

**THE POTENTIAL IMPACT OF CLIMATE CHANGE IN THE  
EAST MIDLANDS**

**An update of the report for East Midlands Sustainability Round Table,  
published in July 2000**

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## CONTENTS

<b>1</b>	<b>Introduction</b>	<b>3</b>
<b>2</b>	<b>New climate scenarios</b>	<b>3</b>
<b>3</b>	<b>New information published since last report</b>	<b>11</b>
<b>4</b>	<b>Actions in the East Midlands</b>	<b>11</b>
<b>5</b>	<b>Summary of action so far</b>	<b>15</b>
<b>6</b>	<b>What has changed in four years?</b>	<b>15</b>
<b>7</b>	<b>Organisation</b>	<b>16</b>
<b>8</b>	<b>Conclusions</b>	<b>16</b>
<b>9</b>	<b>References</b>	<b>17</b>
	<b>Appendix 1: Bibliography and other sources of information</b>	<b>18</b>

### EXECUTIVE SUMMARY

This report updates the report on the Potential Impacts of Climate Change in the East Midlands, published in July 2000 by the East Midlands Sustainable Development Round Table.

New climate scenarios published in 2002 have reinforced the messages about climate change and given greater detail. The requirement for action to adapt to the inevitable consequences has not diminished. Regional agencies are incorporating climate change into their work but little adaptation has happened on the ground. Involving the wider community remains a challenge.

The story on mitigation is more positive. The region has a long tradition of improving energy efficiency and seeking sources of renewable energy. There are many examples of innovative projects which are helping to demonstrate that the government's targets for energy reduction are achievable at no or minimal extra cost and the regional agencies are developing strategies and targets to that end.

## **1 INTRODUCTION**

A report on The Potential Impact of Climate Change in the East Midlands was commissioned by the East Midlands Sustainable Development Round Table (emsdOt) and published in July 2000. Copies of the Summary and Technical Reports are available from the Environment Agency<sup>1</sup> or, as pdf format, at the UK Climate Impact Programme (UKCIP) web site<sup>2</sup>. This report is an update and a summary of work that has happened since the publication date that has a bearing on the conclusions of the 2000 Report. It is expected that all reports will be available on the East Midlands Regional Assembly web site [www.emra.gov.uk](http://www.emra.gov.uk).

Climate events and the projected changes have continued in the news, along with the ongoing saga of the Kyoto Agreement and the failure of the United States and Russia to ratify. UKCIP02<sup>4</sup> (see below) reports that 1998 is still the warmest year in a 142 year record but 2001 became the second warmest and 2003 the fifth warmest on average. 2003 was noteworthy because of a heat wave across Europe during August which resulted in significant recorded deaths for the first time and structural damage and disruption to road and rail transport. Oxfordshire County Council reported that repairs to road surfaces due to the summer of 2003 would cost over £4M.

In terms of precipitation, 2000 was the wettest year in the 20<sup>th</sup> century and the third wettest since records began in 1766. There was 63% more rainfall in 2000 than in the relatively dry year 1996. There has been no discernable trend in annual average rainfall in recent years but the ratio of winter to summer averages has been increasing with an increased intensity of rainstorms. Lloyds has reported that, of the 10 worst recorded storms worldwide, 9 were in the last 10 years.

In the East Midlands and other parts of the UK there were serious floods in the winter of 2000 (and 2004 in the West Midlands). A dry summer in 2003 saw water resources under strain and predictions of a difficult summer in 2004 unless there was significant precipitation in the winter of 2003. February 2004 started with a record night time Central England Temperature of 11.2°C and a mean daytime temperature on the 4<sup>th</sup> of 12.5°C, beating the previous February record of 12.0°C from 1960. Earlier reported migration of birds such as swallows and, particularly, house martins reinforced the message. However, despite the upward trend in average temperatures, snow and ice in February reminded us that global warming does not mean that there will never be cold snaps. The new records and the variability are seen as indicative of the future climate.

On the coast, sea level has been rising around the UK at about 1mm per annum and average wave heights were increased by 10 to 15% between the 1980s and 1990s.

So there is continuing evidence that the climate is changing. The new models show a close link with human activity although this does not prove that climate change is happening as a result of the release of greenhouse gases (GHGs). It could be due to natural or other anthropomorphic causes but the consensus among most scientists working in this field is that the association is now undeniable.

## **2 NEW CLIMATE SCENARIOS**

The 2000 emsdOt Report used UKCIP climate scenarios published in 1998<sup>3</sup> (UKCIP98) as the basis for future climate analysis. UKCIP98 used climate models to produce maps for temperature and precipitation in 2020, 2050 and 2080 for four carbon dioxide emission scenarios. These maps were based on 300km squares, the East Midlands falling into one of these. The 2000 Report involved extra work by Dr R Wilby on the outputs from the UKCIP98 models, using regional models and a statistical downscaling technique to give higher resolution.

UKCIP published a new report in 2002 with revised climate scenarios (UKCIP02)<sup>4</sup>. These were improved in a number of ways, including: more recent economic scenarios as the basis, improved climate models, incorporation of more factors affecting climate (more greenhouse gases and sulphate aerosols) and more derived results. UKCIP02 produced results based on 50km grid squares, giving higher resolution than previously. This update has taken the results from UKCIP02 without further refinement.

In UK terms, the new scenarios show some changes in future years when compared with UKCIP98. The detail of the variation depends on the scenario and the target years.

### What is the basis for the scenarios and how have they changed?

There are four climate scenarios based on emission scenarios that have been derived for a range of purposes by the International Panel on Climate Change (IPCC)<sup>5</sup>. Four scenarios are used for the UKCIP studies: **Low Emissions**, **Medium-Low Emissions**, **Medium-High Emissions** and **High Emissions** (colour coded for later tables). These four cover the expected range of emissions and are each considered equally likely. They assume different emissions of carbon dioxide resulting in different atmospheric concentrations in the model years of 2020, 2050 and 2080. The calculations have resulted in slightly higher estimates of CO<sub>2</sub> atmospheric concentrations for all three years in UKCIP02 compared with UKCIP98.

The principal changes for the East Midlands are summarised below with a commentary on the differences between the results recorded in the emsdOt 2000 study and UKCIP02 that would be significant for the region. Some of these comparisons have been extracted from maps and the differences cover a range. Table 1 summarises the changes in temperature and precipitation annually and for all seasons for the four scenarios. Maps are also included for the East Midlands in Figures 1 to 4 of changes in annual daily temperature, summer and winter precipitation and autumn soil moisture content. These are derived from the maps for the UK courtesy of UKCIP.

