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Public consultation on streamlining EU funding in the European Arctic

Fields marked with * are mandatory.

Identification

Are you answering this questionnaire on behalf of an organisation or as an individual?*

- ○ As an individual person
- ◉ On behalf of an organisation

Your name:*

Text of 1 to 300 characters will be accepted

Dr Jennifer Riley

Contact e-mail:*

Text of 1 to 300 characters will be accepted

This will not be published and will only be used to verify with you that your views are correctly represented in the published results.

Jennifer.Riley@noc.ac.uk

What is the name of your organisation?*

Text of 1 to 300 characters will be accepted

National Oceanography Centre (NOC, www.noc.ac.uk), UK and NOC Delivery Partner the Sea Mammal Research Unity (SMRU, www.smru.st-andrews.ac.uk)

Although you are replying as an individual, is your reply based on your knowledge acquired in your working environment (eg in a private company, government ministry or research organisation) or based on a general interest in this issue?*

- ◉ Working environment
- ○ General interest

Type of working environment*

- ( ) International organisation
- ( ) Public authority
- (•) Research
- ( ) Business
- ( ) Non-governmental organisation
- ( ) Interest group
- ( ) Other

Type of organisation*

- ( ) International organisation
- ( ) Public authority
- (•) Research
- ( ) Business
- ( ) Non-governmental organisation
- ( ) Interest group
- ( ) Other

What type of research organisation?*

- (•) Public research institute
- ( ) Private research
- ( ) University
- ( ) Other

Has your organisation been a beneficiary of EU funds in the past five years?*

- (•) Yes
- ( ) No
- ( ) I don't know

Where are you based?*

Please choose from the 28 EU Member States. If your country is not listed, please select the category "other" and type in the name of the country of where you are based.

- ( ) Austria
- ( ) Belgium
- ( ) Bulgaria
- ( ) Croatia
- ( ) Cyprus
- ( ) Czech Republic
- ( ) Denmark
- ( ) Estonia
- ( ) Finland
- ( ) France
- ( ) Germany
- ( ) Greece
- ( ) Hungary
- ( ) Ireland
- ( ) Italy
- ( ) Latvia
- ( ) Lithuania
- ( ) Luxembourg
- ( ) Malta
- ( ) Netherlands
- ( ) Poland
- ( ) Portugal
- ( ) Romania
- ( ) Slovakia
- ( ) Slovenia
- ( ) Spain
- ( ) Sweden
- (•) United Kingdom
- ( ) Other

Are you a managing authority of EU funds?*

A managing authority of EU funds informs potential beneficiaries, selects projects and generally monitors their implementation.

- ( ) Yes
- (•) No

The Commission is planning to organise a series of workshops regarding economic development in the European Arctic before the end of 2015. Would you be interested in receiving an e-mail alert once registrations open?*

- (•) Yes
- ( ) No

Transparency and privacy

For transparency reasons, the Commission asks organisations to supply relevant information about themselves by registering in the Transparency Register of the European Commission and the European Parliament.

Is your organisation listed in the EU's Transparency Register?

- ○ Yes
- ○ No
- ◉ I don't know

How would you like your contribution to appear?*

- ◉ Under the name supplied (I consent to the publication of all the information in my contribution, and I declare that none of it is subject to copyright restrictions that would prevent publication.)
- ○ Anonymously (I consent to the publication of all the information in my contribution except my name/the name of my organisation, and I declare that none of it is subject to copyright restrictions that would prevent publication.)

Questions

1. Challenges, opportunities, actions

What are, in your view, the main challenges for the European Arctic for the next ten years?*

For example, the World Economic Forum Global Agenda Council on the Arctic identifies **environmental protection**, **investment in infrastructure**, **maritime safety** and **Arctic research** as key challenges for the Arctic region.

From the perspective of the National Oceanography Centre the main challenges for the Arctic in the next 10 years are:

1) Arctic research – where further investment is needed to better understand how the environment is changing. For more detailed information on the research needs please see following sections in this consultation.

2) Arctic Governance – climate change in the Arctic will likely impact the operation of legislation over the coming decades, leading to inadequacies or insufficiencies in governance approaches as the region becomes busier and increasingly altered from present conditions.

