

Analysis and Processing of 3-dimensional Winds Measured by the Aircraft Integrated Meteorological Measurement System



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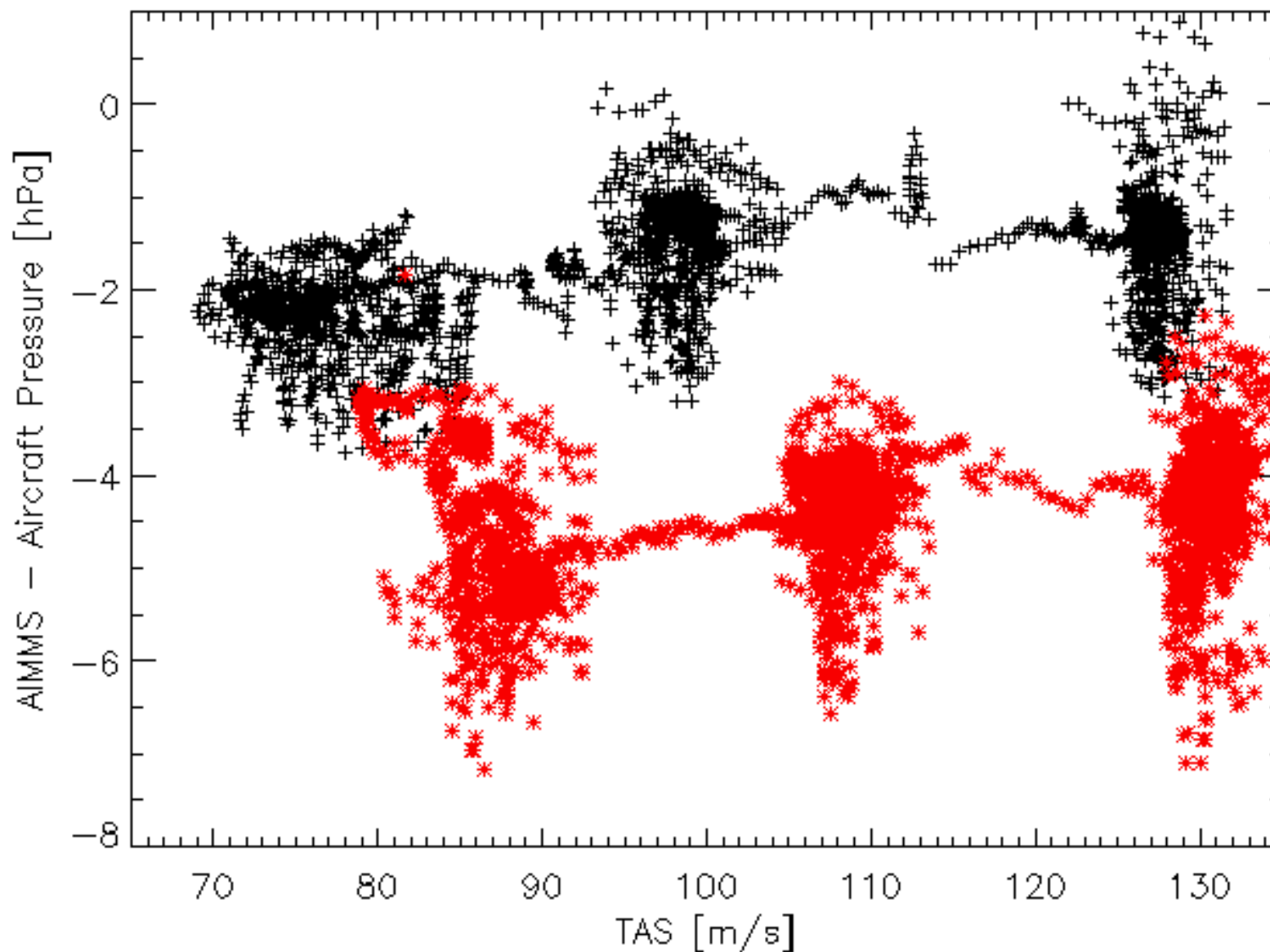
Objective

- To analyze and evaluate atmospheric measurements taken by the Aventech Research Inc AIMMS probe.
- Determine the accuracy of up-draft measurements.

