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The Select Committee on the Arctic

Inquiry on

THE ARCTIC

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Witnesses: Rod Johnson, Rear Admiral Tom Karsten RN and Dr Richard Wood
Members present

Lord Teverson (Chairman)
Lord Addington
Baroness Browning
Lord Hannay of Chiswick
Viscount Hanworth
Lord Hunt of Chesterton
Lord Moynihan
Lord Soley

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Examination of Witnesses

Rod Johnson, former Chief Coastguard, Rear Admiral Tom Karsten RN, UK National Hydrographer, and Dr Richard Wood, Head of Oceans Cryosphere and Dangerous Climate Change, Met Office

Q214 The Chairman: Admiral Karsten, Dr Wood and Mr Johnson, can I welcome you to this evidence session of the House of Lords Arctic Select Committee? This is one of our many evidence sessions. This time we are looking at a bundle of issues such as hydrography information and data about the Arctic, and search and rescue. You should have a copy of all the interests that we have declared in the area, which is there for your information. We will be asking you a number of questions and supplementaries. You will have an idea of the sort of areas we will be covering. Clearly, I am not expecting everybody to answer all the questions, and some of them will be directed very much at an individual’s expertise. However, if any of you have something you think is valuable to the Committee that you want to add, please do so. If one point or another is not covered sufficiently and you want to write in with further evidence, we would welcome that.

First, can I ask you briefly to introduce yourselves, going from left to right from where I am? Mr Johnson, perhaps you could start.
Rod Johnson: I am Rod Johnson. I am the former chief coastguard, and I was in post from 2008 to 2012. I am now in private practice, so the opinions I will be expressing are my own.

Rear Admiral Tom Karsten: I am Rear Admiral Tom Karsten, deputy chief executive at the UK Hydrographic Office and UK national hydrographer.

Dr Richard Wood: I am Dr Richard Wood, head of oceans cryosphere and dangerous climate change at the Met Office.

Q215 The Chairman: Thank you very much. Let us start off, primarily with Mr Johnson. I would like to ask you how extensive search and rescue coverage is in the Arctic maritime region. In which areas might that search and rescue capability be particularly lacking? Has the situation changed significantly since the signing of the Arctic Council agreement in 2011? The Committee visited Svalbard in particular and Tromsø during the summer. Because of the remoteness of the area and the difficulties, they had to mount an extremely complex rescue operation in Greenland at one point. We saw a few tourist ships up there with quite a number of people on them, so this seemed to us to be a particularly important area and one of potential danger for the future. We are very interested in that.

Rod Johnson: As you rightly point out, the issue with the Arctic regions is quite simply the tyranny of distance. Five states have a coastal presence in the Arctic region. All of them have forces that could be turned to search and rescue, but it is not like the UK, where there are standing search and rescue forces with clear response criteria. They are much more units that have search and rescue as one of their many tasks, which include borders, fisheries and military purposes.

To give you a sense of the distance, it is over 2,000 miles from the most northern point of the UK, which is Out Stack north of Shetland, to the Pole. To get a sense of proportion, turning that distance round the other way would take you to Marrakesh, but between Out
Stack and the Pole there is almost no infrastructure. It is that lack of infrastructure, or anything at all, that makes search and rescue response in the Arctic so challenging, because it is all about what you can take with you.

There are forces projected by the five littoral nations. The Arctic Council’s search and rescue agreement was ratified last year and has been tested twice. I have looked at the output report from the last exercise in 2013, which was SAREX Greenland Sea. It was very interesting. It has identified that any SAR operation up there would of necessity be an international effort. No one nation has enough resources to do the sort of operation you were contemplating for a large number of tourists. While the search and rescue organisation up there is not yet mature, it certainly has a progress path towards maturity, so it understands the need for interoperability agreements and the need to share information and its surveillance picture. The search and rescue effort there is on a path towards a point where some degree of assurance may be offered to touristic activities in the high north. However, at the moment what could be mustered and what is required are two different things.

**The Chairman:** You are saying that at the moment it is very much behind the curve, to use a cliché, in the growth of activity there and the search and rescue capability.

**Rod Johnson:** The growth of activity is outstripping the available resources, and that is always the case. Commercial demand will always be much more responsive than any state’s ability to place resources there.

