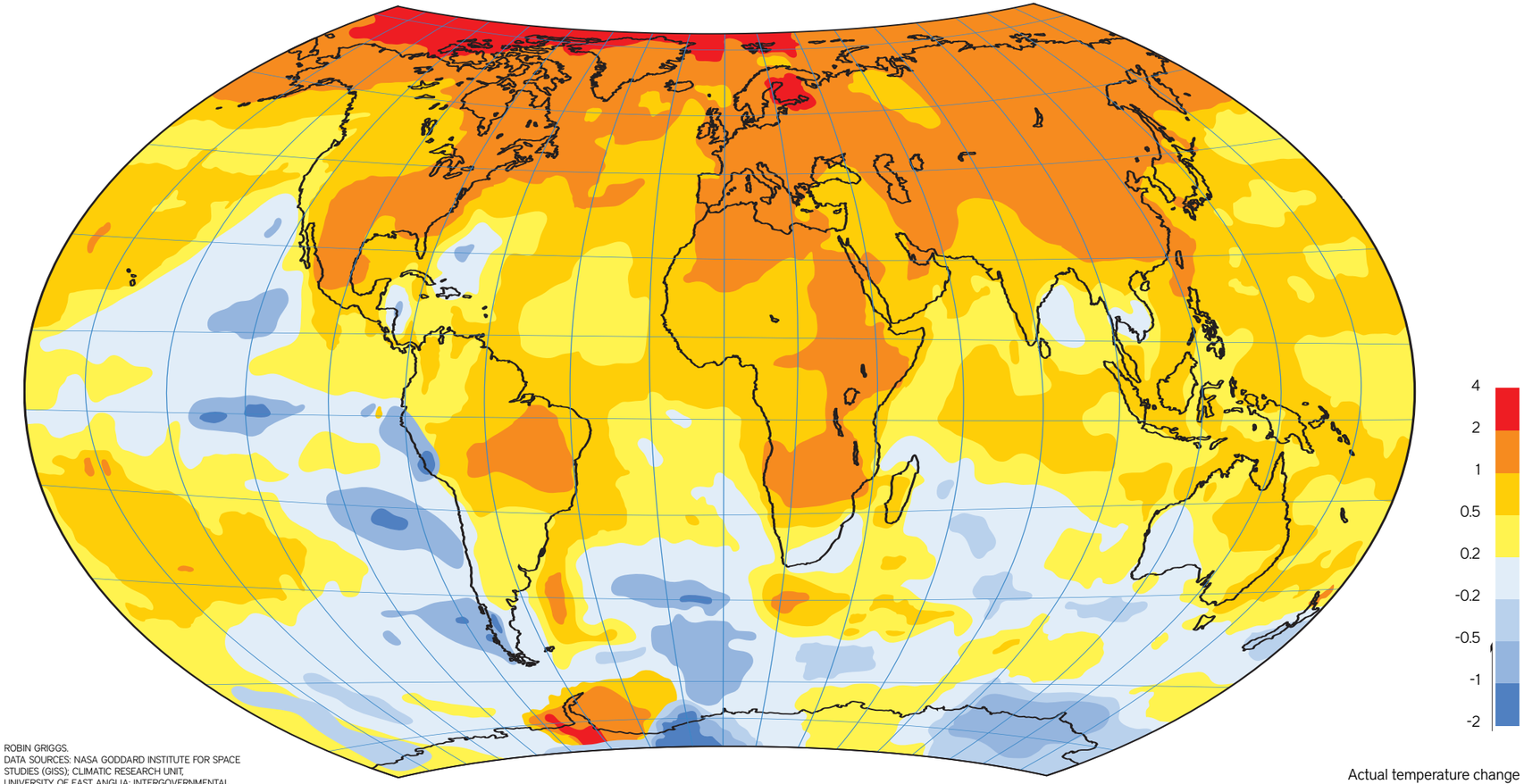
FACING THE FACTS

The scientific community has largely reached consensus: global warming is here, it is primarily a product of man's profligate use of fossil fuels, and the rate of change is accelerating. **Richard Bisgrove** gives an overview of the climate change debate, and what it will mean to garden in the global greenhouse