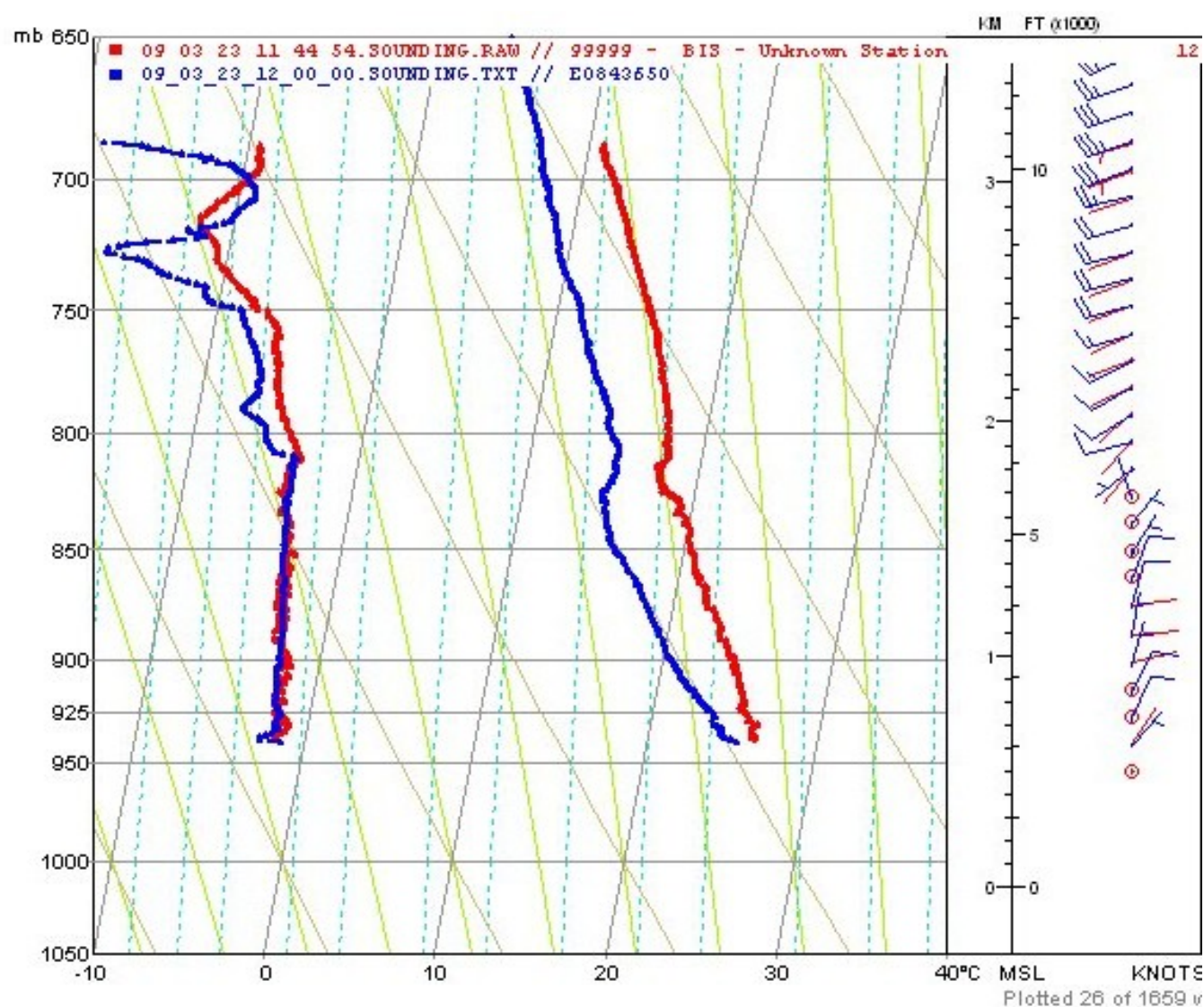


King Air 200 Saudi Arabia Spring 2009

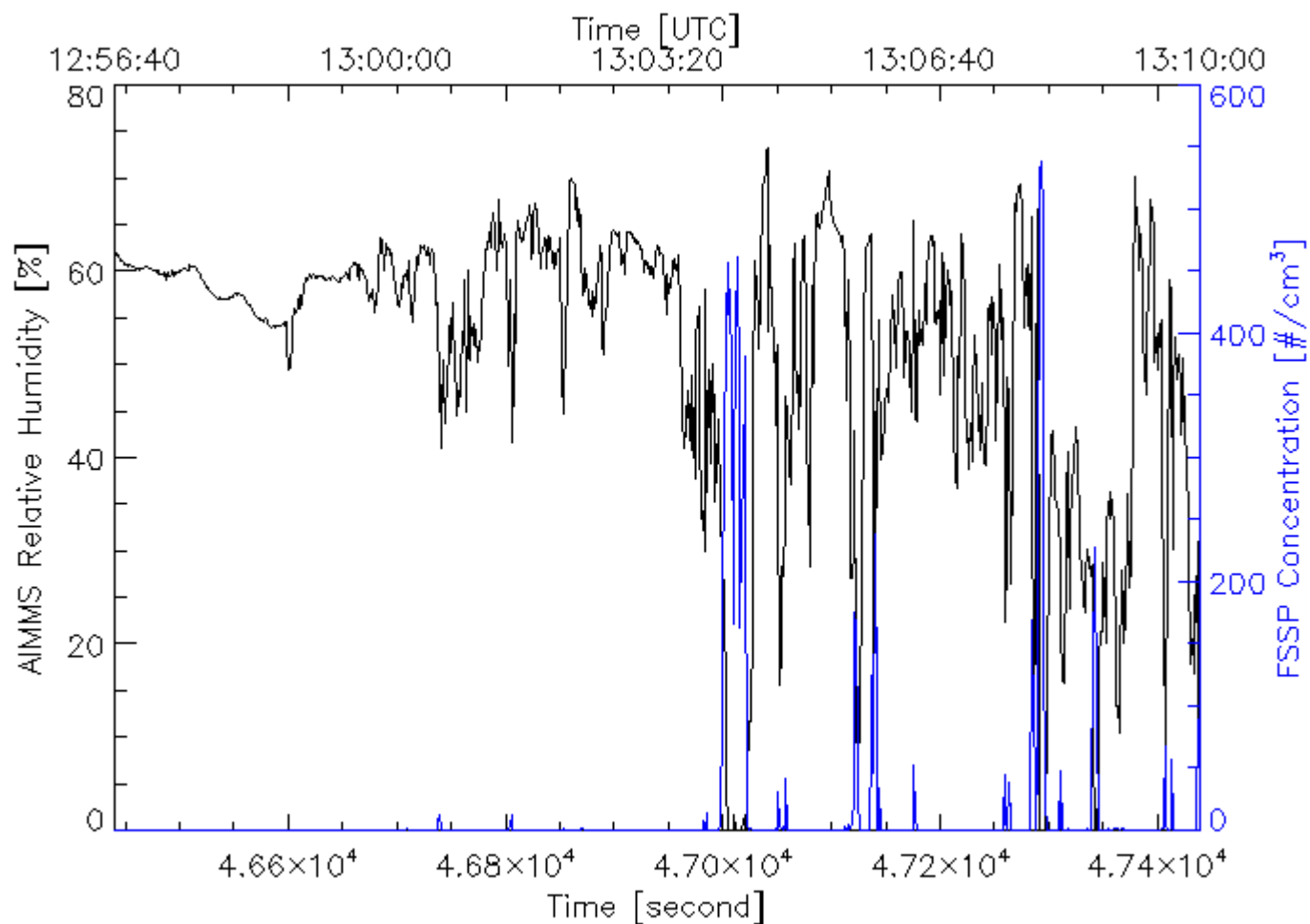




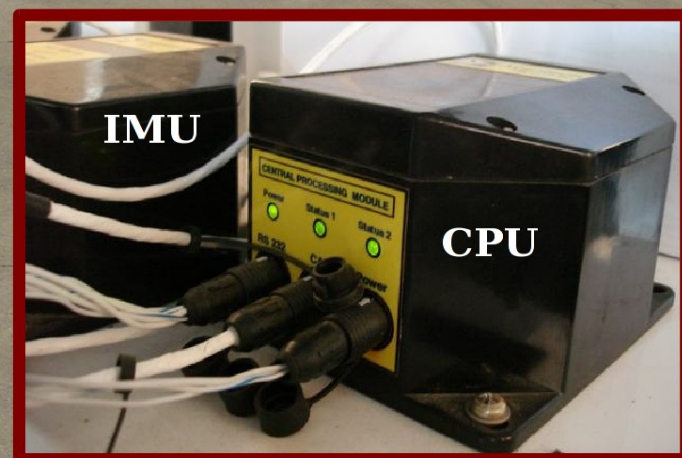
The difference between the Aircraft Integrated Meteorological Measurement System (AIMMS) measured pressure and the