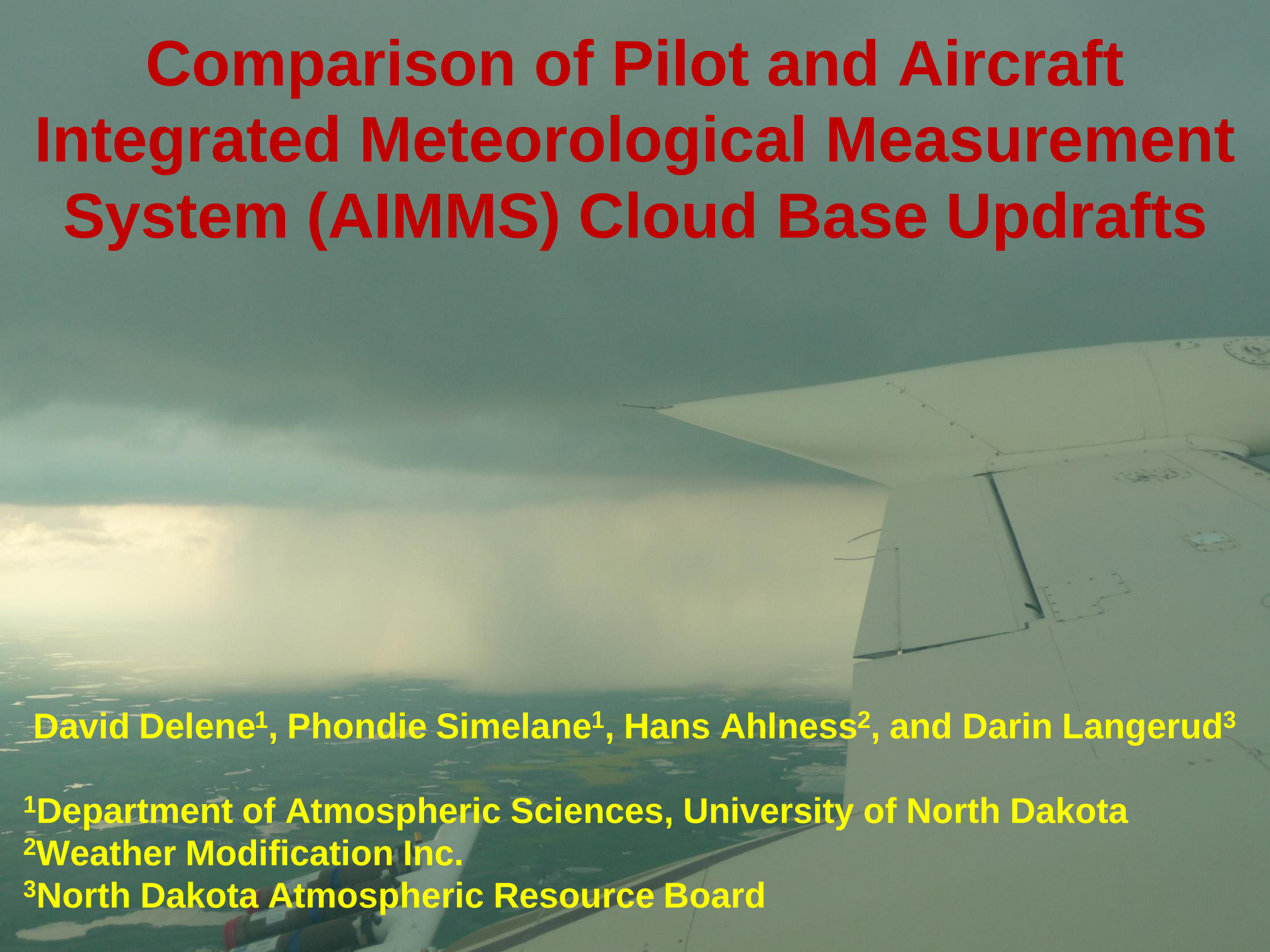
Comparison of Pilot and Aircraft Integrated Meteorological Measurement System (AIMMS) Cloud Base Updrafts



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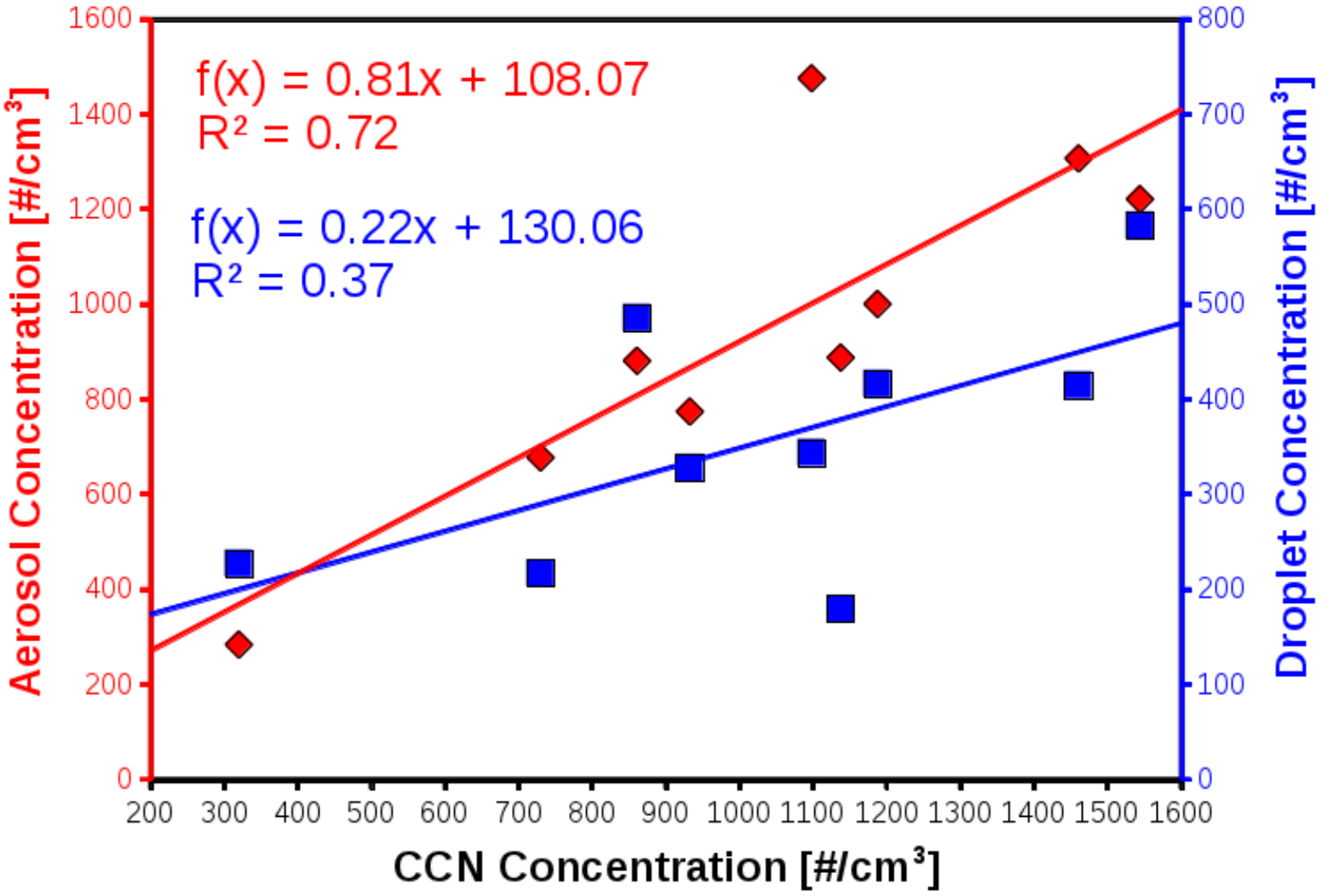
Significance of Updrafts

Updrafts of 0.5 m s^{-1} produce maximum supersaturations of approximately 0.3 %, while 2.0 m s^{-1} updrafts produce maximum supersaturations of approximately 0.6 %.



Measurements of Updrafts

Pilot Estimates

View from the right seat of the Cessna 340 (ND98585) on July 2, 2012.

Gust Probe Instruments

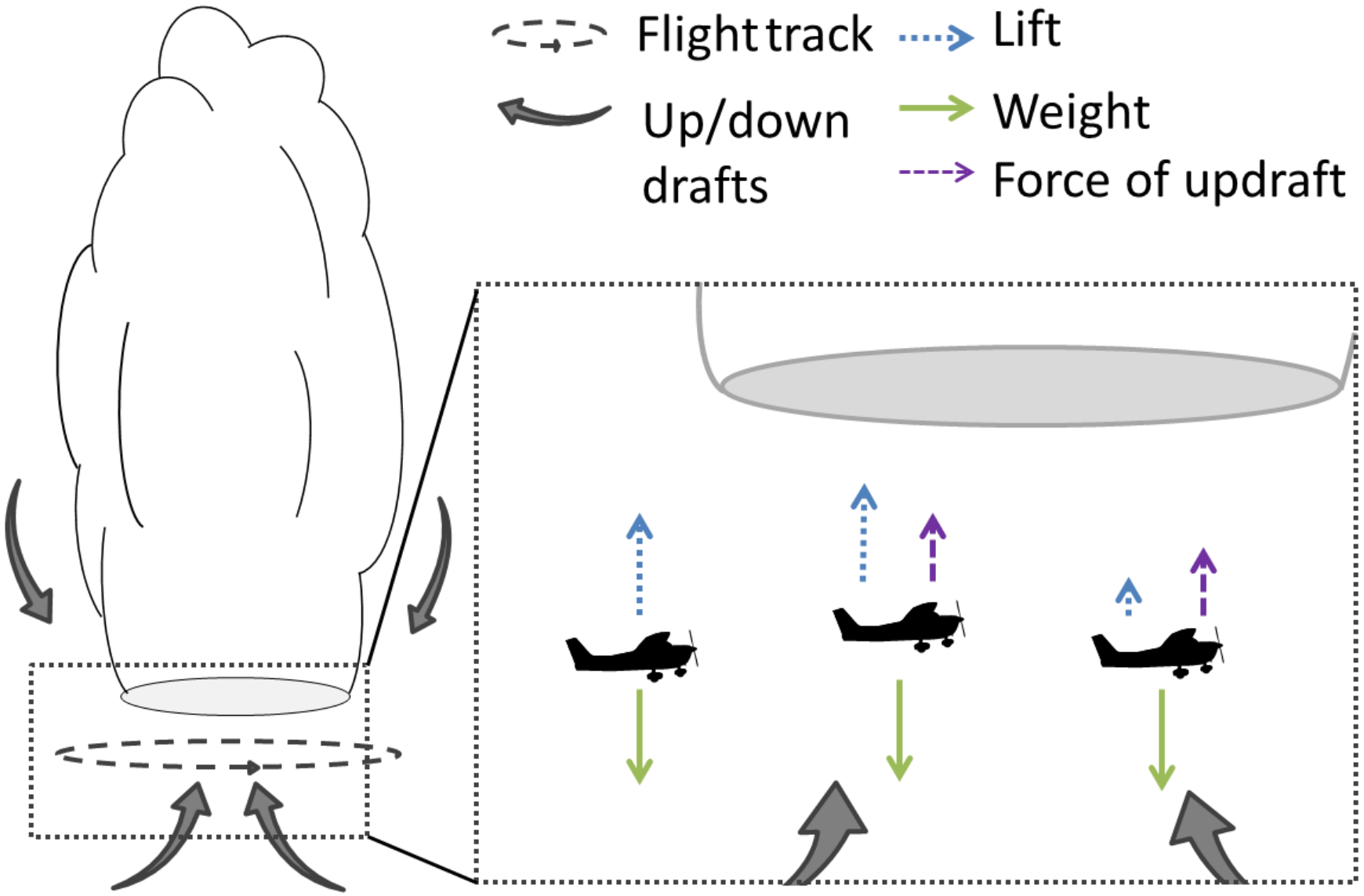
Aircraft Integrated Meteorological Measurement System (AIMMS) under the left wing on the Cessna 340 (ND98585) used during the 2012 POLCAST4 field project.

