

# Carse of Gowrie Climate Change Panel Briefing pack

---



## **Contents**

Introduction and overview  
Recent climate change  
Future climate change  
The effects of climate change  
Evaluation framework



SMALL TOWN AND  
RURAL DEVELOPMENT GROUP



LAND USE  
CONSULTANTS

## Introduction and overview

Climate change is widely considered to be one of the greatest challenges for the 21<sup>st</sup> century. While government agencies and local authorities are increasingly assessing the possible impacts and opportunities that could result from a changing climate, there has been relatively little involvement of local communities. This project aims to address this by setting up a Climate Change Panel for the Carse of Gowrie to explore how climate change could affect the area over the coming decades and, importantly, choices and decisions about the ways in which communities are helped to adapt and become better able to deal with change.

The Carse of Gowrie has been identified as the location for this work for a number of reasons including:

- Existing and potential flooding issues
- Productive agricultural land
- Distinctive settlements and communities
- Important road, rail routes, pylon and pipeline routes
- Proximity to Perth and Dundee

### Project sponsors

The work is being supported by the Scottish Climate Change Impacts Partnership (SCCIP) - an initiative that brings together stakeholders in Scotland to collectively address and prepare for the impacts of climate change.

Climate change will affect all areas of life in Scotland and SCCIP believes that communities have a vital role to play in preparing for and responding to the challenges and opportunities that will occur.

SCCIP supports the establishment of a Climate Change Panel for the Carse of Gowrie and hopes to use the lessons learnt through the workshops to help other communities get involved with understanding what the impacts of climate change might mean for them.

The work is also being supported by Perth and Kinross Council who will use the results to inform planning policies for the area and other work being carried out with agencies including the Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH).

### The role of this information pack

This information pack has been prepared to provide some background information to support the work of the Climate Change Panel. We will take you through each part of the pack as we progress through the three sessions, explaining the information as necessary. This pack also provides links to more detailed sources of information – these are *not* essential reading.

### Weather or climate?

The work of the Panel will focus on **climate** rather than **weather**. The term **weather** refers to day to day or year to year variations in conditions. The term **climate**, on the other hand, refers to average conditions – usually taken over a 30 year period, allowing trends and patterns to be detected.

# Recent climate change

## Summary

There is evidence that the Scottish climate is already changing.

- It is getting warmer overall
- Summers are becoming drier, though there are some important regional variations
- Winters are becoming wetter and generally milder
- On average, there are fewer days with lying snow
- The growing season is getting longer

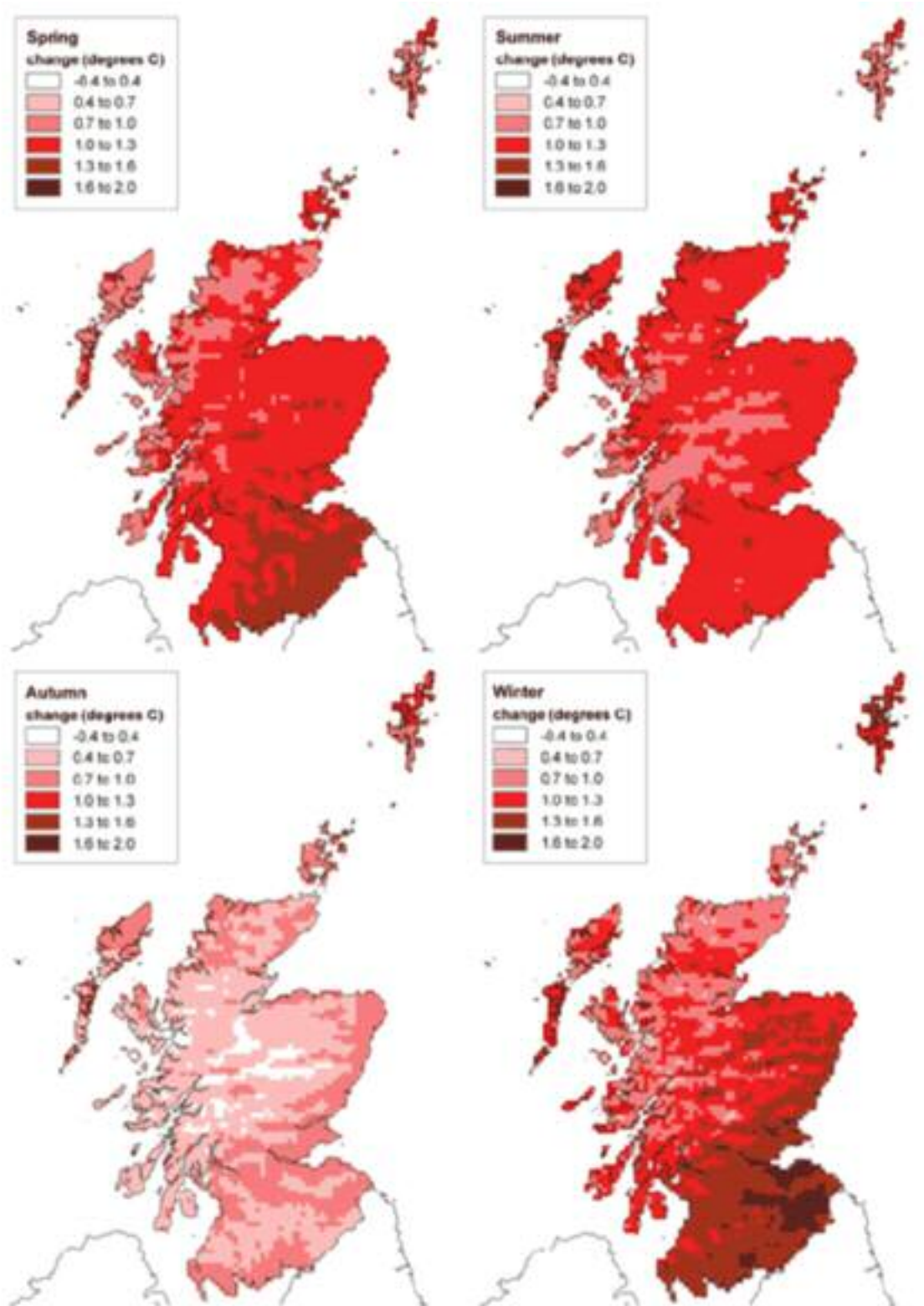
The following pages present information from a comparison of climate figures for the thirty years from 1961-1990 with the thirty years from 1971-2000. The main trends are summarised in the following table:

	<b>Observed change in Scotland's climate between 1961 and 2004</b> (SNIFFER, 2006)
<b>Temperature</b>	Temperatures have risen in every season in Scotland.
<b>Rainfall</b>	Scotland became 20% wetter, with an increase of almost 70% in precipitation in northern Scotland. Heavy rainfall events have increased significantly in winter, particularly in northern and western regions.
<b>Snow cover</b>	The snow season has shortened across the country, with the season starting later and finishing earlier in the year. The greatest reductions have occurred in northern and western Scotland.
<b>Growing season</b>	The growing season has increased significantly, with the greatest change occurring at the beginning of the season.
<b>Days of frost</b>	There has been more than 25% reduction in the number of days of frost (both air and ground frost) across the country.
<b>Sea level</b>	Sea level at all of Scotland's ports has been rising over the last century, with the rate accelerating over the last two decades (now exceeding 3-4 mm/yr in 9 out of 10 ports). (Rennie & Hansom, 2010)

A full digest of climate trends is available online at <http://climatetrendshandbook.sccip.org.uk/>.

# Temperature

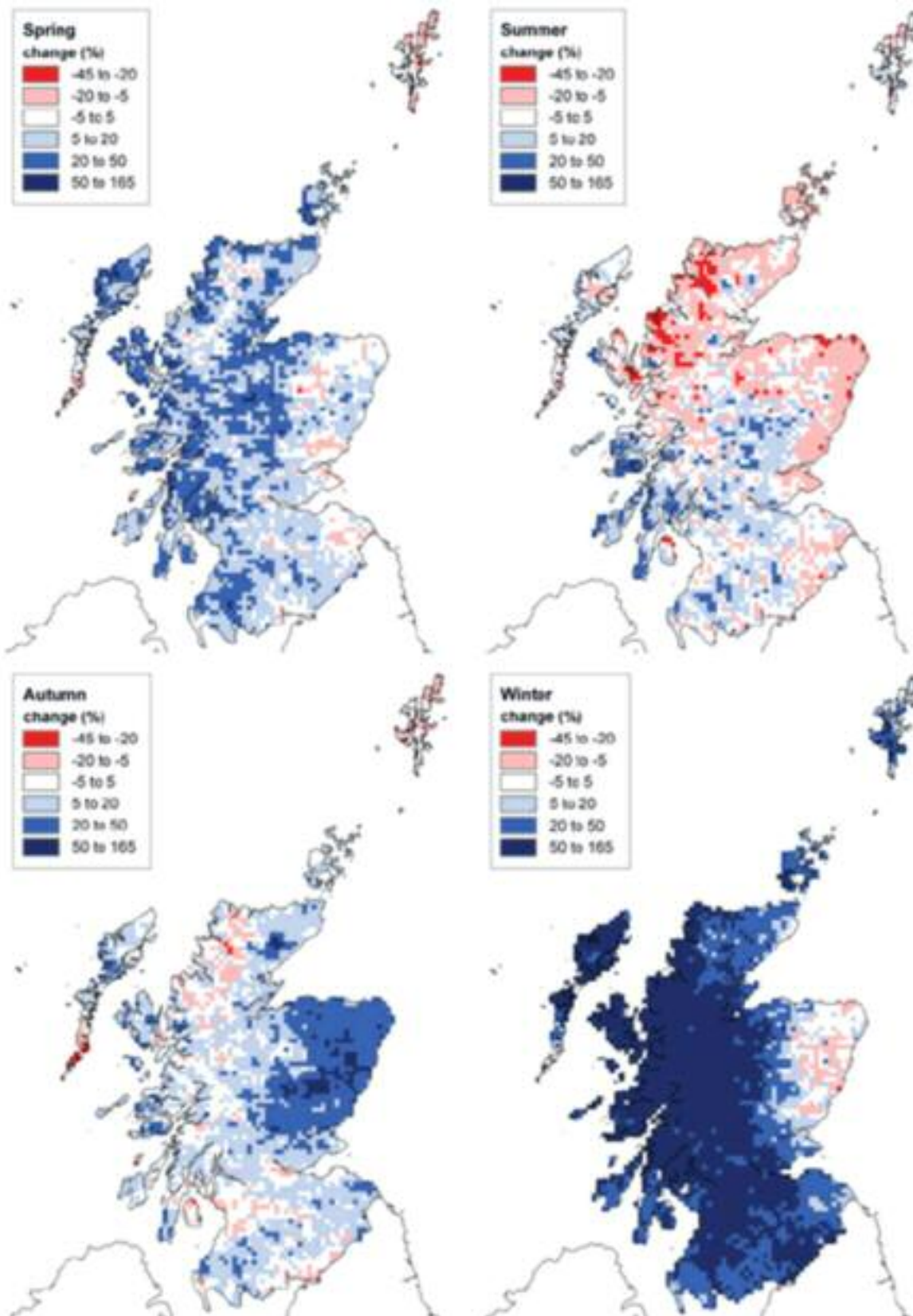
It is already getting warmer, especially in spring, summer and winter



