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# Climate Change and the Built Environment

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# 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

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- 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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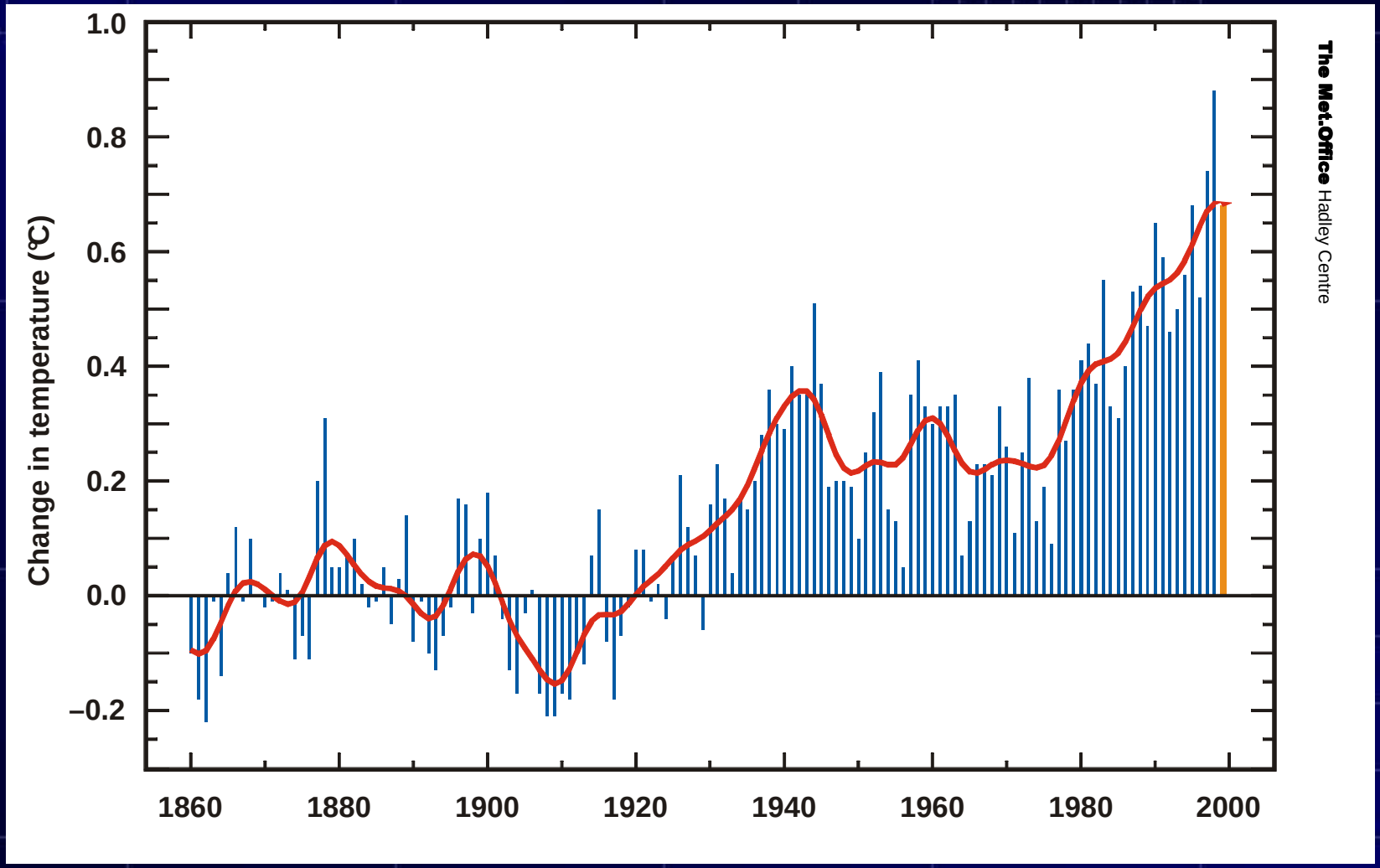
# OBSERVATIONS OF GLOBAL TEMPERATURE

