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Editorial: Urban climate and heat stress – Part 2

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General remarks

The special issue on urban climate and heat stress has been split into two parts. While the first part (DIE ERDE 144, 3-4) presented seven articles on four different German cities (Aachen, Berlin, Gelsenkirchen and Stuttgart), the second one here contains seven articles on studies of cities spanning from Basel, Switzerland, to Akure, Nigeria, such that a much wider range of regional climates, in which the cities are embedded, is covered.

The state of research has been briefly reviewed in the first editorial (see *Scherer* and *Endlicher* 2013), and is thus not repeated here.

Short presentation of the articles

Ifeoluwa Balogun and *Ahmed Balogun* present a study on human bioclimatic conditions in Akure, a medium-sized hot-humid tropical city in Nigeria, based on data from measurements at urban and rural sites in the city. The study revealed diurnal and seasonal variations in urban heat island (UHI) intensity, as well as in a number of fundamental biometeorological variables. The dry season shows pronounced diurnal variations in UHI intensity similar to those frequently reported for mid-latitude cities, while the UHI was weak all the day during the wet season. The authors observed higher frequencies of high temperatures in the city centre and suggest that heat stress and health risks are important problems in Akure.

Krzysztof Błażejczyk, Magdalena Kuchcik, Anna Błażejczyk, Pawel Milewski and *Jakub Szmyd* used the Universal Thermal Climate Index (UTCI) to study the spatial variability of heat stress in urban areas in Poland. Experimental research was carried out in Warsaw, where a very large and significant heat stress gradient between downtown Warsaw and rural stations could be found. The authors also performed a modelling study, using an approach based on geographic information systems (GIS), and applied it to Warsaw as well as to several small spa towns located in various parts of Poland.

A second study on a Polish city is presented by *Anita Bokwa* and *Danuta Limanówka*. Using the example of Krakow, located in the valley of the Wisla river, they

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show that topography is also an important element of climate control with respect to heat stress, besides land cover. During day- and nighttime, they find statistically significant differences in climate conditions, depending on the topographic location. Both urban and rural measurement points located on the valley floor experience the highest numbers of very hot days, heat waves and duration of extreme air temperature.

Susanne Grossman-Clarke, Sebastian Schubert, Thomas R. Clarke and *Sharon L. Harlan* investigate extreme heat events in the summer in the arid Phoenix metropolitan region (Arizona, USA), for the period 2041-2070, with projections based on an ensemble of ten climate models from the North American Regional Climate Change Assessment Program for the SRES A2 greenhouse gas emissions scenario. They find that for the model ensemble-mean a more than six-fold increase in the frequency of extreme heat events is projected, with a fourteen-fold increase of the average number of event days per year in comparison to the reference period.

Seoul, the capital of the Republic of Korea, is the subject of a study by *Kyu Rang Kim, Chaeyeon Yi, Ji-Sun Lee, Fred Meier, Britta Jänicke, Ute Fehrenbach* and *Dieter Scherer*. Using gridded data relevant for local climate assessment at 25 m and 5 m spatial resolutions provided by the Climate Analysis Seoul (CAS) workbench and a set of biometeorological models, they perform a spatially distributed risk analysis regarding excess mortality related to heat stress. One of their findings is that, in an urban quarter studied in detail, the excess mortality risk has actually been reduced by urban redevelopment during recent years.

Ana Monteiro and *Sara Velho* report on research on heat stress carried out in Porto, Portugal. Seasonal variations of thermal comfort in Porto, assessed by means of the Physiologically Equivalent Temperature (PET), and comparing expected and observed daily mortality and morbidity suggest that in southern Europe people's adaptation techniques for reducing heat stress and associated health risks need to be developed much further. The authors argue that social and economic vulnerability must be included alongside with individual characteristics, like age, gender or genetics, when defining the thresholds above which negative health impacts begin to become severe. In addition, climate risk maps for every metropolitan area, with sufficient detail to give locally appropriate temperature thresholds, are proposed.

The article by *Eberhard Parlow, Roland Vogt* and *Christian Feigenwinter* illustrates the importance of distinguishing between different types of UHI. Their study aims to bring more clarity into the subject by assessing the UHI of the city of Basel, Switzerland, using thermal data provided by satellites, a helicopter-borne infrared camera and ground-based measurements of air temperature profiles. They show that UHIs vary essentially with the choice of the respective temperature (land surface or air temperature) and height (surface, street/canopy or roof level).

Conclusions

The studies presented in Part 2 of the special issue reveal that heat stress is a serious problem over a wide range of present-day climate conditions, spanning from hot and humid climates in the tropics over hot and dry ones in subtropical regions to temperate climates of Central European countries like Poland or Switzerland.

The whole special issue contains a large variety of approaches and methods to study urban climates with respect to heat stress, revealing that scientific standards are only partly existing and need to be further developed in the future.

Reference

Scherer, D. and *W. Endlicher* 2013: Editorial. Urban climate and heat stress. – Part 1. – DIE ERDE **144** (3-4): 175-180