These two priority areas are not discrete. Research is needed in the Arctic to understand the changes in the environment and to ensure that development is undertaken sustainably and “Significant knowledge gaps across the Arctic need to be closed urgently” (Emmerson, C. and G. Lahn

[2012] Arctic Opening: Opportunity and Risk in the High North, Chatham House and Lloyd's; www.chathamhouse.org/publications/papers/view/182839). All research activities in the Arctic must comply with local governance and laws. For example diplomatic clearances must be gained in order to undertake Marine Scientific Research (MSR) in waters under State jurisdiction. Much of the Arctic is territorially divided between the Arctic rim countries.

The Marine environment is governed by the UN convention on the Law of the Sea (UNCLOS). According to UNCLOS countries have an Exclusive Economic Zone (EEZ), which extends 200 nm offshore. Diplomatic clearances must be granted for MSR activities being carried out in much of the Arctic Ocean. UNCLOS part 13 sets out the general provisions for MSR including ensuring provision for marine data acquisition, data dissemination and the collaborative workings of large-scale international programmes. Although there is discussion internationally focusing on whether UNCLOS part 13 is fit for purpose, it is our view that UNCLOS part 13 should be maintained and is suitable to regulate access into the Arctic.

As sea ice extent decreases there will become greater opportunities to access more of the Arctic Ocean area. In addition, five Arctic States are actively addressing the extent of their sovereign jurisdiction as in accordance with UNCLOS article 76. (Note the USA is yet to ratify the UNCLOS as such the area beyond 200nm pertinent to the USA will have a different status). This way the full extent of their continental shelf, which extends beyond the 200 nm limit of the EEZ, up to a distance of either 350nm or 100nm seaward of the 2500m isobath, will be realised. Having recognised the full extent of their continental shelf those States will have rights to explore and exploit the living and non-living resources on and beneath the sea floor. Governance of these areas rests not only with the Arctic States, who should ensure responsible use of the seafloor and sub soil, but also the international community, as water column beyond the EEZ are recognised as the High Seas. As such there is an imperative on the international community to ensure Arctic State practice within their jurisdiction does not contravene those States' obligations to the wider community, a fundamental principle of the UNCLOS as outlined in its Preamble. This principle is as much reflected in a recent report by The Arctic Policy Commission which noted that during a paper on national and international interests that its recommendations are somewhat contingent on the cooperation of others who have jurisdictional authority, from the federal government to international waters (www.adn.com/article/20141120/alaskas-arctic-policy-commission-wraps-work-recommendations).

In addition to many other articles relating to the EEZ, the UNCLOS contain specific articles that address Ice-covered areas within a State's 200nm EEZ, which enables them to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction

and control of marine pollution.

Once the extent of the continental shelf has been recognised those areas beyond national jurisdiction will also become of interest as they are subject to a governance regime. However for these areas known as The Area the UN body the International Seabed Authority has quasi jurisdiction, where its rules and regulations must be developed in a way that takes into account the special nature of the Arctic.

It is because of this that marine scientific research and a continued awareness of national and international rules and regulations will be key to better understanding the marine environment, enabling more robust governance and as such responsible use of the Arctic Ocean.

What are, in your view, the opportunities for jobs and growth in the European Arctic for the next ten years?*

For example, in the wider context of blue growth, the European Commission has identified five sectors for further jobs and growth potential in the maritime economy: deep sea mining, marine biotech, coastal tourism, aquaculture and ocean energy.

Changes in the Arctic are likely to lead to new economic and commercial opportunities with investment reaching $100 billion or more (Emmerson, C. and G. Lahn [2012] Arctic Opening: Opportunity and Risk in the High North, Chatham House and Lloyd's; www.chathamhouse.org/publications/papers/view/182839). As ice melts and summers become ice free in the Arctic Ocean greater commercialisation opportunities will arise through the instatement of regular shipping routes, service cable laying and access to natural resources including energy (e.g. oil and gas) and mineral wealth.

Marine geoscience is of key importance to the oil and gas industry, underpinning the exploration of new oil and gas fields. As well as understanding the sub-surface, research into marine geoscience can also provide habitat mapping for fisheries and benthic communities, as well as information on the shallow sea floor where exploration for gas and methane gas hydrates occurs and knowledge of shelf slope stability is needed.