Objective

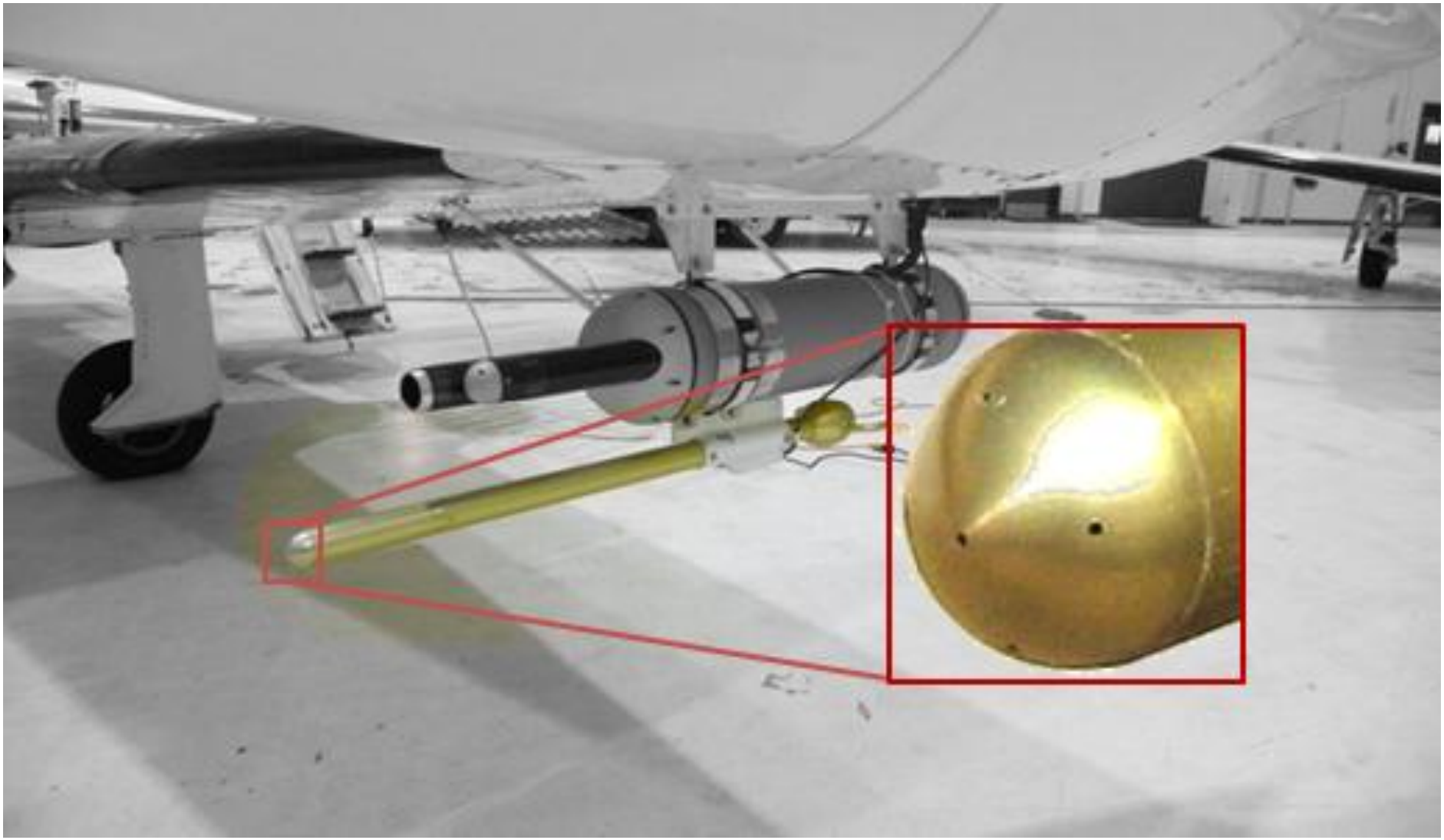
Evaluate the accuracy of vertical wind estimates made by a pilot while flying under a developing cumulus cloud.

The evaluation is done by comparing pilot estimates to Aircraft Integrated Measurement System (AIMMS) measurements.