## Annual averages plus long-term trends, to July 1999



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# UKCIP02 Scenarios


- **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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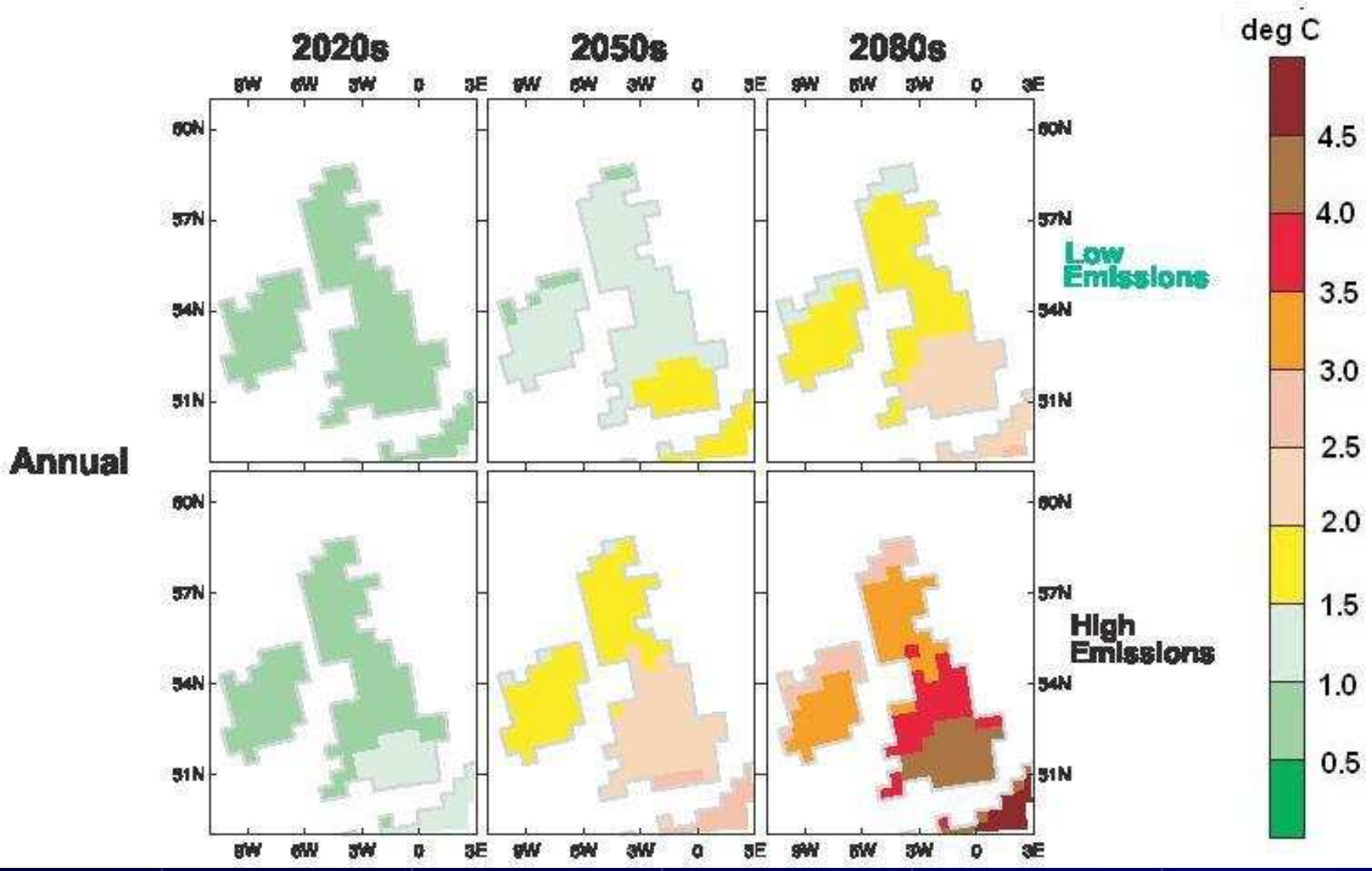
# UKCIP02- Annual temperature



