Arctic Office
NATURAL ENVIRONMENT RESEARCH COUNCIL

c/o British Antarctic Survey,
High Cross, Madingley Road,
Cambridge, CB3 0ET

01223 221426
henry.burgess@bas.ac.uk
www.arctic.ac.uk

Dr Martin Jeffries
Assistant Director for Polar Sciences
Executive Director, Inter-agency Arctic Research Policy Committee
Office of Science and Technology Policy
Executive Office of the President
Washington DC

7 June 2016

Dear Dr Jeffries

WHITE HOUSE ARCTIC SCIENCE MINISTERIAL, 28 SEPTEMBER 2016: INITIAL UNITED KINGDOM CONTRIBUTION

The United Kingdom welcomes the opportunity to submit preliminary contributions ahead of the Arctic Science Ministerial meeting. We recognise that the event offers an important opportunity to galvanise the global Arctic research community and other stakeholders in addressing the key issues facing the Arctic, and the wider international community.

The United Kingdom was pleased to have been invited to attend the GLACIER Summit in Anchorage in August 2015, and we anticipate that senior representatives from Government and the scientific community will wish to lead the British delegation to the coming White House meeting.

Our Arctic research interests are long-standing, well-developed and have strong international connections. Well over 70 British institutions, universities and polar and ocean research centres work in the Arctic. The United Kingdom has been an active and committed member of the International Arctic Science Committee since 1991. As an Observer we engage proactively in the Working Groups and associated sub-groups and taskforces of the Arctic Council. United Kingdom Arctic researchers are highly cited, often as part of multinational teams, and collaborative working is often pivotal to our success.

We have a strong track record in Arctic research logistics, with a research station in Ny-Ålesund, Svalbard; a number of aircraft equipped for Arctic research and logistical support; and dedicated ice-strengthened vessels. The United Kingdom is investing heavily in the next generation of polar research logistics, with the new vessel, *RRS Sir David Attenborough*, due to enter operation by 2019. The Arctic Policy Framework, the first produced by an Arctic Council Observer, puts science at the centre of the United Kingdom's approach to engagement with Arctic nations and those with Arctic research interests.

The response below has been collated by the Natural Environment Research Council (NERC) Arctic Office, synthesising contributions from a sample of the United Kingdom Arctic research community, in close cooperation with the Department for Business, Innovation and Skills and the Polar Regions Department, Foreign and Commonwealth Office. Given the relatively short time available it represents an initial response, and we look forward to further specific discussions within the international working groups on the inputs ahead of the meeting and on the detail of the likely outcomes of the Arctic Science Ministerial meeting.

At this stage of the process, and the multi-year research funding cycle, this initial response does not focus specifically on funding streams, but rather on areas in which we believe there is value in advancing our knowledge through further discussion, planning and international cooperation.

It is important to note that the United Kingdom, in line with many other countries who will be responding to the call for contributions, has science prioritisation and programme funding processes which are fully independent of direct Ministerial and Government Department control. Whilst the overall funding parameters in research sectors are set by the Government, decisions on the design and focus of individual research programmes are led by leading representatives of the research community, working with the relevant Research Council.

Below, we explore the four discussion themes that are to be highlighted at the Arctic Science Ministerial meeting.

Theme I: Arctic Science Challenges and their Regional and Global Implications

In submitting this initial response, we recognise that the global Arctic community has already completed a significant and lengthy programme of analysis and planning through the ICARP III process. We anticipate and hope that the conclusions of the Roadmap set out by that process will inform the programme of the international working groups. Similarly, that the concluding consensus of the recent Arctic Observing Summit in Fairbanks, Alaska will have a clear role in the coming discussions.

We believe that pan-Arctic integrative work should be the key focus. Whilst the United Kingdom has an Arctic research community that works in almost every facet of Arctic science (including the social sciences), we believe that the areas of climate modelling, satellite remote sensing, and *in situ* monitoring through the use of autonomous measuring platforms are ones where we are particularly well-placed to contribute.

