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Climate Change and the Built Environment

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BRE Scotland



Buildings and Climate Risks

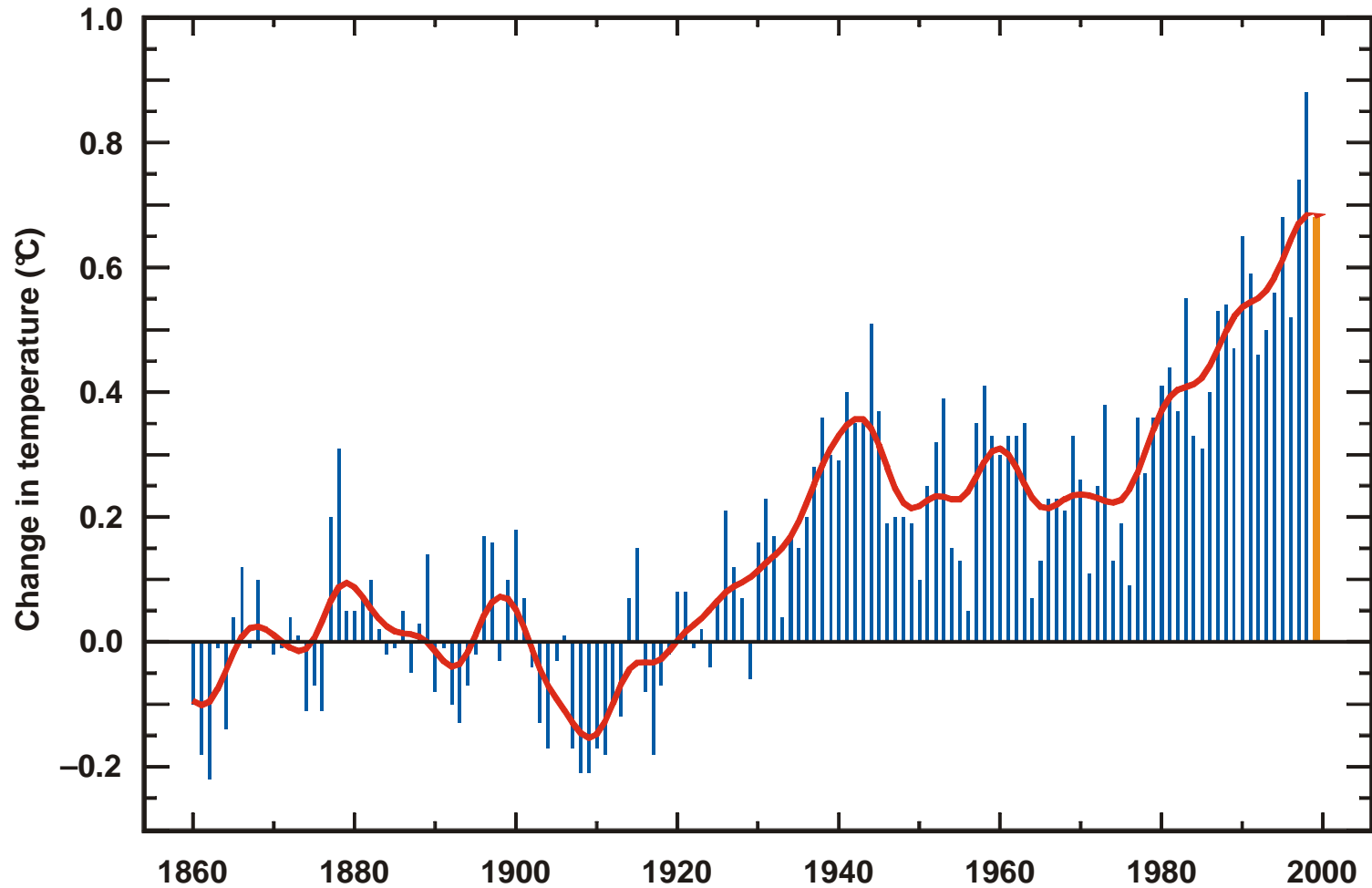
- The climate is changing
- Extreme events are becoming more common
- We can reduce but not eliminate the changes
- The lifetime of buildings is comparable to timescales of climate change

- **The ways in which the climate is changing**
- **How this will impact on buildings**
- **How buildings might be adapted to deal with this**

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OBSERVATIONS OF GLOBAL TEMPERATURE