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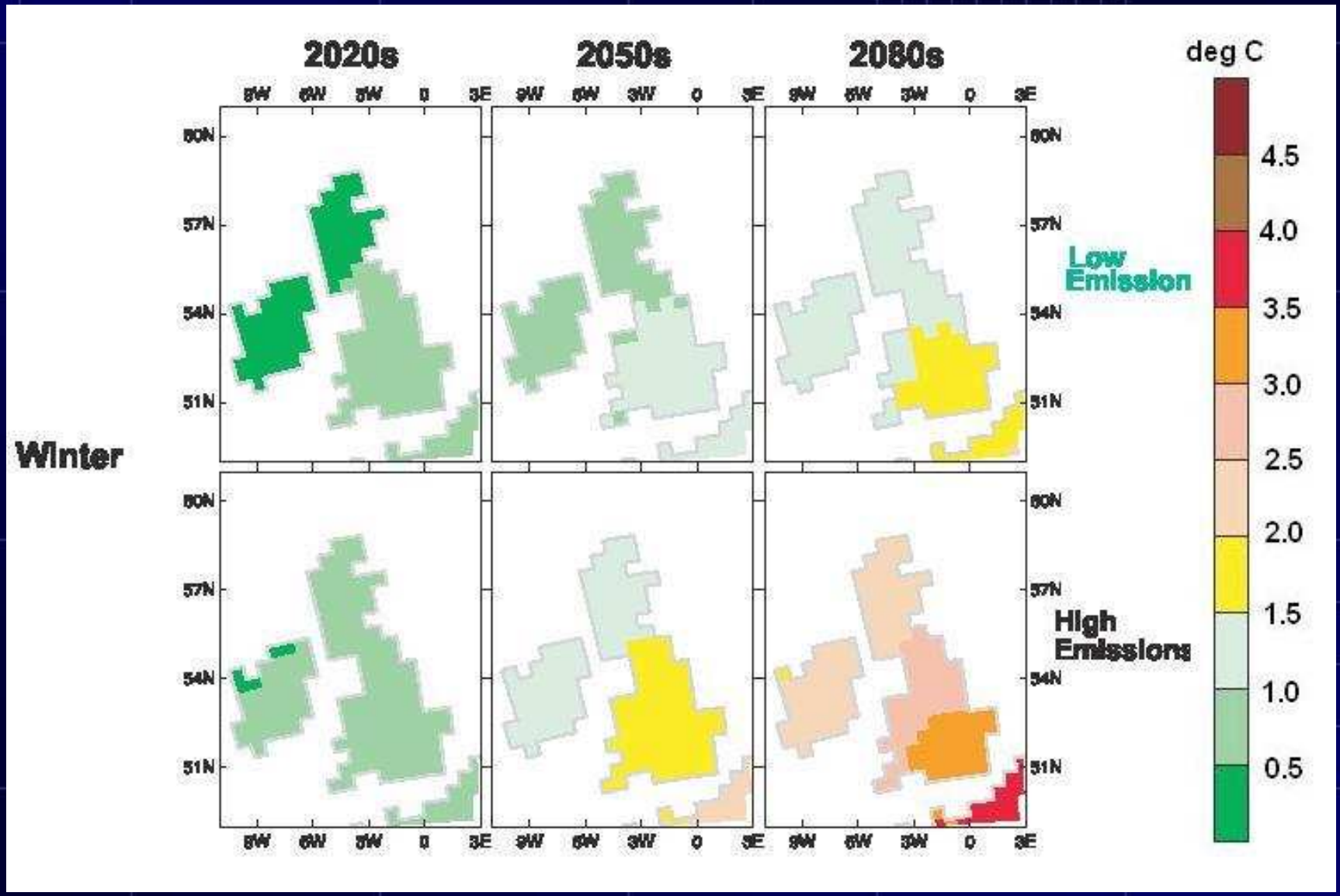
# UKCIP02 - Winter temperature