The people who operate there—I have had the great pleasure of working with them very closely—are extremely resourceful and determined by character. I would not want to portray it as a vacuum up there. They do know what they are doing, and the present population of the Arctic region, either remote indigenous people or science stations, is quite
capable of providing effective search and rescue cover for that. SAREX Greenland Sea 2013 contemplated a scenario where they would have to deal with a large cruise ship. Cruise ships have been up there for a considerable period, fortunately without too many incidents, but the stretch would be a mass evacuation from a large cruise ship, because there is nowhere to take that number of people; it would be a huge logistic operation.

**The Chairman:** You said that two exercises had taken place. The Arctic Council does not have executive authority. How strong is that agreement? Has it really moved things forward? Is it delivering the promise that perhaps was expected of it at the time?

**Rod Johnson:** If you will excuse the awful pun, I think it has broken the ice. There are standing mechanisms by which nations co-operate for search and rescue. Around the world, depending on demand, they have matured to differing degrees. The harshness of the environment up there has traditionally forged a sense of shared peril and effort among the nations, but it was not structured in a particular way.

I noticed that the Arctic Council has declared the search and rescue regions expressly on the basis that it is not a precursor to any form of territorial claim, because within the Arctic Council many territorial claims are still unresolved. Therefore, they have separated out any search and rescue from any territorial claim, which I think is a good thing. They now have an agenda that is essentially the lessons learned from its last two exercises, so the search and rescue organisation up there is on a path towards maturity in a way we have seen mirrored elsewhere in the world where demand has arisen. If we were to look at the end state, we could take the UK, the North Sea basin and the Irish Sea as an example of what happens when a search and rescue structure matures. We are a long way from that in the Arctic, but they are on that path.
Q216 **Lord Soley:** To what extent do you think search and rescue can be isolated from geopolitical tensions there?

**Rod Johnson:** I had the pleasure to serve with Her Majesty’s Coastguard for 26 years. There were occasions when some of the operations we were conducting had the potential to conflict with politics, but they never did. That is because essentially search and rescue is a humanitarian activity. My experience is that, no matter what the tensions might be, when life is in danger all other considerations are set aside.

**Lord Soley:** In answer to the Chairman, you said that Shetland was about 2,000 miles from the Pole, but if I remember rightly it is only about 400 or 500 miles from the Arctic Circle. Have you made any judgments about what the UK could do to enhance search and rescue operations, obviously not throughout the whole of the Arctic—it is a very large area—but within reach of Shetland and northern Scotland?

**Rod Johnson:** Since the loss of long-range fixed-wing maritime patrol aircraft from the UK inventory, there has been little we could offer to our colleagues in Iceland and Denmark in terms of reach. With even the longest range of a modern search and rescue helicopter, you are still short of the Arctic Circle.

On the other hand, the UK has trained officers from Finland, Iceland and Canada in search and rescue techniques going back over the past 15 years, so we have lent them our expertise and we continue to co-operate with them through a variety of fora.

**Lord Soley:** Should we get a long-range aircraft to replace the lost ones? Would they be useful?

**Rod Johnson:** Yes, I think we should. It is all very well to have a surveillance network that can see well over the horizon, but if you cannot reach out and intervene you are missing half the capability.
Lord Hannay of Chiswick: Are there any private-sector assets available in an emergency, or do they simply not exist?

Rod Johnson: Within the Arctic region most of the search and rescue forces are state-based. However, there is a duty upon every shipmaster to render assistance in the event of a distress being declared. Therefore, there may be private resources available on a contingent basis, depending on where the incident is and who is around.

Lord Hannay of Chiswick: I was also thinking of the private resources that are no doubt servicing the various oil and gas platforms and so on.

Rod Johnson: There are examples in the development of the North Sea. For example, BP provides Jigsaw, which is a private rescue service for its own platforms. There are aircraft and ships that service those platforms further north, and they would be available. The gap in capability might arise in the provision of winch-fitted helicopters, or surface units with the right kind of endurance.

The Chairman: It has been suggested that cruise ships should operate in pairs in case there is a problem with one. We would hopefully not have a problem with both. Is that credible, or is it rather pie in the sky?

