

# Limits to adaptation: implications of global temperature changes beyond 4°C for water supply in southern England.

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&beyond  
**4degrees**

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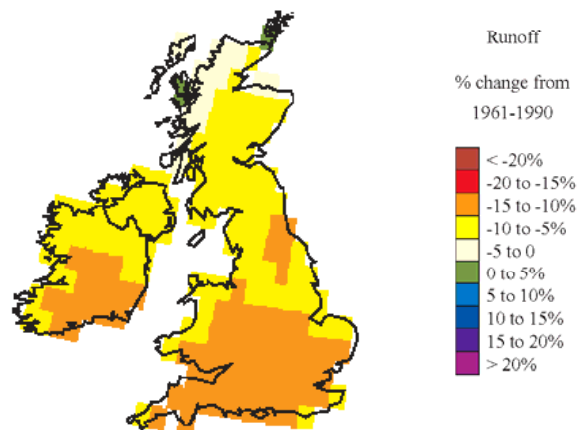
Implications of a global climate change of 4+ degrees  
for people, ecosystems and the earth-system

## Research questions

1. What are the impacts of the different global temperature changes on deployable output and supply-demand balance?
2. Are the new plans robust to these temperature changes?
3. If not, what can be done to ensure future supplies?

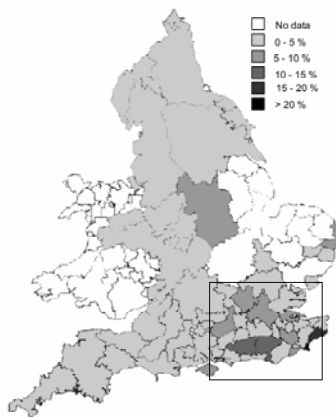
- Climate change and water resources
- Current estimates of climate change impact
- Rescaling methodology
- Impacts on the supply-demand balance
- Implications for planning and adaptation

Change in summer runoff, UKCIP02 medium-high scenario, 2020s

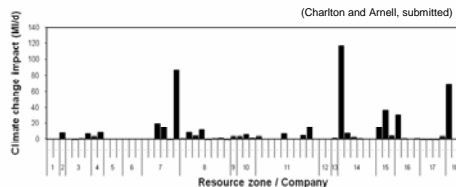


# Climate change and water resources

## Change in resource zone deployable output from the draft Water Resource Management Plans



(Charlton and Amell, submitted)



(adapted from SEW plan)

Climate change impact is 0 - 10% of DO across nine resource zones

# Rescaling climate change impacts

## 1. Emissions / Forcings – based approaches

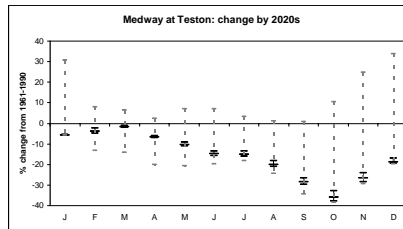


UKCIP02 Medium High scenario: 2020s = 0.88°C / 2080s = 3.29°C



Water resources planning guideline

Chapter 8 and supplementary guidance



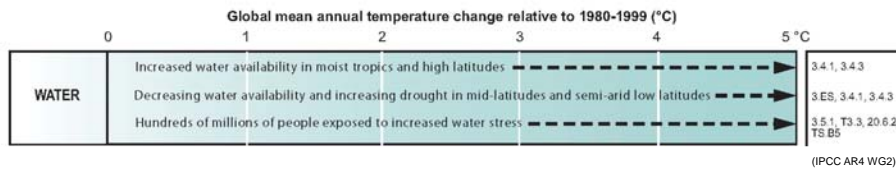
(Amell and Charlton, 2009)

- Reductions throughout year
- Seasonal variation
- Uncertainty – input climate projections
- Impacts of specific forcing?

## Rescaling climate change impacts

### 1. Emissions / Forcings – based approaches

What are the impacts of a specific climate forcing?