Patterns of change in average temperature (in °C) between 1961 and 2004 for each season  
Source: SNIFFER (2006) Climate Trends Handbook  
[www.sniffer.org.uk](http://www.sniffer.org.uk)

# Rain, hail, sleet and snow

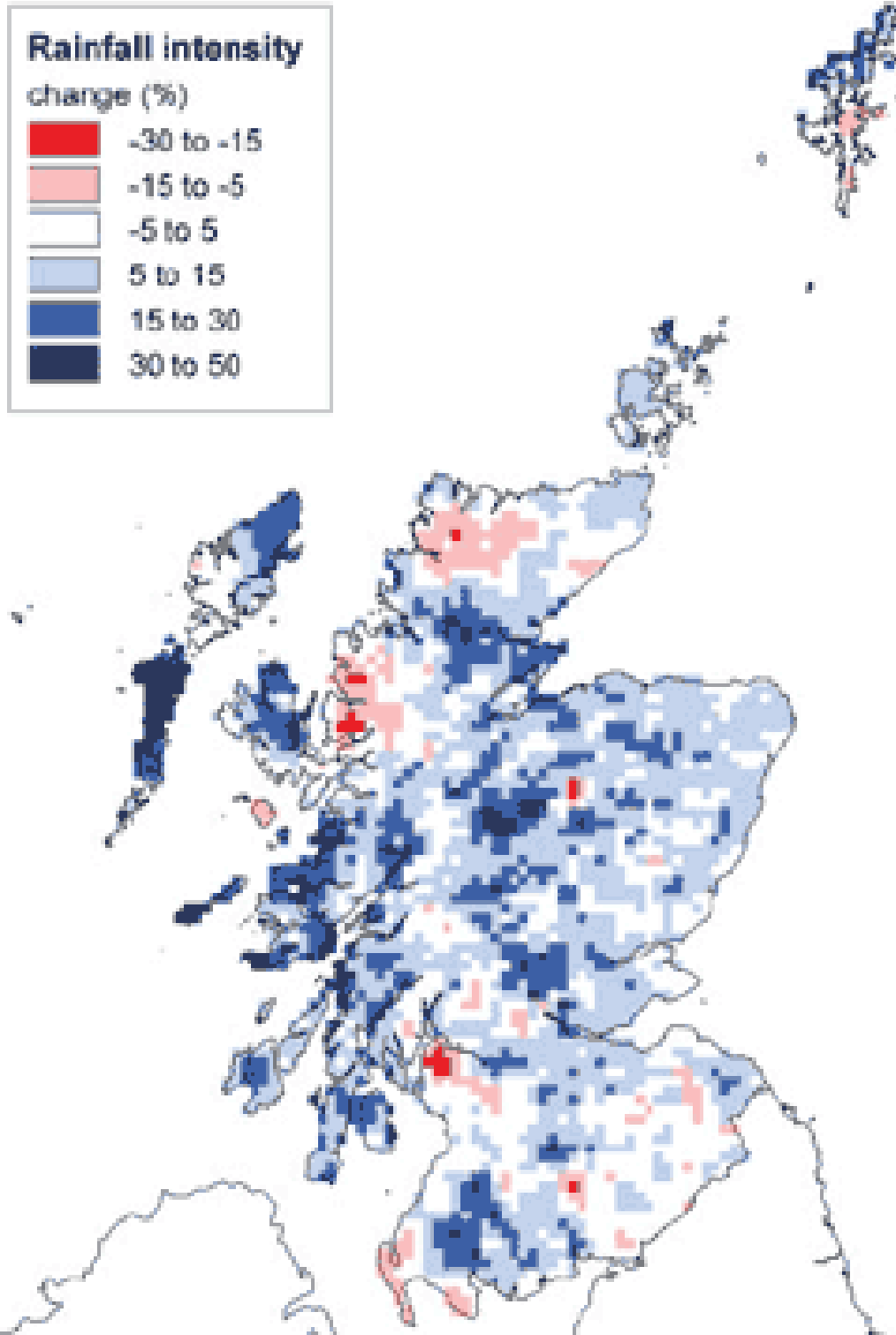
Overall trend towards drier summers and much wetter winters – though with important variations



