

THE ARCTIC

Changes in the Arctic could have major implications for the UK in a number of areas. A meeting of the Foundation for Science and Technology on 4 November 2015 considered how this country should respond to these changes.

Responding to a changing Arctic

Robin Teverson



Lord Teverson chaired the House of Lords Select Committee Inquiry on the Arctic. He has also chaired the Lords EU External Affairs sub-committee, and has spoken for the Liberal Democrats on energy and climate change issues in the Lords. He was previously an MEP, representing Cornwall and Plymouth during the 1990s, and spent his early career in the freight industry. He is also a director of the Marine Management Organisation.

In every Parliamentary session, the House of Lords establishes four 'ad-hoc' select committees to look at items of special interest. Each reports back within a parliamentary year, and then the committee dissolves. The Arctic is a part of the globe where a great deal of change is occurring, due especially to climate change and its repercussions – and was therefore a highly topical subject for an Inquiry¹.

The Committee did not, however, look at the causes of climate change – just the implications for the UK. We felt it was particularly important for the British Parliament – and the House of Lords in particular – to take up this issue because the UK is the nearest non-Arctic state and we have real, longstanding interests there. While there are eight states in the Arctic Council, the Shetlands are a mere 320 miles away from the Arctic Circle.

A changing environment

The minimum area of sea ice cover in the region in summer has almost halved over the past couple of decades. Even more importantly perhaps, the volume of ice has gone down by some 75%, because when the sea refreezes there is only the thickness from one year. That does not affect sea level as such. However, looking forward, the disappearance of the Greenland Ice Sheet would be dramatic. This would raise global sea levels by some 7 metres or 23 feet, which puts the impacts of climate change in the Arctic into perspective!

The Committee went to Spitsbergen in Norway's Svalbard archipelago, a mere 800 miles from the North Pole and largely ice-free these days. While it has a population of just 2,000, it has an excellent university facility. We discussed a number of issues with students and staff while there.

The good news is that the Arctic is one of the best-governed regions of the world. The Arctic Council comprising eight states was founded in

SUMMARY

- The UK is just 320 miles from the Arctic Circle and has a longstanding interest in the affairs of this region.
- Too little is still known about the region and the UK could play a major part in increasing knowledge.
- There has been a lack of focus on the Arctic recently which needs to be rectified.
- A new balance needs to be struck between the UK's involvement in north and south polar regions.
- The UK should consider appointing an ambassador to the Arctic.

1996 and has grown in stature. It has started to create enforceable agreements: of those, one concerns oil spills, another focusses on search and rescue (which is particularly important in the context of increasing tourism).

The Council has a number of observers. The UK was one of the first and in 2013 the number was increased substantially to include India, China, South Korea, Singapore and Italy, Poland and Japan. Why the interest from the fast-growing, large Asian economies? Well, for Singapore, for example, it is clearly around freight and transport routes, but generally it is the draw of resources.

The Arctic is very remote and very different from other parts of the world. Unlike the Antarctic it has no landmass: its high seas are beyond the jurisdiction of individual nations. So there are many challenges.

The Inquiry did not examine issues of security in detail, but this area is not immune from geopolitical events taking place elsewhere. While we were taking evidence, the Russian annexation of Crimea took place. At the same time there was a huge fall in commodity prices for mineral extractors and oil companies. Both had major effects.

Although the Arctic Council does not deal with military matters, it is based on strong

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cooperation in science and in areas like shipping and research. One of the important recommendations that we put forward is that it needs to be isolated from wider international problems. The previous Canadian Government took a robust stance towards Russia and a number of meetings did not take place. Generally, though, cooperation in the Arctic has continued and we welcome that.

The peoples of the Arctic

It should be noted that the Council has special representatives of indigenous people. The Arctic has some four million inhabitants. Most of these live in Russia, but half a million are indigenous people – whether First Nation in Canada, Sami in Scandinavia, Inuit and various Native American tribes. With the growth in the number of observers, there is a concern that their voices could be squeezed out. Yet it is clearly important that those communities are able not only to survive, but to thrive and to be a determinant of development.

There has been talk of a 'scramble for the Arctic'. Yet the number of vessels crossing the Northern Passage around Russia remains very small: ice-breakers remain essential at present. Most traffic is to existing settlements – not transits from one ocean to another. So although these routes can substantially reduce journeys from the Pacific to other areas, this is not going to be a major area of development in the short term.

