

Climate Change Seminars: Supporting effective debate on the Scottish Climate Change Bill

Seminar One: Climate Change and Scenarios for Scotland

'We basically have three choices –mitigation, adaptation, and suffering. We're going to do some of each. The question is what the mix is going to be. The more mitigation we do, the less adaptation will be required, and the less suffering there will be.' John Holdren, President of the American Association for the Advancement of Science

Introduction

The first of the four seminars considered the latest scientific evidence around climate change and what this is likely to mean for Scotland. The international framework for climate change was also discussed. Presentations to the seminar were made by **Prof. Pete Smith** (University of Aberdeen), **Dr Richard Wood** (Met Office Hadley Centre) and **Dr. Chris West** (Director of UK Climate Impacts programme (UKCIP)).

The IPCC and the UNFCCC

The **Intergovernmental Panel on Climate Change (IPCC)** was launched in 1988 with a mandate to assess the science of climate change, the likely impacts and the mitigation and adaptation response the world needs to take. It involves several thousand eminent scientists from across the globe. The IPCC reports draw together the work of all scientists involved, setting out a consensus view that is then presented to governments.

The Intergovernmental Panel advises the **UN Framework Convention on Climate Change (UNFCCC)**, the main international body negotiating on cuts in greenhouse gas (GHG) emissions. The first significant international agreement on climate change was the **Kyoto Protocol** signed by many nations in Japan in 1997. The first 'commitment period' for the Kyoto Protocol ends in 2012. By this time all signatories are expected to have delivered their agreed emission targets.

It should be noted however that despite the Kyoto Protocol, global emissions of GHGs have increased by 70% since 1970 and continue to rise. This is because (i) not every signatory of the Protocol has delivered the emission reductions they committed to and (ii) many of the main polluters - the USA, China and India - remain outside Kyoto.

Negotiations have been underway since Kyoto to develop a plan of action to take the global process forward. Most significant has been the **Bali Action Plan**. This developed a

shared vision for action that includes those key nations (USA, China, India and others) not part of the Kyoto process; agreed action on adaptation and mitigation; and established effective mechanisms for finance and technology transfer to deliver global cuts.

Drawing on the Bali Plan, the challenge for negotiations in current and future Conference of Parties (COPs) of the UNFCCC in Poznan and Copenhagen will be to create a truly global agreement on GHGs that will deliver rapid and significant emission reductions.

What the science is now telling us?

The most recent IPCC report shows that current atmospheric concentrations of carbon dioxide (CO₂) and methane (CH₄) far exceed the levels present in at least the last 650,000 years. It also demonstrates that the increase observed in Greenhouse Gases (GHGs) is the direct result of human action since 1750 in burning fossil fuels, agricultural practices and changing land use.

To summarise the latest IPCC findings on climate change these are that:

- **Warming of the climate system is unequivocal**
- The last 50 years are likely to have had the highest temperatures **for at least the last 1300 years**
- Most of this warming is **very likely** to be the result of human greenhouse gases
- Without emission reduction policies, **global temperature could increase by 1.1 to 6.4C or even higher** in 2100 compared to 1990
- Global mean sea level could increase by 18cm to 59cm
- The frequency and intensity of severe weather phenomena (e.g. heat waves, droughts and floods) is likely to increase

The magnitude of change in global mean temperature predicted by the IPCC is of serious concern. It is accepted that a rise of more than 2C in global mean temperature will lead to an increasingly high risk of catastrophic climate change which will pose serious threats to human life and to global economic and social systems.

Adaptation and Mitigation

The IPCC also reports on the mitigation and adaptation options required. Mitigation and adaptation are linked agendas - the more mitigation achieved the less adaptation that is required.

Stabilising GHGs at a level that should avoid runaway climate change demands very significant cuts in emissions across all sectors of the economy and society. This in turn will require that carbon is placed at the heart of policy through the application of a broad range of fiscal and regulatory tools.

