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Links between the spatial distribution of the surface urban heat island and heat-related mortality in Prague, Czech Republic

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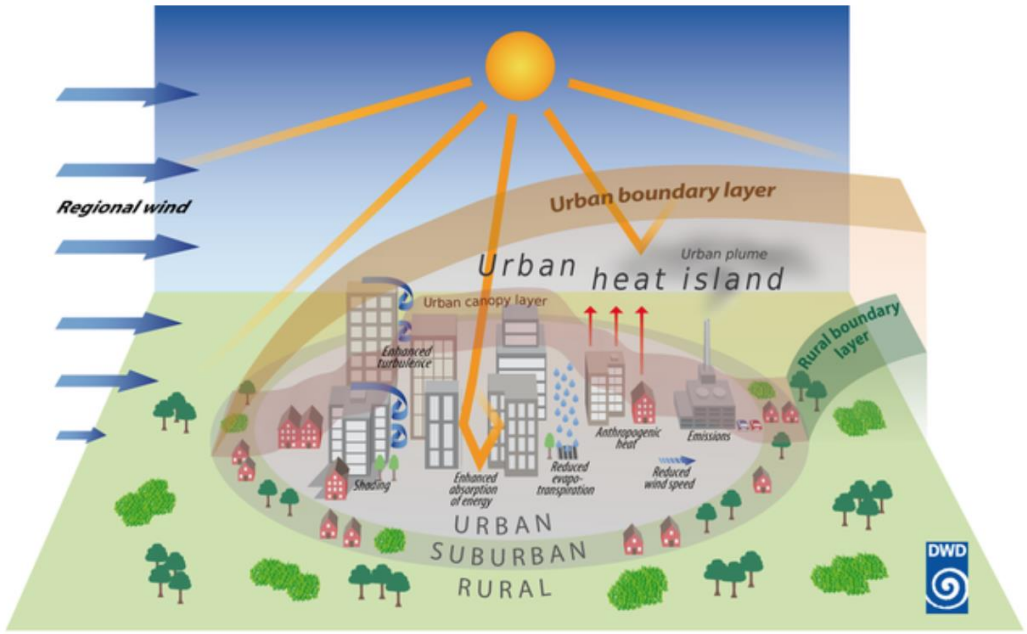
Urban Heat Island Effect



Due to climate change occurrence, duration and intensity of heat waves is very likely to increase. This is more threatening for cities, due to urban heat island (UHI) effect.

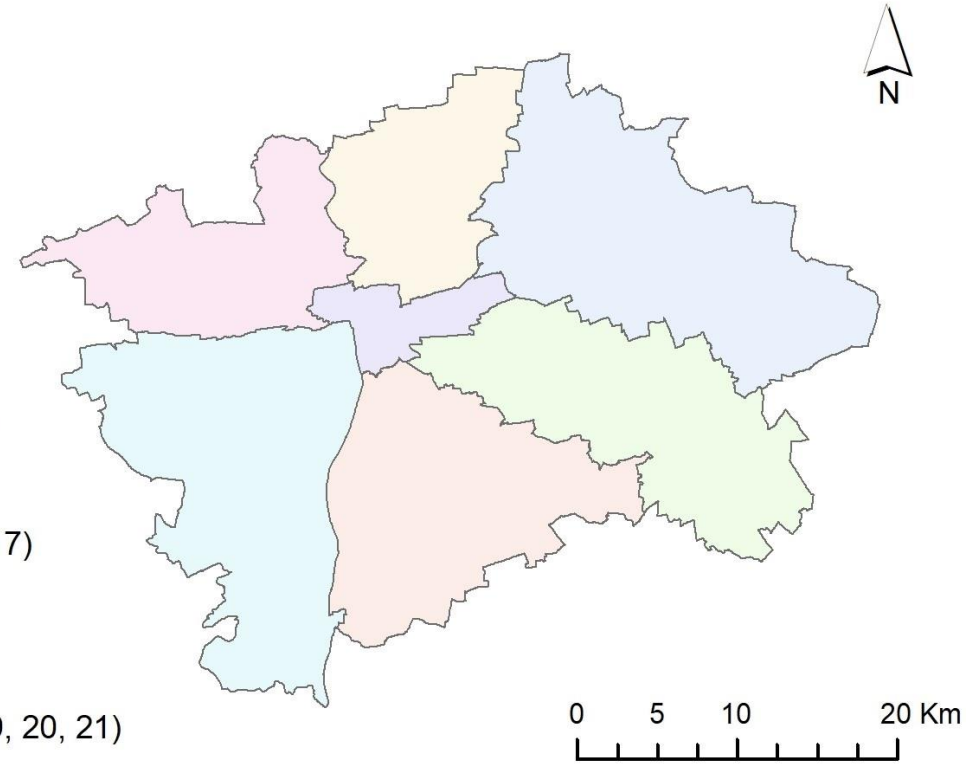
The aim of this study is to investigate links between the spatial distribution of the surface urban heat island (SUHI) and heatwave-related mortality in Prague, the Czech Republic.