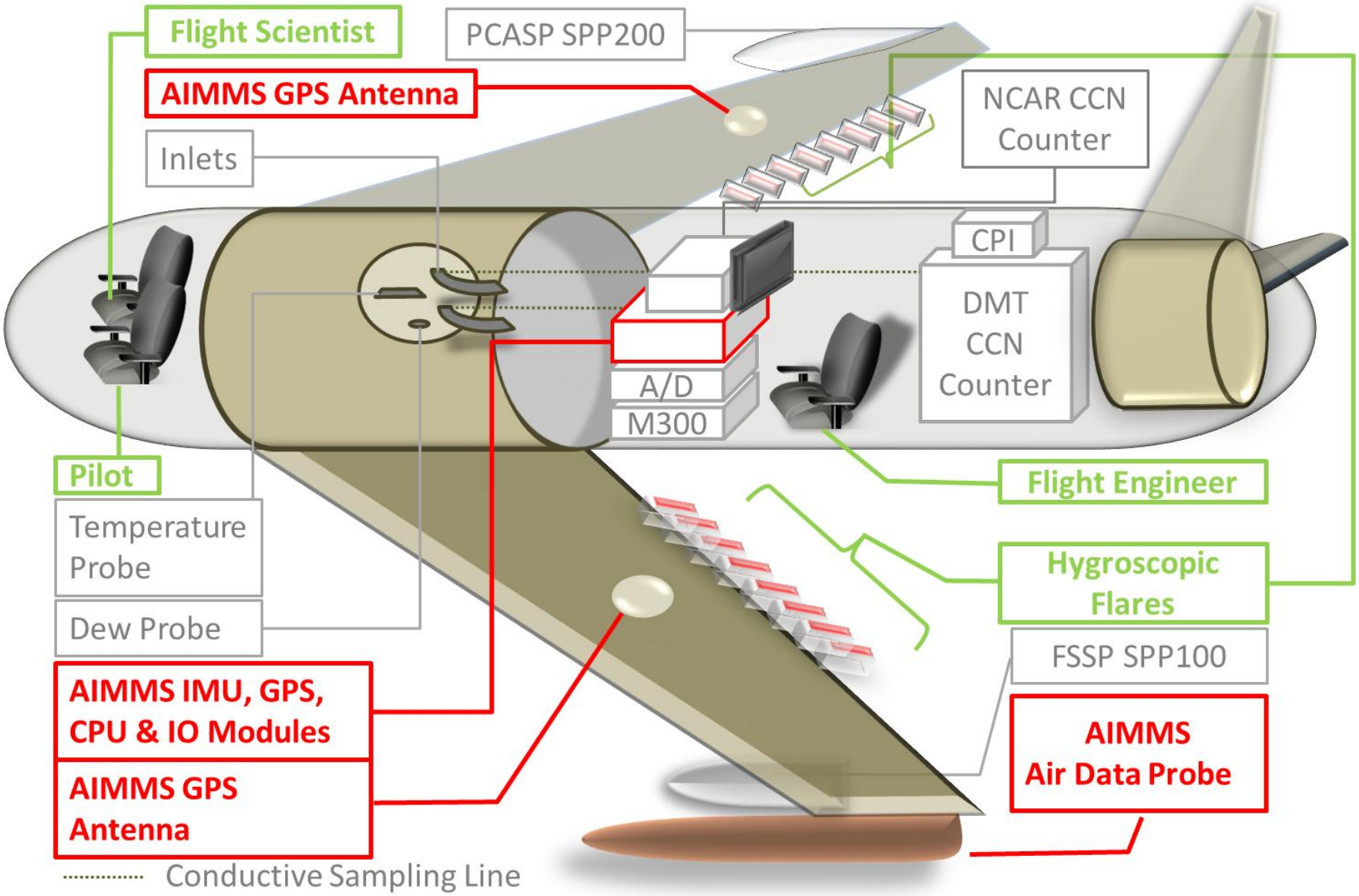
Level Flight Beneath Cloud Base



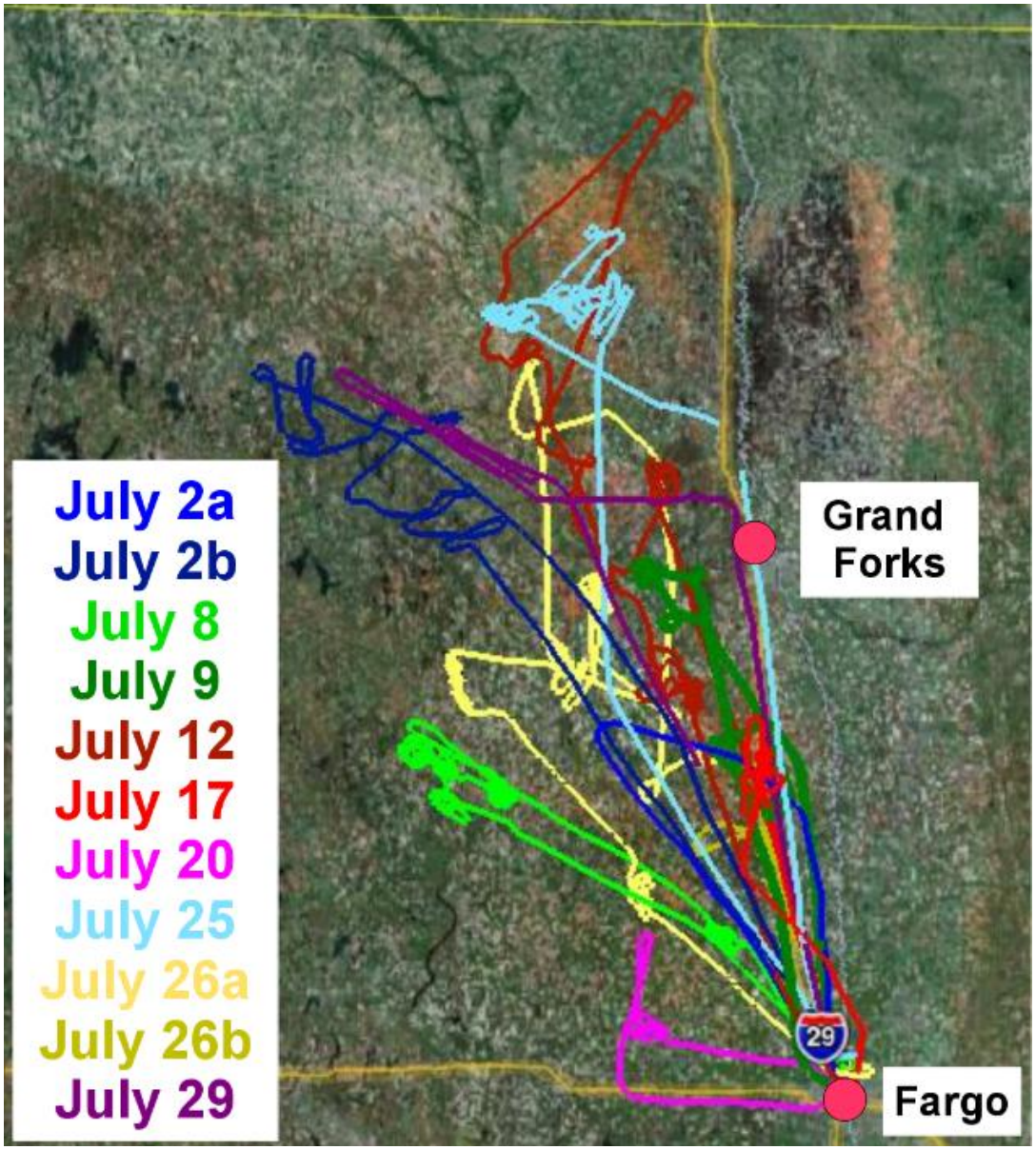
Aircraft Integrated Meteorological Measurement System



2012 Aircraft Instrument Configuration



POLCAST FIELD PROJECT FLIGHTS



6 of the 17 cases included the AIMMS gust probe.