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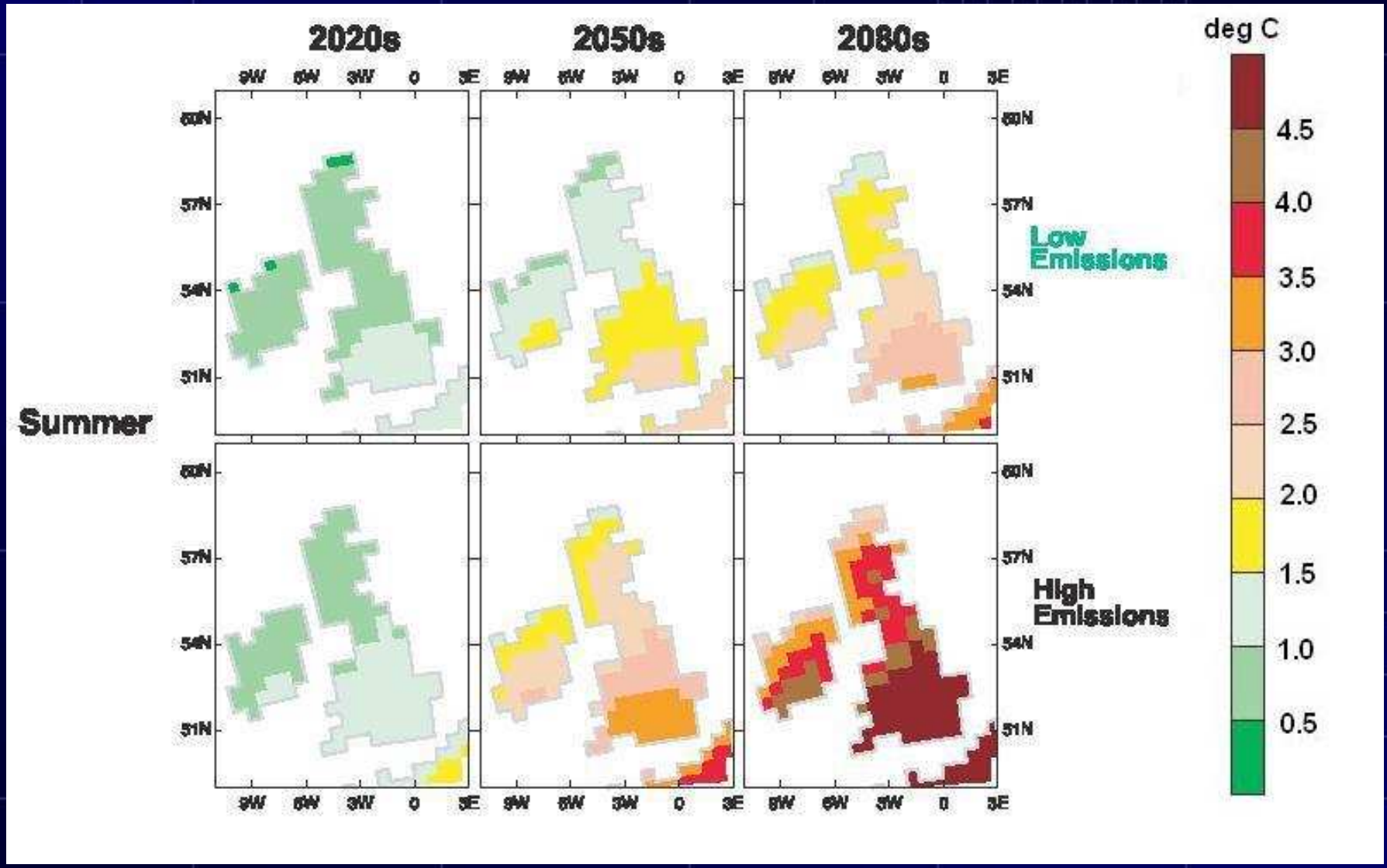
# UKCIP02 - Summer temperature



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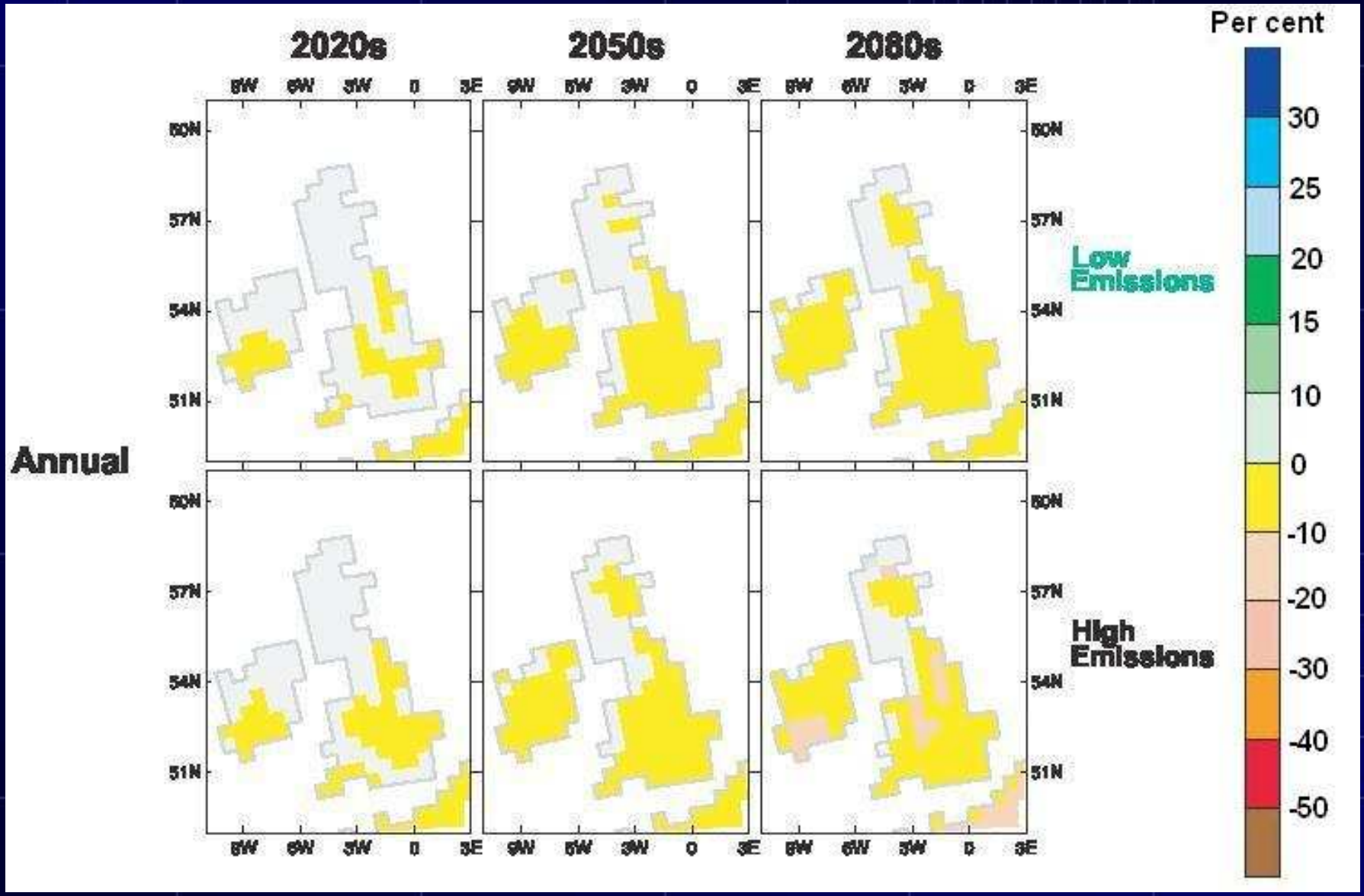
# UKCIP02 - Annual Precipitation