#### 2.1 Changes in temperature

The UKCIP02 full report shows maps of the UK with annual changes in temperature and for four seasons, for four scenarios and for three future time periods (2020s, 2050s and 2080s). A total of 60 maps. The general picture compared with the average for 1961 to 1990 for the East Midlands shows:

- For all emission scenarios, in the 2020s, average annual temperature and seasonal temperatures increase by about 0.5 to 1.0°C, except all summer averages and autumn averages for **Medium-High** and High scenarios which increase by nearer 1.5°C
- The spread widens in future years. By 2080s, the annual average increase is 2.5 to 3.0°C for **Low** emissions to 3.5 to 4.5°C for High. Winter increases in averages are from 1.5 to 2.0° (**Low**) to 2.5 to 3.5°C (High) and summer from 2.0 to 3.0°C (**Low**) to more than 4.5°C (High).

These changes may seem small but the last ice age ended as the result of a shift of about 5°C in annual average temperature. Figure 1 shows enlarged maps for changes in annual average daily temperature in the East Midlands, with **Low** and High emissions for the three time periods.

#### 2.2 Changes in precipitation

A similar set of 60 maps is provided is provided by UKCIP02 for precipitation. Figures 2 and 3 show the percentage changes in summer and winter seasons for Low and High scenarios and for three time periods as before. The main points for the East Midlands are:

- Annual rainfall averages show little change over the whole range of emission scenarios and timescales
- Winter rainfall shows increases across all scenarios with time, with the biggest increase of +30% toward the end of the century for High emissions
- Summer rainfall shows similar decreases, with time. The biggest decrease being over 50% for High emissions towards the end of the century

**TABLE 1: Climate scenarios – Change in temperatures °C (from UKCIP02)**

	Low emissions			Medium-Low emissions			Medium-High emissions			High emissions		
	2020s	2050s	2080s	2020s	2050s	2080s	2020s	2050s	2080s	2020s	2050s	2080s
<b>Annual</b>	0.5 to 1.0	1.0 to 2.0	2.5 to 3.0	0.5 to 1.0	1.5 to 2.0	2.0 to 3.0	0.5 to 1.0	1.5 to 3.0	3.0 to 4.0	0.5 to 1.5	2.5 to 3.0	3.5 to 4.5+
<b>Winter</b>	0.5 to 1.0	1.0 to 1.5	1.5 to 2.0	0.5 to 1.0	1.0 to 1.5	1.5 to 2.0	0.5 to 1.0	1.0 to 2.0	2.0 to 3.0	0.5 to 1.0	1.5 to 2.0	2.5 to 3.5
<b>Spring</b>	0.5 to 1.0	1.0 to 1.5	1.5 to 2.0	0.5 to 1.0	1.0 to 1.5	1.5 to 2.5	0.5 to 1.0	1.5 to 2.0	2.5 to 3.0	0.5 to 1.0	1.5 to 2.0	3.0 to 3.5
<b>Summer</b>	0.5 to 1.5	1.5 to 2.0	2.0 to 3.0	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	0.5 to 1.5	2.0 to 3.0	3.5 to 4.5	1.0 to 1.5	2.5 to 3.5	4.5+
<b>Autumn</b>	0.5 to 1.0	1.5 to 2.0	2.0 to 2.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.0	1.0 to 1.5	2.5 to 3.0	3.0 to 4.0	1.0 to 1.5	2.5 to 3.0	4.5+

**TABLE 2: Climate scenarios – Changes in precipitation % (from UKCIP02)**

	Low emissions			Medium-Low emissions			Medium-High emissions			High emissions		
	2020s	2050s	2080s	2020s	2050s	2080s	2020s	2050s	2080s	2020s	2050s	2080s
<b>Annual</b>	-10 to +10	0 to -10	0 to -10	Nil to -10	0 to -10	0 to -10	Nil to -10	0 to -10	0 to -10	Nil to -10	0 to -10	0 to -10
<b>Winter</b>	0 to +10	+10 to +15	+0 to +15	0 to +10	+10 to +15	+10 to +20	0 to +10	+10 to +20	+25 to +30	0 to +10	+15 to +20	+25 to >+30
<b>Spring</b>	-10 to +10	Nil to -10	Nil to -10	Nil to -10	Nil to -10	Nil to -10	Nil to -10	Nil to -10	Nil to -10	Nil to -10	Nil to -10	0 to -10
<b>Summer</b>	-20 to -30	0 to -10	-20 to -30	-10 to -20	-20 to -40	-20 to -40	-10 to -20	-20 to -30	-40 to -50	-20 to -30	-20 to -40	-40 to >-50
<b>Autumn</b>	0 to -10	0 to -10	0 to -10	0 to -10	0 to -10	0 to -10	0 to -10	0 to -10	0 to -20	0 to -10	0 to -10	0 to -20