<u>Calibration Flight</u>

July 20, 2012

<u>Seeding Flights</u>

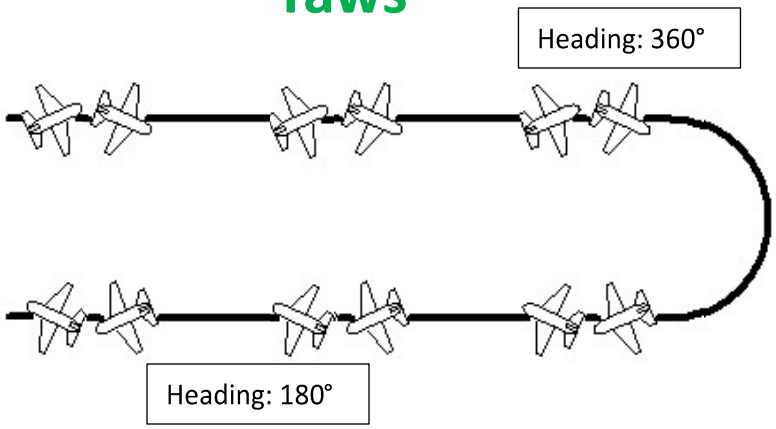
July 26 & 27, 2012

<u>Validation Flight</u>

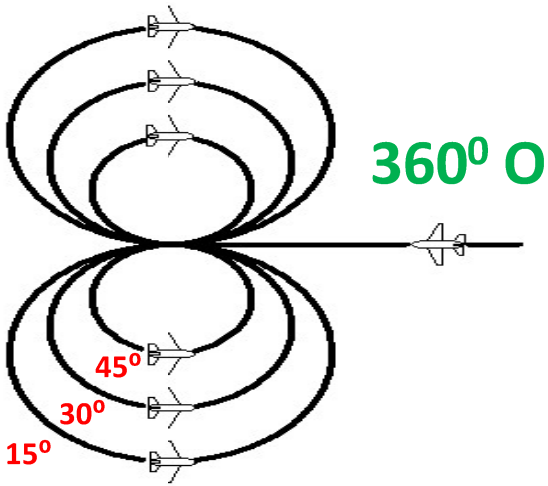
July 29, 2012

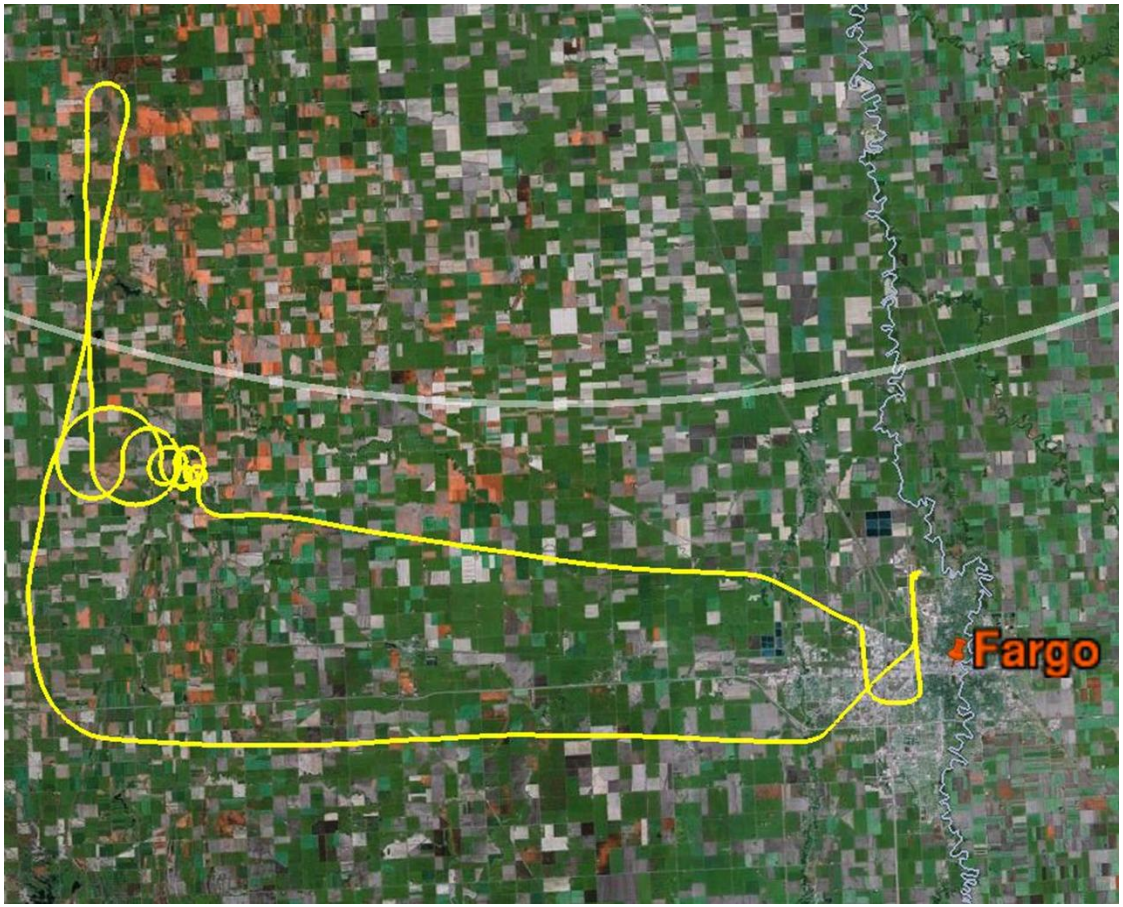
July 20, 2012: Calibration Flight

Yaws



360^0 Orbits

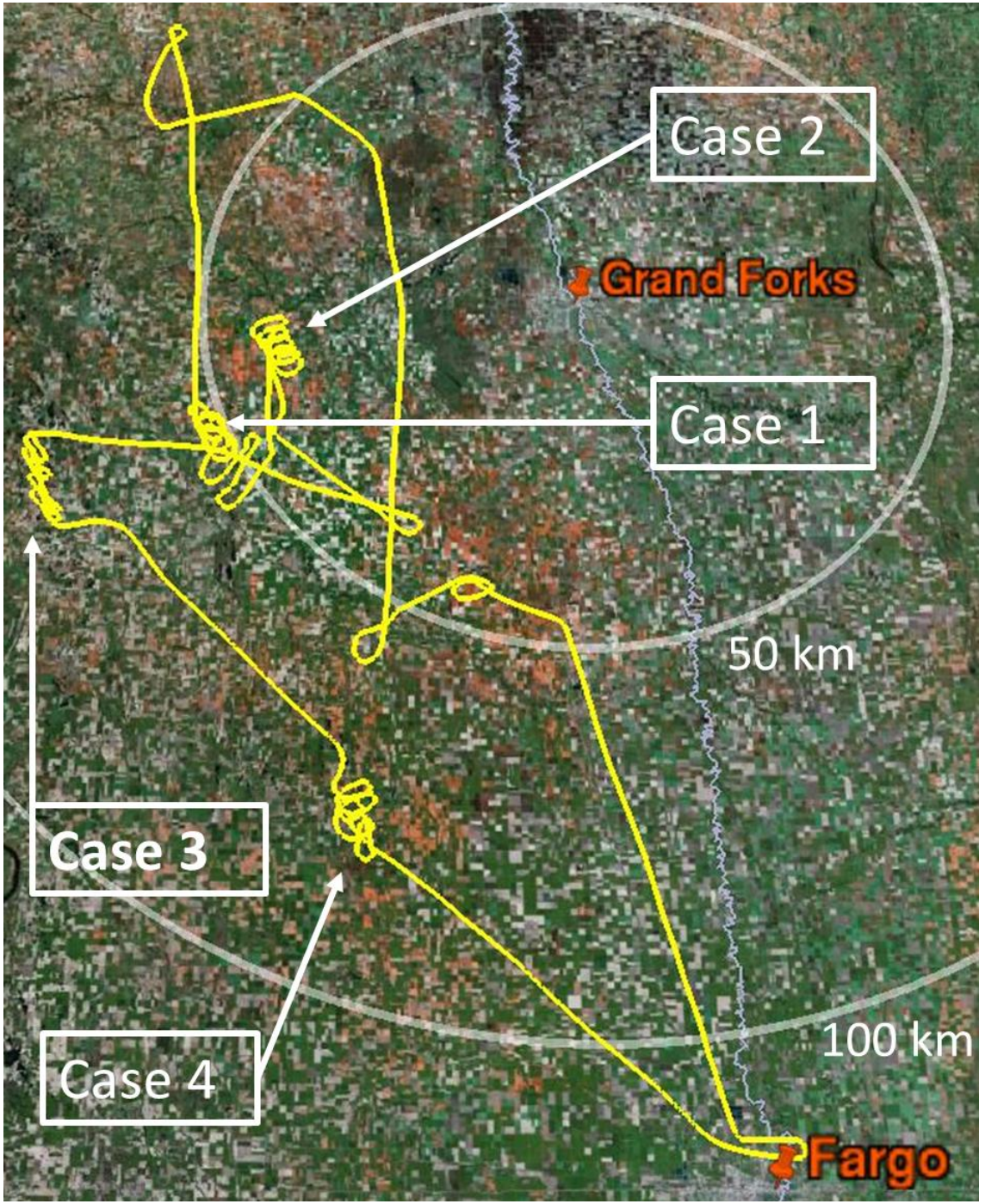




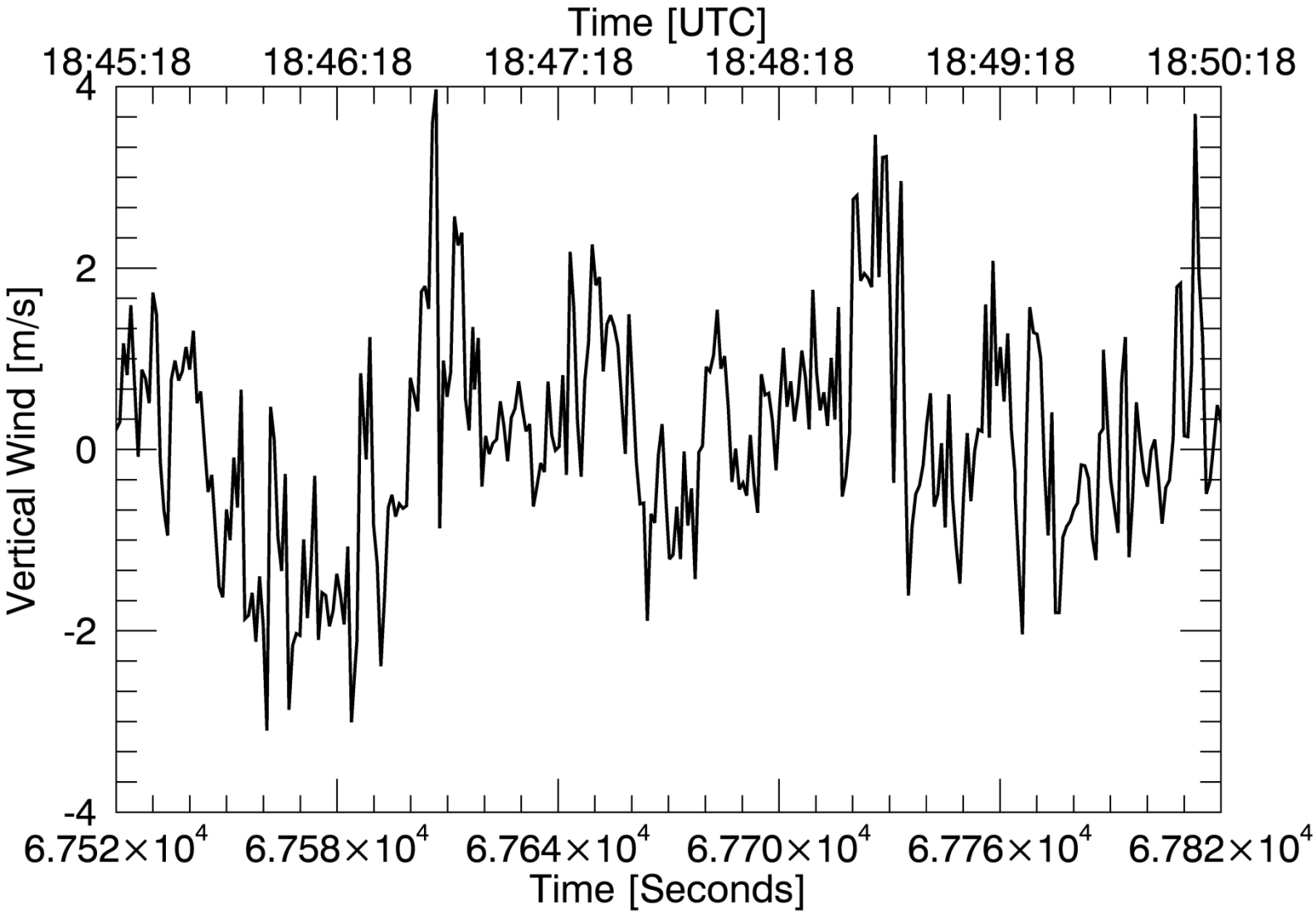
July 26, 2012

Flight track of the first flight conducted on 26 July 2012. The spirals are when samples were made at cloud base, while the long straight legs are transects between possible targets.

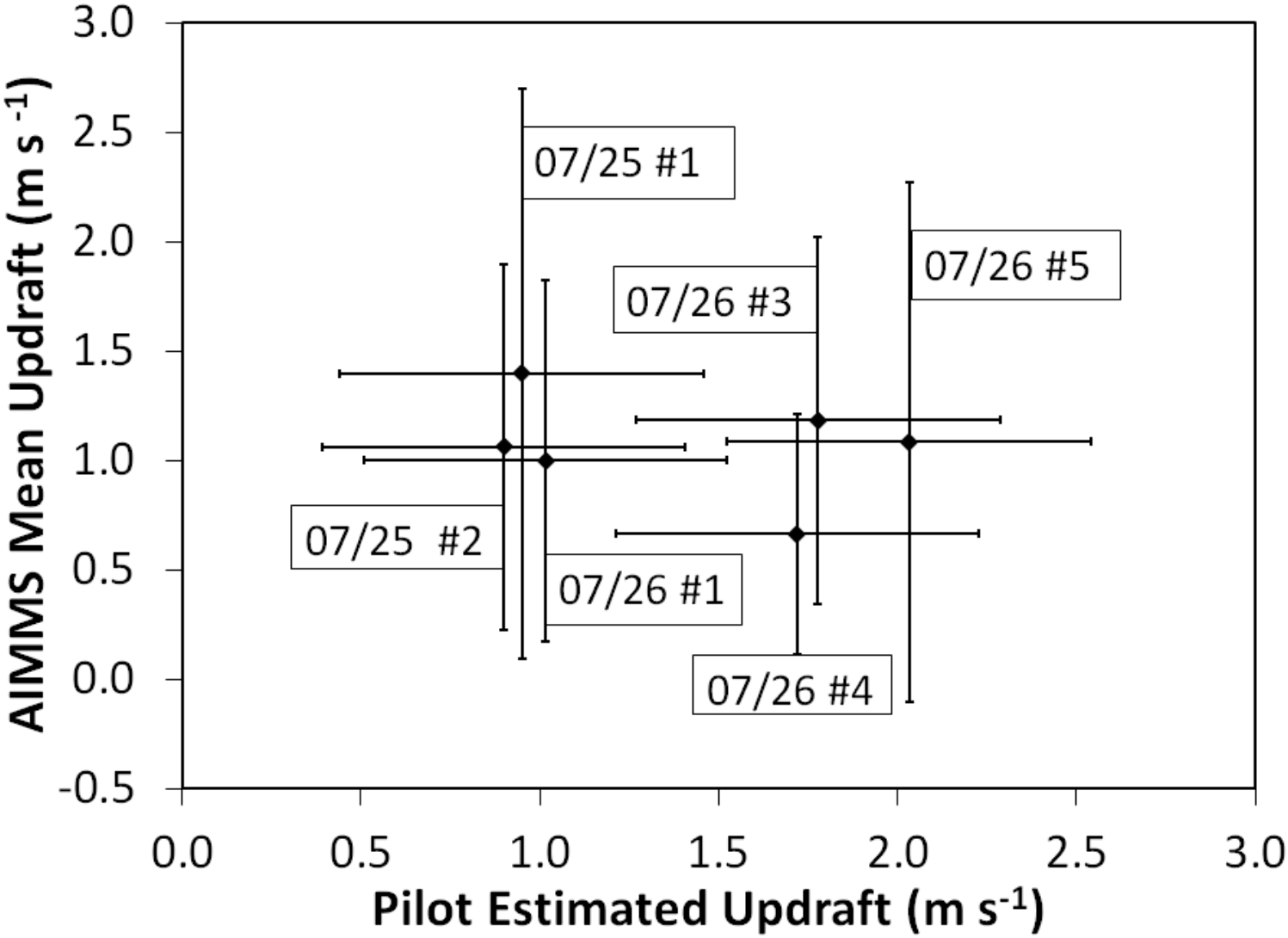
On days with a favorable chance of convection, an aircraft is launched from Fargo to locate targets within 100 km of University of North Dakota's C-band polarimetric radar.