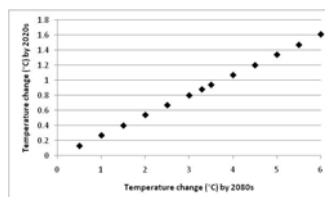


- Rescale pattern of climate change produced by one model to different rates of global temperature increase.
- Use this rescaled pattern in the impacts model.
- Rescale directly on the deployable output climate change impact.

## Rescaling climate change impacts

### 2. Rescaling methodology

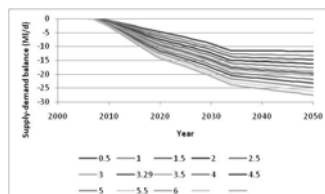
- Select catchment and resource zones.
- Extract supply-demand balance data and calculate climate change impact.
- Select target global temperature change values for the 2080s:  
0.5, 1, 1.5, 2, 2.5, 3, 3.29, 3.5, 4, 4.5, 5, 5.5, 6°C
- Rescale the 2080s temperature values to produce values for the 2020s (ratio of MH 2080s and 2020s values):



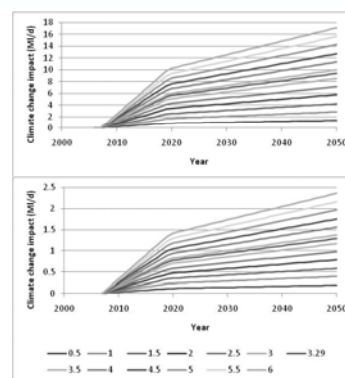
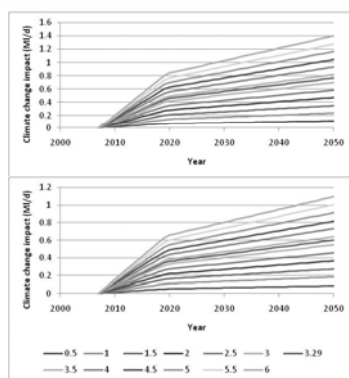
# Rescaling climate change impacts

## 2. Rescaling methodology

- e. Calculate the ratio of the 2020s temperature change values to the 2020s UKCIP02 MH scenario temperature.
- f. Rescale the current water company estimate for the climate change impact (CCI) in 2025/26 for each alternative 2025/26 temperature change value.
- g. Use these CCI values to recreate CCI profiles for each year to 2050/51 using the EA guidelines.
- h. Recalculate the SDB for each temperature increment and each resource zone (RZ) using the new CCI profiles:



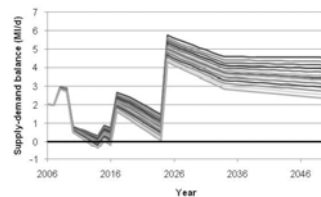
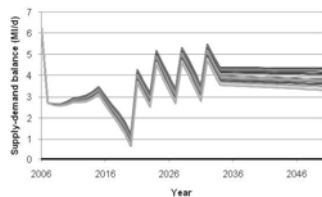
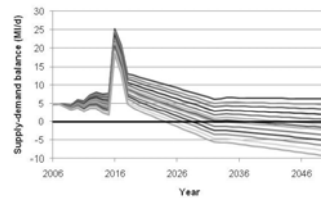
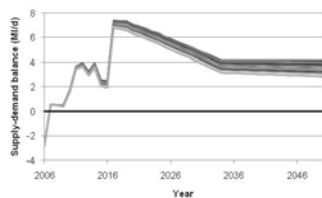
# Climate change impacts and T change



- CCI increases with each T increase.
- Final impact values diverge.

- 78% of CCI occurs in one zone.
- Up to ~8-10 MI/d water needed compared with the MH scenario.

