints 1-2 at 1300' AGL.

1852-1858 Leg 2, waypoints 2-1 at 300' AGL.

1900-1906 Leg 3, waypoints 1-4 at 1300' AGL.

1908-1914 Leg 4, waypoints 4-1 at 300' AGL.

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1915-1921 Leg 5, waypoints 3-4 at 1300' AGL.

1923-1929 Leg 6, waypoints 4-3 at 300' AGL.

1931-1937 Leg 7, waypoints 3-6 at 1300' AGL.

1938-1944 Leg 8, waypoints 6-3 at 300' AGL.

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1946-1952 Leg 9, waypoints 5-6 at 1300' AGL.

1954-2000 Leg 10, waypoints 6-5 at 300' AGL.

2000-2006 Leg 11, waypoints 7-8 at 1300' AGL.

2008-2014 Leg 12, waypoints 8-7 at 300' AGL.

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2016-2022 Leg 13, waypoints 7-10 at 1300' AGL.

2024-2030 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

2031-2037 Leg 15, waypoints 9-10 at 1300' AGL.

2039-2044 Leg 16, waypoints 10-9 at 300' AGL.

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2046-2052 Leg 17, waypoints 9-12 at 1300' AGL.

2054-2059 Leg 18, waypoints 12-9 at 300' AGL.

2101-2106 Leg 19, waypoints 11-12 at 1300' AGL.

2108-2114 Leg 20, waypoints 12-11 at 300' AGL.

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2114 Begin ascent to 4600' MSL/~3000' AGL.

2116-2121 First pass heading NW.

2123-2128 Second pass, heading back SE. Returning to base.

2140 On the ground.

**9/26/19 Pilot notes (RF21)**

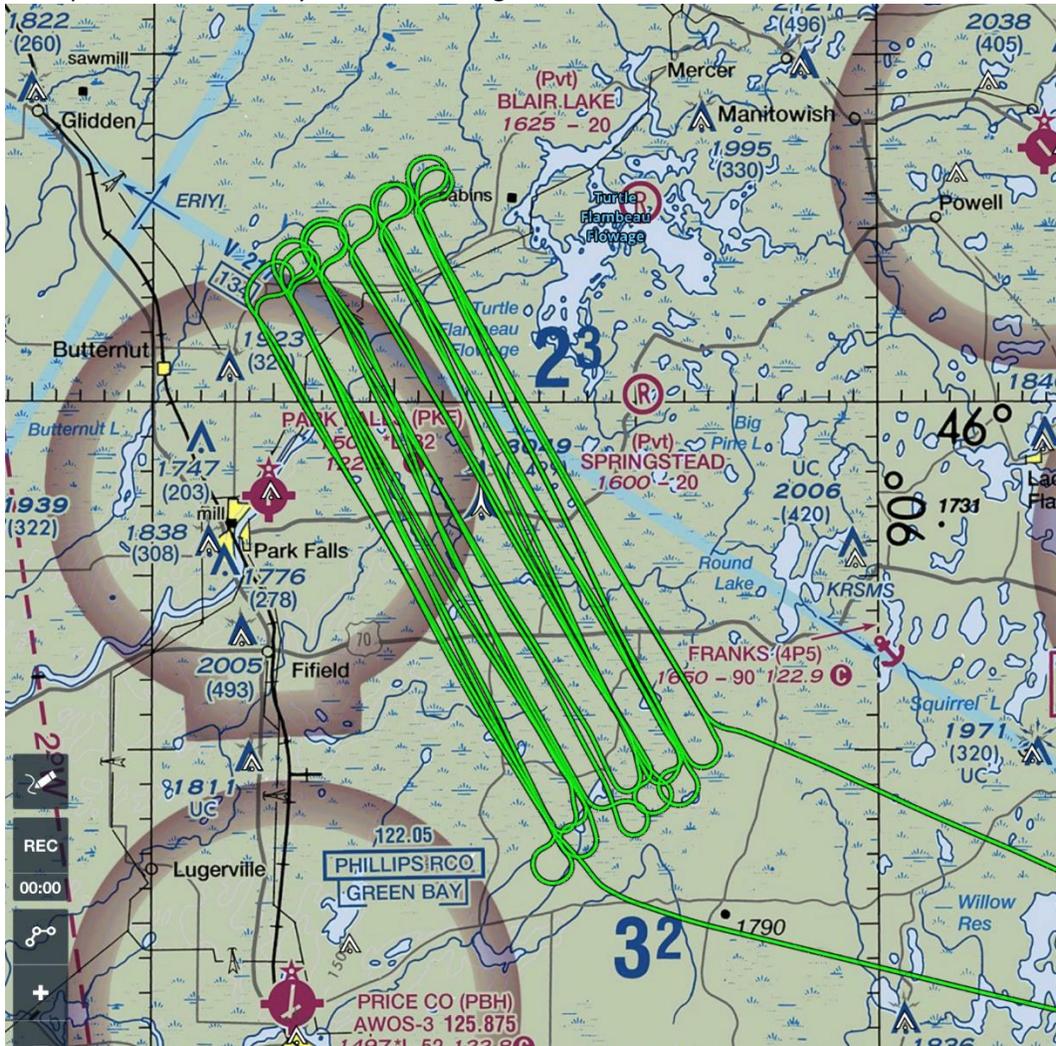
Crew: Wadsworth, Butterworth, Plummer, Deng

Flight Time: 3.0

Planned: Track SE01.

Actual:

As depicted below. Pretty smooth & straight-forward.



**Project:** CHEESEHEAD-19

26 Sep 2019

**Flight:** RF21

*Notes:*

First flight of day, on pattern SE1. Sunny and cool initially, with BL between the two flight levels. Winds centered around 300 degrees, 15 kt at 1300' AGL, variable and often < 5 kt at 300'.

Edgetech deactivated prior to flight.

Crew: Wadsworth, Butterworth, Plummer, Deng; LOD: Morgan

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*Flight Summary:*

UTC Comment

1352 Wheels up.

1405 On pattern.

1405-1411 Leg 1, waypoints 1-2 at 1300' AGL.

1413-1419 Leg 2, waypoints 2-1 at 300' AGL.

1421-1427 Leg 3, waypoints 1-4 at 1300' AGL.

1429-1434 Leg 4, waypoints 4-1 at 300' AGL.

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1436-1441 Leg 5, waypoints 3-4 at 1300' AGL.

1443-1449 Leg 6, waypoints 4-3 at 300' AGL.

1451-1457 Leg 7, waypoints 3-6 at 1300' AGL.

1458-1504 Leg 8, waypoints 6-3 at 300' AGL.

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1505 Briefly holding to ID traffic.

1506-1512 Leg 9, waypoints 5-6 at 1300' AGL.

1514-1520 Leg 10, waypoints 6-5 at 300' AGL.

1521-1527 Leg 11, waypoints 7-8 at 1300' AGL.

1529-1534 Leg 12, waypoints 8-7 at 300' AGL.

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1536-1542 Leg 13, waypoints 7-10 at 1300' AGL.

1544-1549 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

1551-1557 Leg 15, waypoints 9-10 at 1300' AGL.

1558-1604 Leg 16, waypoints 10-9 at 300' AGL.

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1606-1612 Leg 17, waypoints 9-12 at 1300' AGL.

1614-1620 Leg 18, waypoints 12-9 at 300' AGL.

1621-1627 Leg 19, waypoints 11-12 at 1300' AGL.

1629-1634 Leg 20, waypoints 12-11 at 300' AGL.

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1646 On the ground.

**9/25/19 Pilot notes (RF20)**

Crew: Wadsworth, Desai, Plummer

Flight Time: 3.0

Planned: Track SW01.

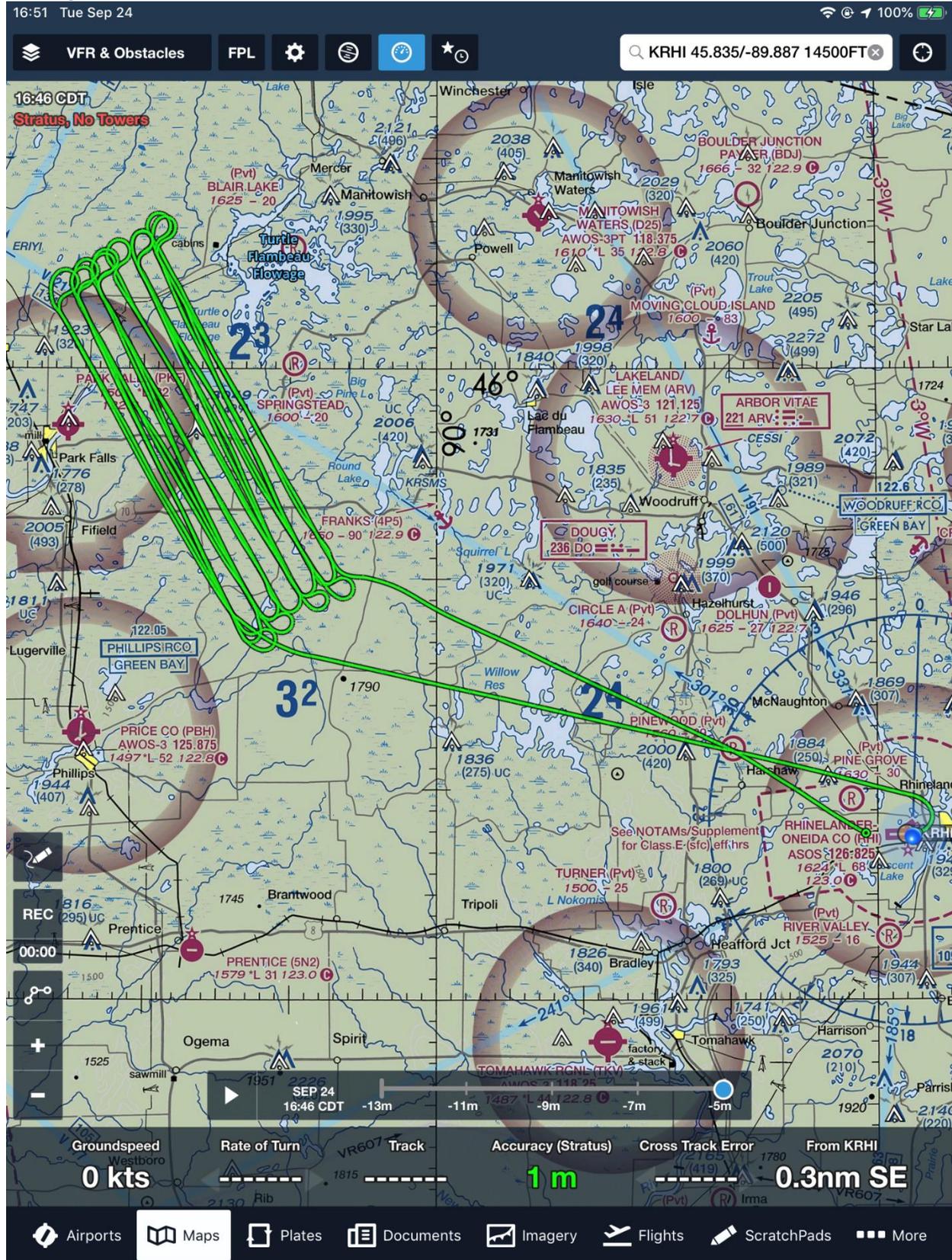
Actual:

Got delayed on refueling so we didn't take off until 1415. Only three crew for this flight. Min bailed-out. Flew the high pattern again at 2500' MSL to remain consistent with the morning flight. Saw a number of birds today, at pattern altitude. Each of them were big. Ducks, geese, or raptors. Abbreviated the last leg a bit as there was a small weather cell that moved over the north end of the track.

Went pretty smooth, although fairly bumpy in flight.



Routing as shown below.



**Project:** CHEESEHEAD-19

25 Sep 2019

**Flight:** RF20

*Notes:*

Second flight of day, on pattern SW1. Delayed on refueling. More turbulent, especially towards end of flight - briefly passed through two showers, and shortened north extent of two final legs to avoid larger shower. **Continued with higher passes at 1000' AGL**; winds centered near 280 degrees at 20-25 kt at 100', 260 degrees at 15 kt at 300'.

Zenith WCL locked due to low water towards end of pattern, in turbulent environment.

Crew: Wadsworth, Desai, Plummer; LOD: Morgan

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*Flight Summary:*

UTC Comment

1912 Wheels up.

1929 On pattern.

1929-1934 Leg 1, waypoints 1-2 at 1300' AGL.

1936-1942 Leg 2, waypoints 2-1 at 300' AGL.

1944-1950 Leg 3, waypoints 1-4 at 1300' AGL.

1951-1958 Leg 4, waypoints 4-1 at 300' AGL.

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1959-2004 Leg 5, waypoints 3-4 at 1300' AGL.

2005-2012 Leg 6, waypoints 4-3 at 300' AGL - **brief shower along leg.**

2014-2019 Leg 7, waypoints 3-6 at 1300' AGL.

2021-2027 Leg 8, waypoints 6-3 at 300' AGL.

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2029-2034 Leg 9, waypoints 5-6 at 1300' AGL.

2036-2042 Leg 10, waypoints 6-5 at 300' AGL.

2043-2049 Leg 11, waypoints 7-8 at 1300' AGL.

2050-2056 Leg 12, waypoints 8-7 at 300' AGL.

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2058-2104 Leg 13, waypoints 7-10 at 1300' AGL.

2105-2112 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

2113-2118 Leg 15, waypoints 9-10 at 1300' AGL.

2120-2126 Leg 16, waypoints 10-9 at 300' AGL.

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2128-2153 Leg 17, waypoints 9-12 at 1300' AGL - **returned before reaching waypoint 12 due to developing shower.**

2134-2140 Leg 18, waypoints 12-9 at 300' AGL.

2141-2146 Leg 19, waypoints 11-12 at 1300' AGL - **shower still in vicinity of waypoint 12.**

2147-2153 Leg 20, waypoints 12-11 at 300' AGL.

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2206 On the ground.

**9/25/19 Pilot notes (RF19)**

Crew: Wadsworth, Desai Plummer, Deng

Flight Time: 3.1

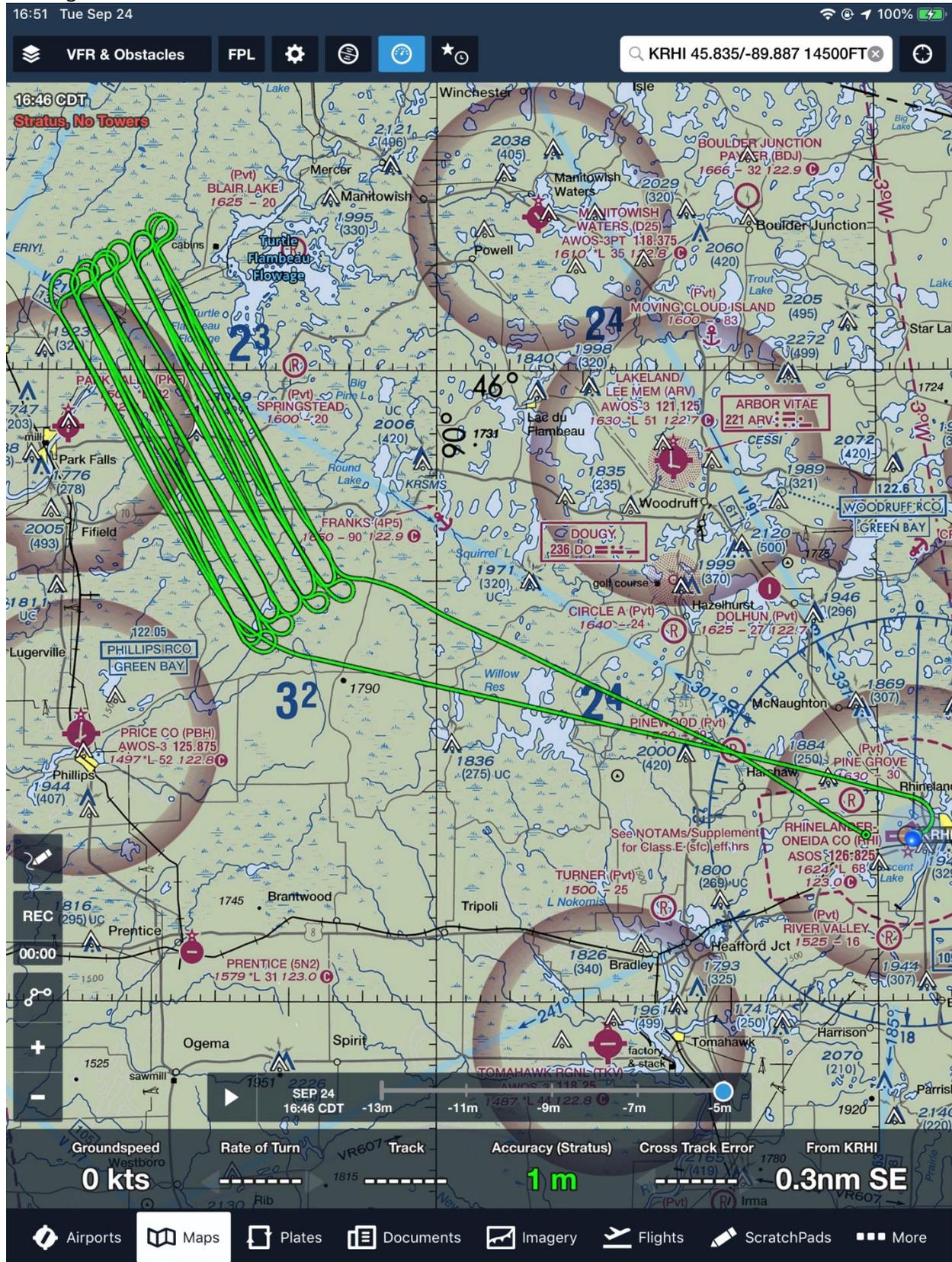
Planned: Track SW01.

