

### Project Outcomes

In order to construct high-resolution climate change scenarios for key case-study locations, BETWIXT has developed a suite of computer-based models to produce common datasets for the other projects in the BKCC initiative. The starting point for this work is the UKCIP02 climate change scenarios, which BETWIXT will develop for shorter time periods and point locations, to meet the particular requirements of the built environment, including information about changes in weather extremes.

BETWIXT is also addressing issues of scenario uncertainty, for example, by analysing the reliability of scenarios of wind speed and direction, and has provided new information on potential changes in the "urban heat island" effect. The latter work indicates the importance of representing urban areas within climate simulations if the aim is to build up a true picture of the impact of climate change within the cities themselves.

The BETWIXT work also indicates that there is considerable uncertainty in the nature and magnitude of extremes of rainfall in future climates. This is especially apparent when dealing with hourly and sub-hourly rainfall – in part, because the statistics of extremes in the current climate are not well known for these short time durations. There is greater certainty concerning the nature of changes in temperature extremes: with consistent tendencies towards more hot days and warm nights, longer heatwaves and fewer cold nights. BETWIXT has demonstrated the large differences that exist between observed and simulated values of wind speed and direction – thus wind scenarios should continue to be treated with caution.

### Stakeholder's Comments

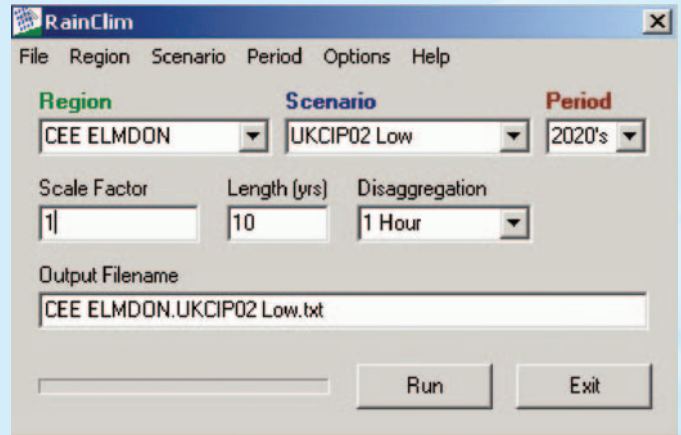
"BETWIXT data is concise, simple and easy to use. The data are given for four different emission scenarios and will certainly provide us with a better picture about how our future energy demand patterns would change under these scenarios"

Ching Lai Hor, GENESIS

### Project Description and Sources

The RainClim software package v1 developed by the University of Newcastle generates rainfall time series for the present day and future time periods for 18 sites in the UK, with time resolutions of 5 minutes and 1 hour. RainClim will be extended to the UK on a 5 km grid.

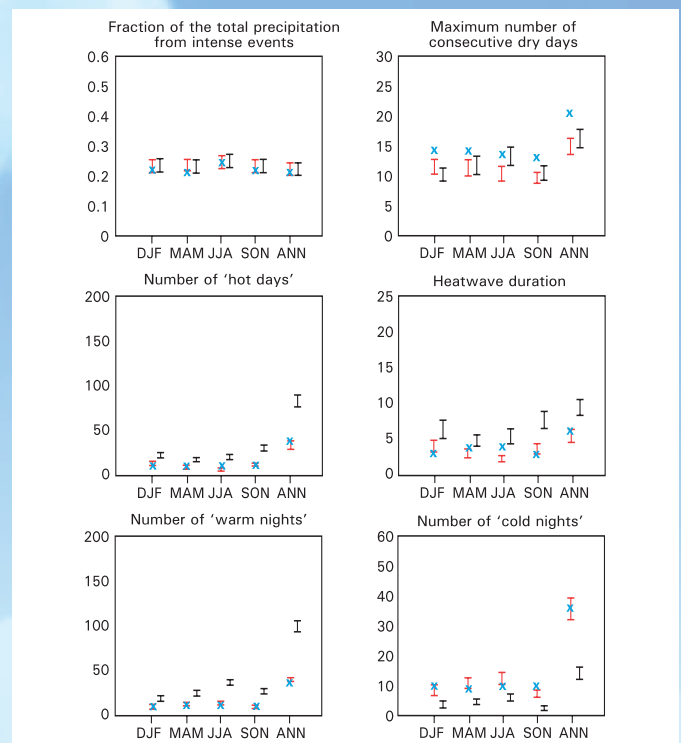
The weather generator developed by the University of East Anglia has been used to construct daily time series scenarios for eight variables (related to temperature, rainfall, sunshine, wind and moisture) and 10 case-study locations (including Manchester, Glasgow, Bradford and Birmingham). An hourly version of the weather generator, linked to RainClim, will also be produced. The RainClim package is available for download by BKCC users.



