

# Pilot Estimates of Vertical Winds Evaluated Using AIMMS Measurements



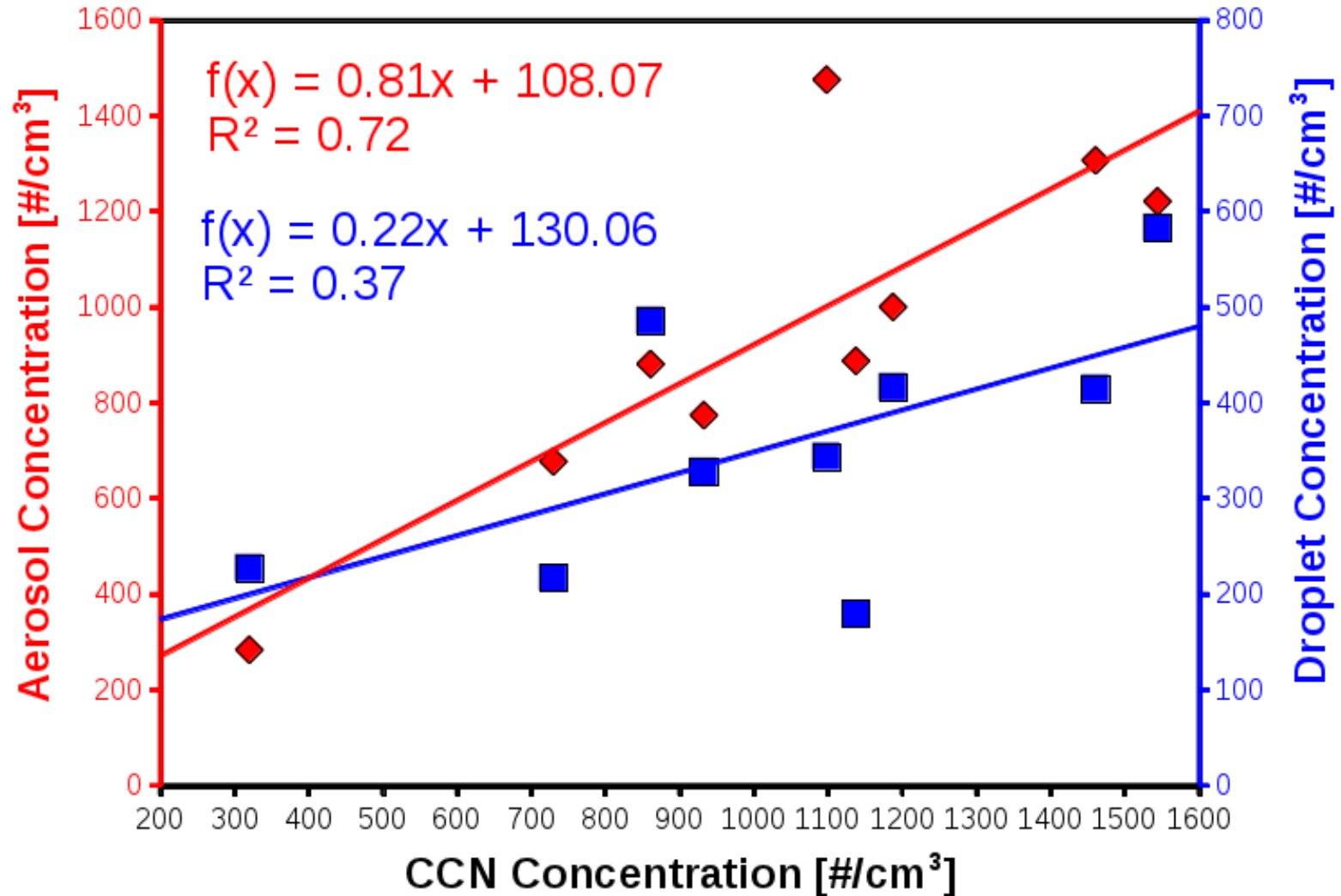
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# Definitions

- **Updrafts:** Vertical winds near the base of cumulus clouds.
- **Cumulus Clouds:** Puffy white clouds that develop from raising air which cools and water vapor condenses to form cloud droplets.
- **Cloud Condensation Nuclei:** Aerosols that water vapor condense on to form cloud droplets.
- **Aerosols:** Suspended solid or liquid particles in the atmosphere.