Patterns of change in precipitation totals (as a percentage) between 1961 and 2004 for each season.  
Source: SNIFFER (2006) Climate Trends Handbook  
[www.sniffer.org.uk](http://www.sniffer.org.uk)

# Rainfall

Some areas are experiencing heavier rainfall

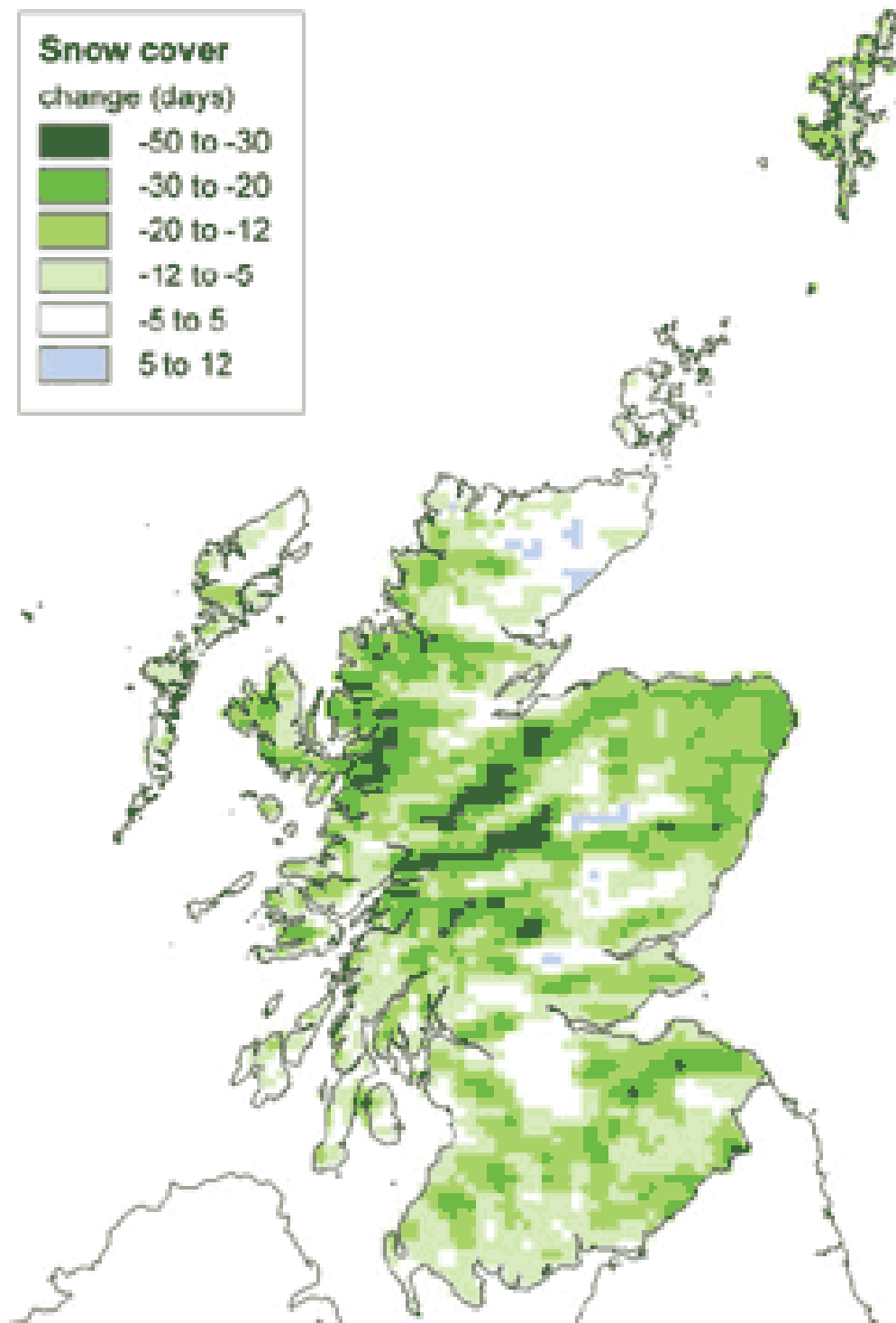


Pattern of change (as a percentage) in rainfall intensity each year on days with 1mm or more of rain, from 1961 to 2004.

Source: SNIFFER (2006) Climate Trends Handbook  
[www.sniffer.org.uk](http://www.sniffer.org.uk)

# Snow cover

Areas like the Sidlaws seeing up to 20 days less snow cover per year (on average!)