pressure measured at the aircraft's static pressure port during the 23 March 2009 aircraft flight in Saudi Arabia. The black plus samples are at 15,000 ft sampling and the red starts at 21,000 ft.



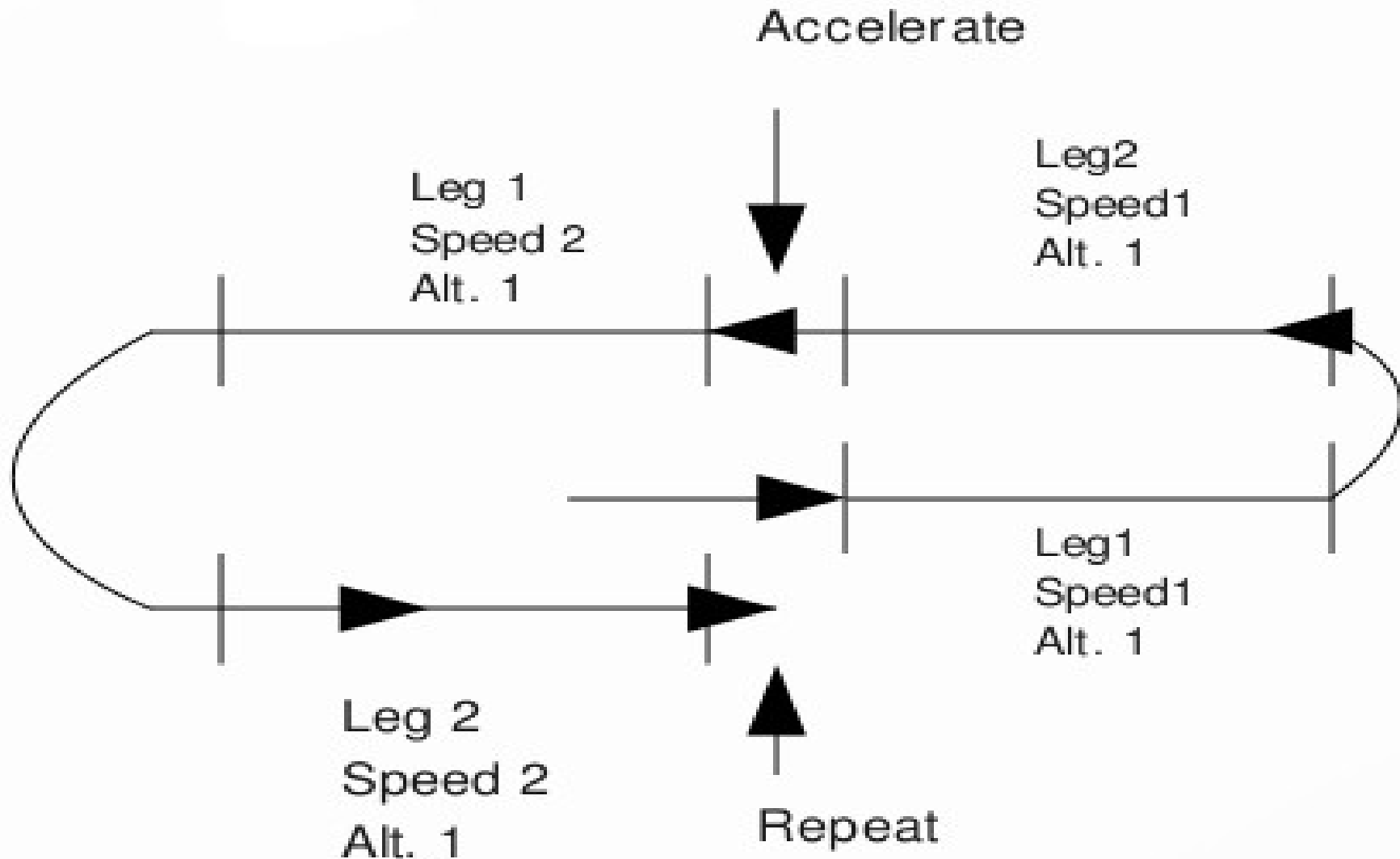
Comparison between the AIMMS measurements (red) and the Riyadh rawinsonde sounding on 23 March 2009. Additional analysis shows that typically the AIMMS probe temperature was greater than the Rosemount temperature and greater than the temperature measured by rawinsonde. The Rosemount temperature probe is a more robust measurement.



