New scenarios of UK Climate Change (UKCIPnext)

Geoff Jenkins, Hadley Centre, Met Office, Exeter
2005 heading to be second warmest on record
(to end August)

Global Average Near-Surface Temperatures 1861–2004

Temperature Difference (°C) with respect to the end of the 19th Century

Source: Hadley Centre
A recent paper in Nature from the Hadley Centre estimates with a high probability that half the risk of the 2003 European summer heatwave can be assigned to man's activities.

Source: Peter Stott, Hadley Centre
European 2003 summer temperatures could be normal by 2040s, cool by 2060s

Temperature change, °C

- observations
- Medium-High emissions

Source: Peter Stott, Hadley Centre
Change in UK precipitation by the 2080s
Medium – High emissions scenario

winter

summer

UKCIP02

Hadley Centre for Climate Prediction and Research
Probability of winter daily rainfall exceedence

Hadley Centre for Climate Prediction and Research
N Sea storm surges could be a metre higher by the 2080s, Medium-High emissions; with a 30cm SLR.
Uncertainties in predictions arise from:

- Emissions uncertainty
- Natural variability
- Modelling uncertainty

Hadley Centre Technical Note 44:
"Handling uncertainties in the UKCIP02 scenarios of climate change",
Geoff Jenkins & Jason Lowe, November 2003

www.metoffice.gov.uk/research/hadleycentre/pubs/HCTN/HCTN_44.pdf
Emissions to 2000, and IPCC projections to 2001

High (SRES A1FI)  Medium-High (A2)  Medium-Low (B2)  Low (SRES B1)

Problem: we do not know the relative likelihood of each emission scenario

Source: CDIAC and IPCC
Land global warming over next 40 years does not depend on emissions scenario

Annual-mean temperature rise, deg C

- High emissions
- Medium-high
- Medium-low
- Low emissions

Source: Hadley Centre
Handling emissions uncertainty in UKCIP02

% CHANGE IN WINTER PRECIPITATION by 2080s under four future emissions scenarios

No difference for 2020s; small for 2050s.

No indication of relative likelihood
This graph shows one possible outcome; there is no predictability for individual years (beyond 5-10 years)
The effect of natural variability on predictions
Change in summer rainfall by 2080s from 3 model runs, Medium-High Emissions

#1 Central England -45%
#3 Central England -55%
#2 Central England -35%
Modelling uncertainties in UKCIP02

% CHANGE IN SUMMER PRECIPITATION

2080s, A2
Modelling uncertainties – IPCC 4AR

Problem: we do not know the relative likelihood of each prediction

Hadley Centre for Climate Prediction and Research
Regional sea level rise
due to thermal expansion and ocean circulation changes only

Source: IPCC

Hadley Centre for Climate Prediction and Research
Planning for highest predictions could waste money
Planning for lowest predictions could jeopardize infrastructure adequacy, with greater costs
Uncertainty allows planners to procrastinate or ignore the problem
Model uncertainty is largest: deterministic predictions no longer justifiable.
Moving from uncertainty to probability

current predictions

future predictions

2080s SW England summer rainfall

Hadley Centre for Climate Prediction and Research
Probabilistic climate predictions

X MODEL VARIANTS

- ATMOSPHERE + CLOUDS
- LAND AND VEGETATION
- CARBON CYCLE
- OCEANS
- ETC.

2050s SW England summer rainfall

Probability

Hadley Centre for Climate Prediction and Research
Change in summer rainfall: 128-member ensemble
July daily maximum temperatures
SE England
(53 member ensemble)

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Hadley Centre for Climate Prediction and Research
Probability of change in England & Wales rainfall

Hadley Centre for Climate Prediction and Research
\$ UR: Single scenario, high resolution, based on several climate models, not just Hadley.

\$ Single deterministic scenarios no longer justifiable; probabilistic predictions are the key.

\$ Probabilistic predictions available only from Hadley Centre model in near future; main problem is combining these with single predictions from other models.

\$ This has implications for daily data, areal averages, etc.

\$ Big "physics ensembles" for probabilistic predictions need huge computing capacity.

\$ This limits resolution to 50km; x2 resolution = x8 computing power.
Next steps

$ Probability predictions, derived from Hadley and other climate models, well underway

$ Defra setting up Steering Group for scenarios.

$ We want to work with high-end users to optimise the way the scenarios are used.

$ Eg: relationships between degree of protection and cost, to convolve with probability curves.

$ Suggestions for case studies very welcome.

$ UKCIPnext launch target: Spring 2008
Emissions uncertainty will be covered, in a manner tbd.

Natural variability uncertainty will be covered.

Model uncertainty will be covered by a combination of Hadley Centre ensembles and other centres' models.

Deterministic predictions are no longer defensible; probabilistic predictions are the key to handling uncertainty.

Available computing power limits the resolution to 50km.

Work with users to optimise application of scenarios.
Cooling from a Gulf Stream collapse: NOT a standard scenario

UK: 3-5°C cooling
Gulf Stream collapse not predicted

Circulation strength (Sv)

High emissions
Medium-High
Medium Low
Low Emissions