

**REVIEW**  
of the official reviewer for dissertation work of  
**Tursumbayeva Madina Orazgaziynna on the theme «Effect of meteorological parameters on air quality in large cities of Kazakhstan»,**  
submitted for the degree of Doctor of Philosophy (PhD) in the Educational Program «8D050204 - Meteorology».

№	Criteria	Eligibility (one of the options must be checked)	Justification of the position of the official reviewer
1.	The topic of the thesis (as of the date of its approval) corresponds to the directions of development of science and/or state programs	<p>1.1 Compliance with priority areas of science development or government programs:</p> <p>1) <u>The thesis was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program)</u></p> <p>2) The thesis was completed within the framework of another state program (indicate the name of the program)</p> <p>3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction)</p>	The work was carried out within the framework of financing the projects of the Ministry of Science and Higher Education of the Republic of Kazakhstan: AP09260359 "Comprehensive assessment of air pollution in Almaty: source-identification, spatiotemporal assessment" (2021-2023) and BR10965258 "Development of a research program to improve air quality in Nur Sultan and Almaty using state-of-the-art analytical methods and modeling tools" (2021-2023).
2.	Importance for science	The work makes/does not make a significant contribution to science, and its importance is well disclosed/not disclosed	The importance of the science is a deep statistical analysis of the different aspects related to the distribution of PM <sub>2.5</sub> . It well described and statistically confirmed that meteorological conditions are contributing to the PM <sub>2.5</sub> distribution and quite high for different years, seasons and even days. The results of studies have practical application and can be used to predict the threshold exceedance in the cities, consequently helps to reduce exposure to the human health in the communities.
3.	The principle of	Self-reliance level:	All the experimental tasks, data analyses, verification of hypotheses



	independence	1) <u>High</u> ; 2) Medium; 3) Low; 4) No independence	and preparation of dissertation have been done independently. The main results have been published in high impact scientific journals, with the applicant being the first author on two of the articles. Based on these results, the level of independence in the Self-reliance level would be evaluated as "High".
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) <u>Justified</u> ; 2) Partially justified; 3) Not justified. 4.2 The content of the thesis reflects the topic of the thesis: 1) <u>Reflects</u> ; 2) Partially reflects; 3) Does not reflect 4.3. The purpose and objectives correspond to the topic of the thesis: 1) <u>correspond</u> ; 2) partially correspond; 3) do not correspond 4.4 All sections and provisions of the thesis are logically interconnected: 1) <u>completely interconnected</u> ; 2) the interconnection is partial; 3) there is no interconnection 4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with the known solutions: 1) <u>there is a critical analysis</u> ; 2) partial analysis; 3) the analysis does not represent one's own opinions, but quotes from other authors	The topic of the dissertation is very relevant to the one of the most critical environmental issues in Kazakhstan related to the studies of PM <sub>2.5</sub> distribution depending on meteorological conditions. Thus, the relevance of the thesis can be "Justified". Indeed, presented information shows a deep analysis of the issue. The purpose of the studies is to show correlation between the distribution of PM <sub>2.5</sub> in relation to the weather conditions. The goal has been achieved by presenting results based on actual information from numerous data and information sources, official sites and publications. New statistic methodologies were used to identify the relationships between the meteorological parameters and PM <sub>2.5</sub> concentrations. The logic of the thesis is built constructively. The outcomes of studies are logically connected to each other, e.g. first, the theoretical part of the issue has been reviewed, then actual data is leveraged to generate statistically justified conclusions demonstrating results by charts, maps, tables with relevant information. In comparison with earlier studies with mainly general statistics, this study shows delves deeper into the data, employing a novel approach to identify correlations. The outcome of the study on the correlation of PM <sub>2.5</sub> distribution with COVID-19 is the key due to given the point that not only transportation is the biggest contributor for PM <sub>2.5</sub> .



5.	Scientific novelty principle	5.1 Are the scientific results and provisions new? 1) completely new; <u>2) partially new (25-75% are new);</u> 3) not new (less than 25% are new)	Along with other results, this study provides a comprehensive analysis of PM <sub>2.5</sub> for largest cities in Kazakhstan as well as in other major cities of the neighboring countries. The results of the studies are emphasizing that not only industrial impact is contributing to the PM <sub>2.5</sub> distribution but also the natural events such as dusty winds are big contributors to the high level of PM <sub>2.5</sub> . At the same time, potentially indirect impact of the windy dusty weather is desertification of the land due to industrial and agriculture activities. This is what can be a root case for the high level of PM <sub>2.5</sub> in Dushanbe and Tashkent.
		5.2 Are the dissertation findings new? 1) completely new; <u>2) partially new (25-75% are new);</u> 3) not new (less than 25% are new)	Most of the ideas introduced in the scientific novelty of the research are novel and tested using actual data from environmental monitoring, meteorological and aerological stations and correlated using new statistic methodologies.
		5.3 Technical, technological, economic or management decisions are new and reasonable: 1) completely new; <u>2) partially new (25-75% are new);</u> 3) not new (less than 25% are new)	Most of the technical and economic managements used for the thesis are novel and acceptable.
6.	The validity of the main findings	All main conclusions are/are not based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities)	Absolutely, no more evidence is required when studies are based on actual data and well-defined statistical approaches.
7.	The main provisions for the defense	It is necessary to answer the following questions for each provision separately: <b>Provision 1</b> 7.1 Is the provision proven? <u>1) proven;</u> 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes;	<b>Provision 1</b> The statistics based on actual data shows quite high level of PM <sub>2.5</sub> compare to the limits provided by WHO. The provision is proven by leveraging very many resources, e.g. published researches, analytics, statistics and actual data. The provision is not trivial, new, widely applicable and proved in all four published articles.