Annual averages plus long-term trends, to July 1999



The Met Office Hadley Centre

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UKCIP02 Scenarios



DEFRA
Department for
Environment,
Food & Rural Affairs

Tyndall°Centre
for Climate Change Research



Hadley Centre

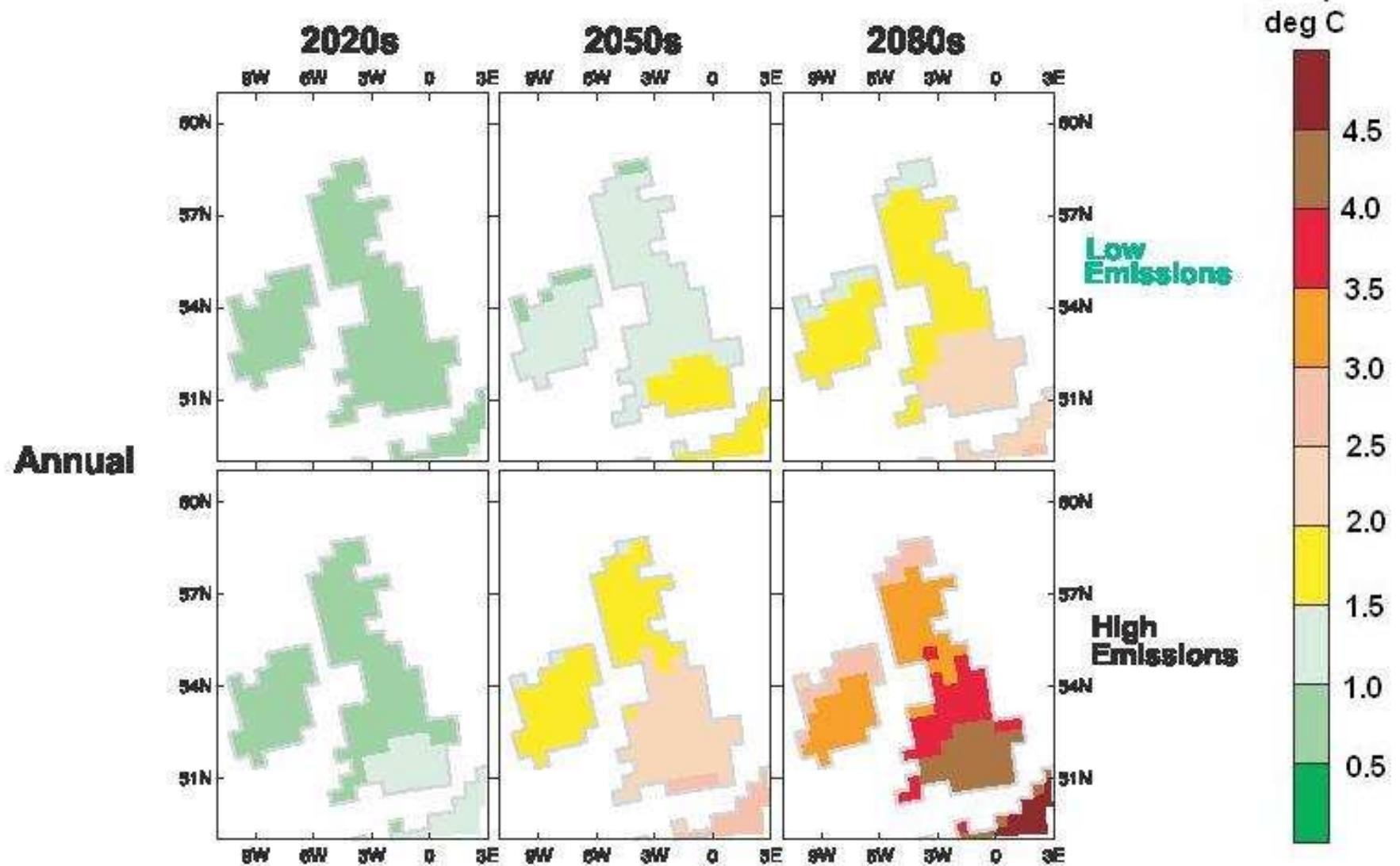
Climate Change Scenarios
for the United Kingdom

The UKCIP02 Briefing Report
April 2002

- **Launched April 2002**
- **Combine socio-economic, climatological and modelling assumptions**
- **Three time frames : 2020s, 2050s and 2080s**
- **Four scenarios :**
Low, Medium low, Medium high and High