Rod Johnson: I think it is a very sensible way forward. A large modern cruise ship could contain anywhere between 2,000 and 4,000 people. The really large ships tend not to go that far north because their trading patterns are somewhere else, but that is still an awful lot of people and they have to go somewhere. There is no infrastructure in the Arctic region, you cannot land them on an ice floe and they have to be put somewhere, so the nearest refuge could be the ship next door. Although it would be quite cramped and crowded, at least it would be relatively safe. The only issue with mutual support is that the life-saving appliances fitted to a passenger ship are designed to get people off, not to get people back
on. I am aware of some excellent work being done by the International Marine Rescue Federation on this very problem. The use of modern slab-sided merchant ships as rescue assets means that getting off is much easier than getting back on again.

The Chairman: That is a very good point.

Q217 Viscount Hanworth: This question is for Admiral Karsten. How well mapped is the Arctic Ocean? Is our hydrographic knowledge of the region good enough in view of the natural hazards? Should we accord a higher priority to the region than we do at present? I imagine that submariners gathered extensive hydrographic information during the Cold War as an adjunct to the hostilities and that knowledge would now be generally available, but I am uncertain about this. Could you comment on that as well?

Rear Admiral Tom Karsten: I do not know whether the chart I provided would be of any use at this point. [Readers are referred to the written evidence from the UK Hydrographic Office available on the ‘Publications’ page of the Committee’s website.]

The Chairman: Indeed.

Rear Admiral Tom Karsten: It is not a complete picture, but it may help to orient us with respect to the standard of charting in the region, which, in a short answer, is fairly ‘curate’s egg’. Some parts are adequate, others are not. If we look at the chart briefly, the red squares reflect UK Hydrographic Office or GB charts. As you see, they cover, at fairly small scale, a portion of the Arctic but not the whole region. Instead, we have a reliance on coastal charts produced by coastal nations, which, with respect to the Arctic, refer primarily to Russian charts of the Northern Sea Route, Canadian charts for the North West Passage; and some Danish charts around Greenland. They are of variable quality for a number of different reasons.
The Northern Sea Route charts are fairly comprehensive in terms of numbers, both on paper and electronically, but the surveys on which they rely are relatively old. Having said that, surveys around the world can be relatively old, except for the most demanding and high-density areas. The question of horizontal positioning, without becoming too technical, can on occasion be slightly tricky. As to paper charts, they are also in Russian and therefore are of most use to local rather than international traffic. I would argue that the northern sea route in coastal terms is relatively well charted.

The North West Passage is a different question. I am sure our Canadian colleagues would be the first to admit that this is a challenging area in hydrographic terms. The coastal area around Greenland is similarly fairly patchy from the Danish perspective. Therefore, the short answer as to the standard of charting is that it is variable across the piece, but that in a way reflects some of the challenges that exist throughout the world.

Your second question was in respect of hydrographic standards in the region. There are technical measurements to how well areas are surveyed. They range from spot-on accuracy to a few metres, to accuracy that both in horizontal and vertical terms is questionable. You could have areas where depth anomalies of some size may exist, and horizontal inaccuracy, for instance the point of a rock being as much as 500 metres or half a mile out of position. Therefore, the technical standards of hydrography in the region are a little questionable, but again that can be the same throughout the world.

Your third question was with respect to priority. From a UK perspective, we aim to chart the world and service the needs of the international mariner. We spend a significant amount of time analysing the densities and movements of shipping around the globe to ensure that the services that we provide the international mariner are up to date. Even with the reduction in ice over the past few years, we believe that, at the moment, there is insufficient priority to
focus much more effort on the Arctic region. To put it another way, there are areas of the world where we have to devote more effort, West Africa being a good example and the South West Pacific being another, and the density of shipping is such that we have to focus such resources as we have on updating those charts first. The time may well come when the amount of traffic in the Arctic, in particular international traffic, increases. At that point we will rapidly readdress that issue and seek to increase what we can offer. For the time being, for transiting traffic on the Northern Sea Route the reliance will be on Russian-produced paper and electronic charts, which I believe are broadly adequate for the purpose, but, as ice recedes, further survey will be necessary because there are large swathes of the Arctic where survey standards are woefully inadequate.

Viscount Hanworth: Referring to our own charts, where would you say the greatest accuracy and inaccuracy is within the regions bounded by red lines on your map?