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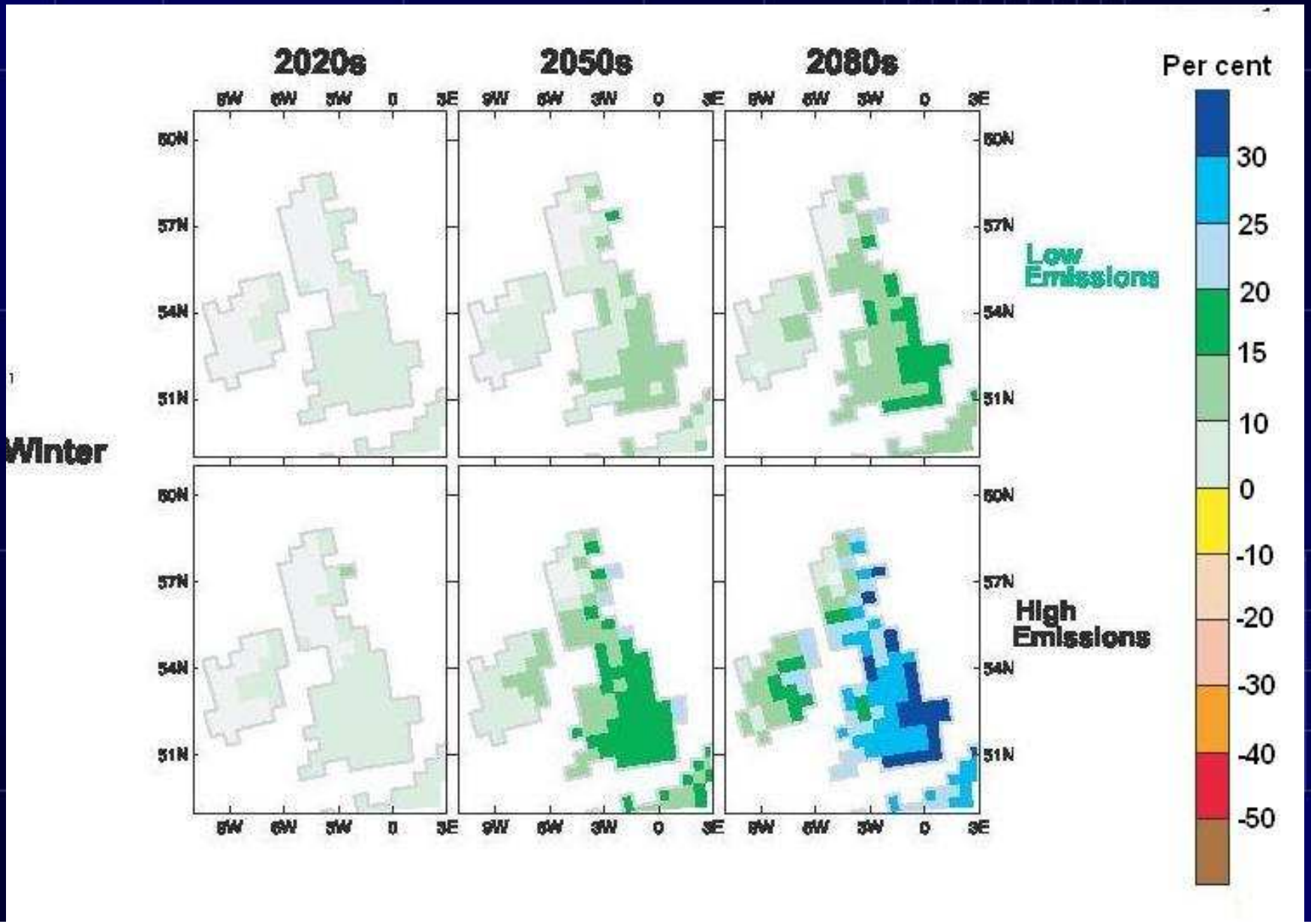
# UKCIP02 - Winter precipitation