# Significance of Updrafts

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

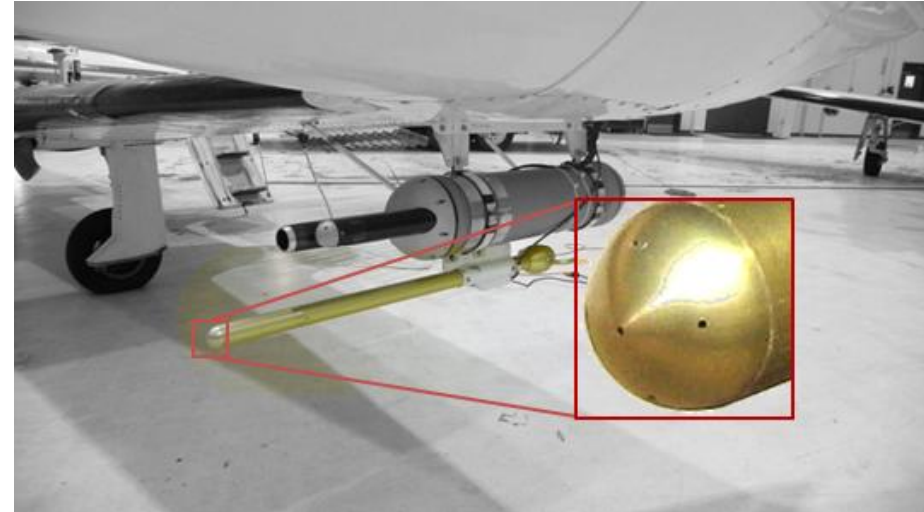


# Measurements of Updrafts

## Pilot Estimates



## Gust Probe Instruments



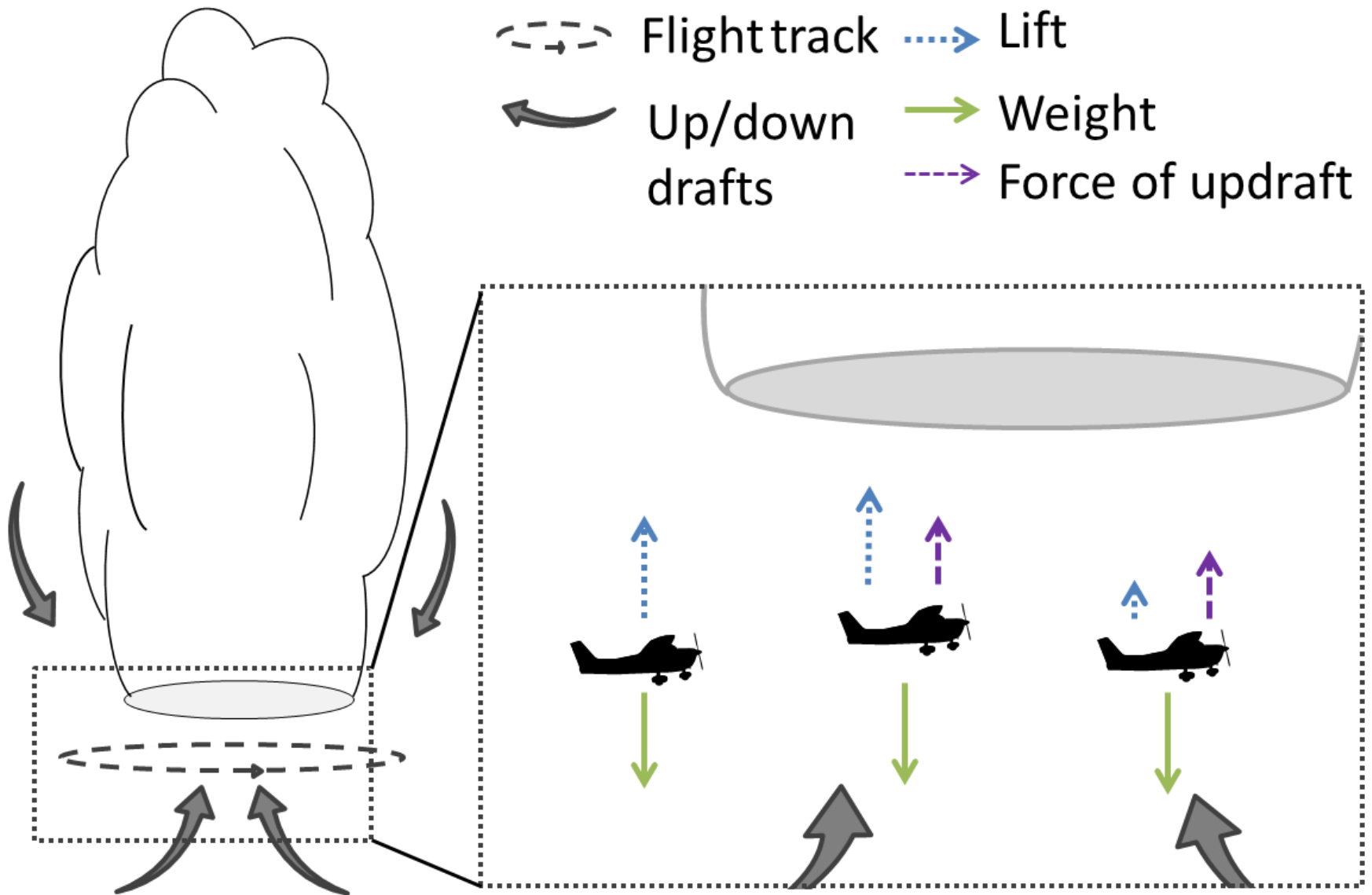