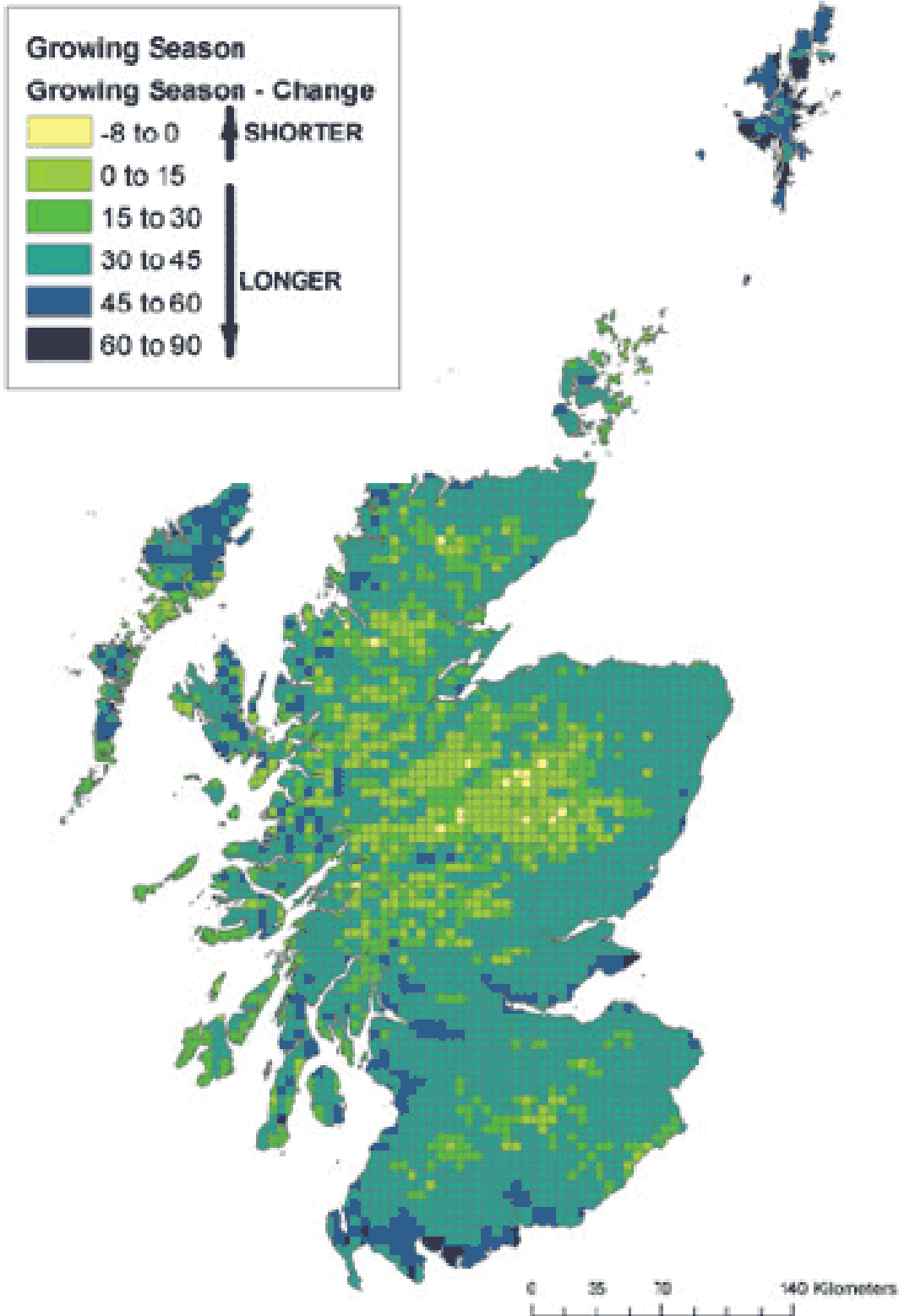
Pattern of change in snow cover (in days) each year, from 1961 to 2004.

Source: SNIFFER (2006) Climate Trends Handbook

[www.sniffer.org.uk](http://www.sniffer.org.uk)

# Growing season

Already more than a month longer, on average, than in the 1960s



Pattern of change in the length of the growing season (in days) from 1961 to 2004 calculated from the extended UKCIP02 dataset.

Source: SNIFFER (2006) Climate Trends Handbook  
[www.sniffer.org.uk](http://www.sniffer.org.uk)



# Future climate change

## Summary

The latest climate change projections published by the UK government suggest these trends will continue:

- Summers are likely to become hotter and drier
- Winters are likely to become milder and in most parts of Scotland, wetter
- Sea levels are likely to rise

These projections are in line with the trends already recorded across Scotland.

The UK Climate Projections (UKCP09) are the latest generation of climate information for the United Kingdom. These provide projections of change for a number of climate variables over this century.