Actual:

Some low clouds early with rain over KRHI that delayed the first takeoff a bit. It gradually passed & the ceiling went to scattered so we departed. Flew the high pattern at 2500' MSL as there was a scattered layer just over 3000' MSL.

Didn't capture an image of the pattern for the first flight. Refer to the notes for RF20 for an image.

Routing as shown below.



**Project:** CHEESEHEAD-19

25 Sep 2019

**Flight:** RF19

*Notes:*

First flight of day, on pattern SW1. Delayed on the ground for showers and low clouds moving over RHI. **Higher-altitude legs at 1000' AGL to stay below cumulus bases;** winds centered near 300 degrees, 15-20 kt at 1000' AGL, 270-300 degrees, 10-15 kt at 300'.

Edgetech measurements unusable.

Crew: Wadsworth, Desai, Plummer, Wang; LOD: Morgan

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*Flight Summary:*

UTC Comment

1420 Wheels up.

1441 On pattern.

1441-1446 Leg 1, waypoints 1-2 at 1300' AGL.

1448-1454 Leg 2, waypoints 2-1 at 300' AGL.

1456-1502 Leg 3, waypoints 1-4 at 1300' AGL.

1504-1510 Leg 4, waypoints 4-1 at 300' AGL.

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1511-1516 Leg 5, waypoints 3-4 at 1300' AGL.

1518-1524 Leg 6, waypoints 4-3 at 300' AGL.

1526-1532 Leg 7, waypoints 3-6 at 1300' AGL.

1534-1540 Leg 8, waypoints 6-3 at 300' AGL.

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1541-1547 Leg 9, waypoints 5-6 at 1300' AGL.

1548-1554 Leg 10, waypoints 6-5 at 300' AGL.

1555-1601 Leg 11, waypoints 7-8 at 1300' AGL.

1603-1608 Leg 12, waypoints 8-7 at 300' AGL.

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1610-1616 Leg 13, waypoints 7-10 at 1300' AGL.

1618-1624 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

1625-1631 Leg 15, waypoints 9-10 at 1300' AGL.

1632-1638 Leg 16, waypoints 10-9 at 300' AGL.

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1640-1646 Leg 17, waypoints 9-12 at 1300' AGL.

1648-1654 Leg 18, waypoints 12-9 at 300' AGL.

1655-1701 Leg 19, waypoints 11-12 at 1300' AGL.

1702-1708 Leg 20, waypoints 12-11 at 300' AGL.

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1722 On the ground.

**9/24/19 Pilot notes (RF18)**

Crew: Wadsworth, Desai Plummer, Deng

Flight Time: 3.0

Planned: Track SE01.

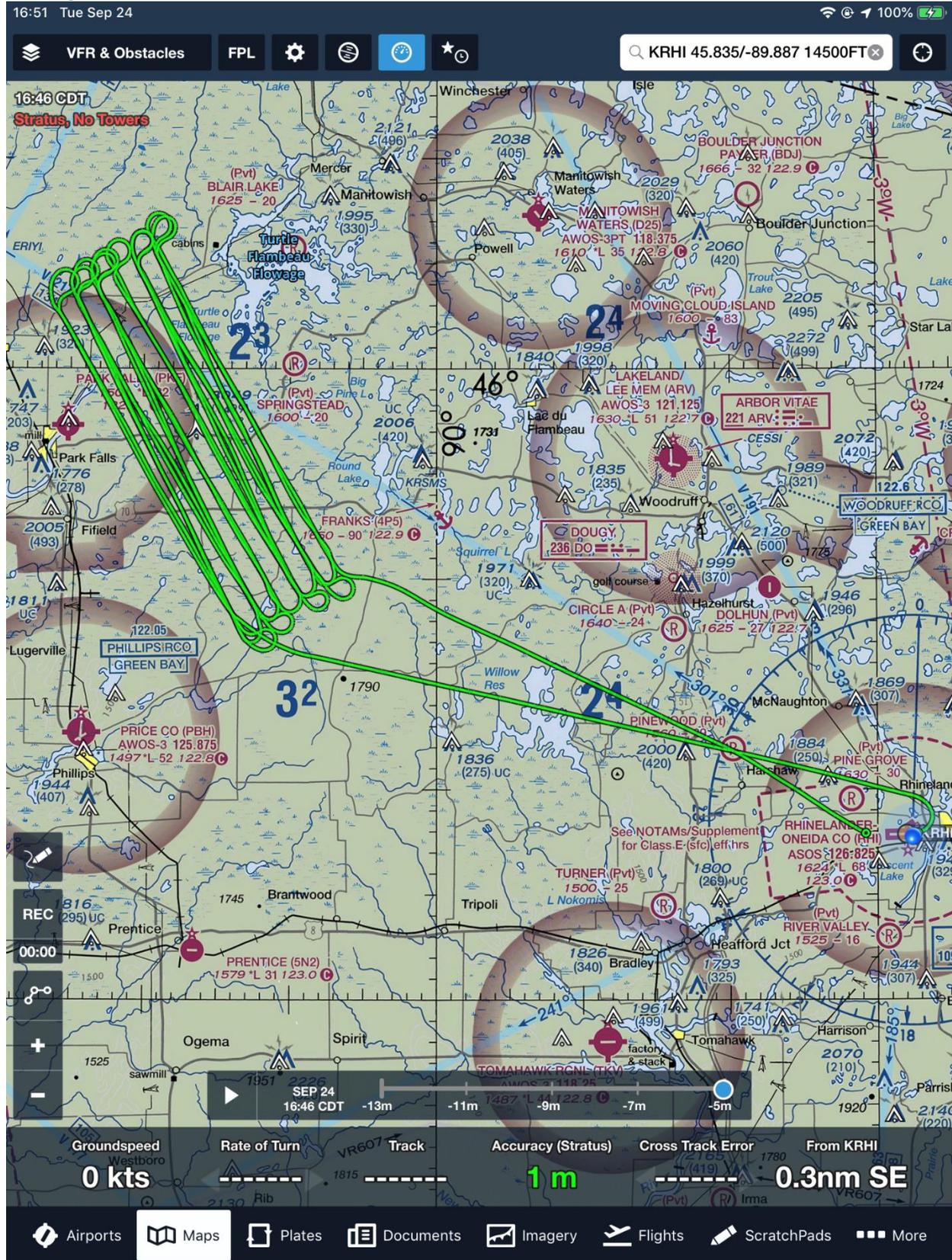
Actual:

Delayed on takeoff a bit. PI had a phone call & the pilot had a nap.

Departed VFR. Flew the pattern as shown. Visibility was good. Tightened-up the turns on the ends. Helped cut some time off the flight from the morning. Started getting altimeter updates from automated weather at Price County. Helped to ensure we maintained altitude as planned.

Routing as shown below.

Routing as shown below.



**Project:** CHEESEHEAD-19

14 Sep 2019

**Flight:** RF18

*Notes:*

Second flight of day, continuing on pattern SE1. Winds at 300' AGL a bit more westerly than for the morning flight, but otherwise similar.

Crew: Wadsworth, Desai, Plummer, Wang; LOD: Morgan

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*Flight Summary:*

UTC Comment

1857 Wheels up.

1911 Starting pattern.

1911-1916 Leg 1, waypoints 1-2 at 1300' AGL.

1918-1924 Leg 2, waypoints 2-1 at 300' AGL.

1926-1932 Leg 3, waypoints 1-4 at 1300' AGL.

1934-1940 Leg 4, waypoints 4-1 at 300' AGL.

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1941-1947 Leg 5, waypoints 3-4 at 1300' AGL.

1948-1955 Leg 6, waypoints 4-3 at 300' AGL.

1957-2002 Leg 7, waypoints 3-6 at 1300' AGL.

2004-2010 Leg 8, waypoints 6-3 at 300' AGL.

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2011-2017 Leg 9, waypoints 5-6 at 1300' AGL.

2019-2025 Leg 10, waypoints 6-5 at 300' AGL.

2026-2031 Leg 11, waypoints 7-8 at 1300' AGL.

2033-2039 Leg 12, waypoints 8-7 at 300' AGL.

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2041-2047 Leg 13, waypoints 7-10 at 1300' AGL.

2048-2055 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

2056-2101 Leg 15, waypoints 9-10 at 1300' AGL.

2103-2109 Leg 16, waypoints 10-9 at 300' AGL.

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2111-2116 Leg 17, waypoints 9-12 at 1300' AGL.

2118-2124 Leg 18, waypoints 12-9 at 300' AGL.

2125-2131 Leg 19, waypoints 11-12 at 1300' AGL.

2133-2139 Leg 20, waypoints 12-11 at 300' AGL.

-----

2149 On the ground.

**9/24/19 Pilot notes (RF17)**

Crew: Wadsworth, Desai Plummer, Deng

Flight Time: 3.4

Planned: Track SE01.

Actual:

Departed a bit early as some convective activity was expected in the afternoon.

Departed VFR. Flew the pattern as shown. Visibility was good. Floated the turns at the ends a bit. Boundary layer elevated during the course of the flight from around 700 AGL to above 2900 MSL.

Flew an extra leg at end of pattern at 4500' for LIDAR purposes. Reversed at the north end and did a gradual descent back down to 1900 ' MSL instead of doing a spiral descent. Some traffic going into Price County Airport today. Routing as shown below.



**Project:** CHEESEHEAD-19

24 Sep 2019

**Flight:** RF17

*Notes:*

First flight of day, on pattern SE1 with subsequent higher-altitude pass and descent along track for CRL profiling. Winds centered near 210 degrees, 15-20 kt at 1300' AGL, 170-180 degrees nearer 10 kt at 300' AGL. Boundary Layer built up over the course of the flight, through the 1300' AGL flight legs by the latter half of the flight.

**Note: EdgeTech chilled mirror hygrometer continued to show invalid response from yesterday's test flight; standard dewpoint and derived moisture variables will not be available from this instrument.**

Crew: Wadsworth, Desai, Plummer, Wang; LOD: Morgan

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*Flight Summary:*

UTC Comment

1338 Wheels up.

1351 On pattern.

1351-1356 Leg 1, waypoints 1-2 at 1300' AGL.

1359-1405 Leg 2, waypoints 2-1 at 300' AGL.

1408-1413 Leg 3, waypoints 1-4 at 1300' AGL.

1416-1423 Leg 4, waypoints 4-1 at 300' AGL.

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1424-1430 Leg 5, waypoints 3-4 at 1300' AGL.

1432-1438 Leg 6, waypoints 4-3 at 300' AGL.

1441-1446 Leg 7, waypoints 3-6 at 1300' AGL.

1450-1456 Leg 8, waypoints 6-3 at 300' AGL.

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1457-1503 Leg 9, waypoints 5-6 at 1300' AGL.

1506-1512 Leg 10, waypoints 6-5 at 300' AGL.

1513-1519 Leg 11, waypoints 7-8 at 1300' AGL.

1522-1528 Leg 12, waypoints 8-7 at 300' AGL.

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1531-1536 Leg 13, waypoints 7-10 at 1300' AGL.

1540-1546 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

1547-1553 Leg 15, waypoints 9-10 at 1300' AGL.

1556-1602 Leg 16, waypoints 10-9 at 300' AGL.

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1604-1610 Leg 17, waypoints 9-12 at 1300' AGL.

1613-1619 Leg 18, waypoints 12-9 at 300' AGL.

1621-1627 Leg 19, waypoints 11-12 at 1300' AGL.

1629-1635 Leg 20, waypoints 12-11 at 300' AGL.

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1637-1643 Repeated final leg track at 4500' MSL to make stacked profile for CRL.

1644-1647 Reverse along same track, descend gradually to 300' AGL, then return to RHI.

1701 On the ground.

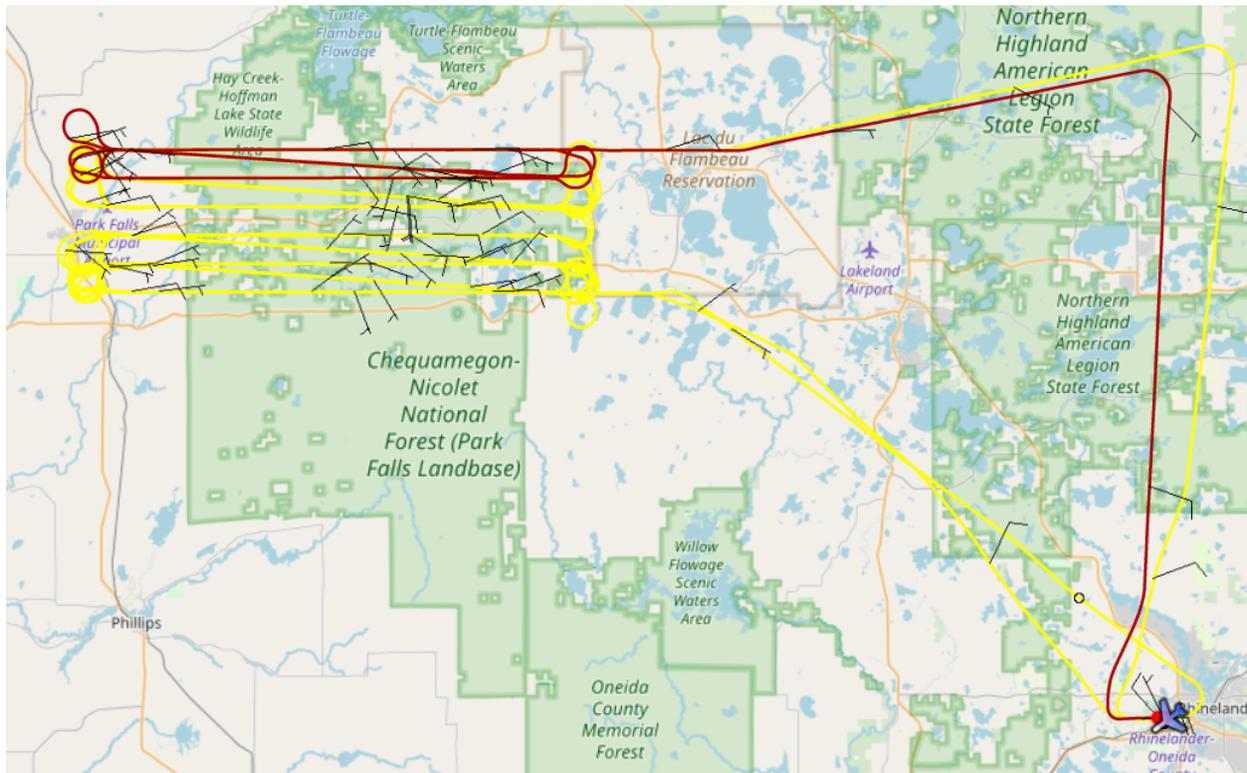
**08/23/2019 Pilot notes (Research Flight 16)**

Crew: Drew, Desai, Oolman, Oncley

Flight Time: 3.1

**Planned:** Takeoff at 14:00. Fly pattern WE012.

**Actual:** Flew pattern WE012. After takeoff, climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned alternating legs at 2900 ft. MSL/ 1900 ft. MSL. After completing the pattern, continued east/northeast at 2900 ft. MSL until north of Rhinelander then returned to Rhinelander.



