HOUSE OF COMMONS

Scottish Affairs Committee

Oral evidence: Defence in Scotland: the North Atlantic and the High North, HC 81

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Watch the meeting

Members present: Pete Wishart (Chair); Sally-Ann Hart; Christine Jardine; Dr Philippa Whitford.

Questions 119-182

Witnesses

I: Professor Jacques Hartmann, Professor in Law, Dundee Law School, University of Dundee.

II: Dr Adam Bower, Senior Lecturer in International Relations, University of St Andrews, and Professor Iain Woodhouse, Professor of Applied Earth Observation, School of Geosciences, University of Edinburgh.

Examination of witness

Witness: Professor Jacques Hartmann.

Q119 **Chair:** Welcome to the Scottish Affairs Committee and our ongoing series of inquiries into and reports on defence. We are doing the High North and the Arctic. We are delighted to have Professor Jacques Hartmann with us, who is now going to tell us whom he represents and anything by way of a short introductory statement. Professor, over to you.

Professor Hartmann: It might be useful to say a few words about myself and my background, so you know where my knowledge comes from. I am originally from Denmark, which is why I have some connections with the Arctic. The Kingdom of Denmark encompasses both Greenland and the Faroe Islands as well. For a few years, I also worked at the Danish Ministry of Foreign Affairs, where I dealt with Arctic issues. I am now Professor of International Law at Dundee University.

One of the things that I often tell people about the Arctic is that, from an international law perspective, there is really nothing special about the Arctic. We have quite a lot of laws that apply to the Arctic. They might not always be enforced or applied correctly, but we do have laws—we do not have a kind of legal vacuum in the High North and the Arctic.

Q120 **Chair:** Thank you. Recent developments in Ukraine have cast a large shadow over the polar ice of the Arctic. There are all sorts of realignments and new, dynamic events, and the theatre is becoming just that little bit more sensitive. I am wondering what your view is of what is happening in the Arctic just now. Is there more likelihood of disagreements over territory or jurisdiction? Is the Arctic likely to become a place or source of conflict?

Professor Hartmann: Yes and no. It has been a source of conflict for quite some time. There are quite a lot of territorial disputes. Uniquely, land territory has all been settled in the Arctic. The last land boundary or border to be settled was Hans Island. Agreement was reached last year, after many years of negotiation. The boundary between Denmark—or Greenland—and Canada was delimited in the 1970s, but they could not agree on this small knoll, or bit of rock sticking out of the water. Agreement was reached last year, which means all land territories have been agreed.

There are some issues concerning what is called the north-west and north-east passages—one goes through near Canada and the other near Russia. That has been ongoing for quite some time: since the 1960s actually, which is why I am saying yes and no. There have been ongoing disputes about the right of passage. Russia claims that part of the waters are internal waters, which means that it has complete jurisdiction over them, and the same is true for Canada.

Another ongoing issue is with the extension of the continental shelf, which is the bottom of the sea, so to speak. Under the 1982 convention on the law of the sea, states may claim an extended continental shelf, which

means that they may claim the seabed from 200 nautical miles up to 350 nautical miles. That is ongoing at the moment, has been for quite some years and will be at least for a decade or two yet. So, there are quite a lot of things going on in the Arctic.

Q121 **Chair:** I am looking at a very interesting coloured map, and it looks like little bits of jigsaw going towards the north pole, and it is all very unclear who has jurisdiction over what. Is who has what in the Arctic all set? How much of that is international, and how much assessed or judged by treaty?

Professor Hartmann: Most of it is regulated by the 1982 United Nations law of the sea convention, which we sometimes refer to as the constitution of the law of the sea. That defines various zones that states may claim. They can claim a 12-mile territorial sea, what is called a contiguous zone up to 24 nautical miles, and what we call an exclusive economic zone up to 200 nautical miles out. Within that, states have sovereign rights, not sovereignty. They have sovereign rights over everything in the water column and on the seabed.

What is unique—not completely, but a bit unique—about the Arctic is that all the states around there have claimed the continental shelf and an exclusive economic zone, or EEZ. That basically creates what is called a doughnut hole—

Chair: A what?

Professor Hartmann: A doughnut hole—that is what we academics call it. To get into the high seas, which are not within the jurisdiction of any state, you have to go through the exclusive economic zone or EEZ of one of the Arctic states. So, it is fairly well defined and understood—I would say it is a matter of law—and most of the boundaries have been settled. All the land boundaries have been settled, but as I said, there is dispute about the Canadian and Russian claims about the zone or title of the water.

Both the Russians and the Canadians claim that their north-east passage and north-west passage are what is called internal waters. Those we treat as land, basically. It means that a state has complete jurisdiction and sovereignty over those waters, and there is no right of access, unlike with what we call territorial waters, for example, which extend from the baseline—the low-water mark—

Q122 **Chair:** We will come to that specifically, because we have a couple of questions we want to ask you about the rights referring to the emerging passages, because we know how sensitive they are.

One thing we have heard quite a lot about is the role of Russia when it comes to all this, and its new muscular presence in the Arctic. What is your view, given Russia's more adversarial attitude towards issues such as the Arctic? Is that likely to create difficulties and problems? Are the Russians likely to be more assertive in making those claims and coming into disputes with nations such as Canada?

Professor Hartmann: That is a difficult question for me to answer because I am only a lawyer, so I don't know so much of the political side of it. I can tell you about some of the legal processes that the Russians have been engaged in. For instance, there is a special committee, established under the law of the sea convention, for claiming the extending of the continental shelf. The Russians have been very active. They were the first to submit a claim back in 2001. They were asked to resubmit that claim, which they did, and they have been very active and outspoken about that.

In February this year, the commission approved the Russians' claim. They can't decide if a state has sovereignty over it. They can just say the data is good, so to say. Since then, we haven't really heard very much from the Russians. That is unusual considering how they have been acting from 2001 up to now. Why? I can't tell you.

Q123 **Chair:** One thing that has surprised us a little bit—other witnesses have said this to us—is that this has very little to do with oil and gas reserves, and that the competition for that is very low. Is that your view too?

Professor Hartmann: Most of the oil and gas in the Arctic is within the exclusive economic zone, so, yes, I would not say that it is about oil and gas. There are some issues of course with what is called rare earth; the Chinese, for instance, also have an interest in the Arctic and international waters in that doughnut hole that I mentioned before.

Chair: We are interested in this doughnut; we will probably come back to that. We like these sorts of terms when describing things.

Professor Hartmann: It is a nice image.

Q124 **Chair:** Yes, indeed. Lastly from me, before I pass over to my colleagues: is international law quite secure when it comes to resource extraction and claims to resources in the Arctic? Is there a clear set of rules that the Arctic partners will abide by when it looks at these things?

Professor Hartmann: Yes, there is a clear set of rules that we have, again, in the law of the sea convention from 1982. All the Arctic states have signed up to that. They issued what is called the Ilulissat declaration in 2018, where they committed themselves to law of the sea and to general international law. Also, the Americans signed that declaration even though they are not parties to the law of the sea convention, so I think the rules are pretty firm, yes.

Q125 **Chair:** There is one example. I can't remember the name of the archipelago of islands at Svalbard, which is under Norwegian jurisdiction, but the Russians have mining rights there. Is that correct?

Professor Hartmann: Svalbard is a very unique case of a kind of divided sovereignty or limited sovereignty. What happened was that, in the 1920s, there was a beginning dispute about Svalbard. What happened was that a treaty was signed, which was called the Spitsbergen treaty—or, today, the Svalbard treaty. It gave the Norwegians a limited sovereignty over the archipelago. That essentially means that the other states that have ratified

that treaty—today, roughly 40 states have ratified the treaty—also have certain rights on Svalbard; among others, that includes mining rights. The Russians have been mining up there for years.

Chair: Excellent. Thank you for that.

Q126 **Dr Whitford:** Some submissions that we have had have highlighted that things like the fishing catch in the High North is likely to increase by up to 20% with climate change and the change in sea temperature. Do you think that fisheries, as opposed to oil and gas and fixed reserves, are likely to become a bone of contention as we see the ice cap receding?

Professor Hartmann: Yes, I think that is almost inevitable and we already have one example. The Faroe Islands, which is part of the Kingdom of Demark, unilaterally increased its TAC—total allowable catch. It had about 5% of the catch of mackerel and, I think, also herring. It unilaterally increased that to 20%—if I remember the numbers correctly—and that created a very awkward situation in which Denmark and the other European countries initiated a case against the Faroe Islands, even though that is part of the Kingdom of Denmark. In the end, it was settled, but the Faroe Islands did increase their catch to 15%.