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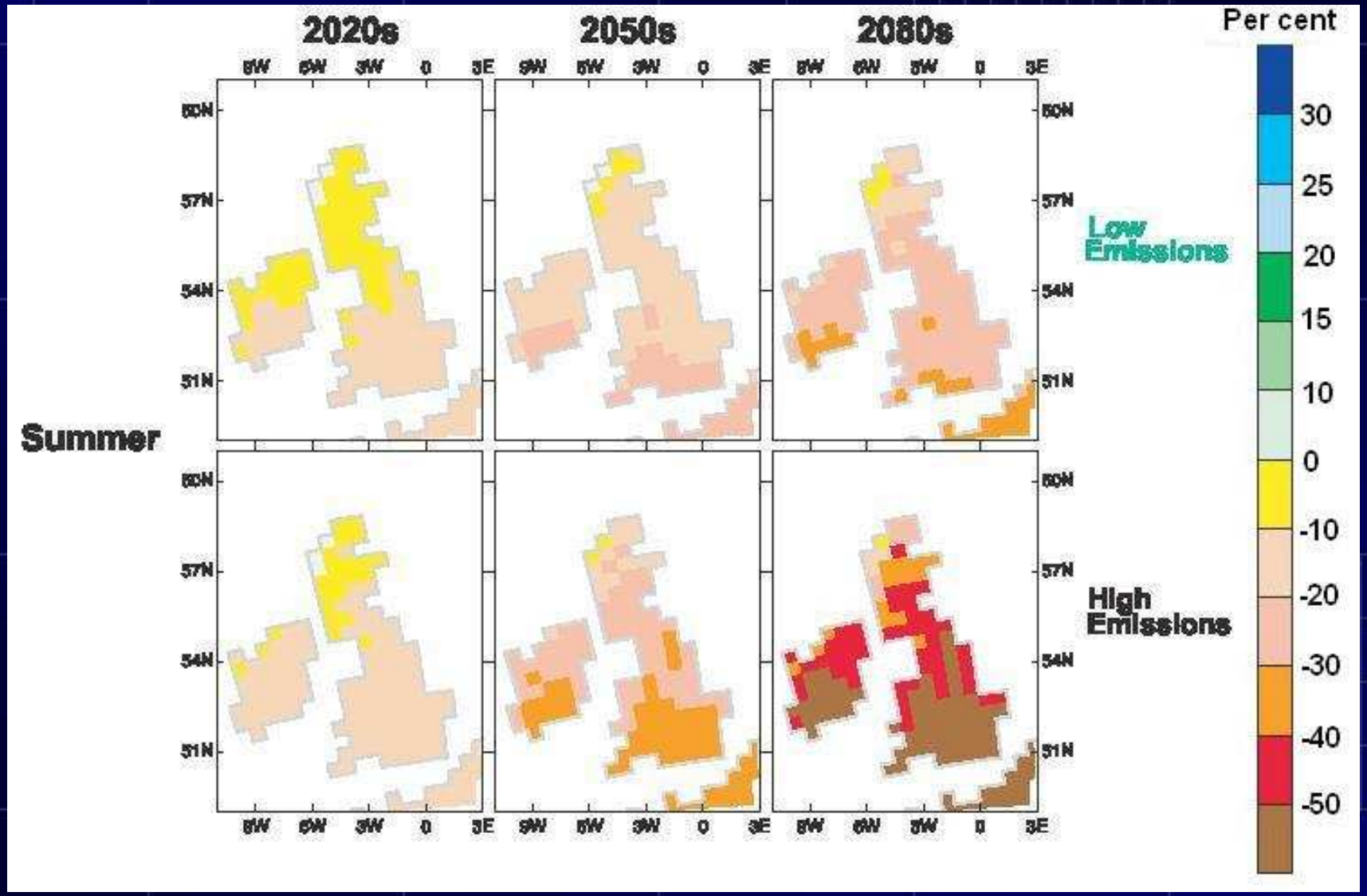
# UKCIP02 - Summer Precipitation