Despite this the IPCC has concluded that:

- A **significant proportion** of GHG emissions can be mitigated at relatively low cost by 2030
- There is **significant mitigation potential in all sectors** (industry, energy, buildings, transport, agriculture, forestry and waste)
- **Action needs to be driven by an agreed global peak emission target. Aiming for a lower target for peak levels of emissions will cost more but as Stern has demonstrated this cost has to be judged against the costs of inaction**
- **Rapid action is required - mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels**

Important Research Areas for Climate Science

Our understanding of the science of climate change has increased significantly over recent years. In terms of the global predictions for climate change some areas of research are particularly important in informing the overall climate change models and the likely adaptation response for Scotland. Taking these in turn:

Sea Level Rise– predicted sea level rises over the 21st century have been revised downward in recent years but it is still likely that sea levels will increase by over 50cm by 2100, posing challenges for low lying areas across the world including in Scotland.

Overall there are still significant areas of uncertainty in predicting sea level rise related to the response of glaciers and ice sheets to climate change - care has to be taken in extrapolating wider or more significant trends from local ice sheet response. Despite this, it should be emphasised that there are serious concerns about a potential ‘tipping point’ which could lead to its eventual collapse of the Greenland ice sheet and a 7m rise in mean sea level. This would take many hundreds of years but would be catastrophic for many millions of people.

The Gulf Stream ‘Switch Off’ – An issue that has attracted much media coverage is the possibility of the Gulf Stream collapsing, plunging Scotland into a colder climate even as the world warms. The collapse is certainly possible and would lead to a cooling of 2-5C over Scotland.

However current research indicates that a total collapse is very unlikely over this century. Instead there may be a gradual weakening of the flow of warm water to the North Atlantic but this will only serve to reduce the rate of warming in Scotland and not lead to cooling.

Arctic Sea Ice – Another issue that has attracted media interest is the decline in Arctic sea ice. Since the 1980s there has been a general decrease in the amount of sea ice. A record low level of sea ice was recorded in summer 2007 although there have been significant annual fluctuations from year to year. The rate of decline in Arctic ice had been more rapid than models predict and it may be that we will reach a point where there is no summer ice in the Arctic within the next two decades.

Adaptation: The UK Climate Impacts Programme

As already noted the greater and more rapid the cuts that are achieved in GHGs the less need there will be for climate change adaptation. However it is clear that regardless of action taken now we will have to adapt to a significant amount of climate change.

The UK's adaptation response is guided by the work of the **UK Climate Impacts Programme (UKCIP)** who prepared their first climate change adaptation scenarios a decade ago and has published a wide range of guidance on aspects of adaptation since.

UKCIP is due to publish its latest climate scenarios (UKCIP08) in spring 2009. The **UKCIP08 scenarios** will provide greater detail with information on the impact of likely climate change on each 25km grid square across the whole UK and also for administrative boundaries (e.g. Local Authority areas) and river basins. The scenarios will also deal better with the uncertainties inherent in climate prediction, will improve accessibility and will provide more information on climate change in the marine environment.

Climate Predictions for Scotland

Scotland has already experienced noticeable climatic change in the last 40 years. Winters have got wetter, especially in western Scotland, while summers have become drier. Overall temperatures have risen with the most significant warming being in summertime in eastern and southern Scotland (see Figure 1 overleaf).

Looking forward, far more significant changes in climate are anticipated over this century. By the 2080s it is predicted that:

- Annual temperatures averaged across Scotland could rise by up to 3.5°C in the summer and 2.5°C in the winter

- Summers will become generally drier across Scotland. There may only be a slight reduction in rainfall in the north-west but as much as a 40% reduction in the south and east
- Scotland's growing season will become longer, by between 30 and 80 days
- Scotland's sea levels will rise, perhaps by up to 600 mm around the mainland
- Average snowfall amounts will decrease, possibly by up to 90% depending on location. Snowless winters may become normal in some parts
- Scotland will have more severe extreme rainfall events