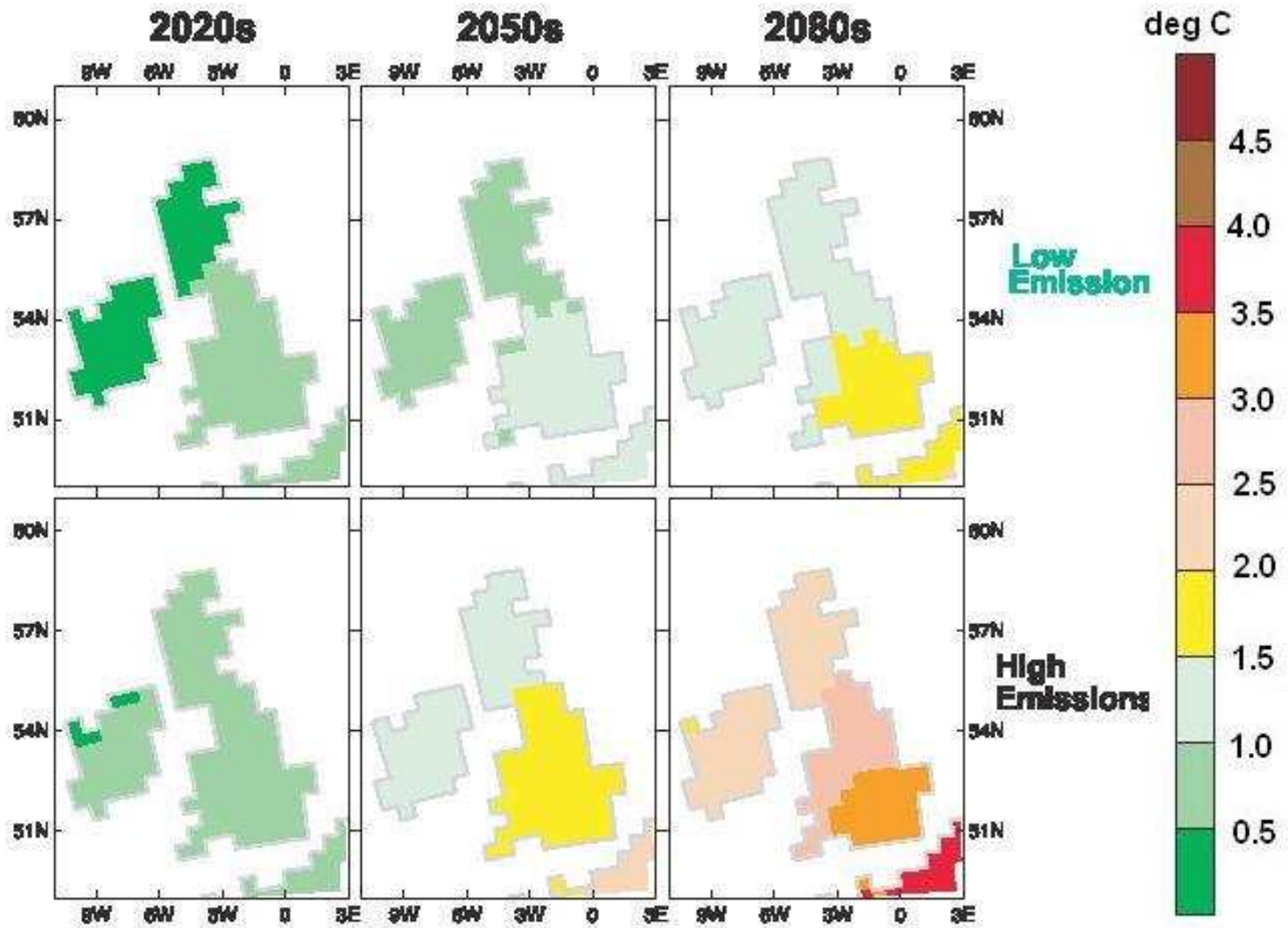
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UKCIP02- Annual temperature



