A13G-0330: Evaluation of 3-dimensional winds measured by the Aircraft Integrated Meteorological Measurement System (AIMMS) Christopher G Kruse, David J Delene, and Cedric Grainger, University of North Dakota (christopher.kruse@und.edu)

Objective

To analyze and evaluate atmospheric winds derived from measurements taken by the Aventech Research Inc. Aircraft Integrated Meteorological Measurement System (AIMMS). These AIMMS data analyzed are from a King Air 200 aircraft during a field project in Saudi Arabia from 15 March 2009 to 15 April 2009.

In-Situ Airborne Measurements

The Research King Air 200 aircraft with the AIMMS probe installed. The components of an AIMMS are an air data probe (ADP), commonly referred to as a gust probe, a differential GPS, an inertial measurement unit (IMU), and a central processing unit (CPU). The CPU uses data from the ADP, GPS, and IMU to derive the winds. The IMU and CPU were mounted in the cabin, the ADP was mounted under the right wing, and the GPS antennas were mounted on the top of each wing.

Calibration

To evaluate the performance of the AIMMS probe, special maneuvers were performed on the 23 March 2009 flight. 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. The performance of the horizontal winds is evaluated by comparing level flight legs in two directions.

Vertical Winds

The time intervals and mean magnitude of vertical wind during the straight and level and porpoise maneuvers at 15,000 feet and 21,000 feet MSL. Each consecutive straight and level maneuver was flown in the opposite direction and the same was done with the porpoise maneuvers. This was repeated at three different speeds and two different altitudes.

Horizontal Winds

The coefficients are used in the calculation of the winds and are applied on all project flights.

Conclusions

• Comparison between three minute northbound and southbound legs agree within the variability of the measurements (1 Hz) which indicates that aircraft maneuvers are not affecting the horizontal wind components.
• Comparison between the level and the porpoising legs agree within the variability of the measurements which indicates that aircraft maneuvers do not greatly affect the wind measurements; however, there is mean negative bias of 24 cm s⁻¹ assuming zero vertical velocity at 21000 ft.
• There is distinct difference between the vertical wind at the highest airspeed compared to the lower two airspeeds.
• There is mean negative bias of 24 cm s⁻¹ assuming zero vertical velocity at 21000 ft.

Future Work

• Analyze different calibration techniques whereby each maneuver type is used independently to determine coefficients related to that aircraft maneuver.
• Fly two AIMMS instruments and compare the resulting measurements.
• Determine if it is possible to calibrate the AIMMS and not have a bias in the vertical wind component.

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