“Nil” is within natural variability

## East Midlands Change in annual average daily temperature

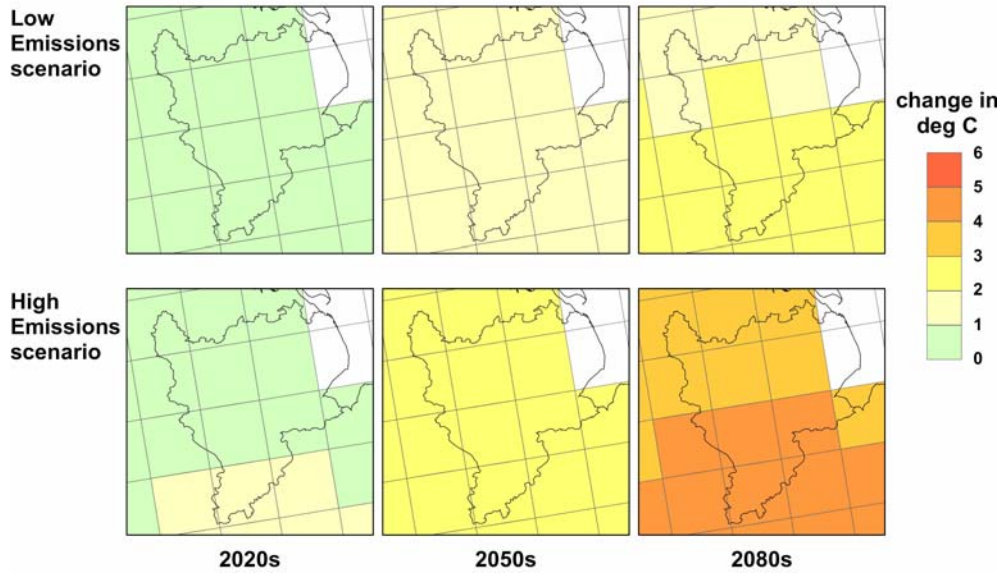


Figure 1: Changes in annual average temperature

## East Midlands Percentage change in summer precipitation

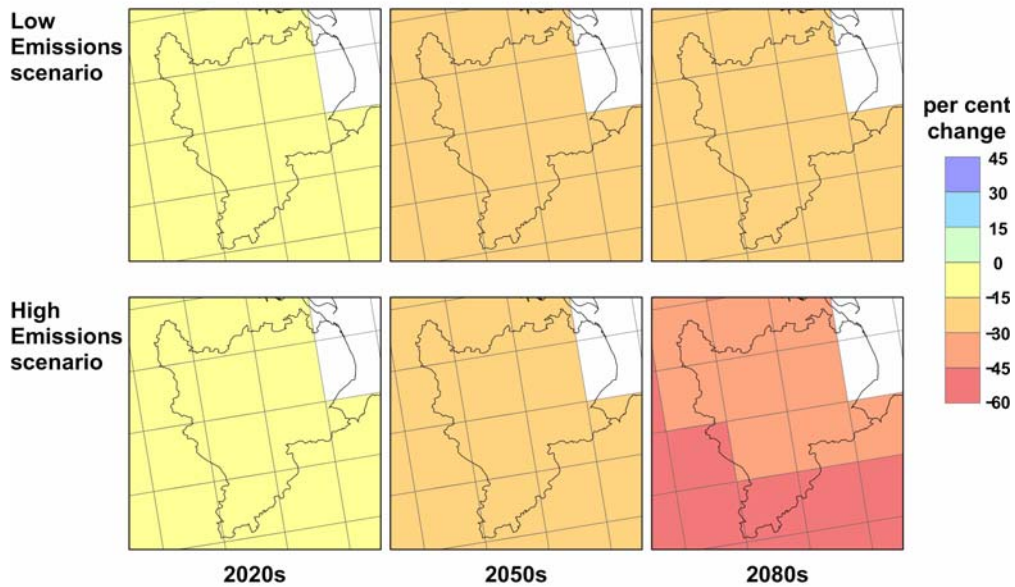


Figure 2: Changes in average summer precipitation

## East Midlands Percentage change in winter precipitation

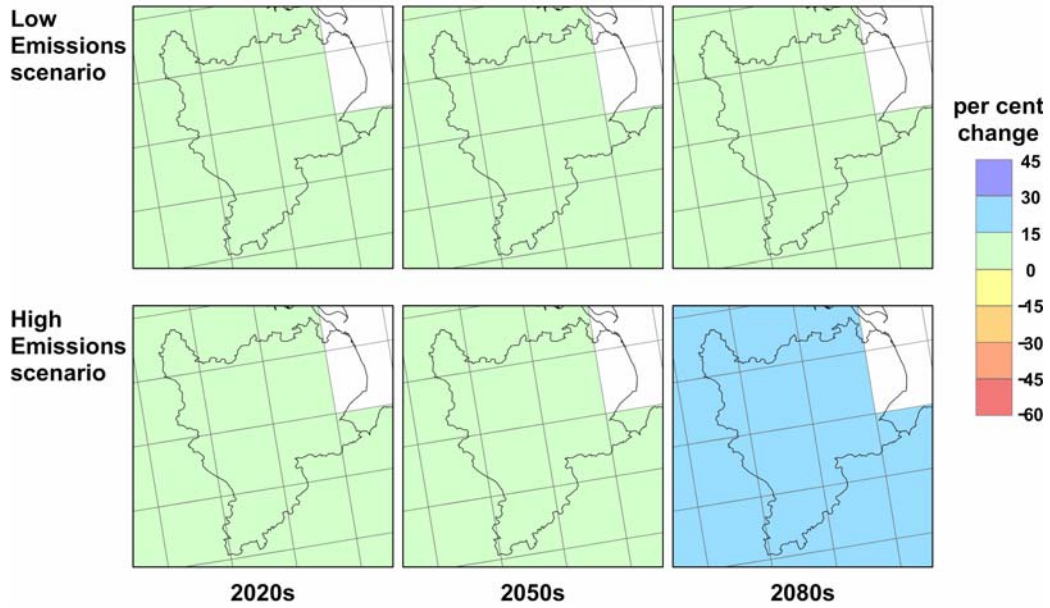


Figure 3: Changes in average winter precipitation

## East Midlands Percentage change in autumn soil moisture content

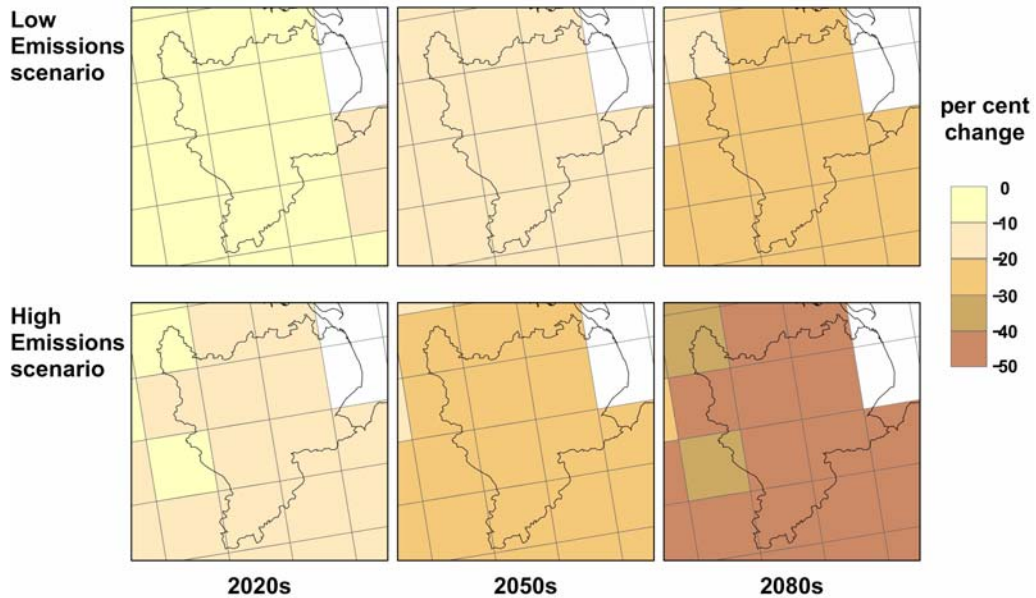


Figure 4: Changes in annual autumn soil moisture content

### 2.3 Other climate changes

UKCIP02 reports on a range of other parameters in varying degrees of detail. Some of the data are restricted to the Medium-High scenario and for the 2080s only but they serve to show the likely trend. The main highlights for the East Midlands are:

**Soil Moisture Content:** Changes in temperature and precipitation as well as wind speed, evaporation and radiation, would be expected affect soil moisture content. The percentage change is relatively small for annual and winter and spring seasons – less than 10% increases and decreases. The most severe impact is in the summer and autumn with decreases of about 30% and 50% by the 2080s; see Figure 4.