Similarly with the expansion of fishing grounds north into Arctic waters there is potential for increased commercial fishing opportunities. The Arctic waters are already highly lucrative with respect to fisheries. In 2002 fisheries of the circumpolar north accounted for more than 10% of the worlds wild fish catch and more than 5% of the crustacean catch (AMAP, 2014. Arctic Ocean Acidification 2013: An Overview).

Furthermore environmental changes in the Arctic can have far field effects away from the true Arctic environment. The circulation in the ocean is three dimensional, and as such, Arctic derived waters can be found at depth outside the geographical limits of the Arctic. A prime example of this is the cold Arctic water flowing five miles west of Shetland at 500 m depth (Baxter et al. (eds.) 2011. Scotland's Marine Atlas: Information for the National Marine Plan. Marine Scotland, Edinburgh). This cold Arctic current is an important feature, sustaining highly productive fishing grounds for the UK. Thus any changes in the Arctic could also have economic and commercial implications and opportunities for UK fisheries.

Overall however, economic development and Blue Growth must be balanced against preservation and protection of the natural environment. In order to be able to protect an environment the baseline against which change is being measured must be known. In the Arctic the baseline is already changing so it will be difficult to assess the impact of any environmental protection measures implemented. Consequently there are also opportunities to grow the research sectors capabilities in the Arctic, creating jobs within academia and industry (e.g. engineering, robotics, ship building and engineering), the latter of which supports the activities of the research community, facilitating sustained ocean observations.

What investment and research priorities do you think are necessary to tackle these challenges?

How could opportunities for jobs and growth between now and 2024 be seized?*

The scientific evidence is currently not sufficient to fully inform policy and development decisions in the Arctic as the data collected in insufficient. This also means that it is difficult to say whether the change in the Arctic region will be “good” or “bad” overall.

As a result research priorities should focus on understanding:
Sea ice, land ice changes and ocean physics, which include
- Changes of sea ice extent, compactness, the degree of sea ice fragmentation (which affects ice floe sizes), ice thickness and age (from multi-year to seasonal sea ice), as well as the associated impacts
- Investigating the unknown impacts of the removal of sea ice and the changes in ocean circulation and changes in the pattern of Arctic currents (spin-up of the Arctic surface and subsurface circulation)
- Changes in the Arctic ocean stratification (including changes in the upper mixed layer) and impacts on climate
- Alteration to coastal erosion rates (due to higher ocean waves and stronger currents) and nutrient loading in the Arctic Ocean
- Thawing of the permafrost
- Measuring global sea levels and the melting of the Greenland ice sheet (resulting in mass transfer from the land to the oceans)
- Sea bed bathymetry of consistently ice free regions
- How mid latitude weather patterns (including changes in air temperatures, storm frequency, tracks and rainfall) and ocean waves will respond to changing ice cover in the Arctic (Francis, J. A. and S. J. Vavrus (2012). "Evidence linking Arctic amplification to extreme weather in mid-latitudes." Geophysical Research Letters 39(6): L06801)

Changes in ocean chemistry and acidification, including
- Increases in nutrient concentrations
- Impacts on carbon sequestration
- Implications for the biological communities (benthic and pelagic)

Changes to the biological community across all trophic levels, including
- Changes in the distribution of marine organisms (particularly plankton and pelagic fish; benthos and demersal fish)
- Alteration of the extent of fish breeding, feeding and migration grounds/routes
- How human activities and pollution (including noise) will affect species and ecosystems
- Which upper ocean organisms will thrive in conditions with direct strong sunlight in summer and complete darkness in winter.
- How the benthic system (invertebrates and demersal fish) will respond to ice-free overhead conditions, i.e. shift from permanent to seasonal to seldom ice-covered and the concomitant change in organic matter supply to the seafloor.

Better understanding the marine geology and seabed topography. This will:

- Provide knowledge to be used for installing infrastructures in the Arctic
- Complement and ensure sufficient understanding of benthic community data.
- Improve knowledge of marine geohazards and slope stability on the continental shelf
- Improve habitat mapping for fisheries management
- Feed into climate change and ocean acidification research through improved understanding of shallow seafloor gas and methane hydrates.

Improved research in these areas will help to ensure sustainable Blue Growth in fishing sectors, baseline environmental data is available for cable laying and oil and gas developments and mineral exploration. This research will also help improve understanding of how the Arctic will have far field effects on global climate and regional fisheries e.g. in the North Atlantic.

