

REVIEW
of the official reviewer for dissertation work of
Tursumbayeva Madina Orazgazievna 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	1.1 Compliance with priority areas of science development or government programs: <u>1) 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> 2) The thesis was completed within the framework of another state program (indicate the name of the program) 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)	1) Yes. The work was carried out within target program financed by the Ministry of Science and Higher Education of the Republic of Kazakhstan 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, and AP09260359 “Comprehensive assessment of air pollution in Almaty: source-identification, spatiotemporal assessment”, 2021-2023
2.	Importance for science	The work <u>makes</u> /does not make a significant contribution to science, and its importance is well disclosed/not disclosed	The work makes a significant contribution to science, and its importance is well-disclosed.
3.	The principle of independence	Self-reliance level: 1) High ; 2) Medium; 3) Low; 4) No independence	1) High, based on the authorship statements in every publication. She is also the first author on two publications published in the following journals: Atmospheric

			Environment (2023) and Aerosol and Air Quality Research (2022).
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.	1) Justified. The work provides a comprehensive study of PM _{2.5} pollution in Kazakhstan and Central Asia and investigates the effect of meteorological factors on air pollution.
		4.2 The content of the thesis reflects the topic of the thesis: 1) <u>Reflects</u> ; 2) Partially reflects; 3) Does not reflect	1) Yes, the content of each article reflects the topic of the dissertation.
		4.3. The purpose and objectives correspond to the topic of the thesis: 1) <u>correspond</u> ; 2) partially correspond; 3) do not correspond	1) 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	1) The series of articles are completely interconnected.
		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	1) There is a critical analysis of the new solutions and methods proposed by the author in the literature review in each article.
5.	Scientific novelty principle	5.1 Are the scientific results and provisions new? 1) completely new; 2) <u>partially new (25-75% are new)</u> ; 3) not new (less than 25% are new)	2) The scientific results and provisions are novel.
		5.2 Are the dissertation findings new? 1) completely new; 2) <u>partially new (25-75% are new)</u> ;	2) Partially new.

		3) not new (less than 25% are new)	
		5.3 Technical, technological, economic or management decisions are new and reasonable: 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	2) Most of technical, technological, economic or management decisions used in the dissertation are new.
6.	The validity of the main findings	All main conclusions <u>are</u> /are not based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities)	All main conclusions in the dissertation are based on scientifically significant evidence or well-grounded. The conclusions are obtained from adequate methods.
7.	The main provisions for the defense	It is necessary to answer the following questions for each provision separately: 7.1 Is the provision proven? 1) <u>proven</u> ; 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes; 2) <u>no</u> 7.3 Is it new? 1) <u>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) <u>yes</u> ; 2) no	7.1 The 1st provision provided in the dissertation, PM _{2.5} levels in Central Asia cities exceeded the WHO annual limit by 4.3–12.6 times. An outdated approach is used for emissions inventory in the studied cities. The verification of the provision was well organized using reliable source of data and overview of the current methodology. The provision was proven in the article published in Atmospheric Environment (2023). 7.2 The provision is not trivial 7.3 It is new 7.4 It has wide application level. 7.5 Yes.
		It is necessary to answer the following questions for each provision separately: 7.1 Is the provision proven? 1) <u>proven</u> ;	7.1 The 2nd provision provided in the dissertation, the COVID-19 lockdown had no significant effect