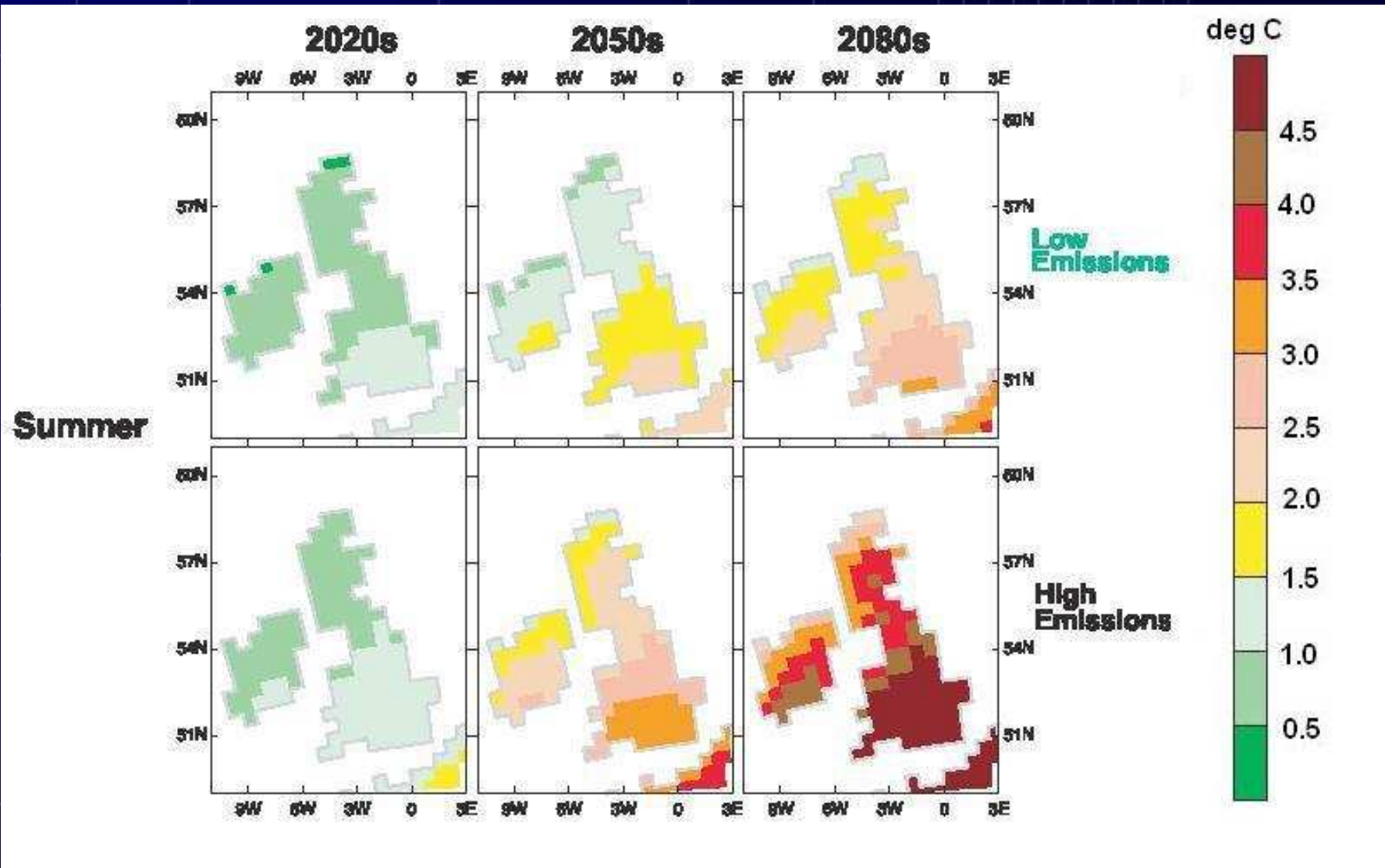
UKCIP02 - Winter temperature

Winter



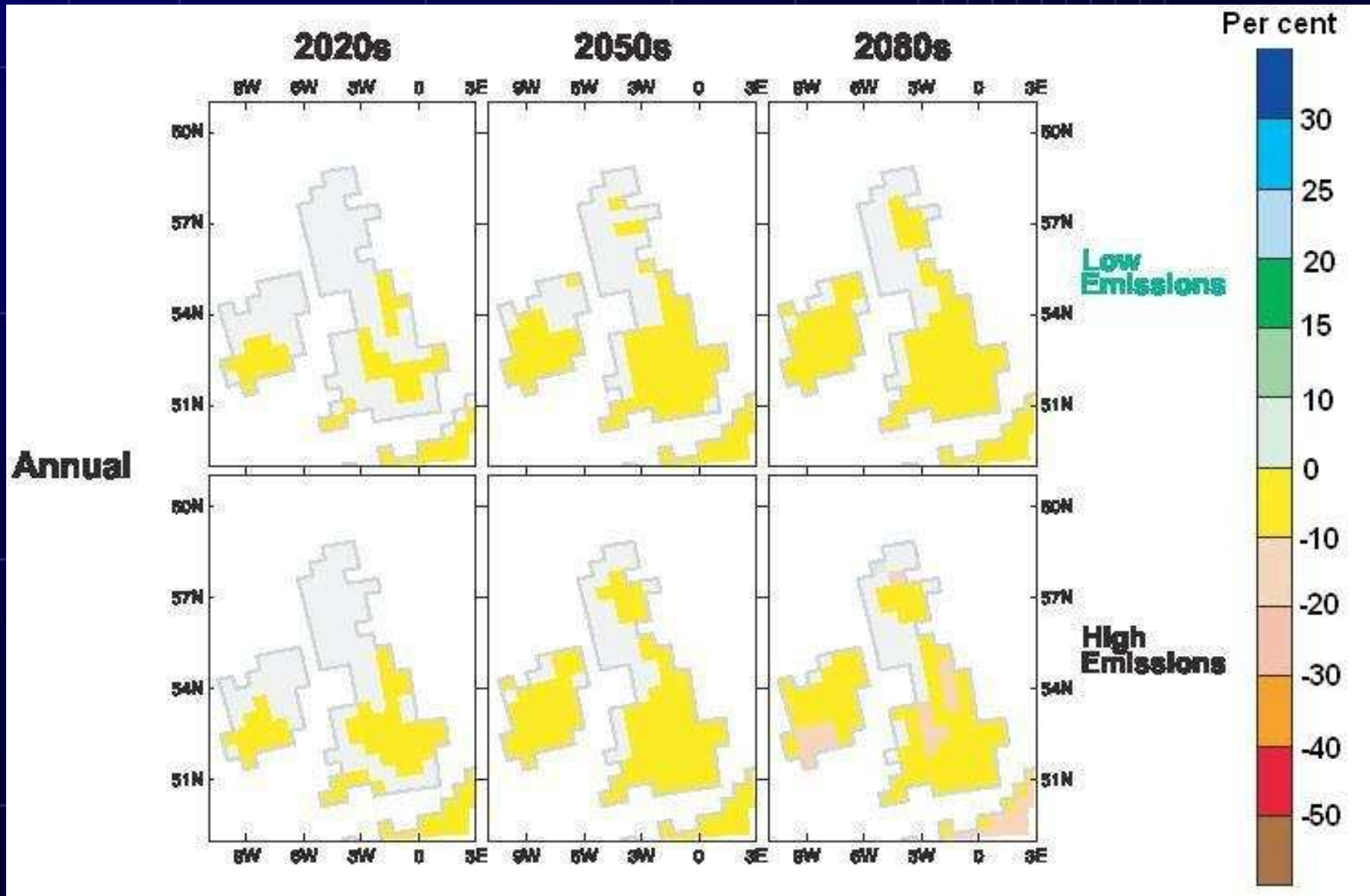
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UKCIP02 - Summer temperature