Administrative districts of Prague were merged in:

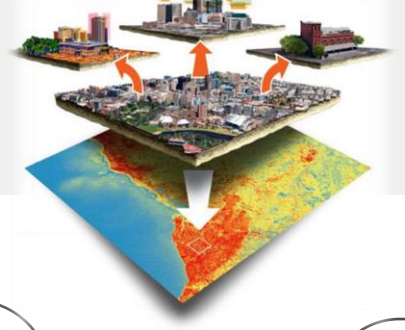
http://www.geoportalpraha.cz/

Districts

- Prague 1 (2, 3)
- Prague 10 (15, 22)
- Prague 4 (11,12)
- Prague 5 (13, 16, 17)
- Prague 6
- Prague 8 (7)
- Praha 9 (14, 18, 19, 20, 21)



Satellite Images



- **Data**: MODIS LST images acquired by Aqua satellite
- **Spatial resolution**: 1 km
- Land Surface Temperature (LST) maps derived by using the Google Earth Engine

Mortality Data

- **Data**: Daily all-cause mortality in Prague
- **Period**: All days for the months May-June-July-September, from May 2001 to 2020
- **94 heatwave days** (HWDs) = at least 2 consecutive days with $T_{mean} > 95^{th}$ percentile

- To overcome the limitation of cloudiness, images/days with more 30% cloudiness were excluded; the remaining 23 images were divided into three groups by their cloud percentage (referred to as selection)
- For each selection, median LST was calculated.
- Relative Risks of mortality calculated for the three selections using Distributed Non-Linear Lag Models.