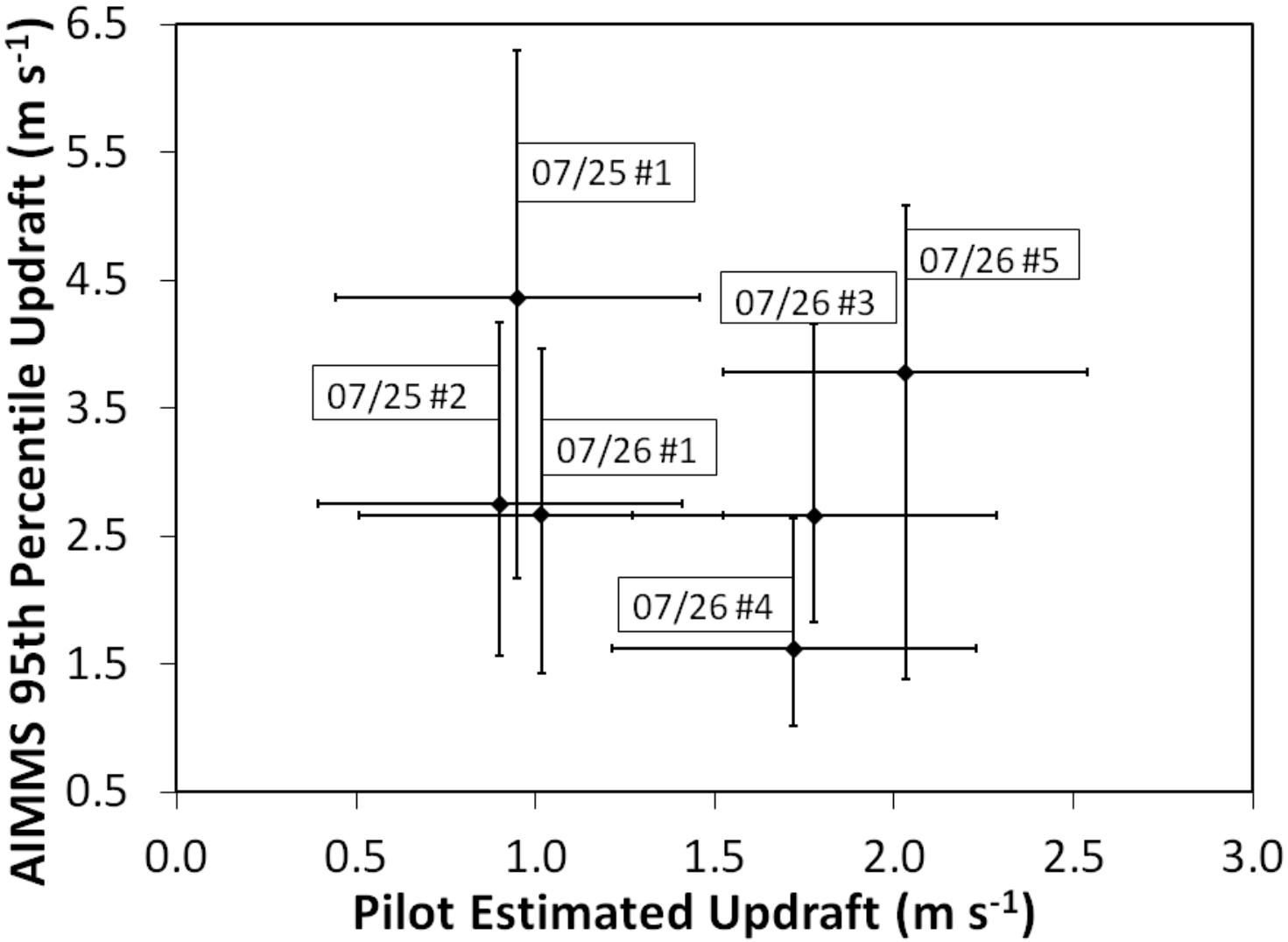
July 26, 2012: Case 1



Vertical wind velocity measured by the Aircraft Integrated Meteorological Measurement System (AIMMS) during the first flight on 26 July 2012 flight over five minutes.



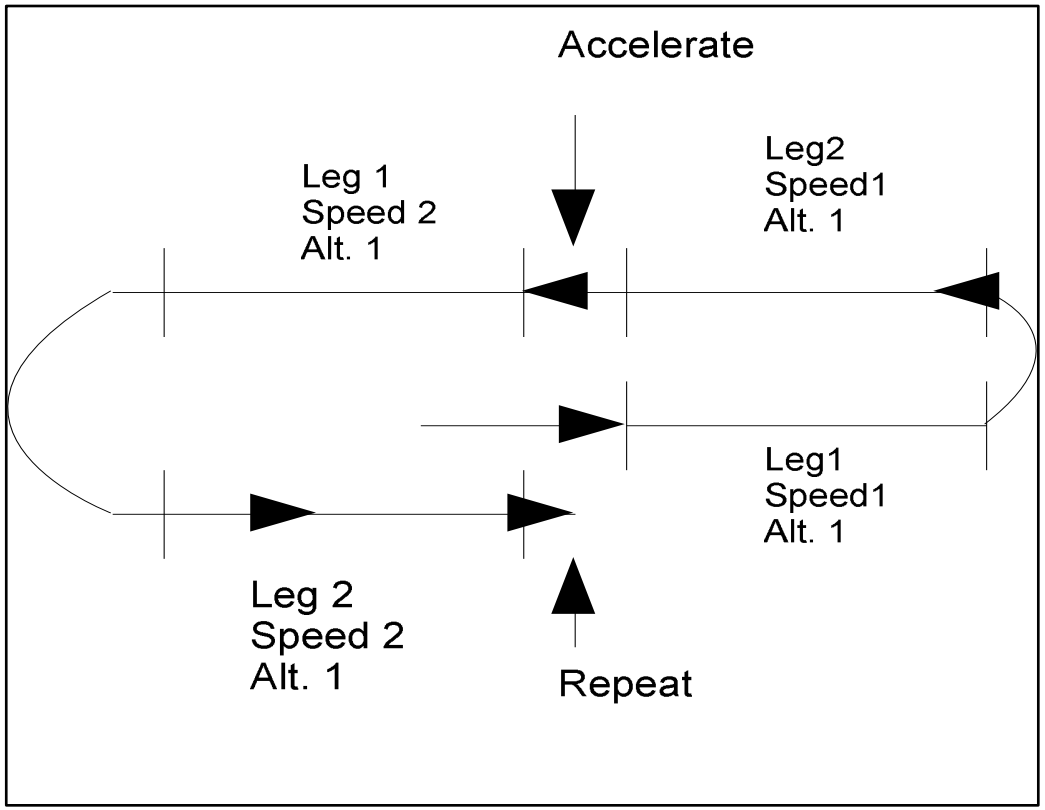
Pilot estimated maximum updrafts versus the mean Aircraft Integrated Meteorological Measurement System (AIMMS) updraft (only positive vertical winds). Horizontal bars denote the ±0.50 m s-1 uncertainty in the pilot estimate. Vertical bars indicate one standard deviation for the 1.0 Hz AIMMS measurements.

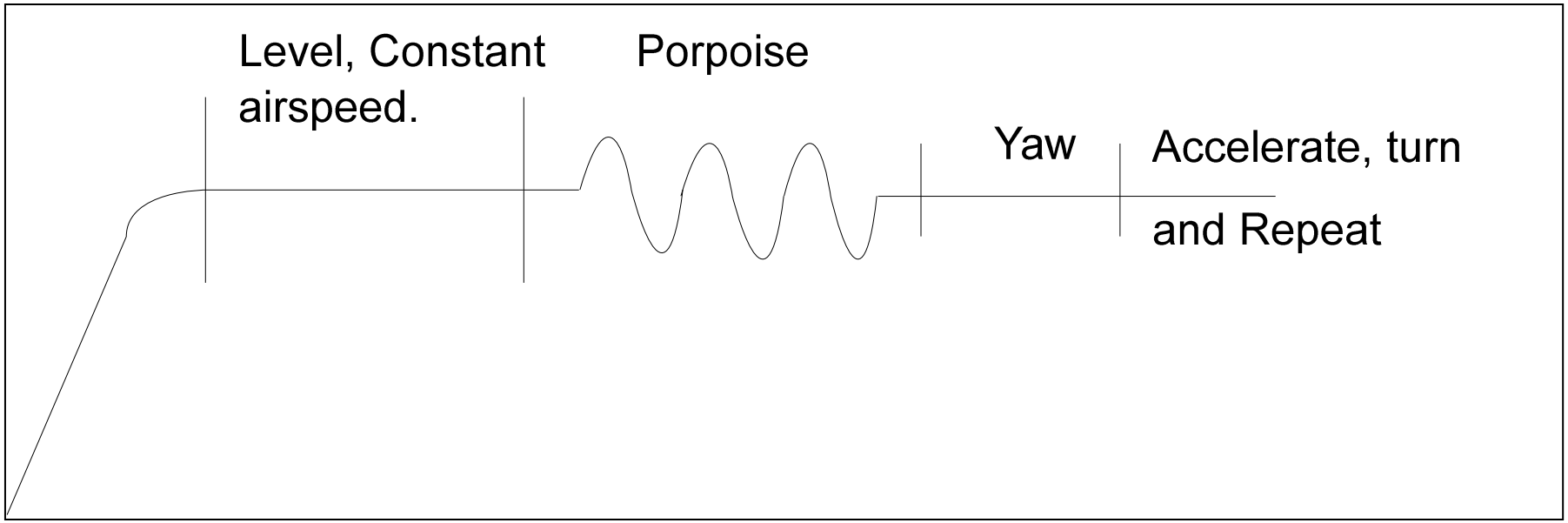


Pilot estimated updraft versus the 95th percentile Aircraft Integrated Meteorological Measurement System (AIMMS) updraft. Horizontal bars denote the ±0.50 m s^{-1} uncertainty in the pilot estimate. The top of the vertical bars denote the maximum value, while the bottom is the 75th percentile of 1.0 Hz AIMMS measurements.