Time series showing the AIMMS relative humidity (black trace) and the FSSP cloud droplet concentration (blue trace) during the 8 April 2009 flight in Saudi Arabia. This time series is during the beginning of the flight just after the aircraft reached a constant flight altitude of 4500 m (temperature of approximately -4 C). As indicated by the FSSP cloud droplet concentration, at approximately 47000 seconds the aircraft first penetrated a cloud.

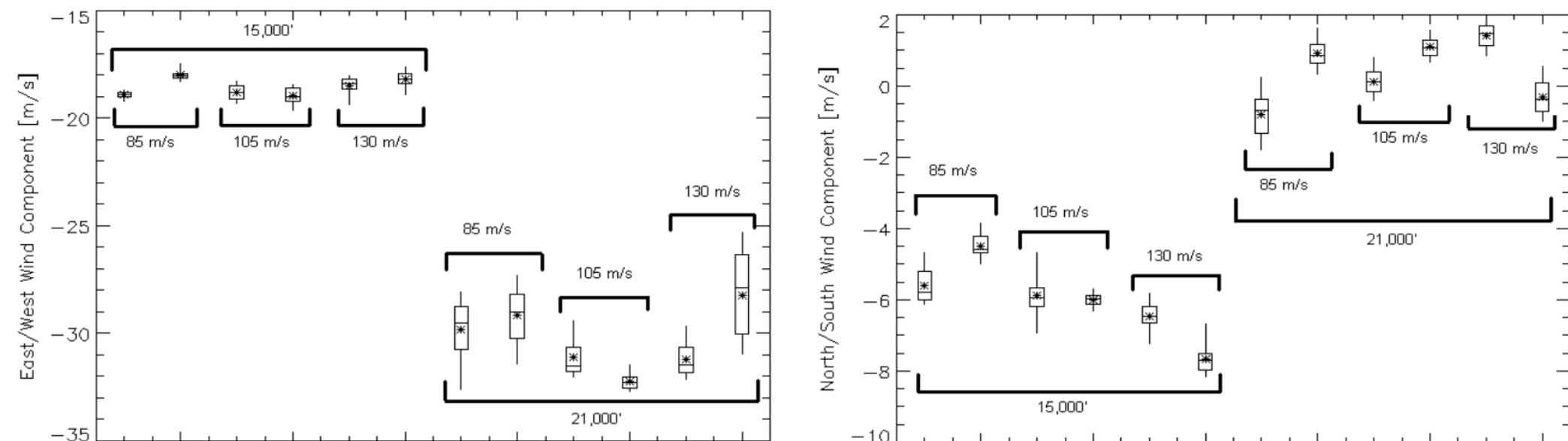


Horizontal Winds Performance Check



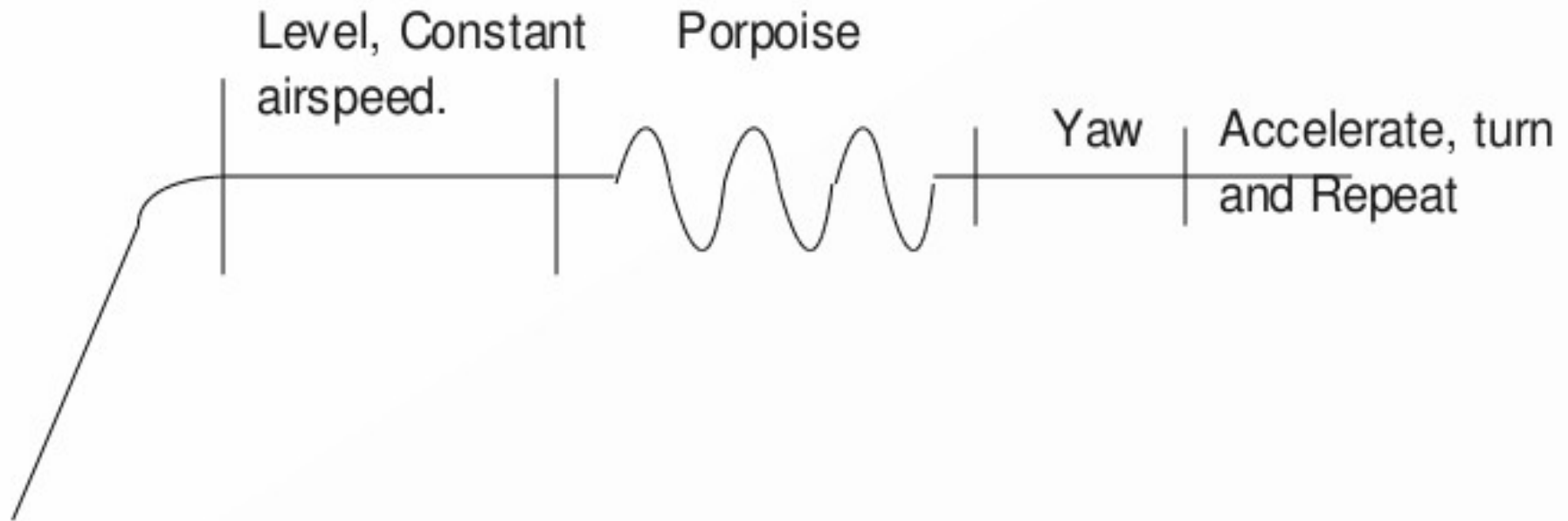
Flight legs were flown in one direction and then flown in the opposite direction at the same altitude and speed. Each set of maneuvers was conducted at three speeds and two altitudes.

Level Flight Legs during 23 March 2009 Saudi Arabia Flight



Summary statistics for the components of the horizontal wind from the AIMMS on 23 March 2009. All box-and-whiskers represent statistics from 1 Hz measurements made over an approximately three minute time period when the aircraft was flying straight and level. The aircraft altitude of the leg is given in the long interval notes and the true air speed (TAS) given by the short interval notes. The solid horizontal line in the center of the box is the median of the distribution, the top and bottom of the box is the 75 and 25 percentiles of the distribution, the top and bottom of the solid line extension is the 95 and 5 percentiles of the distribution, and the stars represent the mean of the distribution.

