OPINION

By Assoc. Prof. Kalina Rosenova Radeva, PhD

Subject: Dissertation for awarding the educational and scientific degree of Doctor in the professional field 4.4. Earth Sciences (scientific specialty Climatology), Faculty of Geology and Geography, Sofia University "St. Kliment Ohridski"

Topic of the dissertation:

CLASSIFICATION OF THE ATMOSPHERIC CIRCULATION TYPES FOR THE REGION OF BULGARIA AND THEIR RELATION WITH LARGE-SCALE CIRCULATION PROCESSES

Authored by Vulcho Petrov Pophristov, PhD student at the Department of Climatology, Hydrology and Geomorphology – GGF, scientific supervisor Prof. Dr. Georgi Rachev

The review has been prepared following the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), its Regulations for Implementation (PPZRASRB), and the Rules for the Conditions and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at Sofia University "St. Kliment Ohridski", adopted by the Academic Council on October 31, 2018. The review of the materials has been conducted in compliance with Order No. RD-38-3/7.1.2025 issued by the Rector of Sofia University "St. Kliment Ohridski" for the appointment of the scientific jury, and the decision from the first meeting of the scientific jury held on January 14, 2025.
Vulcho Popyordanov has submitted all the necessary documents required for the dissertation defense procedure.

Information about the PhD student

Vulcho Petrov Pophristov holds a Master's degree in Physics from Sofia University "St. Kliment Ohridski" and a Master's degree in Information and Control Technologies from the University of Chemical Technology and Metallurgy – Sofia. In his professional career, Vulcho Pophristov has worked as a meteorologist at the National Institute of Meteorology and Hydrology (2015–2022) and is currently employed at the Climate, Atmosphere and Waters Research Institute at the Bulgarian Academy of Sciences. His work focuses on climate process analysis, atmospheric phenomena modeling, and the assessment of long-term climate trends.

The doctoral candidate is the author and co-author of 15 scientific publications, covering various aspects of climatology, including the analysis of atmospheric circulations and their variability, as well as studies on intensive precipitation and extreme meteorological events. His research contributes to understanding regional climate change and has been published in international peer-reviewed journals.

General characteristics and assessment of the content of the dissertation

The dissertation consists of a total of 225 pages, following the established academic model. The structure of the dissertation adheres to the classical format, comprising an introduction, five chapters, a conclusion, a bibliography, and appendices.

Relevance of the Topic. The dissertation addresses one of the most crucial contemporary issues in climatology and meteorology—the study of atmospheric circulation and its direct relationship with climate change. Given the ongoing climate crisis and the increasing frequency of extreme weather events, such research holds paramount importance. The study aims to enhance the understanding of atmospheric processes that shape local climatic conditions in Bulgaria and proposes a methodology for more precise climate change forecasting.

Additionally, the findings on circulation processes hold practical significance for developing regional adaptation strategies to climate change, giving the dissertation both theoretical and applied value. The objective of the dissertation is to develop a detailed and refined classification of atmospheric circulation types in Bulgaria, covering both surface level and the 500 hPa altitude for the period 1871–2020. The defined research tasks are logically structured, ensuring methodological and analytical consistency throughout the study.

The structure of the dissertation is well thought out and logically organized into five separate chapters. Chapter One contains a detailed and well-structured review of the available scientific publications and findings related to the studied topic. Chapter Two provides a detailed discussion of the applied methodologies and introduces the author's approach to the classification of circulation types. The following chapters examine the seasonal and annual trends of atmospheric circulation, with a detailed analysis of the respective results and a discussion of their links to global circulation processes.

The writing style is scientific, precise, and clear, with all analyses supported by appropriate graphs and tables. The conclusion summarizes the results, highlights the significance of the study, and emphasizes its applicability.

Methodological validity and correctness of the analysis. The dissertation employs a comprehensive approach, integrating both traditional synoptic methods and modern statistical and climatological techniques. Particularly important is the application of cluster analysis for the identification of circulation types, which adds scientific rigor and precision to the study.

Additionally, a comparative analysis of existing classification schemes has been conducted, allowing for validation and assessment of the accuracy of the newly proposed methodology. The doctoral candidate clearly and correctly justifies the choice of methods, demonstrating competence and a professional approach to the statistical processing of data.

Results and discussion. The author successfully classifies and identifies different types of

atmospheric circulation for the region of Bulgaria over the study period 1871–2020. Utilizing a comprehensive set of modern statistical methods, he examines in detail the seasonal dynamics and frequency of different circulation models. The significance of the results is highlighted by the detailed tracking of changes in the frequency of individual atmospheric circulation types over the last 150 years, which represents a valuable contribution to the synoptic climatology of the region.

Particularly important are the author's analyses of the seasonal variations of different circulation types and their relationships with global climate processes, such as the North Atlantic Oscillation (NAO), the Atlantic Multidecadal Oscillation (AMO), and other global indices. The author demonstrates the existence of significant statistical dependencies between changes in the frequency of individual circulation types and these large-scale atmospheric processes. These results expand the fundamental knowledge of the mechanisms behind climate change in Bulgaria and have potential applications in climate forecasting and adaptation strategies.

Additionally, the detailed comparative analysis highlights clear trends in the increase or decrease in the frequency of certain circulation types across different climatic seasons. The results convincingly demonstrate that climate change manifests not only through temperature and precipitation variations but also through modifications in atmospheric circulation regimes themselves.

The author also identifies regional differences in the manifestation of circulation processes, determining which areas of Bulgaria are more susceptible to climate anomalies associated with changes in atmospheric circulation. This aspect of the study is directly relevant to improving forecasts for extreme meteorological events such as droughts, heavy rainfall, and temperature anomalies. Furthermore, the analyses reveal that some circulation types exhibit stronger seasonal dependence, such as the increase in anticyclonic processes during winter, which contributes to a higher frequency of temperature inversions and fog.

The results are presented through detailed graphs, statistical analyses, and spatial distributions, which confirm the findings and enhance the understanding of atmospheric circulation dynamics in Bulgaria. This approach not only demonstrates the stability and reliability of the obtained results but also provides a foundation for future research and climate process modeling in the region.

Relevance of the results

The results of the dissertation research have significant scientific and applied value, especially in the field of forecasting and modeling of climatic and meteorological processes. They can serve to improve the accuracy of regional climate models, as well as to better predict and prevent adverse climatic events, which has a direct impact on agriculture, tourism and other economic activities in Bulgaria.

Conclusion

The doctoral candidate demonstrates a broad spectrum of scientific competencies, combining in-depth knowledge of climatic and atmospheric processes with skills in applying innovative research approaches. The obtained results possess significant scientific and applied potential. They not only expand the understanding of circulation regimes over Bulgaria but also provide a foundation for the

development of advanced climate forecasts. The dissertation fully meets the criteria for scientific validity, originality, and practical relevance, necessary for awarding the educational and scientific degree "Doctor". The published scientific works of the author comply with the established requirements and demonstrate his ability to conduct independent scientific research. Based on this, I recommend that the Scientific Jury award Vulcho Petrov Popkhristov the educational and scientific degree "Doctor" in the field of Higher Education - 4.4. Earth Sciences.

13.03.2025

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(Assoc. Prof. Kalina Radeva, Ph.D.)