# Objective

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

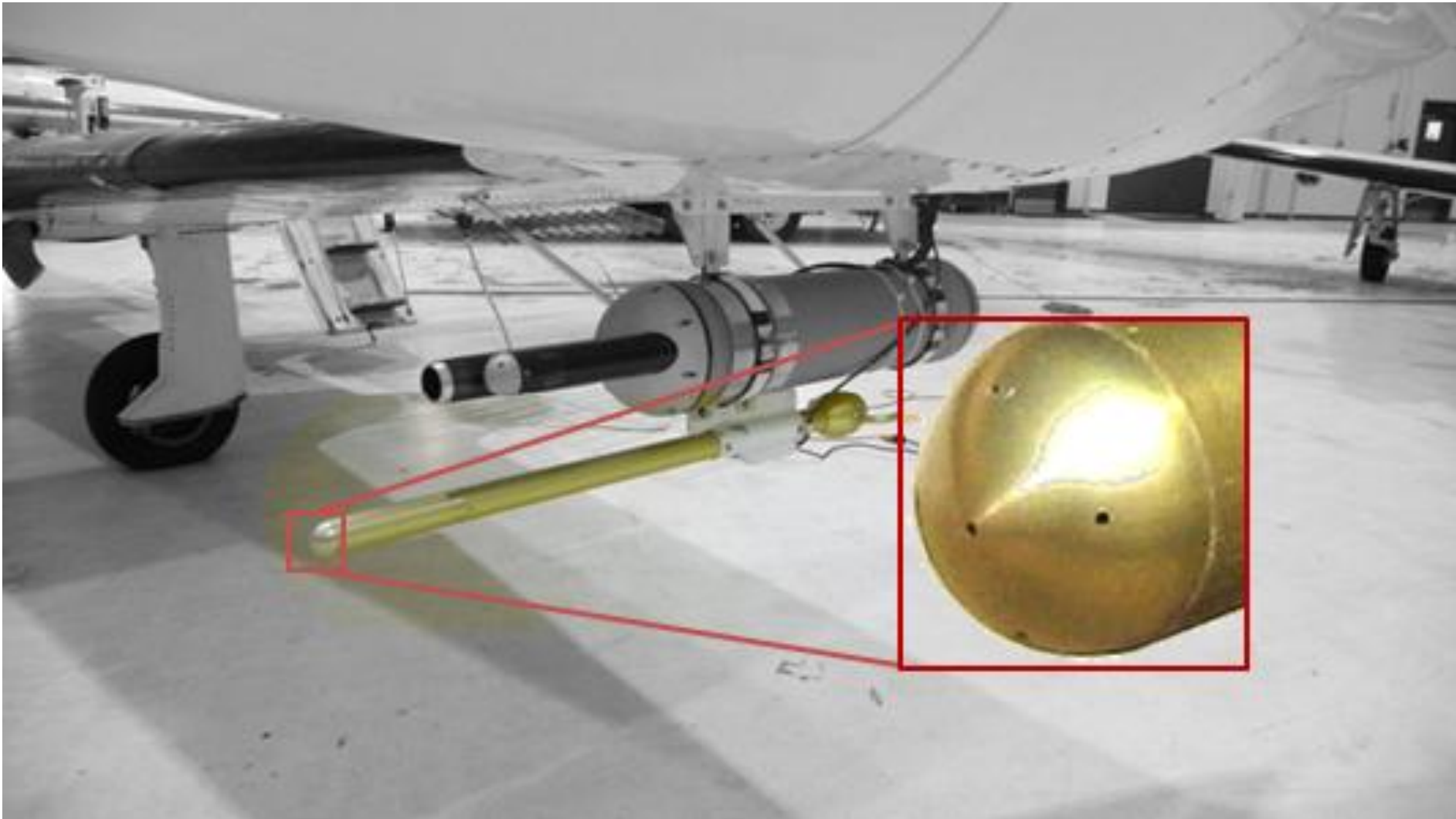


- The evaluation is done by comparing pilot estimates to Aircraft Integrated Measurement System (AIMMS) measurements.