## **CHEESEHEAD RF16 – 23 August 2019 – second flight**

*Tom Drew, Ankur Desai, Larry Oolman, Steve Onkley, Brent Glover (LOD)*

1907	Take off, Edgetech dewpoint hygrometer (TDP) not working
1917-1923	WE12-WE11 at FL029, SCT at 6200 ft msl, cloudier on east end than west
1925-1931	WE11-WE12 at FL019, T=18 C, DP=6 C, winds 6 kt from 60
1933-1938	WE12-WE09 at FL029, T=15, DP=6, winds 7 kt from 110
1940-1946	WE09-WE12 at FL019
1948-1953	WE10-WE09 at FL029
1955-2001	WE09-WE10 at FL019
2003-2009	WE10-WE07 at FL029
2011-2017	WE07-WE10 at FL019
2018-2024	WE08-WE07 at FL029
2026-2032	WE07-WE08 at FL019
2033-2039	WE06-WE05 at FL029
2040-2047	WE05-WE06 at FL019
2048-2054	WE06-WE03 at FL029
2055-2101	WE03-WE06 at FL019
2103-2108	WE04-WE03 at FL029
2110-2116	WE03-WE04 at FL019
2118-2123	WE04-WE01 at FL029
2126-2132	WE01-WE04 at FL019
2133-2139	WE02-WE01 at FL029, T=15 C, DP=6 C, winds 5 kt from 160, clouds pancake like at 6200 ft msl
2140-2146	WE01-WE02 at FL019, T=19, DP=7, winds 7 kt from 100
2147-	Extending line and heading east at FL029
2204	Land

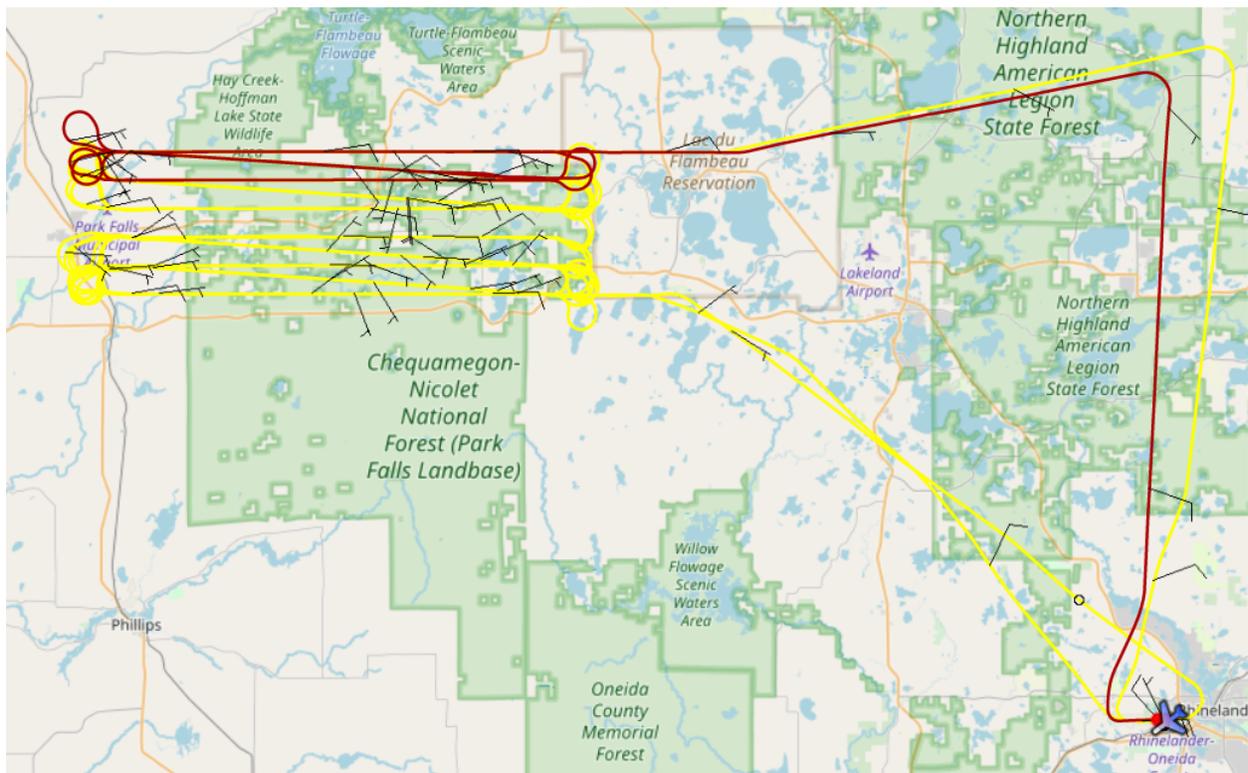
**08/23/2019 Pilot notes (Research Flight 15)**

Crew: Drew, Desai, Oolman, Mineau

Flight Time: 3.1

**Planned:** Takeoff at 09:00. Fly pattern WE012.

**Actual:** Flew pattern WE012. After takeoff, climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned alternating legs at 2900 ft. MSL/ 1900 ft. MSL. After completing the pattern, continued east/northeast at 2900 ft. MSL until north of Rhinelander then returned to Rhinelander.



## **CHEESEHEAD RF15 – 23 August 2019 – first flight**

*Tom Drew, Ankur Desai, Larry Oolman, Sam Mineau, Brent Glover (LOD)*

1357            Take off

1407-1412     WE12-WE11 at FL029, T=12 C, DP= 4 C, winds 6 kt from 60

1414-1420     WE11-WE12 at FL019, T=13, DP=10, winds 8 kt from 70

1422-1428     WE12-WE09 at FL029, water vapor gradient from CRL about 800 ft below

1429-1436     WE09-WE12 at FL019

1437-1443     WE10-WE09 at FL029

1444-1451     WE09-WE10 at FL019

1452-1458     WE10-WE07 at FL029

1500-1506     WE07-WE10 at FL019

1507-1513     WE08-WE07 at FL029, T=11, DP=7, winds 6 kt from 90

1515-1521     WE07-WE08 at FL019, T=15, DP=9, winds 6 kt from 70

1523-1528     WE06-WE05 at FL029, north of the tower this time

1530-1536     WE05-WE06 at FL019

1538-1544     WE06-WE03 at FL029

1546-1552     WE03-WE06 at FL019

1554-1559     WE04-WE03 at FL029

1601-1607     WE03-WE04 at FL019

1609-1615     WE04-WE01 at FL029, a few small fragmented Cu at 5200 ft msl

1616-1623     WE01-WE04 at FL109

1625-1630     WE02-WE01 at FL029, T=13, DP=6, winds 6 kt from 90

1632-1638     WE01-WE02 at FL019, T=16, DP=6, wind 9 kt from 100

1639-1648     Extend the line and fly at FL029 over more lakes. Clouds at 5200 msl more numerous

1648            Head to RHI

1658            Land

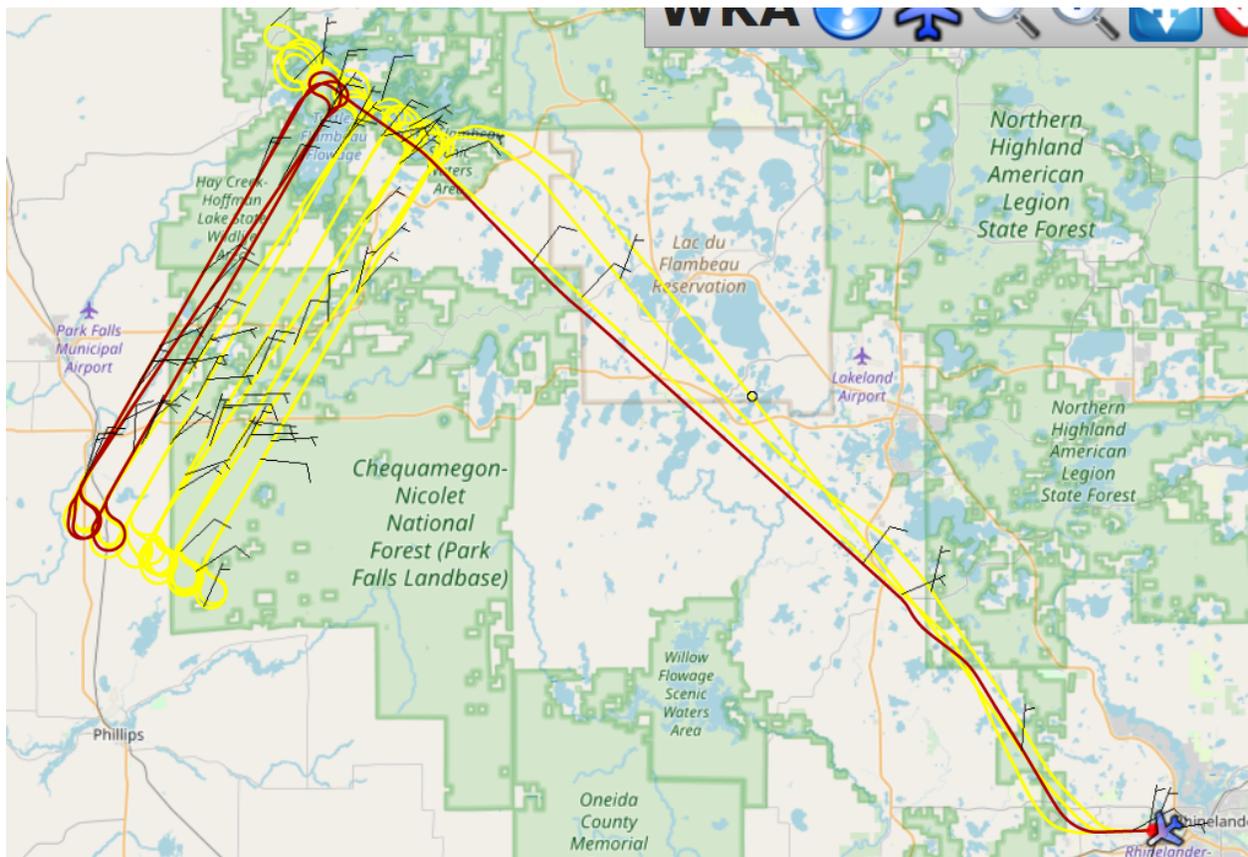
**08/22/2019 Pilot notes (Research Flight 14)**

Crew: Drew, Thom, Oolman, Mikula

Flight Time: 3.1

**Planned:** Takeoff at 14:00. Fly pattern SW12.

**Actual:** Flew pattern SW012. After takeoff, climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned alternating legs at 2900 ft. MSL/ 1900 ft. MSL. Returned to KRHI.



## CHEESEHEAD RF14 – 22 August 2019 – second flight

*Tom Drew, Jonathon Thom, Larry Oolman, Leo, Brent Glover (LOD)*

1900	Take off
1913-1919	SW12 to SW11 at FL029, T=13, DP=7, winds 5 kt from 60, clouds FEW 050 OVC 070
1921-1927	SW11 to SW12 at FL019, T=16 to 13, DP=9, winds 7 kt from 30
1929-1935	SW12 to SW09 at FL029
1936-1942	SW09 to SW12 at FL019
1944-1950	SW10 to SW09 at FL029
1952-1958	SW09 to SW10 at FL019
2000-2005	SW10 to SW07 at FL029
2007-2014	SW07 to SW10 at FL019
2015-2021	SW08 to SW07 at FL029
2023-2029	SW07 to SW08 at FL019
2031-2036 rest of track	SW06 to SW05 at FL029, now NW of WLEF. T=13, DP=9, winds 8 kt from 25, line of Cu at 5 kft msl with a few drops on NE end of track, OVC 085
2038-2044	SW05 to SW06 at FL019, T=17, DP=7, winds 9 from 25
2046-2052	SW06 to SW03 at FL029, a few more raindrops, 5 kft msl cloud layer now extends south of WLEF
2054-2100	SW03 to SW06 at FL019, band of 5 kft clouds extend through center of domain. Looks mostly clear 20 nmi to the NW
2102-2107	SW04 to SW03 at FL029, line of clouds now mostly to the S end of the track
2109-2116	SW03 to SW04 at FL019
2118-2123	SW04 to SW01 at FL029
2125-2131	SW01 to SW04 at FL019
2133-2138	SW02 to SW01 at FL029, T=13, DP=8, winds 10 kt from 40, OVC085
2140-2146	SW01 to SW02 at FL019, T=16, DP=10, winds 13 kt from 30
2146	Heading back to RHI
2200	Land

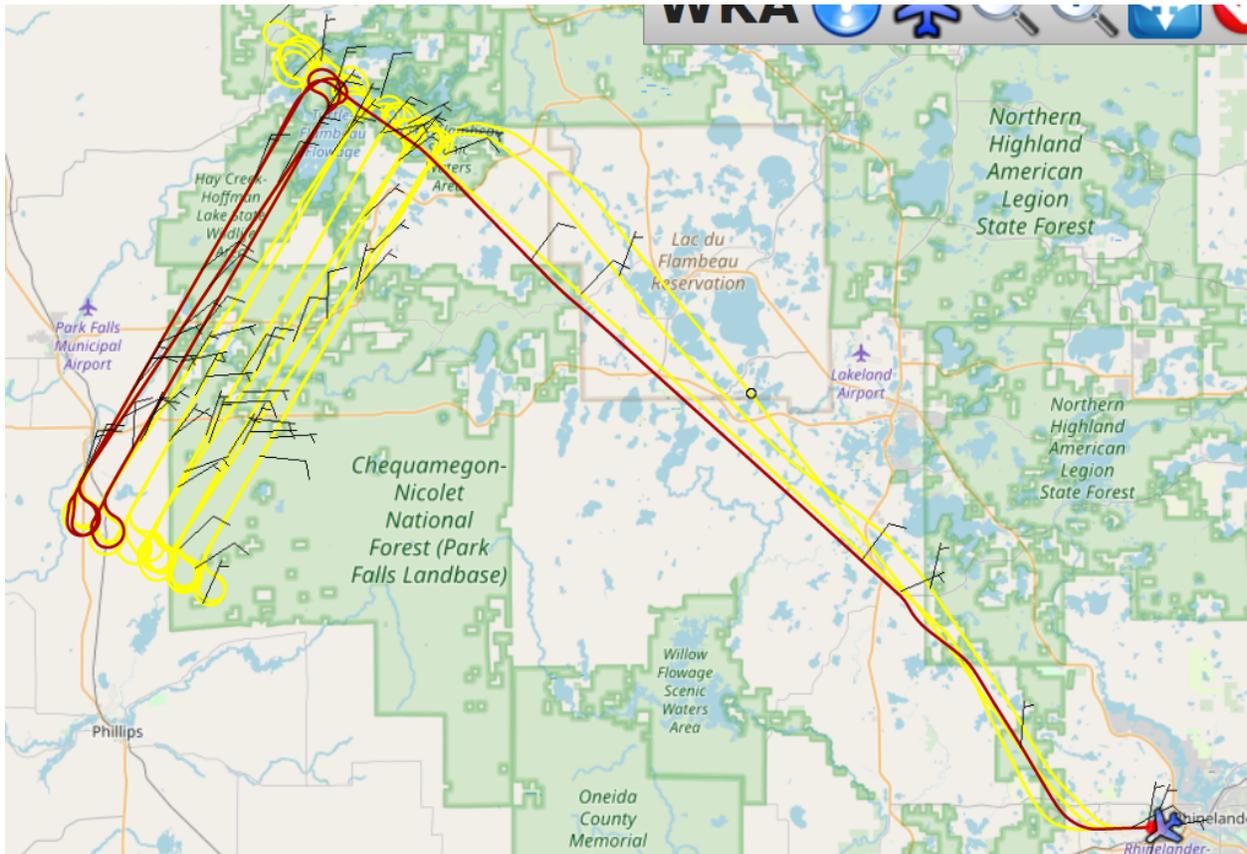
**08/22/2019 Pilot notes (Research Flight 13)**

Crew: Drew, Thom, Oolman, Mikula

Flight Time: 3.3

**Planned:** Takeoff at 09:00. Fly pattern SW012.

**Actual:** Flew pattern SW012. After takeoff, climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned alternating legs at 2900 ft. MSL/ 1900 ft. MSL. After completing the pattern, repeated last leg at 3500 ft. MSL and 4000 ft. MSL. Then completed a spiral down from 4000 ft. for Lidar calibration. Returned to KRHI



## CHEESEHEAD RF13 – 22 August 2019 – first flight

*Tom Drew, Jonathon Thom, Larry Oolman, Leo, Brent Glover (LOD)*

1358 Take off

1402 FL029, overcast 2 kft above the aircraft

1411-1416 SW12 to SW11 at FL029, T=12, DP=5, winds 8 kt from 105, overcast 5 kft above us

1418-1424 SW11 to SW12 at FL019, T=15, DP=8, winds 11 kt from 110, overcast 6 kft above the aircraft

1426-1432 SW12 to SW09 at FL029

1434-1440 SW09 to SW12 at FL019

1435 WCL is not updating display, stopped recording and restarted it. Toggled real-time button on the IDL display code.

1441-1447 SW10 to SW09 at FL029

1449-1455 SW09 to SW10 at FL019

1456-1502 SW10 to SW07 at FL029

1504-1510 SW07 to SW10 at FL019

1511-1517 SW08 to SW07 at FL029, air at NE is slightly warming at FL019 and cooler at FL029 resulting in less stability to the NE. From the CRL the water vapor appears to be more bubbly on this end.