ROBIN GRIGGS.
DATA SOURCES: NASA GODDARD INSTITUTE FOR SPACE STUDIES (GISS); CLIMATIC RESEARCH UNIT, UNIVERSITY OF EAST ANGLIA; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

Actual temperature change 1976–2006 (in °C)

GLOBAL WARMING
The map above shows measured surface temperature changes between 1976 and 2006: it is not a future projection, but a record of global warming over the last three decades. Surface temperatures increased over much of the northern hemisphere: higher latitudes experienced disproportionately more warming, of up to 4°C. The areas of ocean coloured blue cooled slightly, probably due to shifts in cold currents

THE ESTABLISHMENT OF the Intergovernmental Panel on Climate Change in 1988, involving more than 3,000 scientists worldwide, was the first clear indication of the concerns of the United Nations (UN) about human-induced climate change. In 1990 the UK's Meteorological Office created its Hadley Centre for Climate Change to focus on long-term climate modelling. At the Rio Earth Summit in 1992, environmental concerns had to share the platform with social and economic development on our planet but in Kyoto, Japan in 1997 the UN spotlight fell specifically on global warming. The Kyoto Protocol, debated by 141 countries, required signatory countries to reduce their carbon dioxide emissions to 1990 levels by 2012, with further reductions thereafter.

The UK Government was vigorous in its support of the Kyoto Protocol. The Department for Environment, Food and Rural Affairs (DEFRA) established the UK Climate Impacts Programme (UKCIP) in Oxford in 1997 to advise organisations on strategies to cope with or mitigate the adverse impacts of climate change.

The Government also announced its intention to cut emissions by 12.5 percent by 2012, but it now looks unlikely to meet that target. Also in 1997, the Tyndall Centre for Climate Change Research, a multidisciplinary body involving six universities, was set up at the University of East Anglia, Norwich, to research global warming and develop practical, sustainable responses to it.

In November 2002, under the auspices of UKCIP and with the involvement of the RHS, a report, *Gardening in the Global Greenhouse*, was published. At that time, global warming and climate change were still relatively esoteric concepts, discussed largely at academic conferences. In the five years since its publication, climate change has leaped up the political agenda and become an almost daily news item. Gardens have seen their fair share of the headlines, with predictions of grapes in Glasgow, lemons in Liverpool and even olives in Oldham.

The changing climate

When discussing climate change, it is important to understand the difference between the climate and the weather. Weather is what happens every day, while climate is the long-term average of weather conditions. While victims of the June and August 2007 floods may laugh bitterly at reports saying the UK is experiencing increasingly severe droughts, that is nonetheless exactly what the climatic data show – together with an increase in extreme weather events.

It is also important to realise that weather, climate and climate change are complicated subjects that interact in extremely complex ways with many other factors. Urbanisation of the landscape from forest to concrete, whether a new runway at Heathrow or the conversion of a thousand front lawns to paved parking spaces, exacerbates weather impacts. Storm runoff is much more rapid from impermeable paved surfaces, so more land covered with tarmac and concrete means that flood risk is increased – and the impacts of flooding are much greater if the area flooded is a housing estate rather than meadows.

Meanwhile, increased human mobility is becoming an important factor in the spread of plant pests and diseases. As mobility increases and the climate becomes more favourable for pests from warmer regions, new pests and pathogens are more likely to be able to establish a permanent foothold in Britain (see pp52–55).

There are also complex interactions between the earth, the oceans and atmosphere. Drier conditions mean clearer skies and more evaporation, so a 5 percent reduction in rainfall can result in a loss of available water of more than 5 percent. Higher temperatures should mean fewer frosts, but less autumn rain usually correlates with clearer skies, and therefore increased risk of frosts.