For mineral extraction, too, the pace of development will remain slow: indeed, in 2015 Shell stepped back from exploration offshore in the Chukchi sea. It is extremely expensive to set up mining there. One example we heard about was from the Yukon in Canada. Just flying one team of staff to a mine every two weeks and bringing those on leave back to base costs something like US\$100,000. That indicates the remoteness and expense involved.

Because the pace of development is likely to be slow, the Committee believes there is time to set down appropriate rules and to find the right ways to handle development in advance, rather than having to respond later.

The area which astonished us most was the dramatic lack of knowledge about this region – whether in terms of mapping and hydrographic information, or about ecosystems and scientific information. Although the Arctic Council and its various elements carry out a great deal of cooperative science work, there is a huge amount still to do. The UK has a part to play here, working more closely with other observer states and Council members to make sure that we really do increase our knowledge of the region.

There are two areas in the middle of the Arctic which are not designated as Exclusive Economic Zones (EEZ), and there we argued that, in regard to the fisheries industry, there should be a moratorium. Discussions are under way and we very much welcome the progress made in that area.

UK interests

In the Antarctic, the UK has a strategic interest but we have land claims as well. There is also excellent scientific work going on. However, the Inquiry concluded that a better balance is needed between our involvement in north and south polar regions.

The changes in the permafrost urgently require further research. It is vital to understand very much better the impacts of the methane and carbon in the permafrost and also the methane in the Arctic sea floor. With so much development in remote areas depending upon ice roads, permafrost and climate change actually works against on-land development rather than for it. So there are challenges there as well.

The Inquiry recognised the important work undertaken by the International Maritime Organisation, based in London, especially the new Polar Code. However, further improvements are still needed in regard to issues like the use of heavy fuel oil and black carbon emissions.

The UK policy context

Although Britain is the 'nearest neighbour' with a long history of interest in the Arctic, the Inquiry felt there had been a certain loss of focus recently – and this at a time when the rest of the world is devoting more attention to the region. One of our major recommendations was that the UK should appoint an Arctic ambassador, as a number of other countries have done. This should be someone with a scientific background, with some diplomatic experience too, who is able to bring together all the various strands of policy we have in the UK, whether industrial, environmental or geopolitical.

The UK already has a framework strategy for Arctic policy². Although supportive of this policy, the Committee felt it was too defensive and that Britain should show greater leadership while of course showing respect for the Arctic nations on the Council. We can be one of the leading observer nations. In conclusion, the House of Lords will continue its interest in this region and strive to ensure that the UK plays its full part in the future of the Arctic. □

¹ The House of Lords Arctic Select Committee Report www.parliament.uk/arcticcom

² www.gov.uk/government/publications/adapting-to-change-uk-policy-towards-the-arctic

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Increasing our engagement

Jane Rumble



Jane Rumble is Head of the Polar Regions Department at the Foreign and Commonwealth Office. She has been Head of the Department since January 2007, previously having spent over three years as Deputy Head. Jane started her civil service career in the Department of the Environment, where she undertook a range of environmental and corporate policy roles, on topics including health and safety as well as genetically modified crops.

While the beautiful, pristine wilderness depicted in series such as *Frozen Planet* does exist, the Arctic is not all like that.

It is important to recognise that the Arctic is not a homogenous region; it is made up of different countries, peoples and interests. Of the four million inhabitants, the overwhelming majority live in Russia. The northern Norwegian Arctic is quite well developed, whereas northern Canada is quite sparse in terms of population.

Yet it is not an un-governed space: it falls under the jurisdictions of eight Arctic States, five of which border the Arctic Ocean and so have associated maritime rights. There has been mining development and hydrocarbon extraction for several decades. So, while the beautiful, pristine wilderness depicted in series like *Frozen Planet* does exist, the Arctic is not all like that.

The UK is the nearest neighbour to the Arctic and we have maintained a very longstanding interest in the region. But current and future changes in the Arctic will inevitably have significant implications for this country (see Table 1, page 43).

A policy framework

The Government tried to bring all of these considerations together in October 2013, when the UK published its first Arctic Policy Framework¹. It was a matter of walking a very delicate tightrope at the time.

It was important not to overplay our hand because of the sensitivities of some of the Arctic states. The EU had already put forward an Arctic Strategy which was not well received. So we referred to it as a policy framework rather than a strategy. It would be something we could deliver through diplomacy, coordination and engagement.