1518-1525 SW07 to SW08 at FL019

1526-1532 SW06 to SW05 at FL029, now southwest of WLEF

1533-1540 SW05 to SW06 at FL019, T=14.7 to the SW and 15.2 to the NE, DP=11, wind 7 kt from 30 deg.

1542-1547 SW06 to SW03 at FL029, T=12.1 to the NE and 12.7 to the SW, DP=8, wind 5 kt from 70 deg, mostly overcast with some breaks at 9000 ft msl. Some lower Cu with cloud bases around 5000 ft msl are forming to the west.

1549-1555 SW03 to SW06 at FL019

1556-1602 SW04 to SW03 at FL029

1604-1610 SW03 to SW04 at FL019

1612-1617 SW04 to SW01 at FL029

1619-1625 SW01 to SW04 at FL019

1626-1632 SW02 to SW01 at FL029, T=12.8, DP=6, winds 7 kt from 80, clouds FEW050 OVC090

1633-1639 SW01 to SW02 at FL019, T=15.5, DP=9, winds 8 kt from 40

1641-1647 SW02 to SW01 at FL035 for CRL, T=11.1, DP=7, winds 8 kt from 80.

1648-1655 SW01 to SW02 at FL040, a few wispy Cu at the SW end of the line, T=9.6, DP=7, winds 7 kt from 40

1655-1659 Slow spiral down from 4000 ft msl to 300 ft agl

1659 Head to RHI

1715 Land

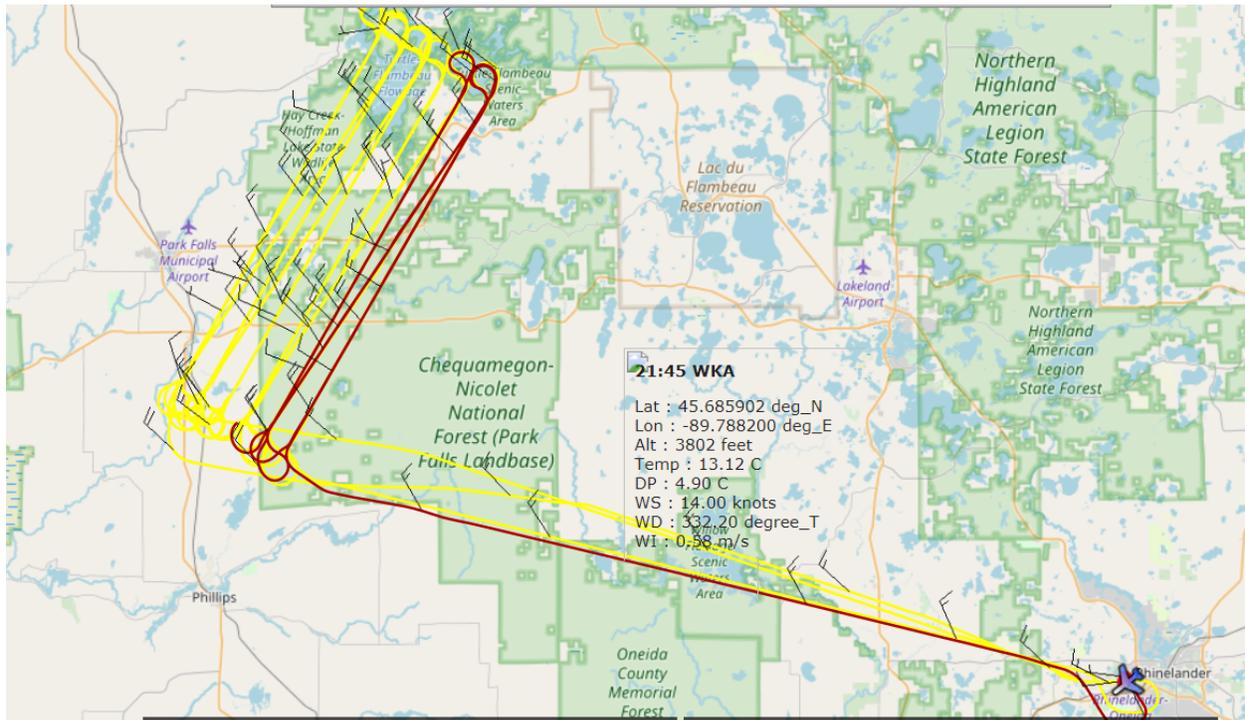
**08/21/2019 Pilot notes (Research Flight 12)**

Crew: Drew, Oolman, Butterworth

Flight Time: 3.1

**Planned:** Takeoff at 14:00. Fly pattern SW01.

**Actual:** Flew pattern SW01. After takeoff, climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned alternating legs at 2900 ft. MSL/ 1900 ft. MSL. Returned to KRHI



## **CHEESEHEAD19 RF12 21 August 2019**

*Tom Drew, Brian Butterworth, Larry Oolman, Brent Glover (LOD)*

1855 Take off  
1911 SW01-SW02 at FL029, T=15, DP=4, winds 16 kt from 330  
1917 Done  
1919 SW02-SW01 at FL019, T=19, DP=6, winds 16 kt from 340, clouds 5500 ft above the aircraft  
1924 Done  
1926 SW01-SW04 at FL029  
1933 Done  
1934 SW04-SW01 at FL019  
1940 Done  
1941 SW03-SW04 at FL029  
1947 Done  
1949 SW04-SW03 at FL019  
1955 Done  
1956 SW03-SW06 at FL029  
2002 Done  
2004 SW06-SW03 at FL019  
2010 Done  
2011 SW05-SW06 at FL029, T=16, DP=5, winds 16 kt from 320  
2017 Done  
2019 SW06-SW05 at FL019, T=18, DP=6, wind 10 kt from 320  
2024 Done  
2026 SW07-SW08 at FL029  
2032 Restart WCL, down since 2021  
2034 SW08-SW07 at FL019  
2039 Done  
2040 SW07-SW10 at FL029  
2046 Done  
2048 SW10-SW07 at FL019

2053 Done  
2055 SW09-SW10 at FL029  
2101 Done  
2102 SW10-SW09 at FL019  
2108 Done  
2110 SW09-SW12 at FL019  
2116 Done  
2117 SW12-SW09 at FL019  
2119 Accidentally put a remote desktop in full screen. <CTRL><ALT><SHIFT>F to exit.  
2151 Land

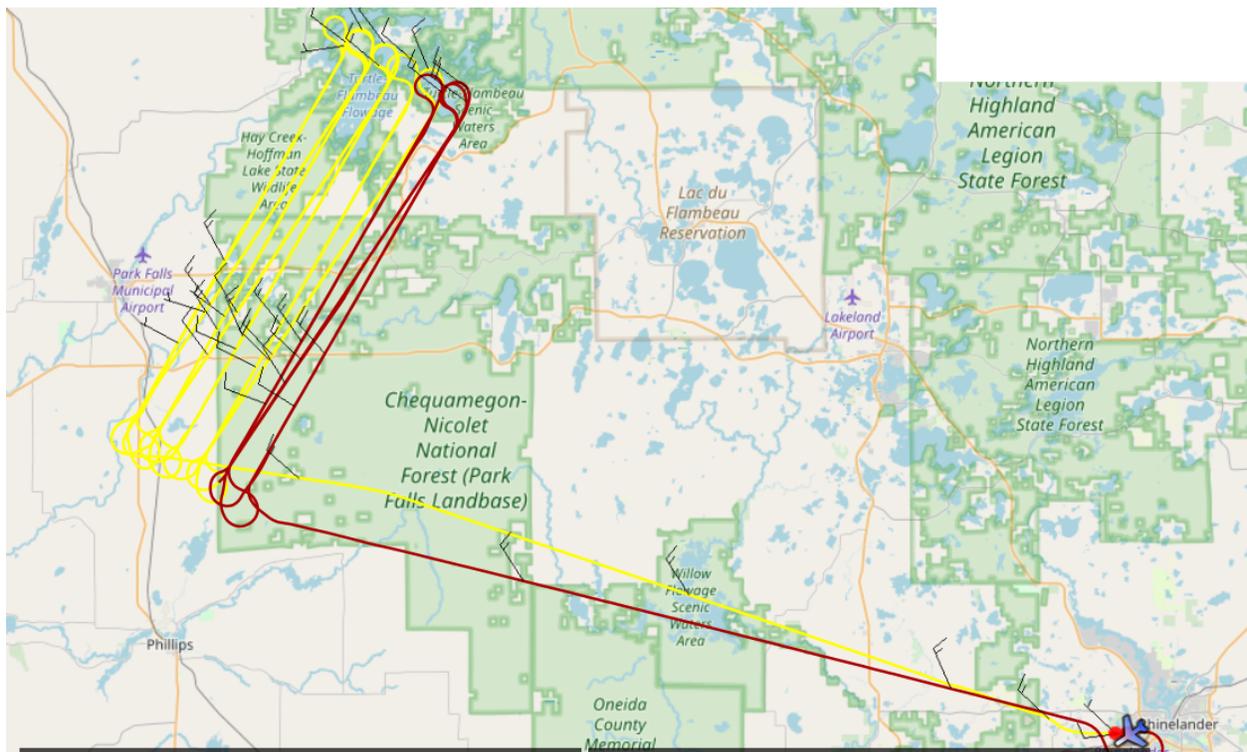
**08/21/2019 Pilot notes (Research Flight 11)**

Crew: Drew, Oolman, Wang, and Butterworth

Flight Time: 3.0

**Planned:** Takeoff at 9:00. Fly pattern SW01.

**Actual:** Flew pattern SW01. After takeoff, climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned alternating legs at 2900 ft. MSL/ 1900 ft. MSL. Returned to KRHI



## **CHEESEHEAD RF11 – 21 August 2019 – first flight**

*Tom Drew, Brian Butterworth, Larry Oolman, Zhien Wang, Brent Glover (LOD)*

1354            Take off, head towards SW1 pattern

1408-1413     SW01-SW02 at FL029, T=14, DP=7, winds 13 kt from 330

1415-1421     SW02-SW01 at FL019, T=16, DP=11, winds 5 kt from 290

1423-1429     SW01-SW04 at FL029

1431-1437     SW04-SW01 at FL019

1438-1444     SW03-SW04 at FL029

1446-1452     SW04-SW03 at FL019

1454-1500     SW03-SW06 at FL029, T=14, DP=8, winds 12 kt from 330

1501-1507     SW06-SW03 at FL019, T=17, DP=9, winds 8 kt from 310

1508-1514     SW05-SW06 at FL029, a few Cu fragments forming 2000 ft above us

1516-1522     SW06-SW05 at FL019

1523-1529     SW07-SW08 at FL029

153-15361     SW08-SW07 at FL019

1538-1544     SW07-SW10 at FL029

1546-1551     SW10-SW07 at FL019

1553-1559     SW09-SW10 at FL029

1600-1606     SW10-SW09 at FL019

1608-1614     SW09-SW12 at FL029

1616-1621     SW12-SW09 at FL019

1623-1629     SW11-SW12 at FL029, T=15, DP=9, winds 18 kt from 320, SCT 3000 ft above the aircraft

1630-1636     SW12-SW11 at FL019, T=17, DP=8, winds 9kt from 305

1636            Done with mission, head back to RHI

1649            Land

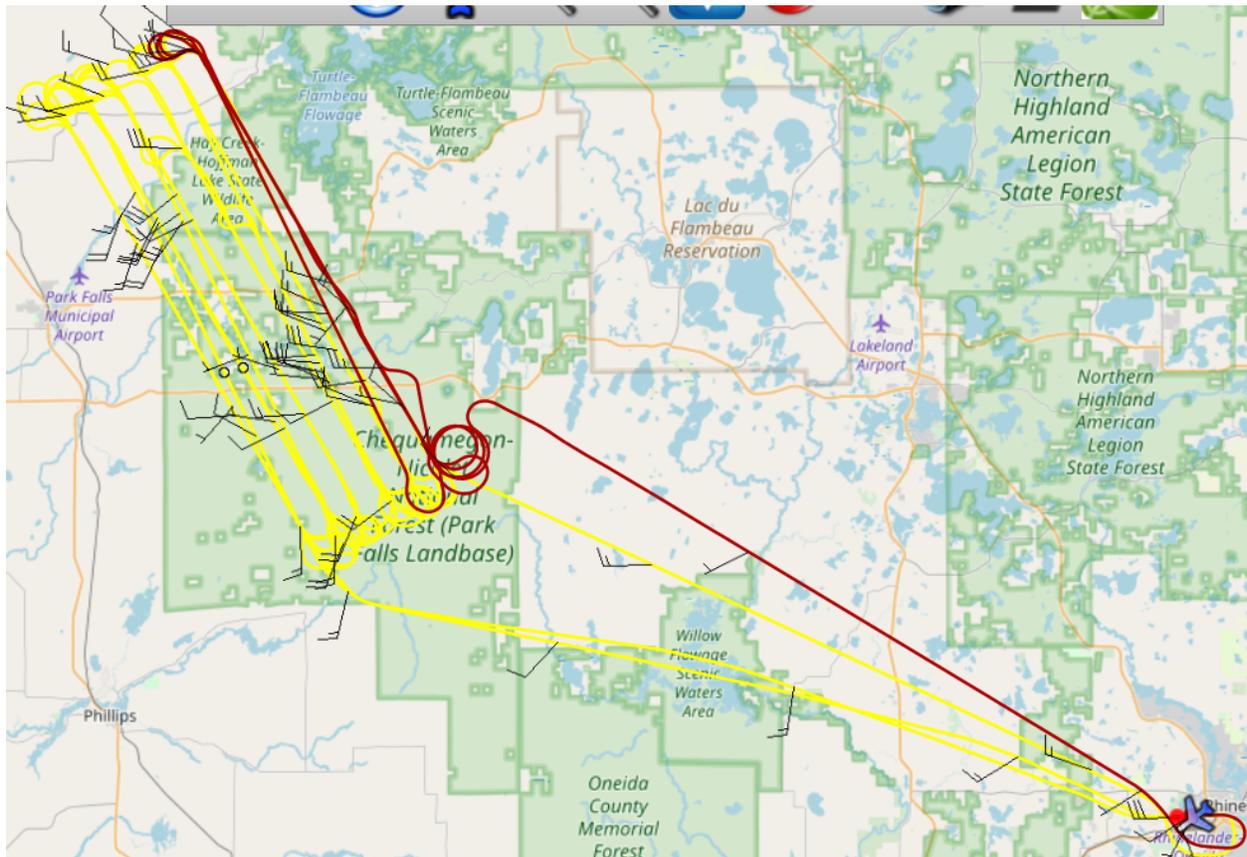
**08/20/2019 Pilot notes (Research Flight 10)**

Crew: Drew, Oolman, Wang, and Desai

Flight Time: 3.1

**Planned:** Takeoff at 2:15. Fly pattern SE01.

**Actual:** Flew pattern SE01. After takeoff, climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned. Repeated the sixth leg (last leg) at 3500 MSL and 4000 MSL, and then spiraled down near SE11 for LIDAR calibration. Returned to KRHI