Greenland Ice Sheet

As highlighted in the commissioning note, the Greenland Ice Sheet is a critical element of the Arctic system. There is a strong view within the United Kingdom research community that, despite the considerable number of research programmes which already operate in Greenland – many of which United Kingdom researchers are involved in - the pace of change and the dramatic implications of that change on issues such as adaptation costs are such that there needs to be a concerted international effort to reduce uncertainty.

We are conscious of the existing work of the Greenland Ice Sheet Ocean Observing System and the Greenland Ice Ocean Observing Network, and believe that there is value in an internationally coordinated programme of research on Greenland, focusing on areas such as mass-balance and ice-ocean interactions. Along with other countries the United Kingdom has good experience of successful work on these areas and is keen to engage in discussions on this approach, in consultation with the Greenland Government and with respect to the associated importance of the human element of Arctic change. A specific proposal to support this approach is given under Theme II below.

Changing Arctic Ocean programme

NERC has a long history of funding Arctic research, including the multi-year £16m Changing Arctic Ocean programme in 2015. This important flagship programme is aimed at making a step change in the understanding of the bio-geochemistry of the Arctic Ocean and its associated ecosystem. The programme will build on the success of the previous Arctic Research Programme, which is now in its final publication and communication phase. There is already a strong international collaboration element and expectation to the proposals submitted to the Changing Arctic Ocean programme. We are exploring ways in which to maximise the impact of elements of this programme through additional international collaboration and potential joint funding calls.

Understanding Marine Ecosystems

At the same time we recognise that a full understanding of the Arctic marine ecosystem cannot be achieved by NERC's new flagship programme alone. This understanding must come from a concerted international scientific effort that works in consultation with the Arctic community, relevant organisations and stakeholders. This inclusive approach will be required if the impacts of climate change and direct human activities are to inform scientific, economic, environmental and societal policies. It is accepted that life in the Arctic Ocean is poorly characterised in terms not only of what comprises the biodiversity, but, especially, in terms of its genetic makeup and the way the life there functions. There is a need for large scale genetic and biological characterisation of Arctic species so that this large resource is not lost to society in large measure, if not totality, permanently. This is especially so for the ecological communities that are intimately associated with sea-ice and those on the seabed in shallow coastal areas, both of which will disappear or be transformed in the coming decades.

Making effective regulatory decisions on conservation policy and investments, and identifying important resources, including biotech material, will depend on establishing these baseline ecosystem measurements. This will require integrated programmes from across the global research community. As such it needs to be a priority for science, Arctic communities, society and industry as well as for national, regional and international policy and governance.

Short lived climate pollutants

Although not responsible for the majority of Arctic warming, the targeting of SLCPs potentially allows more time for technological development of methods for reducing CO_2, while also leading to benefits from improved surface air quality, such as improved human wellbeing and vegetation health. Yet quantification of SLCP impacts on Arctic climate is hindered by incomplete knowledge of remote and local sources and their atmospheric processing, poor observational constraints on SLCP distributions over much of the Arctic region, and limited knowledge of how Arctic temperatures respond to local and remote changes in SLCPs. These are key limitations in our confidence in projections of future Arctic and global change in response to regional emission changes, especially in light of potential future Arctic development facilitated by, for example, reduction in sea ice.

Mobility and effective use of assets

Whilst not a science challenge in itself, the importance of finding ways of ensuring greater mobility of researchers and more efficient use of assets in regions of the Arctic for use by the international community is a key element in being able to address the most pressing issues. For example, research vessels should never be sailing with empty berths. A number of countries, including Denmark, are developing information technology systems for better matching of researchers to logistical opportunities. We believe there is merit in making such approaches much more widespread. A significant amount of strategic and inclusive thinking is needed to know who is doing what, where, when and why. International engagement will be vital to avoid duplication and redundancy and ensure we are making the best use of our limited resources.

Multi-lateral agreements for science funding

There are already a small number of multilateral agreements for science funding through single proposal evaluation, including an agreement between NERC and NSF. Although this agreement is relatively small in scale and only in the first couple of years of implementation, the success of the kinds of international approaches envisaged in the commissioning document is likely to be dependent on the creation of a broader and deeper range of such agreements. Such undertakings are not easily landed and require considerable political will – a potential area for Ministerial agreement and commitment. For the moment, there are few, if any, international funding opportunities for Arctic researchers to work fully together to tackle some of the most pressing issues, with the work that is carried out too often reliant on *ad hoc* or personal arrangements.