The argument was that, because of global warming and the warming waters, fish started to swim further north, basically. One thing is that there is more fish, but one argument that the Faroe Islands made was that, if more fish enter its waters, they also eat other fish, so it is not just that the catch is not proportional to the amount of fish, but it also creates damage to its economy if it does not catch them. I am not an expert in fisheries, but that was one of the arguments that it made.

Q127 **Dr Whitford:** Is that the 2007 mackerel wars, or is that more recent?

Professor Hartmann: No, that was 2007.

Q128 **Dr Whitford:** That was 2007. I am old enough to remember the cod wars as well. Do you think that we are going to have to think about how we police illegal fishing in the High North, and how can that be done? Obviously, it is a very difficult area to keep under surveillance. We are going to be talking about space with the second panel, but do you think that Earth observation, satellites, drones and so on are likely to play a role in things like this?

Professor Hartmann: Yes, I think so. This is one of those areas where the Arctic is not necessarily unique; a lot of unregulated, illegal fishing is going on around the world. The problem with the oceans is that they are enormous, basically, so we can't monitor them. And yes, that will be a problem also in the Arctic, and increasingly so as more fish go up there and it becomes easier to sail and navigate up there.

Q129 **Dr Whitford:** Is someone working on that? Is work going forward on being able to protect fisheries—

Professor Hartmann: Specifically for the Arctic?

Dr Whitford: Yes, for the High North and the Arctic.

Professor Hartmann: Not as far as I remember. I don't think the Arctic Council have specifically looked at that.[1] Well, first of all, they don't have complete jurisdiction to deal with the matter, because in the international waters they have no jurisdiction. They could discuss the exclusive economic zone. The problem is that the war in Ukraine has stopped the Arctic Council functioning in a proper way, which is very unfortunate.

Q130 **Chair:** Are there any other resources that we should be looking at? We have mentioned oil and gas and fisheries, which may become bones of contention. Is there anything else that the Arctic and the High North have that might be contested or people might stake a claim to?

Professor Hartmann: Yes, there are rare earths, potentially on the seabed in the international waters.

Chair: Rare—

Professor Hartmann: Rare earths. They are not really earths; they are minerals that are used in all kinds of technology. If you want to build a smartphone or anything like that, you need them.

Q131 **Chair:** Is this being harvested just now?

Professor Hartmann: No, it is not being harvested. The Chinese have been, quite strategically, buying up mines around the world for quite some years. At some point, they owned, I believe, more than 90% of the global output of rare earth production. They forced some companies to relocate to China if they wanted to have access to the rare earths.

One of the things that we know are in the Arctic are rare earths—among other places, in Greenland. There has been discussion about opening a mine in Greenland. But they are also on the seabed. There are parts of the seabed that are essentially volcanic, and there are on the seabed rare earths that could potentially be extracted. Some of the sources of this are in international waters, and that means that they are the heritage of mankind, basically, unless a UN agency deals with contracts for companies that can mine this. I know there is Chinese interest in mining some of this.

Q132 **Chair:** In your view, will this be managed effectively and will everybody come to an agreement about how this is harvested and managed?

Professor Hartmann: I have my worries about that. The environmental impacts are not really known. The Arctic is a very pristine and delicate environment, so we have to think very hard about extracting rare earths from the seabed in the Arctic.

Q133 **Chair:** One thing that I thought you might have mentioned when asked about other interests was tourism. More and more people—

Professor Hartmann: Yes, tourism is also one of the things that are increasingly attractive in the Arctic—among other places, in Svalbard, but also in Greenland.

Q134 **Sally-Ann Hart:** Good afternoon, professor. You mentioned environmental issues with the seabed, but—just looking at climate change and the melting of the sea ice—if climate change opens up new sea routes through the Arctic, how will states need to respond to increased traffic in order to ensure safety and security in the region? Obviously, that has to do with international law.

Professor Hartmann: There are various initiatives. There is, among others, the Polar Code. That was adopted some years ago and deals with Arctic navigation and security. The Arctic Council have also adopted a special set of rules that deals with Arctic navigation.

Of course, the more ships we have in the Arctic, the more important it is that we know where those ships are and that there is some kind of monitoring of them and also some kind of response in case of emergency. Those are the kinds of issue that need to be dealt with. There are also potential pollution issues, of course, if there are any accidents in the Arctic.

Q135 **Sally-Ann Hart:** So, environmental law issues and so on. In our previous evidence sessions, there were two lines of thought. One is that there will be drastic increases in traffic, which will bring increased security and safety concerns and the risk of maritime crime. The other line of thought is that the increases in the Arctic may not be drastic, because of the basic issues relating to navigation, such as drifting ice and darkness. Do you think that the increase in traffic is likely to be significant?

Professor Hartmann: I can't answer that question; I deal with law, so—

Q136 **Sally-Ann Hart:** Okay, thank you. Looking at the new Russian legislation about navigating the northern sea route, what are the implications of Russia's new law concerning access to the northern sea route?

Professor Hartmann: Again, the Russians are claiming that part of the northern sea route is internal waters, which means that they have complete jurisdiction over those waters. They can also deny access to those waters, unlike, for instance, the territorial sea, where there is a right of innocent passage. Potentially, it could have quite dramatic consequences if the Russian claim is upheld, in the sense that they can then decide who sails through those waters.

The Americans have made the argument that it is an international strait, and that would give you a right of strait passage to sail through. There has been some academic debate about whether that is right or not. Normally, to have a strait, you would have to have two areas of the high sea that are connected by that strait, and you would have some kind of navigation going through. That is true of both the Canadian and Russian waters—there has not really been any navigation going through.

I would not say that the Russian claim has no merit, basically. In the Russian waters, I think that the Americans are the only ones who have sailed through, and have only done it twice without asking permission

from the Russians, so that is not really a lot of navigation beforehand to qualify it as a strait.

Q137 **Sally-Ann Hart:** Okay, so does the legislation that Russia has passed actually challenge the existing norms and rules about freedom of navigation?

Professor Hartmann: No, I wouldn't say so. The claim is that they have drawn what is called a straight baseline. A state is entitled to a baseline, which we normally measure from the low waterline. If you have a very indented coastline, you can draw what is called a straight baseline—that means that you are basically cutting across areas of water—and then everything that is behind that baseline becomes your internal waters.

The only exception to that is if there is an international strait. We have certain conditions that have to be fulfilled; we have to have two areas of international waters and we have to have some kind of navigation going through. International law cannot really tell you how much navigation is needed, but, again, in the Russian case, we have only had two passages through, as far as I know, where the Russians have not given prior permission. As I said, it does not seem to be a spurious claim that the Russians are making, and it is actually quite similar to the claim that the Canadians are making.

Now, there is a little added detail, which is that, under the law of the sea convention, we have a specific provision that deals with sea that is covered by ice for most of the year. Article 234 of the law of the sea convention gives states added powers, basically, in their exclusive economic zone, and both Canada and Russia have also been using that provision to claim some of the rights that they have. However, the claim that the Russians are making now goes much further than that, because they claim that it is internal waters.

Q138 **Sally-Ann Hart:** Okay, and are they right in claiming that it is Russia's own internal waters?

Professor Hartmann: I don't think that I can answer that with a yes or no. I would say that their claim is not without merit. You would have to do some quite detailed analysis of the historical facts to see whether they are right, but I do not think that we can throw out their claim immediately and say that they have no right to those waters.

Q139 **Sally-Ann Hart:** So if you look at the Arctic Council, which I think is made up of eight countries including Russia, how likely is it that other members of the Arctic Council will challenge Russia's assertion, legally or otherwise—for example, through freedom-of-navigation exercises? We know, for example, that when the UK's long-term strategic objective is for the High North to remain an area of low tension and high co-operation, one of the key objectives is to reinforce the rules-based international system, particularly the UN convention on the law of the sea. How does that all interlink with what Russia is currently doing with its own legislation and desire to impose its rule base on that potential navigation?

Professor Hartmann: One of the ways that these kinds of cases are dealt with is by practice. A state can claim something as internal waters, and then most likely the Americans will sail through to show that they have a right of innocent passage. That has not happened on the northern sea route for the simple reason that that has been covered in ice for most of the time, and Americans have not had the technology to sail through for a long time. There were passages through in the 1980s, but as far as I know there have not been any since. The Americans have always been the most outspoken in these cases. They have also been outspoken in this case, but they have not sailed through as much as they have in other areas.

Q140 **Sally-Ann Hart:** In other words, if other Arctic countries want to establish a historic use of that passage, they need to start using it.

Professor Hartmann: Well, it is already a bit late because the Russians have already made that claim, and you would have to have a prior passage going through to show that it is an international strait. That is why I say the Russians' claim is not without merit. Michael Byers wrote a book on this in 2015. It is called "International Law and the Arctic". He analyses both the Canadian claim and the Russian claim, and he cannot really fault the Russian claim.

