Papadopoulos K., Stefanatos N., Paulsen U.S., Morfiadakis E., "*Effects of Turbulence and Flow Inclination on the Performance of Cup Anemometers in the Field*", Boundary Layer Meteorology, 101 (1), pp 77-107, October 2001

Abstract

Four commercial and one research cup anemometers were comparatively tested in a complex terrain site to quantify the effects of turbulence and flow inclination on the wind speed measurements. The difference of the mean wind speed reading between the anemometers was as much as 2% for wind directions where the mean flow was horizontal. This difference was large enough to be attributed lo the well-known overspeeding effect related to the differing distance constant (ranging from 1.7 to 5 m) of the cup anemometers. The application of a theoretical model of the cup-anemometer behavior in a three-dimensional turbulent wind field proved successful in explaining the observed differences.

Additional measurements were taken with the anemometers tilted at known angles into and out of the incident wind flow. Thus, a field-derived angular response curve is constructed for each anemometer and the deviations from published wind-tunnel results are discussed.

The uncertainties of, or false assumptions about, the angular response characteristics of the anemometers contribute the largest amount in the observed errors of mean wind speed even for a horizontal mean flow. The angular response curves are finally used to correct the 10-min mean wind speed. The necessary information for the correction is the turbulent intensity (preferably in the vertical direction) and the mean flow inclination.

For demanding applications, the angular response parameters of cup anemometers should be taken into account. The incorporation of the angular response parameters in a correction scheme would be most robustly applied if their variation with inclination and wind speed was smooth.

Keywords

Cup Anemometer, Inclined Flow Measurement, Over-speeding, Wind Speed Measurement Errors