Boundary-layer height detection with a ceilometer at a coastal site in western Denmark

One year of data from ceilometer measurements is used to estimate the atmospheric boundary-layer height at the coastal site Høvsøre in western Denmark. The atmospheric boundary-layer height is a fundamental parameter for the evaluation of the wind speed profile, and an essential parameter in atmospheric transport- and dispersion models. A new method of filtering clouds from the ceilometer data is presented. This allows for the inclusion of more than half of the data in the subsequent analysis, as the presence of clouds would otherwise complicate the boundary-layer height estimations. The boundary-layer height is estimated with four different detection methods implemented in an automated detection algorithm. Two of the detection methods used have been modified and are shown to improve the detections under certain circumstances. Comparisons of boundary-layer height estimates from ceilometer data are made with those from turbulence measurements of a wind lidar and the two methods are in good agreement. It is found that detecting the boundary-layer height from turbulence kinetic energy considerations with the wind lidar is not recommendable for detecting the boundary layer height during the presence of clouds. The boundary-layer height estimates are then used to analyse the daily evolution of the boundary layer and to perform monthly and annual frequency distributions of the boundary-layer height. For westerly winds bi-modal distributions are often found, which may be separated by different criteria, while for easterly winds it is seldom possible. The ceilometer data shows potential to be used to perform extensive studies of the boundary layer.

General information
State: Published
Organisations: Department of Wind Energy, Resource Assessment Modelling , Meteorology, University of Copenhagen
Contributors: Hannesdóttir, Á., Peña, A., Gryning, S., Hansen, A. W.
Number of pages: 75
Publication date: 2013

Publication information
Publisher: DTU Wind Energy
Original language: English
(DTU Wind Energy Master Thesis M; No. 0039).
Electronic versions:
Boundary_layer_height.pdf

Bibliographical note
Master Thesis
Research output: Research › Report – Annual report year: 2013