Q141 **Chair:** That is interesting. That is the first time we have heard that the Russians might have a legitimate claim on having the sea determined as being within their territory. Should we be bothered about that? We have heard from representatives of the Icelandic and Norwegian Governments who have said, "You don't want to go round there. It's dark. There is lots of ice. It is not a particularly great way to travel." Should we be worried about this, or is this something that might be increasingly important as we go forward?

Professor Hartmann: The northern—both north-west and north-east—passages are a much, much shorter way for European trade to go to Asia. It is about a third shorter, so there is definitely an interest in that. Currently, I don't think it will happen unless you have specially made ships. For most of the year or parts of the year you cannot go through. Some projections say that warming is twice as fast—I have also read it is four times as fast—in the Arctic as it is in other places, so it is foreseeable that we will get quite extensive periods of time where you can sail through these routes. So, yes, then it becomes interesting.

Whether or not the Russian claim or the Canadian claim that this is in internal waters will mean that there will be no international navigation through, we don't know. You could introduce some kind of treaty. There are many other things up for grabs in the Arctic, including fisheries, so there are lots of things that need to be negotiated. Just because the Russians make the claim that it is internal waters, it does not matter. Of course, the law means that they could stop international navigation, but it does not necessarily mean that they will.

Q142 **Chair:** Are they not more interested and concerned about military

warships coming through? The Russians have been sensitive about American warships heading 100 or 200 miles off their coastline. Would they be overly concerned about freight coming through that passage?

Professor Hartmann: Again, I am talking outside of my area, because I deal with the law, but one of the Russians' problems has always been that they do not have easy access to international seas. Warm-water ports have always been a historical issue for the Soviet Union and Russia. They of course would also have an interest in trade going through. They could make money out of that. I think you are right: they would be more concerned about navy ships sailing through.

Q143 **Chair:** I have it in my notes here that the Russians would possibly look at that passage similarly to the Egyptians with the Suez canal. Are there any parallels with that?

Professor Hartmann: No, because we have a treaty. For most of the straits around the world we have a treaty that deals with that.

Q144 **Chair:** We also had a conflict that led up to that being created.

Professor Hartmann: Yes. Often, when there is a skirmish with the Russians, they will prevent international flights over their territory, which means that airlines have to fly all the way round an enormous territory. We could imagine something similar happening here; when relations are good with the Russians, you can go through the north-eastern passage, or the northern sea route, and when they are not good, they close that route. That would be feasible. Making these claims gives them some kind of strategic advantage.

Q145 **Chair:** You would imagine that freight companies would have to adjust their fleet to accommodate the difficulties and issues in getting round that passage. It would not be very convenient, would it, if some months, you could get round, and in others, the passage was closed because the Russians were in a huff about something?

Professor Hartmann: Yes, and big freight companies are logistically very complicated. They plan everything months ahead. It would create a lot of trouble, if this was to happen.

Q146 **Chair:** It is fascinating; we are looking at a possible new route. As you said, we could circumnavigate the world in a third less time than would be required to go through Suez.

Professor Hartmann: And of course energy consumption would be much less that way.

Chair: Indeed. Thank you.

Q147 **Christine Jardine:** There is a great deal of subsea structure in the North Atlantic relating to oil and gas and our offshore industries. There are also electricity and communications cables. There has been a great deal of concern recently about their vulnerability to interference. Keeping away from the politics—as you have said, that is not your area—how clear are states' rights and obligations under international law when it comes to

offshore and subsea infrastructures?

Professor Hartmann: In some areas, they are fairly clear, including where you can lay cables and what permissions you need to lay them. If something happens to them, the rules are not very clear. In fact, I would say that they are non-existent. The rules that we have now essentially derive from a treaty from 1884, which was incorporated into a treaty from 1958 and then into the 1982 law of the sea convention that we have today. It has, among other things, rules on how to put down cables, and on civil liability for damage to cables.

There are no rules as such on the incidents that we see today of deliberate attacks on cables. I mean, there is a civil liability regime in place, but we do not know for sure, for instance, how the use of force rules apply. The state whose ship damages the cable has jurisdiction. For instance, if a Russian-flagged ship damages a cable in international waters, then per the definition, other states do not have jurisdiction to deal with that as a criminal matter, because they are not allowed to exercise jurisdiction in international waters. That would mean that only the Russians would have jurisdiction. That is a quite significant gap in the law.

Q148 **Christine Jardine:** Yes. A very good analogy applies: the poacher is also the gamekeeper in that situation. We have heard from other witnesses that in NATO, the UK largely has responsibility for defending the sea bed and infrastructure there. How is that possible? How can you defend that if the person who damages it has jurisdiction? Is there any way in which the UK can deter or prevent covert surveillance of critical national infrastructure?

Professor Hartmann: I was talking about criminal jurisdiction. You could not arrest these people and prosecute them in domestic courts, but there is nothing as such, as a matter of international law, that prevents the British Navy from sailing around and protecting subsea infrastructure; as far as I understand it, that is what it is already doing. A British admiral[2] said in January in an interview in *The Times* that an attack on important infrastructure was considered an attack on the UK—it was something along those lines. That was quite an important statement.

It was interesting; when we had the explosions on the pipelines earlier this year, both the Danish and Swedish Prime Ministers came out and said that this was not an attack, even though it happened in their exclusive economic zones. Of course, there are certain geopolitical considerations, and they wanted to de-escalate the situation, but as a matter of law, that is quite an important statement to make.

Q149 **Christine Jardine:** From what you have said, there is a lack of clarity and certainty, and much of the infrastructure under the North sea and the North Atlantic is critical to our national security and energy security. Does that leave that infrastructure vulnerable to interference?

Professor Hartmann: As a lawyer, I would always like to have clearer rules, and since we have absolutely no rules around many of the things that we have seen recently—yes, I would say so.

I should add that the general rules and state responsibility of course still apply, so if there is a breach of international law, the wrongdoing state is still liable as a matter of international law. The problem—what complicates this matter a bit further—is that many of these cables are private, so are not owned by the British Government. There are very few companies around the world that maintain and can repair these kinds of cables. There are quite a lot of issues throughout that very important part of our infrastructure, and it has probably not been as thought through as it should have been.

Q150 **Christine Jardine:** It sounds very much, from what you are saying, as if the potential vulnerability has been neither thought through nor addressed. It is something that perhaps needs to be addressed, in the short term certainly, given the increased tension with Russia.

Professor Hartmann: Yes. Again, I am just speaking as a lawyer, but I would have thought that it would be in the national interest of many states to have the capacity at least to repair their own cables, but many states do not have that capacity.

Christine Jardine: With that worrying thought, thank you.

Q151 **Chair:** I suppose this all came to attention with the suspected sabotaging of Nord Stream; they have never really resolved exactly what happened with all that. But isn't this now emerging in the consciousness of nations, particularly those with an interest in ensuring that these types of facilities are left untampered with and left alone?

Professor Hartmann: Yes, but it has happened before; it happened to the Norwegians last year, for instance, when two very important cables were caught.

Chair: That's Svalbard again, yes?

Professor Hartmann: Yes, exactly. The criminal prosecution stopped because they did not have jurisdiction to deal with the matter.

Q152 **Chair:** Is there no way to prosecute this, then? If there was a clear case with Nord Stream and a perpetrator was found, what would happen? How would they be prosecuted and brought to justice?

Professor Hartmann: It would be extremely complicated, to put it mildly. First, let's say there is a foreign-flagged ship. That gives you very difficult access to jurisdiction to arrest that ship; if you arrest it, you will have an international incident. Then, yes, you will have to have domestic laws in place that allow you to exercise jurisdiction; and your jurisdiction as a matter of international law is limited to the 12 nautical miles where you have territorial sea, and then you only have limited sovereign rights—and the rest are out to the open seas, basically. It is not an easy matter.

Q153 **Chair:** I am amazed, like Christine Jardine is, by the response to this issue. Given the amount of stuff that we are now putting into the seas and oceans—forget about your normal pipelines for important oil and gas reserves; I am talking about things like wind-power establishments and

communications—surely Governments must be sitting around the table and thinking, "We really need to get this resolved and get a new regulatory framework in place that takes responsibility for this."

Professor Hartmann: It is not unprecedented. When international civil aviation took off, no states had ever thought about exercising jurisdiction on aircraft, so there were cases where people were fighting on aircraft and then they landed and nobody could prosecute them for anything because they didn't have jurisdiction. These things happen. The problem when we are talking about the law of the sea is that we have very specific provision that says how much jurisdiction you can exercise outside the territorial sea, and there is no margin to exercise more jurisdiction, so to speak.