HWDs filtered by cloud cover: three selections created for comparison

Selection 1

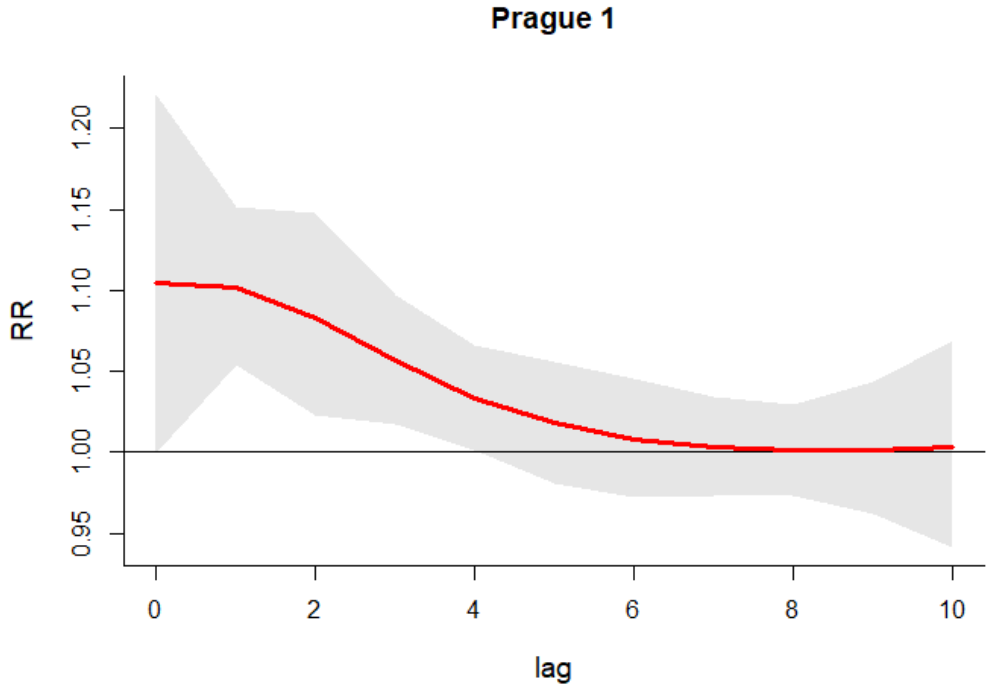
Selection 2

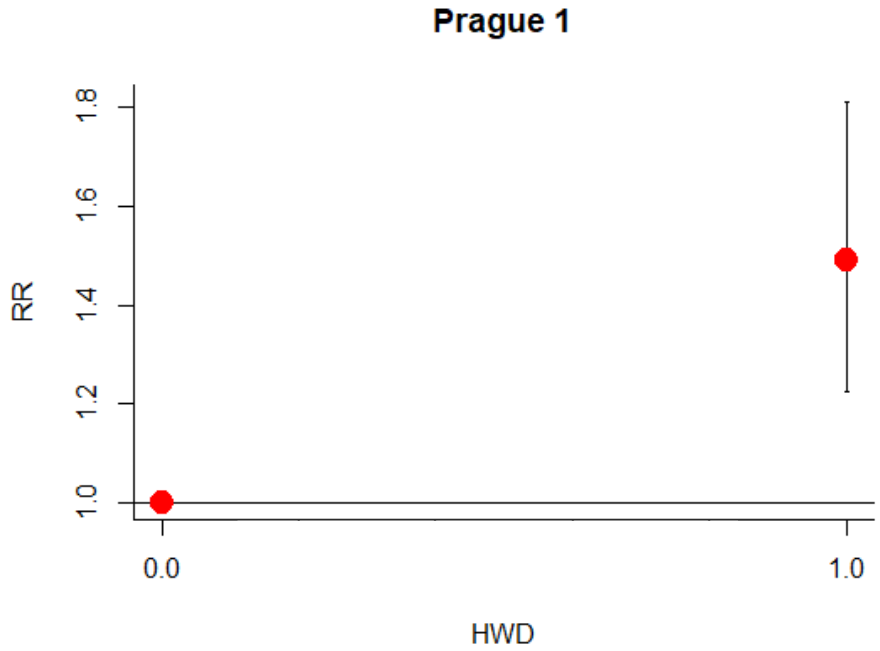
Selection 3

	Cloud Cover Percentage %							
Date	Prague	Prague 1	Prague 4	Prague 5	Prague 6	Prague 8	Prague 9	Prague 10
	< 31 %				< 47 %			
July 26, 2013	30	0	36	41	38	21	36	10
July 19, 2014	30	23	39	29	9	17	46	23
June 25, 2016	29	5	16	42	21	20	36	33
August 12, 2015	25	5	10	34	31	17	31	23
July 25, 2006	24	0	15	34	8	17	43	11
July 18, 2014	23	0	26	34	13	6	25	23
August 14, 2015	20	0	24	15	25	44	17	12
	< 22 %				**< 37 %**			
July 17, 2007	21	21	16	17	34	17	21	24
July 27, 2012	21	0	19	34	6	25	25	11
July 20, 2014	19	0	14	33	20	7	15	23
July 12, 2010	18	0	35	34	23	2	0	12
August 10, 2015	17	13	17	9	28	23	15	22
July 14, 2010	14	0	10	12	6	31	9	28
August 8, 2020	14	0	1	2	12	4	36	24
	< 14 %				**< 29 %**			
August 3, 2003	13	0	10	12	0	3	19	24
July 29, 2018	12	0	3	17	15	27	15	4
August 11, 2015	11	0	19	10	0	16	0	26
June 18, 2013	11	0	3	5	21	12	5	28
August 5, 2015	8	3	9	4	2	4	13	10
July 26, 2012	8	0	3	13	7	0	12	7
July 31, 2017	7	0	17	2	19	6	5	3
August 23, 2011	2	0	0	4	7	2	3	0
August 4, 2015	1	0	0	4	0	0	1	3