Furthermore these research priorities also tie in with both the European Marine Board science commentary “Getting Ready for an Ice-free Arctic”(www.marineboard.eu/publications) and the European Polar Board’s publications (www.esf.org/hosting-experts/expert-boards-and-committees/polar-sciences/publications.html) focusing on development and challenges in the Arctic.

What projects or actions, that could be funded by the EU, do you think should take place between 2014 and 2024?*

To date there is insufficient data on the Arctic to make informed policy decisions. However there is a growing body of scientific evidence which may be of use when making short term policy decisions relating to the Arctic. Nevertheless, scientific understanding of on-going environmental change is needed to realise sound long-term policies. Projects or actions that could be funded by the EU include improving:

1. Observations and modelling in and around the Arctic region to enable robust predictions of future conditions to be made. Overall, the Arctic observational programmes are mostly nationally funded and to the large extend disconnected from each other. The research links are typically made at ‘ad hoc’ manner between groups and individual researchers. The Arctic oceanographic observations should be multi-disciplinary and benefit form the multi-platform approach (i.e., using ships, aircrafts, robotic underwater technologies and satellites). The observations needs to be focused on the Arctic exchanges with the lower-latitude Ocean (Arctic gateways) and also in the Arctic interior

(e.g., Ice tethered platforms, hydrographic transects using sea gliders, etc..). In the new climate state of the Arctic, new measurements are becoming the key: e.g., ocean turbulence and wave measurements. The EU could have a distinctive role in co-funding and coordinating national programmes.

Investment is needed in tide gauge and sea level measurements (www.noc.ac.uk/science-technology/climate-sea-level/sea-level/tide-gauges) through improvements in both the coverage and the ground-truthing of gauge positions with GPS data. The existing tide gauge network in the Arctic is not adequate to provide the full range of data required to give detailed information about the rate of sea level rise, storm surges, or tsunami incidence. Canada have cut their tide gauge network, and Russia is understood to have not invested in the region. Furthermore in-situ data collection could be facilitated by investment in novel technologies such as lab on a chip technologies (which measure chemical properties of the ocean; www.noc.ac.uk/science-technology/research-groups/ote/instruments-sensors/chemical-microsensors), biological sensors (which miniaturise technologies currently reliant on large instrumentation; www.noc.ac.uk/science-technology/research-groups/ote/instruments-sensors/biological-microsensors), and could be used in conjunction with autonomous underwater vehicles. Additionally further support of on increase in the investment of existing animal borne sensor deployment in the Arctic would be a cost effective way to increase information about the physical marine environment and the well being of top down predators at the same time in the Arctic.

Sustained observations (time-series) will be essential to an understanding of the changing baseline environmental conditions. Some of the necessary observations can be efficiently addressed by the technologies noted above; others (particularly biological and ecosystem parameters) will continue to require conventional sampling campaigns to 2024 and beyond. The early establishment of sustained observatories, operating to international best-practise standards, should be a key goal.

2. Access to the region - including access to research facilities by promoting projects, which promote transnational access to facilities (e.g. FixO3; www.fixo3.eu) and shared infrastructures (e.g. the international research base at Ny-Ålesund on the Svalbard archipelago (www.arctic.ac.uk/infrastructure/international-facilities/international-stations) and via bartering for ship time (www.noc.ac.uk/research-at-sea/reasons-set-sail/international-working). Furthermore development of novel technologies such as unmanned autonomous vehicles (e.g. Autosub; www.noc.ac.uk/research-at-sea/nmfss/nmep/autosubs) including the use of animal borne sensors, will help scientists to gain better access to the Arctic in the future.

3. Access to data - Given that data is difficult to collect and

is not fully comprehensive, it is vital that collected data is made freely available though data centres such as the British Oceanographic Data Centre (www.bodc.ac.uk) and the UK's Polar Data Centre, hosted by the BAS (http://www.antarctica.ac.uk//about_bas/our_organisation/eid/pdc/index.php), as well as other international data networks, such as SeadataNet (http://www.seadatanet.org/) and developing Arctic focussed databases and portals such as those hosted by the Arctic Centre (www.arcticcentre.org/InEnglish/SCIENCE-COMMUNICATIONS/Arctic-Databases-and-portals). International connections made through science coordination programmes (e.g. IOC (www.ioc-unesco.org), EuroGOOS (www.eurogoos.eu) and WCRP programmes (www.wcrp-climate.org)) also facilitate access to international datasets.