## CHEESEHEAD RF10 – 20 August 2019 – second flight

*Tom Drew, Ankur Desai, Larry Oolman, Zhien Wang, Brent Glover (LOD)*

1913	Take off
1923-1929	SE01-SE02 at FL029, overcast with clearing west of the research area.
1931-1937	SE02-SE01 at FL019, T=21, DP=16, winds light
1939-1945	SE01-SE04 at FL029, T=19, DP=13, winds 11 kt from 275
1946-1952	SE04-SE01 at FL019
1954-1959	SE03-SE04 at FL029
2001-2007	SE04-SE03 at FL019
2009-2015	SE03-SE06 at FL029
2016-2022	SE06-SE03 at FL019, west side of domain fully in sun.
2024-2029	SE05-SE06 at FL029
2031-2037	SE06-SE05 at FL019
2038-2044	SE07-SE08 at FL029, now NE of tower. East end of domain now fully in sun.
2046-2051	SE08-SE07 at FL019
2053-2059	SE07-SE10 at FL029
2101-2106	SE10-SE07 at FL019, Cu fragments on top of the boundary layer is 1 km above us
2108-2114	SE09-SE10 at FL029
2115-2121	SE10-SE09 at FL019
2123-2129	SE09-SE12 at FL029
2130-2136	SE12-SE09 at FL019
2137-2143	SE11-SE12 at FL029
2145-2151	SE12-SE11 at FL019
2153-2159	SE11-E12 at FL035 for CRL
2154	Correction to get on the line
2200-2206	SE12-SE11 at FL040, still below cloud base of boundary layer Cu
2206	Slow spiral down at SE11
2211	Done, head to RHI
2223	Land

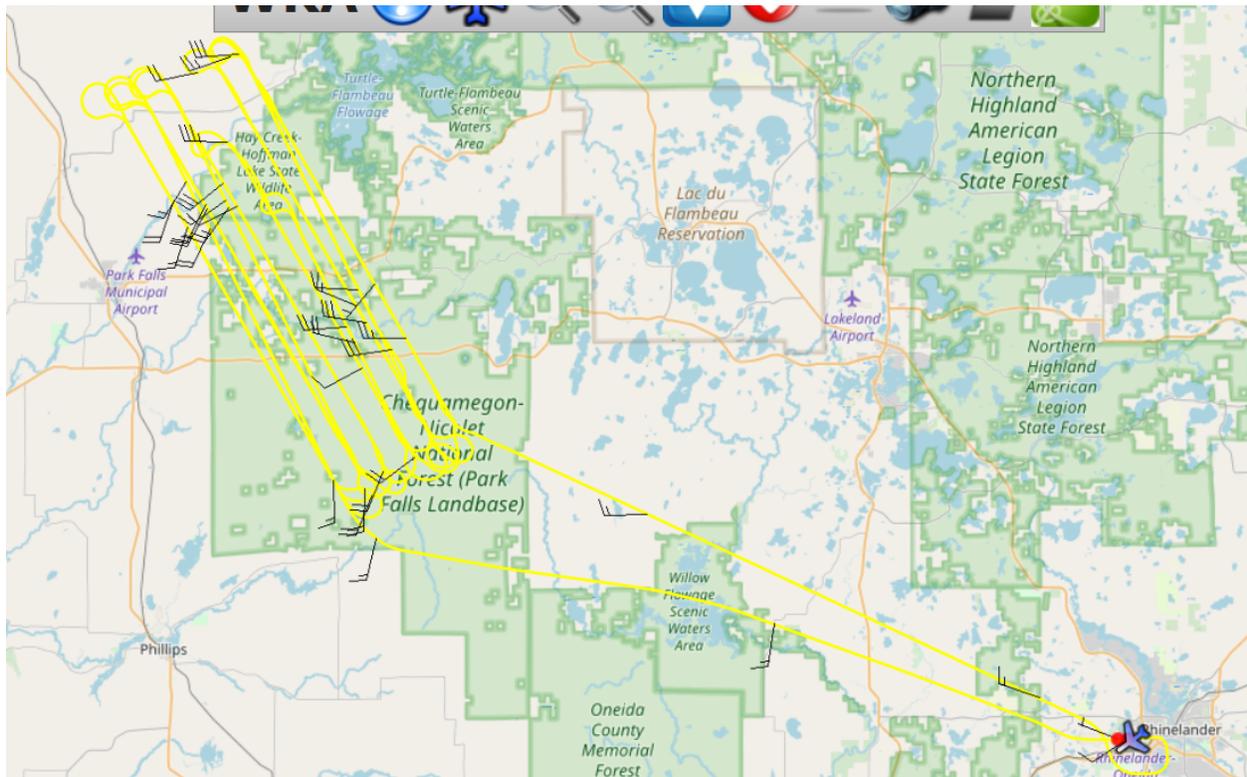
**08/20/2019 Pilot notes (Research Flight 9)**

Crew: Drew, Oolman, Wang, and Desai

Flight Time: 2.8

**Planned:** Takeoff at 8:45. Fly pattern SE01. No additional items.

**Actual:** Flew pattern SE01. After takeoff climbed to 4000 ft. MSL and then descended to 2900 ft. MSL for starting point. Flew pattern as planned except cut short line 4 and line 4 diagonal on the north side due to rain showers in the area. Returned to KRHI



## **CHEESEHEAD RF09 – 20 August 2019 – first flight**

*Tom Drew, Ankur Desai, Larry Oolman, Zhien Wang, Brent Glover (LOD)*

1340            Take off

1341            Climbing out of boundary layer. Very thin dry layer on CRL and in-situ instruments

1352-1356      SE01-E02 at FL029, T=21 C, DP=-3 C, winds 19 kt from 185, cloud layer 4.7 km above aircraft

1358-1404      SE02-E01 at FL019, only high cirrus above the end of the line

1405            Sharp boundary layer. DP dries from +13 to -3. CO2 increases from 370 to 395.

1406-1412      SE01-E04 at FL029

1409            Back in boundary layer at FL029

1414-1420      SE04-E01 at FL019, did not climb into the dry air this time

1422-1426      SE03-E04 at FL029

1428-1434      SE04-E03 at FL019

1436-1441      SE03-S06 at FL029, nexrad composite showing reflectivity at the west end of the line

1443-1449      SE06-E03 at FL019

1451-1456      SE05-E06 at FL029. T=18, DP=12, Wind 25 kt from 230

1456            Virga extending to 1 km above us. Rain during the turn

1458-1504      SE06-E05 at FL019. T=19, DP=14, wind 14 kt from 235.

1505-1509      SE07-E08 at FL029, this track is NE of WLEF.

1510            Hitting filaments of rain, turn early to miss rain shower, Licor 7500 showing dropouts when drops are in the volume

1511-1516      SE08-SE07 at FL019

1518-1922      SE07-SE10 at FL029, turning early, a couple miles past the tower.

1523-1526      Back towards SE07 at FL019

1528-1535      SE09-SE10 at FL029, able to do entire line this time, rain is clearing out

1536-1542      SE10-SE09 at FL019

1544-1550      SE09-SE12 at FL029

1545            Navigation error, back on track. A bit of rain near the end of the line

1551-1557      SE12-SE09 at FL019

1559-1605      SE11-SE12 at FL029

1606-1612      SE12-SE11 at FL019, T=18 C, DP=16 C, winds 7 kt from 230

1612 Done with mission, head to RHI

1647 Land

## **07/13/2019 CHEESEHEAD Pilot notes (Research Flight 8)**

Crew. Sigel, Plummer, Baleri, Desai.

Flight Time: 2.7

**Planned:** Takeoff at 14:00 fly VFR to SW01. Fly the patterns as planned.

**Actual:** Departed RHI at 14:00 VFR. We Flew Direct to SW01 at 4500 MSL. Starting these patterns takes a second to figure out how to join them. It helped to zoom in on the pattern before takeoff. To give yourself an idea of how to join. I forgot to look at the pattern and helped to see it. Ankur pulled out a paper version in flight and I was oriented in a second. I used the right seater for several things. First thing was to look for aircraft and towers. Second I had them tell me when I was 5 miles from the end of the leg. This was helpful because the FMS needle tries to proceed the turn and it give you time to set your bug to make the rest of the leg strait. Third they called out over the way point. Just small things so I could be outside the flight deck as much as posable. Once again it was a new pattern I found no anomalies in anyway with it. Some of the towers at the end of patterns on the west side by Park Falls seem a bit close but are not on the flight path. We flew the pattern and returned to RHI. Aircraft worked well and there was nothing worth noting.



VFR & Traffic



FPL



Settings



Map

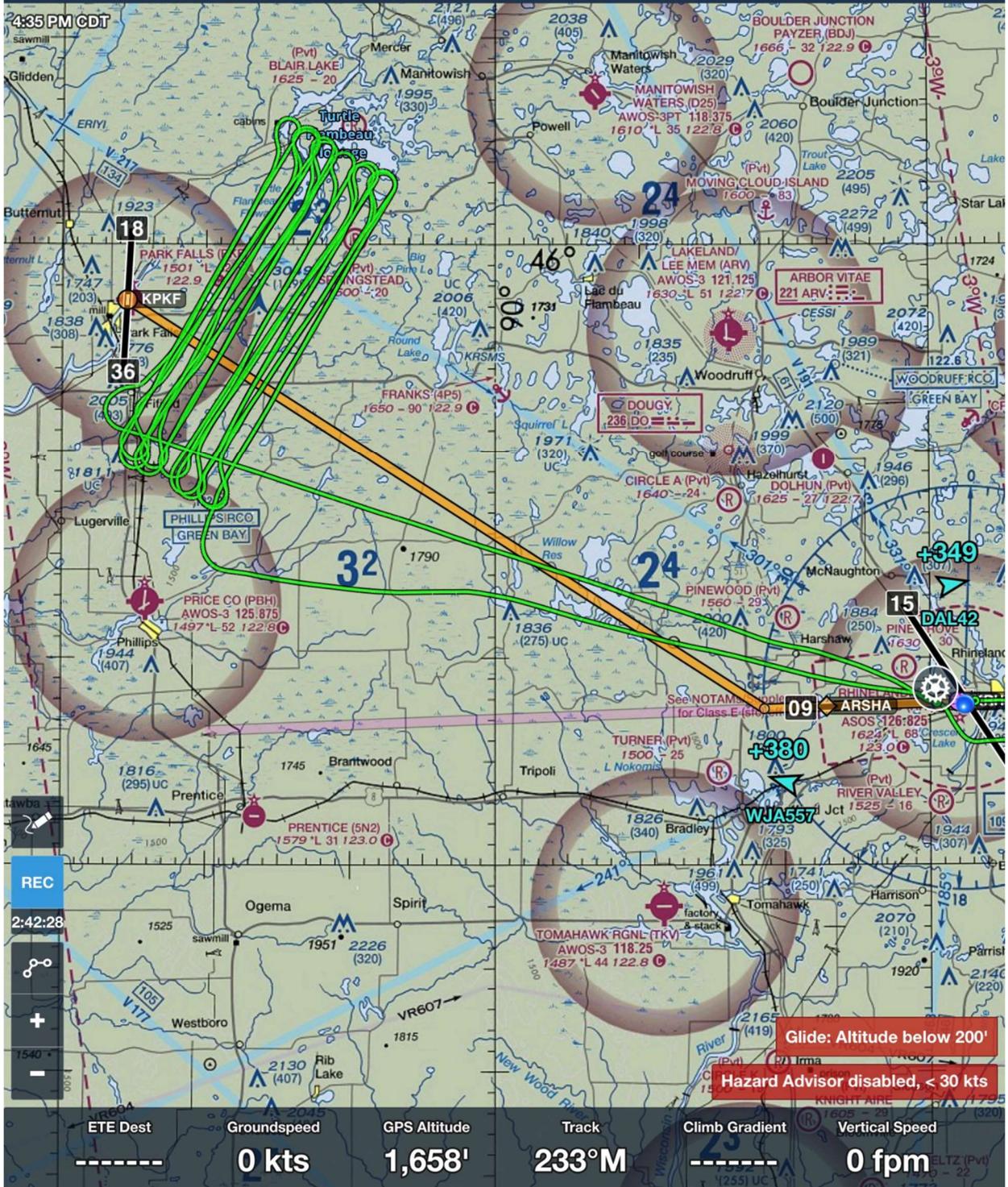


Weather



Star

Search



REC

2:42:28

ETE Dest

Groundspeed

GPS Altitude

Track

Climb Gradient

Vertical Speed

0 kts

1,658'

233°M

0 fpm



Airports



Maps



Plates



Documents



Imagery



Flights



ScratchPads



More

**Project:** CHEESEHEAD-19

13 Jul 2019

**Flight:** RF08

*Notes:*

Second flight of day, on SW1 pattern. System scientist operated lidars, no special maneuvers following pattern.

Zenith lidar data collection interrupted briefly ~2035 UTC.

Crew: Sigel, Desai, Plummer, Baleri; LOD: Little

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*Flight Summary:*

UTC Comment

1856 Wheels up.

1910 Starting at waypoint 1.

1910-1916 Leg 1, waypoints 1-2 at 1300' AGL.

1917-1922 Leg 2, waypoints 2-1 at 300' AGL.

1924-1929 Leg 3, waypoints 1-4 at 1300' AGL.

1930-1935 Leg 4, waypoints 4-1 at 300' AGL.

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1936-1941 Leg 5, waypoints 3-4 at 1300' AGL.

1943-1947 Leg 6, waypoints 4-3 at 300' AGL.

1949-1954 Leg 7, waypoints 3-6 at 1300' AGL.

1955-2000 Leg 8, waypoints 6-3 at 300' AGL.

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2002-2006 Leg 9, waypoints 5-6 at 1300' AGL.

2008-2012 Leg 10, waypoints 6-5 at 300' AGL.

2014-2018 Leg 11, waypoints 7-8 at 1300' AGL.

2020-2024 Leg 12, waypoints 8-7 at 300' AGL.

-----

2026-2031 Leg 13, waypoints 7-10 at 1300' AGL.

2033-2037 Leg 14, waypoints 10-7 at 300' AGL.

Zenith lidar PC rebooted, data collection interrupted briefly.

2039-2044 Leg 15, waypoints 9-10 at 1300' AGL.

2045-2050 Leg 16, waypoints 10-9 at 300' AGL.

-----

2052-2056 Leg 17, waypoints 9-12 at 1300' AGL.

2058-2103 Leg 18, waypoints 12-9 at 300' AGL.

2104-2109 Leg 19, waypoints 11-12 at 1300' AGL.

2111-2115 Leg 20, waypoints 12-11 at 300' AGL.

-----

2130 On the ground.

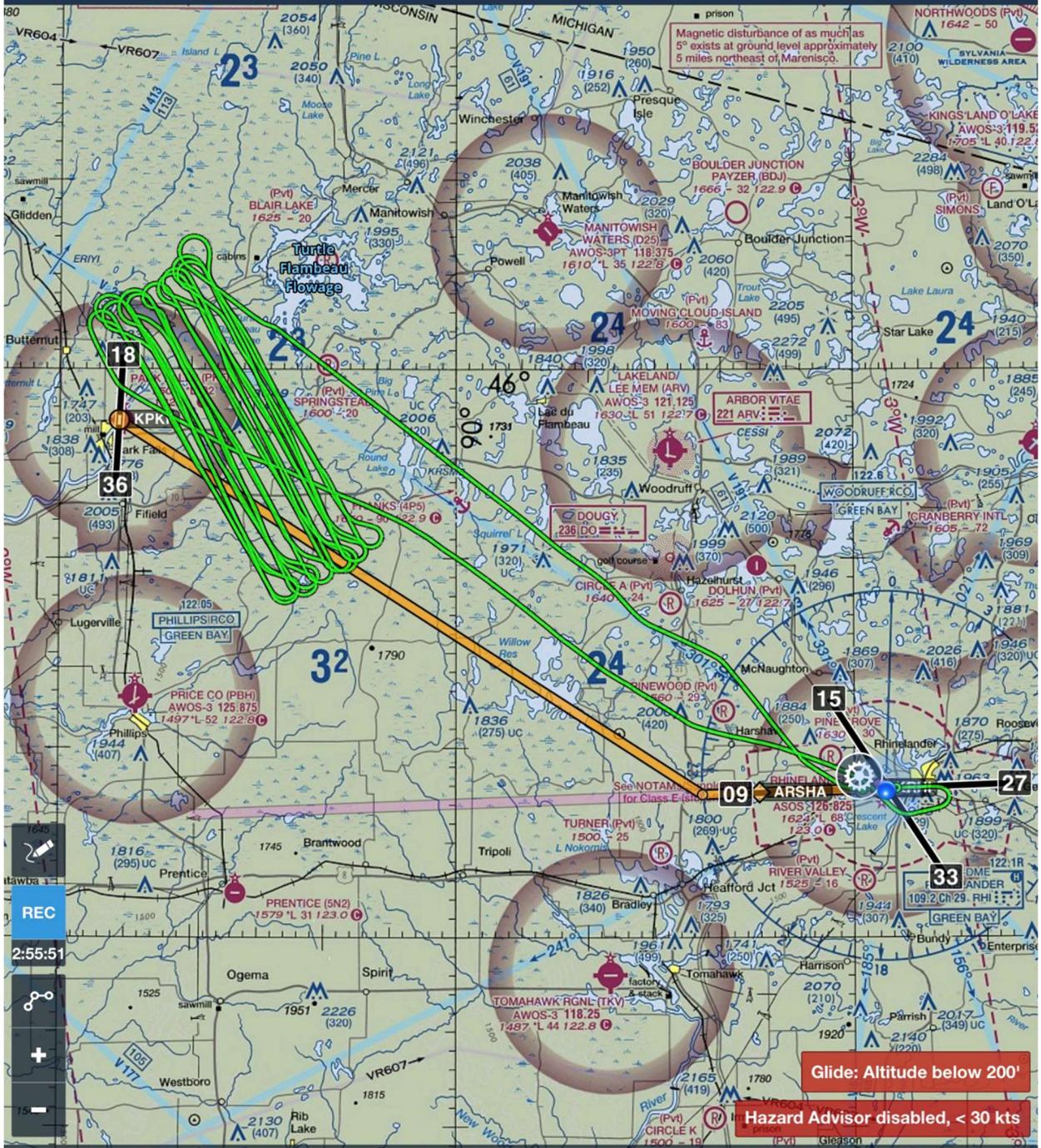
**07/13/2019 CHEESEHEAD Pilot notes (Research Flight 7)**

Crew. Sigel, Plummer, Baleri, Thom.