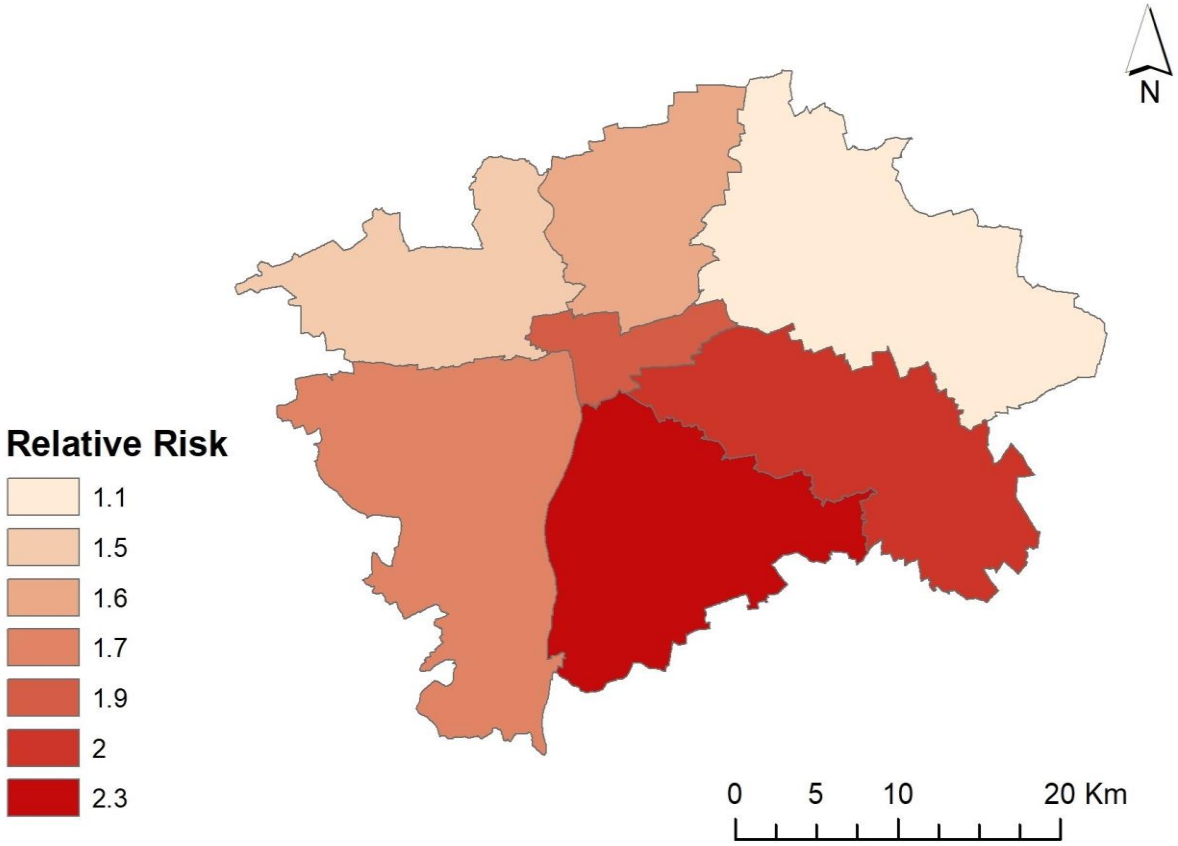
Distributed lag non-linear models

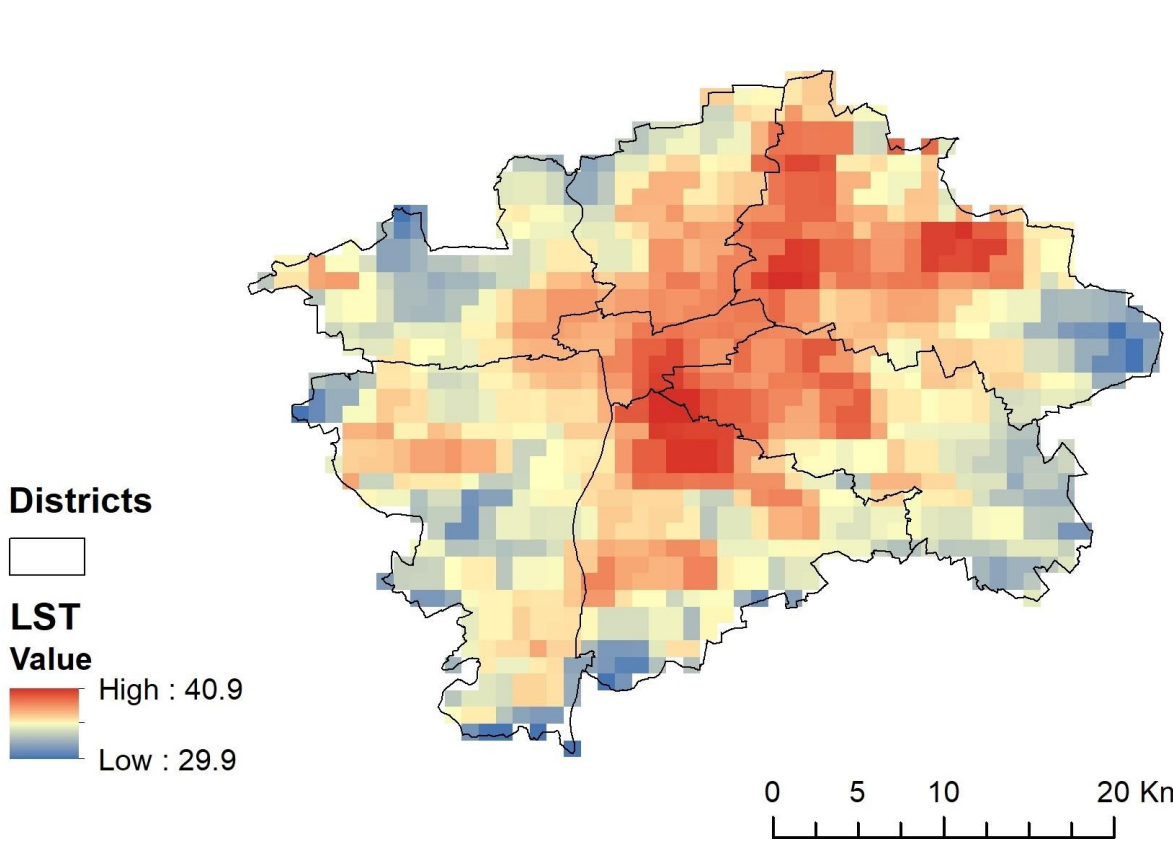
- The relative risk of heat-related mortality on HWDs was calculated via a strata function indicating non-heatwave (0) versus heatwave (1) days.
- HWDs were selected according to Selection 1,2, and 3.
- The lagged effect up to 10 days after the HWD occurence was considered.