4. Understanding of the impacts of climate change - in particular on the economy and society and governance. Arctic climate change will have significant impacts on the governance of, the access to and the investment in the region. Given the EU's focus on Blue Growth, the EU needs continued investment in projects such as EU-ACCESS (www.access-eu.org) which focuses on assessing climatic change impacts on marine transportation (including tourism), fisheries, marine mammals and the extraction of oil and gas in the Arctic Ocean, and Arctic governance structures. Furthermore, it is also that the likely (substantial) increases in marine transportation, fisheries, and resource extraction industries bring with them an additional set of environmental impacts that will require predication, monitoring, and (international) control measures.

Do you see specific needs that EU funding instruments should take into account specifically for the European Arctic?*

EU funding instruments need to promote projects are cross-disciplinary focusing on collaborative research.

2. Implementation

Is there already coordination taking place for sharing cross-border/ transnational priorities for investment in order to better align EU funding instruments?*

- (●) Yes
- ( ) No
- ( ) I don't know

On a scale of 1-10, how would you rate the quality of cooperation between regional authorities in the European Arctic?*

between 1 and 10

1 being poor quality, 10 for being of excellent quality

5

Could you give an example on which your assessment is based? Please specify.*

The above scaling system is inappropriate to make an informed judgment of the quality of cooperation between regional authorities in the Arctic. The quality of cooperation found depends on the scale and subject area on which one is looking at.

For example at the international scale there are many challenges reducing the quality of regional cooperation. An example is data sharing practices, which are not always best practiced between nations. It can be very difficult at the national level to get access to the data collected by other countries undertaking Arctic research. Such difficulties in accessing data can result in duplication of efforts and resources by other national research programmes. It also slows scientific progress and generation of new knowledge for the Arctic, both of which are needed to underpin new economic and Blue Growth.

However, at a national level within the UK marine science community, there are good levels of cooperation. The UK marine science community has access to the Natural Environmental Research Council (NERC)'s significant capabilities in polar ocean observations. Current observational infrastructure includes ice strengthened research vessels, such as the James Clark Ross (www.antarctica.ac.uk/living_and_working/research_ships/rrs_james_clark_ross/index.php) capable of working in ice-covered waters (up to 1 m thick) and the ability to deploy Autonomous Underwater Vehicles (AUVs) under ice to collect data and operate beneath the ice shelf. Access into the Arctic is further enabled through the use of shared infrastructures such as the international research base at Ny-Ålesund, Svalbard (www.arctic.ac.uk/infrastructure/research-station/access-to-the-station/), coordinated through the UK Arctic Office.

Furthermore NERC has invested resources into sustained observation programmes, which will help to better understand long term changes in the Arctic region. These include:

- The Extended Ellet Line (www.noc.ac.uk/ocean-watch/open-ocean/extended-ellett-line), which measures ocean properties in the NE Atlantic where waters flow into and out from the Arctic region and which therefore establishes a baseline against which changes in the Arctic and adjacent waters can be measured

- MASOX (Monitoring Arctic Seafloor – Ocean Exchange) where NOC/NERC have previously provided instrumentation for a sustained seafloor observatory to monitor methane outputs in the Svalbard archipelago.

In the UK NERC provides National Capability funding to underpin NOC expertise in the Arctic and provide leverage for EU projects such as SWARP (Ships and Waves Reaching Polar Regions; http://swarp.nersc.no/). EU projects particularly those promoting international collaboration are therefore good platforms for enhancing effective and successful scientific projects in the Arctic.

Furthermore in the UK NERC supports the Arctic Office (www.arctic.ac.uk/), which brings UK Arctic scientists together across projects such as:

- TEA-COSI (The Environment of the Arctic: Climate, Ocean and Sea Ice) – aiming to deliver a substantial enhancement in the understanding of key Arctic ocean and sea ice processes and their impact on the Arctic and wider climate system, in both the present and future

- SEATS (Submarine Estimates of Arctic Turbulence Spectra) – aiming to provide insight into how the close links between fluid dynamic scales and biogeochemical cycles will change under conditions of an increasingly ice-free Arctic

- Will climate change in the Arctic increase the landslide-tsunami risk to the UK? – This project aims to clarify the frequency and timing of major Arctic submarine slides during the last 20,000 years, and determine which generated far-field tsunamis

At the European level the European Polar Board (http://www.esf.org/hosting-experts/expert-boards-and-committees/polar-sciences.html) and European Marine Board (www.marineboard.eu) both help to coordinate marine scientific research in the Arctic and produce position papers on Arctic science, which present a collective perspective from the scientific community, addressing challenges and knowledge gaps for future Arctic work.

