

Climate change projections for the UK: A farming perspective

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Summary

The climate in the UK is changing and impacts are evident. This along with the projections that the climate will continue to change with impacts requires concerted adaptation within specific elements of the farming community, across agriculture as an industry, the rural community and UK society. This is even more of a concern as the projected changes in climate will offer both opportunities and threats to the agricultural community and that the response of others both within and outside could limit or enhance that community's adaptive potential. This paper begins to explore some of these issues and identifies potential adaptation strategies and measures. It presents this information with the intent of providing a basis for further discussions and actions.

Introduction

The climate in the United Kingdom is changing. This is particularly evident to those whose livelihoods are closely tied to the weather and climate (e.g. farming community), but it is also shown by temperature and precipitation records from across the UK:

- The average annual temperature for all UK regions has risen by between 0.4 and 0.9°C since 1914 and the thermal growing season for plants has increased by up to 30 days since 1900.
- The total summer precipitation has decreased in southern and central parts, typically by between 1 and 40% since 1961. Over that same time period total winter precipitation has increased in almost all parts of the UK, typically by up to 50%. Additionally, there has also been a trend towards heavier winter precipitation for most parts.
- Absolute sea level has increased by approximately 10 cm around the UK coast during the twentieth century, although natural land movements mean there are large regional differences in the actual sea level rise impacting on different parts of the coast.

The impacts of these changes are obvious to most farmers and rural land managers. These impacts, as well as the implications of measures introduced to address these and other impacts (e.g. guidance and policies introduced as a result of land management and conservation concerns, recent disease outbreaks and water shortages) have already begun to affect farming in terms of crops, livestock and farming infrastructure, along with associated technologies, management and practices.

Furthermore, these changes in our climate and the associated impacts are projected to continue:

- The average annual temperature for the UK is projected to rise by between 0.5 and

1°C by 2040 and by between 1 and 5°C by 2100, depending on region and emissions scenario (high confidence). The thermal growing season is expected to continue to lengthen (high confidence).

- There is projected to be up to 50% less precipitation in the summer months (medium confidence) and up to 30% more precipitation in the winter months, depending on region and emissions scenario (high confidence) by 2100. Heavier winter precipitation is expected to become more frequent (high confidence). Soil moisture levels in the summer and autumn are expected to decrease (high confidence).
- Global sea level is expected to continue to rise (high confidence), and by 2100 it could have risen by as much as 80 cm around the UK coast, depending on region and emissions scenario (low confidence) with greater sea-level rise projected in the south of England than in western Scotland due to variations in natural land movements (medium confidence). Extreme sea levels are expected to be experienced more frequently, and by 2100 storm surge events could occur up to 20 times more frequently for some coastal locations and emissions scenarios (medium confidence).

This paper explores further the nature of these projections and in a broad context implications for farming in the UK and what this means in terms of the nature of required responses.

Projected changes in climate for the UK

All aspects of the climate of the UK are projected to be affected by changes in global climate. The following describes some examples of these effects as presented by UKCIP02 (Climate Change Scenarios for the United Kingdom). The examples are for each of the four future emission scenarios, for different seasons, and for three future periods – 2011 to 2040 (labelled the 2020s), 2041 to 2070 (the 2050s) and 2071 to 2100 (the 2080s). The changes in climate for each of these periods reflect a change in the average statistics of weather over a 30-year period. Since all changes are calculated with respect to the average 1961-1990 climate, some portion of these may already have been realised. Describe here are the changes in climate about which we generally have most confidence and generally for the low emissions and high emissions scenarios.

Temperature

By the 2080s, annual temperature averaged across the UK is projected within UKCIP02 to rise by about 2°C (low emissions scenario) to about 3.5°C (high emissions scenario). Annual rates of warming are expected to vary across the UK from 0.1° to 0.3°C per decade for the low emissions scenario, to 0.3° to 0.5°C per decade for the high emissions scenario. The UKCIP02 scenarios also project that the temperature of UK coastal waters will increase, although not as rapidly as over land.