Rear Admiral Tom Karsten: Those charts have been schemed and selected to reflect the needs of the Royal Navy as well as our commercial needs, so they cover two aspects. They are aimed to provide planning support for commercial access to ports along the Norwegian coast and in Russia, so they cover both Murmansk and Archangel, which for us are commercially important ports. You will see the line that follows the Norwegian coast where the availability of better scale charts is much greater. If you were transiting, therefore, from Europe through to Murmansk or Archangel, the standard of charting would be relatively high. For other areas shown on the chart, for instance east Greenland, that would not be the case.

Viscount Hanworth: On a rather different tack—this may also be within your ambit—I am aware that long-term forecasting of the Arctic climate depends crucially on our understanding of the thermohaline circulation both as regards its trends and its variability. A
decade ago there were perverse speculations concerning the weakening of the Gulf Stream, which I imagine would make us very cold, but I believe these ideas have been dispelled. Is the current state of our knowledge really sufficient for the purpose of forecasting?

**The Chairman:** I am sure Dr Wood would like to answer that maybe a little later.

**Viscount Hanworth:** We have also received something today about the jet stream rather than the Gulf Stream, so maybe you might wrap all that up.

**Q218 The Chairman:** I think we will come to that later on. Stephen Harper, the Prime Minister of Canada, has said—I was going to say “threatened”, but that is the wrong word—that for territorial claims it will measure every bit of the sea bed of the Arctic. I think Russia is doing a similar thing for its own claims. Will that provide the same information that you are trying to get here, or is that a completely different set of things? Will some of this be solved by the fact that the territorial disputes drive the need for data?

**Rear Admiral Tom Karsten:** Yes, it will. The fact that the Russians and Canadians are keen to ensure that they understand that the nature of their coastal waters is of direct relevance to the standard of hydrographic product that could be available, so it is to be welcomed.

**Lord Soley:** Is there anything that we are not doing that you think we should be doing?

**Rear Admiral Tom Karsten:** From a UK perspective, the UKHO has a responsibility for charting the world and meeting the needs of the international mariner. We do that with a series of charts of a uniform nature derived from the best products that we could acquire. The level of engagement that we currently enjoy with our colleagues in the Russian hydrographic service always needs working at. To answer your question as to whether there is more that we can do, I think we can increase engagement, if possible, with our Russian colleagues to ensure that we are gaining access to the latest information that they have and
therefore producing a series of charts that at one point might cover the whole of the Northern Sea Route.

**Q219 Baroness Browning:** Is the capacity for weather and ice forecasting in the Arctic currently good enough to ensure safety for shipping and maritime activities? Could we hear a bit more about exactly where you think further improvement should be made? I am looking to Dr Wood to answer that. On the back of that, in relation to what we have heard about cruise ships that already go into these waters, to whom exactly do they apply to get a risk analysis and information that makes them think that commercially it is safe enough to go ahead? Which body would they go to for that green light to proceed? I turn to Dr Wood first on the question of forecasting.

**Dr Richard Wood:** I should preface my reply with some context here. For response to emergencies in particular, it is important that there is a single authoritative source of information on weather and environmental conditions. The lead bodies for that are designated by the International Maritime Organization and the World Meteorological Organization, and for the Arctic those are based in the Arctic states. The UK’s contribution to this through the Met Office comes primarily through our global weather prediction capability, which is then an input to the more detailed forecasts produced by these regional centres. The Met Office forecast is widely shared among the international weather forecasting centres. Indeed, it is generally seen as one of the leading global forecast products, so that information goes into that decision-making.

We have the capability to rapidly develop a relocatable regional modelling capability for particular crisis regions. I am not aware of that having been done for the Arctic specifically, but it has been done in the past for a number of natural disaster regions or operations of the UK military, so that capability is there.
To answer the question about the ability to forecast in the Arctic, it is a particularly challenging region for a number of reasons to do with both observations and modelling. We are very reliant in the Arctic on satellite observations, because clearly the surface network is not there. Interpreting that satellite data can be more difficult in the Arctic than in some other regions. To give you an example, the satellites that measure sea surface temperature essentially measure something to do with the radiation coming off the surface of the ocean. They then interpret and process that to give information about surface temperature. The algorithms and methods that we use to do that are very much focused on ice-free regions, particularly near the ice edge where you have a mixture of water and ice. The algorithms to process that satellite data are quite complex and need a certain amount of ground-truthing from in situ observations to help us improve them.