At the global scale, loss of snow cover means that energy that was formerly reflected back into space – or that used to melt snow – will instead warm the soil. Warmer, snow-free conditions in the vast tracts of peat bogs at higher latitudes will also increase the release of methane, a gas with a much more powerful greenhouse effect than carbon dioxide. As our understanding of these interactions and feedback increases, climate scientists are constantly refining their computer models. Currently there is widespread concern that Arctic and Antarctic ice sheets are thawing with unprecedented speed – an area of ice equivalent to ▶

'THE FREQUENCY OF DAMAGING STORMS HAS INCREASED IN RECENT YEARS, AND IT SEEMS LOGICAL THAT INCREASING THE ENERGY INPUT INTO THE ATMOSPHERE MIGHT LEAD TO MORE TURBULENCE'

the size of 10 UKs melted in the Arctic in 2007, leaving the iconic Northwest Passage free from ice for many months.

Climate scenarios

The recent global warming trend and its correlation with rising carbon dioxide levels is clear (see graphs, below), but how much change is the UK likely to experience? In 2002, UKCIP produced a range of climate change scenarios predicted for the 30-year periods centred on the 2020s, 2050s and 2080s, based on a computer model running different socio-economic and carbon-emission assumptions. These UKCIP02 scenarios (see p27) are still the most current information available on climate projections for the UK until a new report, UKCIP08, is published in October 2008.

The model indicates that changes will be greater in the South East of the UK than in the north and west, for temperature and rainfall. Summer temperatures in the South East are predicted to rise by as much as 1.5°C in the 2020s, 3°C in the 2050s and 4.5°C in the 2080s, with winter increases only a degree or so less. UK summer rainfall is predicted to fall by 20–40 percent by the 2080s.

The previous scenarios, published in 1998, suggested that winter rainfall would probably increase. This caused widespread consternation in the gardening world, because plants that will grow well in a warmer and drier summer climate would be much more sensitive than our present garden flora to winter wet. The UKCIP02 scenarios suggest, however, that although 10–30 percent more rain may fall during winter, the higher temperatures will result in more of this rain evaporating back into the atmosphere, so the availability of water in soil in winter may actually decrease. It is likely, however, that winter rain will be concentrated increasingly into heavy downpours, so flooding and temporary waterlogging of the soil may become more serious problems, especially for plants that prefer good drainage.

The jury is still out on the effect of global warming on wind speeds, but the frequency of damaging storms has increased in recent years, and it seems logical that increasing the energy input into the atmosphere might lead to more turbulence. Atlantic hurricanes certainly seem to be increasing in both frequency and strength.

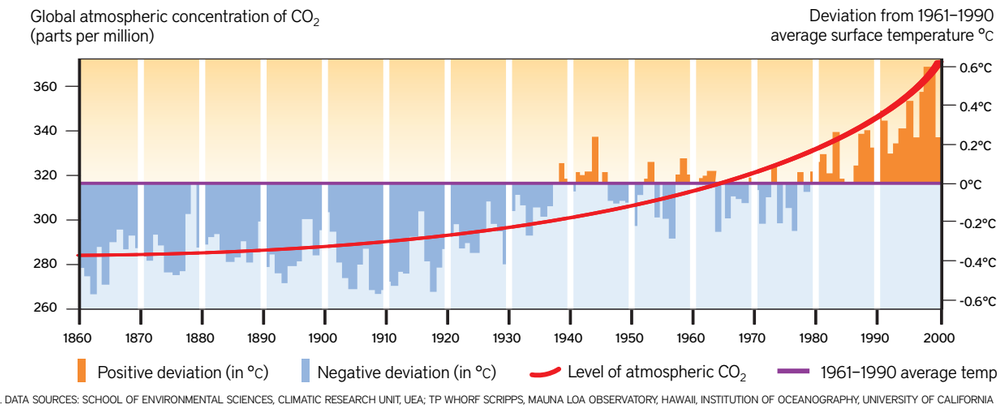
Sea-level rise, caused by water in the oceans expanding as it warms, plus meltwater from icecaps and glaciers, will have more impact in the south of the UK than the north. The south is slowly sinking, and the north is rising as it is still 'bouncing back' from the weight of the immensely thick covering of ice in the last ice age that melted some 10,000 years ago. Sea level is expected to rise between 0–60cm in Scotland, but by 15–85cm for much of southern England in the next few decades.

