City thermal comfort under the heatwave conditions

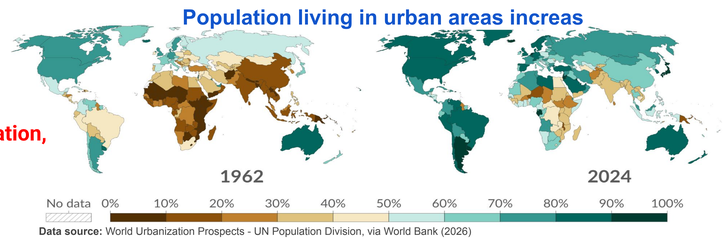
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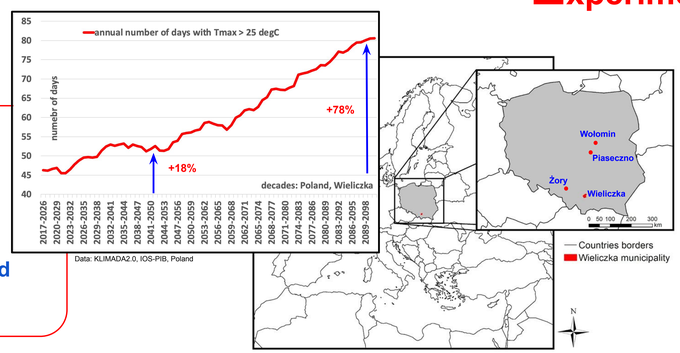
A World Urbanization Prospects (UN DESA's Population Division)

In 2025 cities house the 45% of the global population, up from 20% in 1950

Before 2050, 2/3 of global population is expected to be absorbed by urban areas

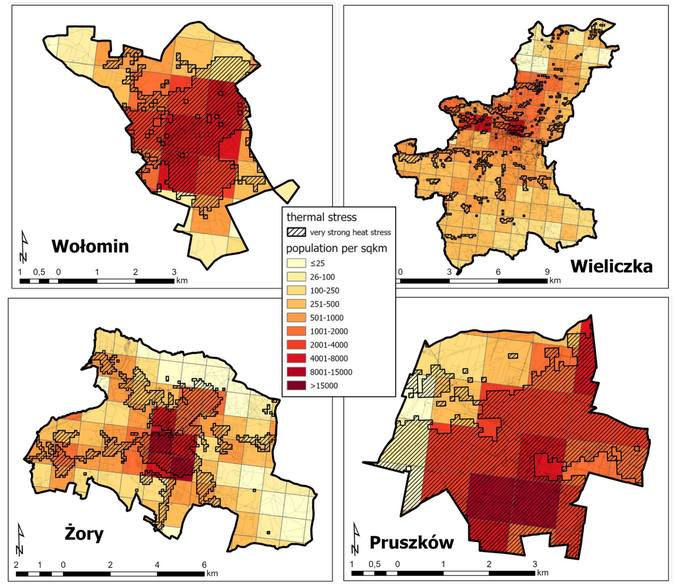


IPCC reports: during XXI c. heatwaves will become longer, more frequent, and more intense



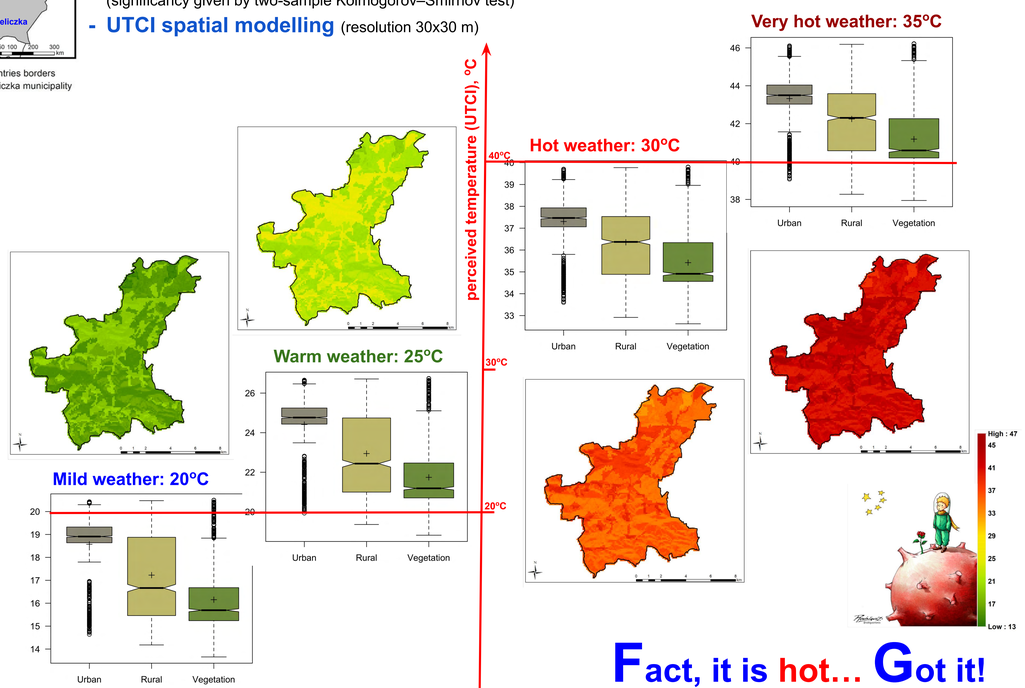
Heatwave: any chance for outdoor thermal comfort in the city?

- 4 mid-size cities in Poland (50 000-70 000 inhabitants)
- Spatial heat stress modeled for hot weather (30°C)
- Population density



Experiment: how big is the "hot" difference for city & no-city

- Example: Central European municipality Wieliczka, Poland (UNESCO heritage)
- 4 air temperature scenarios: 20°C, 25°C, 30°C & 35°C
- UTCI response for 3 types of environment: city, rural, vegetation
- Distribution of UTCI values in four weather types - box plot (significancy given by two-sample Kolmogorov–Smirnov test)
- UTCI spatial modelling (resolution 30x30 m)



Diversity of spaces matters for ...feeling hot or not

...how we perceive the temperature of our surroundings is determined by the quality of the topoclimatic conditions (land use, land cover, ground permeability, materials used for constructions) as the local response for the surface energy balance

Bioclimatic response to how we experience temperature is the UTCI index

$$UTCI = 3.21 + 0.872t + 0.2459\mathrm{Mrt} - 2.5078 \cdot v10 - 0.0176f$$

UTCI - Universal Thermal Climate Index [°C]; t - air temperature [°C]; Mrt - average radiation temperature [°C]; v10 - wind speed at 10 m above ground level [m s^{-1}]; f - relative air humidity [%]

Insights

- Heatwaves cause severe heat stress in small and medium-sized towns (20–70,000 inhabitants)
- The level of thermal stress varies spatially and increases with the density of urban fabric
- From a social perspective, the link between severe heat stress and densely populated areas is highly detrimental

& applications:

- smart urban planning: reducing thermal stress by improving the quality of topoclimatic factors
- Spatially targeted social and health support at heat-vulnerable populations
- the strategic adaptation of cities to climate change

Fact, it is hot... Got it!

QR me @Aneta Afelt

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