Internationally the WCRP programme CLiC (Climate and Cryosphere, www.climate-cryosphere.org/) brings together the international research community to address the challenges and steer the course of scientific research in the polar regions (including the Arctic). Furthermore specific Arctic forums in the USA such as FAMOS (Forum for Arctic Modeling Synthesis and Analysis, http://web.whoi.edu/famos/) work well to bring scientists together to discuss cutting edge scientific problems and challenges in the field of polar and Arctic science.

The Arctic Council is the major coordinating body for Arctic rim countries and allows Arctic Circle countries and intergovernmental

organisations observer status. The UK has permanent observer status granted which is coordinated through the Foreign and Commonwealth Office (FCO). The science community, in particular NOC, has a memorandum of understanding with the FCO, thus scientific input can be provided to the FCO and hence presented in the Arctic Council fora.

Furthermore at the international governance level UNCLOS and the IMO work to legally regulate the global ocean, including the Arctic. Currently, it is our opinion that the regulation of Marine Scientific Research (MRS) within UNCLOS is sufficient. However the EU-Access project, of which NOC had provided research on the impacts of climate change on Arctic Governance over the next 30-years has identified deficiencies in the current Arctic Ocean laws and regulations. Such deficiencies are likely to be compounded by increasing activities, particularly shipping, tourism, resource exploration and exploitation and fishing. Efforts are in place to address some areas of ocean governance such as the development by the IMO of a mandatory Polar Code for shipping and the two binding agreements, Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic and the Agreement on Cooperation on Marine Oil Pollution, Preparedness and Response in the Arctic, both negotiated under the auspices of the Arctic Council. Rigorous and harmonised legislation, enforced at national level will be needed to ensure adequate governance and the Arctic Council is likely to be the most appropriate mechanism by which to achieve this.

Do you think regional cooperation in the European Arctic could be improved?*

- (●) Yes
- ( ) No
- ( ) No opinion

If so, in what areas could regional cooperation be improved?*

- [x] The cooperation could be more structured
- [ ] Best practices could be exchanged better
- [ ] Exchange and/or twinning programmes between authorities could take place more frequently
- [ ] Joint-training facilities could be improved
- [ ] A shared longterm foresight and analysis structure should be put in place
- [x] A structure for longterm joint-financial planning should be installed
- [x] Other

Please specify

To improve data sharing policies in the Arctic between regions the EU could consider setting up an agreement similar to the WOCE data sharing agreement (www.scor-int.org/CLIVARData1.pdf). Further to this is ensuring that data is archived properly through a single dedicated Arctic database

Similarly promoting bi-lateral agreements between countries will help to promote better scientific collaboration and enable more agility in negotiating data sharing practices (e.g. www.nerc.ac.uk/latest/news/nerc/nsf-geo/). Multilateral agreements such as the Galway Statement (http://europa.eu/rapid/press-release_IP-13-459_en.htm) can also be useful to promote better-coordinated activities.

The Russian Arctic plays an important role when trying to understand the physical drivers in the Arctic as well as the Arctic Ecosystem. However, access to this region and cooperation with Russian authorities is very difficult, while most of the Arctic communities/ authorities work quite closely together.

3. Specific questions

You are kindly requested to indicate what you see as the **main challenges** for the following areas in the European Arctic. You would also be able to suggest **concrete actions and projects**.

3.1 Improving connectivity and communication systems (within and links to the region)

According to you, how much of a challenge do these areas represent concerning connectivity and communication systems in the European Arctic?

	Major challenge	Medium challenge	Minor challenge	No opinion
Intermodal transport (including ports and airports), road and rail systems, inland waterways.*	○	◉	○	○
Energy systems and security of supply*	○	◉	○	○
Telecoms and Information Technology (Digital agenda)*	○	○	○	◉
Space technologies (including communications, weather and climate, navigation)*	◉	○	○	○

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to improve **intermodal transport** in the European Arctic.

