Computational models of human response to urban heat
*From physiology to behaviour*

Melnikov, V.

**Publication date**
2021

**Citation for published version (APA):**
Publications


PMAS conceived the idea for this study. VM conducted the literature review, formulated the models, performed the simulations and wrote a draft of the paper. VVK and PMAS validated the methodology and results and edited the paper.


VM performed the literature study, formulated the model, performed calibration of the model parameters, validation of the model and sensitivity analysis, wrote a draft of the paper. VVK and MHL conceptualised the study, validated the model and the results of computational experiments, edited the paper. PMAS conceived the idea for this study, validated the system dynamics model and sensitivity analysis and edited the paper.


VM designed and performed empirical and computational experiments, conducted their analysis and wrote a draft of the paper. VVK conceptualised the computational study and validated it, MHL validated computational study, conceptualised empirical study and validated its analysis. PMAS initiated the research and validated the methodology and results. All authors participated in drafting and editing the paper.
VM designed and conducted the experiment, created the computational models, performed the analysis of the data and drafted the paper. GIC conceptualised the experiment, validated the experimental design and procedures, data analysis. VVK and MHL validated the experimental design and procedures, computational models and their results. PMAS conceptualised the study, validated the methodology and results. All authors participated in drafting and editing the paper.

AP extended and performed simulations of the computational model of HIIS. VM provided thermoregulatory model and simulated the scenarios of heat exposure. AP and VM contributed equally in conceptualising the study, obtaining and validating the results, writing a draft of the paper. VVK conceptualised the methodology and validated the results of computational study. PMAS conceived the idea for this research, conceptualised the methodology and validated the results. VVK and PMAS edited the paper.

I thank my supervisors and peers from the computational science laboratory of the UvA and the Complexity Institute in Singapore, for giving me an opportunity to collaborate, diversify my interests, contribute my skills and knowledge. These collaborations have resulted in several papers not presented in this thesis:


Bibliography


[73] Liang Chen and Edward Ng. “Outdoor thermal comfort and outdoor activities: A review of research in the past decade”. In: Cities 29.2 (2012), pp. 118–125.


[102] T Doherty and Edward A Arens. “Evaluation of the physiological bases of thermal comfort models”. In: *ASHRAE Transactions* 94.1 (1988), pp. 1371–1385. URL: [https://escholarship.org/uc/item/6pq3r5pr](https://escholarship.org/uc/item/6pq3r5pr)


[140] P Gupta, Y Li, and G Fernie. “Effects of temperature and time of day on pedestrian walking speed”. In: International Conference on Aging, Disability and Independence. 2008.


[198] Sutyajeet Soneja et al. “Exposure to extreme heat and precipitation events associated with increased risk of hospitalization for asthma in Maryland, USA”. In: Environmental Health 15.1 (2016), p. 57.


Afterword

“Only in small Russian towns is the pedestrian still loved and respected. There he still owns the streets; he strolls along in the road without a care...”

Ilya Ilf and Yevgeny Petrov, 
The Little Golden Calf, 1931

Extremely hot days are now common in the summer even in Nordic Saint Petersburg. And during such days it is a special kind of pleasure and privilege to find yourself carelessly strolling on the streets of one of its many satellite towns – heritage of its imperial past. The observation on small Russian cities, made 90 years back, holds true to a large extent even nowadays.

The studies of this thesis provide a comprehensive understanding of the phenomenon of human response to outdoor thermal environments. The developed models serve as tools for urban scientists and planners to study this response in different scenarios. These tools will help to propose solutions for thermally comfortable urban environments, so that pedestrians regain their ownership of the streets in large cities worldwide.
Acknowledgements

It will not be an exaggeration to call the doctoral research a complex system evolving and shaping over the time. Its final content and form is a result of hundreds of interactions between me and people. These people, thus, played their invaluable role in this thesis, and I want to express my gratitude to:

Professor Peter Sloot for being a teacher. There is no another person, from whom I learned so much and in so different ways. Being able to have discussions with him, sitting reclined in the chairs, is probably the most rewarding experience of my doctorate.

Professor Gerhard Schmitt for conceiving the project, being a visionary principal investigator, aspiring me to grow in many capacities and providing means and support for it.

Valeria Krzhizhanovskaya for being not just a supervisor, but person who believed in me may be more than me myself. At moments of despair, her determination was my consolation that this thesis will materialize.

Michael Lees for always insightful discussions and excellent points, which made the studies so sound. Additional thanks are for his patience and persistence in improving my writing.

Georgios Christopolous for his decisive role in conceptualization, design and analysis of human behaviour experiment.

My father, Rafael, for ingraining curiosity and model-thinking in me since my early years. I wish, I could appreciate it more back then.

Nikita Kogtikov for committing his time to assist me in tasks of video processing and building the model of experimental area. Mathematical and general discussions with him were a unique experience.

Alva Presbitero for being a great collaborator and co-author of the study of interaction of heat stress and human innate immune system, for her advice and moral support in course of my research.
Michelle Jiang, Conrad Heinz Philipp, Lea Rüfenacht, Jimeno Fonseca, Mathias Berger, Mohsen Nazemi, Panos Mavros and other friends and colleagues from Future Cities Laboratory, who have supported and inspired me, added so much taste and flavor in my research and general Singapore experience.

Vivek Sheraton for great discussions and collaborations. Ng Bee Wee for administrative assistance. Other research and administrative staff of Complexity Institute, NTU for support.

Ivana for her moral support and for gifting me a book, which led to an epigraph and afterword, which so genuinely motivate this thesis. Ivan for help with graphical materials be it recruitment posters or front matter of this thesis. Daria and Maxim, Anastasiya and Dimitar for always being there to help, to assist and to cheer me up in the best Russian fashion. Leonid for assistance in tools for experiment. Carmen and Militsa, Dmitry and Ayana for being peer PhD candidates to share worries and glories with.