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Computational models of human response to urban heat

From physiology to behaviour

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Publications

1. Melnikov, V., Krzhizhanovskaya, V. V., & Sloom, P. M. A. (2017). Models of pedestrian adaptive behaviour in hot outdoor public spaces. *Procedia Computer Science*, 108, 185-194.

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.

2. Melnikov, V., Krzhizhanovskaya, V. V., Lees, M. H., & Sloom, P. M. A. (2018). System dynamics of human body thermal regulation in outdoor environments. *Building and Environment*, 143, 760-769.

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.

3. Melnikov, V. R., Krzhizhanovskaya, V. V., Lees, M. H., & Sloom, P. M. A. (2020). The impact of pace of life on pedestrian heat stress: A computational modelling approach. *Environmental research*, 109397.

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.

4. Melnikov, V. R., Chritopoulos G. I., Krzhizhanovskaya, V. V., Lees, M. H., & Sloot, P. M. A. (2021). Empirical evidence of pedestrian sun avoidance behaviour reveals perceived cost of walking under the heat stress. *In preparation for Nature Human Behaviour*.

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.

5. Presbitero A., Melnikov V. R. & Sloot P. M. A. (2021). Heat stress and the human innate immune system: balancing inflammation with physical activities. *In preparation for BMC Environmental Health*.

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.

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1. Aspembitova, A., Feng, L., Melnikov, V. & Chew, L. Y. (2019). Fitness preferential attachment as a driving mechanism in bitcoin transaction network. *PloS one*, 14(8), e0219346.
2. Sheraton, M. V., Melnikov, V. R. & Sloot, P. M. A. (2019). Prediction and quantification of bacterial biofilm detachment using Glazier–Graner–Hogeweg

method based model simulations. *Journal of theoretical biology*, 482, 109994.

3. Sheraton, M. V., Chiew, G.Y.G., Melnikov, V., Tan, E.Y., Luo, K., Verma N. & Slood, P.M.A. (2020). Emergence of Spatio-Temporal Variations in Chemotherapeutic Drug Efficacy: In-Vitro and In-Silico 3D Tumour Spheroid. *BMC Cancer*, 20(1).

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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.

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