**Variability:** The main change is an increase in the variability between years, particularly of summer temperatures and winter precipitation.

**Cloud cover:** Small increase in winter but, by 2080s, a decrease of up to 15% in summer.

**Relative humidity:** Modest changes leading to up to 12% decrease in summer in 2080.

**Daily wind speed:** The worst case is up to about 10% increase in the winter.

**Snowfall:** 60 to 90% decrease.

**Depressions:** A small increase in the number overall with up to 40% increase in “deep depressions” in winter.

It should be noted that there is more uncertainty associated with these measures than with temperature and precipitation.

#### Changes to the Gulf Stream

It is theoretically possible that climate changes could significantly affect the Gulf Stream on which the UK depends for its temperate climate. This could make the climate colder, with continental winters more like northern Europe. However, this is considered extremely unlikely, certainly within the timescale of UKCIP02 – to the end of the 21<sup>st</sup> century.

There is a predicted weakening of the Gulf Stream which does bring a reduced warming effect on the UK climate from that source but it is more than compensated for by the warming due to greenhouse gases. This is factored in to the results reported.

### 2.4 Extreme events

Structural damage and economic disruption as well as the effects on humans and biological systems are probably more affected by extreme events than the average trend. UKCIP02 gives more information on these although it is not as extensive as that for average results.

**Precipitation:** There are various ways of looking at this but all give a similar message. By the end of the century there could be a doubling of the frequency of extreme winter rainfall events. Although the actual number of days remains small at two or three per annum, these are a common cause of flooding.

An alternative way of looking at the results is the return period (the long-term average time between events). For eastern England the range is 10 to 20% increase in the winter precipitation



associated with a 2 year return period (15 to 25% decrease in summer). Extrapolation to longer return periods (flood and drought risk usually refer to return periods of 20 to 100 years) is difficult with only a short historical data record. For example, UKCIP02 states that “amount of daily rainfall that at present could be expected to occur on average once in every 20 winters in south east England, increases by between 15 and 30% (depending on scenario).

Overall, the probabilities of extreme rainfall events increases in winter and decreases in summer.

**Temperature:** As with precipitation, there is a number of ways of looking at this. “Extremely warm days” (defined in terms of 90<sup>th</sup> percentile) could increase by up to 30 days in the summer. Over a full year this is 60 days (compared with the reference period 1961 to 1990). Similarly, the frequency of exceedance of any particular temperature will increase. Currently, there is only about a 1% chance that the summer temperature on any day will exceed 30°C in Central England. By 2080 this probability could be 20%. Temperatures could exceed 40°C once a decade by the 2080s.

Conversely, the number of frosty days will decrease in winter.

## **2.5 Other factors**

### **Growing season**

The higher temperatures lead to an increase in the length of the growing season by between 40 and 100 days, depending on scenario. (Defined as temperature above 5.5°C for five consecutive days until below 5.5°C for five consecutive days).

### **Heating and cooling requirements**

By comparing periods when the temperature is below 15.5° and above 22°C, and by how many degrees, UKCIP02 has made an estimate of the changes in the number of degree days. This can be used for estimating heating or cooling requirements. Depending on scenario, the percentage relative change for heating degree days is a reduction of between 20 and 45%. The absolute number of cooling degree days varies between 40 to 200 – depending on scenario and location.

### **Sea level rise**

Global sea level rise is expected to be about 6cm by 2020, between 14 and 18cm by 2050 and between 23 and 36cm by 2080, depending on scenario. Actual sea level rise at any point depends also on land movements over the same period. As eastern England is subsiding, the relative change for that coast is between 22 and 82 cm by 2080. The UKCIP02 results suggest a slightly lower rate of rise than UKCIP98.

There is a long lag time in the thermal expansion of the sea and so it is estimated that, even with significant reductions in CO<sub>2</sub> emissions in coming years, sea level could continue to rise by about 1 metre over several centuries.

Coastal flooding is caused by a combination of high relative sea level, low atmospheric pressure and increased wind speed. Wind direction is also important. It has already been noted that these are all going in the direction of increasing the risk. There is a lot of uncertainty in combining these factors but the overall results suggest a further increase in the risk.

## **2.6 Variations across the Region**

It can be seen in Figure 1 that there are variations in the changes in temperature across the region. The south is warmer under all scenarios. Precipitation (Figures 2 and 3) does not vary so much but summer precipitation is reduced the most in the south during the 2080s for the High scenario. These results reflect the overall picture for the UK.

There is similar variability from north to south across the Region in some of the other measures.

## 2.7 Comparison with 2003 Report

The emsdOt report used a different methodology to produce the maps and some other data. It started with the UKCIP98 report and extracted some data then conducted a more detailed analysis on one scenario – equivalent to Medium-High.

**Table 3: Comparison of the differences between the results from the two reports**

emsdOt 2000	UKCIP02
<b>Temperature</b>	
Range: Annual +1.1 to +3.2°C from Low to High by 2080s from UKCIP98	Range: Annual +2.5 to +4.5°C from Low to High by 2080s
Annual +2.7 to 3.1°C, Winter +3.3 to +3.8°C, Summer +2.2 to +3.1°C by 2080s downscaled*	Range: Annual +3.0 to +4.0°C, Winter +2.0 to +3.0°C, Summer +3.5 to +4.5°C by 2080s under <b>Medium-High</b>
<b>Precipitation</b>	
Winter +11% by 2050s under <b>Medium-High</b>	Winter +10 to +20% by 2050s under <b>Medium-High</b>
Summer -16% by 2050s under <b>Medium-High</b>	Summer -20 to -30% by 2050s under <b>Medium-High</b>
Annual +4 to +13%, Winter +20 to +35%, Summer -10 to -35% by 2080s downscaled*	Range: Annual 0 to -10%, Winter +25 to +30%, Summer -40 to -50% by 2080 under <b>Medium-High</b>
<b>Evaporation</b>	
Annual +14%, summer +15%, autumn +29% by 2050s under <b>Medium-High</b>	No data

