To:
Scientific jury,
Determined by Order РД-38-3/7.1.2025
of the Rector of Sofia University „St. Kliment Ohridski"

Attached I present: REVIEW he PhD thesis for awarding the educational and scientific degree „Doctor" in professional field 4.4. Earth Science

PhD candidate: Valcho Petrov Pophristov

Scientific advisor: Prof. Georgi Rachev

Reviewer:

Prof. Nelly Stefanova Hristova
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I declare that I am not in a conflict of interest within the meaning of § 1, point 2a of the Additional Regulations with the applicant for a scientific degree or for an academic position „ Professor".

The opinion is compiled in accordance with the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB) (SG No102, 23.12. 2022), the Regulations on the Implementation of the Development of Academic Staff in the Republic of Bulgaria (SG No. 15, 19.02, 2019), the Regulations on the Conditions and Procedure for Obtaining Academic Degrees and Filling Academic Positions at Sofia University.

To
Scientific jury,
Determined by Order РД-38-3/7.1.2025
of the Rector of Sofia University
„St. Kliment Ohridski“

REVIEW

by Prof. Nelly Stefanova Hristova
on the PhD thesis for awarding the educational and scientific degree „Doctor“
in professional field 4.4. Earth Science, Climatology

PhD candidate: Valcho Petrov Pophristov
Scientific advisor: Prof. Georgi Rachev

1. GENERAR DATA FOR THE CAREER DEVELOPMENT OF THE CANDIDATE

Valcho Pophristov graduated in Information and Control Technologies from the University of Chemical Technology and Metallurgy in 1997 and completed a master's program in Meteorology at the Sofia University „St. Kliment Ohridski“, Faculty of Physics, in 2016. He has worked successively as a compact disc matrix operator, system administrator, meteorologist at the National Institute of Meteorology and Hydrology, and since 2022, as an assistant at the Institute for Climate, Atmosphere, and Water Research (ICAW), Bulgarian Academy of Sciences. He is the author of two independent scientific publications and a co-author of 13 scientific papers.

All documents for the admission to the public defense meet the mandatory requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) (amended, State Gazette No. 102 of December 23, 2022), the Regulations for the Implementation of the Law on the Development of the Academic Staff (RILDASRB), and the Regulations on the Conditions and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at Sofia University „St. Kliment Ohridski“.

2. ANALYSIS AND EVALUATION OF THE DISSERTATION

2.1. General Characteristics of the Dissertation: Volume and Structure

The dissertation „Classification of Atmospheric Circulation Types for the Region of Bulgaria and Their Relation to Large-Scale Circulation Processes“ comprises a total of 173 pages and 52 pages of appendices. The dissertation includes an introduction, four main chapters, conclusions, a bibliography with over 100 sources, and rich illustrative material – 47 tables and 111 figures.

2.2. Analysis and evaluation of the Introduction and main chapters

Introduction

The dissertation's introduction encompasses the relevance of the topic, object and subject of research, goal, tasks, and research limitations. The doctoral candidate demonstrates a high level of scientific culture and methodological precision: convincingly formulating the topic's relevance by emphasizing that climate is determined by a complex of factors: geographical latitude, relief, altitude, vegetation, and proximity to water bodies.

A key moment is the substantiation of the necessity for synoptic situation typification. The author argues for the emergence of dynamic climatology as a scientific discipline striving to understand the spatial and temporal movement of air masses, barometric formations, and atmospheric fronts. In the context of global climate changes, understanding regional atmospheric processes acquires primary significance.

First Chapter

The first chapter of the dissertation presents a detailed historiographical review of existing atmospheric circulation classifications. The doctoral candidate analyzes fundamental classifications such as Vangengheim-Girs, Hess-Brezovsky, and Lamb, emphasizing the regional characteristics of the Balkan Peninsula. Special attention is paid to national developments, specifically the classic work „Weather Types in Bulgaria". This historiographical review demonstrates a profound knowledge of scientific literature and the ability to critically analyze existing research.

Second Chapter

The second chapter reveals the methodological foundations of the research. The doctoral candidate thoroughly presents two primary approaches to atmospheric circulation classification – subjective and objective – argumentatively justifying the choice of the subjective method. He details the classification criteria and introduces 13 types for the 500 hPa level and 16 types for the surface level.

Particularly important is the emphasis on the specifics of Bulgarian relief, which strongly deforms wind direction and necessitates a specific research approach. The methodology includes barometric field analysis at two isobaric levels – 500 hPa and surface level – using multiple reanalysis databases, a complex statistical toolkit (Mann-Kendall, Sen-slope, correlation analysis), and data processing from barometric maps four times daily. Three primary reanalysis bases were used: 20th century reanalyzes, NCEP CFSR/GFS Reanalyses, NCEP/NCAR Reanalyses.