Flight Time: 2.9

**Planned:** Takeoff at 9:00 fly VFR to SE02. Fly the patterns as planned.

**Actual:** Departed RHI at 8:00 VFR. We Flew Direct to SE02 at 4500 MSL. Start decent to Before SE02 to 2900 MSL to fly the pattern. The weather was being called 10SM Sky clear at RHI. This was a new pattern but at this point I'm feeling fairly comfortable. There were no anomalies. I just kept an eye out for A/C and towers. There were no surprises on the patterns in the A/C or with towers. Being that is was a weekend there were a considerable more small A/C flying. All of them flying at VFR altitudes and much higher than us. After completing the pattern we returned to RHI. We turned slightly to avoided potential traffic on the return flight. The flight went well and there were no problems with the aircraft.



ETE Dest      Groundspeed      GPS Altitude      Track      Climb Gradient      Vertical Speed

-----      0 kts      1,681'      -----      -----      0 fpm

**Project:** CHEESEHEAD-19

13 Jul 2019

**Flight:** RF07

*Notes:*

First flight of day, on SE2 pattern. System scientist operated lidars, no special maneuvers following pattern.

Crew: Sigel, Thom, Plummer, Baleri; LOD: Little

-----

*Flight Summary:*

UTC Comment

1405 Wheels up.

1422 Starting at waypoint 12.

1422-1426 Leg 1, waypoints 12-11 at 1300' AGL.

1428-1433 Leg 2, waypoints 11-12 at 300' AGL.

1435-1439 Leg 3, waypoints 12-9 at 1300' AGL.

1441-1446 Leg 4, waypoints 9-12 at 300' AGL.

-----

1448-1452 Leg 5, waypoints 10-9 at 1300' AGL.

1455-1459 Leg 6, waypoints 9-10 at 300' AGL.

1501-1506 Leg 7, waypoints 10-7 at 1300' AGL.

1507-1513 Leg 8, waypoints 7-10 at 300' AGL.

-----

1515-1519 Leg 9, waypoints 8-7 at 1300' AGL.

1521-1526 Leg 10, waypoints 7-8 at 300' AGL.

1527-1532 Leg 11, waypoints 6-5 at 1300' AGL.

1533-1539 Leg 12, waypoints 5-6 at 300' AGL.

-----

1541-1545 Leg 13, waypoints 6-3 at 1300' AGL.

1547-1552 Leg 14, waypoints 3-6 at 300' AGL.

1554-1558 Leg 15, waypoints 4-3 at 1300' AGL.

1600-1605 Leg 16, waypoints 3-4 at 300' AGL.

-----

1607-1611 Leg 17, waypoints 4-1 at 1300' AGL.

1613-1618 Leg 18, waypoints 1-4 at 300' AGL.

1620-1625 Leg 19, waypoints 2-1 at 1300' AGL.

1627-1632 Leg 20, waypoints 1-2 at 300' AGL.

-----

1651 On the ground.

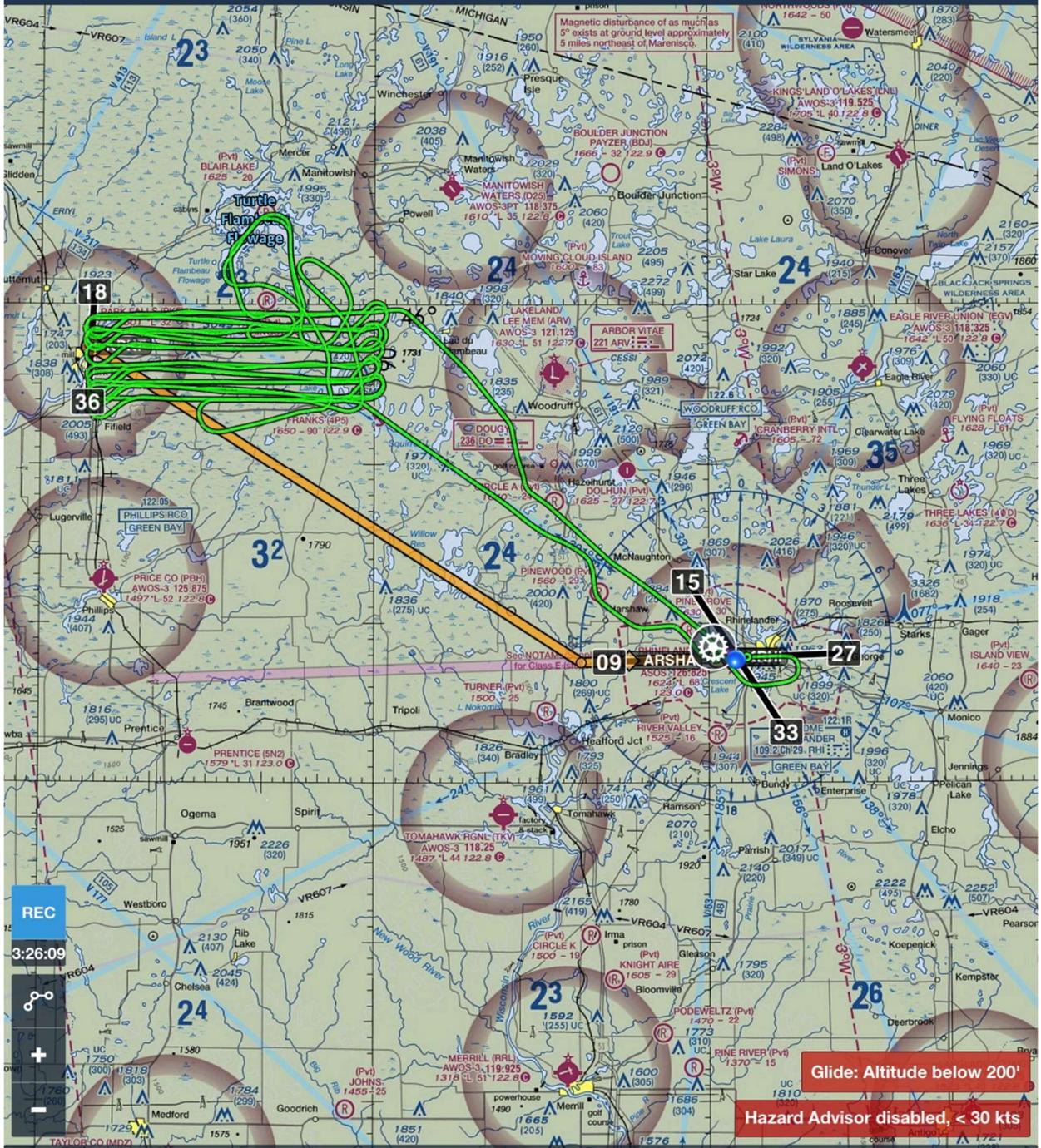
## 07/12/2019 CHEESEHEAD Pilot notes (Research Flight 6)

Crew. Sigel, Plummer, Little, Butterworth.

Flight Time: 3.2

**Planned:** Takeoff at 12:00 fly VFR to WE012. Fly the patterns as planned. Starting early to avoid incoming thunder storms.

**Actual:** Departed RHI at 12:00 VFR. We Flew Direct to WE012 at 4500 MSL. We could see there was a small shower at the end of the first leg. I started the leg from WE012 to WE011. About half way though the leg it started to rain and reduced forward visibility. I decided to abort the leg and give the storm time to pass. Dave was in communication with the crew on the ground and they were updating him on the movement and speed of the storm. This was helpful for making the decision to stay and wait it out. I flew to the north and took a sightseeing tour. We took two laps to the north and the storm had moved to the south enough to restart the patterns. The ceiling at this time I estimated to be around 4000 MSL and 10 miles visibility. This was a problem because A/C that were normally flying at higher altitudes were now trying to stay under the clouds and right at our altitude. I diverted once to miss another A/C. The other A/C never got within 5 miles but was right at 2900 MSL. I had to turn twice on the way home to avoid other aircraft. The visibility was good and could see them. The flight was uneventful. This flight was cool and not turbulent. This turned out to be a very long day by the time we were done. I tried to keep at as simple as possible and concentrate on the low level legs. The aircraft worked well and we returned to RHI.



REC  
3:26:09

ETE Dest      Groundspeed      GPS Altitude      Track      Climb Gradient      Vertical Speed

-----      0 kts      1,612'      236°M      -----      0 fpm



**Project:** CHEESEHEAD-19

12 Jul 2019

**Flight:** RF06

*Notes:*

Second flight of day, continuing on WE2 pattern. Observer & system scientist operated lidars.

Convection moving through observational domain early in flight, diverted around it until clear to start research measurements.

Crew: Sigel, Butterworth, Plummer, Little; LOD: Burkhardt/Little

-----

*Flight Summary:*

UTC Comment

1752 Wheels up.

Diverting for convection, on station at waypoint 12 at ~1833 UTC.

1833-1839 Leg 1, waypoints 12-11 at 1300' AGL.

1841-1845 Leg 2, waypoints 11-12 at 300' AGL.

1847-1852 Leg 3, waypoints 12-9 at 1300' AGL.

1854-1859 Leg 4, waypoints 9-12 at 300' AGL.

-----

**Note, cell tower approximately at waypoint 10.**

1900-1906 Leg 5, waypoints 10-9 at 1300' AGL.

1908-1912(divert early for tower) Leg 6, waypoints 9-10 at 300' AGL.

1914-1919 Leg 7, waypoints 10-7 at 1300' AGL.

1920-1925 Leg 8, waypoints 7-10 at 300' AGL.

-----

1927-1933 Leg 9, waypoints 8-7 at 1300' AGL.

1934-1939 Leg 10, waypoints 7-8 at 300' AGL.

1941-1946 Leg 11, waypoints 6-5 at 1300' AGL.

1948-1952 Leg 12, waypoints 5-6 at 300' AGL.

-----

1954-1959 Leg 13, waypoints 6-3 at 1300' AGL.

2001-2005 Leg 14, waypoints 3-6 at 300' AGL.

2007-2013 Leg 15, waypoints 4-3 at 1300' AGL.

2015-2019 Leg 16, waypoints 3-4 at 300' AGL.

-----

2021-2027 Leg 17, waypoints 4-1 at 1300' AGL.

2028-2033 Leg 18, waypoints 1-4 at 300' AGL.

2035-2040 Leg 19, waypoints 2-1 at 1300' AGL.

2041-2046 Leg 20, waypoints 1-2 at 300' AGL.

-----

2100 On the ground.

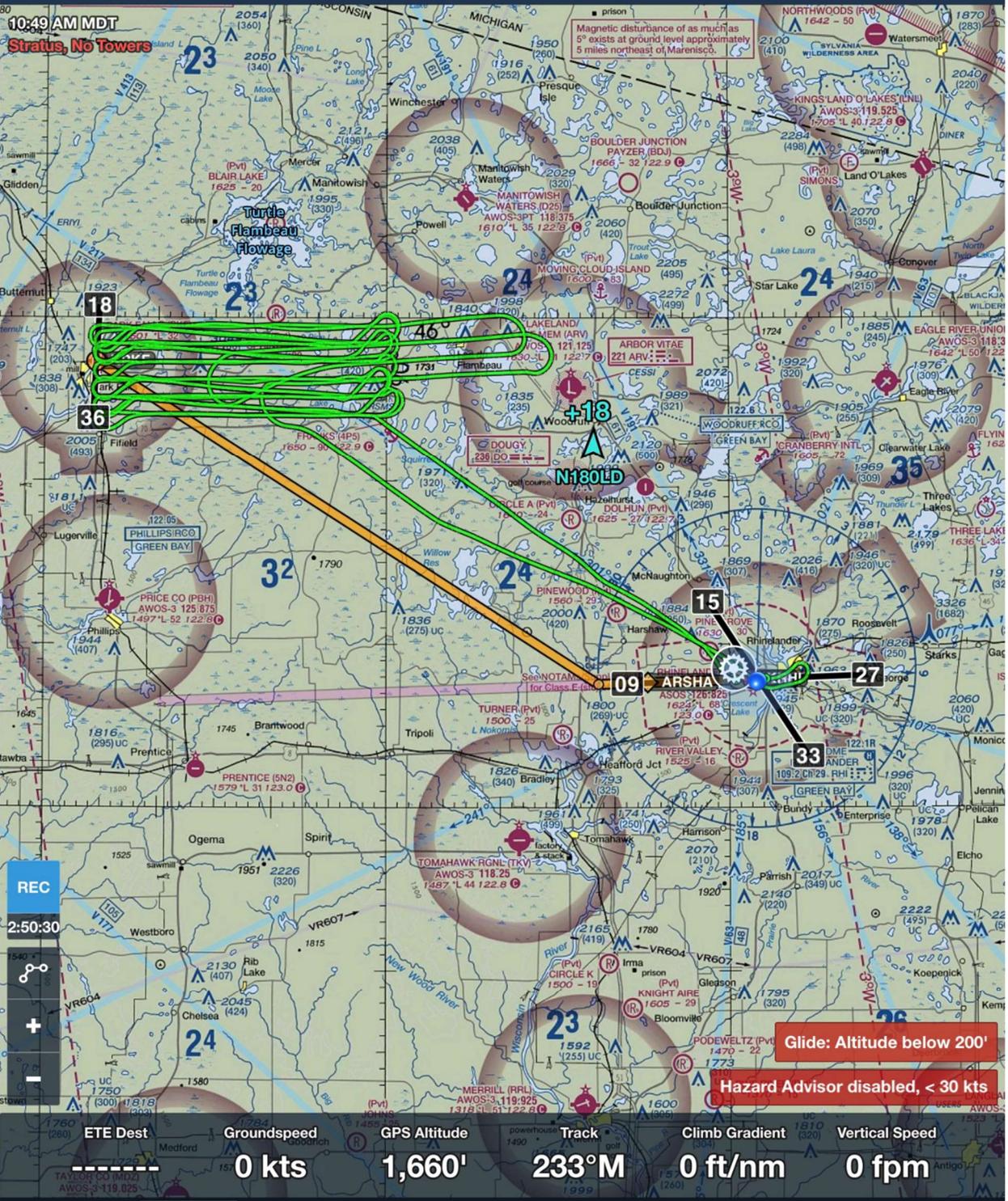
**07/12/2019 CHEESEHEAD Pilot notes (Research Flight 5)**

Crew. Sigel, Plummer, Wang, Butterworth.

Flight Time: 3.1

**Planned:** Takeoff at 8:30 fly VFR to WE012. Fly the patterns as planned. Start early to avoid an afternoon weather front.