**Baroness Browning:** Is that ground information forthcoming?

**Dr Richard Wood:** It is. It is a slow process through internationally co-ordinated research programmes, because clearly the observational programmes need international co-ordination to make sure that they are in the right places. This is an area where there is good international collaboration. The Met Office hosted a workshop on this back in December last year to bring together the experts in these areas. There are programmes that tend to evolve on the time scale on which research programmes evolve, so they take multiple years to spin up. They also have to be synchronised with the release of new satellites. When a new satellite goes up there will be a concerted effort to put observations in place on the ground to do the ground-truthing. This work goes on, but it remains challenging because we do not have the routine observations coming in every day from the ground network to give a different perspective on the satellites.

**Baroness Browning:** This sounds like quite a long process.
**Dr Richard Wood:** It certainly is. It tends to be synchronised with the new satellite instruments as they go up. The algorithms are developed by a bunch of scientists in different groups. In the UK we produce a particular analysis of the surface temperature and sea ice. That is produced daily and fed into weather forecast centres around the world; it is widely disseminated, but compared with the other groups around the world, this is one of the regions where there is still some uncertainty going from the observations that come in to our globally complete fields of sea ice and sea surface temperature. You have to fill in the gaps, and there are choices about how you fill in the gaps and process the satellite data. We see considerable uncertainty. When you do that in different ways, you get slightly different answers.

**Baroness Browning:** CruisesRus decides today that next season it is going to produce a lavish brochure and take people into these waters. Whom does it consult to do that risk analysis on the basis of the forecast at that time?

**Rod Johnson:** Before the ship can go up there, there are a number of hurdles to be passed. First, in no particular order of significance, the ship has to be at the very least ice-strengthened to work in ice. The individual company will do a risk assessment to decide whether or not the ship can go up there and the competence of the crew who are taking her up. At the moment that is slightly informal and relies upon the experience of the particular operator, but the International Maritime Organization is on the cusp of launching the Polar Code. That would require a much more explicit safety regime for ships and crews to operate in that area.

**Baroness Browning:** To which body do they go for weather and ice forecasts?

**Rod Johnson:** They would go to a number of sources. They may be seeking that commercially, they may go to the forecasting authorities in the area they are operating in,
they may go to the Met Office. It is a commercial decision; it is something that they would pay for.

**Lord Hunt of Chesterton:** We have had evidence before—we looked at your map—that all round the coast of Russia are large areas that are quite shallow. The nature of this area of the world is changing. There are huge currents coming down the rivers. We know that the English Channel changes considerably from year to year, and the methods you use to calculate that use satellites, waves and so on. With climate change changing these huge currents and rivers, is this not an area that is slightly risky? You are going quite close to the coast in these shallower waters. Is this part of the research, investigation and new technology that is coming in?

**Rear Admiral Tom Karsten:** Yes. It is a very dynamic area and it needs to be updated as often as possible to ensure nothing has been missed. My understanding is that the limitation is about 12 metres through the Kara Sea, so we are talking about relatively shallow navigational routes. There are new methods for establishing hydrographic bathymetry data whereby you can use satellite-derived bathymetry, but that requires relatively clear water to take a photograph from which you can then discern some sort of depth.

**Lord Hunt of Chesterton:** There is also a method of using dirty water and looking at surface waves. I saw this at the Taunton lab when I was head of the Met Office.

**Rear Admiral Tom Karsten:** It probably does not have sufficient accuracy to take large vessels through relatively shallow water, so it is only indicative. I think that would be a relatively inaccurate form of data collection.

**Viscount Hanworth:** You mentioned surface temperature measurements from satellites, but do you also transduce information from buoys or ships as well, and to what extent is that useful?
Dr Richard Wood: It certainly is. There are research data from land stations around the edge, which are clearly important. There are relatively few data from the ocean surface. Clearly, there is not a lot there, but things like ice-tethered platforms will produce some basic met data. Given the sparsity of data, every bit you can get is helpful, so those things are useful.

Viscount Hanworth: That comes from different nations.