In general, there is projected to be greater warming in the southeast than in the northwest of the UK (Figure 1), greater warming in summer and autumn than in winter and spring, and greater warming during the nights in winter and during the days in summer. As would be expected, increasing temperatures means that heating 'degree days' (an index used to calculate how much energy is needed to heat a building to a given temperature) will decrease, and cooling 'degree days' (a similar index, but used to indicate energy needed for cooling buildings) will increase.

Precipitation

UKCIP02 shows winter precipitation increasing for all periods and for all scenarios (Figure 2). By the 2080s, this is expected to range, depending on the region, from between 10 and 20 per cent (low emission scenario) to between 15 and 35 per cent (high emissions scenario). For summer, the pattern is reversed and almost the whole of the UK is projected to become drier, with a decrease in rainfall for the low emissions scenario of up to 35 per cent, and for the high emissions scenario of 50 per cent or more. The largest changes in precipitation in both winter and summer are projected to occur in eastern and southern parts of England, while the changes are smallest in northwest Scotland.

UKCIP02 suggests that there will be less snow over the whole UK (all emissions scenarios), with the largest percentage reductions – perhaps up to 90 per cent or more by the 2080s for the high emissions scenario - around the coast and in the English lowlands. In relative terms, the Scottish Highlands are project to experience the smallest reductions, but even here total snowfall by the 2080s might decrease by 60 per cent or more relative to present-day totals. UKCIP02 also suggests that some areas of the UK are increasingly likely to experience quite long runs of winters without any snow.

Extreme seasons and years

Changes in the probabilities of selected seasonal climate extremes for central England and Wales as projected within UKCIP02 are summarised in Table 1 for the medium-high emissions scenario. It is also should be noted that the extremely high temperatures as occurred in the summer of 2003 in southern England (and most of eastern Europe) are projected to be normal during the summers in the 2050s and relatively cool compared to those projected for the 2080s (Figure 3).

Table 1. The percentage of years for which central England and Wales are projected to experience various seasonal anomalies relative to the average 1961-90 climate (medium-high emissions scenario)

Type of anomaly	Anomaly	Percentage of years		
		2020s	2050s	2080s
Mean temperature				
A hot '1995-type' August	3.4 °C warmer	1	20	63
A warm '1999-type' year	1.2 °C warmer	28	73	100
Precipitation				
A dry '1995-type' summer	37% drier	10	29	50
A wet '1994/95-type' winter	66% wetter	1	3	7

Impacts of the projected changes in climate

The IPCC in its recently released Fourth Assessment Report, concluded that at mid- to high-latitude regions (includes the UK), moderate to medium local increases in temperature (1-3°C); along with associated carbon dioxide increases and rainfall changes, can have small beneficial impacts on crop yields. Furthermore, it is concluded that warming of up to 2°C will have positive impacts on pasture and livestock productivity in humid temperate regions. The assessment also concludes that further warming is projected to have increasingly negative impacts on all regions.

Other conclusions that may be of interest to the UK agricultural community include:

- Projected increases in the frequency of heat stress, droughts and flooding events will reduce crop yields and livestock productivity beyond the impacts due to changes in mean variables alone, creating the possibility of surprises.
- Climate variability and change also modify the risks of pest and pathogen outbreaks, with negative consequences for food security.
- Longer dry periods in summer with more rain falling as intense rain events are projected to lead to changes in the seasonality of water resources – too much or too little, wrong place and/or wrong time.
- Food trade is projected to increase in response to climate change as those disadvantaged become more reliant on imports to meet demand.
- Sea level rise will tend to increase the salinity of coastal groundwater; boreholes; surface storage areas; and rivers with low flows (e.g. Norfolk Broads) - limiting the availability of water from these sources for irrigation.
- Sea level rise is also projected to lead to the increased loss of coastal wetlands, including salt marshes – corresponding need to manage replacement as part of a broader coastal adaptation.