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# UKCIP02 - Summary of Changes
# www.ukcip.org.uk

| | Winter | Summer |
|---|---|---|
| Temperature | ⇑⇑ | ⇑⇑ |
| Precipitation | ⇑⇑ | ⇓⇓inS ⇑inN |
| Sea level | ⇑ | ⇑ |
| Vapour Pressure | ⇑ | ⇑ |
| Radiation | ⇓ | ⇑inS⇓in N |
| Wind speed | | ⇑ |
| Severe Gales | | ⇑ |
| Potential Evapotranspiration | ⇑ | ⇑ inS |

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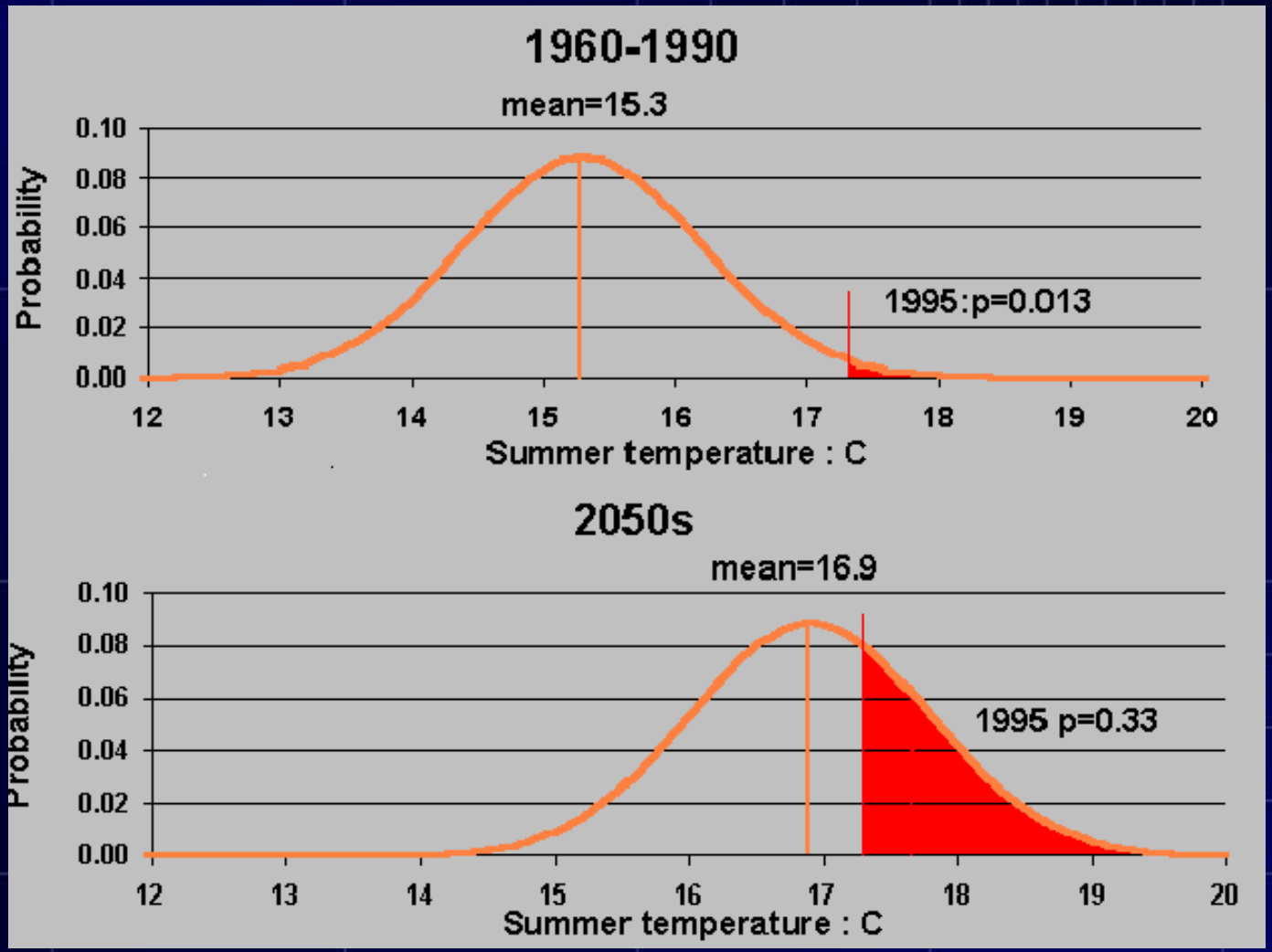
# Small changes in means lead to big changes in occurrence of extremes




