Geophysical Research Abstracts, Vol. 9, 02406, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02406

Analysis of aircraft-type specific errors in AMDAR weather reports from commercial aircraft

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Automated weather reports from commercial aircraft provide an increasing amount of input for operational numerical weather prediction models. AMDAR (Aircraft Meteorological DAta Relay) is a WMO-coordinated program that contributes such reports. The daily number of AMDAR reports has reached over 200.000 in 2006 and is still increasing.

Few studies, so far, have investigated the quality and errors of AMDAR data. Some of these studies revealed the existence of errors depending on the aircraft type. Since different airlines use different algorithms to generate AMDAR reports, it remains unclear, whether the dependency on the aircraft type is caused by different physical properties of the aircraft or by different processing algorithms in the avionics software.

In the present study, a high resolution dataset was used to investigate the physical type-dependent errors of AMDAR reports. For this dataset, AMDAR measurements have been taken at the highest possible frequency by Lufthansa aircraft landing at Frankfurt (EDDF) on 22 days in 2003. All of these AMDAR data have been processed by the same software. Hence, influences of different processing algorithms cannot be expected.

In our study, vertical profiles measured by aircraft are compared to radiosonde soundings as well as to averaged aircraft profiles. The comparison of aircraft and radiosonde profiles revealed that aircraft type dependent differences are of the same order as mesoscale variations between neighboring radiosonde soundings.

From the comparison of single to averaged vertical aircraft profiles, it could be shown

that temperature measurements have systematic aircraft type specific differences of up to almost 1 K. This is much more than the random temperature error of most types that was found to be around 0.3 K.

The errors identified in the AMDAR wind measurements can be regarded as a aircraft type specific error vector, fixed to the aircraft reference system. I.e. as fixed wind biases in longitudinal (parallel to the flight direction) and lateral (horizontal, perpendicular to the flight direction) direction. The largest systematic biases in wind measurements were found to exist in longitudinal direction. The random error, however, was found to be larger in lateral direction, than in longitudinal direction.