Responding to changes in climate

Adaptation, along with mitigation, is an essential part of addressing the challenges and opportunities associated with climate change – mitigation to address the anthropogenic causes of climate change (reducing the rate and magnitude of the changes) and adaptation to address the residual impacts and opportunities resulting from a changing climate.

Irrespective of the success of mitigation efforts, there will still be some degree of unavoidable climate change, and the projected magnitude and rate of those residual changes will still require addressing through adaptive actions. This unavoidable climate change stems from our current commitment to climate change as a result of historic greenhouse gas emissions and the persistence of these gases in the atmosphere, as well as the slow but building response of the oceans to atmospheric warming (Figure 3). This delayed response of the oceans will result in temperatures and sea level continuing to increase for several decades (and in the case of sea level rise, perhaps several centuries) beyond any emission reductions resulting from mitigation measures.

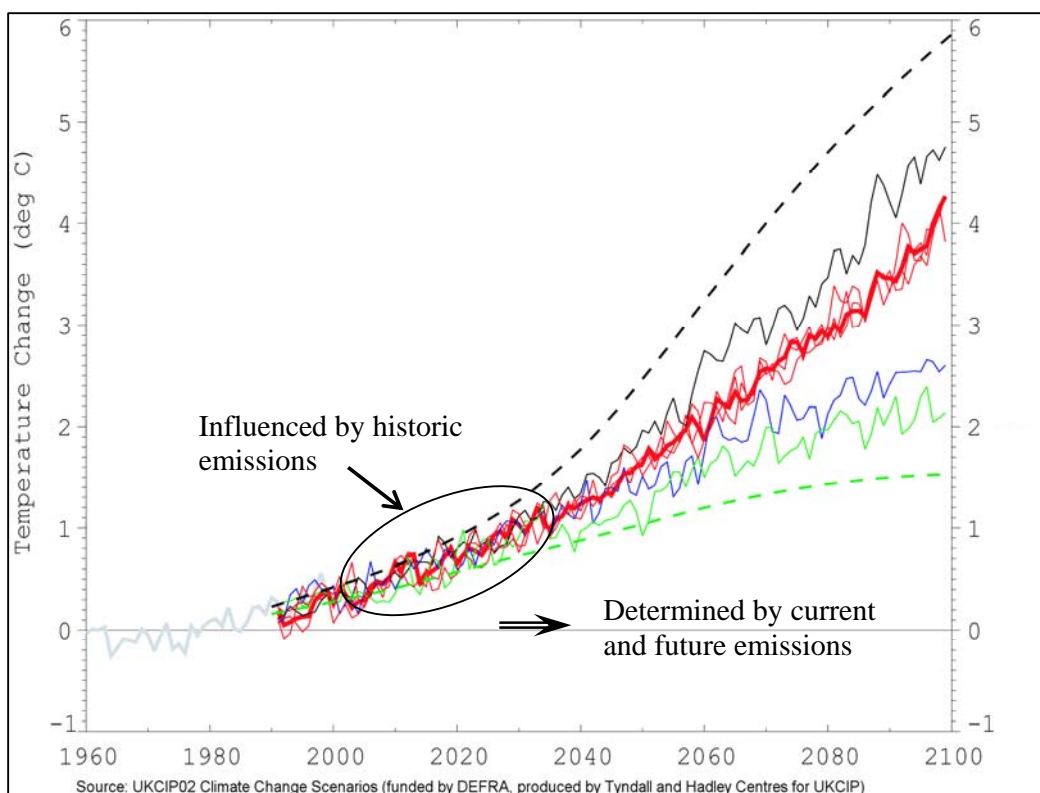


Figure 3: Future projections of change and the need for adaptation and mitigation. The figure depicts the projections of average global temperature based on different emission scenarios (dashed lines envelop the range of future changes with the various coloured curves representing projections associated with specific emission scenarios). The figure shows that adaptation is needed to deal with the impacts of changes in climate to which we are already committed (influenced by historic emissions) and those we will experience in the future (impacts of residual changes). Mitigation is also required to reduce the magnitude and rate of climate change.