**Actual:** Departed RHI at 8:30 VFR. We Flew Direct to WE012 at 4500 MSL. Start decent to Before WE012 to 2900 MSL to fly the pattern. The weather was being called 10SM Sky clear at RHI. It was very good visibility. The patterns at this point are feeling fairly comfortable. There were no anomalies. Ive just been concentrating on make them as precise as posable. After completing the pattern we flew two legs at 3500 and 4500 feet MSL and returned to RHI. The flight went well and there were no problems with the aircraft.



**Project:** CHEESEHEAD-19

12 Jul 2019

**Flight:** RF05

*Notes:*

First flight of day, on WE2 pattern. Short stacked passes for background CRL measurements following completion of pattern.

Crew: Sigel, Butterworth, Plummer, Wang; LOD: Little

-----

*Flight Summary:*

UTC Comment

1340 Wheels up.

1349 Starting at waypoint 12.

1349-1356 Leg 1, waypoints 12-11 at 1300' AGL.

1358-1402 Leg 2, waypoints 11-12 at 300' AGL.

1404-1410 Leg 3, waypoints 12-9 at 1300' AGL.

1412-1416 Leg 4, waypoints 9-12 at 300' AGL.

-----

**Note, cell tower approximately at waypoint 10.**

1418-1424 Leg 5, waypoints 10-9 at 1300' AGL.

1426-1430 (divert early for tower) Leg 6, waypoints 9-10 at 300' AGL.

1432-1438 Leg 7, waypoints 10-7 at 1300' AGL.

1440-1444 Leg 8, waypoints 7-10 at 300' AGL.

-----

1446-1452 Leg 9, waypoints 8-7 at 1300' AGL.

1454-1458 Leg 10, waypoints 7-8 at 300' AGL.

1500-1505 Leg 11, waypoints 6-5 at 1300' AGL.

1507-1511 Leg 12, waypoints 5-6 at 300' AGL.

-----

1513-1519 Leg 13, waypoints 6-3 at 1300' AGL.

1521-1525 Leg 14, waypoints 3-6 at 300' AGL.

1527-1533 Leg 15, waypoints 4-3 at 1300' AGL.

1534-1539 Leg 16, waypoints 3-4 at 300' AGL.

-----

1541-1546 Leg 17, waypoints 4-1 at 1300' AGL.

1548-1553 Leg 18, waypoints 1-4 at 300' AGL.

1555-1600 Leg 19, waypoints 2-1 at 1300' AGL.

1602-1606 Leg 20, waypoints 1-2 at 300' AGL.

-----

A couple stacked passes for CRL background measurements.

1609 4 kft MSL.

1617 4.5 kft MSL.

1625 5 kft MSL.

1644 On the ground.

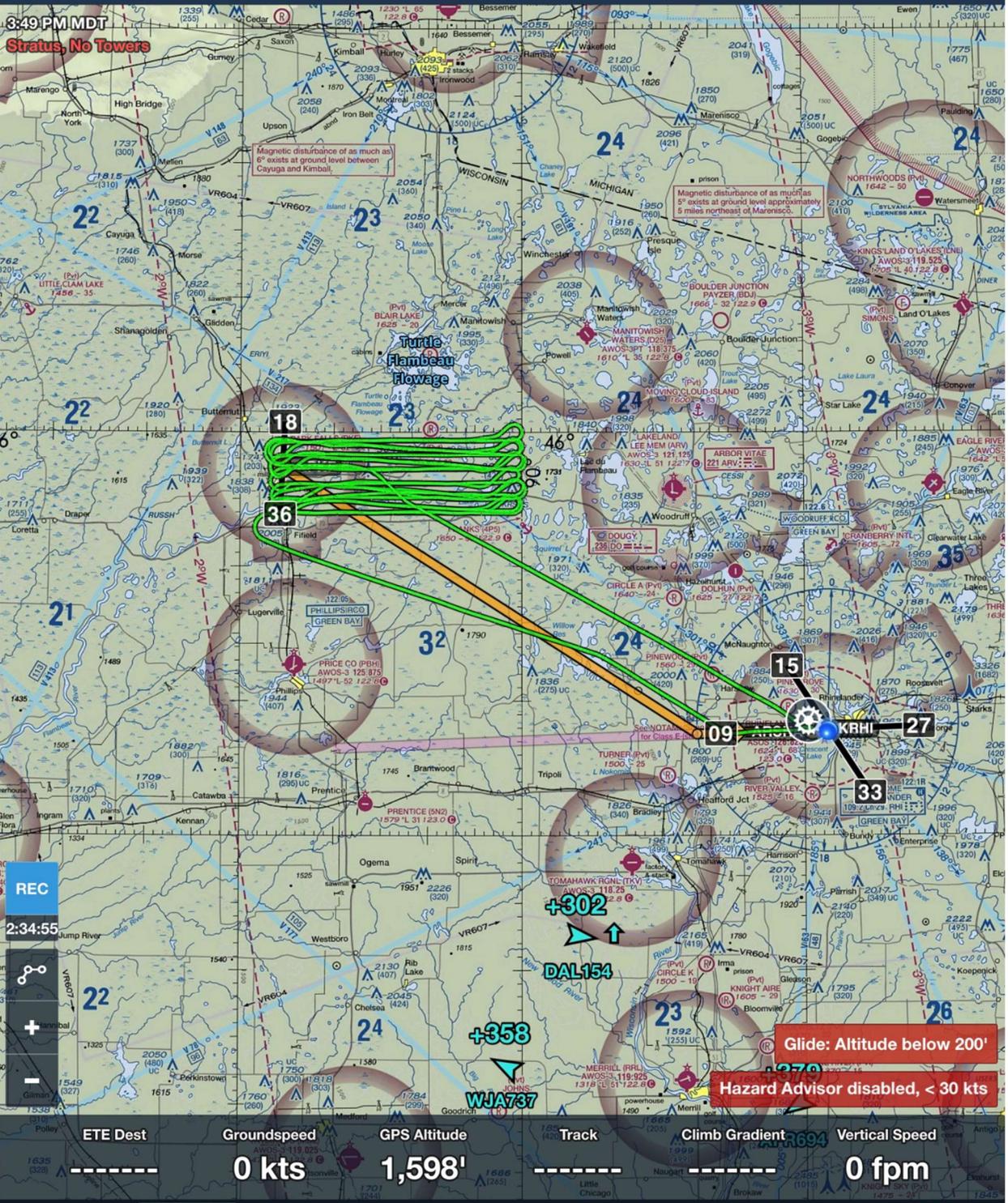
**07/11/2019 CHEESEHEAD Pilot notes (Research Flight 4)**

Crew. Sigel, Metzger, Plummer, Wang

Flight Time: 2.6

**Planned:** Takeoff at 14:00 fly VFR to WE01. Fly the patterns as planned.

**Actual:** Departed RHI at 14:00 VFR. We Flew Direct to WE01 at 4500 MSL. Avoided the tall tower on the way out 4500 feet clears it and is comfortable distains. Before Crossing WE01 descended to 2800 MSL starting the pattern. The weather was being called 6SM Sky clear at RHI. It was good visibility. The flight was uneventful. Not as much bird activity or aircraft. This flight was Hot and turbulent. It was a long day and by the time we got done I was tired. I tried to keep at as simple as posable and concentrate on the low level legs. No problems. The aircraft worked well.



3:49 PM MDT  
Stratus, No Towers

Magnetic disturbance of as much as 6° exists at ground level between Cayuga and Kimball.

Magnetic disturbance of as much as 5° exists at ground level approximately 5 miles northeast of Marengo.

REC

2:34:55

Glide: Altitude below 200'  
Hazard Advisor disabled, < 30 kts

ETE Dest Groundspeed GPS Altitude Track Climb Gradient Vertical Speed

0 kts 1,598' 0 fpm

Airports Maps Plates Documents Imagery Flights ScratchPads More

**Project:** CHEESEHEAD-19

11 Jul 2019

**Flight:** RF04

*Notes:*

Second flight of day, on WE1 pattern.

Crew: Sigel, Metzger, Plummer, Wang; LOD: Little

-----

*Flight Summary:*

UTC Comment

1859 Wheels up.

1914-1920 Leg 1, waypoints 1-2 at 1300' AGL.

1923-1927 Leg 2, waypoints 2-1 at 300' AGL.

1929-1934 Leg 3, waypoints 1-4 at 1300' AGL.

1936-1940 Leg 4, waypoints 4-1 at 300' AGL.

-----

1942-1947 Leg 5, waypoints 3-4 at 1300' AGL.

1949-1954 Leg 6, waypoints 4-3 at 300' AGL.

1956-2001 Leg 7, waypoints 3-6 at 1300' AGL.

2003-2008 Leg 8, waypoints 6-3 at 300' AGL.

-----

2010-2014 Leg 9, waypoints 5-6 at 1300' AGL.

2016-2021 Leg 10, waypoints 6-5 at 300' AGL.

2023-2028 Leg 11, waypoints 7-8 at 1300' AGL.

2030-2034 Leg 12, waypoints 8-7 at 300' AGL.

-----

2036-2041 Leg 13, waypoints 7-10 at 1300' AGL.

2043-2048 Leg 14, waypoints 10-7 at 300' AGL.

2050-2055 Leg 15, waypoints 9-10 at 1300' AGL.

2057-2101 Leg 16, waypoints 10-9 at 300' AGL.

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2103-2108 Leg 17, waypoints 9-12 at 1300' AGL.

2107-2114 Leg 18, waypoints 12-9 at 300' AGL.

2116-2121 Leg 19, waypoints 11-12 at 1300' AGL.

2123-2128 Leg 20, waypoints 12-11 at 300' AGL.

-----

2144 On the ground.

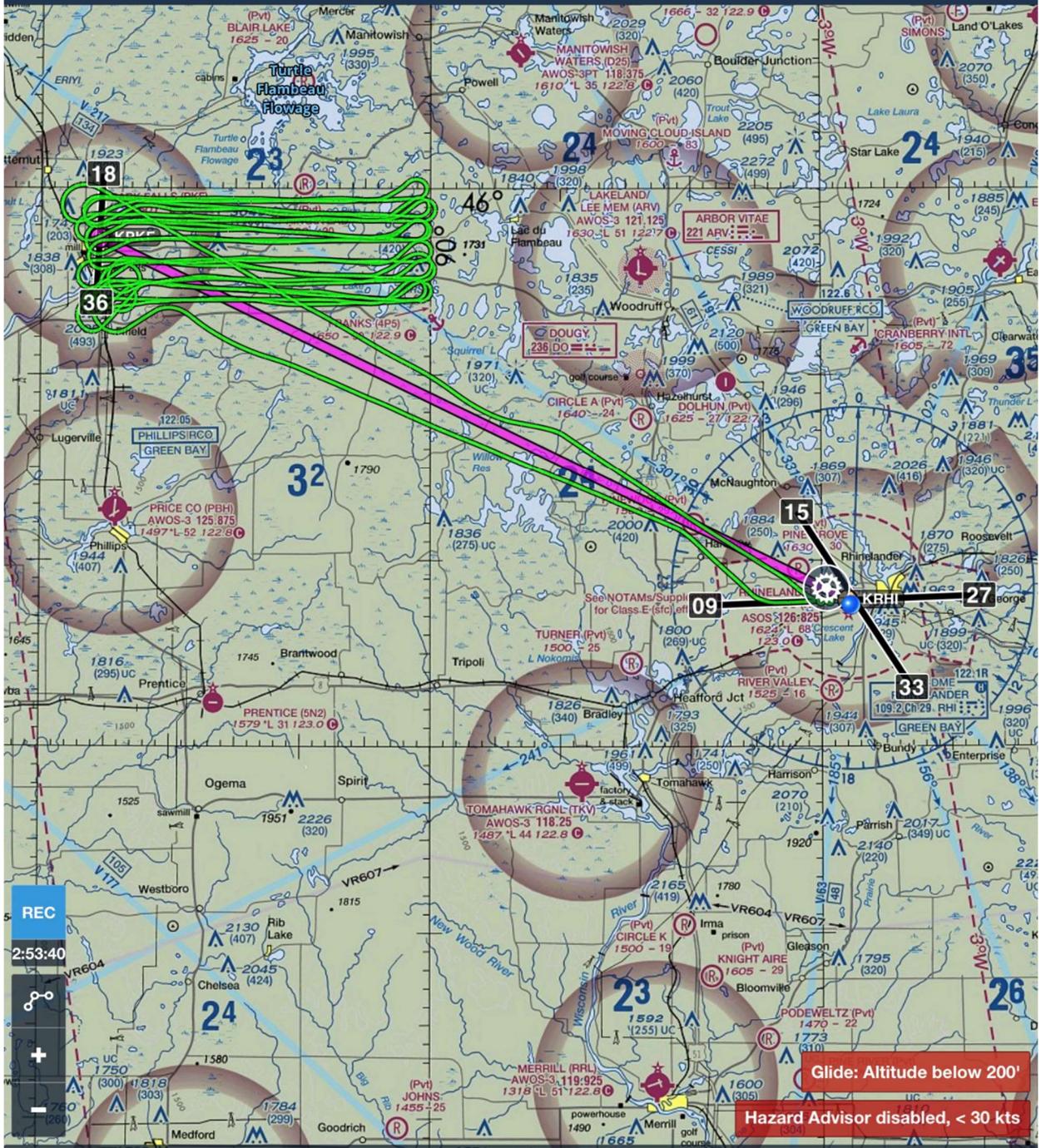
### **07/11/2019 CHEESEHEAD Pilot notes (Research Flight 3)**

Crew. Sigel, Metzger, Plummer, Wang

Flight Time: 3.0

**Planned:** Takeoff at 9:00 fly VFR to WE01. Fly the patterns as planned.

**Actual:** Departed RHI at 9:00 VFR. We Flew Direct to WE01 at 4500 MSL. Note this rout takes you over the tall tower if you depart 27 and go direct to WE01. Before Crossing WE01 descended to 2900 MSL starting the pattern. The weather was being called 10SM Sky clear at RHI. It was very good visibility. This was the same pattern we had flown previously but backwards. This pattern put us on our lower legs closer to Park Falls (PKF). This took some consideration when approaching the end of the legs due to the airport and keeping a safe distance from the town and buildings. I elected to start up before reaching the end of the legs to give myself more separation from town and towers. I've been monitoring two frequencies while flying 119.95 and 122.90. Monitoring 122.90 came in handy today because there was two aircraft operating out of PKF. I was able to communicate with them and stay clear. The altitudes I stay with 1900 and 2900 which I was hearing were too high. I just stayed with them. I also stayed with left hand turns for all of the pattern turns. 40 degree bank turns work well for the high turns and a standard rate 30 work well while climbing after 500 feet. A forty degree works well for intercepting the coarse and then descending after that. After completing the pattern we flew a spiraling accent to 8000 feet MSL and returned to RHI. The flight went well and there were no problems with the aircraft.



REC 2:53:40

ETE Dest 0 kts    Groundspeed 1,646'    GPS Altitude 320°M    Climb Gradient 0 fpm    Vertical Speed



**Project:** CHEESEHEAD-19

11 Jul 2019

**Flight:** RF03

*Notes:*

First flight of day, on WE1 pattern. Spiral ascent to 8 kft MSL for CRL profile following pattern.

Crew: Sigel, Metzger, Plummer, Wang; LOD: Little

-----

*Flight Summary:*

UTC Comment

1405 Wheels up.

1419 Starting descent to waypoint 1.

1421-1427 Leg 1, waypoints 1-2 at 1300' AGL.

1428-1433 Leg 2, waypoints 2-1 at 300' AGL.

1436-1440 Leg 3, waypoints 1-4 at 1300' AGL.

1442-1447 Leg 4, waypoints 4-1 at 300' AGL.

-----

1449-1454 Leg 5, waypoints 3-4 at 1300' AGL.

1456-1501 Leg 6, waypoints 4-3 at 300' AGL.

1503-1509 Leg 7, waypoints 3-6 at 1300' AGL.

1511-1515 Leg 8, waypoints 6-3 at 300' AGL.

-----

1517-1522 Leg 9, waypoints 5-6 at 1300' AGL.

1524-1528 Leg 10, waypoints 6-5 at 300' AGL.

1530-1535 Leg 11, waypoints 7-8 at 1300' AGL.

1537-1542 Leg 12, waypoints 8-7 at 300' AGL.

-----

1544-1549 Leg 13, waypoints 7-10 at 1300' AGL.

1551-1555 Leg 14, waypoints 10-7 at 300' AGL, avoided traffic near end of leg.

1558-1603 Leg 15, waypoints 9-10 at 1300' AGL.

1604-1609 Leg 16, waypoints 10-9 at 300' AGL.

-----

1611-1616 Leg 17, waypoints 9-12 at 1300' AGL.

