EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-137-1, 2009
9th EMS / 9th ECAM

9th EMS Annual Meeting
9th European Conference on Applications of Meteorology
High resolution meteorology
- applications and services

Inversion and shear layer detection using AMDAR and wind profiler soundings

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The terminal area of Frankfurt airport (EDDF) offers as unique opportunity to campare vertical soundings of the planetary boundary layer (PBL) by two independent sources.

One of these sources is a wind and temperature radar profiler (WTR/RASS) located at the western end of the main pair of runways. This wind temperature radar (WTR) is a Scintec “AP1000” radar wind profiler with RASS (radioacoustic sounding system) extension “WT RASS”. The WTR/RASS at Frankfurt is the first wind profiler for operational purposes, which uses RASS also for wind measurements.

The second source are AMDAR (aircraft meteorological data relay) data collected by commercial passenger aircraft. They contain at least time, position, temperature, wind speed and direction. German weather service (Deutscher Wetterdienst, DWD) collects hourly profiles at the Central European airports. Since Frankfurt is not completely closed at night, this setup leads to a roughly continuous coverage with hourly vertical profiles.

Together, both offer a rare opportunity to compare the ability of both systems to identify inversion and windshear layers in the terminal area. To asses the degree of consent between layers detected by both systems, we use probability of detection (POD). The mutual inversion POD is in the range 40 to 60%, except at night below 250 m. With the weak shear criteria used to gain sufficient statistics, consenting shear detection is limited to low-level jets and similar structures. Only the lower edges of detected layers agree well. The vertical extent and top heights of layers detected are frequently underestimated by WTR/RASS in general.

AMDAR data seem to be more suitable for the detection of elevated inversions (and probably shear layers). In Contrast, WTR/RASS data are more suitable for detecting low and shallow as well as short-lived structures. In turn, data fusion of both systems seems to be advantageous for monitoring of hazardous atmospheric structures in the terminal area.