Screenshot of the RainClim Version 1 user interface.

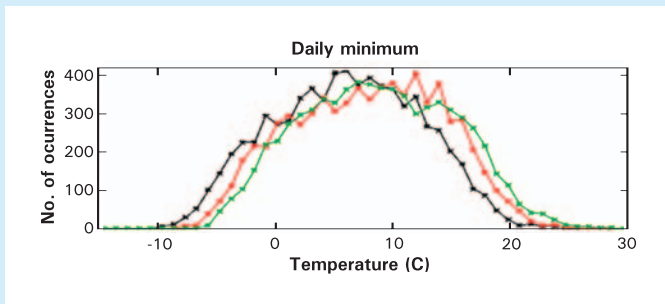
The Hadley Centre for Climate Change Research has, for the first time, implemented a parameterisation of urban land surfaces and anthropogenic heat sources in the land-surface scheme of the Hadley Centre Atmospheric General Circulation Model.

The following diagrams illustrate simulated rainfall and temperature extremes (I) and the impact of doubled CO<sub>2</sub> climate change and urban heat release (II).



(I) Rainfall and temperature extremes simulated by the Climatic Research Unit (CRU) daily weather generator for Manchester Ringway, for winter (DJF), spring (MAM), summer (JJA), autumn (SON), and the year (ANN).

The close agreement between blue (observed) and red (modelled) values indicates that the weather generator successfully reproduces present-day extremes (with the exception of the maximum number of consecutive dry days which are underestimated). Differences between red (modelled, present day) and black (modelled, 2041-2070 for the UKCIP02 Medium High Emissions scenario) values indicate future changes. The clearest changes are for longer dry periods in summer, more frequent hot days and warm nights, longer heatwaves and fewer cold nights.



(II) Illustration of the relative impact of doubled- $\text{CO}_2$  climate change and urban heat release.

The lines show the distributions of night-time minimum temperatures over urban land in SE England over twenty years in three global climate model simulations – each line shows the numbers of nights with temperatures falling to each 1-degree band. The black line shows the simulation with present-day  $\text{CO}_2$  and heat release, the red line shows the simulation with doubled  $\text{CO}_2$  but still present-day heat release, and the green line shows the simulation with doubled  $\text{CO}_2$  and tripled heat release. The further the lines are to the right, the warmer the temperatures. Doubling  $\text{CO}_2$  exerts the most important effect on temperature distributions, but tripling the heat release is also significant.

## Potential Applications

BETWIXT acts as a service to the other projects in the BKCC programme, and is developing best practice in the application of high resolution climate change scenarios in impacts studies. The BETWIXT work plan was drawn up in close consultation with BKCC participants, with two workshops providing further opportunity for consultation and feedback.

The BETWIXT scenario data are being used as input to a number of the impacts models developed within other BKCC projects and are also publicly available for more general use by other users. The AUDACIOUS project, for example, is using RainClim output in their urban drainage models. In addition, scenario data from the CRU daily weather generator forms an important input into ASCCUE's risk assessment work for Greater Manchester.

Outside of BKCC, the scenario data have been used to investigate the impacts of climate change on health and on London's transport systems. The urban heat island work has been presented at a meeting convened by UKCIP and hosted by the Greater London Authority on climate change and the urban heat island.

## Sharing the Outcomes

The BETWIXT work is described in a series of technical briefing notes which are suitable for a broad audience, including stakeholders as well as academic users. These notes are available from the project web site, together with other information and data resources for BKCC participants and others.

See website for up-to-date details:  
[www.cru.uea.ac.uk/cru/projects/betwixt/](http://www.cru.uea.ac.uk/cru/projects/betwixt/)

Anticipated project completion date:  
 March 2006

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