

## 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 Halounova, CSc.

Opponent prof.Dr.Ing.Karel Pavelka

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### Topicality of the doctoral thesis theme

Commentary: This thesis aimed to harness the capabilities of machine learning in generating air quality datasets using various data sources including satellite remote sensing, meteorological inputs, land cover, topography, observations from ground monitors, among others.

excellent  above average  average  below average  poor

### Fulfilment of the doctoral thesis objectives

Commentary: I can responsibly say that the objectives of the thesis have been met, they are listed in paragraph 3, pages 4-5.

excellent  above average  average  below average  poor

### Research methods and procedures

Commentary: The methodology has been developed correctly, it is described in paragraph 4 (4. Research methods used) The integration of remote sensing and ground-based data contributed to the development of a comprehensive and robust methodology to explore the research objectives. Open source software and open data were used in the research.

excellent  above average  average  below average  poor

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

Commentary: The results of the PhD student's work are of high quality from the point of view of a technical university; it concerns the narrow problem of air quality assessment and monitoring; the PhD student has published several articles on this topic, which describe the results of the research and have therefore already been evaluated positively by reviewers worldwide (especially articles in Remote sensing)

excellent  above average  average  below average  poor

<b>Importance for practice and for development within a branch of science</b>				
Commentary: The work provides exact results in terms of global air monitoring and shows new possibilities of data processing using machine learning. The results have been successfully published in peer-reviewed journals.				
<input type="checkbox"/> excellent	<input checked="" type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor

<b>Formal layout of the doctoral thesis and the level of language used</b>				
Commentary: The thesis is presented as an annotated set of journal papers; there is little opportunity to judge the relatively short accompanying text. The text is correct in content, contains all relevant information and complements information from published articles Neither I nor the PhD student are native English speakers; from my point of view, the text is written in good enough English.				
<input type="checkbox"/> excellent	<input checked="" type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor

<b>Statement on compliance with citation ethics</b>
Citation ethics were respected, I found no serious problems.

<b>Remarks</b>
<p>You've been working with MODIS data. Are there other similar devices and free data?          MODIS. How long has the data been available and what is the outlook for the future?          Particulate matter (PM) with a diameter less than or equal to 10 µm (PM10) can enter humans through breathing, and these particles are more dangerous the smaller their diameter.          Is this the main danger to humans, or are there other dangers in the air for the environment in general? You write that there is a danger especially of respiratory cancer for humans; but we live in community with other creatures. Is there any study that points to this issue as well? I mean, animal diseases for example? Part of your paper analyses the effects of COVID-19 on AOD levels over Europe. For the last two years, a vicious war has been waged in the eastern part of Ukraine. Millions of tons of toxic substances are entering the air from explosives, fires and leaks from destroyed facilities. Can this be monitored from satellite data in terms of the state of the air?          You write in the conclusion that the machine learning methodology can be used in similar air quality studies to estimate other pollutants such as O3, NO2, SO2, CO. Do you intend to continue this research or is this a topic for another PhD student?</p>

<b>Final assessment of the doctoral thesis</b>
The thesis is beneficial for the field of study and I recommend it for defence.

<b>Following a successful defence of the doctoral thesis I recommend the granting of the Ph.D. degree</b>		
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Date: 19.11.2023

Opponent's signature: .....

