REVIEW

By Associate Prof. Dr. Eugenia Evgenieva Sarafova

Subject: dissertation for awarding the educational and scientific degree *"doctor"*

in the scientific specialty *"Cartography (incl. Thematic geographic mapping - Geographic Information Systems)"*

Dissertation topic:

“Geospatial model for air quality evaluation in the city of Sofia"

Author: Milena Simeonova Stefanova, doctoral student at department "Geospatial Systems and Technologies", Faculty of Geology and Geography, SU "St. Kliment Ohridski"

Research supervisor: Assoc. Prof. Dr. Stelian Dimitrov

The review was prepared following the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LAD), the Rules for its Application (LADLA) and the Rules for the Terms and Conditions for Acquiring Scientific Degrees and Holding Academic Positions at SU "St. Kliment Ohridski", accepted by decision of the Academic Council on 31.10.2018. The review of the materials is following Rector's order No. RD-38-154/27.3.2024 for the procedure for acquiring the educational and scientific degree "doctor" in a professional direction 4.4. Earth Sciences "Cartography (Thematic Geographical Mapping) - Geographical Information Systems" by full-time doctoral student Milena Stefanova, with a dissertation on the topic "Geospatial model for air quality evaluation in the city of Sofia".

Doctoral student Milena Stefanova has fulfilled the minimum national requirements for obtaining the degree "Doctor" and has submitted all the documents required for the dissertation defense procedure.

1. Information about the PhD student

Milena Simeonova Stefanova was born on 15.07.1995 in the city of Sofia. In 2018, she graduated with a bachelor's degree in Regional Development and Politics at SU "St. Kliment Ohridski", Faculty of Geology and Geography. By the end of 2019, she graduated as a Master in Planning and Management of Territorial Systems at the same university and faculty. From February 2020 until 2024, she was a doctoral student in the Department of Geospatial Systems and Technologies. The candidate's professional experience includes internship positions in various private and public organizations related to mapping, processing, and analysis of geospatial data, writing technical documentation, communication with partners, and project management. From January 2023 until now, PhD student Stefanova works as a junior expert in the Ministry of Environment and Water, Directorate "Waste Management and Soil Protection". A good impression is made by the large number of projects in which Stefanova has taken part - Improving the conservation status of natural habitats 4070 and 5130 under the parameter "Future perspectives" (2021), Preparation of Flood Risk Management Plans for Romania (2021), Expansion and improvement of the Geographic Information System for the needs of Water and Sewerage for the town of Kardzhali (2020-2021), Design and construction of an integrated geographic information system for the municipality of Silistra (2020), etc.

The work experience reference from the PhD student's CV shows a deep interest in the topics related to environmental protection, the use of programs, policies, and spatial data to solve specific problems in this thematic area.

Milena Stefanova is enrolled for full-time doctoral studies in professional direction 4.4. Earth Sciences by order RD 20.323 of 31.01.2020, with a term until 01.02.2023. She was awarded the right of public defense by order RD-20-594 of 07.03.2023, effective from 01.02.2023.

2. Evaluation of the dissertation work

The dissertation covers a volume of 183 pages and an appendix with a volume of 100 pages. It is structured into the following parts: an introduction, three chapters, and a conclusion. The text is illustrated with numerous figures that are not numbered consecutively. This creates some difficulties in reading and understanding the text. In the table of contents at the beginning of the dissertation and also in the text, numerous figures are described that are not present in the main text but are presented as an

appendix to the dissertation. The aim, object, subject, and tasks of research are clearly defined.

a. **Relevance of the topic**

Clean air is an extremely important topic both globally and for the city of Sofia, due to its direct impact on people's health, the environment, and economic development. In the context of the city of Sofia, the problem of air pollution is particularly acute due to specific factors such as the geographical location, which limits the natural circulation of air, intensive car traffic, and the extensive use of solid fuel for heating during the winter months. Addressing these issues is critical not only for improving the quality of life of the people living in Sofia, but also for achieving sustainable urban development, which is a key element for the future prosperity of any society. This proves the importance of the topic and the extreme importance of the problem under consideration.

b. **Chapter AIR QUALITY – BASIC CONCEPTS AND LEGISLATIVE FRAMEWORK**

This chapter covers basic concepts related to air, weather, and climate; basic definitions, means of monitoring, and an analysis of the state of the problem around the world are considered. Some inaccuracies in expression are admitted in the text, e.g. *"The so-called air consists of... The Earth's atmosphere consists of air."* Numerous claims are not supported by citations. The chapter provides an overview of atmospheric air quality, as well as the main types of pollutants. The normative documents, laws, and strategies for AQ are defined.

c. **Chapter GEOGRAPHIC INFORMATION SYSTEMS AND THEIR APPLICATION FOR THE PURPOSES OF AQ MANAGEMENT**

The chapter on GIS examines the application of these technologies to the study of air quality issues. In the first 6 pages, the doctoral student reviews the basic concepts related to GIS, which, given the nature of the dissertation work and the

decades of application of these technologies in environmental management, is unnecessarily detailed.

d. Chapter GEOSPATIAL MODEL FOR ASSESSMENT OF AIR QUALITY IN THE CITY OF SOFIA

In this part of the dissertation, the author examines the main sources of data for the AQ - from EEA, AIRTHINGS, Luftdaten , etc. Numerous figures have been made showing the values of various indicators from the stations of the aforementioned sources.

