

STATEMENT

By Prof. Daniela Yordanova Avetisyan, PhD

Space Research and Technology Institute – Bulgarian Academy of Sciences, appointed as a member of the Scientific Jury by Order № 01-168/23.07.2026 of the Director of the National Institute of Geophysics, Geodesy and Geography – Bulgarian Academy of Sciences (NIGGG-BAS) on the dissertation submitted by Vanya Emilova Stoycheva for the award of the educational and scientific degree “Doctor” (PhD) in Professional Field 4.4. Earth Sciences, Doctoral Programme “Physical Geography and Landscape Ecology”, at the National Institute of Geophysics, Geodesy and Geography – Bulgarian Academy of Sciences (NIGGG-BAS).

Author of the PhD thesis: Vanya Emilova Stoycheva

Title: *“Integrated Assessment of Regulating Ecosystem Services in Urban Areas”*

Scientific supervisor: Prof. Stoyan Nedkov, PhD

Scientific advisor: Prof. Davide Geneletti, PhD

Vanya Stoycheva holds a BSc in Geography (2020) and an MSc in Landscape Ecology and Natural Capital (2021) from Sofia University “St. Kliment Ohridski”. Since 2022, she has been a PhD candidate in Physical Geography and Landscape Ecology at NIGGG-BAS; in 2023, she completed an Erasmus+ traineeship at the University of Trento. Since March 2025, she has been an Assistant Professor in the Applied Geoinformatics Section at NIGGG-BAS. Her research focuses on mapping, modelling and spatial assessment of ecosystem services, and she has participated in more than five national and European projects in ecosystem services and biodiversity.

The dissertation addresses the integrated assessment of regulating ecosystem services in urban areas, with Sofia, Bulgaria, as the case study. It comprises 201 pages, including 61 figures, 13 tables and 285 references. It is structured into an introduction, a methodological background, five research chapters presenting the individual studies, and a synthesis integrating their results within the overall research framework.

The main objective is to develop a methodological approach for the integrated assessment of regulating ecosystem services in urban areas. The research progresses from identifying

priority services and reviewing methods, models and datasets, through testing their applicability and developing spatially explicit supply–demand–balance assessments, to an integrated multi-tiered framework. It is demonstrated for six priority services in Sofia: air purification, noise attenuation, flood regulation, pollination, pest control and cooling regulation.

I consider the methodological framework one of the main strengths of the dissertation. Ecosystem-service supply is assessed using specialised models, including InVEST and the EnhancES toolbox. Demand assessment combines indicators of population vulnerability and exposure with service-specific biophysical hazard indicators, enabling areas of high demand to be compared spatially with service supply.

The multi-tiered approach distinguishes three assessment levels according to data availability, quality and applicable methods: Tier 1 relies primarily on expert assessment, Tier 2 uses statistical or biophysical data adapted for geospatial analysis, and Tier 3 applies detailed data and modelling methods. Air purification, flood regulation and cooling regulation are assessed at Tier 3, while combinations of Tier 1 and Tier 2 are applied to noise attenuation, pollination and pest control.

The integrated assessment uses GIS-based Optimized Hot Spot and Optimized Outlier analyses to identify spatial concentrations, trade-offs and synergies among ecosystem services. A further methodological result is the geospatial database for Sofia developed by integrating the national ecosystem database, Urban Atlas and CORINE Land Cover, demonstrating the framework on heterogeneous real-world spatial data.

I positively assess the synthesis of the research results, which relates them to the objective and individual tasks and identifies the multi-tiered framework as a major outcome. The author critically discusses uncertainties related to input-data quality, model performance and validation. A limitation is that the transferability of the proposed framework has not yet been tested in other urban areas; applying it to cities with different environmental conditions, spatial structures and data availability would provide an important direction for further validation and assessment of its broader applicability.

The scientific contributions follow directly from these results. Particularly significant are the spatially explicit approaches to ecosystem-service supply and demand; the integration of vulnerability, exposure and hazard indicators; the MAES-based multi-tiered framework for six regulating ecosystem services; the GIS-based identification of trade-offs and synergies; and the

integrated geospatial database for Sofia. The distinction between scientific, methodological and applied contributions is well substantiated.

The dissertation research is presented in five scientific works: three published articles, one manuscript under review in *Urban Climate* and one submitted to *Acta geographica Slovenica*. Vanya Stoycheva is first author of four of the five works. The author-contribution statements document her leading role in conceptualisation, methodology, data preparation and analysis, validation, visualisation and manuscript preparation, providing clear evidence of a substantial personal contribution and the required level of scientific independence.

CONCLUSION

The dissertation “Integrated Assessment of Regulating Ecosystem Services in Urban Areas” is a coherent and methodologically sound study with clearly identifiable scientific, methodological and applied results. Its particular value lies in linking ecosystem-service supply, demand and spatial balance within a common MAES-based multi-tiered framework and demonstrating it for six regulating ecosystem services in Sofia.

Based on the quality of the dissertation, its scientific results and contributions, the related scientific works and the candidate’s clearly demonstrated personal contribution, I give a positive assessment and recommend that the Scientific Jury vote in favour of awarding Vanya Emilova Stoycheva the educational and scientific degree “Doctor” (PhD) in Professional Field 4.4. Earth Sciences, Doctoral Programme “Physical Geography and Landscape Ecology”.

30/09/2026

Sofia

Prepared by:

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