

## Opponent's review of the Doctoral Thesis

Candidate Ing. Saleem Ibrahim

Title of the doctoral thesis Integrating Satellite Remote Sensing, Machine Learning and GIS for Fine-Scale Analysis of Air Quality: Aerosol Optical Depth Estimation

Study Programme Geodesy and Cartography

Tutor prof. Ing. Lena Halounová, CSc.

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### Topicality of the doctoral thesis theme

Commentary: Modelling air pollution can certainly be considered a topic of high relevance in current world as well as utilization of artificial intelligence in this regard.

excellent     above average     average     below average     poor

### Fulfilment of the doctoral thesis objectives

Commentary: In my opinion, all the set objectives were met.

excellent     above average     average     below average     poor

### Research methods and procedures

Commentary: I evaluate the selected methods and procedures positively. It is evident from the work that the student understands the topic and proceeded systematically. He has demonstrated a range of knowledge and skills in various fields such as remote sensing, spatial data processing, artificial intelligence, air quality monitoring.

excellent     above average     average     below average     poor

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

Commentary: The student created and validated three significant models (AOD for Europe, PM2.5 for Europe and PM2.5 for the Czech Republic) based on artificial intelligence and used these models to derive publicly available datasets spanning over several years.

The student is also the main author of four scientific papers related to the topic of PhD thesis. All these papers are published in journals indexed by Web of Science database.

excellent     above average     average     below average     poor

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

Commentary: In my opinion, doctoral thesis helps to increase knowledge in the treated topics, as also evidenced by a decent citation rate of published articles. I appreciate the fact that all datasets have been made publicly available by the author.

excellent     above average     average     below average     poor

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

Commentary: The evaluated thesis is at a high level, the text is appropriately structured and coherent. Since English is not my first language, I don't dare to evaluate it. However, in my opinion, the text of the thesis is also of a high level from the linguistic point of view.

excellent     above average     average     below average     poor

### Statement on compliance with citation ethics

The student correctly cites used references, I haven't found any issues related to this topic.

### Remarks

I do not have any major critical remark related to realized works. Still, I have one general remark related to the delivered thesis itself. The thesis is composed of a brief introductory text followed by four published papers. Although the published papers are well written, they mainly concentrate on a description of realized works and their results. I therefore miss in the thesis a more complex introduction to a state of the art of the problematics and to a reasoning applied for choosing the methodology and methods of the realized works (to give an example: it would be e.g. good to know how and why the author decided to choose the extra trees methods over other options).

Specific comments and questions:

P12: I would like to comment on your first publication entitled Statistical Study of MODIS Algorithms in Estimating Aerosol Optical Depth over the Czech Republic. If I understand it right, you have used a different sample of values for testing individual algorithms (different number of values, maybe even coming from different set of days). For a proper comparison of individual algorithms, you should use an identical dataset in your evaluation.

P21: your AOD model is based on a product derived from MODIS measurements. Can you please compare this product with the SLSTR product of Sentinel-3 mission and explain why did you decide to use the MODIS one?

P21, Figure 1: why is the Brno AERONET station missing on the map?

P41, Figure 1: why does the number of used measurements differ so strongly among countries?

P48: I can imagine that the PM<sub>2.5</sub> can vary strongly on a local scale (over few kilometers or first tens of kilometers). Your model uses a very dense spatial resolution of 1 km. I wonder if your model is able to capture local changes of PM<sub>2.5</sub> or not? Your maps presented on P48 look very smooth without any local or regional patterns. How did you decide to choose the 1 km spatial resolution?

P57: have you offered your PM<sub>2.5</sub> model for the Czech Republic to the CHMI or another public or non-public institution?

### Final assessment of the doctoral thesis

I evaluate the submitted thesis very positively and definitely recommend it for a defence.

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

**yes**  **no**

Date: November 7, 2023

Opponent's signature: .....  .....

