VIEWpoint 新观点

Correcting urban bias in large-scale temperature records in China

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Explainer

Accessible research from Climate Science for Service Partnership (CSSP) China, for decision-makers No.10

Focus

A robust temperature record allows for a deep understanding of the mechanisms that impact on local and regional temperatures. Temperature measurements are often affected by their surroundings which can cause a bias. Urbanisation is probably the most common source of systematic bias in land surface temperature records. There is considerable uncertainty in the bias especially in regions where urban expansion is rapid. Wang, Tett, and Yan (2017) found that increasing urban land fraction (the proportion of surrounding area that is developed) increased minimum temperatures yet had negligible impact on maximum temperatures for Eastern China.

Importance

In developing nations, urbanisation is rapid and dynamic, causing biases in land surface temperature records at local and regional levels. Climate models are best used for large-scale average changes in temperature and are not directly comparable to local measurements in rapidly urbanising regions such as Eastern China. As human populations are concentrated in cities, if we want to quantify the changing risk of extreme temperatures to cities based on climate model projections, we need to apply a correction for the impact of urbanisation at local and regional levels.

Approach

A corrected daily surface air temperature dataset observed at 753 meteorological observation sites in China from 1980–2009 [Li and Yan, 2009, 2010] was combined with a reanalysis dataset and a long-term land cover dataset made from multiple data sources [Hu et al., 2015]. For each site the trend in urban land fraction for the nearest 10km x 10km pixel was calculated.

The temperature trend observed at each urban site is assumed to be the sum of large-scale temperature trends, local urban temperature trends and 'noise' which represents unknown processes.

Reanalysis data provide the most complete picture currently possible of past weather and climate, being a blend of observations with past short-range weather forecasts rerun with modern weather forecasting models. The reanalysis data was used to represent the long-term temperature trends. Local warming was assumed to be proportional to urban land fraction.

The urban impact on maximum temperature was small and statistically insignificant, however it increased minimum temperature, with a change from 0% to 100% urban fraction leading to an increase of 1.7±0.3°C, with urban warming being responsible for ~9% of the trend in regional minimum temperature for Eastern China for 1980-2009.

Next steps

Urban land fraction is an important factor when determining local urban warming but other factors include anthropogenic heating, the degree of urbanisation and the local background climate.

Previous techniques have relied on population data for calculating urbanisation but these data are often out of date, this methodology is more robust and could be applied to other regions.

References

Wang et al., 2017 DOI:10.1002/2016GL071524
Li & Yan 2009 DOI:10.1080/16742834.2009.11446802
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Hu et al., 2015 DOI:10.1007/s12665-014-4000-4

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