Q154 **Chair:** If there are to be business opportunities for a number of nations—I am thinking primarily of the United Kingdom and, within the United Kingdom, Scotland with its proximity to the Arctic and some of the opportunities that are starting to develop there—surely we will need some sort of regulatory framework in place: a treaty-based regime that allows for the development of opportunities to be realised.

Professor Hartmann: Yes, and ideally that would take place within the International Maritime Organisation—through negotiations there in order to agree on how we deal with these matters.

Q155 **Chair:** Are you looking forward to the Arctic Council reconvening and taking some sort of interest, role and responsibility in these areas? I think it is in the next few weeks, isn't it, that Norway takes over the chair again?

Professor Hartmann: Yes. Well, I hope that they will reconvene and that they will get up there and start again, but even if the Arctic Council had an interest in this, there is only so much that they can do, because there is sovereignty out to 12 nautical miles and sovereign rights out to 200 nautical miles, and they do not have the jurisdiction of the law of the sea convention. So even if the arctic states decided that they wanted to deal with this, they could not force other states to comply with that set of rules.

Q156 **Dr Whitford:** Obviously, the UN convention on the law of the sea is 40 years old, and now the subsea infrastructure is much more extensive, and we all depend on it much more. Is it more through that route of upgrading the law of the sea convention that you could bring the international community together?

Professor Hartmann: That would make sense. Either do it under the law of the sea convention or do a special treaty that deals with this. Again, as I said, most of the rules that we have in the law of the sea convention are from the 1800s, so there is definitely a need to update the rules. The problem is that these kinds of negotiations can take a very long time. The law of the sea convention's root is in 1949; then we go through a series of conventions, and we did not get a convention to be signed until 1982, which was the fifth in a line. It then took more than another 10 years for it to enter into force. It is the same with the recent treaty on biodiversity, which also took almost two decades to negotiate. These things are quite

lengthy, but of course the narrower you can make the topic of the negotiation, the faster you can do it.

Q157 **Dr Whitford:** But obviously, as you say, while we are thinking about it in the High North because of the change of circumstance with the ice cap melting and the change of circumstance with Russia, increasing subsea infrastructure is everywhere, so almost all maritime nations would have an interest—

Christine Jardine: All nations.

Dr Whitford: Yes, all nations. Your cable goes somewhere.

Professor Hartmann: There are some suggestions that we could deal with it under piracy. There is a quite elaborate definition of piracy in the law of the sea convention. Personally, I think it is a bit of a stretch of the existing definition, but if some states came behind that idea and started to deal with this as piracy, you could change a treaty without actually negotiating a new treaty through practice under that existing treaty. That is also an avenue. Let us say, for instance, that the UK started to deal with this matter as one of piracy. If other states did not object, that would be a perfectly legal avenue under international law.

Dr Whitford: Quite an eye-opener.

Q158 **Chair:** Absolutely. We were in Congress last week and, as part of our conversations with colleagues in Capitol Hill, this came on the agenda. There does seem to be a renewed interest or increased interest among colleagues in the States about what is happening in the Arctic and the High North. There was a convention in Alaska in the last few weeks—you will obviously be more than aware of that. Are these types of forums starting to become increasingly necessary and relevant? Will there be a number of international forums put in place to try to look at some of these issues?

Professor Hartmann: Sometimes, we just discover holes in the law and, yes, then we start discussing them. I saw the painting of Churchill out in the hall, and I think he said, "to jaw-jaw is always better than to war-war." So, yes, I think there is more debate coming up on these things. It is also because we have become more aware of these legal loopholes.

Chair: Thank you ever so much. That was a fascinating session. You gave us a lot to think about in terms of the evidence you have presented to the Committee. If you have any further thoughts, please get in touch; we are always happy to receive any further communications or anything that will assist us.

Professor Hartmann: If there is any way I can assist, please let me know.

Chair: We are very grateful to you. Thank you ever so much for your time today.

Examination of witnesses

Witnesses: Dr Adam Bower and Professor Iain Woodhouse.

Q159 **Chair:** Thank you ever so much, gentlemen, for joining us this afternoon. We will now specifically look at the space sector and the opportunities and challenges that that might present. I will let you fine gentlemen introduce yourselves and who you represent, and anything by way of a short introductory remark.

Dr Bower: Thank you very much, Committee members. My name is Dr Adam Bower, and I am from the University of St Andrews. It was a pleasure to meet many of you at the session held at St Andrews previously.

Chair: And thank you ever so much for the generosity at St Andrews University. It was fantastic, and we are very grateful for your assistance in this inquiry.

Dr Bower: I am delighted to be here, so thank you so much. Like my colleague in the previous session, I will very briefly mention my background. I am a scholar of international relations and international law—but not a lawyer, I always have to hasten to add—studying the politics of international law, particularly around the regulation of armed violence and international criminal justice.

In recent years, that has shifted towards an interest in outer space and particularly space security, looking particularly at military interactions and the regulation of military interactions. I think that feeds into this Committee's interests, particularly—and this something I think we will come back to in the conversation—because of where Scotland is geographically located. What I will quickly say, by way of that, is that geographically, Scotland provides a really optimal place for the launching of smaller rockets in particular. With miniaturisation, small rockets can take quite a few small satellites, and those small satellites in turn can do quite a few important and powerful things. My colleague, Professor Woodhouse, is better placed to speak to all the detail on that than I am. The second thing is that, as you all know, Scotland is already a major hub for small satellite construction and the component parts, and also for data analysis. I think that is, again, a strength.

Maybe one point I can add some illumination on later in the discussion is something that I mentioned in my written evidence, which I know the Committee has seen, around the public-private entanglement. There is a different way of putting that: the way I see it—and this is a trend around the world—is that Governments in particular are going to rely increasingly on private companies for these kinds of services for space launch, but also for Earth observation and other capabilities, including broadband internet access. That is a way in which Governments can, in a relatively cost-effective way, augment and supplement services, but—and this may be the point I end on—that introduces a range of interesting problems, politically and legally, around whether or not commercial operators

become implicated, for example, in security dynamics in awkward ways. The war in Ukraine is the obvious example.

One thing we might be thinking of is how using commercial services feeds into those kinds of political discussions here in the United Kingdom and for the UK's allies and partners, but also what other kinds of legal considerations need to be taken on board as a matter of international law when thinking about those interactions. I will leave it there for now.

Q160 **Chair:** I am sure that colleagues will want to unravel some of that and look at some of the issues and challenges around the things you just presented to us. First of all, we will have Professor Woodhouse.

Professor Woodhouse: Thank you for inviting me. I am here as an expert on the Earth observation side of things—so, the space industry more generally, not specifically in the Arctic. I am a professor of applied Earth observation at the University of Edinburgh. I focus on data, and I focus on radar in particular.

Radar has particular value in the context of the High North, because it is often dark and cloudy, and radar can see through clouds and it can see in the dark. It has particular interest, as you will have noticed, in the defence strategy. Synthetic aperture radar in particular is mentioned as something that the UK should have renewed strength in, because back in the '90s the UK was very strong in imaging radar in space, and then we waned a little bit. There is an opportunity to come back to that.

I am also involved a little bit in the commercial side. Dr Bower mentioned the role of commercial companies. I am a co-founder of several companies in Edinburgh, including Earth Blox, most recently. That has a focus on the fact that data—if you look back to Facebook in 2004, nobody anticipated the fact that the real value in something like that is in the data.

I think there is an opportunity for the UK to essentially catch up. We get distracted, when we talk about space and satellites, by the hardware—they make better photo opportunities and they make the news, even when they do not go quite so well as planned.

Chair: I wonder what example you are thinking of.

Professor Woodhouse: But it is the data that has the scalable opportunities and enormous risks in terms of security. The one point I would stress is that we should not forget about the data. However unphotogenic it might be, it is fundamentally important.

Q161 **Chair:** Obviously, this has emerged as quite a key interest for us, as you pointed out, Dr Bower. I think it was you who first got us excited about this, in terms of this inquiry. We have looked quite a lot at and asked a number of people about the opportunities that exist. Is this important? Are we at a point where this will be meaningful, significant and increasingly important for some of the economic interests and partnerships we might have in the commercial sector? Give us a sense of how big you think this might be for the UK, but for Scotland in particular.

Dr Bower: Thinking both domestically and internationally, as I suggested, there is a geographic advantage to launching smaller rockets from northern latitudes, particularly to access what are known as highly inclined orientations—so, polar or sun-synchronous orbits. If you can imagine the equator that runs through the Earth, those are orbits where the satellite will be traversing at quite high relative degrees. That is advantageous because as those satellites go around, the Earth is rotating underneath. That gives a satellite in those kinds of highly inclined orientations a view of almost the entirety of the Earth over a number of successive passes. That also allows satellites to see or observe other things at high, high latitudes, including in the Arctic. That can be valuable for a variety of civilian, environmental and military operations.