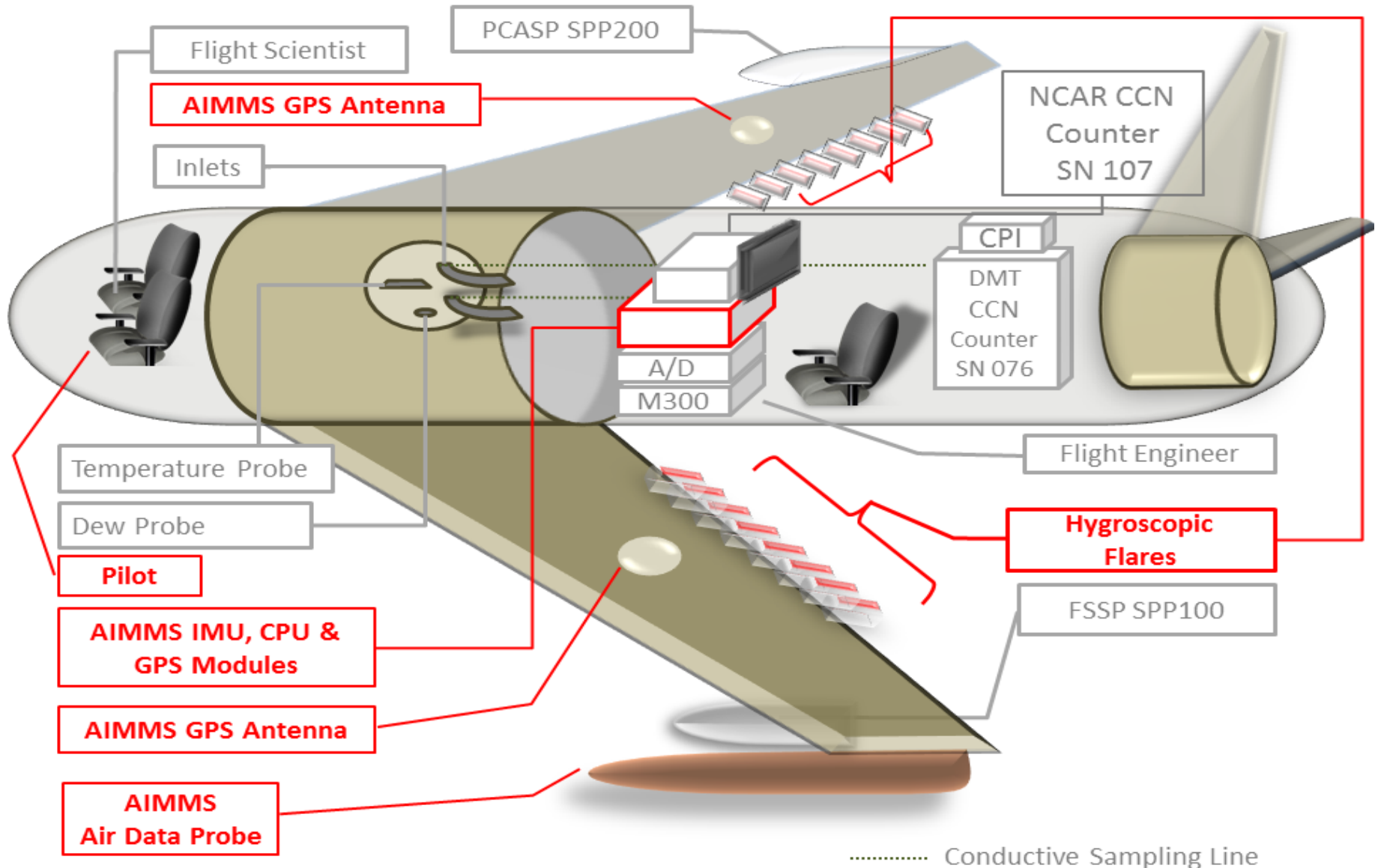
# Level Flight Beneath Cloud Base



# Aircraft Integrated Meteorological Measurement System