With improvements in shipping routes across the Arctic there will also need to be additional infrastructure built in high northern latitudes to allow for ships to dock and goods to be transported on land to and from the ports. Warming global temperatures is causing the permafrost to melt and significant coastal erosion to take place, especially in areas that were previously ice covered. As such the establishment and maintenance on land infrastructure to support the additional ocean transport will be challenging and need sound engineering and science underpinning its development.

Would you have comments or additions here or would you like to propose concrete actions or projects that could take place **to improve energy systems** in the European Arctic and **security of supply**?

When considering the security of energy supply in the Arctic consideration of where pipelines are located onshore will be challenging as the permafrost melts and ground becomes increasingly unstable to locate heavy industry or long term pipelines. Careful planning underpinned by sound engineering and environmental advice will be needed.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place for **space technologies** in the Arctic.*

Satellites are key for providing data on changes in ice extent and variations in sea level, sea surface temperature and primary productivity. Through the UK's contributions to the European Space Agency (ESA) we are able to help inform data product development and get access to data from specific Earth Observation (EO) missions. The next series of ESA EO satellites (the Sentinel series) will help fill in some gaps in our knowledge in the Arctic region through the launch of the Sentinel Series of satellites. However, these will still be restricted in their polar coverage. The CryoSat mission currently covers up to 88° North. However, improvements in satellite coverage would enable more comprehensive data collection. The Cryosat satellite can deliver precise information on changes in ice thickness. Despite having a real need for continued data provision Across the Arctic region in the long term there is currently no planned follow on after the end of the current Cryo-sat mission. The sentinel series of satellites will continue to provide cover for Arctic satellite data provision but in order to ensure maximum efficiency and support of new economic growth and investment in the Arctic a satellite mission with dedicated scientific capacity and polar (Arctic) coverage is needed. Further, the Jason-2 and -3 satellites allow measurements of global sea-surface height, to an accuracy of a few centimetres every 10 days, which allows ocean circulation and mean sea level to be determined. This data is used in support of weather forecasting, climate monitoring and operational oceanography (www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Altimetry_missions). The proposed Jason-CS satellite missions will enhance these capacities. On going support of these EO science programmes, through encouragement of Arctic observing capacity, is necessary to better understand the future impacts of change in the Arctic.

Would you have ideas for further areas to improve connectivity and communication systems? Please also mention any further projects or ideas you might have.

No comment

3.2 Protecting the environment, climate change adaptation, emergency prevention (including natural or man-made disasters)

According to you, how much of a challenge do these areas represent concerning protecting the environment, climate change adaptation and emergency prevention in the European Arctic?

	Major challenge	Medium challenge	Minor challenge	No opinion
Maritime security*	◉	○	○	○
Biodiversity and landscape*	◉	○	○	○
Use of renewable energy, energy efficiency and savings*	◉	○	○	○
Air and soil quality*	○	◉	○	○
Natural disasters *	◉	○	○	○
Climate change adaptation*	◉	○	○	○
Water quality and maritime spatial planning*	◉	○	○	○
Risks relating to increasing human activity in the Arctic (for example oil spills)	◉	○	○	○

Would you have comments or additions here? Please specify any concrete actions or projects that could take place for **maritime security** in the European Arctic.

In order to undertake MSR in international waters diplomatic clearances need to be gained to enable legal access into exclusive economic zones (EEZ) according to UNCLOS. EEZ extend 200nm offshore and grant the sovereign state special rights over allowing exploration and use of marine resources, including energy production from water and wind. Furthermore nations have access to the continental shelf up to 350 nm offshore, for which diplomatic clearance is also needed for research activities accessing the seabed.

Through NERC's national capability funding of the National Marine Facility Sea Systems (NMFSS), staff at NOC have the expertise and knowledge facilitate the granting of diplomatic clearances for MSR (www.noc.ac.uk/research-at-sea/nmfss/research-ship-management-group) by other member states and to inform the case for UK applications. Our experience is that states are being more rigorous in their assessment of MSR applications and we expect this will become increasingly an issue in the Arctic.

Some regional powers exercise much higher levels of control over access to the Exclusive Economic Zones (EEZ) and may extend their continental shelf claims. The region is subject to a high likelihood of geopolitical change, which may increase the risk of reduced access to Arctic waters for marine scientific research.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place for **biodiversity and landscapes** in the European Arctic.

