MODELLING THE IMPACTS OF CLIMATE CHANGE ON CITIES: HEAT RELATED MORTALITY AND ADAPTATION OPTIONS

ARCADIA FACTSHEET 6

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High temperatures and heatwaves are associated with large impacts on society. This factsheet provides information on the effect of climate change and an intensification of the Urban Heat Island (UHI) effect on mortality risk. This risk can be reduced through adaptation strategies aimed at increasing resilience to high temperatures and reducing anthropogenic heat emissions. The greatest benefits are seen when both strategies are implemented in parallel.

Context

- High temperatures and heatwaves are associated with large impacts on society. For example, increasing mortality risk to vulnerable sections of the population.
- People are generally acclimatised to their local climates but there are limits to the amount of heat exposure an individual can tolerate. Beyond this threshold people can suffer from heat exhaustion and heat stroke which can result in death.
- Those living within cities are also particularly vulnerable to high temperatures due to the UHI effect. The UHI will be affected by future climate change as well as changes in land and energy use.

Method

- Heat related mortality can be calculated based on epidemiological studies of mortality.
- These studies highlight historic relationships between mortality statistics and daily temperature data (fig. 1).
- These relationships are applied to current and future temperature time-series data, provided by the urban spatial weather generator, to estimate future mortality risk.
- A mean daily temperature threshold of 19.2°C was used, above which heat related mortality increases on average by 3.1% per 1°C rise.
- Probabilistic results are able to be provided for a range of climate scenarios and time-periods (e.g. fig. 2 shows results for the 2030s and 2050s assuming high and low emissions).
- Adaptation is considered by shifting the threshold value by 1°C and 2°C.
- This illustrates the effect of autonomous or planned adaptation on heat related mortality. For example, by decreasing external temperatures or increasing personal resilience to heat through behavioural change or natural acclimatisation.

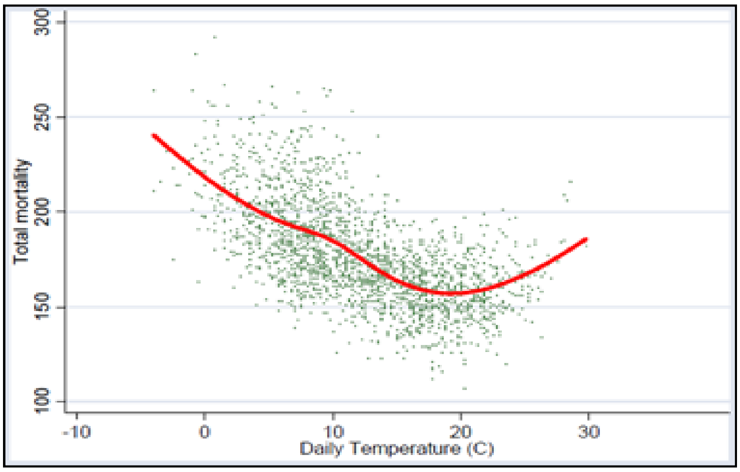

Fig. 1: Daily temperature vs. mortality in London

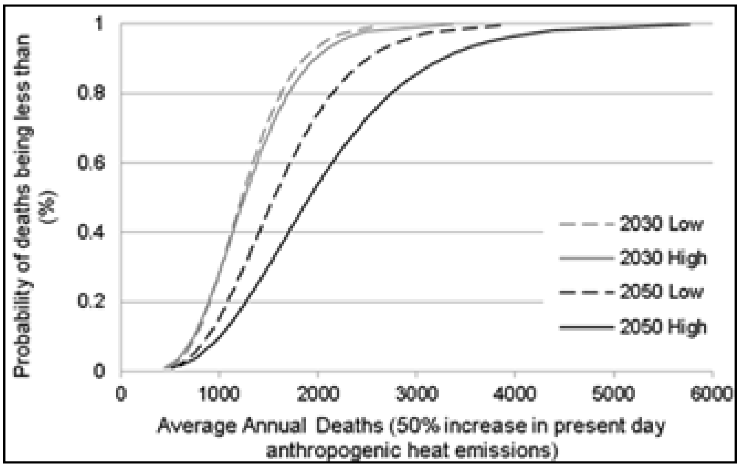

Fig. 2: Probability of average annual heat mortality

Heat related mortality risk

- If anthropogenic heat emissions increase by 50% from the present day, increasing the UHI intensity, 842 additional heat related deaths per year are projected for Greater London by the 2050s (median result, high emission scenario).
- If anthropogenic heat emissions were stabilised at the present level this would be reduced to 603 additional heat related deaths per year in Greater London by the 2050s (median result, high emission scenario).
- This highlights the potential benefit, in the form of reduced mortality, that stabilising or reducing anthropogenic heat emissions could have at a city level, for example through urban greening schemes and reduced energy use.
- Increasing the mortality temperature threshold by 1°C could reduce annual heat related mortality by 32 to 42% depending on the climate scenario used.
- Increasing the mortality temperature threshold by 2°C could reduce annual heat related mortality by 57% to 69%.
- Therefore, it is important that heat-related adaptation is considered in terms of measures to restrict temperatures in urban areas as well as by implementing adaptive measures to deal with residual temperature increase.
- The greatest benefits are seen when both strategies are implemented in parallel (fig. 3).