Theme II: Strengthening and Integrating Arctic Observations and Data Sharing

The Arctic is a challenging region in which to operate both long-term and intensive campaign-based measurement activities. It is therefore highly beneficial to share expertise, resources and infrastructure between organisations and nations to maximise scientific and policy benefit from investment in such activities. Efforts are ongoing to synthesise data available from the Arctic region and to make this available across the scientific community, to build new capability for international observing networks, and in particular to improve collaboration with Russian scientists to improve collaborative scientific endeavours and accessibility of historical data sets for the Siberian Arctic region. There is a need to support the growing movement towards free and timely access to scientific data, for example GEO data sharing principles. The realisation is that uninhibited access to data stimulates innovation, delivers added-value datasets, as well as new methods, insights and approaches.

Greenland Ice Sheet Ocean Observing System (GrIOOS)

There are a range of initiatives in the United Kingdom with the potential to contribute to further enhancements to Arctic observing systems. For example, there may be value in considering opportunities to extend the Extended Ellett Line (sampling) undertaken by a range of key institutions in the United Kingdom to Greenland. This would allow us to provide full GO-ship ocean science to the remote SE Greenland coast every two years, and annually by Glider campaigns. The current NERC National Capability funded programme takes a ship to Iceland every year, enhanced by Gliders. This part of the ocean circulation (the Denmark Strait and SE Greenland Shelf) has been called the 'Aorta' of the North Atlantic and it is the main gateway for waters exiting the Arctic and joining the southward 'ocean conveyor'. It is also the region where the ocean waters that interact with the Greenland Ice Sheet are at their warmest. Such a potential proposal is only one of a number of possible approaches.

Cabled Observatories

There have been long-running discussions about the potential for a cabled observatory in the Canadian waters of the Arctic Ocean and we understand that further discussions with the Canada First Research Excellence Fund are underway. Such proposals have a strong international element. The United Kingdom has a strong track record in Marine Autonomous Measuring Systems and is well-placed to work collaboratively with such cabled observation systems given the strategic investment that has been supported by NERC and others in recent years, through initiatives such as NEXUSS, the Doctoral Training Partnership that supports the operation and development of marine and remotely operated autonomous systems.

The United Kingdom also has a range of other observational infrastructure systems, including a long term array of moorings that are part of the Svalbard Observing System. Such approaches could tie to international efforts for large fixed observatory sites within the Arctic region.

Sea-ice forecasting

There is a pressing need to develop better capability for forecasting sea-ice extent and distribution. The annual SEARCH competition on sea-ice forecasting demonstrates that there is still a considerable way to go, even with predictions over timescales of months. Improving this position is likely to require pan-Arctic distributed data gathering networks and improved data assimilation techniques to bring the short-term forecast models up to a reliable standard and then to incorporate them into the global climate models for long-term forecasting. The United Kingdom makes a strong international contribution to sea ice modelling and observations.

Robotic and autonomous platforms

The United Kingdom is a world leader in the design and manufacture or robotic and autonomous platforms. The existing NERC autonomous platforms at the National Oceanography Centre, which are already being deployed for under ice work, will be supplemented with a new 1500m depth-rated Autosub Long Range (ALR1500) and a new 6000m depth-rated autonomous underwater vehicle (Autosub6000 Mk2). This will provide even more support and extended range to future under-ice and deep-ocean science, including a number of upcoming major marine research programmes such as the Changing Arctic Ocean programme. There will also be investment in command-and-control systems for efficient fleet management, together with the investment in the NEXUSS Centre for Doctoral Training in robotics to ensure that we continue to train the next generation of leaders in this exciting field. Engagement of NEXUSS students in the challenging environment of the Arctic offers considerable opportunities.

There are positive approaches within the United Kingdom to develop biosensors for Arctic deployment to expand the range of sensors suited to measuring biogeochemical parameters. This is part of joint United Kingdom and Norwegian funded programmes, with a particular focus on British expertise in data communications and sensor developments.

