Referee Report for the Doctoral Thesis entitled

"Physical Modelling of Flow and Diffusion in an Urban Canopy"

by Klara Bezpalcova

Subject:

The dispersion of pollutants in complex urban terrain is still not fully understood. It was the purpose of the doctoral thesis to provide more insight into the subject by a number of carefully designed experiments in the wind tunnel facility of Hamburg University.

Staring point was a field experiment carried out in the Great Basin Desert in Utah/USA. An artificial village made up by 120 ship containers was built and passive tracers from continuous and instantaneous sources were released. At selected positions, mean and turbulent velocities as well as concentrations were measured.

The doctoral candidate was tasked

- to replicate selected field trials in a boundary layer wind tunnel under controlled ambient conditions,
- to analyze the field and wind tunnel data, to compare them with each other and to find plausible explanations for what was observed, and
- to enhance the scope of the data set by additional measurements in the wind tunnel in order to close gaps in the results and in our knowledge.

Accomplishment:

At first the doctoral candidate made herself familiar with the particularities of urban boundary layers. Based on the current state of the art she provides an overview on what is known about the distribution of mean and turbulent properties within and above urban canopy layers.

It follows a presentation of the MUST field experiment and a careful selection of those cases which can be replicated in a neutrally stratified boundary layer wind tunnel. A strategy for her own experiments is being developed, and the effort to generate a wind tunnel boundary layer with mean and turbulence characteristics in the model scale 1:75 is described. Once the boundary layer flow with acceptable properties was achieved, the candidate performed extensive flow field measurements in an array which parallels that of numerical grid models. Finally the study was complemented by a series of experiments in which the dispersion of passive pollutants released from continuous and instantaneous source was investigated. The candidate used a sophisticated experimental set-up with two fast-response concentration probes operating in parallel. This set-up allowed her

to carry out some unique measurements which opened the chance to characterize - among other things - plume meandering within the urban canopy layer.

Appraisal:

The PhD-student proves with her thesis that she is capable to work at the forefront of research in the field of atmospheric boundary layer physics. She is able to understand and to coherently explain complex issues of our field. She is proficient in the application of modern measurement techniques, is capable of generating data of high quality, of analyzing the data in an adequate manner and of drawing the right conclusions. The presentation of results is clear, and the gain of scientific insight exceeds the standard of normal PhD-theses.

The doctoral candidate gives a shining example for the fact that the advance of modern instrumentation - which allows measurements with high-resolution in time - gives a similar push to experimentalists as does the advance of powerful computers for the numerical modellers. From the numerous results presented the correlation measurements should be particularly mentioned. To my knowledge such measurements have with this perfection never been performed before. The "urban" data set the candidate provides is probably the richest which presently exists. These data are not only of academic value but of practical value as well. They will be used as a reference in the European COST action on "Quality Assurance and Improvement of Micro-Scale Meteorological Models".

Although the English is not always perfect and requires improvement, I am confident that the thesis if submitted by the candidate to the University of Hamburg would have been given a very good mark (magna or summa cum laude).

Hamburg, January 5, 2007