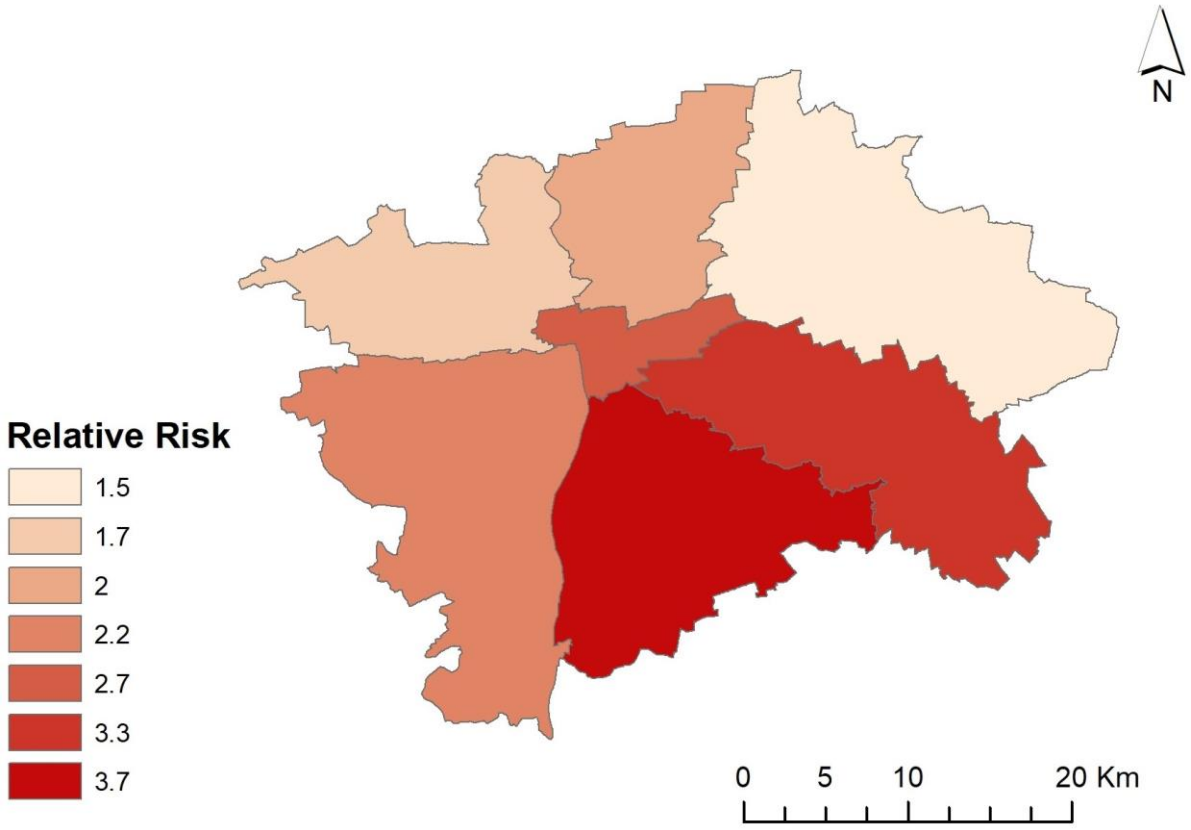


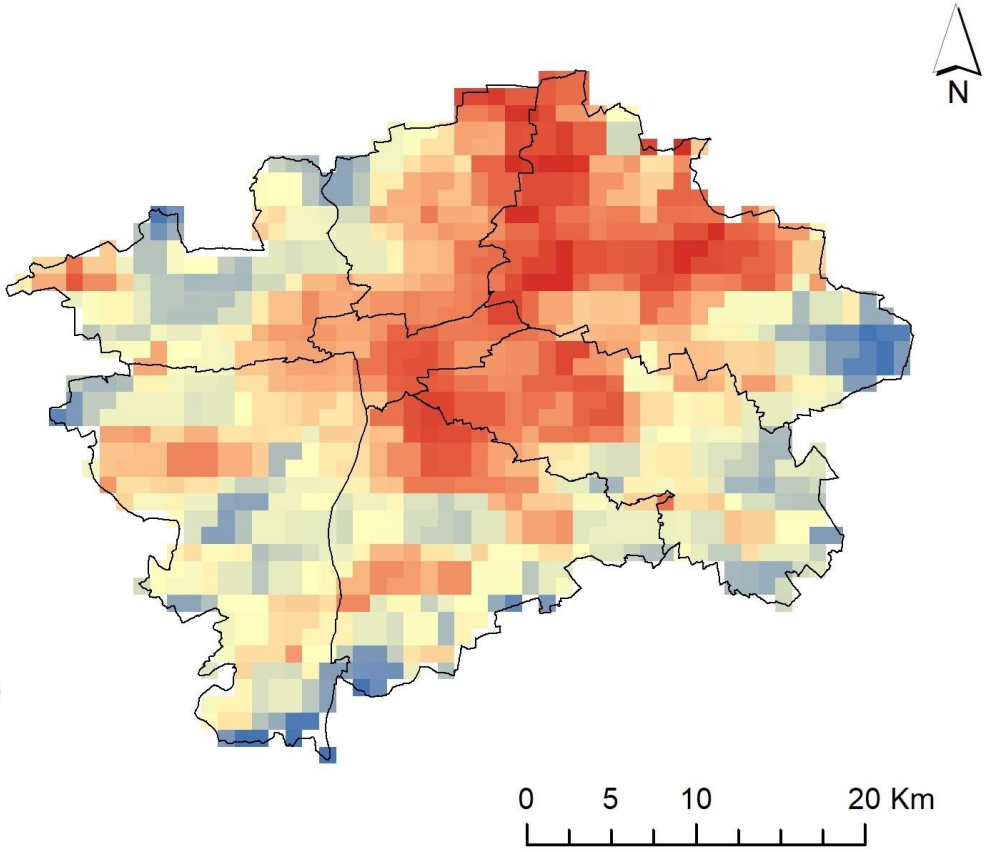
Relative Risk and LST comparison: Selection 1