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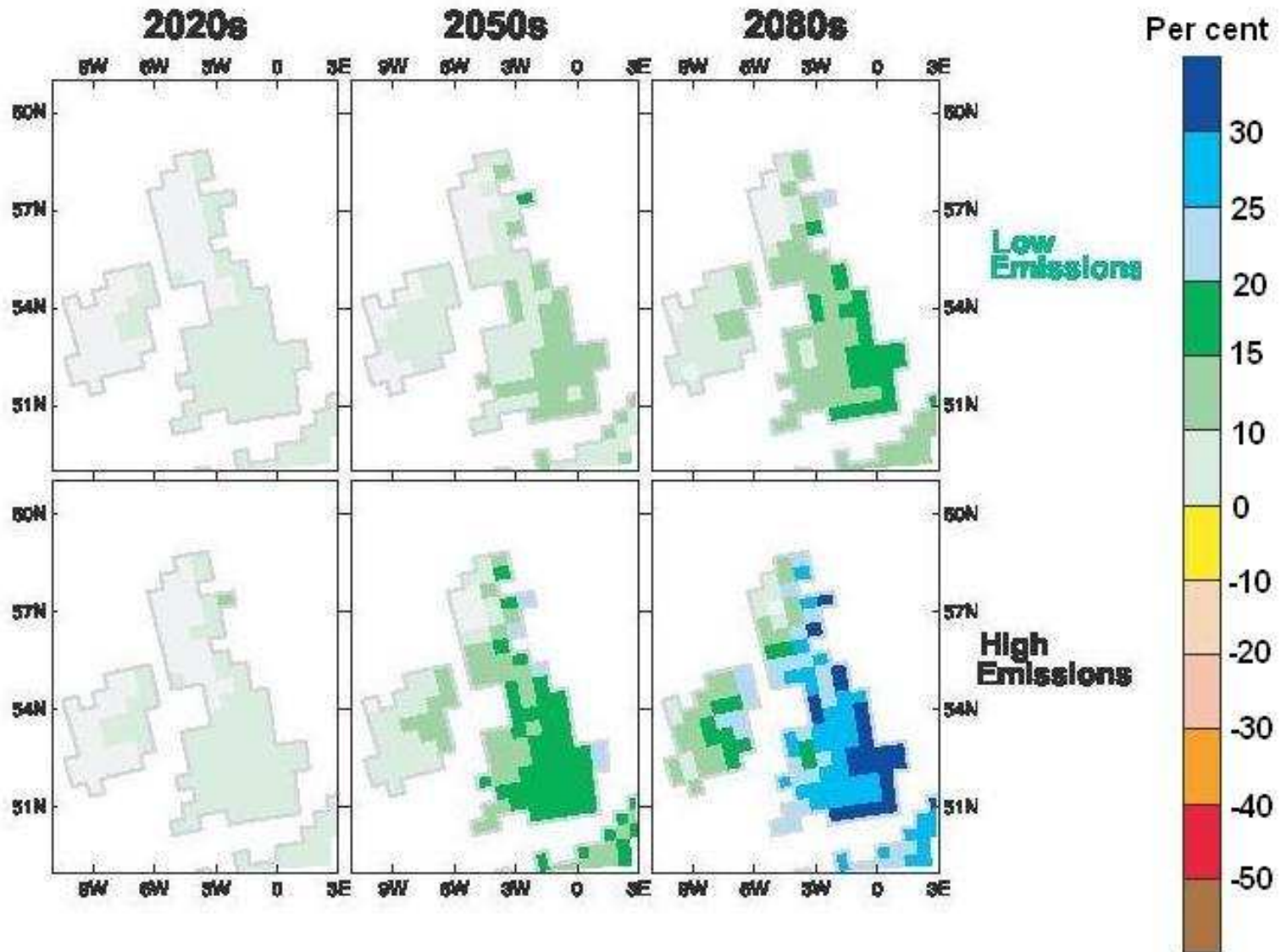
UKCIP02 - Annual Precipitation



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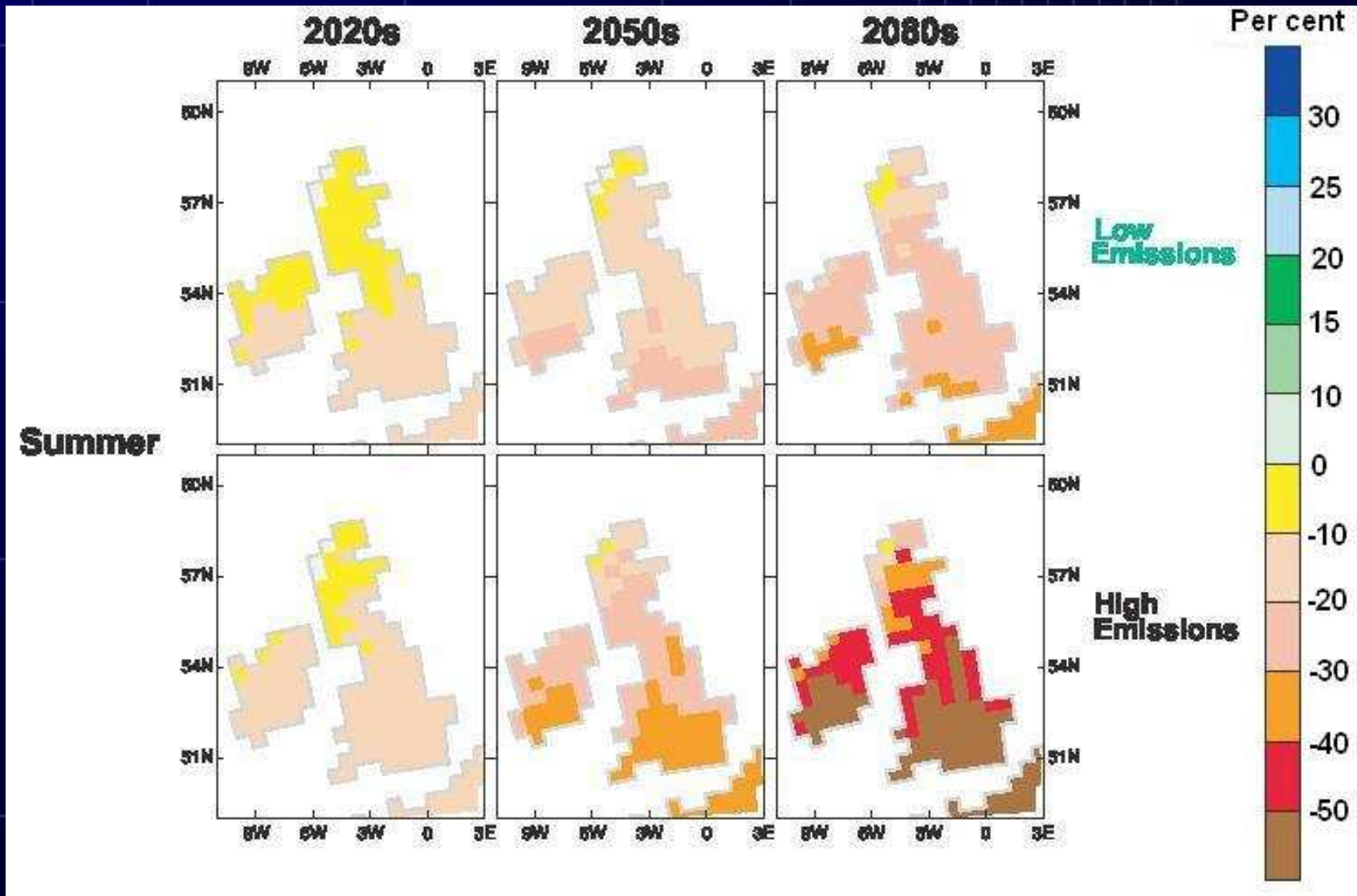
UKCIP02 - Winter precipitation