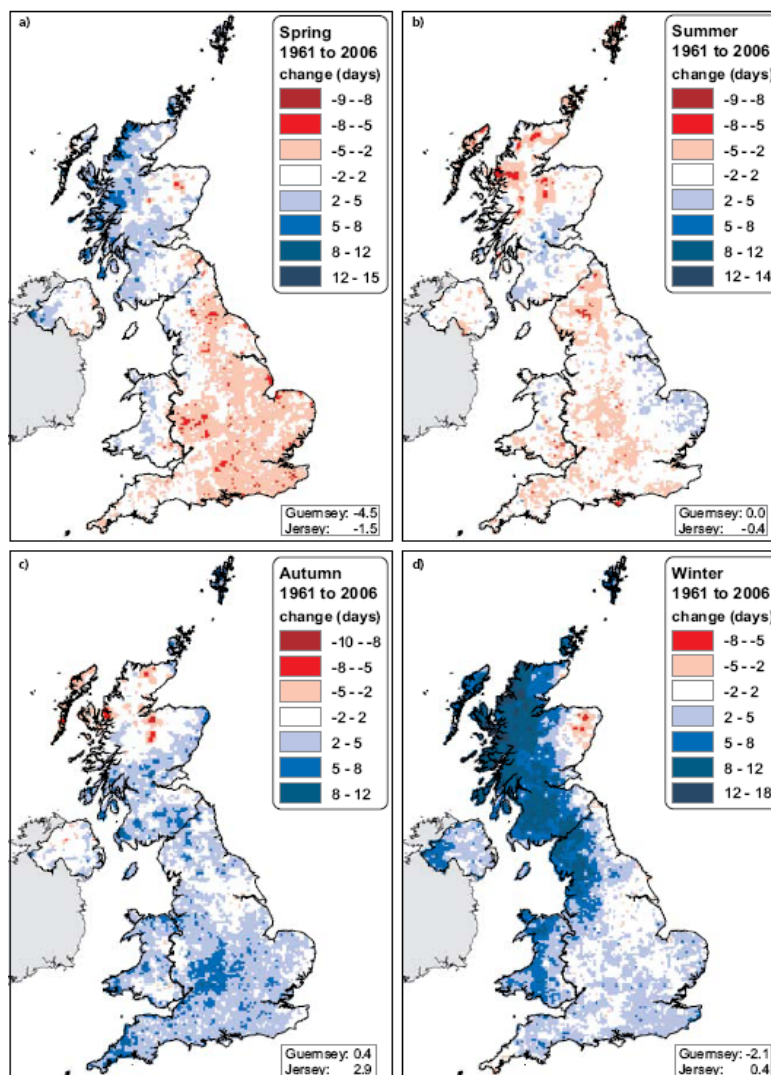


Fig 1: Changes in seasonal precipitation in Scotland 1961-2006

Not all the impacts of these changes will be negative - some will in fact be positive - but all will require an adaptation response. Important areas of adaptation Government will have to address include:

- **Coastal flooding:** Coastal regions could be flooded and coastal wetlands threatened
- **Water resources:** While impacts will be less for Scotland than other world regions, there are potential negative impacts caused by reduced summer precipitation for agriculture on the east coast
- **Food production:** Positive impacts on crop growth and range of crops that can be grown
- **Human health:** Increase in temperature could cause vector-borne (insect-carried) diseases to spread to higher altitudes and higher latitudes. Heat-wave impacts on human health will increase with the young, old and poor most at risk. At the same time fuel poverty may decline although the benefits of the rise in temperature may be offset by increased winter precipitation and therefore dampness
- **Ecosystems:** Impacts on ecological and physiological processes, altering growing season length, biomass production, competition, leading to shifts in species ranges and possible extinctions

A fundamental challenge in planning for adaptation will be to deal with uncertainty. Government, individuals and businesses already deal with weather uncertainty all the time - the challenge will be to factor in the added uncertainty caused by changes in both average and extremes of weather and climate.