In addition, realisation of the potential benefits projected for agriculture with warming of less than 2°C will also require directed adaptive actions. The benefits will not necessarily accrue autonomously, nor will the same benefits result with the same effort (i.e. need for targeted actions to realise benefits).

As such, adaptation to address the impacts of climate change should be part of a strategy to reduce our vulnerability today and tomorrow. An effective approach to adaptation is one that includes:

- Building adaptive capacity - creating the information (research, data collecting and monitoring, awareness raising), supportive social structures (organisational development, working in partnership, institutions), and supportive governance (regulations, legislations, and guidance) that are needed as a foundation for delivering adaptation actions; and
- Delivering adaptation actions – measures directed at minimising, adjusting to and taking advantage of the consequences of climatic change.

These two categories reflect the range of adaptation measures and strategies from which a good adaptation response can be developed. Targeted measures directed at building adaptive capacity are fundamental to delivering responsive adaptation actions. Many organisations have begun the process of building adaptive capacity through understanding the nature of the issue and risks, identifying and engaging the community/players, and assessing the situation (risks and thresholds) and likely adaptive responses.

Delivering adaptation actions requires consideration of purpose and social, economic, technological and environmental feasibility. In terms of purpose, adaptation is normally required because of inadequacies related to coping with existing or projected climate risks (including variability and extremes) or because of a desire to exploit beneficial climatic opportunities. As such, these adaptation actions and strategies are normally targeted at:

- Living with and bearing losses or risks – accepting that pre-impact systems, behaviours and/or activities no longer can be sustained nor pursued or accepting the loss of assets as they are/will be no longer feasible or worth sustaining.
- Preventing effects or reducing exposure to risks – these are associated with either relocating, changing what is exposed, or building climatic resilience with the objective of allowing pre-impact systems, behaviours and activities to continue but introducing measures to reduce exposure to the new/heightened risks. It also includes eliminating exposure to risks by changing to a different use or location. These types of strategies are often adopted where the assets at risk are so valuable that a “living with risk” strategy is unacceptable. Building resilience, however, does include “living with risk”. Measures adopted in this latter case involve minimising exposure to risks to a defined acceptable level through reducing the consequences of the resulting impacts and/or facilitating earlier and less costly recovery following exposure. Better preparedness and contingency planning are additional approaches that can prevent effects or reduce exposure to risks.
- Sharing responsibility for any losses or risks – reducing the financial and social losses or exposure to risk by use of insurance, sharing the associated costs of adaptive responses, and relief efforts (e.g. government, NGO or community relief efforts).
- Exploiting opportunities – changing use or location to exploit opportunities afforded by changes in climate and increasing capacity to manage opportunities resulting from changing climate. Measures considered under this strategy include introducing a new activity, practices, management strategies, or species (crop, livestock) when pre-impact climate constraints no longer exist (or associated risks are no longer a limiting factor) as well as changing behaviour or practices to take advantage of more favourable climate conditions.

In practice, adaptation will often involve a mixture of response strategies: some building climatic resilience (e.g. enhanced design specifications), some “living with risks” (e.g. increased preparedness and contingency planning), and some acceptance of loss (e.g. accepting occasional losses or reductions in quality). The specific mixture will be case specific as it will depend on such things as risk aversion, as well as the values and capacity of the affected and responding community/organisation. An optimum mixture may also include adopting measures that also allow for the exploitation of opportunities (e.g. changing location of existing activities deemed no longer viable at their current location and introducing new replacement activities at that original location). Considering the nature of projected changes in climate (potentially rapid change, continuing change over the long-

