ABSTRACT

The habilitation thesis entitled *Advancements in urban climate research within a climate change perspective* represents an extended summary of my scientific and professional activities developed after I defended the Ph.D. thesis (2004), and outlines the future plans. At the same time, it concentrates our results in the field of urban climatology placing them within the climate change perspective, in order to support the better preparation and adaptation. The thesis is structured in two main sections and it also includes the corresponding references. The scientific outcomes are presented as complete research studies, part of them being already published in prestigious scientific journals.

The first part of the thesis starts with an overview of my career which points out the scientific and professional milestones. It gives a general idea about my background, skills, scientific interests, and professional path. This overview reflects that urban climate, climate variability and changes and climate extremes were the main topic that I tackled in research projects and publications. Besides, it is a good opportunity to emphasize the complexity of the topics, the international dimension, and the novelty of the approaches.

In the Section 1.2, I present my main contributions to the urban climate research. Starting with a research outline which defines the general perspective, I describe in-depth our investigations, results, and current research developments regarding the Urban Heat Island (UHI) of Bucharest. Since the heat waves and extreme temperatures represent a major hazard, and a significant warming (e.g. summer averages about 2°C higher than today by 2021-2050) is likely to occur in the area, we have explored the characteristics of the UHI in the present climate, striving for estimating as accurate as possible the future conditions. Using mainly satellite remote sensing products, we could determine the shape, the intensity and the diurnal variations of the UHI, pointing out its relationships with the urban land cover. We proposed an original, objective method to delimitate the UHI based on attributing the UHI limits to shifting points statistically significant identified on urban thermal transects.

Section 1.3 illustrates my achievements in the field of Climate variability and changes. The selected reports have a regional coverage (South-Eastern Europe and Carpathian Mountains region), and address both observed and future variability. For the next decades (2021-2050), based on the A1B SRES IPCC scenario, an ensemble Regional Climate Models returned a warming trend over the entire South-Eastern Europe, while the precipitation amounts are likely to decrease in the southern areas, while stable and light increasing may characterize the northern parts.

Dramatic changes may occur in the aridity of some areas, shifting it from one aridity category to another. There are seasonal and monthly differentiations in the observed climate trends over the Carpathian Mountains region, and they are extensively presented in the habilitation thesis for ten meteorological variables. For example, along 1961-2010, a spatially generalised increasing of the monthly maximum temperatures occurred in May-August, while the cloudiness increased in September-October.

Section 1.4 contains several contributions to the climate extremes research, presenting a study on the drought at national level, and the characteristics of the thermal extremes in the Carpathians. The drought study pledges for the use of the Standardized Precipitation Index (SPI), as a universal meteorological drought index, flexible, robust and available. At the best of our knowledge, this is one of the very few and the most complex analysis of the spatial and temporal variability of the meteorological droughts in Romania based on SPI outputs. Monthly and seasonal SPI values were used to characterize drought spells and revealed poor spatial patterns over Romania, in concordance with previous studies. There is no evidence showing that the drought frequency, magnitude, or intensity is more consistent in a region than in others. The precipitation deficit leading to meteorological drought in Romania originates in large scale processes, while the Carpathian Chain and local conditions induce certain spatial features. As regards the thermal extremes in the Carpathians, connections with large-scale atmospheric circulation were investigated using rank-based correlation coefficients and four circulation indices (Atlantic Multidecadal Oscillation, East Atlantic, East Atlantic/West Russia, North Atlantic Oscillation). There is a significant warming signal over the area, with warm-related indices presenting more significant trends than the cold-related ones, with more coherent spatial patterns of change.

Section 1.5 presents to my contributions to enhancing methods and data quality used in climatology. I would mention the following: (1) constant use of GIS in climate research; (2) promoting the use of remote sensing products in climatology, either radar, or satellite; (3) enhancement of solar radiation models at fine temporal scale; (4) data homogenisation; (5) adjustement of measured precipitation.

The plans for the future career development are based on a SWOT analysis of the present stage, and I stressed the determination to bring more contributions to the urban climate research within the climate change perspective. Providing enhanced knowledge about urban climate for scientific and applied purposes in order to support the welfare of the people could be considered the bottom line of my plans for future scientific and professional career.