Scotland, along with some of its Nordic allies and partners, has the advantage of geography. There are places for these kinds of launch facilities, and that is already occurring. In a variety of Ministry of Defence and Government documents, and in Scottish Government documentation, there is reference to Scotland's ability to play a major role on the industrial side. I suggest that this is also—and you see this more in Ministry of Defence documentation—a way for the United Kingdom to contribute to allies and partners. This is one among many contributions that might be made. There are the launch facilities themselves, but we could go further to speak of the industry itself and having domestic capability in the development of satellites and components. There is also the educational sector, and the ability to have a highly qualified, highly skilled sector. World-renowned universities—including the University of Edinburgh, which is very well known in this area—are attractive both in terms of bringing people into the United Kingdom and keeping them here, and as a way for the United Kingdom to demonstrate a capability for allies and partners.

I can't quantify that for you very easily. I simply note that, for example, the Scottish Government and UK Government documentation points out that Glasgow already builds as many small satellites as anywhere else in Europe. I believe it is one of the largest hubs in the world, and that is just one demonstration. I think there are at least 130 space companies operating in Scotland now. Professor Woodhouse can speak more to the detail, but I suggest that in terms of the international dynamic, this is a way in which the United Kingdom has a significant role to play. There are ways in which it could do more, but we are already recognising the contributions to, for example, the Five Eyes intelligence-sharing alliance and related things with NATO and others.

Q162 **Chair:** We will have Ministry of Defence Ministers coming to this Committee to answer for themselves, but do you have the view that the UK is alert to the opportunities presented by space-based technologies? I think you do. You hinted in your response that this will be an increasing part of our NATO contribution.

Dr Bower: I think so. I am not an expert on NATO burden sharing specifically, but this is definitely an area where the United Kingdom can make contributions perhaps beyond what it is doing now. Like with

anything, choosing to spend money in one area does not necessarily mean that an equal amount of money is available for something else. One big discussion, which you see in documentation and in submissions from other academics and colleagues, too—the Defence Committee last year had a similar inquiry—is that there is a theme about making trade-offs and where the United Kingdom can best spend money. I am happy to discuss that more, but I think that yes, there is a recognition. We know this now, and it has been discussed in other fora.

It connects to the maritime domain as well. We are using space technologies to augment and enable basically everything we are doing in modern life. That extends well beyond the defence sector. It is vital in the Arctic and the High North, but everywhere else in addition. I think you are seeing space become a more important component of that discussion. The standing up of Space Command would be another indicator of that as well.

Q163 **Chair:** Professor Woodhouse, you touched on the relationship between the commercial sector and defence interests. There are obviously going to be some tensions along the way. How would you characterise that relationship? Is it working or is there something we need to look at? How are they resolving some of the difficulties that might be presented?

Professor Woodhouse: I cannot think of any immediate examples in the UK of that being done successfully. The US tends to do a much better job. A couple of radar companies in the US are flying small satellites that are collecting radar. They get core, long-term contracts from the DOD that essentially keep their lights on and allow them to grow competitively. Operations in the UK in particular, but also more broadly, do not seem to be quite the same. That challenge of improving the way in which the Government procure space and satellite services is something that is worthy of taking a closer look at, because I don't think we do it very well.

Q164 **Chair:** So it would be good to do more work on building that relationship and ensuring that both sectors are properly looked after?

Professor Woodhouse: Yes.

Dr Bower: Can I add another brief example? The United States' closest neighbour, Canada, where I am from originally, has a company called MDA, which does synthetic aperture radar and is very well known for it. It also feeds a fair bit of that in through the Canadian Government and, if I am not mistaken, to the United States and others as well. So there is another place that the UK Government could look to among their closest partners for evidence or examples of how that process may be done.

Chair: Excellent. Thank you.

Q165 **Christine Jardine:** You have already answered some of what I was going to ask, about the significance for Scotland of the defence industry and the capability of what we already have, but what defence and security applications do you think some of these companies in the North Atlantic and High North might have?

Professor Woodhouse: One very specific thing is tracking ships. We have heard about the challenge of cables, and in fact one of the fibre-optic cables from the satellite-receiving station on Svalbard was lost. There are two cables for redundancy, and they have lost that redundancy. That was in January '22. Whether or not that is a significant date is a discussion for another time. That applies to the process of distributing the data that is collected. Arguably a key strategic asset in Svalbard is the satellite-receiving station. Being able to track ships in all weathers is significant. RADARSAT from MDA was the first really successful commercial radar satellite back in the '90s. It made its money simply by faxing out an image that showed the captain of a ship where the sea ice was so that they could plan a more efficient route through it. That made them one of the most successful companies in Canada for a while. Very specifically in the High North, there are lots of key applications like that.

In terms of other contexts, if you look at where the commercial radar satellites are collecting data, you will see a huge hotspot around Ukraine at the moment. That is because the level of detail is super high resolution imagery, and it is guaranteed, because you do not have to worry about cloud cover or what time of day or night it is. You do have to worry about electronic countermeasures and the interference that can be generated. Even with the civilian radar satellites from the European Sentinel missions, there is clear evidence that there has been interference with those, essentially by blasting out noise that covers up parts of the image.

Q166 **Christine Jardine:** What advantages do these have over, say, drones, which are popular and perhaps widely seen as the way ahead? What additional capabilities or advantages are there?

Professor Woodhouse: Drones have lots of advantages. They are part of a suite of things you would use in an intelligence gathering situation. The key thing about satellite systems is that they are out of the way. They can collect data without anybody knowing that they are collecting data. From an airborne point of view, imaging radar is quite advantageous because it looks out to the side, so you can be in your own airspace while imaging across a border. It is a fit-for-purpose kind of thing, but the satellite contribution is quite significant in terms of being able to collect anywhere in the world at short notice and without anyone knowing.

Dr Bower: On the political and legal sides, one of the advantages of satellites is that, going back to the beginning of the space age, it was understood and acknowledged that satellites by the nature of orbit have to be traversing over the Earth repeatedly, except in one very particular type of orbit, which we are not speaking about right now. It was understood that that would not constitute a violation of territorial sovereignty. I think we are all familiar with the high-altitude balloon incidents over North America over recent months. There are two very interesting things about that. One is that US officials at various points said, "Well, this isn't such a big deal because satellites can collect similar types of data"—in terms of precisely what was being collected and in what way, there might be advantages to balloons in some circumstances—and yet it was acknowledged that this was a violation of territorial sovereignty, and the

United States felt it was entitled to shoot these down using armed force. A satellite does not sit within the same legal and political definition, if that makes sense. Satellites are going to be passing overhead of our allies and our adversaries all the time. That is understood. One could perhaps imagine scenarios in which an adversary would choose to use hostile measures against satellites with varying degrees of damage, but the point is that these are happening all the time, and that is different from drones, aircraft or other things in the airspace. States cannot claim airspace rights in orbital space, so, in that respect, satellites offer an advantage politically and legally, in addition to the other things that were mentioned.

Q167 **Christine Jardine:** This might be a difficult question for you to answer, although it does seem slightly obvious. Do you think the Ministry of Defence is sufficiently alert to the opportunities for space-based capability to contribute to defence in the North Atlantic and High North?

Dr Bower: I am not an expert on the internal discussions, so I wouldn't want to go too far. What I would say is that you do see increasing references to space and the importance of space in public documentation, and, in the United Kingdom, and indeed in other western Governments—NATO allies and so forth—the discussion of the importance of both space and space assets for enabling military operations. For example, most western Governments have now officially declared that space is an operational domain—not necessarily a war-fighting domain, although that is the language used by the United States, which alarmed some, but an operational domain alongside others such as maritime or airspace. I think that acknowledges the importance to some degree.

I do not know to what extent the Ministry of Defence has gone a long way down the route to thinking about the interface between commercial and Government. I am not able to speak to that particularly. However, I think it is fair to say that there is a growing acknowledgement of the importance of these kinds of things in the High North. If I can, I will just add one quick example of that. Professor Woodhouse mentioned synthetic aperture radar, which is a great, really important use case for this; another would be secure communications. I am sure Members are familiar with the Skynet military communications satellite system. The UK Government have, I believe, committed to invest another £5 billion over 10 years in upgrading that to Skynet 6.