Dr Richard Wood: That comes from different nations, but it can generally be shared.

Q220 Lord Addington: We are wondering how the Arctic environment affects safety awareness and activities, such as search and rescue, in other ways. For instance, how is the effectiveness of GPS and high-frequency radio that far north affected? Would it be a good idea to increase bandwidth in the Arctic to connect better with the satellite system? The question is about electronic communications generally and what happens, and how that is changed by the Arctic environment.

Rod Johnson: Starting with GPS, that suffers in higher latitudes. Essentially, it is a system where the receiver looks at satellites passing overhead and uses time difference to form position lines that intersect. If the intersection of those lines is not obtuse because the satellites being seen are unfavourably aligned, the position is harder to interpret. Satellite geometry in higher latitudes is often unfavourable. The system is prone to disturbance through the effects of the ionosphere and the sun. Those corrections can be broadcast through the wider area by geostationary satellites, but they are above the equator so the ability to get wide area corrections is also slightly diminished. Therefore, the faith one can place in GPS is reduced, but a prudent navigator will be using more than one means of navigation anyway.
Satellite communication is probably the most reliable means of communicating up there because, as evidenced by the aurora borealis, the reflecting layer that normally works for radio waves, the ionosphere, is prone to disturbance by solar weather, more so in the polar regions than anywhere else.

With regard to bandwidth or additional means, I am not aware of any particular congestion, but I have not operated up there for a continuous period of time. I do not know whether any other members of the panel can shed some light on that.

*Rear Admiral Tom Karsten:* I operated in the Antarctic as captain of HMS “Endurance” for a couple of years and therefore two seasons. While the circumstances in the Antarctic are very different, the geography, in the sense of where it is, is similar, and clearly there are challenges in operating at higher latitudes with your ability to hit a satellite and get the information you need and communicate in the way you would wish. Therefore, there are challenges in relation to using that sort of facility.

*Lord Hannay of Chiswick:* Will the existence of Galileo, when it comes into operation, make any difference, or is it open to exactly the same problems as GPS?

*Rod Johnson:* It is similar in concept. Therefore, it will be prone to the same sort of limitations that the Chinese, Russian and American systems have, although Galileo has a slightly enhanced capability for the promulgation of what we call wide area correction: in other words, its ability to correct.

Polar navigation is not for the inexperienced; it is an art form. It is not a mainstream activity. One of the requirements of the Polar Code will be on the competence of the individuals who operate there, because ultimately the navigation systems are what they are; it is the person operating them and their understanding of the particular challenges who is most important.
Q221 Lord Hannay of Chiswick: To switch to a completely different subject—the possible impact of a significant oil spill in the Arctic—could Mr Johnson say what technologies and methods exist for responding to an oil spill in either ice-covered or ice-present sea? Have these methods been proved to be effective? Have there ever been instances where they have been shown to work, as opposed to just working in theory?

Rod Johnson: Cleaning oil out of the sea is a very difficult process, even on a nice day in a warm ocean. Oil is a particularly intractable substance. To give you some idea of the percentages, mechanical recovery—scrubbers and skimmers—might get you 5% of the loss, evaporation would be another few per cent, bioremediation takes care of a significant proportion of the oil—that is, wave action breaks up the substance—and some of it simply disappears. We do not know where it has gone. Twenty-five per cent of the loss from Deepwater Horizon is unaccounted for; we just do not know where it went—it is gone—so it will be lying somewhere waiting to be discovered.

Skimming is not possible in ice-covered water because there is literally ice in the way. The oil would go under the ice. In addition, oil is very temperature sensitive. To pump around a cargo of crude oil or oil fuel it needs to be the temperature of a very hot cup of tea to make it flow. Therefore, as soon as you introduce it into cold water under ice it become very viscous and difficult to deal with. I have seen incidents of small losses of lighter fractions of oil as a result of grounding in the North West Passage and conventional booming technology—in other words, putting an inflatable boom around the ship—has contained the spill. However, we have not seen an incident involving a large-scale loss of a viscous fraction where ice is present, so at the moment that is indeterminate. I certainly would not want to try it.