The key trends the projections identify for Scotland are:

- Hotter, drier summers
- Milder, wetter autumn and winter

We can also expect to see:

- Increase in summer heat waves, extreme temperatures and drought
- Increased frequency and intensity of extreme precipitation events
- Reduced occurrence of frost and snowfall
- Sea level rise

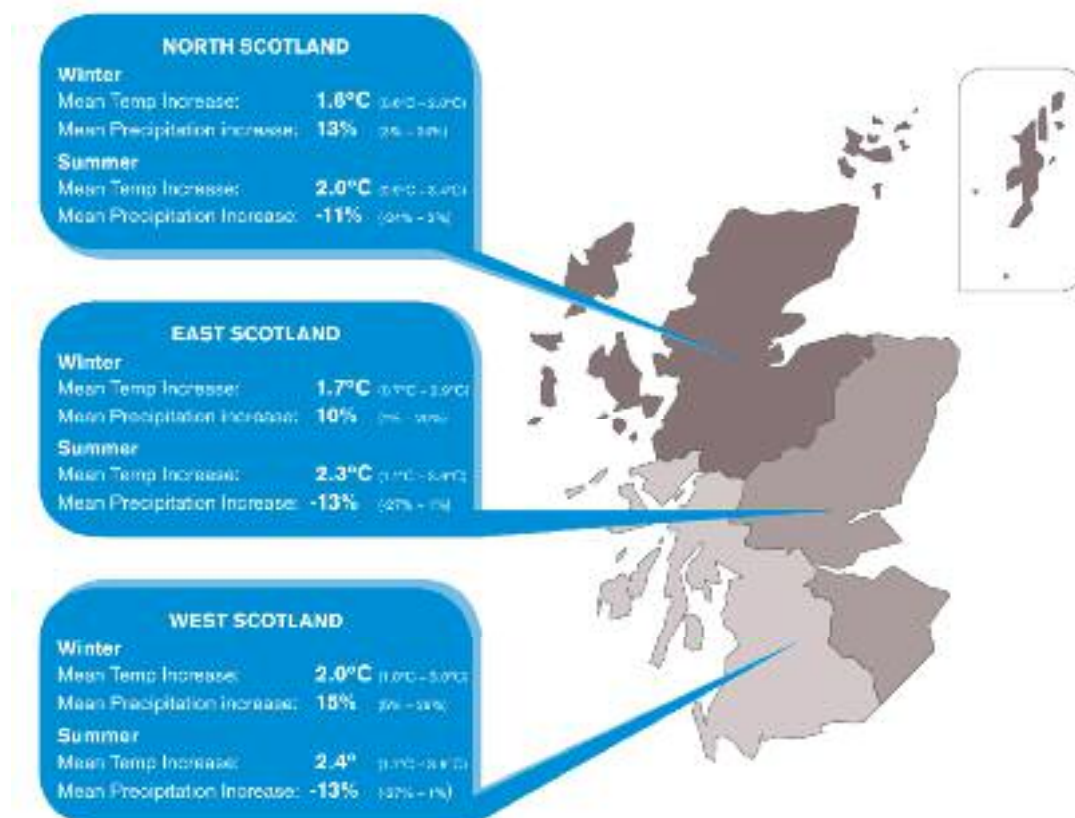
The projections suggest that, by the 2050s, the Carse of Gowrie could have temperature and rainfall characteristics similar to those of the Isle of Wight (1961 to 1990).

More detailed information, which will be explained during the Panel meetings, is included on the following pages.

More information is available at <http://ukclimateprojections.defra.gov.uk/>

Climate information is provided in UKCP09 for three Scottish 'climate regions' (defined by the Met Office), as shown below. The data show projected change in mean temperature and precipitation for winter and summer in the 2050s under a medium emissions scenario.

### Projected changes in temperature and precipitation: 2050s, medium emissions scenario



Source: SCCIP 2009

UKCP09 are probabilistic projections which assign a probability to different possible climate change outcomes. In the above figure the main numbers represent the mid point of the probability range, known as the central estimate. Taking Eastern Scotland as an example, there is a 50% chance the summer mean temperature will be more than 2.3 degrees C hotter and a 50% chance it will not have increased quite that much. The figures in brackets show the range within which the actual change is likely to be. In this case, the projections suggest that it is very unlikely the increase in summer average temperature will be less than 1.1 degrees C or greater than 3.9 degrees C.

**UKCP09 Climate change projections (high emissions, 10%, 50% and 90% probability projections) for the Carse of Gowrie (792)**

Climate variable	Period	Change unlikely to be less than	Change that is as likely to happen as not	Change unlikely to be more than
Mean annual temperature	2050s	+1.4°C	+2.3°C	+3.4°C
	2080s	+2.2°C	+3.4°C	+5.1°C
Summer temperatures	2050s	+1.3°C	+2.8°C	+4.6°C
	2080s	+2.3°C	+4.4°C	+7.1°C
Winter temperatures	2050s	+0.7°C	+1.8°C	+3.1°C
	2080s	+1.3°C	+2.6°C	+4.2°C
Summer rainfall	2050s	+3%	-14%	-30%
	2080s	0%	-22%	-42%
Winter rainfall	2050s	0%	+3%	+29%
	2080s	+7%	+25%	+51%
Relative sea level rise (Dundee)	2050	+3.6cm	+17.9cm	+32cm
	2080	+6.9cm	+31.3cm	+55.8cm

The UKCP09 projections are complex – they cover different time periods (thirty year slices from now until the end of the century), different levels of carbon emissions (reflecting the extent to which we manage to reduce emissions from fossil fuels), and different levels of probability (from changes that only have a 5 or 10% probability of occurring to changes that have a 90 or 95% probability of occurring). For the purposes of the Panel discussions, we will be looking at figures for 2050 and 2080, based on high carbon emissions (reflecting where we are at the moment) and taking the 10% (very unlikely), 50% (as likely to happen as not) and 90% (very likely) probability levels.