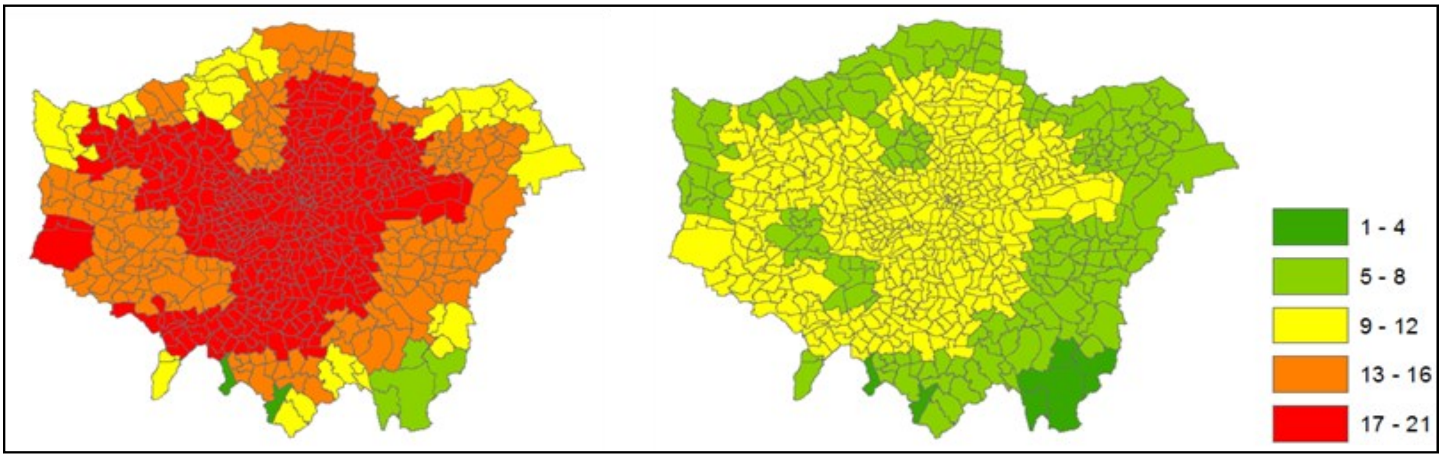

Fig. 3: A comparison of the spatial pattern of annual heat related mortality in Greater London for the 2050s (median result, high emission scenario) with no adaptation (left) and adaptation (right)

Heat related mortality of daily events

- Heat related mortality can also vary widely on any given day.
- An advantage of the spatial weather generator is that it provides coherent data across grid cells so that information on daily events can be assessed.
- Results highlights that both the frequency of days and the number of deaths per day are set to increase by the 2050s (fig. 4).
- This approach could also be used to assess mortality change during future heatwave events.

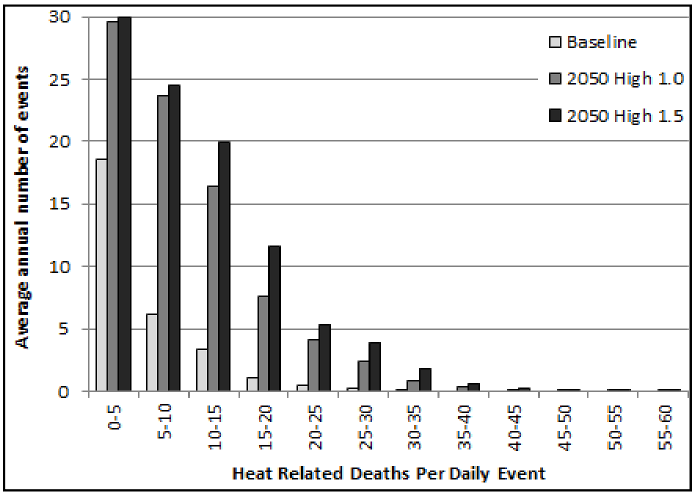

Fig. 4: Frequency of heat related deaths in Greater London assuming anthropogenic heat emissions remain stable (1.0) and increase y 50% from the baseline (1.5)

Policy relevance

- The modelling approach can provide information to help facilitate the coordination of policy makers from different areas.
- It highlights potential benefits of adaptation, which may cross policy areas.
- It can be used to inform and improve the resilience of urban areas and their inhabitants.

For additional information see:

- ARCADIA website: www.arcc-cn.org.uk/project-summaries/arcadia/
- ARCADIA Factsheet 2