

**Petr DOBROVOLNÝ, Lukáš KRAHULA**

**THE SPATIAL VARIABILITY OF AIR TEMPERATURE AND NOCTURNAL URBAN HEAT ISLAND INTENSITY IN THE CITY OF BRNO, CZECH REPUBLIC**

This study seeks to quantify the effects of a number of factors on the nocturnal air temperature field in a medium-sized central European city located in complex terrain. The main data sources consist of mobile air temperature measurements and a geographical database. Temperature measurements were taken along several profiles through the city centre and were made under a clear sky with no advection. Altogether nine sets of detailed measurements, in all seasons, were assembled. Altitude, quantity of vegetation, density of buildings and the structure of the transportation (road) system were considered as explanatory variables. The result is that the normalized difference vegetation index (NDVI) and the density of buildings were the most important factors, each of them explaining a substantial part (more than 50%) of overall air temperature variability. Mobile measurements with NDVI values as a covariate were used for interpolation of air temperature for the entire study area. The spatial variability of nocturnal air temperature and UHI intensity in Brno is the main output presented. Air temperatures interpolated from mobile measurements and NDVI values indicate that the mean urban heat island (UHI) intensity in the early night in summer is at its highest (approximately 5°C) in the city centre and decreases towards the suburban areas.

**Darko OGRIN**

**LONG-TERM AIR TEMPERATURE CHANGES IN LJUBLJANA (SLOVENIA) IN COMPARISON TO TRIESTE (ITALY) AND ZAGREB (CROATIA)**

The cities of Ljubljana, Trieste and Zagreb are proximate in terms of distance but differ in terms of geographical and climatic conditions. Continuous meteorological measurements in these cities began in the mid-19<sup>th</sup> century. The 100-year trends of changes in mean annual and seasonal air temperatures for these cities are presented here, evaluating the differences between them which result from their different geographical and climatic positions. Differences in trends between Ljubljana and Zagreb that result from different measurement histories and the impact of urban climate are also presented: the impact of city growth on air temperatures in Ljubljana after 1950 was not completely eliminated in the process of data homogenization. The lowest air warming trends occur in the maritime climate of Trieste (mean annual air temperature: +0.8°C 100 yr<sup>-1</sup>), where measurements were continuously performed in the densely built-up section of the city. The strongest trends occur in Ljubljana, mainly due to city growth (mean annual air temperature: +1.1°C 100 yr<sup>-1</sup>). Comparing the linear trends in Zagreb-Grič and in Ljubljana, the impact of Ljubljana's urban heat island on the 100-year warming trend was assessed at about 0.2°C, at 0.3 - 0.4°C for the trend after 1950, and if non-homogenized data are used, at about 0.5°C.

**Katja VINTAR MALLY, Matej OGRIN**

**SPATIAL VARIATIONS IN NITROGEN DIOXIDE CONCENTRATIONS IN URBAN LJUBLJANA, SLOVENIA**

Ambient nitrogen dioxide (NO<sub>2</sub>) concentrations are regularly measured at only two monitoring stations in the city centre of Ljubljana, and such scanty data are inadequate for drawing conclusions about spatial patterns of pollution within the city, or to decide on effective measures to further improve air quality. In order to determine the spatial distribution of NO<sub>2</sub> concentrations in different types of urban space in Ljubljana, two measuring campaigns throughout the city were carried out, during the summer of 2013 and during the winter of 2014. The main source of NO<sub>2</sub> in Ljubljana is road transport. Accordingly, three types of urban space have been identified (urban background, open space along roads, and street canyon), and their NO<sub>2</sub> pollution level was measured using Palmes diffusive samplers at a total of 108 measuring spots. This article analyses the results of both measuring campaigns and compares the pollution levels of different types of urban space.