The key principles are set out under three broad pillars. There is the Human Dimension looking at governance and engagement of the indigenous people in the region. We recognise that the Arctic Council is the pre-eminent body for governance of Arctic matters and the one that we will engage with. However, it does not cover items like fishing, defence, security: so there are other forums through which we interact as well.

Within the Environment Dimension, the objective is to gain greater understanding of the Arctic through scientific collaboration and to promote policy development on the basis of sound science.

The third, the Commercial Dimension, includes energy security, shipping, bio-prospecting and fisheries among other issues.

SUMMARY

- The Arctic is not homogeneous; it consists of a number of different countries, peoples and interests.
- As the nearest neighbour to the Arctic, developments there will inevitably have implications for the UK.
- Particular emphasis is being placed on scientific cooperation.
- The UK's primary policy objective is that the Arctic should remain peaceful, stable and well-governed.
- The UK is strengthening bi-lateral agreements with Arctic states.

So, the framework encapsulates the ways in which the UK has been trying to increase its engagement using communication and outreach. We have a focus on education and our website² is a feeder into the UK's geography curriculum. It is promoted through the Royal Geographical Society and is being upgraded to ensure that it is mobile- and tablet-compatible and can be viewed on YouTube.

The House of Lords Inquiry

The Lords Inquiry has performed a very valuable service in bringing focus to a topic that is often regarded as both vast and nebulous. It was a very useful exercise to go through all of the different aspects of the Arctic and its interaction with the UK, while not being side-tracked onto climate change, which is a vast and separate issue.

The Government's response was published in July 2015³. The date is important because it was after the General Election, so this is a statement of current Government policy. It endorsed the previous framework, but it also set out a number of further steps which add to the trajectory of UK Arctic engagement and interest.

Some of the key actions have been concerned with making sure, as far as possible, that the UK is well represented on the scientific and technical bodies of the Arctic Council. Particular emphasis has been given to scientific cooperation and in fact the UK was one of very few observer states to submit full information on its methane and black carbon emissions targets.

Our team has been representing the UK at

Arctic events around the world. Perhaps surprisingly, there are more events about the Arctic than about the Antarctic! The recent Glacier Conference, hosted by President Obama and US Secretary of State John Kerry, aimed to coordinate input to the Paris climate change conference by the Arctic states and observers, pointing out the effects of change on the Arctic.

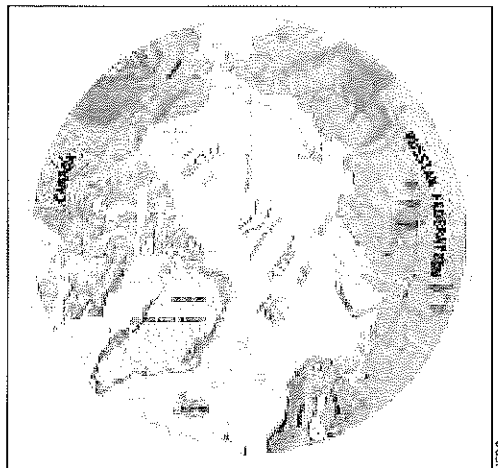
The UK has also been active in the science and innovation network; there are over 75 universities and institutes that have some Arctic focus. A Danish report ranked the UK as fourth in number of citations and third in the number of articles on this topic. So when some of the Arctic States say that the UK is not truly 'bi-polar', we can demonstrate that, actually, we are. The UK's research station in the Ny-Ålesund in the Svalbard archipelago, which was the subject of a 'virtual visit' by the Lords Committee, is also producing great science.

In regard to our commitment to science in the region, the £15 million investment allocated for 2010-15 is now bearing fruit. The results of several research projects have already been published. A further £16 million has now been announced for Arctic research and we are promoting this across the Arctic states to ensure we get international engagement. The UK is also to have a new polar research vessel: although its primary task is to support the UK's presence in Antarctica through science, it will operate in both north and south polar regions and I am sure it will do lots of work in the Arctic.

Strengthening engagement

The UK's future priorities can be broadly divided into two: 'international' and 'domestic'. The main priority remains that the Arctic should remain peaceful, stable and well-governed. Given the events taking place today, we are not complacent about the effort required from the Arctic States, and indeed observer states like the UK, to ensure that this remains the case. Without this, everything else is, frankly, completely academic.

We need to maintain the UK's commitment to



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the Arctic Council and ensure that this country is well-represented. We are also looking at strengthening our bi-lateral engagement with the Arctic States. There is already a good Memorandum of Understanding (MOU) with Canada, as well as one with Norway which we are about to renegotiate.