	<p>2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes; <u>2) no</u> 7.3 Is it new? <u>1) yes;</u> 2) no 7.4 Application level: 1) narrow; 2) medium; <u>3) wide</u> 7.5 Is it proven in the article? <u>1) yes;</u> 2) no</p>	<p>on PM_{2.5} levels in major cities of Kazakhstan and Central Asia. The verification of the provision was well organized using several sources of data (Kazhydromet and US embassy monitoring stations). The provision was proven in the article published in Atmospheric Environment (2023) and Environmental Processes (2022). 7.2 The provision is not trivial 7.3 It is new 7.4 It has wide application level. 7.5 Yes.</p>
	<p>It is necessary to answer the following questions for each provision separately: 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; <u>2) no</u> 7.3 Is it new? <u>1) yes;</u> 2) no 7.4 Application level: 1) narrow; 2) medium; <u>3) wide</u> 7.5 Is it proven in the article?</p>	<p>7.1 The 3rd provision provided in the dissertation, slow-moving air masses are typical for high PM_{2.5} episodes in Almaty (67%), while Astana may be affected by neighboring industrial cities. The verification of the provision was well organized using backward trajectory analysis with HYSPLIT model. The provision was proven in the article published in Atmospheric Environment (2023) and Urban Climate (2023). 7.2 The provision is not trivial 7.3 It is new 7.4 It has wide application level. 7.5 Yes.</p>

		<p><u>1) yes;</u> 2) no</p> <p>It is necessary to answer the following questions for each provision separately:</p> <p>7.1 Is the provision proven? <u>1) proven;</u> 2) rather proven; 3) rather not proven; 4) not proven</p> <p>7.2 Is it trivial? 1) yes; <u>2) no</u></p> <p>7.3 Is it new? <u>1) yes;</u> 2) no</p> <p>7.4 Application level: 1) narrow; 2) medium; <u>3) wide</u></p> <p>7.5 Is it proven in the article? <u>1) yes;</u> 2) no</p>	<p>7.1 The 4th provision provided in the dissertation, daily averaged PM_{2.5} concentrations negatively correlated with planetary boundary layer height (PBLH), wind speed, and ventilation coefficient. The verification of the provision was well organized using ERA5 reanalysis data and sounding data. The provision was proven in the article published in Atmospheric Environment (2023) and Aerosol and Air Quality Research (2022).</p> <p>7.2 The provision is not trivial</p> <p>7.3 It is new</p> <p>7.4 It has wide application level.</p> <p>7.5 Yes.</p>
8.	The principle of reliability Reliability of sources and information provided	<p>8.1 Choice of methodology - is justified or the methodology is described in sufficient detail <u>1) yes;</u> 2) no</p> <p>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: <u>1) yes;</u> 2) no</p>	<p>1) All methodology sections (equations, data etc.) were described in detail in each article.</p> <p>1) Yes, the results were obtained using modern methods of scientific research (HYSPLIT modelling, Potential increase method, bulk Richardson number method, reanalysis data etc.) and methods of processing and interpreting data using computer technologies (python</p>

			libraries).
		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	1) Yes, theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research and were published in high-ranking journals.
		8.4 Important statements are <u>confirmed</u> / partially confirmed / not confirmed by references to current and reliable scientific literature	All important statements in articles are confirmed by references to reliable scientific literature sources.
		8.5 Used literature sources are <u>sufficient</u> /not sufficient for a literature review	All articles have sufficient amount of used literature sources that provide comprehensive background information for each research.
9	Practical value principle	9.1 The thesis has theoretical value: 1) <u>yes</u> ; 2) no	1) Yes, the theoretical value of this work is that it provides crucial insights into Central Asia's air quality raise awareness about PM _{2.5} pollution among the general public and governmental agencies in Central Asian countries, fostering cooperation and knowledge exchange to tackle 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	1) The results obtained in this dissertation have a high potential for application in forecasting and mitigating PM _{2.5} pollution episodes.
		9.3 Are the practice suggestions new? 1) completely new;	Practice suggestions regarding the improvement of the current

		2) partially new (25-75% are new); 3) not new (less than 25% are new)	observational network and emission inventory methodology are new.
10.	The quality of writing and design	Academic writing quality: 1) high; 2) average; 3) below average; 4) low.	The quality of academic writing is high in every article. All the articles are published in high-ranking journals and describe the topic of dissertation well.

I recommend:

1) to award the degree of Doctor of Philosophy (PhD) or Doctor of Specialization;

Copies of the reviews of the official reviewers are handed over to the doctoral student no later than 5 (five) working days before the defense of the thesis.

Official Reviewer:

Postdoctoral Research Fellow, Nazarbayev University

Parya Broomandi

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