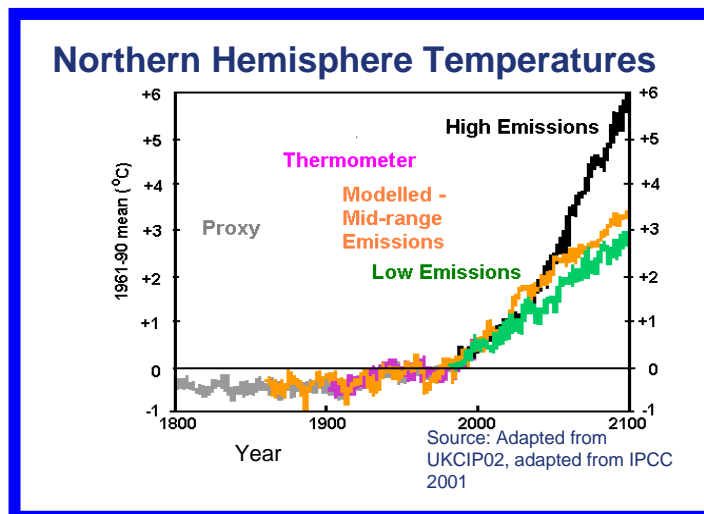
\* "Downscaled" is the statistical method referred to in Section 2, only applied to the **Medium-High** scenario.

It is not easy to extract other comparisons but the table shows that the main differences between the two reports are:

- Projected temperatures are generally higher again by between 0.5 and 1°C by the 2080s.
- Increases in winter precipitation in 2080s are marginally less; decreases in summer precipitation higher.

In summary, even hotter and drier in summer but winters not quite as warm or as wet as previously reported. To put these differences in context, they are estimates over a period of 80 years and to some extent reflect the variations in the assumptions in the scenarios used as well as improvements in the modelling, etc.

The most significant point is that the changes predicted for the period to 2050 for temperature for all scenarios do not vary much – see Figure 5 below:



**Figure 5: Climate scenarios do not diverge until 2050**

Thus, any decisions that are made now with a life expectancy of less than 50 years can probably be considered independently of the scenarios. Conversely, whatever actions are taken in the next few years to mitigate carbon dioxide or other greenhouse gas emissions, will not have any effect on the predicted changes to temperature for at least 50 years.

### **3 NEW INFORMATION PUBLISHED SINCE THE LAST REPORT**

The impacts of and adaptation to climate change and the associated issues around carbon dioxide emissions, energy efficiency, renewable energy and related research have been a growth industry. There have been government reports and a white paper on energy targeting a 60% reduction in carbon emissions by 2050; various research reports from IPCC and UKCIP and their partners on the science of climate and adaptation; most regions of the UK have produced an impact report and new organisations set up specifically to manage or fund activities associated with energy use have started to add to the literature. In this short review it is not possible to do them all justice. Appendix 1 is a selective bibliography of some key publications and pointers to other sources of information.

### **4 ACTIONS IN THE EAST MIDLANDS**

There has been a start to co-ordinate action in the East Midlands since the publication of the emsdOt report in July 2000. The Regional Assembly produced an Environment Strategy<sup>6</sup> in 2002 which included commitments to respond to the emsdOt report. Table 4 picks out the two most relevant policy statements which are about mitigation. Other policy statements (for example on water resources and flooding) refer to climate change but usually in the context of wider issues. The need for action is expected to be reinforced in the East Midlands Energy Strategy, to be launched on 26 March 2004, and in the revision to the Integrated Regional Strategy, to be published in early 2005.

#### **4.1 Energy use and efficiency**

This is the area where most activity has occurred. Some action is driven by national initiatives such as the introduction of the Climate Change Levy and carbon trading. Regionally, several projects are under way which are demonstrating the application of mitigation techniques: use of renewable sources and improved energy efficiency. The box below gives some examples. This is not meant to be comprehensive but gives a flavour of the sort of work being undertaken. Many of these projects also address other sustainability issues such as water use and waste production.

#### **Demonstration projects for energy efficiency and renewables:**

- Several local authorities are improving the energy efficiency of their own property and purchasing green electricity
- 11 East Midlands local authorities have signed up to the Nottingham Declaration
- 6 local authorities (out of 24) are involved in the Councils for Climate Protection project aimed at achieving a 20% reduction in community energy use
- Several LAs involved in energy partnerships
- The region's universities are all active in energy research
- Newark and Sherwood District Council identified as a Beacon LA for tackling fuel poverty
- Leicester City is progressing a £5M Combined Heat and Power initiative
- Nottinghamshire CC has installed several wood burning boilers in schools
- Sherwood Energy Village, Chesterfield Innovation Centre, Mablethorpe Wind Park, Hockerton Housing Project, Daventry Solar Plan, Millenium Green Scheme at Collingham are some examples of practical projects
- Milton Keynes/South Midlands Sustainable Community approved. The Regional Assembly has published "Viewpoints on Sustainable Energy in the East Midlands" and plans to commission work to evaluate the regional projects.
- Boots plc awarded Energy Manager of the Year 2002

The Regional Assembly consulted on a proposed Regional Energy Strategy in June 2003 (Towards a Regional Energy Strategy) <sup>7</sup> with the ambition to become an exemplar region. A policy statement and action plan will be produced later this year setting out in more detail the targets for energy saving and renewables in detail. The Action Plan will also seek to improve understanding among the public on the importance of energy use and its impact on climate.

The summary targets are likely to be the same as those in the Regional Environment Strategy. This contains two policy statements directly related to climate change. Other policy statements are also impacted by or contribute to the issue.

