Constructing weather scenarios: an overview of issues/methods and the UKCIP02 scenarios

The rationale and starting point for BETWIXT
Predicting the future using climate/weather scenarios

A climate/weather scenario is: ‘a coherent, internally consistent and plausible description of a possible future state of the world’

Constructed using output from general circulation models (GCMs) and regional climate models (RCMs)
A modelling system for detailed regional scenarios

- Coupled GCM (300km atmosphere)
  - SST/sea-ice change from coupled GCM
  - 150km global atmospheric GCM
  - Improved circulation from 150km atmospheric GCM
  - 50km regional climate model (RCM) for any region
The Hadley Centre Global Climate Model (HadCM3)
Hadley Centre Regional Climate Model (HadRM3)

50 km grid
Carbon dioxide concentrations: IPCC scenarios
The UKCIP02 downscaling/scaling strategy
Mean precipitation change

2020s

2050s

2080s

Summer

Low Emissions

High Emissions

per cent

30
25
20
15
10
0
-10
-20
-30
-40
-50
Key disadvantages for BKCC (1)

- HadAM3/HadRM3 run for 1961-1990 & 2071-2100 only
- so no time-series output for intermediate periods
Key disadvantages for BKCC (2)

- HadRM3H output is only available at the daily timescale, not sub-daily
- Scenarios gateway: Monthly time series T and P only
Key disadvantages for BKCC (3)

- Spatial resolution of 50 km x 50 km
- Grid square rather than point/station information
- This is a particular problem for rainfall/wind speed
Variability and spatial scale

- Variability of a precipitation time series is different depending on the spatial scale it represents.
- Characteristics change as we average more stations from a larger area.

- A “true” grid-box mean from an infinite number of stations within that box.
- Number of stations needed to estimate the variability of the “true” mean series depends on the box size and the relationships between stations within the box.

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Key disadvantages for BKCC (4)

- Some features of present-day climate are poorly represented, particularly with respect to extremes, even if we do a ‘fair’ comparison
Relative difference (%) in return period magnitudes between HadRM3H and scaled UKMO data (1960-1990)

(a) 1-day event and 10-yr return period (RP),
(b) 1-day event and 50-yr RP,
(c) 10-day event and 10-yr RP
(d) 10-day event and 50-yr RP

From Fowler et al., 2004. New estimates of future change in extreme rainfall across the UK using regional climate model integrations. 1. Assessment of control climate. J. Hydrol. (Accepted)
BETWIXT aims to overcome these disadvantages, whilst maintaining consistency with UKCIP02

- By using ‘change factors’ calculated from the same HadRM3H simulations as used to produce the UKCIP02 spatial patterns
- By using UKCIP02 multiplying factors
The BETWIXT scenarios

- Consistent with UKCIP02
- Low, medium-low, medium-high, high
- 2020s, 2050s, 2080s (and present-day)
- Daily/hourly/sub-hourly time series
- Observed data and scenario data will be provided in same format
The cascade or explosion of uncertainty

- uncertainties in emissions
- different model responses
- internal model variability
- natural climate variability
Global temperature (2000 - 2100)
The cascade or explosion of uncertainty is not fully addressed by UKCIP02 or BETWIXT scenarios....

- Discussed in technical briefing notes
- Handling uncertainties in the UKCIP02 scenarios of climate change: Jenkins & Lowe, 2003
- CRANIUM