Vertical Winds Performance Check

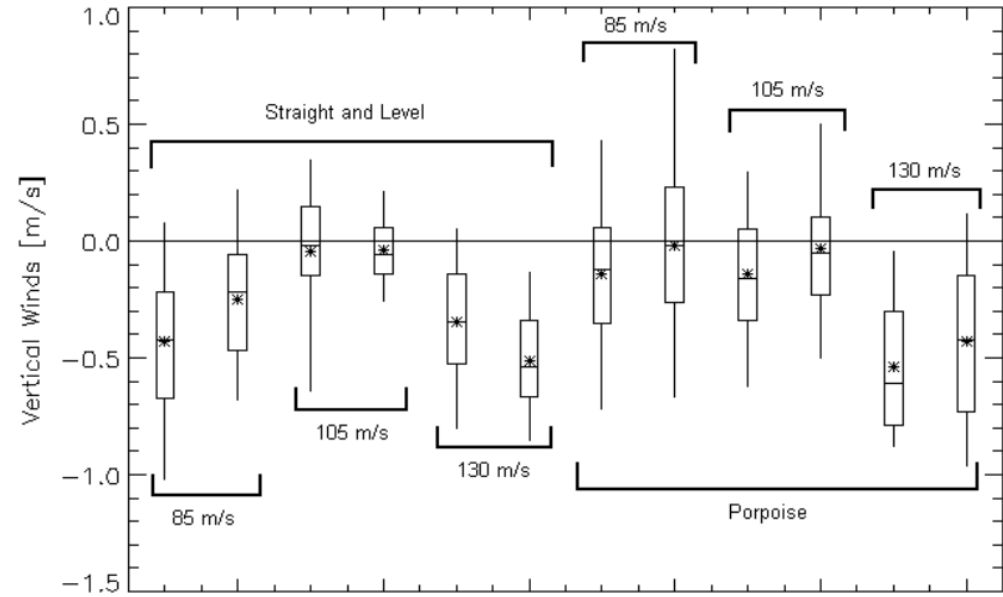
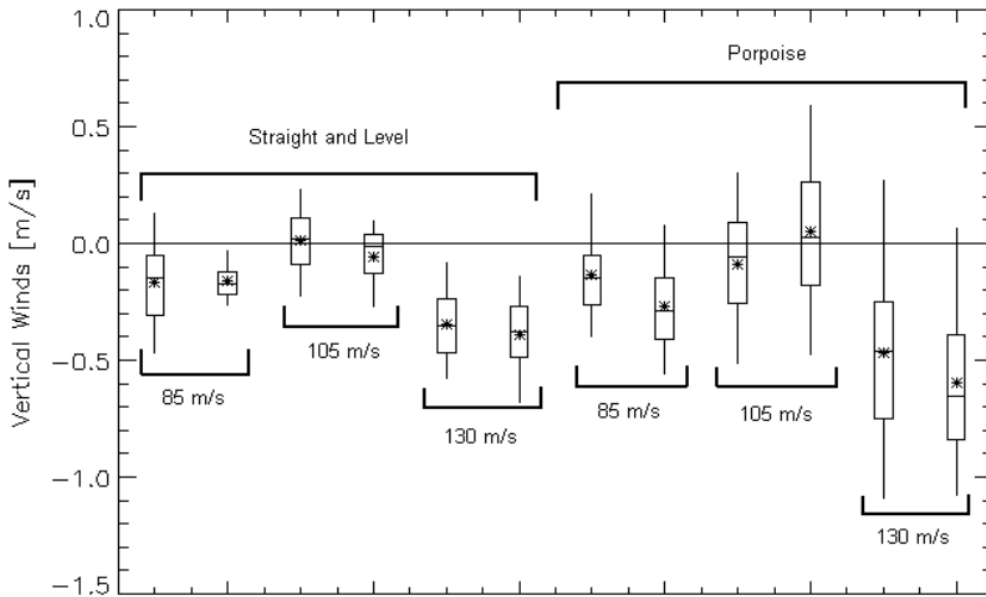


Each leg flown consisted of a straight and level constant speed maneuver followed by a porpoise and side-slip maneuver.