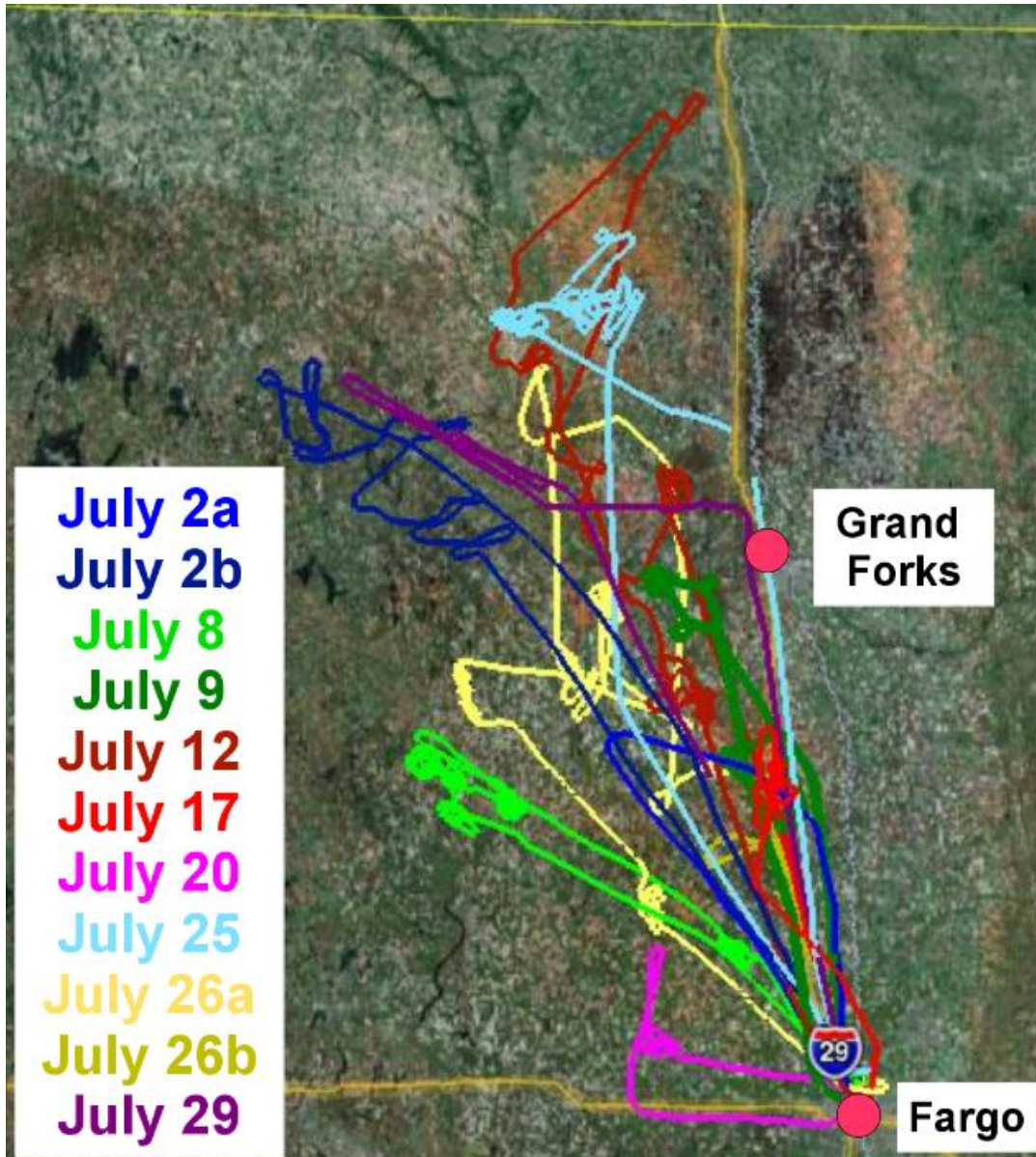


# 2012 Aircraft Instrument Configuration





# POLCAST FIELD PROJECT FLIGHTS

