

## Opponent's review of the Doctoral Thesis

Candidate Ing. Jakub Jeřábek

Title of the doctoral thesis Studying of dominant factors influencing a shallow runoff formation at a small catchment scale

Study Programme Water Management and Water Engineering

Tutor Ing. David Zumr, PhD.

Opponent prof. Ing. Radka Kodešová, CSc.

e-mail kodesova@af.czu.cz

### Topicality of the doctoral thesis theme

Commentary: The aim of this study was to investigate the effect of soil layering and surface topography on surface and subsurface runoff. The work was mainly focused on the affect of the compacted layer (e.g., plow pan) and the effect of the compacted wheel tracks. Understanding the processes related to the formation of runoff is key to assessing the catchment water regimes. The work is thus very topical.

excellent    above average    average    below average    poor

### Fulfilment of the doctoral thesis objectives

Commentary: The electrical resistivity tomography (ERT) method was used to assess deep structures. This method was also applied to assess a degree of compaction of a compacted layer via comparison of a resistivity and selected soil properties (e.g., bulk density, penetration resistance). The ERT method was also used to evaluate an influence of wheel tracks on soil water distributions after irrigation events. Author also focused on an evaluation of a surface roughness, connectivity of the soil surface, and its impact on a formation of the surface runoff. Finally, author attempted to evaluate an impact of the surface roughness, roughness of an interface between layers, and wheel track on the subsurface water flow. Based on the results, the main factors and processes were identified. The objectives were met.

excellent    above average    average    below average    poor

### Research methods and procedures

Commentary: The procedures were correct and corresponded to the requirements for the given issue. Up-to-date tools and methods were used for the solution.

excellent    above average    average    below average    poor

### Results of the doctoral thesis – dissertant's concrete achievements

Commentary: The author devoted a lot of effort to the measurements, processing of the experimental data, data interpretation, and subsequent simulations of the observed water regimes. Procedures for obtaining data and the methods' application are discussed. Furthermore, the author correctly identified the main factors determining the studied processes. Some of the results were already published in scientific journals. The dissertation thus demonstrates his broad

knowledge and abilities.

excellent     above average     average     below average     poor

### Importance for practice and for development within a branch of science

Commentary: Knowledge of the factors and processes that determine surface and subsurface runoff in small catchments is key if we want to evaluate and predict hydrological conditions in these catchments. Obtaining reliable data on the structure of surface and subsurface soil layers, thorough data analysis and subsequent mathematical modeling can thus play a very important role, for example, in the design of measures to prevent a shallow runoff and related flash floods, soil erosion, rapid transfer of substances used in agriculture to surface waters, etc. The results of the dissertation clearly contributed to the expansion of knowledge in this area. They can be adopted to evaluate the hydrological conditions of small watersheds in practice.

excellent     above average     average     below average     poor

### Formal layout of the doctoral thesis and the level of language used

Commentary: The language level of the work is good. I noticed only a few minor mistakes, which I will not comment. I have remarks regarding the clarity of the work. Some are listed below.

excellent     above average     average     below average     poor

### Statement on compliance with citation ethics

I have no comments.

### Remarks

It is obvious that the author wrote this thesis based on his already published papers. Nevertheless, he could also include the latest publications dedicated to this topic. This way he could better indicate the novelty and importance of his results.

In chapter 3, there is a very short summary of the influence of soil management on soil water dynamics. It should be noted that the influence of, for example, tillage practices depends on the soil type. It is true that the no-till usually exhibits a reduction in the top saturated hydraulic conductivity compared to conventional tillage. However, our study in Luvisols also showed that the hydraulic conductivity at  $h=-2\text{cm}$  was greater under no-till practice than that under conventional tillage. It should also be noted that the extent and properties of the plow pan can also be different in different soil types, because its formation is determined not only by compaction but in some soils also by a transport of clay particles and other soil components and their accumulation in the plow pan layer.

Chapter 6 in context with other chapters feels a bit unbalanced. Although I understand that this is because the details of the studies are given in the attached articles. Still, I think this chapter could be extended.

Section 6.1 lacks information on soil types, which is at least given in the attached article. But what I miss in the article "Geophysical survey as a tool to reveal subsurface stratification at within a small agricultural headwater catchment: a case study" is an information on whether (or why there was not) an effort to validate the ERT profiles using information about the actual geological structure, occurrence of groundwater, etc. The article states that electrical resistivity transects were recalculated with the use of Archie's law to hydraulic conductivity for investigating the hydrological behavior of the subsurface. But the method was not further explained. Please explain this method during the defense.

I also ask for a more detailed comment on the possible correlation between penetration resistance and electrical resistivity (which, given the trend, I see as problematic) and the related condition "the water saturation should not be lower than the field capacity".

The procedures and results related to the modeling of surface runoff (chapter 7) and infiltration into tilled soil (chapter 8) are very valuable. Unfortunately, I must admit that I was initially somewhat lost in performing the experiments. Even though the author declares that they are described in detail in section 6, this is not the case. The information is gradually presented in individual parts. Therefore, it is a bit difficult to find out what and when was measured and then considered in the following simulations (particularly in chapter 8). For instance, the approach (regarding the input data, i.e., plot, variables, and positions of corresponding sensors, etc.) applied when using an inverse modeling for optimization of the soil hydraulic properties is not clear. Is the one-dimensional approach correct when simulating infiltration with expected intensive runoff? How was runoff determined/included in this case? The same questions apply to the 2D simulations. How information from zero-tension lysimeters contributed to the 1D modeling or 2D simulations. It should also be noted that the zero-tension lysimeters cannot interpret an actual progress of water flow towards deeper layers. Nevertheless, the 2D simulations are especially interesting. If I understand correctly, the presented approach and results have only been presented at conferences. Therefore I recommend their publication in a scientific journal as soon as possible.

**Final assessment of the doctoral thesis**

This is a high-quality dissertation with an indisputable scientific and practical benefit. Therefore, I recommend this thesis for defense.

**Following a successful defence of the doctoral thesis I recommend the granting of the Ph.D. degree**

yes <input checked="" type="checkbox"/>	no <input type="checkbox"/>
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Date: 11. 10. 2022

Opponent's signature: .....