We are working with the EU to encourage a positive outcome to the fisheries moratorium, as well as engaging in future European Polar Net scientific opportunities. We hope that UK companies will involve themselves in the Arctic Business Forum.

Within the UK we are looking forward to engaging with the newly reinvigorated All-Party Parliamentary Group on the Polar Regions, chaired by James Gray with his deputy Neil Carmichael. They have an ambitious agenda which we are supporting.

We hope to hold a Wilton Park conference in 2016, once again to reinforce the UK's position in the affairs of the region. The intention is to examine where the UK and the other observer states can support the work of the Arctic Council through wider international forums where the Arctic States themselves would be in the minority. □

¹ www.gov.uk/government/publications/adapting-to-change-uk-policy-towards-the-arctic

² www.discoveringthearctic.org.uk

³ www.gov.uk/government/publications/responding-to-a-changing-arctic

Climatic	Environmental	Economic
Arctic changes have the potential to affect UK, European and global weather patterns.	UK shares a common marine and avian biodiversity with much of the Arctic.	Thought to hold 25% of the world's undiscovered hydrocarbons.
Melting ice sheets contribute to global sea level rise.	Potential shifts in the distribution of marine species, including fish stocks.	Potential new trade routes.

Table 1. Three key areas of interest in the Arctic

Understanding changes in sea ice

Julia Slingso



Dame Julia Slingso DBE FRS DSc is Chief Scientist at the Met Office. She leads a team of over 500 scientists working on a broad portfolio of research that underpins weather forecasting, climate prediction and climate change projections. Since joining the Met Office, she has sought to integrate the UK community in weather and climate research to ensure that the UK receives maximum benefit from its science investments.

Looking at the seasonal evolution of Arctic sea ice cover over recent decades, the evidence is clear. As the years progress, the cover gradually drops, particularly in summer to the minimum in September. Over the decades, from the 1980s to the present day, sea ice extent moves further and further below the long-term average for 1981-2010, with some years lying outside the 30-year spread, especially in summer. In recent years there have been some large losses of summer sea ice cover.

While it is possible to debate whether or not the Arctic is changing by cherry-picking individual years, reviewing the figures decade-by-decade shows that something very dramatic is happening.

Another way to characterise this phenomenon is to plot the difference from the long-term average for each month since records began in 1979. What becomes apparent is an overall decline in sea ice cover for all the months of the year. In the early part of the record there is a fairly random variation in the monthly anomalies suggesting no seasonal preference. Then in 2007, a dramatic minimum in summer ice occurs, associated with anomalous wind patterns over the Arctic: the winds were unusually strong and quite a lot of the ice was advected across the basin, revealing a lot of open water.

Since then, the Arctic has moved into a different pattern of behaviour with the monthly anomalies showing a strong annual cycle indicative of large ice loss in summer followed by recovery in winter. Today, the whole system is much more fragile in the summer months. The ice re-forms in the winter but is lost again quite quickly in the summer. Is this a tipping-point in a system close to the edge of sustainability?

By the end of this century, under a high emissions scenario as envisaged by the International Panel on Climate Change (IPCC), the Arctic may be completely ice-free in summer. While there is a great deal of uncertainty in when that will actually happen, the IPCC has been very clear about the general direction of travel.

Ice volumes

However, it is not just the cover but the volume of ice that is important, since it is the volume that determines the mass and energy balance. There have been studies for some time based on data from submarines and so forth, but more recently

SUMMARY

- The Arctic is a very complex system which has seen significant changes.
- Advances in observations and modelling have improved our understanding of the region.
- Further changes are expected in years to come as the planet continues to warm.
- Changes in the Arctic are likely to have impacts further afield.
- Understanding the links between the Arctic and UK weather and climate is becoming increasingly important.

the CryoSat programme has made it possible to map the sea ice thickness.

So a really good understanding of ice thickness and hence ice volume is now emerging. What we see is that much of the multi-year ice has been lost; indeed, a large part of the Arctic now is covered by single-year ice (or close to). The consequence is that a storm like the one that occurred in August 2012 can break up the ice cover: this was the principal reason for dramatic loss that year. These storms are unusual, but they occur from time to time and could be the final blow for the summer Arctic ice.