Aircraft and vessels of opportunity

An interesting proposal which has emerged from the informal consultation around this response is whether the large number of commercial aircraft and vessels movements in the Arctic present an untapped resource for environmental monitoring. For example, there are significant numbers of commercial aircraft routes in Alaska, Canada and other parts of the high north. The aircraft are flying relatively consistent routes, at known times, across a range of altitude, with existing on-board instrumentation.

An interesting question posed by researchers here is whether it might be possible to add an extra suite of sampling instrumentation to a commercial aircraft to turn it into an effective environmental sampling platform, to produce extremely valuable monitoring. We understand that Lufthansa have already taken such an approach with some of their aircraft, although not with a specific Arctic focus.

The scientific and practical potential for such an approach is under consideration by atmosphere researchers in the United Kingdom, in discussion with colleagues in Fairbanks, Alaska. There may be similar opportunities with vessels of opportunity in the Arctic Ocean.

'Data rescue'

A regularly mentioned theme is the issue of the 'rescue' of previously produced Arctic data from Navy logs, whaling ships' records, early Arctic explorers and others to provide valuable historic information on sea-ice and other environmental conditions in the Arctic. A number of projects have already focused on specific areas, using a combination of researchers and volunteers to obtain and digitise key elements. We understand that such an approach has been taken with the Arctic log data from United States' Navy vessels. There is some expertise in the United Kingdom in this area and considerable interest in developing larger scale programmes, with some proposals already submitted that will make a step-change in the access and digitisation of these records.

Satellite monitoring and sea-ice modelling

The United Kingdom has a well-developed capability in the use of satellite monitoring, most notably in the development, operation and interpretation of the various iterations of Cryosat. The products are central elements in the work within the United Kingdom on refining sea-ice models and predictions, in which there is considerable expertise, deployed in partnership with numerous other international researchers.

Data-sharing

A persistent issue is the ability of countries with diverse Arctic research interests to share data in a timely and effective manner. Despite repeated assertions that data will be made available to the wider international community, the reality is often that the data do not become available in an accessible form, or becomes available long after they are required. The multiplicity of data portals/data bases/data archives/knowledge centres militates against effective dissemination, as does the absence of political will and divergent cultural approaches to data-sharing. The consequence is that expensively collected data is not worked hard enough. We believe that a commitment to practical steps on common data archiving and accessibility could be an important aspect of Ministerial discussions. The ongoing negotiations within the Arctic Council's Scientific Cooperation Task Force demonstrate that progress in these kinds of difficult areas is possible, and that extending the benefits of such forthcoming agreements to all those contributing to Arctic research collaboration is key.

International funding mechanisms

Beyond national funding mechanisms the United Kingdom plays a leading role in understanding the multi-sectorial impact of Arctic change, as well as the enhancement of the current capabilities for assessing and predicting Arctic change. We have co-ordinated a number of large interdisciplinary Arctic programmes funded by the European Union. Such examples include: ICE2SEA (2009-2013) and the current ICE-ARC (2014-2017) programme.

This programme (Ice, Climate, Economics – Arctic Research on Change) brings together physicists, chemists, biologists, economists, and sociologists from 21 institutes from 11 countries across Europe. With a budget of €12M we aim to better understand and quantify the change in the Arctic marine environment, investigate the consequences of these changes both on the economics of the area and globally, as well as to improve our understanding of the impacts of change on local communities.

The United Kingdom continues to be active in this co-ordinating role. For example we have recently submitted to the European Union a potential programme that stimulates international collaboration to deliver an Arctic observing network that is fit for the 21st century. The Arctic-UNION programme of research is a multi-partner initiative to create and deliver a sustainable and flexible integrated Arctic Observation System (iAOS). Such a system is essential to ensure sustainable development, improve scientific understanding, and enable adaptation and mitigation to Arctic change within and beyond the Arctic. The ambition of Arctic-UNION is to bring together, for the first time, a team of world-class multi-disciplinary Arctic experts from almost 50 partner institutions and collaborators from internationally-recognised Arctic organisations. We anticipate that the decision on this programme will be made well before the Arctic Science Ministerial meeting.

The United Kingdom is a leader and contributor to the ongoing development of EU-PolarNet, which contains strong Arctic elements. We anticipate that the key elements of the EU-PolarNet approach will have been well-represented by other responses, including by the European Commission itself.