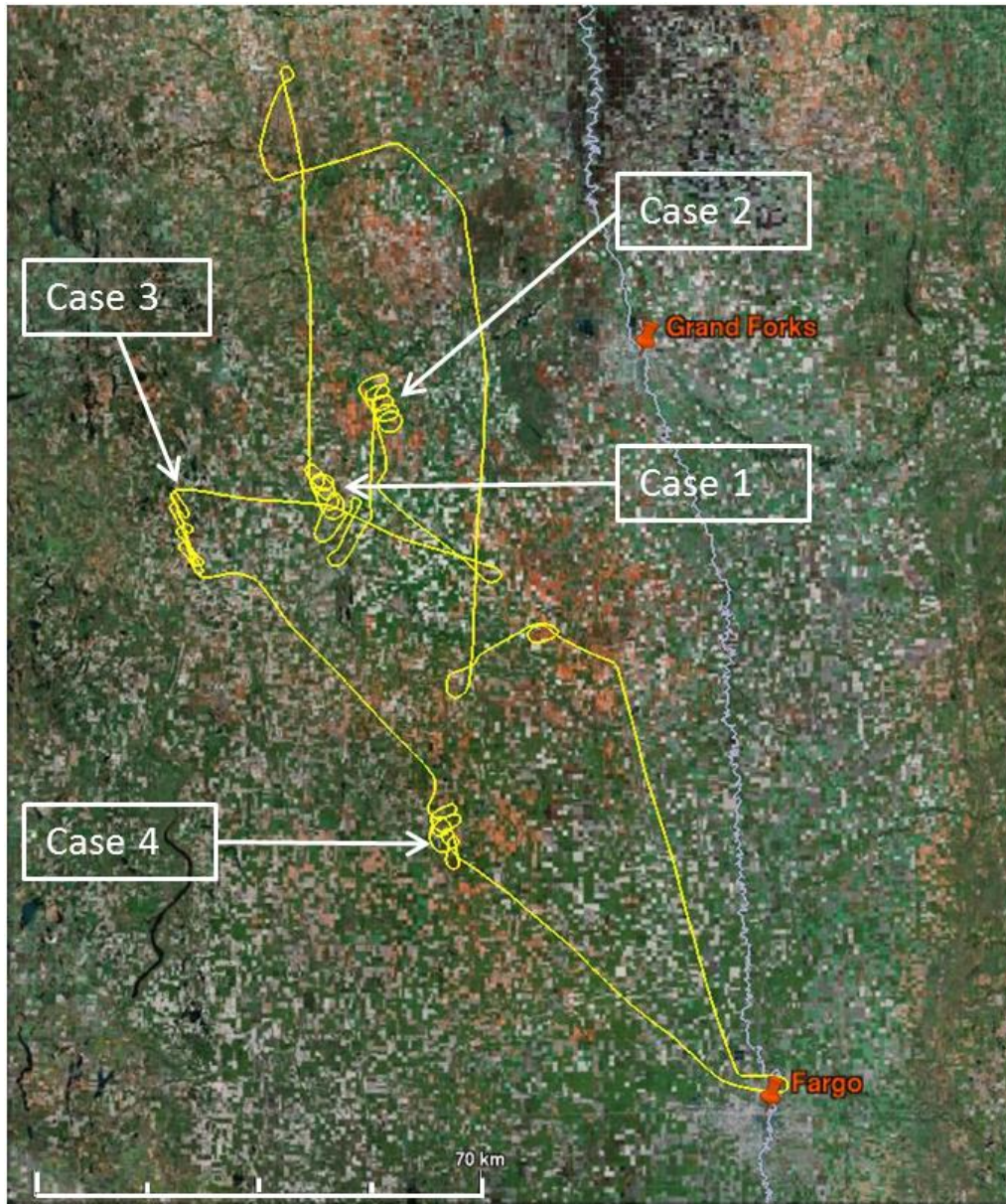


Flight tracks of POLCAST4 Field projects.

6 of the 17 cases included the AIMMS gust probe.