Skynet sits in a very particular type of orbit known as a geosynchronous geostationary orbit, which is much further from Earth—just a little less than 36,000 km. It sits right at the equator, the advantage of which is that the satellite moves at the same rate that the Earth rotates. When you situate a satellite right over the equator, it appears to hover, in effect, in the sky from the vantage point of Earth, which is useful because you then have a continuous line of sight for communication. However, those satellites cannot really communicate above 70° latitude because of the curvature of the Earth. In those instances, you need alternative telecommunications capabilities if you want to use satellites.

There are ways of augmenting and designing alternative orbits; the United States and the Soviet Union—Russia—designed that. That could be another important use case for commercial operators—broadband and telecommunications networks such as SpaceX's Starlink and OneWeb—that could provide another means of getting secure communications. That would require a variety of technical discussions in terms of security and so forth, but it would be another way that this would go forward.

Q168 **Christine Jardine:** Thank you. That is absolutely fascinating and very useful. We have talked about the size of Scotland's space manufacturing sector and technology sector, but I wonder how our space sector actually compares to that of Arctic allies.

Professor Woodhouse: I don't know the figures, but I know that within the UK, Scotland definitely punches above its weight. At the latest count, there are over 180 commercial companies in Scotland doing something to do with space, and 29 of those specifically handle Earth observation data. That is significantly more than 20% of the UK's activity. We are, I think, generally seen to be quite ahead of the game compared to many of our allies. The exceptions are countries like Canada, where, because they have a relatively small population compared to the area of the country, using satellites to measure their home national assets has always been strategically quite sensible, so they have been quite far ahead, I would say, in that regard. Of course, Alaska and the US are significantly so. Helsinki is actually quite a hotspot for small satellite creation; a lot of the technology is probably associated to its history of building mobile telephones, so the universities there often build their own satellites and things. There are other little hotspots around that are interesting and, if anything, Scotland should be looking to work closely with them.

Dr Bower: I have just one point on the space launch side of things. We were speaking before about space launch/spaceports facilities in Scotland and particularly the one that is most fully developed in terms of vertical launch at the moment, SaxaVord in Shetland. As I understand it, it is anticipating that there will be launch opportunities in the next year or so.

Probably the most obvious direct comparisons in the Arctic region would be in Norway and in Sweden, and there are facilities there that are either existing or contemplated: one at Esrange in Sweden; and one at Andøya Space Centre, which is more established but I don't believe has been doing launches yet of this type. The main difference is that both of those are considerably further north; about 68° or 69° north latitude, as compared with about 60° for SaxaVord.

On the other hand, while it might gain some efficiency to be even further north, of course you are then, by definition, typically further from the places that are producing the satellites or the component parts—the rockets and so forth.

Without being expert on those particular facilities or the geography, my suspicion is that one of the reasons SaxaVord is considered to be so desirable, and this would go for other facilities in Scotland as well, is that

it has an advantage of northerly latitude but without as much of a trade-off in terms of the distances. That is not to say that it's simple, but it is comparatively—perhaps—more advantageous to bring the material necessary to those places.

One thing to note is that because we are talking about comparatively smaller rockets, the facilities in turn can be smaller. Many rockets that would be anticipated for these kinds of facilities could even be put in shipping containers to be moved; there are ideas for containerised rockets. Again, those could be brought by ship or by aircraft. So there are opportunities there.

That would probably be the two most obvious comparisons among our Nordic and northerly allies, but I'm not aware of the specific figures and how that would measure. All of these are in development, really.

Q169 **Christine Jardine:** Taking into account that northerly location but the proximity to the production of the rockets and the hardware, is there potential—to what extent do you think there is potential—for Scottish spaceports to be used as launchpads for satellites perhaps belonging to more southerly allies, whether for defence or for other purposes?

Dr Bower: I would say absolutely. Again, this comes back to a theme I raised at the beginning. One of the things to note is that many of these facilities are envisioned to be commercial in nature. As I understand it, SaxaVord is a commercial entity; it is not a United Kingdom Government entity.

Now, of course, the UK Government or another Government, or indeed a private company or a university, can participate in a launch. It will often be the case that it won't necessarily be only one customer buying all the payload space on one of these rockets. Because of the size of these smaller satellites now, it may be possible to have many satellites on even a relatively small rocket. As a result, you may have multiple clients—customers.

That introduces all kinds of complexity in terms of commercial contracts. It might also introduce questions about the extent to which the UK Government want to regard this as a way of having an assured access to space. It's not a UK Government facility—not an MOD facility—so it would require ongoing arrangements with those facilities.

Again, without speaking on anyone's behalf, I would also hazard to guess that commercial entities are also keen to try to keep themselves at least at some arm's length from the Government. They want to say "We are servicing a variety of customers" along the way.

Q170 **Dr Whitford:** I just need to point out that I have the Prestwick spaceport on my patch, so you will all forgive me for punting for that. I think it is exactly as you were saying, Dr Bower, about proximity; what is said about Glasgow is that it produces more satellites by number than anywhere outside California, so it is a significant hub. But the Scottish space strategy—I understand, Professor Woodhouse, that you were part of the

group contributing to that—is looking at an end-to-end process: manufacture, launch, downstream data analysis and then action.

Scotland is in really quite a good position. Prestwick is just 45 minutes down the road; we've got 55° latitude, and yet northerly, so Scotland is in really quite a strong position. But how do we make sure that we are really making the benefit of all that?

We had the national space strategy from the UK Government in September 2021. We have obviously had the space strategy in Scotland, really at a similar time. They both highlight the commercial side, and the UK one to some extent the defence and security side of it. But the national space strategy for the UK was followed by a defence space strategy, which certainly did not recognise it in the High North and Arctic. It recognises it in a general sense, but do you think the UK Government, which has responsibility for defence and security, is not picking up on what we talked about—the difficulty of terrain, the darkness and the ice—where space really can give you information that you cannot get in any other way?

Professor Woodhouse: I guess the easy default is because the satellites are orbiting the entire Earth, and there are other difficult environments. There are probably still parts of the tropics that have not really been imaged very much because of the cloud cover, for example. Cloud cover is a problem in the High North, but it is also a problem in the intertropical convergence zone down in the tropics. There are opportunities across the globe in terms of where there are particular difficulties with accessing data. That might be because you do not have sovereignty over an area, or it may be just because of environmental characteristics. It may be because of the speed of response: if something happens in the South Pacific, you can have high-resolution satellite imagery within hours. It is possible that singling out the Arctic and the High North in a national strategy—it is not for me to say whether that was the right thing to do or not, but I can understand why that would not necessarily be singled out. It is one of many places where satellite data has an important role to play.

Q171 **Dr Whitford:** Are you surprised that it has not really been mentioned? I don't mean that it would be all about that, but along with other areas that are very difficult to access. I know we were talking about radar and the advantage of that, but there is the high-resolution imagery of forest fires, earthquakes and CO_2 emissions; the potential of low-Earth orbit and Earth observation is just enormous. Are you surprised that they are not saying, "Okay, here are particular areas where this can solve a problem we have"?

Professor Woodhouse: Far be it for me to comment on the quality of the strategic documents that the Government has put out but, arguably, both the civilian one and the military one do not focus a lot on specific ambitions. There are not a lot of specific goals that are tangibly laid out with a clear timescale and an ambition to hit these. In that respect, they are similar.

Q172 **Dr Whitford:** As Dr Bower said, there are five spaceports in Scotland and three are quite close to launch. SaxaVord is talking about later this year, and Prestwick is next year, so they are all quite imminent. But they are

commercial, and they are talking about commercial. Do you think there is enough discussion within Government, with Governments and within strategies about closer civilian and military working? Looking at them, there may be military customers rather than a recognition of—

Professor Woodhouse: If I make a comparison to the US—from my experience, it is at the top of the list—we are quite far behind. Historically—again, I will bring up data—the US attitude, which is that if taxpayers have paid for it, taxpayers get access to it, has helped in terms of meteorological data and mapping data, whereas in the UK, in the way that we structure the Ordnance Survey or the Met Office, we expect them to recoup money. But what you see in the US is that it grows an incredible ecosystem of small companies that get that data for free, add value to it and sell that on, and they can do that without a large capital expenditure, because they do not have to buy the data in the first place. It gets back to the issue of procurement and finding better ways for the Ministry of Defence, but other parts of Government as well, to work well with the commercial sector in the space and satellite domain. I think we have some catching up to do.

Q173 **Dr Whitford:** Dr Bower, do you think the two Governments—the UK Government and the Scottish Government—are doing enough to realise the potential?