term, and the degree of uncertainties), an effective approach to adaptation should consist of enhancing the flexibility or resilience of hard-to-reverse investments, particularly those expected to have a long design life (e.g. infrastructure for utilities, transportation infrastructure, buildings, and forest plantations) and enhancing information and its accessibility and utility. In the case of infrastructure and systems, an effective approach would be to time introduction of adaptation measures to coincide with planned maintenance and/or upgrading or to take advantage of opportunities that arise with unscheduled interruptions or breakdowns. This timing could reduce the overall costs of the adaptation measure, particularly when considering associated capital and labour costs.

Adaptation as a response to a changing climate

Establishing and enhancing adaptive capacity is fundamental to ensuring effective response to climate change and the resulting impacts. Included are measures such as:

- Increasing awareness of changes in climate, associated vulnerabilities and adaptation options and sharing knowledge within the farming and rural land management communities;
- Training (new technologies, and practices);
- Pulling together the agricultural community (e.g. farmers, suppliers, crop and livestock researchers, policy makers, buyers, etc.) to identify, assess and deliver adaptation options;
- Representing the broader agricultural and rural land management communities in discussions with regulators and policy makers; and
- Facilitating dialogues with others with interests in agriculture and rural communities for the purpose of identifying sustainable adaptation options.

The Home-Grown Cereals Authority, partly through this conference, is playing a role in helping to build this adaptive capacity.

For agriculture, adaptation measures that are part of the adaptation repertoire under consideration include the following:

Living with and bearing losses or risks:

- Accepting periodic losses or reductions in the overall quality of home-grown cereals – what is a sustainable loss or reduction in overall quality.

Preventing effects or reducing exposure to risks

- Building climate resilience:
 - Contingency planning for water shortages;
 - Improving soil management with the objective of better managing soil fertility and moisture
 - Field management to prevent excessive erosion and creation of ruts;
 - Ensuring security of seed and crop storage facilities to deal with changes in moisture and temperature, as well as projected increases in pests (mice and rats);
 - Improving fertiliser, herbicides and pesticide use to reduce wastage (e.g., scheduling, preventing/reducing non-effective applications, field inspections/monitoring and other management techniques); and
 - Improving use of climate and weather forecasting in the timing of operations.
- Changing use and/or location:

- Making available cereal varieties that can take advantage of the new conditions and/or that are less at risk as a result of the new conditions (e.g. longer growing period, require less water, etc.);
- Introducing new machinery (able to deal with changed soil moisture conditions during harvest and planting); and
- Changing crops or introducing different mixtures that are consistent with the new climate conditions.

Sharing responsibility for any losses or risks:

- Purchasing additional crop insurance; and
- Cooperating with neighbours to increase available water resources (shared water reservoirs and rainwater harvesting facilities).

Conclusions

The climate is changing and there are and will be impacts for agriculture for which adaptation measures are and will be necessary. When identifying options and a pathway to a sustainable future, it is important to recognise the nature of your vulnerabilities and opportunities. The trend is towards warmer wetter winters and hotter summers with more lengthy dry periods but, as has always been the case, climate will continue to be variable. We will still see wet summers (as the most recent summer) and dry winters (as in 2006-07), but once again less often. In addition, what we identify as normal climate will change as summers, as experienced in southern England in 2003, become typical by mid-2100 and actually would be a cool summer by the 2070s. As the UK climate changes the focus will need to be placed on adaptive management and ensuring systems and practices are fit for purpose and consistent with acceptable levels of risk.

For more information on climate risks and adaptation, please visit the UK Climate Impacts Programme's website at www.ukcip.org.uk.