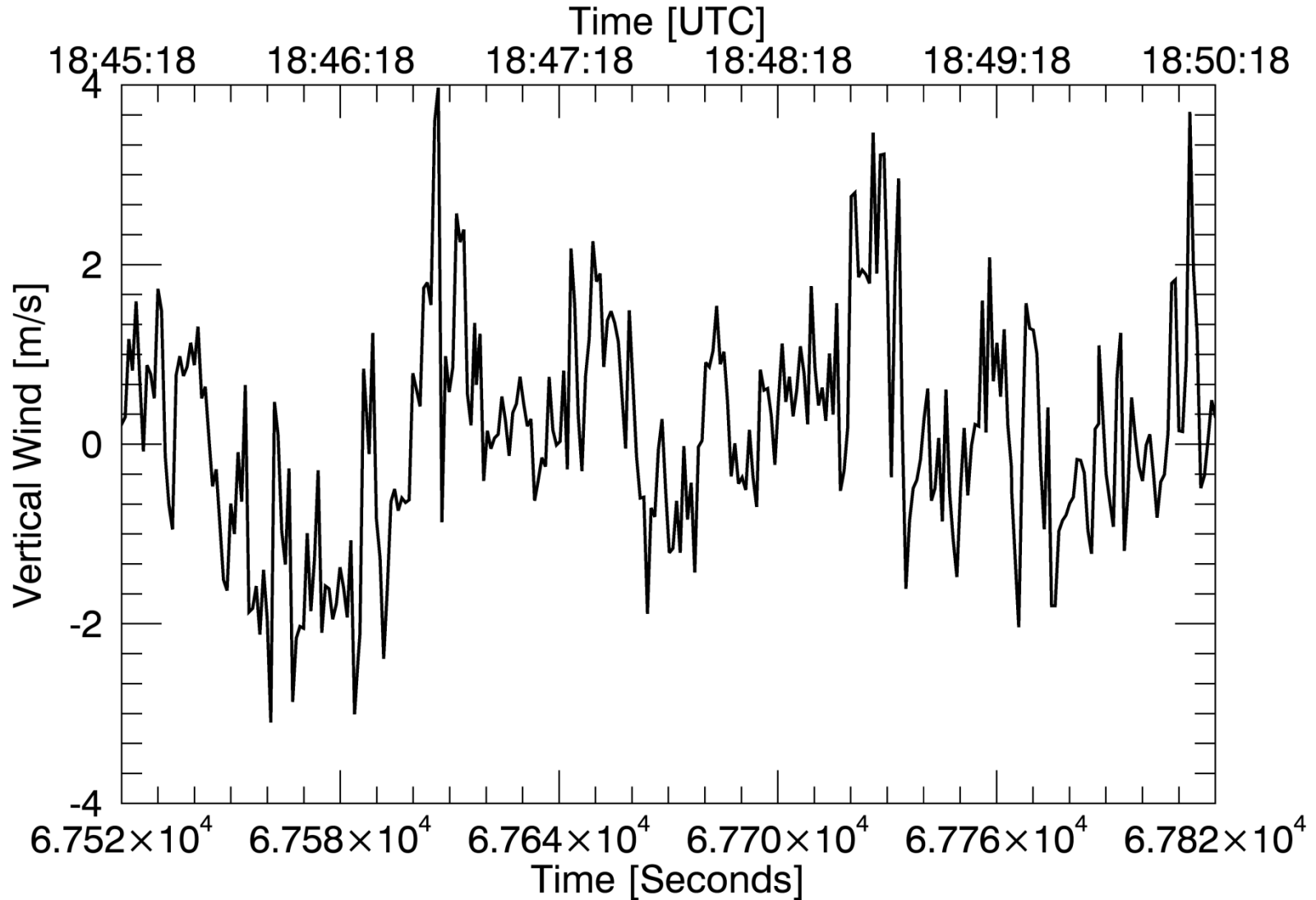
# July 26, 2012



*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.