Lord Hannay of Chiswick: But you would not necessarily have the option.
Rod Johnson: No; that is quite true. I have discussed at length with colleagues from other nations spills in the Arctic, and I have given presentations on it. When I consulted my colleagues and asked, “What advice would you have me give to the august audiences I am talking to?”, they said, “Do not have a spill”. That was their advice.

The Chairman: Is that a PowerPoint presentation you have given before?

Rod Johnson: Yes, it is.

The Chairman: I think we would be quite interested to see that. It may be your commercial property.

Rod Johnson: Not at all. I will send it across to you.

Q222 Lord Hunt of Chesterton: My next question is about how you are working with other organisations. We have talked about the Met Office, Hydrographic Office and HM Coastguard. There are other organisations in the UK, are there not, such as the maritime organisation BMT, which are also interested in satellites? There is also the question of collecting and sharing data with all these different organisations, because the Met Office can do its forecasting only when it is sharing data—this has been referred to before—and shipping produces that. Some of the exploration platforms do not necessarily share data. Is that being taken seriously enough in light of the risks in working in these areas?

Dr Richard Wood: The basic met data have a long history of being well shared around the world from the global meteorological observing network. As you rightly point out, there are observations outside that network. While I cannot comment specifically on cases in the Arctic, I am very aware of cases in the marine environment around the UK where, working with other partners, often in the private sector, it is possible to gain access to those data to feed into forecasts. It tends to be done on a more ad hoc basis, but those efforts do take place and yield access to data.
Rear Admiral Tom Karsten: From a hydrographic perspective, we have close bilaterals with most of the Arctic states and therefore transmission of data by that means is relatively effective. Within the international space the International Hydrographic Organization is a very effective body in seeking to collaborate across borders. It is not quite as open in the Arctic as it is everywhere else in the world. The UK has sought to become an observer at the Arctic Regional Hydrographic Commission, but to date has not been able to achieve that. With respect to commercial survey, I think more work could be done in engaging with commercial activity to gain access to the data that have been secured for drilling or exploration purposes and use it for hydrographic purposes.

Lord Hunt of Chesterton: The Met Office has a system of sferics, which it operates almost globally, and is able to see much more lightning activity in very northern latitudes, which is important for many purposes. I have the feeling that in principle that is an open system. It used to be secret. Does that contribute to significant information about the changing environment?

Dr Richard Wood: I do not know the specifics of that, so I will have to get back to you.

Lord Hunt of Chesterton: It is a Met Office system. Sadly, it is not widely used even though it is on the internet, but it is an important part of the changing environment.

Viscount Hanworth: Can I go back to the question that was postponed? We asked for information about ocean circulation in order to feed into our predictions. Should that be enhanced? Is this matter really unpredictable, or do we have a handle on it?

Dr Richard Wood: I guess this arises from the question about the Gulf Stream or the North Atlantic overturning circulation.

Viscount Hanworth: There is also of course Jet Stream, if you want to include that in the whole complex system.
Dr Richard Wood: The latest state of the science is that circulation is expected to weaken as a result of climate change and that will have an effect on climate all round the northern hemisphere. It may in some regions moderate the effects of global warming, for example. Therefore, that effect is built into climate models and is very well understood. The idea of a rapid collapse or shutdown is something that has happened in the past, but the consensus is that it is very unlikely over the 21st century. There are a few model simulations which suggest that it is possible in the 22nd century. It is important to keep researching it because there may be a commitment to that. You may be committed to that happening before you see it occur.

Within the Atlantic we are now monitoring that circulation much more closely than we were 10 years ago. We have developing observing systems everywhere south of the Greenland-Scotland axis and into the Atlantic. Within the Arctic itself, as I think you have heard from previous witnesses, observing the ocean state is extremely difficult. The ARGO buoys which pop up and down in the rest of the ocean cannot really operate under ice because they cannot surface. Therefore, we have to rely on a number of different technologies. There are some emerging technologies that will help us there. The ice-tethered profiler is one; the autonomous vehicle that can travel under ice is another. There is real promise of technology on the horizon to help us with this, but it is not there in a routine operational monitoring sense at the moment.

Viscount Hanworth: Things are on the way but we do not yet know their consequences.

Dr Richard Wood: Yes.

