

What spatial resolution do we need for an urban network of air temperature sensors?

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The University of Birmingham is presently in the process of deploying over 250 sensors across the city of Birmingham to create a unique urban climate laboratory. This project will be one of the first to use the data from this exercise and will investigate the overall success of the deployment strategy. A range of techniques will be used to identify redundancy or gaps in the coverage leading to recommendations for future deployment in other urban areas.

The aim of my research team is to identify, model and promote adaptation to the impacts of urban heat and climate change on the people and infrastructure of major conurbations. A long-term aim is to build a unique climate laboratory across Birmingham, the second most populous city in the UK consisting of a high resolution nested network of sensors monitoring the urban climate – *The Birmingham Climate Laboratory* (BUCL). In 2010, NERC invested £700k in BUCL by funding the networks to measure and monitor the spatial extent of the urban heat island in Birmingham (Fig. 1):

1. Coarse array of 29 weather stations across Birmingham located in secure primary electrical substations (+3 new rural sites to complement the existing rural reference site at Coleshill)
2. Wide area array consisting of 131 Wi-Fi air and humidity sensors located at schools across the conurbation (1 per ONS Super Output Area)
3. Fine scale array covering the Central Business District and consisting of 50 sensors per km².

BUCL will result in Birmingham becoming the most heavily climate instrumented urban area in the world and will become a unique facility of international importance. Data made available from BUCL will be used to answer the key research questions currently under investigation such as what is the impact of the current and future climate on the people and infrastructure of a major conurbation.

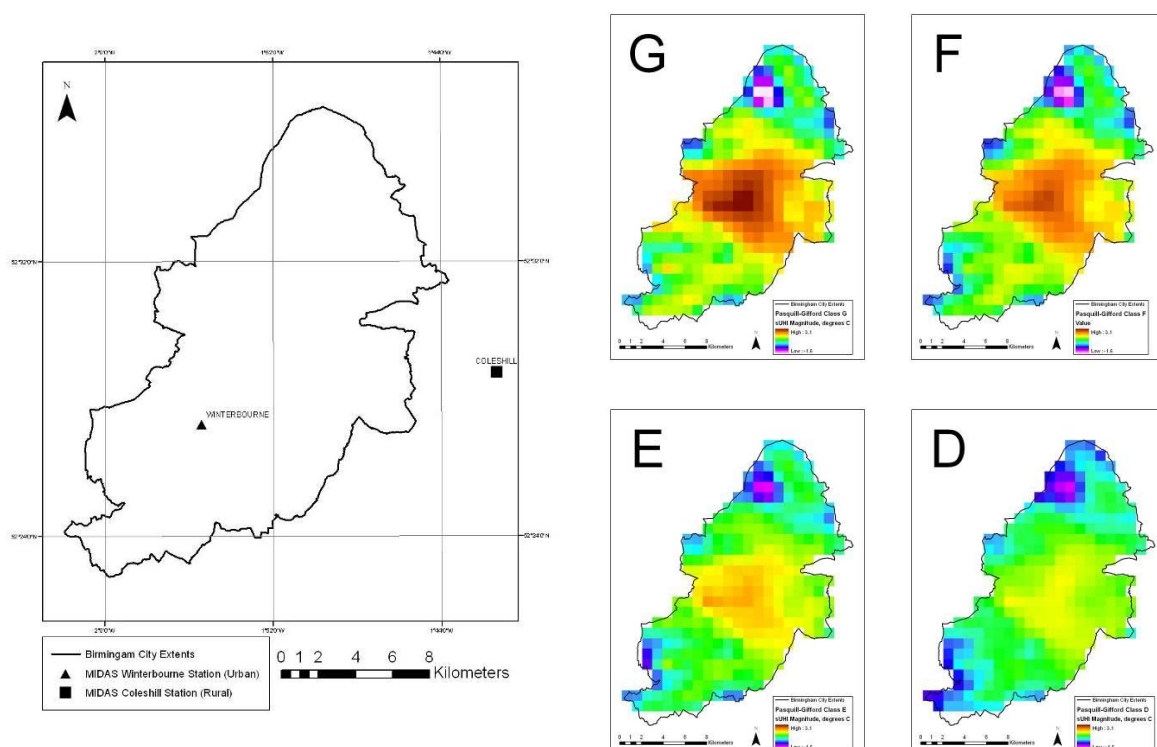


Figure 1: Average surface temperatures from remote sensing for Birmingham under four Pasquill-Gifford stability classes D, E, F and G. (Tomlinson et al, 2011)

The overall aim of this project is to assess whether the deployment strategy used by BUCL is successful and follows on from similar work already completed for the road weather sector (see Hammond et al, 2010). Once instrumentation has been deployed, it will be possible to use techniques to identify any redundancies / gaps in the network. The aim will be met by the following objectives:

1. Identification of redundancy in the networks by comparing pairs of samples of climate data (Fig. 2)
2. Identification of gaps in the network by investigating urban climate zones (e.g. Stewart & Oke, 2009). This will be achieved by using new primary data collected by transect techniques and / or satellite imagery (Figure 1).
3. Provide an optimised deployment strategy to cover the entire West Midlands conurbation.

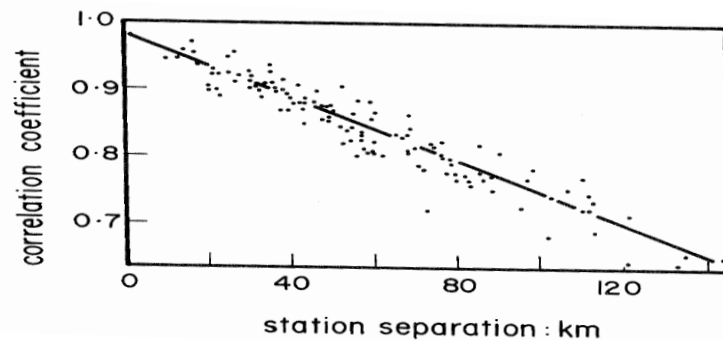


Figure 2: Effect of distance of station separation (Linacre, 1992)

Presently, there are few cities which have an air temperature sensor network at a suitable resolution to fully verify climate models. BUCL will be a unique facility and few cities can justify the expenditure on such a network. However, BUCL also provides the foundations to test models and alternative approaches to temperature monitoring so that other cities need not require such a network. Hence other cities will be looking at similar technologies to instrument their urban areas, and this project will seek to provide guidance on the number of sensors required. This project may find significant redundancy in the BUCL network and as such sensors may become available for deployment elsewhere in the West Midlands. Alternatively, additional sensors may be procured to instrument the entire West Midlands conurbation, thus extending the spatial extent of BUCL.

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References

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