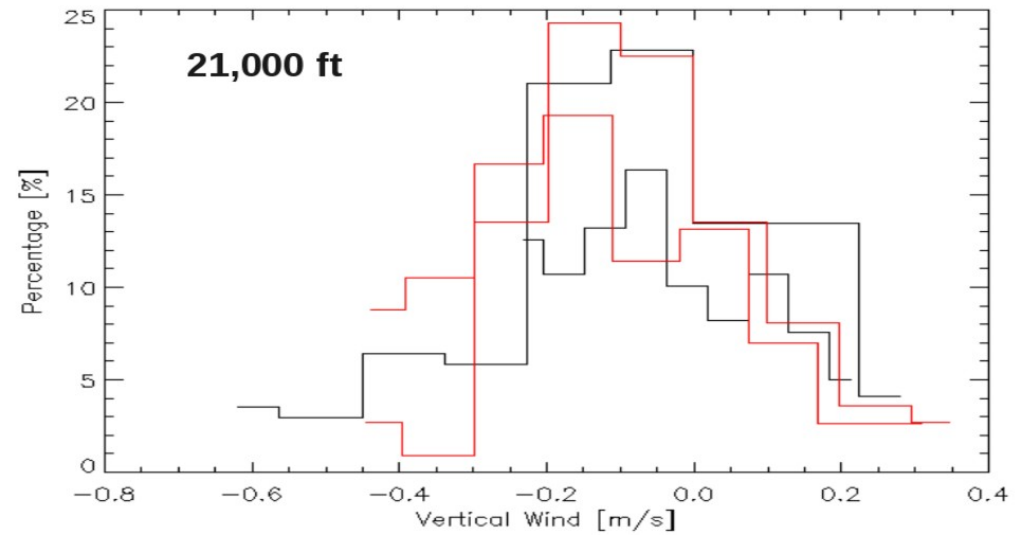
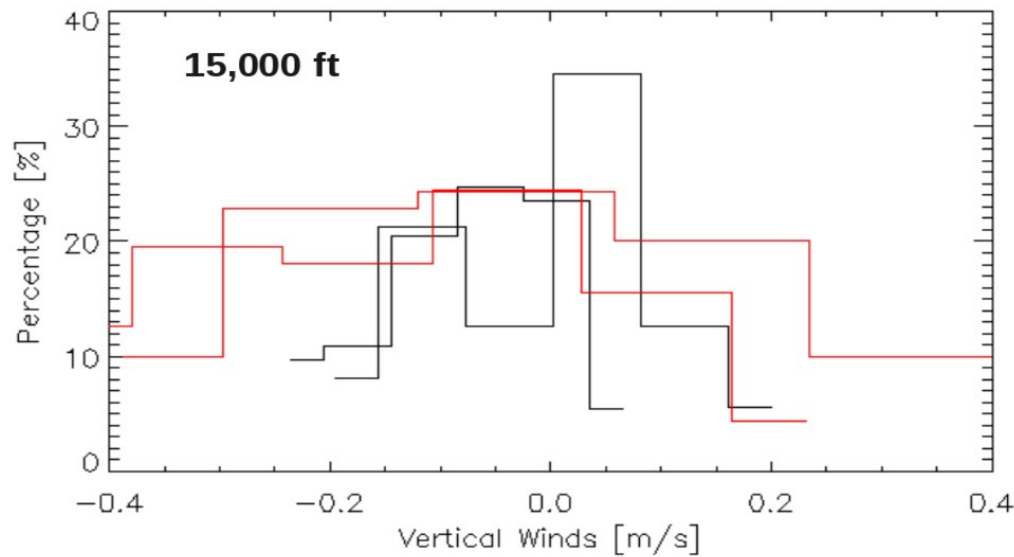
Flight Legs during 23 March 2009 Saudi Arabia Flight

15,000'

21,000'



Summary statistics for the vertical wind from the AIMMS on 23 March 2009. All box-and-whiskers represent statistics from 1 Hz measurements. The first six box-and-whiskers are level legs and the last six box-and-whiskers are for porpoise legs. The solid horizontal line in the center of the box is the median of the distribution, the top and bottom of the box is the 75 and 25 percentiles of the distribution, the top and bottom of the dotted line extension is the 95 and 5 percentiles of the distribution and the stars represent the mean of the distribution.



Histograms of the distribution of 1 Hz vertical winds at 15,000 ft (left) and 21,000 ft (right) during straight and level legs (black solid lines) and during porpoise maneuvers (red solid lines) during the AIMMS on 23 March 2009 flight in Saudi Arabia. The true air speed for all maneuvers was approximately 105 m/s.

Conclusions

- The aircraft static pressure on the King Air 200 has a dynamic pressure affect of up to 5 mbars that is not corrected for in the current data processing.
- Analysis shows that typically the AIMMS probe temperature was greater than the Rosemount temperature and greater than the temperature measured by rawinsonde (by as much as 5⁰ C.
- Cloud free comparisons between the AIMMS and rawinsonde soundings indicate good agreement (Figure 5), measurements in and near clouds indicate that relative humidity data was very poor with the AIMMS typically measuring zero relative humidity in clouds.

Conclusions: Winds

- Analysis of the 23 March 2008 wind validation flights indicates that horizontal winds and vertical winds were not greatly affected by aircraft motion which indicates an acceptable winds calibration.
- The vertical wind distributions agree (overlap); however, the vertical winds during the porpoise maneuvers generally have wider probability distributions. The wider probability distribution during porpoise maneuvers indicates that not all of the aircraft movement is removed and improvements can be made to obtain more accurate vertical winds.

Thanks for Listening



Any Questions