**TABLE 4: Climate policies, success criteria and targets from the Regional Environment Strategy<sup>6</sup>**

<b>Policy ENV 6: To minimise greenhouse gas emissions and protect the environment when adapting to the challenges and taking up the opportunities which climate change will bring.</b>	
<b>Success criteria:</b> Lower levels of emissions of greenhouse gases, more energy in the region generated by processes that do not cause greenhouse gas emissions and regional companies taking a lead in taking up new business opportunities for developing technologies climate change may require.	
<b>Targets</b>	
a) Emission level of basket of six greenhouse gases that contribute to climate change (CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, HFC, PFC, and SF <sub>6</sub> ).	a) Reduction by 12.5 % below 1990 level over the period 2008-2012.
b) Emission levels of CO <sub>2</sub> .	b) Reduction by 20% below 1990 level by 2010.
e) Emission of level of basket of six greenhouse gases per unit of GVA (or GDP)	e) Year on year improvement in resource productivity of regional economy
<b>Policy ENV 8: To encourage the reduction of the environmental impact of energy use in the region</b>	
<b>Success criteria:</b> An increased number of renewable energy installations, reduced impact of our energy use in the region on climate change and greatly improved public awareness of energy matters.	
<b>Targets</b>	
a) Proportion of renewable energy generated within the region going to the National Grid.	a) 102Mwe by 2003 465Mwe by 2010 1000Mwe by 2020.
b) Energy use per household.	b) 20% improvements in energy efficiency by 2012 and a further 20% by 2020.
c) Proportion of energy from Combined Heat and Power (CHP) plants in the region.	c) Increase to 708 MWe by 2010

#### 4.2 Impact and Adaptation

The emsdOt Report highlighted the most vulnerable areas for the Region. There were:

- Water Resources and Quality
- Flooding – Urban and Lowland
- Agriculture
- Coastal Region
- Biodiversity
- Manufacturing, Services and Retail
- Construction and Building

- Tourism and Recreation
- Transport

Since publication a number of things have happened that relate to these priorities.

**Water Resources:** The Environment Agency has published “A Water Resources Strategy for the East Midlands”<sup>8</sup>. This adopted a scenario approach similar to that for the UKCIP climate research. It looks at how the supply and demand balance could be met to 2025 and takes climate change into account (based on UKCIP98). Higher temperatures will increase demand, but increased winter rainfall could benefit groundwater and reservoir recharge (although increased variability in rainfall could make this less predictable). Balancing demand from public supply, agriculture, biodiversity and similar interests with the need to get the supply position in balance in some parts of the region means that demand management and flexibility in the face of uncertainty will be required. This work is now being taken forward over several years with a series of Catchment Management Abstraction Strategies (CAMS) for each catchment.

**Flooding:** Severe flooding occurred in the Trent catchment in October and November 2000. Over 600 properties were flooded (property damage, based on ABI estimates, up to £20M and incurring costs to the Environment Agency for response and subsequent repairs of about £1M). The severity could be related to the estimated return periods which ranged from about 1 in 50 years to 1 in over 100 years across the area affected. This single event could not be blamed on climate change but is indicative of the potential impact of the increasing risk.

#### **The hardening views of the insurance industry to flooding**

Insurance cover for flood risk is unique to the UK and The Association of British Insurers (ABI) is concerned about the increasing level of claims. They are basing their concerns on an anticipated 15 to 30% increase in winter rainfall leading to a 20% increase in peak river flows. They suggest that this will halve the effectiveness of current defences or double the risk of urban flooding. Sea level rise is seen as increasing the flood risk 30 fold. They are basing their argument for improved defences in order to maintain insurance cover on the need for a 1.3% risk (equivalent to a 1 in 75 year event). In the East Midlands, those properties that are protected will generally be to about 1 in 100 years on an historical basis.

The Midlands Region of the Environment Agency is about to publish a Strategy for the River Trent Catchment which will address the future protection against flooding.

Not all flooding is due to rivers overflowing their banks or topping the defences. In urban areas, overcharged sewers (surface or combined) can cause flooding of roads and property. Much of the sewerage system is fairly old and designed for lower flows. Responsibility for maintenance and improvements is usually with the water service companies (although some may be privately owned or the responsibility of other organisations). The water companies plan their investment programme on a 5 year cycle linked to the price review by the Office of Water Services (OFWAT). Severn Trent Water Limited’s business plan includes submissions to deal with historical and new flooding events but this has yet to be agreed. New sewers are now designed to a standard with an allowance for climate change.

#### **Agriculture**

No specific regional actions responding directly to climate change have been identified although the CLA has prepared a national report and there is a national study –REGIS (see Appendix 1). Agriculture and the rural economy have ongoing problems, beyond the scope of this report, which are justifiably assuming priority. In fact, many of the outcomes that could ensue from the review of the Common Agricultural Policy and the Government’s policies for rural regeneration could be beneficial to the some of the issues raised in the emsdOt report.

### **Coastal issues**

Flooding from the sea is the main issue identified due to climate change. The Environment Agency already makes an allowance of 6mm per annum for sea level rise in planning future defences. The Lincolnshire coast and the Humber estuary are the only parts of the region affected. As well as raising defence heights, alternatives are planned which involve realignment of the defence inland creating new wash land and salt marsh to compensate for losses elsewhere. This is a requirement under the Habitats Directive and will be beneficial for biodiversity

### **Biodiversity**

Little has happened locally in the last four years in the context of climate change. English Nature is embarked on a long term national project looking at the impact of climate change on biodiversity (Monarch, see bibliography). The most recent phase has produced a toolkit that will be used to inform the review of the regional Biodiversity Action Plan targets in 2005/6. It is also just starting on another phase, to report in March 2005, which will contain guidance on the impact of climate change on biodiversity, region by region.

### **Manufacturing services and retail**

The most noticeable response from business to the overall issue has been the complaints about the climate change levy. However, East Midlands Development Agency (emda) is concerned to improve the international ranking of the region, including its low position in respect of resource productivity. In the Regional Economic Strategy<sup>9</sup>, emda records the “pressing need for the implementation of a clear regional programme to both adapt to the impacts of climate change, and significantly reduce the current emissions of greenhouse gases”. Emda see that as requiring “a more considered and integrated view towards regeneration and economic development in the river corridors and extensive low-lying areas of the region” and that “step change is required in mainstream development by incorporating more sustainable design into economic and environmental opportunities, so as to minimise the use of water, energy and raw materials”. The following are included among the key activities:

- **Reduce the emissions of greenhouse gases by business** through improved resource and energy efficiency programmes in partnership with organisations such as the Carbon Trust.
- **Develop a more resource efficient business culture** through a campaign aimed at SMEs to demonstrate and help realise the business benefits of using fewer resources and minimising waste.
- **Increase the electricity generated from renewable sources** through technology and knowledge transfer to the power and energy generation clusters.
- **Encourage sustainable approaches to floodplain development** through awareness-raising to developers and the insurance industry, and incorporation of more resilient design.

With the relevant targets:

**5% of electricity to be generated from renewable sources by 2005**

**8.3% of electricity to be generated from renewable sources by 2010**

Emda also identify environmental technologies as a cluster for development, particularly “green” technologies.

### **Construction and Building**

No specific actions from this sector could be identified although some developments have focussed on energy saving – see earlier box. However, Regional Planning Guidance and the attitudes of the planning authorities are discouraging development in flood risk areas.