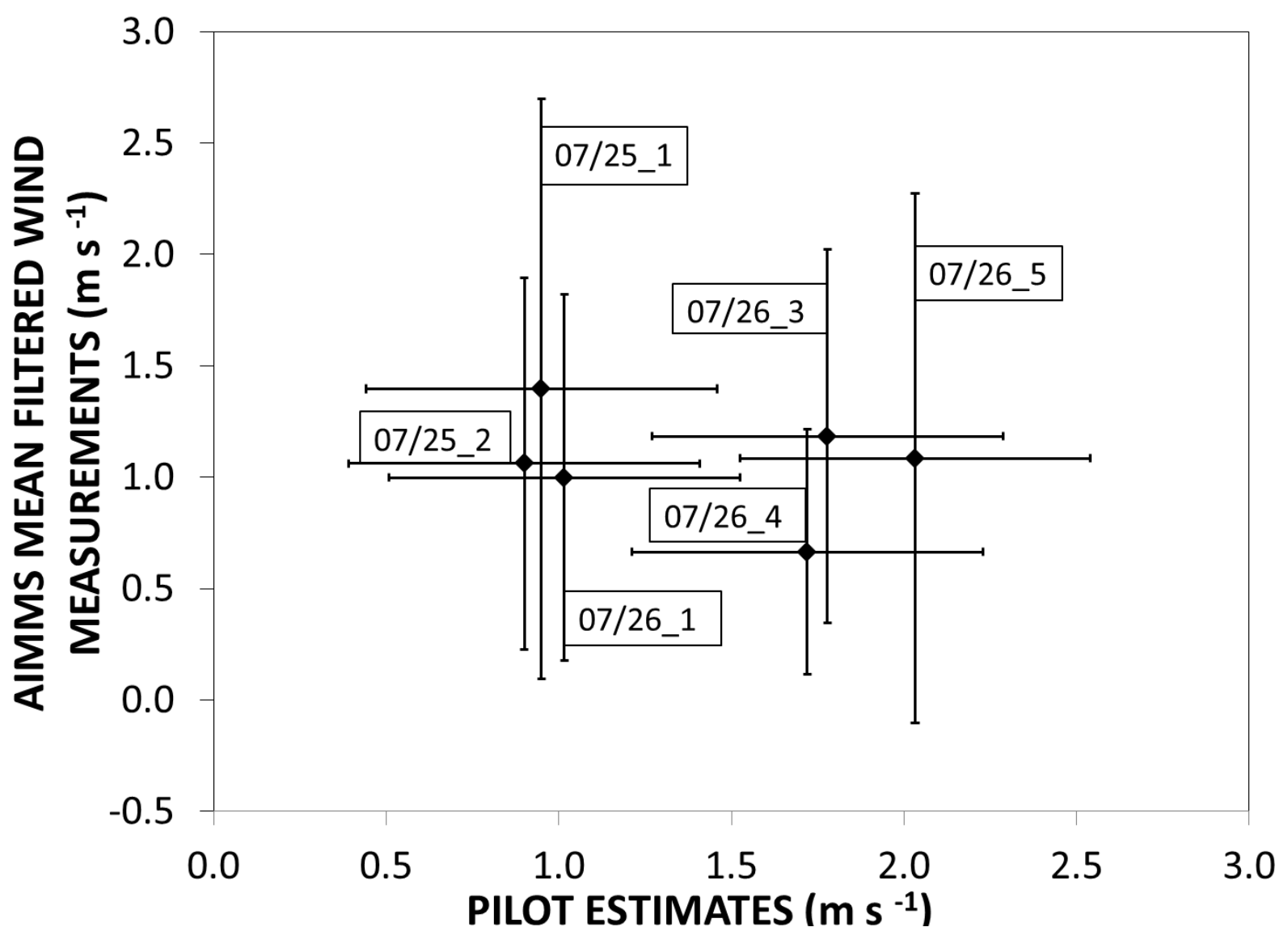
# July 26, 2012: Case 1



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

Date Num.	Tar. Num.	Time (sfm)	Pilot (m s <sup>-1</sup> )	Type U/F	Mean (m s <sup>-1</sup> )	STD (m s <sup>-1</sup> )	5 <sup>th</sup> (m s <sup>-1</sup> )	25 <sup>th</sup> (m s <sup>-1</sup> )	50 <sup>th</sup> (m s <sup>-1</sup> )	75 <sup>th</sup> (m s <sup>-1</sup> )	95 <sup>th</sup> (m s <sup>-1</sup> )
07/25 1	1	72,267	1.0 ± 0.50	U	-0.20	1.74	-3.04	-1.16	-0.37	0.63	2.87
				F	1.40	1.30	0.11	0.41	1.05	2.17	4.37
07/25 1	2	74,300	1.0 ± 0.50	U	0.29	1.11	-1.24	-0.43	0.17	0.97	2.31
				F	1.06	0.83	0.10	0.39	0.86	1.57	2.71
07/26 1	1	67,518	1.0 ± 0.5	U	0.13	1.21	-1.89	-0.62	0.12	0.86	1.94
				F	1.00	0.82	0.11	0.38	0.79	1.43	2.67
07/26 1	3	71,251	1.8 ± 0.5	U	-0.07	1.41	-2.25	-0.73	-0.14	0.88	2.28
				F	1.18	0.84	0.09	0.53	1.02	1.83	2.66
07/26 1	4	72,893	1.8 ± 0.50	U	-0.18	0.84	-1.50	-0.73	-0.24	0.24	1.32
				F	0.66	0.55	0.04	0.18	0.54	1.02	1.62
07/26 2	5	78,960	2.0 ± 0.50	U	-0.14	1.19	-1.56	-0.87	-0.38	0.26	2.26
				F	1.09	1.19	0.06	0.26	0.67	1.39	3.78

The flight date and number, the day's seeding target number and the Aircraft Integrated Meteorological Measurement System (AIMMS) analysis start time are given. The start time is in Universal Time as the number of second from midnight (sfm) on the day the flight starts. The mid-range of maximum updrafts provided by the pilot are given with the uncertainty encompassing the overall range. AIMMS measurement statistics (mean, standard deviation (STD), and percentile values) are given for each case. AIMMS statistics are based on 5 minute of 1 Hz measurements. U denotes unfiltered (all measurements) statistics and F denotes filtered measurements where only positive vertical wind measurements are included in the statistics.



Horizontal bars represent  $\pm 0.50 \text{ m s}^{-1}$  pilot uncertainty. Vertical error bars indicate  $\pm$  one standard deviation for the AIMMS 1 Hz measurements obtained over five minutes. Boxes denotes the flight date and corresponding case number. Three points (07/25 1&2, and 07/26 4) have been offset for visual clarity of error bars.

# 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 95<sup>th</sup> percentile range of AIMMS measurements.

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



# QUESTIONS