Winter



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UKCIP02 - Summer Precipitation



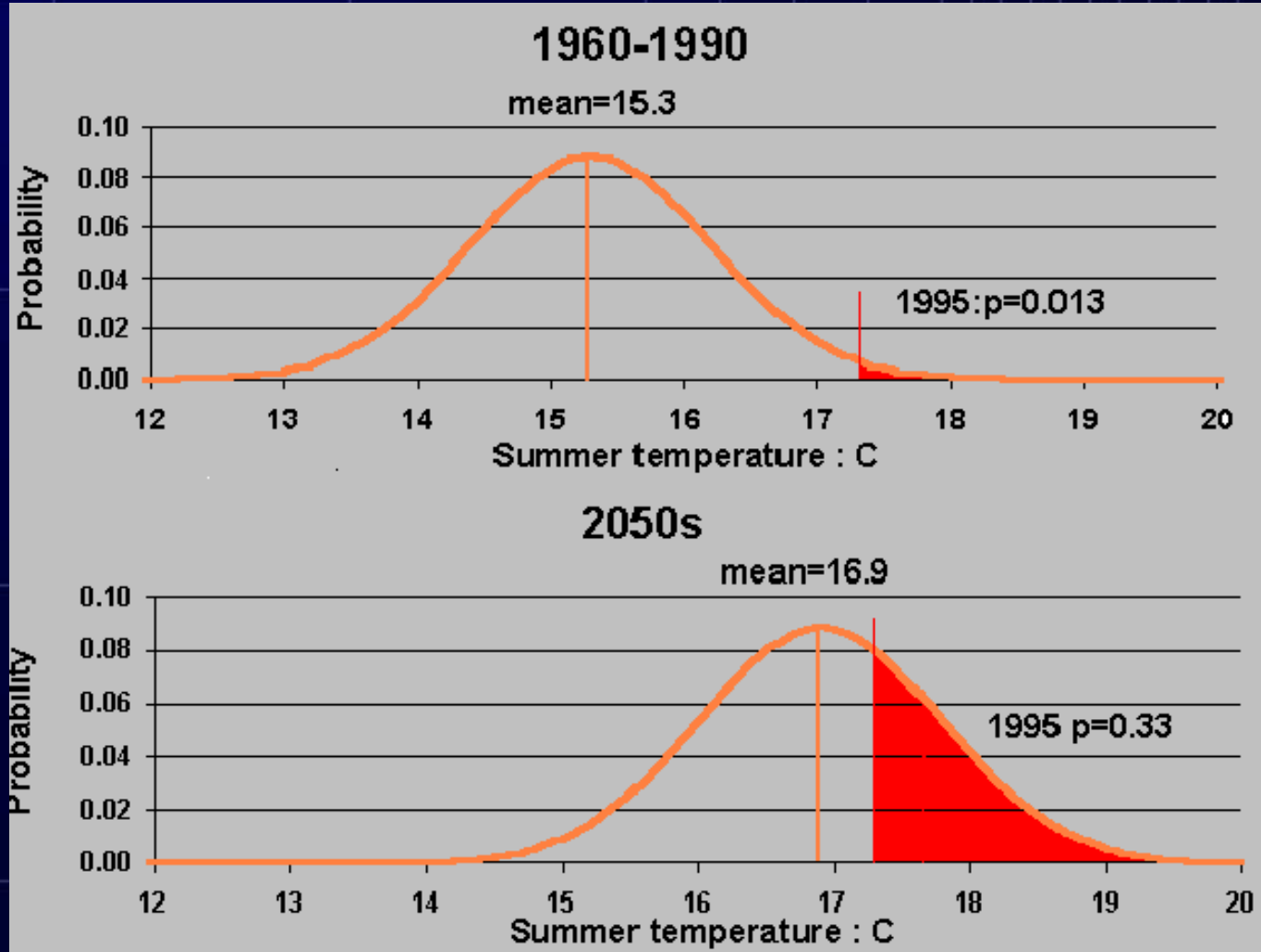
UKCIP02 - Summary of Changes

www.ukcip.org.uk

	Winter	Summer
Temperature	↑↑↑	↑↑↑
Precipitation	↑↑↑	↓↓↓ in S ↑↑ in N
Sea level	↑↑	↑↑
Vapour Pressure	↑↑	↑↑
Radiation	↓↓	↑↑ in S ↓↓ in N
Wind speed		↑↑
Severe Gales		↑↑
Potential Evapotranspiration	↑↑	↑↑ in S

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Small changes in means lead to big changes in occurrence of extremes



1 in 80

1 in 3

Predicted impacts - British Isles

- Warmer winters and summers
- Sea level rise
- Wetter winters, more intense rain
- Drier summers
- Possible higher wind speeds
- More extreme events (high temps & sea storm surges)

Winter temperatures

Rising winter temperature improves internal conditions in some houses.

Rise of 1, 2 or 3°C in January temperature reduces the death rate from hypothermia by 2%, 3.5% and 5% respectively

Fall in energy use for heating by the 2080s:

Low Scenario 8%

High Scenario 20%

Summer temperatures

Very hot years more common

⇒ Small rise in health problems - rise of 1, 2 or 3°C in August leads to rise in death rate from strokes etc. of 0.0, 0.1 and 0.4% respectively.

⇒ More discomfort ⇒ **air conditioning**

⇒ **Impact on energy use!**

Cooling buildings - shading



- Solar shading can be effected by:
 - ✓ External shading devices or building detail
 - ✓ Glazing
 - ✓ Trees
 - ✓ Buildings