Emda have the following key activities for Construction and Building:

- Encourage sustainable approaches to floodplain development through awareness-raising to developers and the insurance industry, and incorporation of more resilient design.
- Encourage the use of sustainable design for new developments to result in less use of water, energy and raw materials through a programme of demonstration projects and the spread of good commercial practice.

### **Tourism and Recreation**

Tourism is identified as a potentially strong growth area by emda and in 2003 “Destination East Midlands”<sup>10</sup>, the Tourism Strategy, was published. This is aimed at capitalising on the growth to achieve a 2% increase in visitor spend by 2010. North West Region is just starting a major climate impact study on tourism which could inform the East Midlands.

### **Transport**

The developing Regional Transport Strategy focuses on improving transport, including public transport. This is not aimed specifically at adapting to climate change, but parts of the strategy will help towards achieving reductions in CO<sub>2</sub> emissions. Local authorities are producing transport plans and implementing or encouraging new services. For example, in Nottinghamshire traffic growth has stabilised and bus patronage has increased.

## **5 SUMMARY OF ACTION SO FAR**

Regional policy has recognised the importance of climate change and started to incorporate aspects into long term strategies and plans. There is happening mostly in energy use with many projects planned or under way targeting energy efficiency and renewable energy. This is perhaps not surprising as there is now a Government drive promoting this but the Region is building on a longer history of interest and action on energy use.

Adaptation has been recognised in other aspects of policy such as water resources and flood protection and significant investment is planned and under way by the Environment Agency and the water companies. Local authorities and the regional bodies such as the Regional Assembly and emda have incorporated actions and targets into their strategic documents. Outside of that small circle, for example in business or the wider public, there is little sign of recognition of the issues – except perhaps from those that are most at risk from flooding.

## **6 WHAT HAS CHANGED IN FOUR YEARS?**

The new climate scenarios have firmed up the range of possible future climates, improved the confidence in the results and emphasised that some change is inevitable. Reducing CO<sub>2</sub> emissions is part of national policy and a necessary step to avoiding the worst scenarios. However, Figure 5 indicates that what ever progress is made, the outcome for the next 50 years is probably fixed. In that timescale:

- Temperatures could increase by up to 2°C depending on season – more than twice the change in the whole of the last century.
- Winter rainfall could have increased by about 15%. Summer rainfall could decrease by up to 30%.
- Autumn soil moisture contents could fall by an additional 20 to 30%.

These changes reinforce the conclusions from the emsdOt report. The new scenarios neither reduce the impact nor the need for adaptation; if anything they increase the need.

Particular risks that are reinforced since the emsdOt report are:

- Damage to infrastructure due to extreme temperatures.
- Increased stress and risk of mortality from heat.
- Increased risk of skin cancer.
- Increased risk of flooding either by reducing the level of protection of existing defences or increasing the frequency and extent of flooding in unprotected areas. Urban areas will be at increased risk from sewers surcharging. Problems gaining insurance cover.
- Reduced availability of water and increasing demand.
- Pressure on agriculture and biodiversity.
- Possible increase in the risk of storm damage.

On the positive side:

- Reduced damage and accidents due to cold weather.

- Reduced mortality due to cold weather.
- Reduced expenditure on heating by the poor.
- Longer growing period.

Uncertain impacts:

- Energy demand: less for heating but potentially more for cooling.
- Business opportunities in energy and adaptation.

### **A changing world**

We must not forget that many other factors will change in the coming century. Political, economic and social circumstances could have just as much effect on the factors described as anything that results from climate change. Most of the changes in the 20<sup>th</sup> century were caused by these influences rather than the changing climate. In the context of this report, the long term concern about the security of energy supplies could force faster action.

## **7 ORGANISATION**

The East Midlands Sustainable Development Round Table took up the challenge on climate change early in the life of the East Midlands Regional Assembly. As the Assembly has become established and developed its priorities, the Assembly has taken on the work started by the Round Table. It has set up a group on *Promoting Sustainable Development*, which reports to the Assembly's Policy Board. In turn the *Promoting Sustainable Development Group* has set up a *Climate Change Steering Group*, which is pursuing a number of climate change projects including this updating of the July 2000 study; sustainable communities and construction; water resources and biodiversity.

## **8 CONCLUSIONS**

The new climate scenarios have reinforced the messages about the need to reduce GHG emissions and to plan to adapt to the inevitable changes. Qualitatively, the results show similar trends but there are differences in the detail.

Some action has been taking place in the East Midlands:

- The main activity has been in energy efficiency and renewable energy, continuing work already in progress in 2000.
- The Environment Agency and the water companies have responded to some of the issues arising in water management.
- There are plans to develop policies on biodiversity.
- Climate change is recognised as an issue to be included in regional strategic documents.

In some areas, particularly energy use, the East Midlands is probably ahead of many others with plans and targets in place. Otherwise, little progress appears to have been made in terms of adaptation and, especially, in gaining recognition in the wider audience outside of government agencies and local authorities.



- 1 The Potential Impacts of Climate Change in the East Midlands (July 2003); East Midlands Sustainable development Round Table. Summary and Technical Reports available from Environment Agency, 550 Streetsbrook Road, Solihull, B93 1QT.
- 2 UKCIP web site: [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 3 Hulme, M., Jenkins, G.J. (1998) Climate Change Scenarios for the UK: scientific report. UKCIP Technical Report No.1, Climatic Research Unit, Norwich, UK.
- 4 Hulme, M., Jenkins, G.J., Lu, X., Turnpenny, J.R., Mitchell, T.D., Jones, R.G., Lowe, J., Murphy, J.M., Hassell, D., Boorman, P., McDonald, R. and Hill, S. (2002) Climate Change Scenarios for the United Kingdom: The UKCIP Scientific Report, Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich.. Also available at reference 2.
- 5 IPCC (2001) Climate Change; The Scientific Basis. Cambridge University Press, Cambridge, UK.
- 6 East Midlands Regional Assembly (2002) Regional Environment Strategy. Available at [www.emra.gov.uk](http://www.emra.gov.uk)
- 7 Towards a Regional Energy Strategy (2001). Available at [www.emra.gov.uk](http://www.emra.gov.uk)
- 8 Environment Agency (2001) A Water Resources Strategy for the East Midlands. Available at [www.emra.gov.uk](http://www.emra.gov.uk). Based on national and regional (Midlands and Anglian) strategies produced by the Environment Agency and available as above.
- 9 East Midlands Development Agency (2003) Destination 2010; Regional economic strategy for the East Midlands 2003 – 2010. Available at [www.emda.gov.uk](http://www.emda.gov.uk)
- 10 East Midlands Development Agency (2003) Destination East Midlands: The East Midlands Tourism Strategy 2003 – 2010. Available at [www.emda.gov.uk](http://www.emda.gov.uk)

## APPENDIX 1 BIBLIOGRAPHY AND OTHER SOURCES OF INFORMATION.

This Appendix lists some of the major relevant publications published since 2000. It is by no means comprehensive! The references should enable the interested person to make a start in any particular field of interest. Web sites are given where available as these often contain other useful publications and links to other sites.