The doctoral candidate introduces the following classification structure: 13 types for the 500 hPa level – 5 anticyclonic types and 8 cyclonic types; 16 types for the surface level – 5 anticyclonic types, 8 cyclonic types, and 2 low-gradient types. The detailed classification of atmospheric circulation is one of the scientific contributions of the dissertation.

Third Chapter

The third chapter represents the essence of the scientific research – a detailed analysis of circulation types, which reveals an exceptionally rich and multifaceted picture of atmospheric processes over Bulgaria. The doctoral candidate introduces a precise classification, distinguishing circulation types for two isobaric levels – 500 hPa and surface level.

Particularly impressive are the quantitative discoveries: over 65% of the days in the year are characterized by cyclonic circulation at the 500 hPa level, while anticyclonic types dominate almost half the days at the surface level. The study reveals complex seasonal variations – for example, cyclonic circulation is most frequent during winter (68.8% of days) and least frequent during summer (61.2% of days).

The scientific value of the chapter lies in the multidirectional correlation analysis between circulation types and meteorological parameters. The doctoral candidate convincingly demonstrates how different circulation types influence temperature and precipitation, discovering statistically significant dependencies. For instance, the anticyclonic type A4 is associated with the most significant increase in average temperature during summer months, which directly corresponds with observed climate changes.

Fourth Chapter

The fourth chapter represents an extensive study of the relationships between circulation types and large-scale circulation processes, making it a methodologically innovative part of the dissertation. The doctoral candidate analyzes four key ocean oscillations – AMO, NAO, AO, and IOD – revealing extremely complex climatic mechanisms.

Particularly significant are the correlation findings: different ocean indices demonstrate varying intensities of influence on atmospheric circulation. For example, it has been established that the more frequent appearance of the Azores anticyclone ridge is facilitated by warmer ocean waters in the Atlantic and Indian Oceans. Interestingly, the frequency of surface cyclones located north of Bulgaria is in strong positive correlation with water temperatures in the Atlantic and Indian Oceans.

Exceptionally valuable is the conclusion that the increasing frequency of these cyclones is a direct consequence of global warming, confirming the hypothesis of climate transformations through specific empirical evidence. This part of the dissertation is a highly professional scientific analysis that reveals the complex interrelationships between large-scale circulation processes and atmospheric circulation over Bulgaria.

Dissertation Conclusions

The dissertation conclusions are structured in two main directions: regarding the classification of atmospheric circulation and regarding the relationships with large-scale circulation processes.

The first group of conclusions reveals quantitative and qualitative transformations: increase in anticyclonic types at 500 hPa; statistically significant reduction of anticyclonic types at the surface; increase in cyclonic and low-gradient types, connection between these changes and global warming. Particularly significant is the conclusion about precipitation: a cyclicity with a 50–60-year period has been established, which allows forecasting precipitation quantities in the coming decades. The second group of conclusions reveals complex climatic mechanisms: influence of ocean temperatures on circulation types; relationships between various ocean oscillations and barometric formations; confirmation of the global warming hypothesis through multi-factor analysis.

2.3. Critical Remarks on the Dissertation

In the presented dissertation, certain deviations from the strict academic style of scientific exposition are noticeable. In some places, the author uses overly conversational and informal expressions that do not correspond to the high standards of scientific communication (e.g., instead of „leading influence"– „determining factor"; instead of „it is observed" – „it is established", etc.). Descriptive formulations are found instead of precise scientific terms, asymmetry is noted in the analysis of different circulation types. The statistical significance of some correlations is marginal. These critical remarks do not diminish the overall high scientific value of the dissertation.

2.4. Recommendations for Future Work

If the doctoral candidate continues his further scientific research, I recommend validating the proposed classification method with alternative approaches and, if possible, including a prognostic component, as well as connecting the current results with global climate studies.

CONCLUSION

Valcho Pophristov dissertation possesses undeniable scientific contributions. First and foremost, this is the first study of atmospheric circulation for Bulgaria with such a long-term period. The methodology, volume, and depth of analysis make it exceptionally significant scientific research. The discoveries about large-scale circulation processes' influence on the regional climate are particularly valuable. The doctoral candidate demonstrates a profound knowledge of scientific literature, excellent mastery of research methods, and high analytical culture. The study has significant potential for practical application in the field of climate forecasts, water resource management, and agricultural planning. Scientific contributions in brief: innovative methodology, extensive period, practical applicability.

I confidently recommend that the scientific jury award the educational and scientific degree of „Doctor" to the candidate in the field 4.4. Earth Sciences.

18.3.2025 Reviewer: Prof. Nelly Hristova

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