Impacts on gardens

How will all this affect our gardens? Gardens are special ecosystems (see pp58–61), combining many different plants and materials such as water, wood and concrete. In gardens, fortunately, plants are much more adaptable to climate change than those in natural and semi-natural ecosystems, where the fight for survival is fierce. ▶

TEMPERATURE CHANGE AND ATMOSPHERIC CARBON DIOXIDE LEVELS, 1860–2000

The graph shows: 1) annual temperature deviations from the 1961–1990 average, from 1860 to 2000 (orange and blue bars, right scale); 2) the rise in global atmospheric carbon dioxide concentrations (red line, left scale) during the same period in parts per million



ROBIN GRIGGS. DATA SOURCES: SCHOOL OF ENVIRONMENTAL SCIENCES, CLIMATIC RESEARCH UNIT, UEA; TP WHORF SCRIPPS, MAUNA LOA OBSERVATORY, HAWAII, INSTITUTION OF OCEANOGRAPHY, UNIVERSITY OF CALIFORNIA

Most climate models predict rises in both the strength and the frequency of storms

For anyone who is managing an historically important garden and wants it to look in 2050 as it did in 1750, there are problems ahead, as the National Trust is already aware (see pp48–51). For home gardeners, there will be few plants in the garden today that will not survive the climate (note climate, not weather) of 2050, but by then the garden and its owners are likely to have changed in many ways, for political, social, environmental and commercial reasons.

Changing outlook

The average effect of climate change will be that summers will be hotter and drier. Lawns will turn brown, bedding plants and vegetables will require more water, trees may scorch and lose their leaves prematurely, hosepipe bans may be more widespread. Gardeners themselves will need to retreat into the shade and drink more water.

Winters will be increasingly mild: less frost, much less snow, but more rain, and in heavier downpours. Spring will come earlier (currently, it is arriving two to six days sooner per decade) and summer will extend longer into what would have been autumn (currently, two days later per decade). Clear autumn skies should result in brighter autumn colours – if the leaves have not already crisped and fallen due to water stress. These changes will be even more marked in the wider landscape than in gardens.

In simplistic terms, a 1°C temperature rise is equivalent to moving 100 miles further south. Assuming a 3°C temperature rise in the UK by the end of the 21st century (which already seems a significant underestimate), Britain will 'move south' – actually, the climate will move north – by the equivalent of 300 miles. Effectively, this is 3 miles per year or 12 metres a day. To visualise what seem like small rises in temperature in terms of a threatening cloud (or warming rays, for the optimists) spreading across the land at this speed helps put the phenomenon into perspective.

What can we do? Other contributors will answer this question in more detail in the following pages, but in general terms there are many things that we can do in our gardens (see opposite). There are signs that the world is beginning to wake up to the reality of climate change; indeed, the UK Government has committed itself to reducing greenhouse gas emissions by 60 percent by 2050 – but it is yet to spell out how it plans to achieve this. Of equal concern is how the emissions of developing economies, particularly of China and India, will affect global greenhouse gas emissions. Gardeners cannot save the world by installing another water butt, but they can be exemplars of the good practices needed to adapt to, mitigate and eventually help to halt global warming. ■

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Further reading For more on the global picture of climate change, see Information, pp62–63