1618-1622 Leg 18, waypoints 12-9 at 300' AGL.

1624-1629 Leg 19, waypoints 11-12 at 1300' AGL.

1631-1635 Leg 20, waypoints 12-11 at 300' AGL.

-----

1636 Spiral to 8 kft MSL for CRL vertical profile.

1655 On the ground.





**Project:** CHEESEHEAD-19

9 Jul 2019

**Flight:** RF02

*Notes:*

Second flight of day, continuing on WE2 pattern. No extra measurements following pattern.

Crew: Sigel, Desai, Plummer, Wang; LOD: Little

-----

*Flight Summary:*

UTC Comment

1902 Wheels up.

1911 Starting at waypoint 12.

1911-1917 Leg 1, waypoints 12-11 at 1300' AGL.

1918-1923 Leg 2, waypoints 11-12 at 300' AGL.

1926-1930 Leg 3, waypoints 12-9 at 1300' AGL.

1932-1937 Leg 4, waypoints 9-12 at 300' AGL.

-----

**Note, cell tower approximately at waypoint 10.**

1938-1943 Leg 5, waypoints 10-9 at 1300' AGL.

1945-1950 (divert early for tower) Leg 6, waypoints 9-10 at 300' AGL.

1951-1956 Leg 7, waypoints 10-7 at 1300' AGL.

1958-2002 Leg 8, waypoints 7-10 at 300' AGL.

-----

2004-2008 Leg 9, waypoints 8-7 at 1300' AGL.

2010-2015 Leg 10, waypoints 7-8 at 300' AGL.

2016-2021 Leg 11, waypoints 6-5 at 1300' AGL.

2023-2027 Leg 12, waypoints 5-6 at 300' AGL.

-----

2029-2034 Leg 13, waypoints 6-3 at 1300' AGL.

2036-2041 Leg 14, waypoints 3-6 at 300' AGL.

2042-2047 Leg 15, waypoints 4-3 at 1300' AGL.

2049-2054 Leg 16, waypoints 3-4 at 300' AGL.

-----

2056-2100 Leg 17, waypoints 4-1 at 1300' AGL.

2102-2107 Leg 18, waypoints 1-4 at 300' AGL.

2108-2113 Leg 19, waypoints 2-1 at 1300' AGL.

2115-2120 Leg 20, waypoints 1-2 at 300' AGL.

-----

2131 On the ground.

## **07/09/2019 CHEESEHEAD Pilot notes (Research Flight 1)**

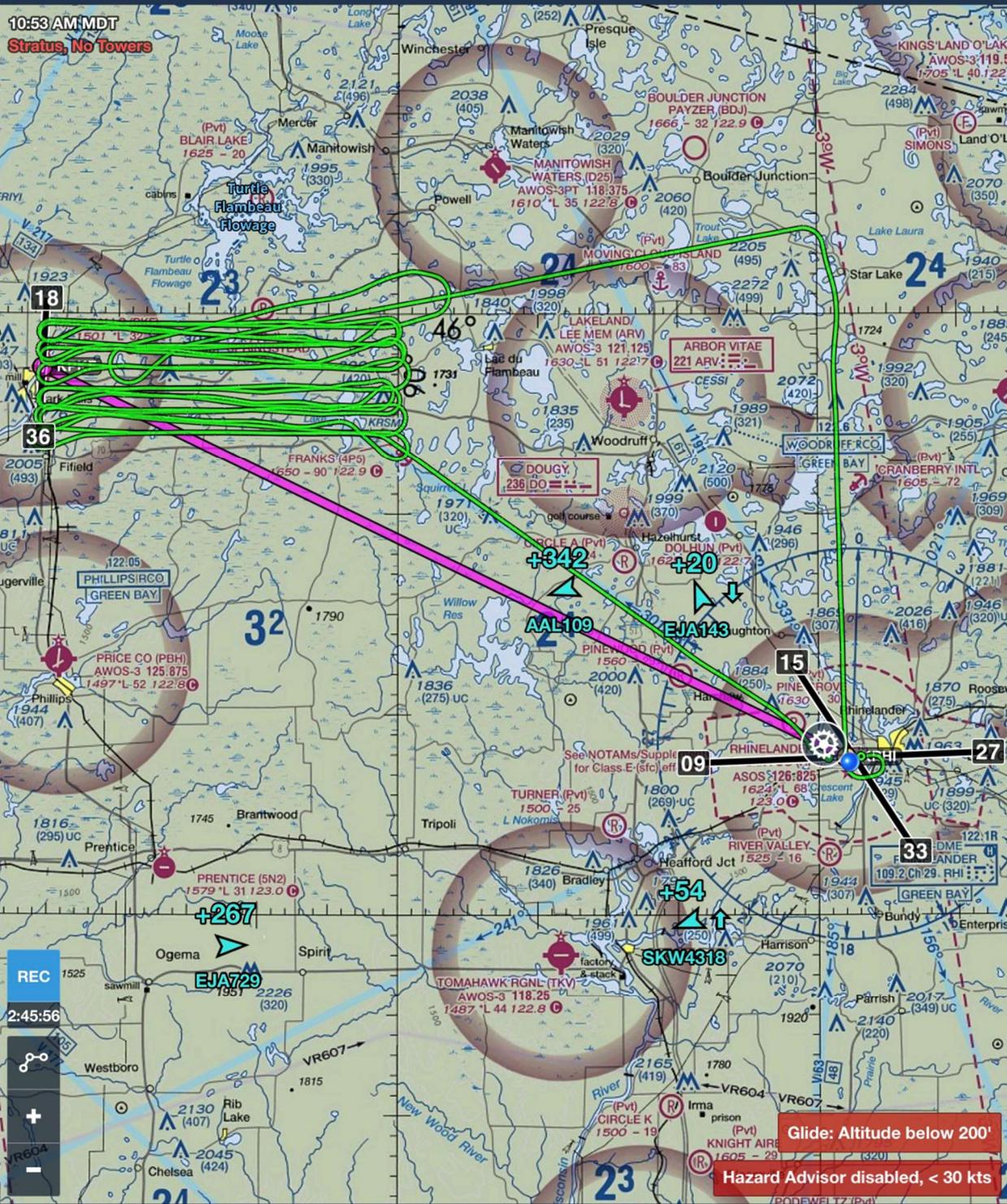
Crew. Sigel, Plummer, Deng.

Flight Time: 3.0

**Planned:** Takeoff at 9:00 fly VFR to WE012. Fly the patterns as planned.

**Actual:** Departed RHI at 9:00 VFR. We Flew Direct to WE012 at 4500 MSL. Before Crossing WE012 descended to 2800 MSL starting the pattern. The weather was being called 6SM Sky clear at RHI. It was more like 3 miles and Smokey. I would still say this felt comfortable due to having flown the pattern before. The visibility steadily increased to be about 4 to 5 miles. The main tower was visible on the first leg. Also on the first leg (WE011) we passed a tower that is east of the end of the leg. Its 400 feet tall but not much of a concern do to those legs being done at 2800 MSL. I've been monitoring two frequencies while flying 119.95 and 122.90. 119.95 is to let the drone pilot launch when we reach WE06. At this point we are north of the big tower and the drone will remain south of it. 122.90 is the CTF for Park Falls (PKF). PKF is not busy and I haven't seen any traffic go in or out. We do make several turn in the vicinity of PKF on the west side of the pattern. The altitudes we flew changed from 2800 to 2900 MSL and were the same 1900 for the lower altitude. I stay with left hand turns for all of the pattern turns. The patterns are taking less time than thought and staying with left turn takes another complication out of it. After completing the pattern we flew two legs over the area at 4500 MSL and 3500. The flight went well and there were no problems.

10:53 AM MDT  
Stratus, No Towers



## 07/09/2019 CHEESEHEAD Pilot notes (Research Flight 2)

Crew. Sigel, Plummer, Deng.

Flight Time: 2.6

**Planned:** Takeoff at 14:00 fly VFR to WE012. Fly the patterns as planned.

**Actual:** Departed RHI at 14:00 VFR. We Flew Direct to WE012 at 4500 MSL. Before Crossing WE012 descended to 2800 MSL starting the pattern. The weather was being called 6SM Sky clear at RHI. It was at least 6SM when looking at the ground. I would call it 4 looking forward. We had two aircraft pass within 4 miles of us and could never pick them up. This area is full of low flying float planes. The good thing is we are not in the main flyway. They are staying mostly over the water. We turned once to avoid an eagle and he was diving to get out of the way. Not as much bird activity as the day before. This flight was Hot and turbulent. The crew did a great job of pushing the A/C in the hanger and were able to keep it cool on the ground. The heat and turbulence was defiantly a factor on fatigue. I wasn't worn out till the last leg. It was on my mind and something to pay attention to. The flight went well and there were no mechanical problems.

**Project:** CHEESEHEAD-19

9 Jul 2019

**Flight:** RF01

*Notes:*

First flight of day, on WE2 pattern. Shifted upper passes from ~1200' to ~1300' AGL (from 2800' to 2900' MSL) for this and subsequent flights. Short stacked passes for background CRL measurements following completion of pattern.

Crew: Sigel, Desai, Plummer, Wang; LOD: Little

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*Flight Summary:*

UTC Comment

1356 Wheels up.

1407 Starting at waypoint 12.

1407-1412 Leg 1, waypoints 12-11 at 1300' AGL.

1413-1418 Leg 2, waypoints 11-12 at 300' AGL.

1420-1425 Leg 3, waypoints 12-9 at 1300' AGL.

1427-1432 Leg 4, waypoints 9-12 at 300' AGL.

-----

**Note, cell tower approximately at waypoint 10.**

1433-1438 Leg 5, waypoints 10-9 at 1300' AGL.

1440-1445 (divert early for tower) Leg 6, waypoints 9-10 at 300' AGL.

1447-1452 Leg 7, waypoints 10-7 at 1300' AGL.

1454-1458 Leg 8, waypoints 7-10 at 300' AGL.

-----

1459-1504 Leg 9, waypoints 8-7 at 1300' AGL.

1506-1511 Leg 10, waypoints 7-8 at 300' AGL.

1513-1518 Leg 11, waypoints 6-5 at 1300' AGL.

1519-1524 Leg 12, waypoints 5-6 at 300' AGL.

-----

1526-1531 Leg 13, waypoints 6-3 at 1300' AGL.

1533-1537 Leg 14, waypoints 3-6 at 300' AGL.

1539-1544 Leg 15, waypoints 4-3 at 1300' AGL.

1545-1550 Leg 16, waypoints 3-4 at 300' AGL.

-----

1552-1557 Leg 17, waypoints 4-1 at 1300' AGL.

1559-1603 Leg 18, waypoints 1-4 at 300' AGL.

1605-1610 Leg 19, waypoints 2-1 at 1300' AGL.

1612-1616 Leg 20, waypoints 1-2 at 300' AGL.

-----

A couple stacked passes for CRL background measurements.

1619 ~3000' AGL.

1626 ~1800' AGL.

1647 On the ground.

**Project:** CHEESEHEAD-19

23 Sep 2019

**Flight:** TF06

*Notes:*

Pilot familiarization flight over limited portions of observation domain, initially in most congested area of pattern SE1, then surveying central tower and cell tower at SE end of pattern. Ran data system and collected lidar data.

EdgeTech was not usable - apparently locked in heating cycle, manual balance cycle/cooling control did not mitigate issue. TDP and related derived moisture variables invalid.

Crew: Wadsworth, Plummer, Deng; LOD: Morgan

-----

*Flight Summary:*

UTC Comment

1710 Wheels up.

1722 Starting left side of pattern SE1.

1722-1728 Leg 1, waypoints 1-2 at 1300' AGL.

1731-1736 Leg 2, waypoints 2-1 at 300' AGL.

1739-1745 Leg 3, waypoints 1-4 at 1300' AGL.

1747-1753 Leg 4, waypoints 4-1 at 300' AGL.

1756-1802 Leg 5, waypoints 3-4 at 1300' AGL.

Stepped over to survey central tower.

1804-1810 Leg 10, waypoints 6-5 at 300' AGL.

1810 Turn to survey cell tower at waypoint 10 in EW pattern, ~2000' AGL, then continue on to RHI.

1827 On the ground.

**08/19/2019 Pilot notes (Test FLT. 4)**

Crew: Drew, Oolman, Wang, and Desai

Flight Time: 1.4

**Planned:** Takeoff at 10:00. Fly a couple legs of SE01 and leg 9-10 on WE01.

**Actual:** Took off flew to starting point at 3000 MSL. Flew first lines and then skipped to 5-6. Chatted to NOAA to go ahead and fly the drone. Tried them on the radio, but their range is pretty limited. They called us on the radio once on the WE01 W-E leg. After crossing tower near WE10, returned to KRHI.

## **CHEESEHEAD TF04 - 19 August 2019**

*Tom Drew, Ankur Desai, Larry Oolman, Zhien Wang, Brent Glover (LOD)*

1459            Take off  
1510-1516     Start SE01 to SE02 line, FL029 towards NW  
1513            T=15 C, DP=6 C, winds 14 kt from 250 degT  
1518-1524     SE02 to SE01, FL019 towards SE  
1526-1532     SE01 to SE04 at FL029  
1534-1540     SE04 to SE01 at FL019  
1541-1546     SE03 to SE04 at FL029  
1548-1554     On SE06 to SE05 at FL019  
1600-1606     On WE09 to WE10 at FL019  
1606            Head back to RHI  
1617            Land

## **CHEESEHEAD TF03 – 14 August 2019**

*Tom Drew, Thomas Mazzetti, Larry Oolman, Min Deng, Brent Glover (LOD)*

1745 Take off

1750 WCL over temperature

1757 WCL started

1824 Start line northbound above Rock Creek at 2000 ft agl

1829 Reverse course and drop to 500 ft agl

1836 Head back to Laramie

1847 Land

**Project:** CHEESEHEAD-19

8 Jul 2019

**Flight:** TF02

*Notes:*

Pilot survey flight over CHEESEHEAD domain. Winds are from the south, so using the WE2 pattern starting from the southeast (waypoint 12). As the terrain meant we could not acquire enough CRL data ahead of time based out of KLAR, we are recording data as normal to the extent that it does not interfere with the pilot. We made two stacked passes for the CRL following completion of the pattern; data were recorded incorrectly so no measurements to the surface were available.

Crew: Sigel, Plummer, Wang; LOD: Little

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*Flight Summary:*

UTC Comment

1403 Wheels up.

Ground level is ~1600' MSL enroute. Will use 1900' MSL (300' AGL) and 2800' MSL (1200' AGL) as starting points (note, moved to 1300' AGL for subsequent flights).

Times approximate, but ~25 minutes for each set of four passes.

1413 Waypoint 12, approximately ten minutes ferry time to SE corner of domain.

1413-1418 Leg 1, waypoints 12-11 at 1200' AGL.

1420-1423 Leg 2, waypoints 11-12 at 300' AGL.

1425-1430 Leg 3, waypoints 12-9 at 1200' AGL.

1432-1437 Leg 4, waypoints 9-12 at 300' AGL.

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**Note, cell tower approximately at waypoint 10.**

1439-1444 Leg 5, waypoints 10-9 at 1200' AGL.

1446-1450 (divert early for tower) Leg 6, waypoints 9-10 at 300' AGL.

1452-1457 Leg 7, waypoints 10-7 at 1200' AGL.

1459-1503 Leg 8, waypoints 7-10 at 300' AGL.

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1505-1510 Leg 9, waypoints 8-7 at 1200' AGL.

1512-1516 Leg 10, waypoints 7-8 at 300' AGL.

1518-1523 Leg 11, waypoints 6-5 at 1200' AGL.

1524-1530 Leg 12, waypoints 5-6 at 300' AGL.

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1532-1537 Leg 13, waypoints 6-3 at 1200' AGL.

1538-1543 Leg 14, waypoints 3-6 at 300' AGL.

1544-1549 Leg 15, waypoints 4-3 at 1200' AGL.

1550-1556 Leg 16, waypoints 3-4 at 300' AGL.

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1558-1603 Leg 17, waypoints 4-1 at 1200' AGL.

1605-1610 Leg 18, waypoints 1-4 at 300' AGL.

1611-1616 Leg 19, waypoints 2-1 at 1200' AGL.

1617-1622 Leg 20, waypoints 1-2 at 300' AGL.

1628 Starting stacked passes for CRL, approximately 2000' AGL.

1633 Second pass, approximately 3000' AGL.

1640 Done, enroute to RHI.

1653 On the ground.