Dr Bower: Forgive me if this sounds like a dodge. I think it is hard to say in the abstract, in part because to my mind, it comes down a lot to what Government wants out of particular space sector capabilities. If I could put it in the context of the Ministry of Defence, they would frame this in terms of the own-collaborate-access framework—that is to say, capabilities that would be sovereign owned, sovereign controlled. Skynet 6 would be an example of this: a military-owned, if you like, communications system, albeit operated by Airbus on a day-to-day basis, and I believe that is switching to Babcock in future. Then, there are a lot of capabilities that the UK already has access to through its collaborative network. It has access to, for example, the encrypted signal on the United States' GPS system—the global positioning system. What it did have was access to the Galileo public regulated service—the encrypted signal from the EU's global navigation satellite system. It does not have that anymore, having left the European Union, but of course it has access to the public signal.

There are ways in which there can be collaboration through Five Eyes, NATO and others. There is the new group—I believe it is called the combined space operations group—which is the Five Eyes plus France and Germany. There are ways in which the United Kingdom can have access to highly influential and significant space capabilities without buying them itself.

The third category is this access framework. It is the idea that there may be instances where, instead of directing companies to build a system for the United Kingdom Government, whether MOD or someone else, they can purchase off the shelf or, sometimes, partially bespoke systems that already exist. I think partly what Professor Woodhouse is referring to is

these kinds of combinations of systems. The US Government are, indeed, far in front on this. Sometimes they are partnering with commercial operators that have an off-the-shelf option for Earth observation, but the United States Government is going to be imposing a variety of its own requirements on that system, such as that they get first-use access on the imagery and so forth.

If this is something the Committee is going to be putting forward to MOD—this is an area I am just curious about and do not know as much about—I think the question may be, "What would be the MOD's position more specifically about how they apply that use-collaborate-access framework in these particular areas?" There may well not be a need to develop a parallel global navigation satellite system like a GPS for the UK. I think that would be tremendously expensive. There are other systems that are available. There might be other instances, whether that is secure military communications or some forms of Earth observation, where it would be worth having a capability that is UK-owned or directed.

My point on all that is that there is then a question of how to integrate with industry. Obviously, from an industrial perspective and from supporting a high-tech sector, it is valuable to be investing in these areas. The UK Government, for example, noted investment in the Earth observation sector of, I believe, £200 million over the next period—I don't know the number of years. That might be an example.

My question—just thinking from the areas that I study—would be more, "To what extent are those investments intended to help generate a solid industry and to encourage high-skill jobs, and perhaps the development of training at university, colleges or elsewhere? How much of that is to have capability on hand at all times or to have access to capabilities when the need arises?" That is a complicated mix of different needs based on, I presume, assumptions about future security dynamics as well. For example, in the MOD context, we could think how environmental agencies and others would have similar kinds of considerations that would feed into a procurement strategy going forward.

Q174 **Dr Whitford:** Obviously, quite high on the UK risk register are the effects of climate change, such as flooding and so on, so it is defence in that wider sense rather than just military. You touched on how, having left the EU, the UK obviously does not have access to all the aspects of Galileo but is also outside Copernicus. Are the UK Government doing enough around research? At the moment, these companies have grown up organically. In Scotland, there is now this narrative of an end to end, and that stimulates people to think, "Why don't we fill this gap or that gap?" You talked about investment in R&D; is there enough going on to grow this sector as much as it can be grown from the civilian use perspective—the ecological Earth observation—but also meeting those kind of security requirements?

Dr Bower: I think Professor Woodhouse can speak much more to that question. I would just add one really quick thing, which is that there are opportunities, for example, to have access to some of the programmes that the United Kingdom is not in at the moment. For example, it would be

possible to negotiate around the public regulated service of the EU Galileo system. I understand the United States and Norway have both pursued that with the idea being that even in the United States, with the most developed GNSS in the world, redundancy would be beneficial. There may be opportunities even outside of formal political arrangements, which for the moment do not seem possible, to actually gain access to some of these things. I will leave the other part to Professor Woodhouse.

Professor Woodhouse: The short answer is no. We have been very slow to act appropriately, and Copernicus, and all the complications about that, has been a big issue. For example, the £200 million is, to some extent, a bit of a catch-up on the fact that we have not been part of Copernicus. We could discuss the breakdown of that, but a large chunk of it is, appropriately, going into our European Space Agency membership. Some of it has, arguably, been a bit rushed—I am giving my personal opinion here—and not necessarily joining up the proper assets in the UK to make the most of that. There is often a sense of desperation to make up for the fact that we are losing out in Copernicus, and that is not necessarily the best environment to make wise and thoughtful strategic decisions. I will put it like that.

Q175 **Dr Whitford:** Are we losing researchers because of that? I have a medical background, and Horizon and being outside of clinical trials has caused a sort of brain drain. Are we seeing that from young developers?

Professor Woodhouse: It would be difficult to tease that out from the general impact of Brexit, in terms of scientists in the UK whose home country is another part of Europe that is still part of the EU. I have not seen any analysis to be able to tease that out.

One thing that we should also be careful of is that the environment our universities have been put in tends to mean that for every UK person we are skilling up in order to feed into the highly skilled workforce of the space and satellites sector, we are also training up a whole bunch of students who are going to leave the UK. I do not know how to fix that, and I am not suggesting that I know a solution, but I think we should be careful about the fact that if you are looking at it as a competitive thing for the Scottish space sector, or the UK space sector in general, if we are not actually investing in ways for businesses to train their workforces—that might not be just cash incentives, but other, creative incentives—or making it easier for overseas students to stay once they have finished studying, then we are inevitably training up our competitors as fast as we are training up our home workforce. That has to be taken into account whenever we are talking about skills and the like.

Q176 **Sally-Ann Hart:** Good afternoon to both of you. Dr Bower, you mentioned the "entanglement" between the public and private sectors on satellites. You argued in your submission that questions of space policy in the defence and civilian realms cannot be easily separated, adding that "security and defence considerations invariably bleed into ostensibly civilian realms". What are the key areas where they overlap?

Dr Bower: In terms of technology?

Sally-Ann Hart: Yes, and perhaps the areas where they overlap both civilian, and defence and security.

Dr Bower: The thing I would highlight in the first instance, and this comes out a bit in the written evidence as well, would be space launch capability. There are two Scottish-based space companies in particular that are nearing the point where they will credibly be doing orbital launches, and then there are the space launch facilities in Shetland and Sutherland, and of course at Prestwick as well. So one thing would be the capability to put objects in space in the first instance. All of those are envisioned principally, as I understand it, as leading as commercial operations; these are companies that are building rockets to launch satellites and operating the space launch facilities themselves.

The second part is the satellites, the components and the data that enable a variety of applications. Many applications can be civilian in nature—for example, monitoring sea ice, tracking animals in the Arctic, or using radio frequency emissions to try to track vessels, whether they are illicit fishing vessels or other—but, of course, all of those have their own military and security applications alongside that.

The point that I was trying to make about entanglement is that it is often said that almost all space technology is inherently dual use—that is, the capability to take a high-resolution image could be useful for documenting human rights abuses, tracking wildlife, or to find an adversary's vessel, for example, in the Arctic. Equally, broadband telecommunications—another major use case now—can be hugely beneficial for remote communities having more reliable internet access, but of course, as we are seeing in the war in Ukraine, commercially provided broadband internet is vital, alongside Earth imagery, both to the Ukrainian civilian population and the Ukrainian military in command and control, and other significant military roles.

The difficulty becomes that these capabilities are often provided by commercial entities that see themselves principally as businesses. They are there to provide a service. It is often the case that right now Governments are the largest clients for these services. The United States Government is by far the largest buyer of commercial Earth imagery, if I am not wrong—Professor Woodhouse can correct me. For all that Elon Musk is talking about being unfettered by the shackles of Government, SpaceX has largely relied on US Government contracts, particularly in its early phases.

What we see from that, if I can go back to Ukraine briefly, is that when a private company changes its mind, or suggests that perhaps it does not want to be involved in the same way any more, there can be real dependency issues. SpaceX has at various points over the last year said, "We're not sure we're so comfortable with continuing to provide internet access to the Ukrainian side in the armed conflict." Whether that was because they were rattled somewhat by comments made by the Russian

Federation in public forums, I'm not sure—I couldn't speculate—but that raised alarm bells in the United States and in Ukraine, and among western allies. They had come to rely on that capability partly to sustain the civilian population and the war effort. That was being provided principally by a private company, albeit in a contract with a Government.

One thing that I would like to suggest in this discussion is that these are difficult challenges for Governments to work through. There might be a lot of ways in which it is really beneficial and cost-effective to rely on commercial operators to provide Earth imagery, other forms of remote sensing, space launch, the production of satellite components or the satellites themselves, or data analysis. One that we have not mentioned is space situational awareness, which is to say the monitoring of the space environment—the orbital environment.