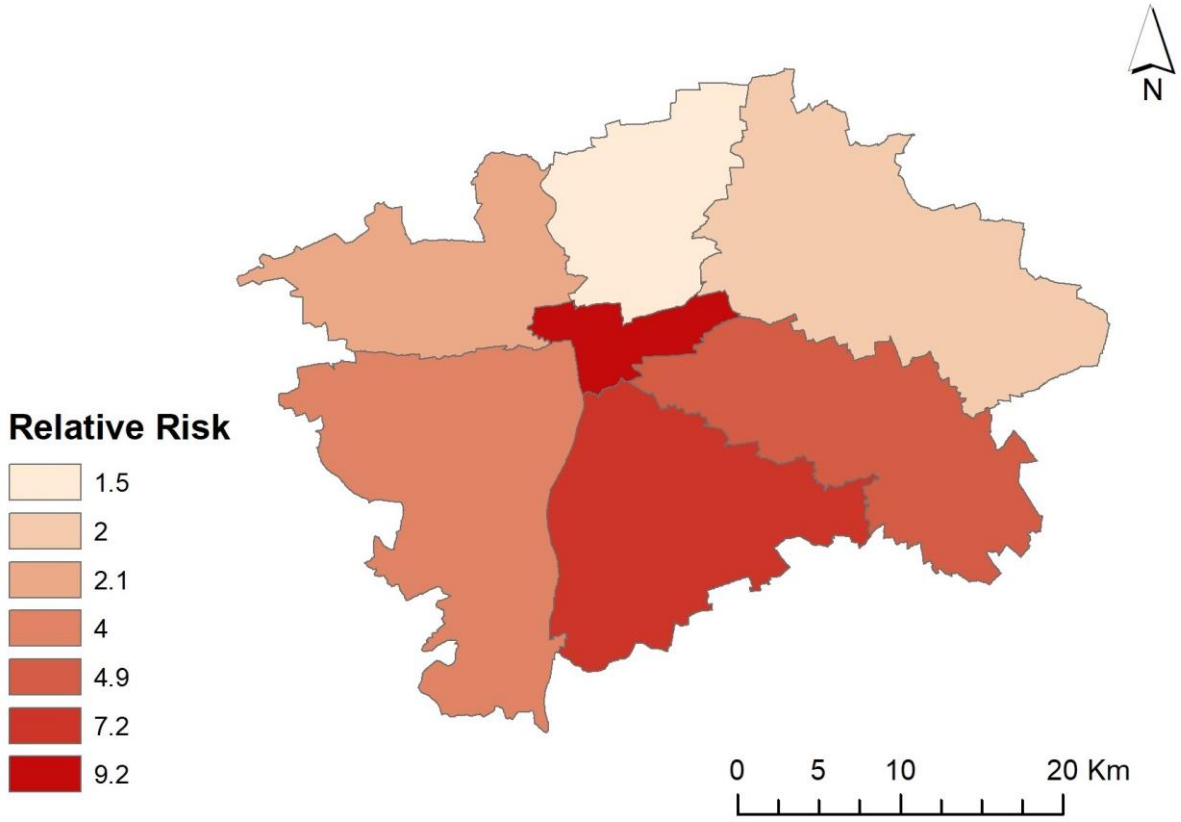


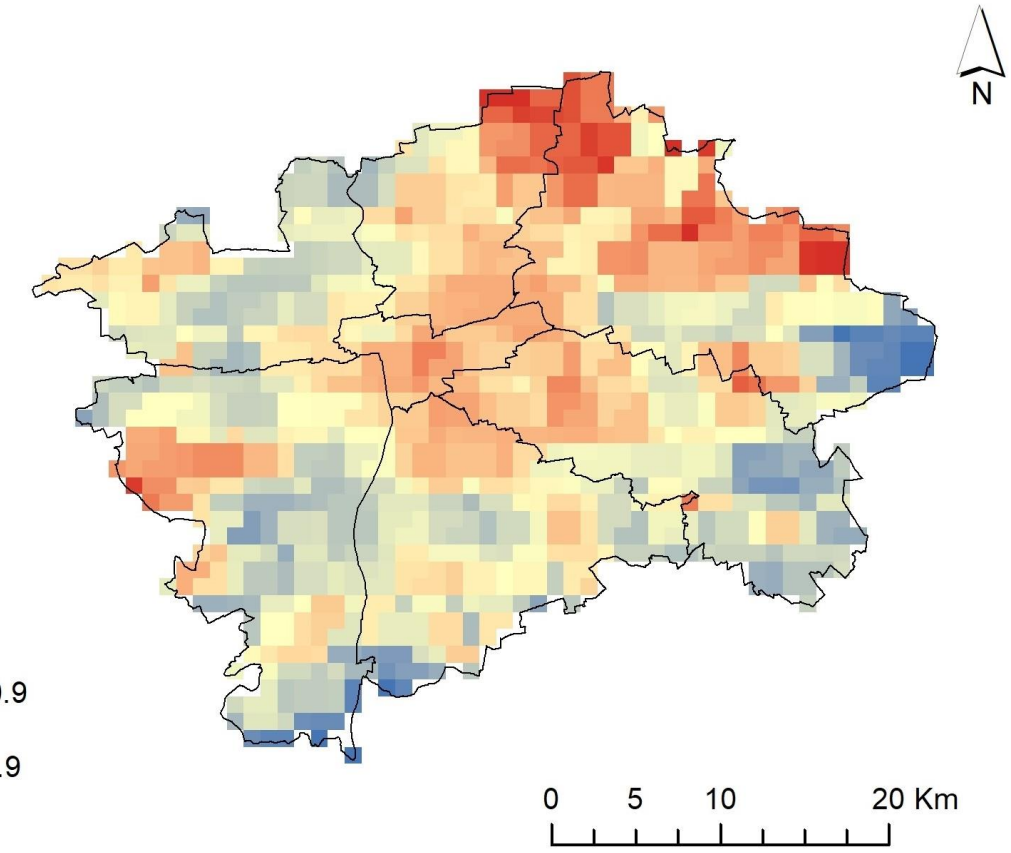
Relative Risk and LST comparison: Selection 2





Relative Risk and LST comparison: Selection 3





Conclusions

- Although the LST maps are a convenient tool for identifying hot spots, they only partially explain the spatial distribution of heat-related mortality. Therefore other factors need to be considered when implementing measures to reduce heat-related mortality.

- Cloud coverage also plays a role in heat-related mortality and LST: The images with less cloud coverage explain better the spatial distribution of heat-related mortality. Therefore similar studies should take into account while selecting images.

- These are preliminary results of the ongoing research. The study may help identify the areas with the highest impact on human health in Prague, where the mitigation measures should target.

Thank you for your attention

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