Dynamics of Arctic sea ice

Arctic sea ice is not static. It does not just form and melt in the same place, it moves around, driven by the great currents – the ocean circulation which is strongly influenced by the bathymetry of the Arctic. In addition, there is a great deal of fresh water flowing in from the Eurasian continent. About 40% of the rivers drain into the Arctic. How that fresh water gets mixed into the central Arctic sea is of great interest, but not something we understand well yet.

It should also be recognised that the pattern of circulation and ice-movement, as well as the ocean currents, can be disrupted by changes in atmospheric circulation. With an anti-cyclonic atmospheric circulation, fresh water accumulates in the Beaufort Gyre and, in the opposite situation, fresh water is exported.

Why does that matter? Because that changes the density of the water flowing out of the Arctic and into the Atlantic and that in turn can affect the

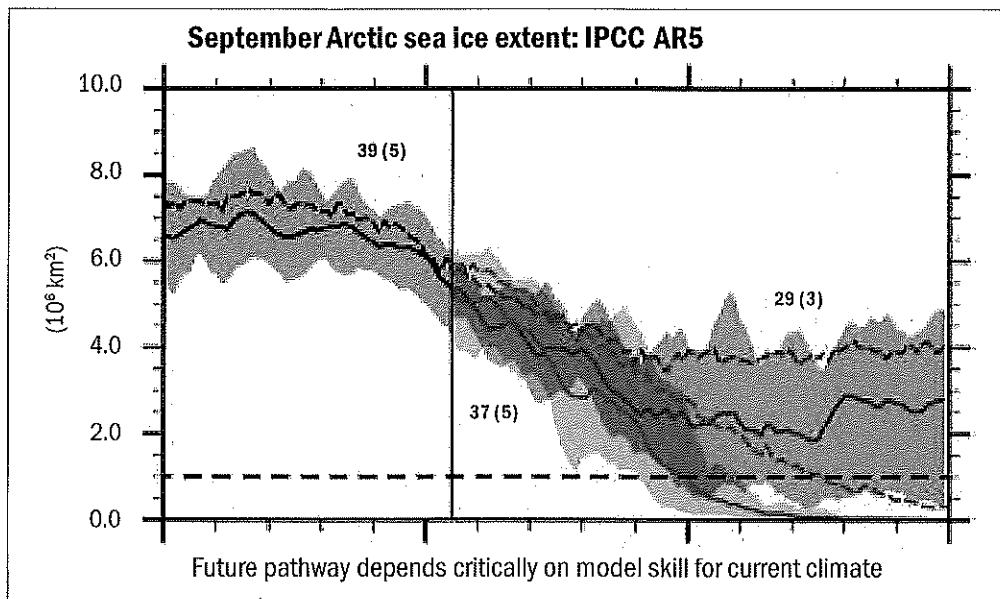


Figure 1. Reducing uncertainty in Arctic sea ice predictions

strength of the Atlantic Thermohaline Circulation. Over recent years, there has been a fall in the salinity of the water in the Beaufort Gyre. At some point, that water may propagate out of the Arctic and come into the North Atlantic, changing the strength of the thermohaline circulation.

The Arctic is a complex system

Some people see the Arctic as a deceptively simple system: an increase in temperature causes ice to melt; this results in a darker surface which absorbs more of the sun's energy; and so on. That is a one-dimensional view of the Arctic which bears little relation to what is actually happening. The region is much more complex. The transport of energy, of salinity, of heat, of fresh water from river outflows and indeed pollutants like black carbon into the Arctic and out again – all are absolutely critical for describing the very subtle energy balance of the whole system.

That complexity explains why the IPCC projections of September Arctic sea ice have such a wide spread. However, it is possible to give a relatively clear message of where the region is heading. When we take all the IPCC models, in some instances there might still be summer sea ice by the end of the century.

If we take only the more realistic models based on their ability to represent observed Arctic sea ice behaviour – and there are only a few of them (five out of 37) – then we get a different perspective of when the Arctic might be ice-free in September; it happens sooner rather than later. So there is still much uncertainty which we need to reduce if we are to get a clear idea of where the climate is heading.

As the Arctic opens up, there will be an increasing need for weather forecasting and the forecast-

ing of ice movement in the region. That is what the World Meteorological Organisation's Polar Predictions Project is concerned with. There are significant challenges here in understanding the meteorology of Arctic weather systems, yet this is vital for successful operations in the Arctic and for ships to cross the Arctic safely in summer.