**Márton KISS, Ágnes TAKÁCS, Réka POGÁCSÁS, Ágnes GULYÁS**  
**THE ROLE OF ECOSYSTEM SERVICES IN CLIMATE AND AIR QUALITY IN URBAN AREAS:  
EVALUATING CARBON SEQUESTRATION AND AIR POLLUTION REMOVAL BY STREET AND  
PARK TREES IN SZEGED (HUNGARY)**

The evaluation of ecosystem services can provide essential help in incorporating the multifunctionality of urban ecosystems in planning and management processes. Two important regulating services of urban trees, carbon sequestration and air pollution removal, are evaluated in this article for different types of tree stands (streets, parks) in the city centre of Szeged (Hungary). The necessary calculations were carried out by an adaptation of the targeted model (i-Tree Eco), based on a large complete tree inventory dataset. The analyses revealed the main tendencies in differences between tree species considering the tree condition, which affects the service-providing capacity to a high degree. The effects of differences in tree management on the chosen ecosystem services were investigated by comparing two pairs of tree alleys. Based on our observations, clear cuts and complete tree alley changes are not advisable from an ecosystem service point of view.

**Hana STŘEDOVÁ, Tomáš STŘEDA, Tomáš LITSCHMANN**  
**SMART TOOLS OF URBAN CLIMATE EVALUATION FOR SMART SPATIAL PLANNING**

Air temperature and humidity conditions were monitored in Hradec Králové, Czech Republic, by a network of meteorological stations. Meteorological sensors were placed across a representative variety of urban and suburban environments. The data collected over the 2011–2014 period are analysed in this paper. The data from reference standard meteorological stations were used for comparison and modelling purposes. Air temperatures at the points of interest were successfully modelled using regression relationships. The spatial expression of point measurements of air temperatures was provided by GIS methods in combination with CORINE land cover layer, and satellite thermal images were used to evaluate the significance of these methods. The use of standard climate information has low priority for urban planners. The impact of the urban heat island on city residents and visitors was evaluated using the HUMIDEX index, as it is more understandable for urban planners than temperature conditions as such. The aim of this paper is the modification, description and presentation of urban climate evaluation methods that are easily useable for spatial planning purposes. These methods are based on comprehensible, easily available but quality data and results. This unified methodology forms a theoretical basis for better urban planning policies to mitigate the urban heat island effects.

**Lívia LABUDOVÁ, Pavol FAŠKO, Gabriela IVAŇÁKOVÁ**  
**CHANGES IN CLIMATE AND CHANGING CLIMATE REGIONS IN SLOVAKIA**

In the context of climate change, scientists discuss the relevant reference periods for the assessment of changes in climate. Recently, many studies have been published comparing recent conditions with the last reference period: 1961–1990. In this paper, the trends of annual, seasonal and monthly average air temperature, as well as annual, seasonal and monthly precipitation totals in Slovakia, are presented to point out changes which will probably show up in the next reference period: 1991–2020. In the second part of paper, changes in the climate regions in Slovakia are analysed, comparing spatial distributions in the period 1961 – 1990 and in the period 1961–2010.

**Dalibor VÝBERČI, Marek ŠVEC, Pavol FAŠKO, Henrieta SAVINOVÁ, Milan TRIZNA, Eva MIČIETOVÁ**  
**THE EFFECTS OF THE 1996–2012 SUMMER HEAT EVENTS ON HUMAN MORTALITY IN SLOVAKIA**

The impacts of summer heat events on the mortality of the Slovak population, both in total and for selected population sub-groups, are the foci of this study. This research is the first of its kind, focusing on a given population, and therefore one priority was to create a knowledge base for the issue and to basically evaluate existing conditions for the heat-mortality relationship in Slovakia. This article also aims to fill a void in current research on these issues in Europe. In addition to overall effects, we focused individually on the major historical heat events which occurred in the summers of 2007, 2010 and 2012. During the heat events, a non-negligible negative response in mortality was recorded and fatal effects were more pronounced during particularly strong heat events and periods which lasted for two or more days. In general, females and the elderly were the most sensitive groups in the population and mortality was characterized by several specific effects in individual population groups. The most extreme heat periods were commonly followed by a deficit in mortality, corresponding to a short-term mortality displacement, the pattern of which varied in specific cases. In general, displaced mortality appeared to compensate for a large part of heat-induced excess deaths.