Figures have been used to illustrate the analyses, but interpolation methods have been used that show too generalized results - it is illogical to make interpolations for a territory of such an area when there are one, two, or a few more points for which we have data. This leads to the creation of cartographic materials that could seriously mislead the audience.

Concerning the created web map with a visualization of the analyzed data sets, it can be said that, in the ideal version, it would complement the cartographic materials of the dissertation very successfully. When the map is initially opened, dots of different colors are visualized, indicating (perhaps) the data and their threshold values. The color scheme and dot size used could be better matched and understood - in future research on the topic or using the functionalities of this web application, I would recommend that the PhD student develop the application only after a clear concept of visualizing the data has been made.

Clicking on an object on the map brings up a very long list of attribute fields that show the entire data structure. This does not allow them to be easily understood and interpreted.

A bad impression is also made by the lack of change in the names of the fields - when creating web applications, it is not right to use column names from the database in their original form (eg ID_1 and similar), because this contradicts the good practices and logic of UX design.

Unfortunately, the ordering of the fields is done in a different and not logical way - it would be good if the attributes follow some logical path, for example

from January to December, or from the first year of research to the last. In this case, they are arranged in an order that creates such difficulties in their interpretation that it completely renders the existence of the map in this form meaningless - e.g. the columns are arranged in an order that does not match the logic - January, April, July, etc. Reading the data becomes even more unclear, adding the fact that it is not clear to which year these months refer - for example, January_3, July_13, etc.

The purpose and tasks of the dissertation define the need for a detailed study of all available data sources. Just such a source, widely used worldwide and in Europe to create several European policies, plans, programs, and projects, is the data from the Copernicus program. There are two whole services dedicated to the atmosphere - the Climate Change service, which deals with the issues of a changing climate and which provides one of the largest scientifically sound databases on the subject focused on the territory of Europe, and the Atmosphere service, which provides data (including in Bulgaria to NIMH and other organizations) on air quality. Copernicus is mentioned only once in the thesis, and that is when citing a study that is not in the list of references, which means that the result of the analysis in the thesis does not show the full picture of the data available at the moment a huge part of the EU policy in the area of AQ is currently based on these data, and they are absent from the developed database through which geospatial modeling is carried out.

e. CONCLUSION

In the final part of the dissertation, the doctoral student presents the conclusions and makes recommendations for future development on the topic related to the AQ. Among them is *"the construction of a network of sensors to monitor air pollution and the localization of polluted territories",* as well as the need for data for the analysis of transport, the car fleet in the capital, etc.

3. Evaluation of dissertation publications

The research conducted during the doctoral studies was published in two articles - Analysis of the PM10 concentration on the territory of the city of Sofia during 2015-2020 and Geospatial analysis of the PM10 indicator status for the city of Sofia. The content of both is largely similar to the corresponding parts of the dissertation.

4. Contributions

In the dissertation, 5 contributions are presented, of which I accept contributions 1-4. Contribution 5 states *"For the scientific work, other potential sources of information that could be used to study the state of the air in the city and the country have been studied and presented"*. I believe that this part of the research has not been done completely, in the necessary volume and quality.

5. Abstract

The abstract is structured in a volume of 87 pages. It begins with a reference for the dissertation work, which includes a list of used literature, which, as already mentioned, is inaccurate. The content meets the requirements for the structure and volume of an abstract for a dissertation.

6. Opinions, recommendations, remarks and questions about the dissertation

PhD student Milena Stefanova has done in-depth research related to spatial data and their application for the evaluation of AQ. I believe that the merits of the work are mostly related to the detailed and clear definition, analysis of the positives and negatives of the legislative framework, and state of the problem. The technical work of creating a database and especially its visualization could be greatly improved. The text contains numerous inaccuracies, and inconsistencies in the numbering of figures, quotations, and the literature used. I believe that when developing a dissertation, it is necessary to consider the chosen topic from all possible sides - in terms of used data, software, platforms, applications, and achievements, which in this case was not fully achieved. Cartographic materials designated as figures in the dissertation may be greatly enhanced visually. The web map needs a

complete overhaul to be understandable to the audience, even to specialists familiar with this subject.

The text is written clearly and in a good academic style, which shows a good command of the terminology especially that related to the regulatory framework.

7. Conclusion

Despite the critical remarks, I believe that PhD student Milena Stefanova has done a significant amount of work, processing large amounts of data for research purposes. I give my positive assessment and propose to the Scientific Jury **to award** doctoral student Milena Stefanova the educational and scientific degree "Doctor" in the scientific specialty "Cartography (incl. Thematic Geographical Mapping - Geographic Information Systems)" for the dissertation "Geospatial model for assessing air quality in the city of Sofia".

Reviewer

11.06.2024

Associate Prof. Eugenia Sarafova