1 in 80

1 in 3

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# 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)

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# 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%

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# 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!**

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# 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)

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# Cooling design

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

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# 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

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# 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

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# 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**

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# 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**

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# 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**

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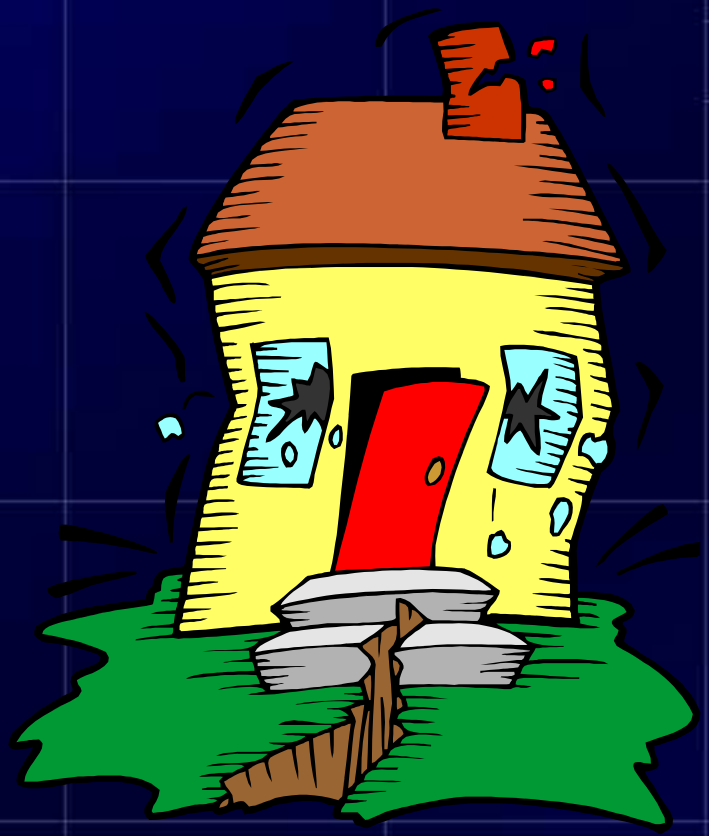
# Subsidence risk



- 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

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# Subsidence

- 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?

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# 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

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# More frequent severe winds

- Structural damage

⇒ Dislodged tiles

⇒ (Flat) roofs removed

⇒ Gables sucked out

⇒ Falling trees and chimney stacks

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# 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

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# 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

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# 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

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# 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

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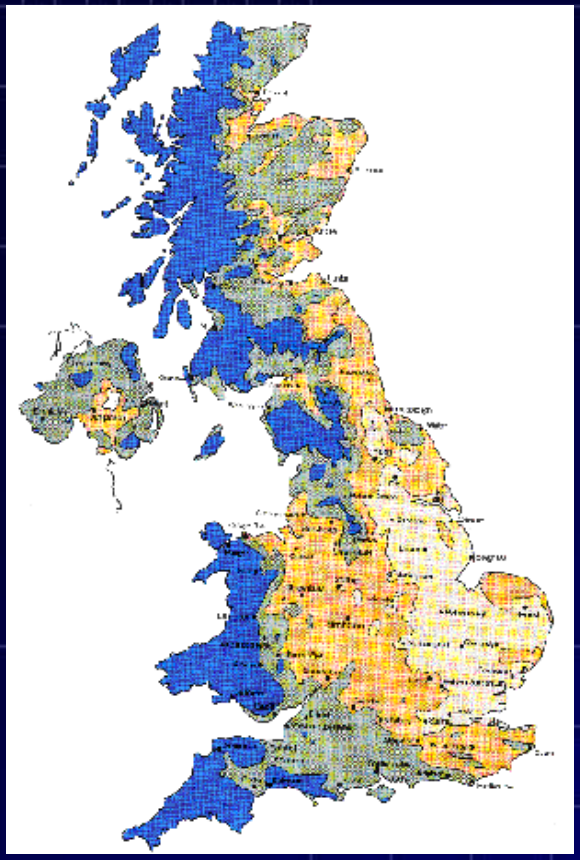
# Increased driving rain

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



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# Rising ground temperatures

- Ground contaminants become more active

⇒ More aggressive attack to foundations

⇒ Radon and other landfill gasses penetrate buildings more easily

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## 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

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## 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

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## 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

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# Climate change and buildings

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