# The effects of climate change

The following pages provide some information on the possible effects of climate change. It is helpful to distinguish between:

The *Direct effects* of climate change which could include:

- Winter flooding along rivers
- Summer drought
- Flooding along the coastline and changes in coastal processes
- Impact on woodlands and natural habitats
- Possible increase in storm damage
- New species, pests, diseases affecting plants, trees, crops, animals and humans

... and the implications of the way in which we respond to climate change – including:

- *Climate change adaptation* – actions we take to reduce the negative effects of the changing climate (e.g flood protection) or to benefits from positive effects of climate change (e.g. new crops, or improved opportunities for outdoor recreation and tourism). We have a number of choices or options when considering how we adapt to climate change. This work will help inform these by asking how resilient are communities to the kinds of changes that could occur, and what can be done to tackle areas where they are vulnerable.
- *Climate change mitigation* – actions we take to reduce carbon emissions in order to reduce or slow the pace of climate change. This includes renewable energy schemes (wind, hydro, biomass, biogas, solar and tidal for example) and energy efficiency measures (e.g. insulation), but could also include measures to increase the amount of carbon locked up on the environment by expanding woodland or managing upland peatbogs. Again, we have choices about the emphasis placed on different kinds of mitigation.

The following pages look at what these types of change could mean for a series of topics.

## Trees, woodlands and forests

### Direct effects could include:

- Damage caused by storms, new pests and diseases, spread of 'invasive' species such as rhododendron
- Stress to woodlands and trees resulting from summer drought and winter water-logging

### Adaptation effects could include:

- New woodland planting as part of flood management strategies – slowing run-off into rivers
- New woodland planting to form habitat networks – helping plants and animals adapt to the changing climate
- Loss of small woodlands as a result of agricultural expansion – better growing conditions
- New shelterbelts to provide shelter in winter and shade in summer
- Changes in the types of trees grown in 'productive' forests, especially in eastern Scotland. Trends towards 'continuous cover forestry' as an alternative to clear fell, and avoidance of higher and more exposed locations
- Possible use of woodland planting to make steep slopes more stable

### Other effects could include:

- New woodland planting to absorb carbon from the atmosphere

## Rivers, burns and lochs

### Direct effects could include:

- An increase in flooding and changing patterns of erosion and deposition as a result of increases in winter rainfall. Damage to river habitats, bridges and nearby property
- Low flows during drier summer months could affect river and wetland habitats and species
- Low flows could affect water supplies and waste water disposal and water quality

### Adaptation effects could include:

- Measures to reduce the speed of run-off within river catchments – woodland expansion, restoration of natural floodplains, management of peatbogs to store water
- Flood protection works to protect towns and villages at risk of flooding – engineered solutions
- Upgrading of drainage systems to cope with winter rainfall
- Increasing use of reservoirs to store winter rainfall for use in drier summers, possibly to export to drier parts of the UK

### Other effects could include:

- Development of small and larger hydro-electric power schemes

# Infrastructure

## Direct effects could include:

- Impact of sea level rise on coastal infrastructure, including harbours and coastal road and rail routes

## Adaptation effects could include:

- Upgrading of road and rail infrastructure (drains, culverts, flood lagoons, etc.) to cope with increased rainfall
- Measures to prevent flooding in towns and villages – ‘Sustainable Urban Drainage Systems’ – flood storage, permeable surfaces, ‘green’ roofs
- Measures to protect roads, railways and property from land slips
- Adaptation or abandonment of port and harbour infrastructure
- The development of reservoirs and pipelines to supply water to other parts of the UK
- Upgrading of waste water treatment plants to cope with storm flows in winter and low flows in summer

## Other effects could include:

- Development of renewable energy schemes – wind farms, tidal barrages, hydro, and associated power lines

# Agriculture

## Direct effects could include:

- summer droughts, winter flooding and storm damage could result loss of field boundary trees
- Increase in pests and diseases

## Adaptation effects could include:

- New crops, different animal breeds
- Expansion of arable into more marginal areas, and more intensive use of better land
- Increase in outdoor stock rearing, where compatible with higher winter rainfall
- Longer growing season – earlier sowing, later harvesting
- Measures to reduce soil erosion during wetter winters – use of ground cover crops, timing of ploughing and other operations
- Changing pattern of farm woodlands – increase in shelter belts and habitat networks but possible loss of field boundary trees and small farm woods where agriculture becomes more intensive
- New farm buildings for animals, storage and processing of crops or for farm energy schemes