- Reduce unwanted heat gain in summer
(Some methods allow heat gain in winter)

Cooling design

- Cooling Alternatives:
 - ✓ Natural ventilation
 - ✓ Night cooling
 - ✓ Mixed mode
 - ✓ Low-energy cooling



Reduce casual gains



- ✓ Use energy-efficient lighting
- ✓ Utilise lighting controls
- ✓ Judicious use of daylight
- ✓ Use office equipment with low energy standby settings

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Modify the environment



- ✓ Use light surfaces
- ✓ Add vegetation
- ✓ Add water



Milder and more humid winters



- Mould growth in housing
- Respiratory allergies
- Increased condensation
- Internal pollution
- Legionella risk

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Flooding

- More intense precipitation
- More common storm surges
- Rising sea levels



Will combine to make flooding of buildings
more common

Flooding

- ⇒ Damage to furnishing, decoration, internal plaster, partitions, flooring and electrical system.
- ⇒ Contamination from sewage, run off from surrounding land or salt water.
- ⇒ Structural collapse from undermining
- ⇒ **Makes buildings uninsurable**

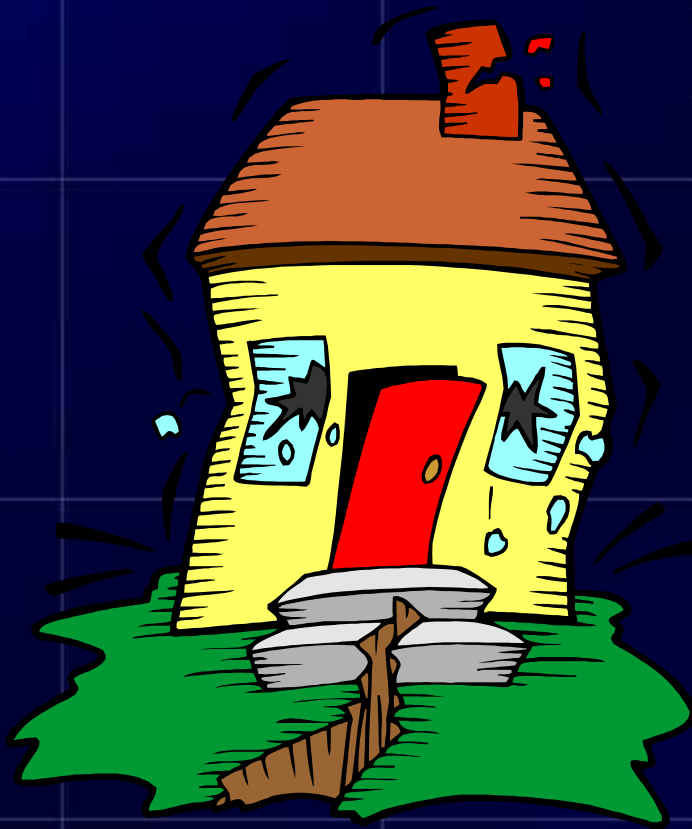
Flooding

- Avoid flooding by appropriate siting of buildings ⇒
planning issues : PPG25
- Protect buildings by embankments, design roads etc
so run of does not affect buildings
- Design buildings to minimise damage
- Choose materials which are resistant to water
damage
- Protect the electrical system
- **CIRIA Guidance**