Q224 Lord Moynihan: While you have answered the question about whether there are sufficient data about the Arctic to make informed decisions about activities such as shipping, tourism and energy exploitation, perhaps you could go further and say whether there are
any specific gaps that you would like to see filled. Let me ask the same question from a
different perspective. If you were to sit down with your Canadian and Russian colleagues, or
your Finnish, Swedish or Norwegian friends, with a significant budget at your disposal, what
would you prioritise for collaboration in data collection, co-operation, research, modelling,
monitoring stations and so on? Where would your priorities be if you had that budget?
Where do we have competitive advantage in this country that could contribute to the
benefit of all the Arctic nations? What would your list be?

**Rod Johnson:** I am very tempted by the idea of a large pot of money. I would start shopping
with capability. The Icelanders have one long-range aircraft, the Danes can muster two,
there is a standby C130 that the International Ice Patrol uses from the American side of
things, but in terms of searching and covering the ground I would be looking for fixed-wing
platforms, either through the state or some form of partnership arrangement with the
private sector. I would certainly be looking at improving the resources available for
international training and exercising. There were 1,000 personnel involved in SAREX
Greenland Sea. There is a considerable cost there to be swallowed for training. However,
because the environment is so harsh and the distances so huge, without increasing the
tempo of training internationally it will take longer to uncover the lessons we need to learn
to answer the question you have posed.

**Rear Admiral Tom Karsten:** In the Arctic, capacity is the same issue in hydrographic terms.
In a perfect world, I would argue for open sharing of all information, open pooling of all
hydrographic assets, and an opportunity to gain as much data as possible in the open waters
across boundaries and share it.
From a UK perspective, what do we offer? I think we have significant cartographic skills given our responsibilities around the world and, given our activity in the Antarctic, we also have significant hydrographic surveying skills from operating in ice.

**Dr Richard Wood:** I will answer more from a research perspective. We absolutely have to work in the context of international research and, as the question suggested, play to our strengths. I would highlight two areas. One is observations of the detailed processes that are going on in the Arctic, for example in Arctic clouds, ocean mixing and so on, where the UK has excellent expertise. The other is the development of the models of all components of the climate system and, in particular, we have strength in coupling those models together—the oceans, ice, atmosphere and so on and the flows of energy and water between them. That leads us on to potential capabilities in more long-term forecasting, for example on seasonal timescales. It is very much a research problem but one where the UK is well placed to take a lead.

**Lord Hannay of Chiswick:** Admiral, if I understood your answer rightly, you were not looking to new hard material assets, you were saying that existing knowledge, if more widely shared, would be hugely valuable. Could you put your finger on who is preventing the sharing of that knowledge? Who currently possesses it? Are we to assume that is largely the United States and Russia, or is it wider than that?

**Rear Admiral Tom Karsten:** I do not think that is necessarily the case. From a national perspective, the sharing of hydrographic data is relatively well developed in the Arctic region. Perhaps more fruitful opportunities exist in engaging with commercial operators in the region who carry out surveys for different purposes, and it is a matter of ensuring we gain access to those data. There is inadequate capacity around the world for the sorts of sophisticated hydrographic surveys that need to be done. Therefore, I suspect there will
always be a shortfall in the amount of up-to-date data that we would like to get our hands on.

**Q225 The Chairman:** Can I ask each of you for just one comment? One of the things the UK Parliament is particularly concentrating on is what the UK should be doing. I do not know whether each of you has one key thing in your own areas you would hope we might recommend in our report the UK Government do. Is there anything you have not gone through before that comes to mind?

**Dr Richard Wood:** I think it would be largely my answer to the previous question. Understanding the way energy, water and chemicals flow between the parts of the system in the Arctic is a particular research priority that we are very well placed to follow up.

**Rear Admiral Tom Karsten:** Briefly, it would be to continue to offer such expertise as we have for the greater good of hydrography around the world, particularly in the Arctic.

**Rod Johnson:** I think it would be to continue to support the UK’s current engagement with the other search and rescue services around the North Atlantic rim.

**Lord Hunt of Chesterton:** I think you referred to fixed-wing aircraft.

**Rod Johnson:** I have spoken a little about that.

**Lord Hunt of Chesterton:** Keep speaking.

**The Chairman:** We have reached our time limit. It has been a very useful session in all three of your specialist areas, which are ones that will feature very importantly as part of the fabric of our report. Thank you very much indeed.