All of those are areas where commercial operators, including in Scotland, are making major contributions, but of course relying on those means that there may be times at which that reliance introduces challenges, whether because companies change or they have a range of multiple clients. It can be complex, and I think that that needs to be thought about carefully—to what extent these are dependencies, built up over time, that make Governments vulnerable if there is a change in service provision, if that makes sense.

Q177 **Sally-Ann Hart:** Is it a question of insurance? Is that the issue? Obviously, private companies will not want to have their technology destroyed. We saw Putin assert, as you say, that civilian and commercial space systems are legitimate targets when they contribute to military operations. They all seem to be making some kind of contribution to various countries' defence or security, so what is the issue for the private companies? Is it insurance, or do Governments need to get their own technology up?

Dr Bower: I think that insurance is going to be one aspect of this. Without wanting to speak on what I presume are a variety of ongoing private conversations in the United States, the United Kingdom and many other places, I think that it is definitely the case that commercial operators are increasingly aware that they may operate in a legal grey zone in some instances. There may be vulnerabilities there, whether it is forms of insurance or agreements to indemnify commercial operators against loss. I think that that is something that has been discussed. I am not aware of any public discussions on that so far, but I believe that these kinds of conversations are ongoing.

It becomes difficult, of course, because commercial operators understandably want to put forward that they are businesses, providing a service to clients. When they are providing services to Governments, or conceivably to non-governmental entities that may be involved in activities that fall within the security or defence realm, that can become challenging. There are domestic legal remedies for some of these things, but there is an international law component to it as well—definitely insurance indemnification. Then there would be discussions about whether

Governments wanted to signal more publicly that commercial capabilities are considered part of critical national infrastructure that might then warrant some form of response. I would not want to get too far into making judgment calls on whether that is appropriate or not. These are definitely ongoing conversations, I am certain of that.

Q178 **Sally-Ann Hart:** If there are ongoing conversations, do you think that the UK and Scottish Governments sufficiently recognise the overlap between civilian and defence space policy here? Do you get the impression that they do, in your experience?

Dr Bower: Anecdotally, yes, but maybe not as much or to the same degree as the United States, for example; this is a theme that we have come back to a few times now. I am more familiar with conversations in Canada and the United States, so I would be more comfortable saying that I definitely have seen, or heard of, those conversations happening in a variety of formats.

I am not personally aware of whether those conversations are ongoing here, but I would be astonished if the UK Government was not also aware of these things, given how closely they operate and integrate with their major allies and partners—including in the war in Ukraine, but not only there—and given, as we have discussed, all the commercial capabilities that are being developed in this country. I couldn't go further than that in terms of specifics, as I am not aware of the conversations myself.

Sally-Ann Hart: Thank you. Professor Woodhouse, do you have anything to add?

Professor Woodhouse: I would echo the fact that, certainly on the Earth observation side of things, everything is dual use. Typically, everything used in the civilian domain is something that has been declassified because the military has gone on to the next stage. Radar is originally a military instrument. Most of the very high-resolution optical companies that are providing data would have developed their IP and their technology based on defence contracts prior to that, which is why the Americans have a bit of a lead on that as well.

One of the issues with the Svalbard satellite receiving station is that all the accessible data is civilian; I think there are some commercial companies that use that. Does it contravene the treaty of Svalbard if somebody uses that in a military context, because it happens to be data that is available for a particular time? As far as I know, that has not been resolved. That is another example that shows that you cannot escape dual use. As to whether the UK is keeping up with that—like Dr Bower, I am not party to specific conversations. It feels like they are a bit slow and there has not been enough discussion about how to make the most of that.

We have been talking about quite narrow ideas—the space and satellites contribution, and working in harsh environments—but there are also things that the UK is very strong on, like robotics, which has a relevance to what happens in space, but also to what happens on the surface: the

harsh, extreme environments where you don't want to send humans. There is a broader perspective. If anything, I think the discussions in the UK have always been very siloed.

The MOD seems to be very much talking to themselves, and the particular parts of Government do not seem to be very good at looking out across the particular skills in other areas. Robotics is mentioned in the UK's national space strategy, but it doesn't come up often in conversations like this, when we are talking about space and satellites. We tend to talk about communications and Earth observation or launch capability.

Q179 **Chair:** Lastly from me: if we got you back in 10 years' time, when we might be surveying what has been achieved and where we are going, what would you expect to be the situation when it comes to space technology, particularly its use within the military? Is this going to be fast paced, as we have seen with the advent of technologies like the internet, broadband and so on? Is this starting to really open up for us?

Professor Woodhouse: There are two things. I would like to see the UK having really got a hold of the data side of things. It's that old adage: the only person making money in a gold rush is the person selling the spades. Look at the UK, for example; I don't know the figures, but I am very confident that Amazon Web Services—which does all the data storage, and the uploading and downloading of data, and gets paid every time somebody does that—is probably making more money than any other Earth observation company in the UK at the moment. That might be an exaggeration, but the idea is that you wouldn't call Amazon Web Services a space company, but they are handling everybody's data. They are actually providing all the high-intensity, high-volume data services that everybody else is paying for.

My ambition would be for the UK in 10 years' time to have really grasped that and to have led the way, and to make sure that we have some national capability, because we have national capability in supercomputing, AI and data analysis.

Q180 **Chair:** Is there any sense of all these sectors coming together? We have discussed AI in this House on several occasions now. We are obviously excited about the opportunities as this develops. Is there a coming together of the space sector, AI and—I don't know—biotechnologies as well?

Professor Woodhouse: I will give a shout-out to Space Scotland, which got some UK Space Agency funding that is allowing them to do a lot of building across the various activities in Scotland, including linking up with the National Robotarium, which is just outside Edinburgh on the Heriot-Watt campus, for example. I think they are linking up with fintech and the whole financial services sector, and looking at high-performance computing and AI and linking that together.

There is another area where Scotland probably has an opportunity that hasn't really been exploited yet: we are world leading in gaming, which also requires that high-volume, high-intensity computing. It involves

visualisation and human-computer interaction, and there are many skills embedded in that sector that have a possible crossover.

Dr Bower: I agree with everything that Professor Woodhouse said. If you look at the trend lines, all the expectations are that space becomes an increasingly central part of the way in which we operate in modern digital economies. All the trend lines are indicating a rapid growth in the number of satellites on orbit. I mean, already you've gone from something like 2,000 or so a few years ago to about 6,000—

Q181 **Chair:** Are we beyond the space junk characterisation of outer space? Has that gone now?

Dr Bower: This is what I was going to come to. One of the big challenges is that as we put more things up into orbit, we really do have an increasing problem with the debris that is left behind. One way in which the United Kingdom more broadly is involved in that is through partnership with Astroscale, which is originally a Japanese company but has a UK component, that looks at ways of removing debris from orbit. Again, in among everything else, that might well be something to which the leading-edge technology and thinking that is already being done in Scotland can contribute.

My concern is that there are lots of very good and useful things that we can be doing with space, but one sometimes gets the sense of an exuberance to get up there as fast as possible. That is not speaking specifically of the Scottish space sector, but just the world in general. I would hope that we are taking sombre reflection a little bit on why, and about which operations and roles are in that mix.

Q182 **Dr Whitford:** Can I come back to Professor Woodhouse? Obviously, Scotland is the first to have put out the idea of its road map to a sustainable space industry, from manufacture to the fuels used to reusability and so on. Is that something small-scale that Scotland would be able to contribute: encouraging people to think about that issue—that we don't want to trash space in the way we have done with other environments?

Professor Woodhouse: Yes. Space Scotland has a team that is specifically looking at that and driving forward that strategy, so it is something that Scotland has been the first to put down on paper and have a tangible approach to.

We talk about space junk, but one of the amazing things about Scotland is the very dark skies in certain parts of Scotland. It is not just about the space junk; the prospect of having more artificial stars in the night sky than natural ones is a potentially aesthetic and human condition kind of scenario that we have to consider. It is about not just the junk, but the impact that it has on our night-time environment, which for some cultures is more significant than just the aesthetics.

Chair: Absolutely. Well, we knew the session would be fascinating. Thank you ever so much for coming down and talking to us about the

opportunities in space. I know that one person was taking lots of notes, given their interest in what is happening in Prestwick. If you feel there is anything else you could usefully contribute to this inquiry, please get in touch with the Committee. Thank you ever so much for coming along.

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[1] Clarification from Professor Hartmann 28/04/23: *Canada, the People's Republic of China, the Kingdom of Denmark (in respect of the Faroe Islands and Greenland), Iceland, Japan, the Republic of Korea, the Kingdom of Norway, the Russian Federation, and the United States of America signed the International Agreement to Prevent Unregulated Fishing in the High Seas of the Central Arctic, which entered into force in 2021.*

[2] Clarification from Professor Hartmann 28/04/23: Admiral Sir Tony Radakin