London's response to severe weather and climate – Contribution from the National Centre for Atmospheric Science climate division.

In a changing climate, Londoners are likely to be affected by increased frequency of severe weather events, including windstorms, intense precipitation and heat waves. In addition, changes in the regional circulation may increase the frequency of air quality events.

This summary of recent findings on the changing risks of heat waves and air quality events contributes to the following two questions, posed in the Greater London Authority's 11th July call for evidence on the impact of climate change on Londoners:

1. What do climate change projections tell us about the likely increase or decrease in different weather risks in coming decades?

2. Has the consensus about likely changes in the risks of severe weather changed in recent years?

Heat wave risk

Heat waves significantly affect UK mortality and morbidity (Johnson et al. 2005). This impact is amplified in London by the urban heat island effect, which results in higher temperatures relative to surrounding rural regions. London's dense population renders the city vulnerable to the increased mortality and morbidity associated with high temperatures (Hajat et al. 2014).

Daily maximum temperature (i.e. the highest temperature reached during the day) is a good indicator of heat stress. Under a medium emissions scenario, daily maximum temperature in the southeast of England is projected to warm by 1.2 – 7.3 deg C by the 2050s, relative to the 1961-1990 baseline (UKCP09). The UKCP09 plot reproduced below shows the probability of the change in daily maximum temperature in SE England being less than a given value. According to this, under a medium emissions scenario, there is ~50% chance that the daily maximum temperature in SE England will warm by 3^0C by 2050, with ~25% probability of warming exceeding 4^0C. For context, the 2003 summer was of the order of 4^0C warmer than usual in London.

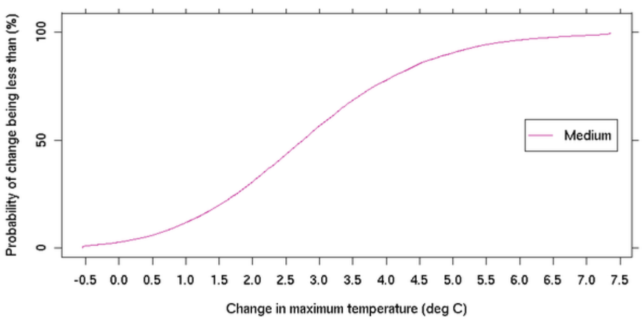

Figure 1: Probability of the change in a given maximum temperature for a medium emissions scenario for SE England (UKCP 09).

Such warming would be reflected in a significant increase in the frequency of high impact heat waves, like the one that occurred in 2003 (Beniston 2004). The likelihood of hot summers will, however, vary from decade to decade, in the future – as it does now. The variability of the climate on time scales from years to decades is illustrated by Figure 2, which shows a time series of Central England Temperature (Parker et al. 1992).

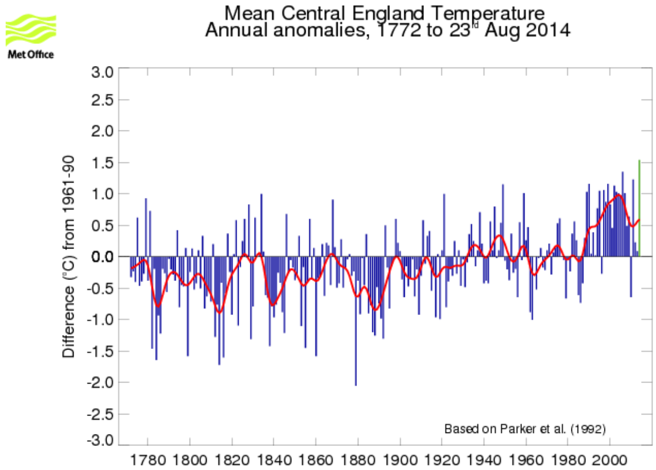

Figure 2: Annual mean Central England Temperature relative to the 1961-1990 annual mean. The red line is a 10-year running mean. Figure reproduced from http://www.metoffice.gov.uk/hadobs/hadcet/

A recent study has used an integrated assessment approach to investigate the impact of very hot summers on Londoners (Jenkins et al. 2014). The climate projections referred to in the study were based on the UKCP09 dataset. These data were adjusted to account for variability in the weather on fine spatial scales, and the temperature inside buildings. The climate projections were then combined with models of morbidity and mortality for a range of adaptation scenarios. The study found, that under a high emissions scenario, by 2050, there could be an average 842 extra heat related deaths in London. It was further found that adaptive measures, which reduce the temperature/mortality response curve by 1-2 ^{0}C, would reduce this figure by 32-69%.

Air quality events

Londoners are exposed to more air pollution at present than any other community in the UK (http://www.londonair.org.uk/LondonAir/guide/WorstPlace.aspx). Whilst the cause of air pollution can be thought of as being an emission based problem, regional scale meteorology plays a big roll in regulating the strength of air pollution episodes and changes in regional scale meteorology in the future will impact air quality. The most important meteorological phenomenon controlling air quality is atmospheric blocking or stagnation events. A recent study has quantified the global response of atmospheric stagnation events to climate change, concluding that by the end of the century there will be increases in the number of days that stagnation events occur in many parts of the globe (Horton et al. 2014). A key conclusion of this being that emission based control strategies for air quality will need to take into account changes in the frequency of stagnation events to deliver the improvements they are intended for. However, that study (based on global climate model data) was unable to provide evidence for robust increases in stagnation events affecting London and the UK.

References:

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