To join the debate on how climate change may affect gardening, visit **www.rhs.org.uk/climate** or write to: *The Garden,* 4th Floor, Churchgate, New Road, Peterborough PE1 1TT.
Email: thegarden@rhs.org.uk; please include a postal address

Making a difference in the garden

Richard Bisgrove offers some personal advice on what gardeners can do to minimise their carbon footprint in an effort to garden more sustainably

GAP PHOTOS / CLIVE NICHOLS

NTPL / MIKE HOWARTH

▼ **Be grateful that we live in what is still a green and pleasant land.** Most of the effects of climate change in UK gardens in the 21st century should be manageable, and we have an excellent infrastructure, from fire brigades to insurance policies, to support us in what are predicted to be more extreme events, such as floods and storms. In recent years, for example, a number of damaging tornadoes have hit the UK (below). Insurance premiums will increase no doubt; rising sea levels may affect low-lying areas of East Anglia and the South East. Yet such problems are relative: much of the developing world faces not brown lawns or wilting wallflowers but droughts, desertification and inundation by rising sea levels that threaten livelihoods and lives.

▲ **Be adventurous with new plants and ideas.** My olive and bananas are doing well and my *Albizia* was flowering better each year until a summer gale felled it; the new suckers look promising, however. I failed with *Strelitzia* (bird of paradise) last winter but will try again.

Provide more shade for summer, using pergolas and similar structures, so that you can continue to enjoy the garden when it is too hot to work in it. If plants succumb to recurrent droughts or new pests, simply try growing something else.

The 'grasses and perennials in gravel look' is both drought tolerant and low maintenance, but is not the only option for UK gardens in a warmer future (see pp38–43).

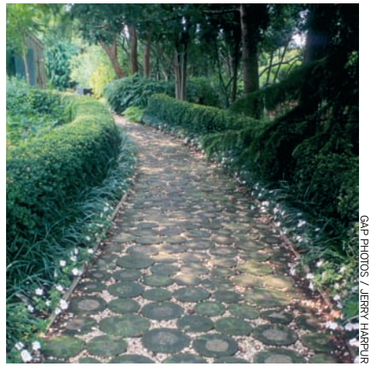
▲ **Be flexible and adaptable.** Much of the armoury of the gardener rests in the ability to avoid problems rather than trying to control them. Keeping the garden in a vigorous condition, with a diverse range of youthful plants, will help guard against disaster as, if one plant fails, the gap can easily be filled.

The 1987 great storm (above) was so devastating because there had not been a similar storm for nearly three centuries. Trees had grown to great sizes, and were ultra-susceptible to the winds when they came. The initial result seemed disastrous, but the long-term effect was a regeneration of many moribund gardens and a healthier, more resilient tree population.

GENE RHODEN / STILL PICTURES

▶ **Be greener: store rain water for use in dry weather, and store carbon inside plants and in the soil.** Temperate forests store about 8kg of carbon per sq m above ground and 25kg in the soil. Grassland stores less than a kilogram above ground but 24kg in its root mass and soil. Arable land stores little carbon above ground and only 6kg in the soil.

Organic and permeable materials (right) are better for paving than concrete, which causes large amounts of carbon to be emitted into the atmosphere in its manufacture and transport, and offers nothing in return. Deep cultivation of the soil to add organic matter, organic mulching, and growing woody plants all help to remove carbon dioxide from the atmosphere (and also help the soil absorb and store water).



GAP PHOTOS / JERRY HARPUR

Think 'sustainable' when buying gardening tools and working in the garden. Sharpen the shears, abandon the powered hedge-trimmer, and invest in a hand-propelled mower. It is still possible to find push mowers and they are fine for small gardens. For larger lawns, a cylinder mower uses much less fuel than a rotary. The savings in carbon emissions to be made by such changes are small, but they add up if everyone contributes, and the spread of energy consciousness from individual gardens to the rest of the globe may just tip the balance.