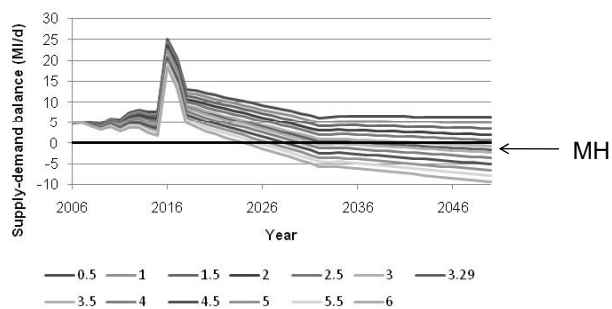
## Impact on the final planning SDB



- SDB decreases
- Impact timing is brought forward
- All RZs except one are in surplus

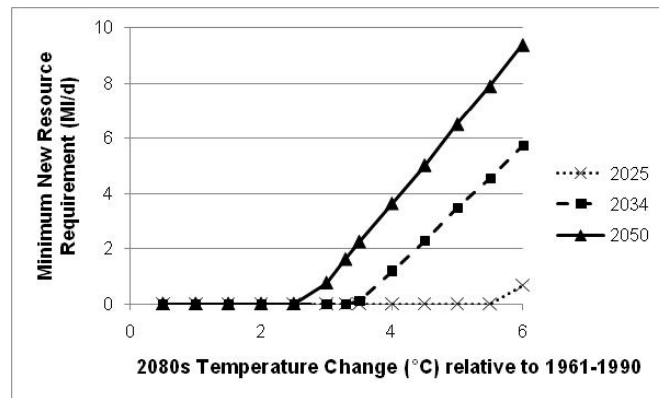
- Plans are generally robust
- Gains from planning options can be seen clearly

## Deficits and uncertainty



- SDB deficit (plan fails):  
3°C – 2044    3.29°C – 2038    3.5°C – 2032    4°C – 2031
- With each 0.5°C increase failure occurs 1-2 years earlier
- Ignores uncertainty (constant); greater headroom.

## Minimum new resource requirement



- Up to 9.4 MI/d more water needs to be found:  
~10 % of DO or ~12 % of demand
- Potential for supply failures if no further steps are taken

## Adaptation – preferred water strategy

### Supply side

- New winter storage reservoir in East Sussex
- New winter storage reservoir in Kent
- Improving eight existing underground water sources
- Developing five new underground water sources
- Building two new strategic pipelines

### Demand side

- Metering 90% of customers by 2020
- Reducing leakage
- Adopting customer supply pipes



## Adaptation options

### Supply side

#### Preferred: 24.6 MI/d

Balcombe Rehabilitation  
Cowbeech New Biological treatment work  
Increase Licence Rate at Eridge  
Increase DO at Crowhurst Bridge  
Clay Hill Reservoir  
SEW Transfer, Bewl to Best Beech: RZ7 to RZ2

#### Additional options from feasible list: 86.0 MI/d

Effluent Re-use Newhaven to River Ouse  
Effluent Re-use Newhaven to Barcombe Reservoir  
Withyham Reservoir  
Bevern Stream Reservoir  
Broyle Reservoir  
Laughton Reservoir  
Honor Oak to Whitely Hill; SR TR-03 a  
Surrey Hills to Whitely Hill; SR TR-02 a

### Demand side

#### Preferred: 1.6 MI/d

Universal metering  
Leakage reductions included in baseline  
Leakage Reduction - find and fix by zone C1: RZ2  
Leakage Reduction - pressure management by zone: RZ2

#### Additional options from feasible list: 1.9 MI/d

Water Audit Pack  
Water Audit Pack - 11,200 metered  
Trigger Gun vouchers - 5,600  
Leakage Reduction - find and fix by zone C2: RZ2

## Adaptation options

### Generic barriers

*apply to the adaptation challenge*

- is the need for adaptation recognised?
- can the need for adaptation be defined?
- can potential adaptation options be identified?
- can adaptation options be evaluated?
- can an option be selected?

### Specific barriers

*apply to individual options*

- are there physical limitations on the performance of the option?
- are there financial constraints on the adoption of the option?
- are there socio-political constraints on its adoption?
- are there institutional factors within the organisation or its regulatory / market context that constrain the adoption of the option?

(Arnell and Charlton, 2009)

## Summary

- Estimates of climate change impacts could be much greater than currently accounted for if temperature increases beyond 4°C.
- Most of the resource zone plans assessed are robust to future changes, one is not.
- Earlier intervention is necessary.
- Previously rejected water management options will have to be reconsidered.
- These estimates are preliminary and conservative, particularly lacking a consideration of increased climate uncertainty.

Thank you

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