	<p>2) no</p> <p>7.3 Is it new?</p> <p><u>1) yes;</u></p> <p>2) no</p> <p>7.4 Application level:</p> <p>1) narrow;</p> <p>2) medium;</p> <p>3) <u>wide</u></p> <p>7.5 Is it proven in the article?</p> <p>1) yes;</p> <p>2) no</p>	
	<p><b>Provision 2</b></p> <p>7.1 Is the provision proven?</p> <p><u>1) proven;</u></p> <p>2) rather proven;</p> <p>3) rather not proven;</p> <p>4) not proven</p> <p>7.2 Is it trivial?</p> <p>1) yes;</p> <p>2) no</p> <p>7.3 Is it new?</p> <p><u>1) yes;</u></p> <p>2) no</p> <p>7.4 Application level:</p> <p>1) narrow;</p> <p>2) medium;</p> <p>3) <u>wide</u></p> <p>7.5 Is it proven in the article?</p> <p>1) yes;</p> <p>2) no</p>	<p><b>Provision 2</b></p> <p>In Provisions 2, results indicated that despite a significant reduction in traffic during the COVID-19 lockdown, PM<sub>2.5</sub> levels remained high. Such results highlight the influence of other factors. The provision 2 is proven, not trivial, new, and widely applicable and proven in two articles published in Atmospheric Environment and Environmental Processes.</p>
	<p><b>Provision 3</b></p> <p>7.1 Is the provision proven?</p> <p><u>1) proven;</u></p>	<p><b>Provision 3</b></p> <p>In Provisions 3, results indicated that slow moving air masses are responsible for 67 % of all the PM<sub>2.5</sub> pollution episodes in Almaty</p>



	<p>2) rather proven;  3) rather not proven;  4) not proven  7.2 Is it trivial?  1) yes;  2) no  7.3 Is it new?  <u>1) yes;</u>  2) no  7.4 Application level:  1) narrow;  2) medium;  3) <u>wide</u>  7.5 Is it proven in the article?  1) yes;  2) no</p>	<p>while Astana may be affected by neighboring industrial cities. The provision 3 is proven, not trivial, new, and widely applicable and proven in two articles published in Atmospheric Environment and Urban Climate.</p>
	<p><b>Provision 4</b>  7.1 Is the provision proven?  <u>1) proven;</u>  2) rather proven;  3) rather not proven;  4) not proven  7.2 Is it trivial?  1) yes;  2) no  7.3 Is it new?  <u>1) yes;</u>  2) no  7.4 Application level:  1) narrow;  2) medium;  3) <u>wide</u>  7.5 Is it proven in the article?</p>	<p><b>Provision 4</b>  In Provisions 4 the results indicated that lower level of the height of the atmospheric boundary layer, wind speed within the planetary boundary layer and ventilation coefficient negatively correlated with PM<sub>2.5</sub> concentrations. The provision 4 is proven, not trivial, new, and widely applicable and proven in two articles published in Atmospheric Environment and Aerosol and Air Quality Research.</p>



		1) yes; 2) no	
8.	The principle of reliability Reliability of sources and information provided	8.1 Choice of methodology - is justified or the methodology is described in sufficient detail 1) <u>yes</u> ; 2) no	The methodologies used in the dissertation were described sufficiently and explained in detail.
		8.2 The results of the thesis were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) <u>yes</u> ; 2) no	Yes. The results of the dissertation were obtained using a modern methods of scientific research and methods of processing and interpreting data using computer technologies. It is see that the author of the thesis used reliable source of data to analyze information. I am impressed with level of data has been used to review all available information.
		8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results have been proven on the basis of a pedagogical experiment): 1) <u>yes</u> ; 2) no	Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research and published in a series of articles in peer-reviewed journals.
		8.4 Important statements are confirmed / partially confirmed / not confirmed by references to current and reliable scientific literature	The discussions and results were confirmed by relevant scientific literature.
		8.5 Used literature sources are sufficient/not sufficient for a literature review	The literature sources in the dissertation are sufficient.
9	Practical value principle	9.1 The thesis has theoretical value: 1) <u>yes</u> ; 2) no	The theoretical significance of the work is the overview of the situation with PM <sub>2.5</sub> across the world, Central Asia and Kazakhstan. By connecting various aspects based on actual data and analyzing correlations and predictive factors, the study demonstrates a strong theoretical understanding of the issue.

		9.2 The thesis is of practical importance and there is a high probability of applying the results obtained in practice: 1) <u>yes</u> ; 2) no	The value of the thesis is the practical part of the outcomes that can be used to predict and alarm on the high level of the PM <sub>2.5</sub> in the cities to mitigate the impact to the human health.
		9.3 Are the practice suggestions new? 1) completely new; 2) <u>partially new (25-75% are new)</u> ; 3) not new (less than 25% are new)	The study is suggesting reviewing as many components as possible including sources of PM <sub>2.5</sub> , meteorological parameters, pollution episodes to predict PM <sub>2.5</sub> and its potential risk to health.
10.	The quality of writing and design	Academic writing quality: 1) <u>high</u> ; 2) average; 3) below average; 4) low.	It is really well written and structured dissertation.

I support:

1) to award the degree of Doctor of Philosophy (PhD).

**Official Reviewer:**

Candidate of Science in Geoecology  
(place of work, academic title)

(signature)

Anargul Kalelova  
(FULL NAME)