### Climate Science

- 1 Climate Change 2001: The scientific basis. Produced by the Intergovernmental Panel on Climate Change (IPCC). Reviews previous history, GHG emissions, understanding of the processes involved and the extent of human influence. Summary Report from IPCC Secretariat c/o World Meteorological Organisation, 7bis Avenue de la Paix, C.P. 2300, CH-1211 Geneva 2, Switzerland. See also [www.ipcc.ch](http://www.ipcc.ch).
- 2 Socio-economic scenarios for climate change impact assessment: a guide to their use in the UK Climate Impacts Programme (2000). Gives the background to the scenarios used for UKCIP work. Published by UKCIP. Available at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 3 Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report (2002). Update on previous study (UKCIP98) and the basis for this report. Published by Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, UK. Available on web site [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 4 Other information can be found at:
  - The Tyndall Centre: [www.tyndall.ac.uk](http://www.tyndall.ac.uk)
  - Meteorological Office: [www.met-office.gov.uk](http://www.met-office.gov.uk)

### Energy use and mitigation

- 1 Climate Change The UK Programme (2000). DETR proposals on emission reductions. Available from The Stationery Office.
- 2 Energy – The Changing Climate. 22<sup>nd</sup> Report of The Royal Commission on Environmental Pollution (2000). Set the scene for future reports by recommending a 60% reduction in carbon dioxide emissions. Published by The Stationery Office. Available at [www.rcep.org.uk](http://www.rcep.org.uk)
- 3 The Energy Review (2002). Report from The Performance and Innovation Unit on the issues around energy security and moving towards a low carbon economy. Published by the Cabinet Office.
- 4 Our energy future – creating a low carbon economy (2003). Government White Paper that sets out proposals to reduce carbon dioxide emissions by 60% by 2050 and, amongst other things, to ensure that every home is adequately and affordably heated. Published by DTi and available on their web site [www.dti.gov.uk](http://www.dti.gov.uk). The same web site is a source of many energy policy papers.
- 5 Carbon UK (2002). A general review of some of the issues. By Tina Fawcett, Andrew Hurst and Brenda Boardman, published by Industrial Sustainable Development Group, Environmental Change Institute, University of Oxford, 5 South Parks Road, Oxford OX1 3UB. See also [www.changingclimate.org](http://www.changingclimate.org)
- 6 Other information about organisations that support the policy or help fund work can be found for example at:
  - The Carbon Trust: [www.thecarbontrust.co.uk](http://www.thecarbontrust.co.uk)
  - D-carb UK: [www.d-carb-uk.org](http://www.d-carb-uk.org)
  - Carbon Reduction Plan: [www.cred-uk.org](http://www.cred-uk.org)
- 7 European Union Directive on Energy Performance in Buildings; Directive 2002/91/EC, published 16<sup>th</sup> December 2002.
- 8 European Union Directive on the Promotion of Electricity Produced from Renewable Energy Sources in the Internal Electricity Market; Directive 2001/77/EC, published 27<sup>th</sup> September 2001.

## Impacts and Adaptation

- 1 Potential UK adaptation Strategies for climate change; Technical report (2000). Report by consultants ERM for DETR. Looks at strategies and potential costs across a range of potential impacts.
- 2 Climate change: Assessing the impacts – identifying responses (2000). Highlights of the first five scoping studies completed under the UKCIP programme. Published by DETR. Available at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 3 Climate Change and Agriculture in the UK (2000). Published by MAFF.
- 4 Assessment of Potential Effects and Adaptations for Climate Change in Europe (2000). Published by The Europe Acacia Project, Jackson Environment Institute, University of East Anglia, Norwich, UK.
- 5 Climate Change and UK Nature Conservation (2000). Published by DETR and MAFF.
- 6 Climate Change: UK Farmland Birds in the Global Greenhouse (2000). Published by RSPB.
- 7 Water Resources for the Future, a Summary for England and Wales (2001). Published by the Environment Agency with Regional Appendices.
- 8 National Appraisal of Assets at risk from Flooding and Coastal Erosion (2000). Produced by Halcrow et al for MAFF.
- 9 Health Effects of Climate Change in the UK (2001). Reports from an Expert Committee on likely impacts on health. Published by Department of Health.
- 10 The Implications of Climate Change for the Insurance Industry an update and the outlook to 2020 (2001). Published by Chartered British Insurers.
- 11 Climate Change and Nature Conservation in Britain and Ireland, MONARCH – Modelling Natural Resource Responses to Climate Change (2001). Published by UKCIP at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 12 Climate Change and the Rural Economy (2001). Published by the CLA.
- 13 A Midsummer’s Nightmare? The Future of UK Woodland in the Face of Climate Change (2001). Published by the Woodland Trust.
- 14 REGIS – Regional Climate Change Impact and Response Studies in East Anglia and North West England (2002). Contrasts two regions and different scenarios to look at coastal and river flooding, agriculture, water and biodiversity. Available at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 15 Gardening in the Global Greenhouse, The impacts of Climate Change on Gardens in the UK (2002). Published by the National Trust and the Royal Horticultural Society. Available at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 16 Climate Change: Impacts on UK Forests (2002). Published by the Forestry Commission.
- 17 Climate change and local communities – How prepared are you? (2003). An adaptation guide for local authorities. Published by COSLA and others. Available at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 18 Climate Adaptation: Risk, uncertainty and decision-making (2003). Published by UKCIP and available at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 19 Building Knowledge for a changing climate – The impacts of climate change on the built environment. Sets out a research programme funded by UKCIP and the Engineering and Physical Sciences Research Council. Available at [www.ukcip.org.uk](http://www.ukcip.org.uk)
- 20 The impacts of climate change: Implications for DEFRA (2003). Highlights impacts on policy development. Available from DEFRA.

See also [www.ukcip.org.uk](http://www.ukcip.org.uk) for all the UK regional reports and the forthcoming publication on the cost implications.