Theme III: Applying Expanded Scientific Understanding of the Arctic to Build Regional Resilience and Shape Global Responses

Improved predictability of Arctic response to lower latitude emission changes (e.g. resulting from clean air legislation) and potential increases in Arctic emissions will enable the development of policies designed to minimise Arctic climate change while allowing economic development, and building resilience in vulnerable regions. This may require the development of new long-term monitoring technologies as well as the application of improved scientific understanding. Understanding of future changes in mid-latitude climate variability (weather) will require improved prediction of Arctic climate response to future emission changes.

<u>Pollution Control</u>

There have been significant advances in the field of pollution control in the Arctic Ocean environment, not least the binding agreement on Oil Spill Preparedness by the eight Arctic Council members, and on recent work on oil spill prevention. The decline in the transit traffic on the North East Sea Route and the results of oil and gas price volatility on infrastructure investment may have also reduced the perceived risks. As should the introduction of the Polar Code in 2017. But the medium- to long-term trend – both in overall volume and size of individual vessels - must be considered to be upwards in terms of marine traffic, with the consequent increased likelihood of a significant pollution incident.

There is a consistent view in the United Kingdom Arctic research community that there is considerable value in coordinated activity to address key questions such as: the longevity of contaminants; the break-up and dispersal of spills; the impact on the marine environment and the resilience of the eco-system.

Infrastructure

The United Kingdom has a number of programmes aimed at understanding the challenges posed by permafrost thawing, including projects supported by the Natural Environment Research Council and the Department for Energy and Climate Change, working closely with UAF and NPS in Alaska, amongst others. There have also been international collaborations on issues such as how reindeer herders are dealing with climate and landscape change.

Theme IV: Arctic Science as Vehicle for STEM Education and Citizen Empowerment

The challenge of data coverage in the Arctic region and the strong interest from local and indigenous people in monitoring and understanding rapid change in their own communities, make it ideally suited to initiatives such as community-based science and monitoring. This has the advantage of empowering local communities to play a role in shaping the knowledge that will lead to implementation of policies to protect their environment. In addition to natural sciences the United Kingdom has a strong social science sector with a good track record in engaging on Arctic issues.

Practical examples

Within the ICE-ARC programme we are partnering with local communities to ensure the science being performed is locally, regionally and globally relevant. Capacity-building within the communities, along with the promotion of inclusive and sustainable research programmes that recognise the value of traditional and local environmental knowledge, are key. Research programmes are developing new community-based methods and techniques for gathering observational data in ways that involve local rights and free, prior and informed consent of the communities. This approach is further advanced within the proposed Arctic-UNION programme.

Education and outreach initiatives

The United Kingdom has developed a range of Arctic and wider polar educational and outreach initiatives and has an active interest in further developing these approaches to maximise their impact. www.discoveringthearctic.org.uk is a nationally-available, web-based educational resource that directly supports the national curriculum for primary and secondary school children. The initiative was developed in 2009 and all being well, will be refreshed and made fully compatible for tablets and smartphones within the next year.

There is a widespread acknowledgment of the value of STEM education and increasing numbers of British polar scientists and researchers have achieved STEM-accreditation to enable them to deliver educational and outreach programmes in combination with teachers and others.

The Open University has developed extremely popular distance learning educational resources connected to polar science, not least in connection with the BBC's internationally recognised *Frozen Planet* television series.

By connecting our research station on Ny-Ålesund through live link-ups to schools around the United Kingdom, the United States and many other countries we have been able to bring real Arctic science into numerous classrooms over the last several years. The Government has recently announced its intention to develop a new Polar Explorers programme in connection with the commissioning of the new polar research vessel, RRS *Sir David Attenborough.*

Summary

This is an initial response to the request for contributions to the four themes ahead of detailed discussions in the months to come. We look forward to engaging with you and others in that process and to developing a strong programme and promising proposals ahead of the Ministerial meeting itself. Depending on how you envisage constructing the working groups to take forward the individual theme areas, we would be keen to nominate specific contacts for each of the groups.

Yours sincerely

Henry Burgess

Henry Burgess

Head, NERC Arctic Office