EMS Annual Meeting Abstracts
Vol. 15, EMS2018-508, 2018

New insights from an experimental hot-air balloon flight for measuring low level winds in the surroundings of Cabauw.

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A field experiment with a hot-air balloon was conducted in the vicinity of Cabauw (The Netherlands). Recreational hot-air balloon flights contain useful wind information (De Bruijn et al, 2016). On a yearly basis about 6000 flights are taken place, mainly during the morning- and evening transition. To collect the data, an app for smart-phones has been developed. In this experiment we investigate the accuracy of smart-phones GPS using a geodetic GNSS receiver as ground truth. A comparison of positions reveals that smart-phones equipped with a GNSS-chip are fairly inaccurate and the standard deviation of the absolute position in the horizontal plane is 5 [m]. However the relative positions are much accurate, resulting in horizontal velocity errors of 1 [m/s]. The standard deviation in altitude is less accurate and is beyond 12 [m]. The position error can be improved by averaging in time and the processed data are suitable for the calculation of the horizontal wind vector. We have validated the balloon wind data with observations from the Cabauw tower and the results are encouraging. We have measured the speed of the hot-air balloon relative to the surrounding air with a sonic anemometer and we have developed a theoretical model for the movement of the balloon. It appears that the balloon's tracks deviates slightly from the ABL-wind and tends slightly towards the geostrophic flow.

E.I.F. de Bruijn, S. de Haan, F.C. Bosveld, B. Wichers Schreur and A.A.M. Holtslag, Observing Boundary-Layer Winds from Hot-Air Balloon Flights, Weather and Forecasting, 2016, 31, 5, 1451-1463, doi:10.1175/WAF-D-16-0028.1.