This is very exciting. The Year of Polar Prediction – which actually lasts for two years, mid-2017 to mid-2019 – will be a major international initiative employing a number of additional observing systems around the rim of the Arctic Ocean. It will complement the more fundamental research that is also going on.

Prediction tests our current understanding of a system and our ability to simulate it, so this project promises to open up many scientific insights.

There has also been a great deal of progress in the last few years in the use of fully-coupled climate models for seasonal forecasting of the summer sea ice minimum in the Arctic. The latest models have a much higher resolution in the ocean and atmosphere, and the simulation of the Arctic is much-improved. Last year's forecast of $4.4 \times 10^{12} \text{ m}^2$ for the September monthly minimum in Arctic summer sea ice extent was very close to what was observed.

Impacts on the UK

So what does a warming Arctic mean for the UK? There has been speculation about Arctic amplification – that a large warming of the Arctic is disrupting our weather patterns and leading to more prolonged spells of settled weather but also some very stormy weather. Is it changing the nature of the Jetstream, perhaps? Well, the jury is still out on this and the

FURTHER INFORMATION

The House of Lords Arctic Select Committee Report
www.parliament.uk/arcticcom

Adapting To Change: UK policy towards the Arctic
www.gov.uk/government/uploads/system/uploads/attachment_data/file/251216/Adapting_To_Change_UK_policy_towards_the_Arctic.pdf

House of Lords debate on the Select Committee Report on the Arctic
www.publications.parliament.uk/pa/ld201516/ldhansrd/text/151103-0001.htm#15110341000427

Government response to House of Lords report
www.gov.uk/government/publications/responding-to-a-changing-arctic

Arctic Council www.arctic-council.org

British Antarctic Survey www.bas.ac.uk

Discovering the Arctic www.discoveringthearctic.org.uk

Foreign and Commonwealth Office
www.gov.uk/government/organisations/foreign-commonwealth-office

Met Office www.metoffice.gov.uk

Scott Polar Research Institute www.spri.cam.ac.uk

latest research does not give this much credence.

On the other hand, observations do suggest that low Arctic sea ice in summer predisposes us to a negative North Atlantic Oscillation in winter – in other words it might be a colder winter. Yet this is not the only factor affecting UK weather, take the big El Nino event this year for example. There are so many factors that analysing and predicting what the Arctic itself is doing to our weather is incredibly difficult.

There is a very long way to go before we have the ability to give a definitive answer on what the changing Arctic might mean for the UK. Yet it is hard to believe the changes that are going on there will not affect the water masses that enter the North Atlantic and hence the Thermohaline Circulation. The Gulf Stream is part of that circulation and so understanding how the changing Arctic will affect the ocean is vital and requires a great deal more work.

The Arctic is a really complex system which has seen significant changes commensurate with global warming. Further changes can be expected as the years go by and the planet continues to warm. The Arctic will not change linearly, though, because of the interaction between natural variability and long-term climate change. However, understanding the links between the Arctic and UK weather and climate is becoming increasingly important and we must make it, and continue to make it, an active area of research. □

The debate

Issues raised in the debate included the impact of geopolitics, global warming and the coordination of UK efforts.

The nature of the changes in the region and the resulting opportunities (as well as dangers) are global in their impact. More distant states, such as India and Singapore, understandably share the UK's interests and concerns about climate, scientific research, energy supply, shipping routes, etc.

It has been a major success to date to insulate international cooperation in the Arctic from wider geopolitical tensions. Can this continue, though? The sanctions against Russia in the wake of its annexation of Crimea could have adverse consequences for research and other cooperation in the Arctic. The more that major countries outside the region see their interests being directly affected by events in the Arctic, the more likely that friction and conflict may arise, not only between those states but also between them and the eight Arctic States. Not all states interested in the region can be relied upon to consider the concerns of the indigenous population too. Perhaps greater application

of 'soft sciences' in Arctic issues could help deal with potential international problems.

The stability of the Greenland ice shield is not yet a problem but the impact of melting on global sea levels would be immense. Moreover the effect of a global temperature rise on such ice sheets could be felt for centuries after temperature had stabilised.

Effects of melting

Melting permafrost in the summer will destabilise buildings, cut off transport links and potentially release large quantities of methane, a potent greenhouse gas. Changes of water temperature influence fish habitats. For example, cod are seeking cooler waters by moving north from the Labrador coast.

The UK's potential contribution to developments in the Arctic extends well beyond science into areas such as oil, gas and minerals developments, as well as law, finance and insurance. These interests could be better coordinated. □