## Other effects could include:

- Spread of energy crops - willow and other types of biomass



## Towns and villages

### Direct effects could include:

- Increase risk of flooding – along rivers and on the coast, and where drainage systems are unable to cope with winter rainfall
- Impacts on historic building stock – wetter winters, hotter summers

### Adaptation effects could include:

- Upgrading of river and coastal flood defences – new barriers, flood storage areas
- Changing building design - materials and techniques may change to include energy efficiency measures, microrenewables and features such as green roofs and walls
- Increased use of outdoor space include parks, greenspaces, town squares, riversides during warmer, drier summers
- Increasing numbers of tourists and visitors in popular holiday areas
- habitat networks to help plant and animal species adapt to climate change and the effects of habitat loss

### Other effects could include:

- Wider use of small scale renewable energy – solar panels, small wind turbines, biomass plants

# Recreation and tourism

## Direct effects could include:

- Milder winters are likely to affect winter sports – including skiing, climbing and hill walking
- Sea level rise could affect coast recreation sites – including paths, beaches, historic sites, caravan parks, golf courses
- Wetter winters could make path erosion and flooding more frequent

## Other effects could include:

- Effects of renewable energy developments on recreation and tourism areas
- Creation of recreation opportunities associated with new woodlands

## Adaptation effects could include:

- Warmer and drier summers are likely to result in an **increase in recreation and tourism activity**, particularly in more accessible areas around settlements and key transport corridors. This is likely to result in pressure for additional recreation and tourism infrastructure in these areas.

# Historic environment

## Direct effects could include:

- Impact of sea level rise on historic sites along the coast
- Impact of sea level rise on historic coastal towns and villages
- Effects of drier summers, wetter winters, higher temperatures, increased pests and diseases on historic parks and gardens – policy woodlands etc

## Adaptation effects could include:

- Expansion of agriculture or woodland could affect archaeological sites
- Increases in visitor numbers could put pressure on some historic sites

## Other effects could include:

- Effects of small scale renewable energy equipment on historic towns and villages
- Effects of large scale renewable energy schemes including wind farms and tidal barrages on historic sites

# Biodiversity

## Direct effects could include:

- Changing distribution of plants and animals – moving north and uphill to maintain current climatic conditions – losses where species unable to move
- Loss of key upland habitats dependent on freeze thaw cycles
- Impacts on peatlands from summer drying and winter flooding / erosion
- Invasion of grasses into upland peat and heather moorlands
- Spread of invasive plant and animal species
- Loss of coastal habitats due to sea level rise
- Damage to river habitats due to flooding and erosion

## Adaptation effects could include:

- New habitat networks to help species adapt to changing climate
- Sustainable river and coastal flood management – creating new habitats
- Native woodland expansion

## Other effects could include:

- Changing heather moorland to reduce carbon emissions from burning
- Positive management of peatlands to retain carbon

## Coasts and firths

### **Direct effects could include:**

- Increase in flood risk along the coast
- Permanent loss of land to the sea
- Changes in patterns of erosion and deposition
- Impacts on coastal and estuarine habitats and landscapes

### **Adaptation effects could include:**

- New coastal flood defences to protect property, roads, rail and high quality farmland
- The development of 'managed realignment' projects to retain natural coastal habitats, landscapes and flood defences.

### **Other effects could include:**

- Development of tidal power generation infrastructure

# Evaluation framework

To help us judge the effects of climate change, we will be looking at the kinds of benefits the community derives from the surrounding area. This reflects the fact that different people value things like woodland or the coast for different reasons. The approach is based broadly on the concept of 'ecosystem services' – rather a technical way of way of saying we need to understand what is important and why.

For the purpose of the Panel discussions, it will be sufficient to familiarise yourself with the types of benefit set out in the table on the next page. We will introduce and discuss these with the Panel and there will be an opportunity to add any further categories you think are important.

More information on the underlying concept of ecosystem services is available on the following website: <http://www.ecosystemservices.org.uk/>

## Types of benefit derived from the local area

Benefit	Examples
Recreation	Walking, riding, cycling – routes and areas.
Tourism	Visitor activity, attractions, part of the way the area is promoted or portrayed
Learning	Formal and informal source of education about the natural and cultural heritage
Wildlife	Presence and awareness of important plants and animals
Food and timber	Cultivated crops, farmed sheep and cattle, game and wild food, timber
Freshwater	Source of drinking water
Fuel	Wood, peat, hydro, wind
Calm	Restorative benefits e.g. from woodland, or as a result of perceived remoteness
Inspiration	Resulting from beauty, drama, wild, romantic or powerful character of the landscape – can be individual or related to arts and literature
Escapism	Influence of remoteness, and escape from stress or reversion to childhood
Sense of place	Distinctive landscape contributing to identity of area or community
Sense of history	Permanence of natural landscape, evidence of history of human activity
Spiritual values	Religious or non-religious – character of the landscape, specific features or buildings etc.
Water regulation	Storing water, accommodating floodwater
Climate regulation	Storing carbon in soils and vegetation, providing shelter