Flooding guidance

- Design Guidance on Flood Damage to Dwellings
- HMSO Edinburgh 1996
- BRE Good Repair Guide 11:
Repairing Flood damage
 - Part 1 : Immediate action
 - Part 2 : Ground floors and basements
 - Part 3 : Foundations and walls
 - Part 4 : Services, secondary elements, finishes and fittings

Subsidence risk



- Dry summers, wet winters
- Claims could increase by 50-100%
- Increase of £200-400 million (UK)
- ✓ Dig 0.5m deeper foundations
- ✓ UK Cost £32 million

- Increased evapo-transpiration dries shrinkable clays
 - ⇒ Movement of foundations
 - ⇒ Cracking of walls
 - ⇒ Sticking of doors and windows
 - ⇒ Disruption of service pipes
 - ⇒ Collapse
 - ⇒ Alteration of terms of insurance policies?

BRE Subsidence

- In existing buildings
 - Underpin
 - Fell trees
- In new build
- Improve foundation design
- Minimise water demand from trees
 - oak, willow, eucalyptus high demand
 - beech, birch, mulberry low demand
- NHBC 'Building near trees' Standard 4.2

More frequent severe winds

- Structural damage
 - ⇒ Dislodged tiles
 - ⇒ (Flat) roofs removed
 - ⇒ Gables sucked out
 - ⇒ Falling trees and chimney stacks



Structural damage from wind

- Build to present standards!
- Increase design wind speeds in standards and codes
- Consider design to reduce aerodynamic loads
- Ensure regular maintenance
- Be aware of trees likely to cause damage

Wind Damage



- Average increase in wind speed of 6%
- One million more damaged homes per year
- UK Cost £1-2 billion
- ✓ Improve codes and roof aerodynamics
- ✓ Retrofit aerodynamic features or retro-strengthen existing roofs

Effects of driving rain



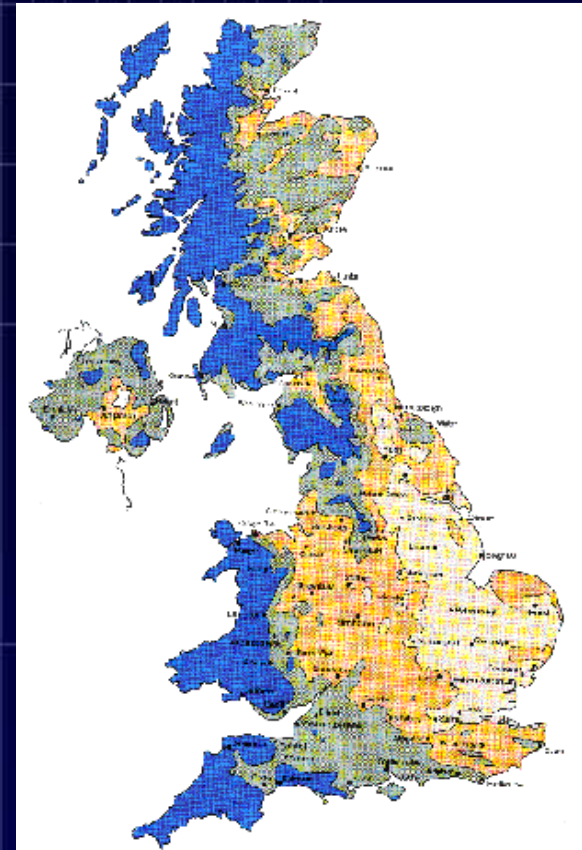
- Water ingress
- Full cavity fill insulation may not be suitable
- ✓ Render
- ✓ Change window details
- ✓ Increase eave overhang
- ✓ Improve maintenance and repair regimes

Increased driving rain

- More rain impact on buildings
 - ⇒ Wetter facades - Algal growth - Frost attack?
 - ⇒ Wetter insulation and structural timber?
 - ⇒ Rain penetration around openings, joints etc

Increased driving rain

- Existing buildings
 - Good maintenance
- New Building
 - Good Workmanship
 - Use existing practice for exposed areas
 - Modify the driving rain map



Rising ground temperatures

- Ground contaminants become more active
 - ⇒ More aggressive attack to foundations
 - ⇒ Radon and other landfill gasses penetrate buildings more easily

Construction process

- **Increased temperatures**
 - ⇒ Less days lost from snow and frost
 - ⇒ workers at more risk from heat and UV exposure
 - ⇒ Concrete curing more difficult in hot dry weather
 - ⇒ More UV damage to stored materials

Construction process

- **More wind and rain**
 - ⇒ Site flooding more common
 - ⇒ Site more hazardous and difficult to work on - especially scaffolding and tower cranes
 - ⇒ Wind damage to lightweight materials stored on site

Construction process

- Modularisation and prefabrication reduces impacts of site weather
- Provide shading and water supply for hot weather
- Protect sites from flooding
- Provide appropriate site storage for materials
- Recognise that working make have to be restricted in adverse weather

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Climate change report

**‘Potential Implications of Climate Change in
the Built Environment’**

Hilary M Graves and Mark C Phillipson

FBE Report 2

Climate change and buildings

- Most existing construction, and practically all new construction will still be in use at the end of the century.
- We are therefore addressing a current issue and not a future one.