

Supervisor's review on Mgr. Hana Chaloupecká “Sudden release of toxic gas in a built-up environment “ doctoral thesis

Hana Chaloupecká started her Ph.D. studies at the Department of Meteorology and Environmental Protection, now the Department of Atmospheric Physics at the Faculty of Mathematics and Physics, Charles University in 2012 immediately after her graduation. With the basic principles and methods of physical modelling, which became main the instrument for the study of flow and diffusion in the atmospheric boundary layer and were used during the dissertation, the student was acquainted with the diploma thesis entitled "Flow and diffusion within the urban area". The thesis dealt with the so-called inverse problem. It means the quantitative assessment of the location and the rate of discharge of the source from the measurement of ground concentrations at two points. It should be noted that many of the researchers are currently undergoing this task. Another source of her skills became from collaboration with the staff of the laboratory. Inspirational for the dissertation was the regular active participation of Hana Chaloupecká at international conferences or workshops. Here is a need to underline a regular international workshop called Physmod. Its participants are predominantly specialists and PhD students in the branch of the physical modelling. In the framework of the workshop are discussed new projects, new proposed methods, results often unpublished. Here, the doctoral candidate has received additional suggestions and recommendations for her further work.

Research of flow and diffusion inside, resp. over urban areas had been being mainly focused on cases of long-term stationary or non-stationary gas leakage. Increasingly frequent industrial accidents cases, however, require the study of so-called instantaneous release. It means the cases where the turbulent time scale is the order of more time of leakage. It is not, in principle, possible to use the usual modelling methods (mathematical and physical). The purpose of the thesis was a relatively general study of gas distribution within urban areas in the case of short-term gas release. It would be possible to formulate a problem as an interaction between two random events, turbulent flow and random leakage. It was necessary to apply an assembling method to quantitative describe the interaction. This means that in the case of physical modelling, to perform series identical experiments and then to determine the corresponding value-dependent variables. This formulated task consisted of three main steps: 1) the design and implementation of the experimental arrangement, 2) the implementation of identical experiments, and 3) the statistical processing of the obtained data.

In the first step, a simplified model of urban area was designed, which corresponded in particular to Prague's Vinohrady quarter, i.e. a block of houses, including their courtyards. Then she designed a source model that is capable of generating an instant, perfectly defined puff controlled by a PC. Finally, it was necessary to prepare such an experimental set up in order to meet the similarity criteria. Finally the criteria were verified.

In the second step the doctoral student made about 40 thousand experiments. At each point, 404 identical experiments were performed. However, at the beginning it has been shown that this amount is sufficient to produce a representative sample. Then database for further processing was created from the data thus obtained.

The third step was devoted to the actual processing of measured data. Of course the data was verified at first. Subsequently, the mean values of the dependent variables and the other

characteristics of these processes were determined from the data for the all points of the space.

After these terrible anabases, the obtained quantities were evaluated, discussed, and compared, with similar quantities for long-term leakage. The results were then published in two articles in a magazine with IF and in one chapter of the book. Another article for the IF magazine is in the review process.

It should be added that the whole process was solved in the context of the project COST Action ES1006: "Suddenly released dispersing clouds in a built-up environment „that was supported by the Ministry of Education, Youth and Sports. The database servers for validation mathematical models designed for this case.

The obtained results are applied in the framework of the project TJ - Program for the Support of Applied Research ZÉTA: "Short-term Leakage of Hazardous gases into the Atmosphere". The project is solved in cooperation with researchers of Fire Rescue Service of the Czech Republic. The aim of the project is to modify the operational models for integrated components of the rescue system in case of short-term leakage. Some results of this project are already mentioned in the dissertation.

I note that the thesis has significantly done exceeded the requirements for doctoral dissertation and it is at a high international professional level. I can still say that such professional results have so far only been obtained at foreign top-level institutions. I would add that a specialist in meteorology will certainly find work shortages in his field, aerodynamics will similarly find shortcomings in his field, but the combination of these disciplines is another significant benefit of the work.

For these reasons, as a supervisor, I can state that the original goals of doctoral studies were not only achieved but were significantly exceeded. A large part of the results have been successfully published. I also state that she has fulfilled all study duties according to the study plan.

Based on the above, I recommend that the submitted thesis be accepted as a doctoral dissertation for the defence and after her successful defence H. Chaloupecká was awarded by the Ph.D. degree.

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