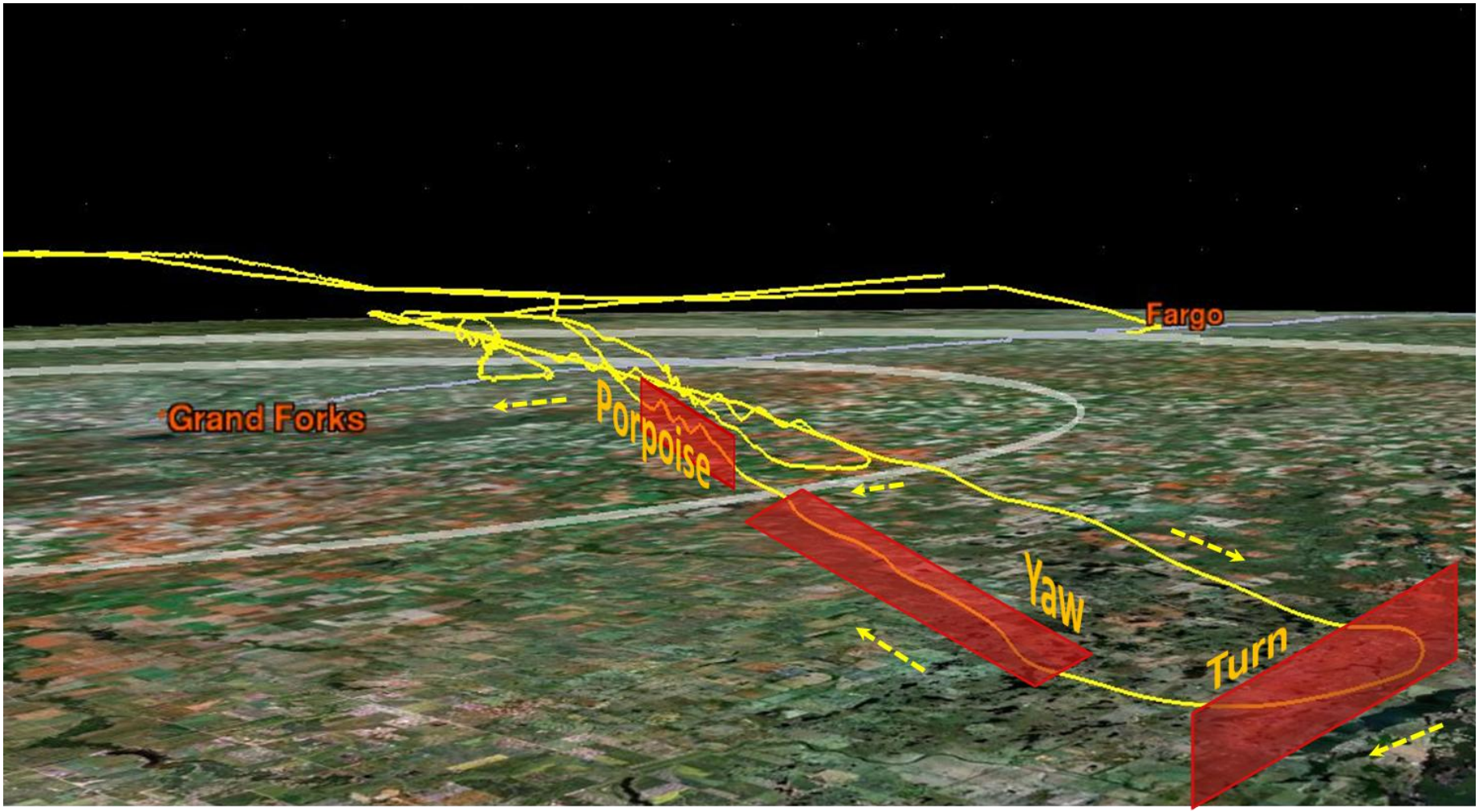
July 29, 2012 Validation Flight

Repeat maneuvers on right for three air speeds: minimum, midrange, and maximum.



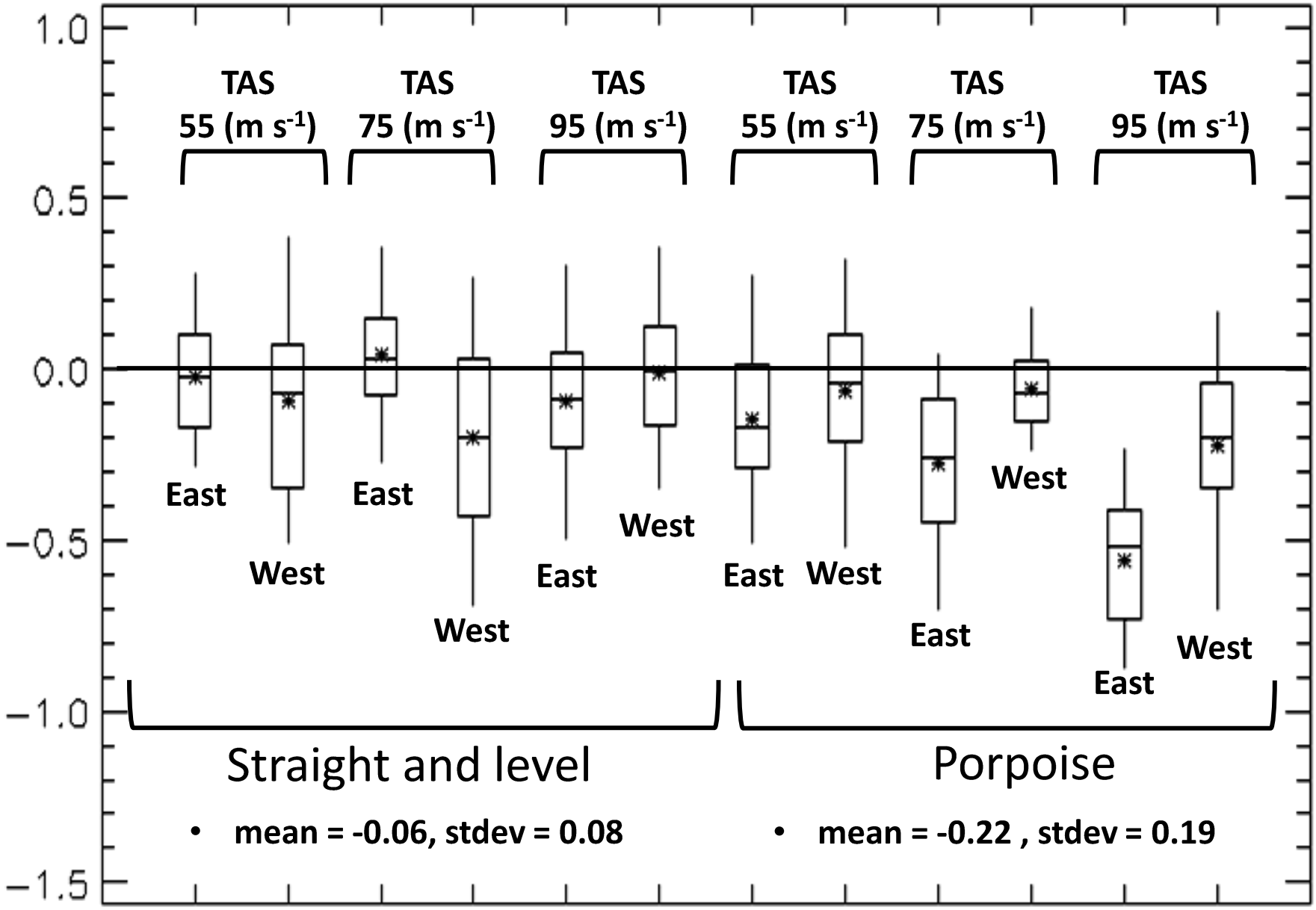


July 29, 2012 Validation Flight



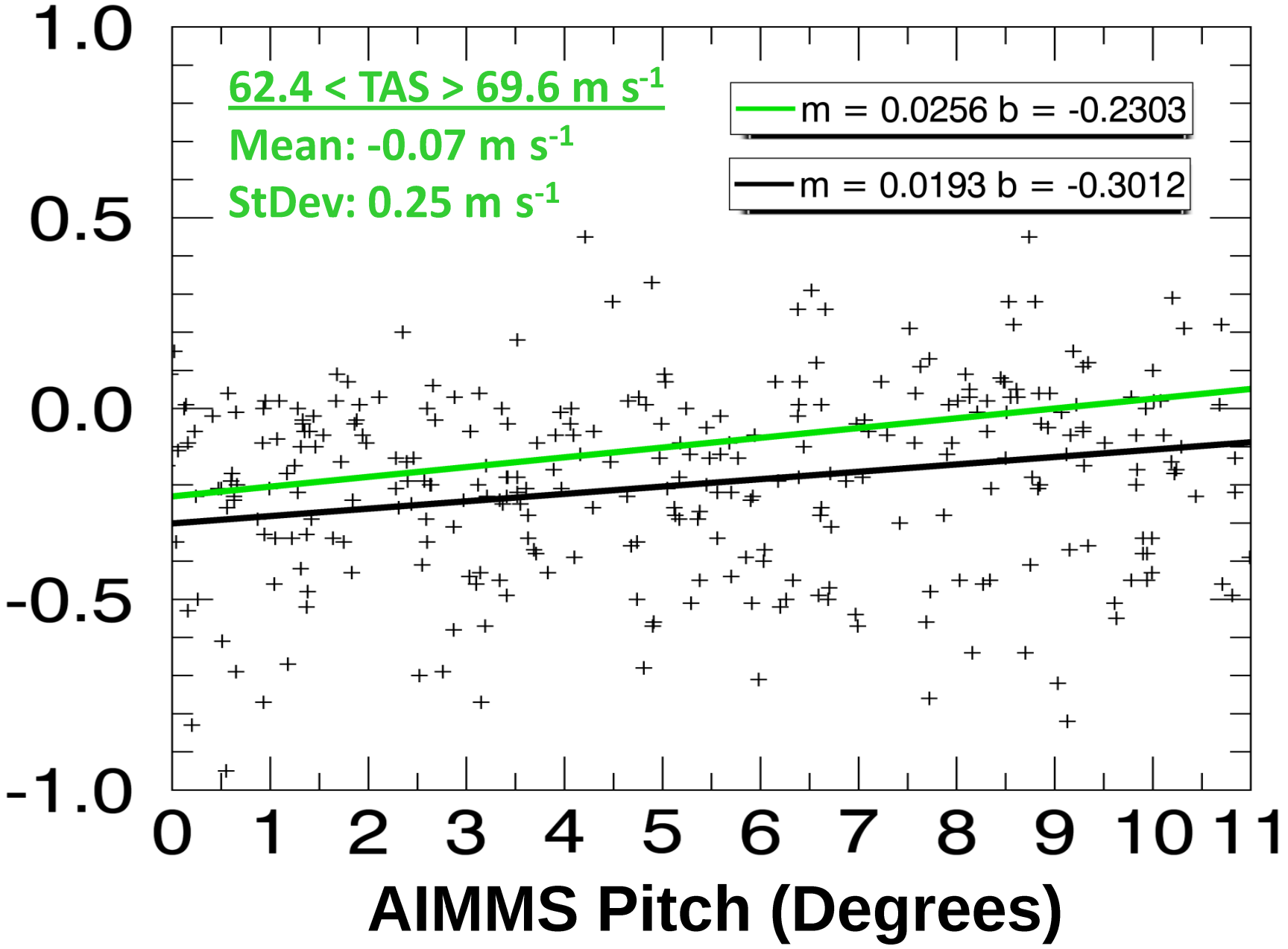
Flight track of the first flight conducted on 29 July 2012. AIMMS validation maneuvers were conducted after checking out some clouds near Grand Forks.

