

Sonic flow distortion experiment

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We will present results from a field experiment with multiple sonic anemometers, and will address the question about residual errors of wind tunnel based calibrations that are transferred to atmospheric measurements.

Ultrasonic anemometers have become standard components of high quality in-situ instrumentations, because of the long term calibration stability, fast response, wide dynamic range, and various options of built in quality control. On the downside of this technology is the fact that the sound transducers and the carrying structure represent obstacles in the flow causing systematic deviations of the measured flow from the free flow.

Usually, the correction schemes are based on wind tunnel observations of the sonic-response as function of angle of attack under stationary conditions. Since the natural atmospheric flow shows turbulence intensities and scales, which cannot be mimicked in a wind tunnel, it is suspected that the wind-tunnel based corrections may be not (fully) applicable to field data.

The wide spread use of sonic anemometers in eddy flux instrumentations for example in the frame of EuroFlux, AmeriFlux or other international observation programs has therefore prompted a - still controversial - discussion of the significance of residual flow errors.

In an attempt to quantify the flow distortion in free field conditions, 12 identical 3-component sonics with 120 degree head symmetry were operated at the north margin of an abandoned airfield. The sonics were installed in a straight line in WE-direction at 2.6 m height with a mutual distance of 3 meters and with an azimuth increment of the individual sonics of 11 degrees. Synchronous raw data were recorded with 20 Hz sample rate. Data of about 12 hours with southerly winds (from the relatively flat airfield) were analyzed. Statistical homogeneity of the wind field in the range of the instruments line was assumed, but a variable finite turbulent decay constant was accounted for, which was estimated from the data.

The free field flow distortion estimates will be discussed in comparison with wind tunnel observations.