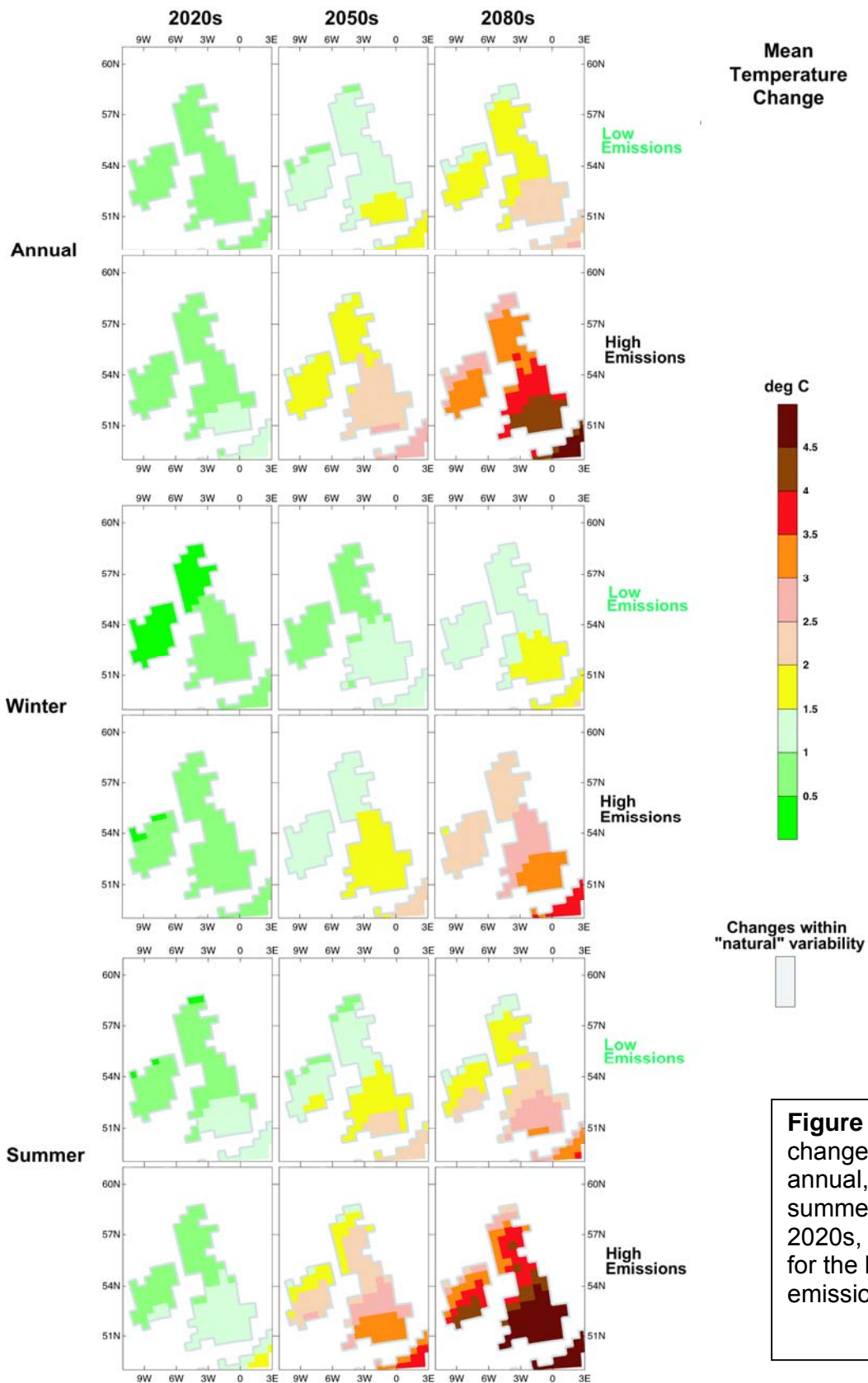
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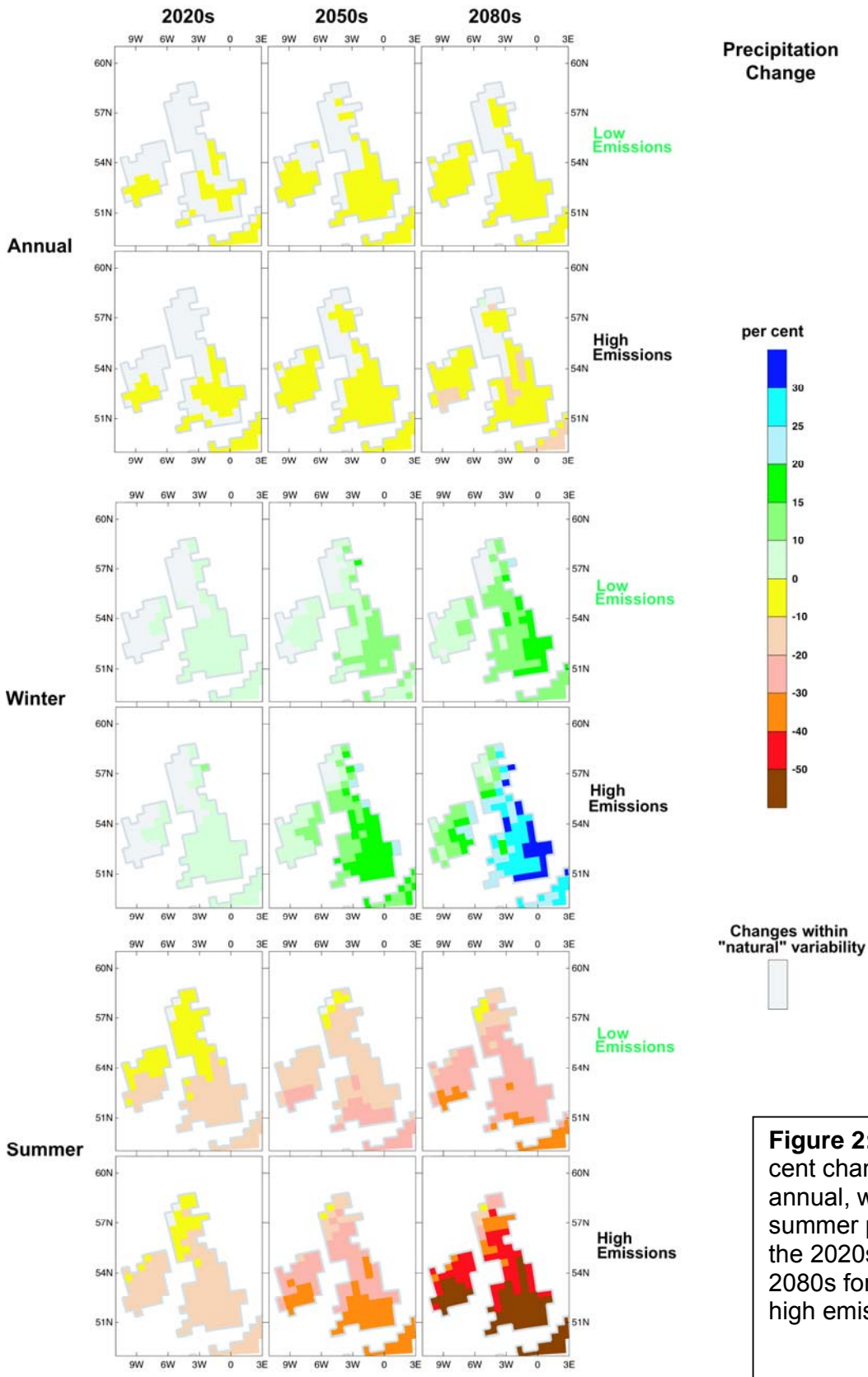


Figure 2: Projected per cent change in average annual, winter and summer precipitation for the 2020s, 2050s, and 2080s for the low and high emissions scenarios.