NORTH DAKOTA, JULY 29, 2012

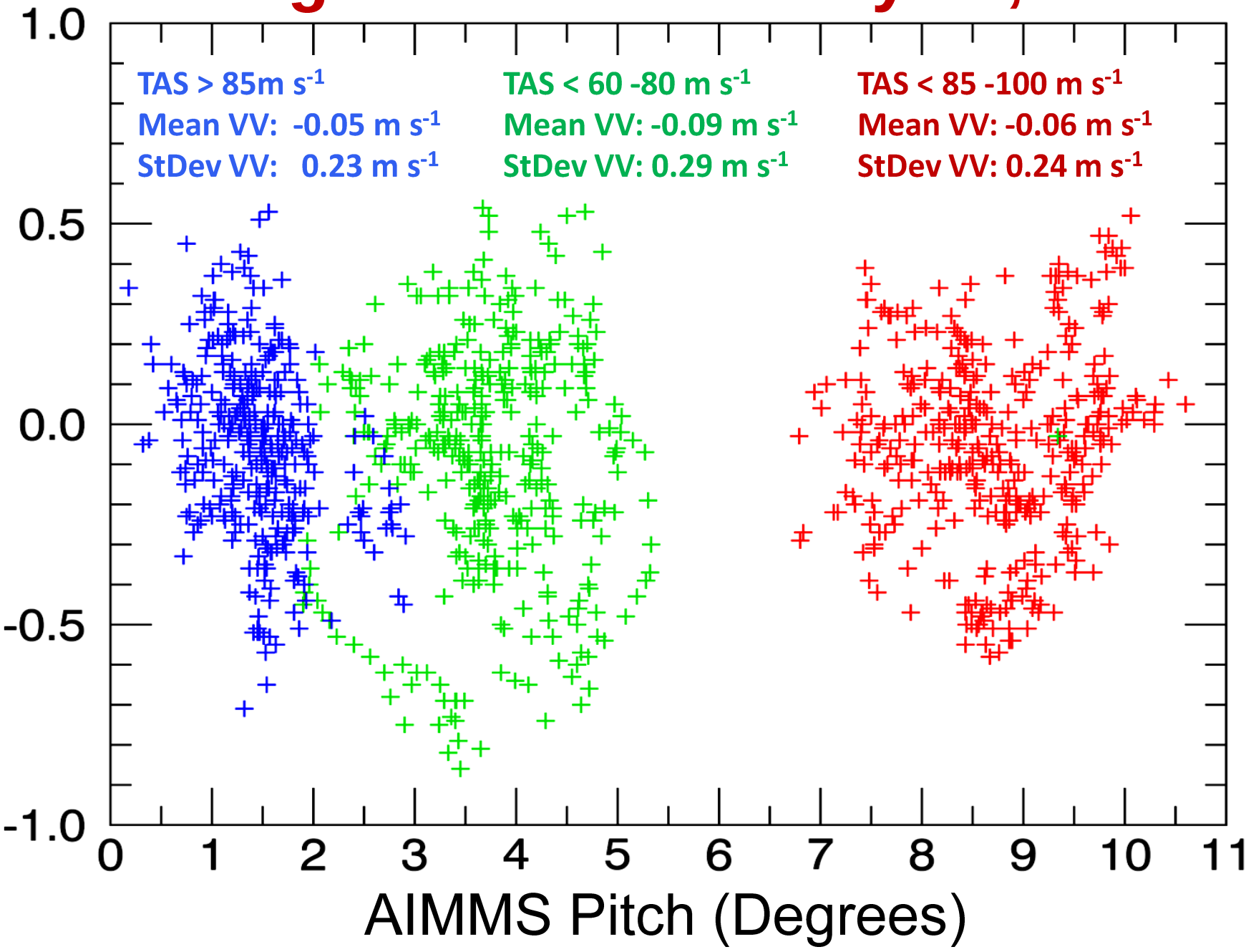


Overall mean = -0.14, stdev = 0.16

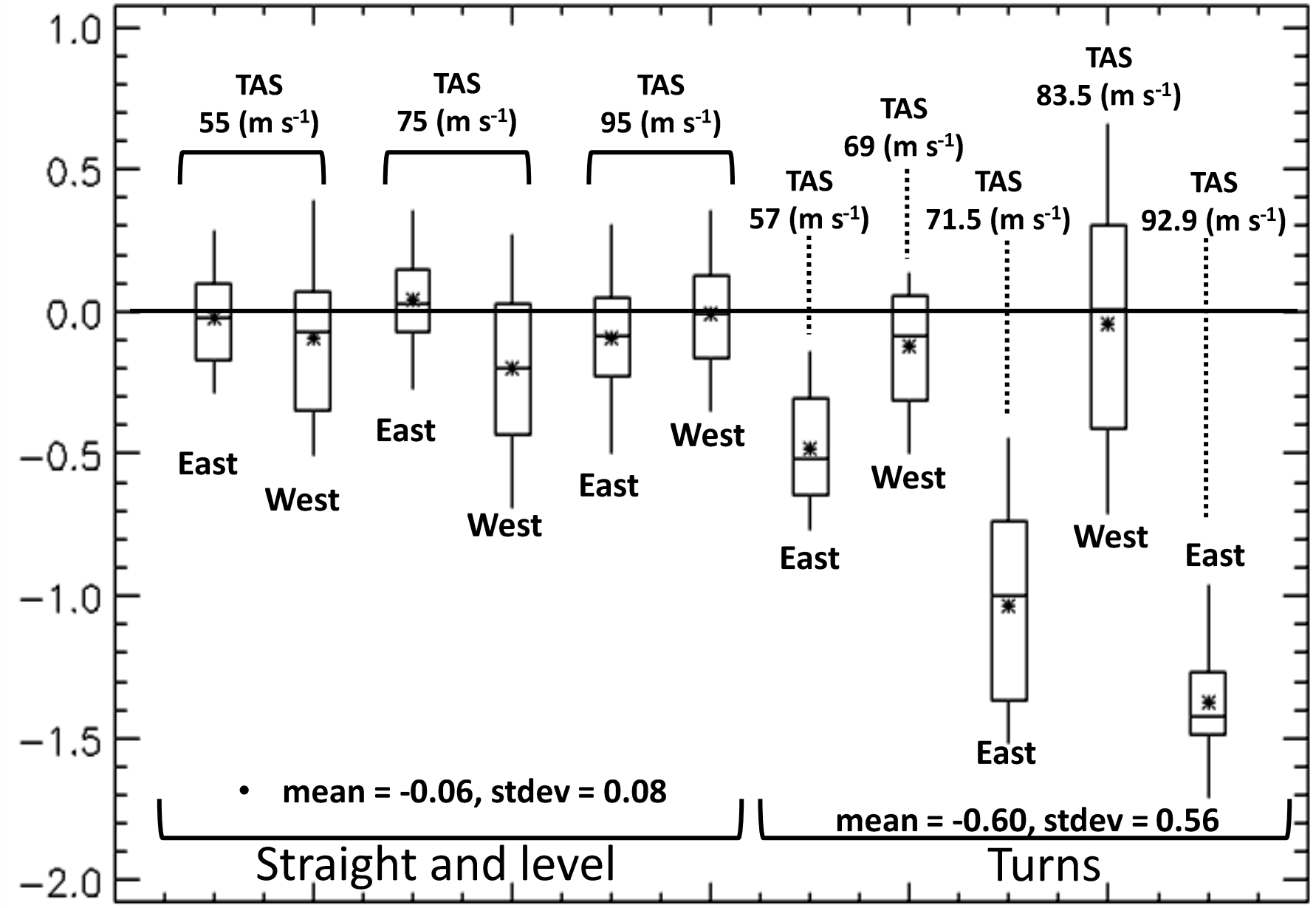
Porpoise: July 29, 2012



Straight and Level: July 29, 2012

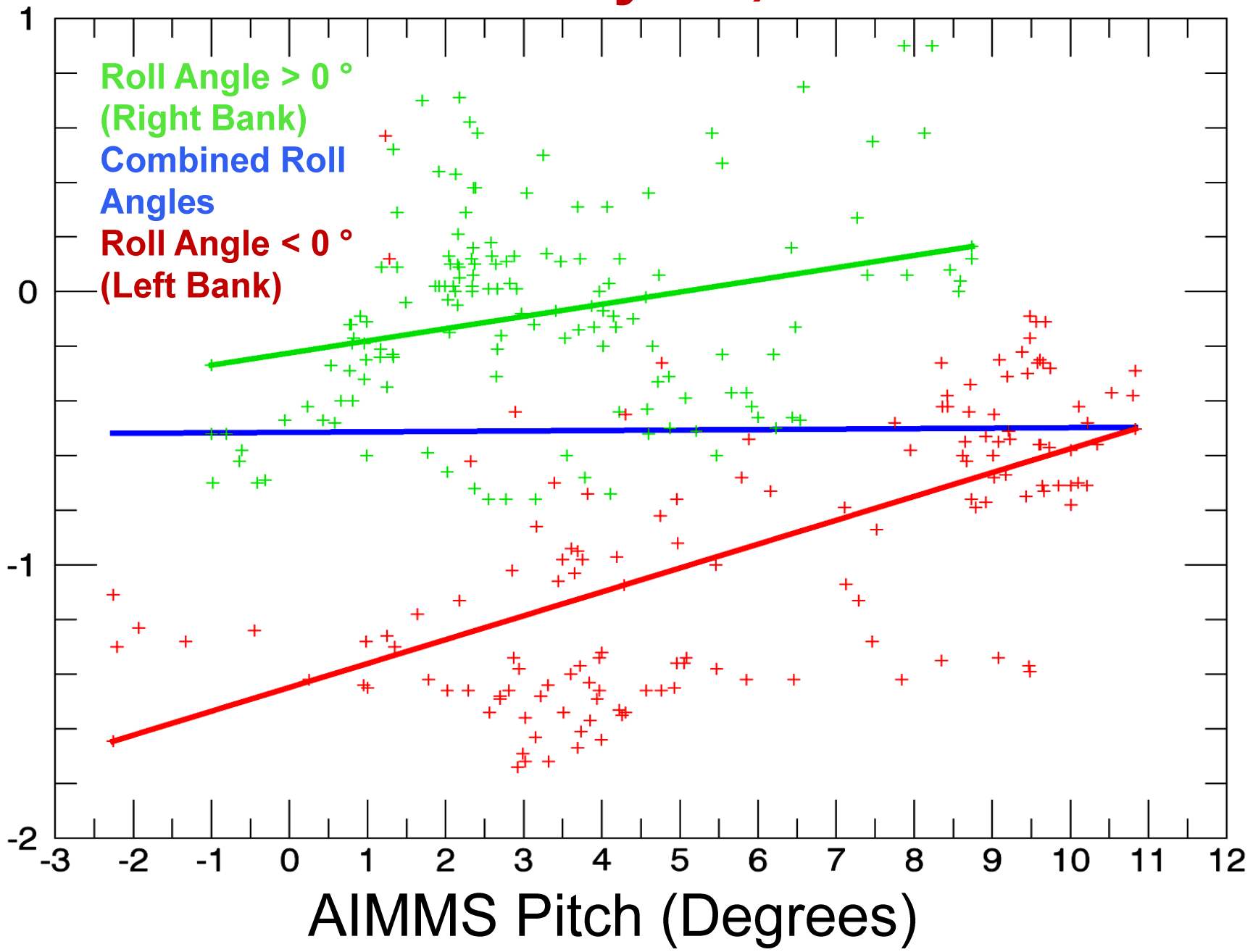


NORTH DAKOTA, JULY 29, 2012



Overall mean = -0.32, stdev = 0.44

Turns: July 29, 2012



Conclusion

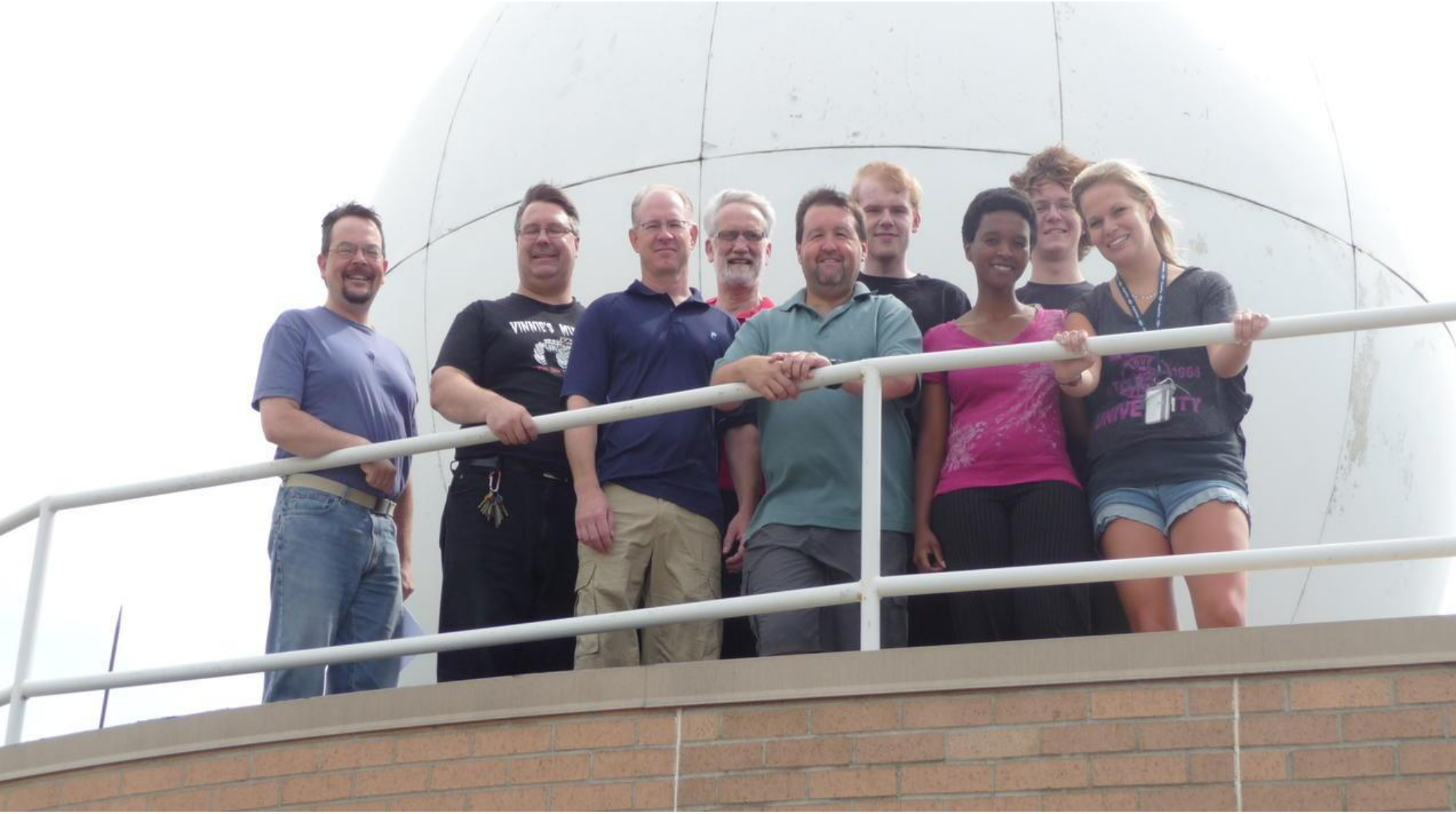
- Three cases show pilot estimates agreeing with the mean updraft AIMMS velocities; however, the pilot estimates are high for the remaining three cases.

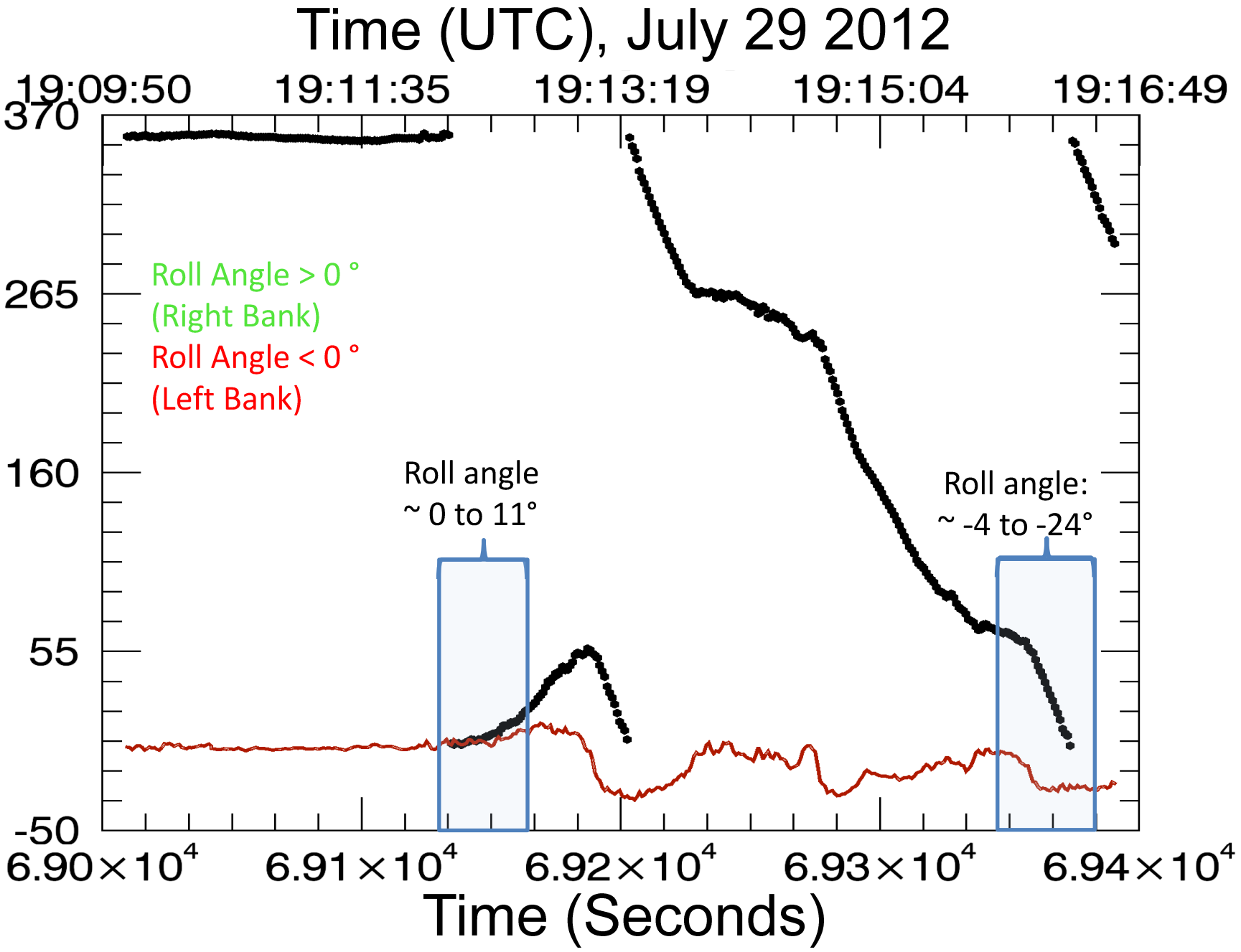
- For five cases, the pilot estimates are below the 95th percentile range of AIMMS measurements.

- The POLCAST-2012 cases demonstrates the difficulty for pilots to discern the difference between a 1.0 m s^{-1} (200 ft min^{-1}) and a 2.0 m s^{-1} (400 ft min^{-1}) updraft.

- Validation flight confirms that AIMMS was well calibrated during the POLCAST-2012 field project.

QUESTIONS

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19:13:19
19:15:04
19:16:49
370
265
160
55
-50
Roll Angle > 0 °
(Right Bank)
Roll Angle < 0 °
(Left Bank)
Roll angle
~ 0 to 11°
Roll angle:
~ -4 to -24°
6.90×10^4
6.91×10^4
6.92×10^4
6.93×10^4
6.94×10^4
Time (Seconds)