The distribution standing stocks and diversity of biological communities and biodiversity will be altered by rising water temperatures, sea ice melt (landscape change), and changing nutrient inputs from riverine runoff, as well as increased human activities. Highly specialised species (e.g. polar bears) dependent on the Arctic sea ice for their survival will likely become endangered or extinct. However, other species will thrive. This change is already evident with declines in populations of polar bears in some Arctic regions. Furthermore, new fish species are now being caught in trawls in the Arctic, including North Atlantic mackerel and cod. Changes in fish stocks in the Arctic will have economic and commercial impacts. The release from permanent or seasonal ice cover will have an extraordinary impact on the ecology and biogeochemistry of the Arctic Ocean, from the sea surface to the seafloor, with likely knock-on impacts to adjoining seas and oceans.

The UK and the National Oceanography Centre has a strong research community examining the driving factors and impacts of a changing Arctic climate. However, such research needs continued investment to ensure that data continues to be collected at sufficient spatial and temporal resolution to be able to document the rapid changes that are occurring. Some elements of the Arctic system are currently under observed especially biological systems (including surface, water column, and seafloor communities).

Enhanced riverine inputs (as discussed previously) are causing increases in nutrient concentrations in the Arctic. However, little is known about their fate. NOC scientists have undertaken pioneering baseline research , which suggests that, for unknown reasons, nitrate inputs to and outputs from the Arctic balance. However, the Arctic acts as a large source of phosphate and silicate. This implies that the Arctic plays a key and poorly understood role in shaping North Atlantic planktonic ecosystems. Changes to such planktonic ecosystems have knock on impacts to higher trophic food levels, and to the seafloor systems that depend on them. New miniaturized sensor technology included in animal-borne sensors enables us to not only record basic physical parameters of the Arctic Ocean, but e.g. light level and fluorescence data are now recorded as well enabling us to investigate the links between the physical environment, the first trophic level and how marine mammals mitigate to the changes.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to improve the **use of renewable energy, energy efficiency and savings**.

No Comment

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to improve **air and soil quality** in the European Arctic.

Emissions from ships should be minimised - emissions from ships transiting through the Arctic can be a source of pollution (e.g. soot particles from low grade fuel oil coating sea ice and changing its reflectivity resulting in a warming feedback effect). It will be important to mitigate against such pollution by ensuring compliance with new ship fuel regulations.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to better counter **natural disasters** in the European Arctic.*

The dissociation of methane clathrates in the continental shelf under the sea may cause sediments on the shelf slope to destabilise. Such destabilisation may trigger tsunami events. Land ice, such as the Greenland Ice Sheet, is also melting and further contributing to freshwater input to the Arctic Ocean. The weight of the ice on land deforms the Earth's crust and mantle. As the weight of the ice is removed the crust and mantle are able to rebound. This is known as isostatic rebound and has the potential to cause earthquakes and trigger tsunami events.

Evidence of such a tsunami event has been observed in the sediment core paleoclimate record off the coast of Norway. Further research from a paleo, contemporary and future modelling perspective will enable better understanding of the impacts of dissociation. One such project currently funded in the UK is:

'Will climate change in the Arctic increase the landslide-tsunami risk to the UK?' - This project aims to clarify the frequency and timing of major Arctic submarine slides during the last 20,000 years, and determine which generated far-field tsunamis. Submarine landslides near to the UK that are large enough to generate tsunamis have been very rare and it is thought that only six have occurred beneath the Norwegian and Greenland Seas during the last 20,000 years. However, more research is needed to better understand the mechanisms triggering landslide occurrence and their likelihood for tsunami generation and propagation towards the UK and the rest of continental Europe.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to improve **adaptation to climate change** in the European Arctic.

> Undertaking environmental monitoring - as coastal (port and harbour) and offshore (oil/gas) infrastructures are built there will be a need to ensure environmental compliance and monitoring is undertaken to protect the environment. Investment at EU level could help promote and enhance environmental monitoring capabilities within the Arctic especially if projects and actions focused on utilising specific scientific expertise in both industry and academia.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to improve **water quality** or **maritime spatial planning** in the European Arctic.

> Management of invasive species - Ballast water in ships is known to transport non-native species from one ocean region to another, causing native species to become endangered or extinct through competition for resources. Such invasive species need to be managed. The impacts of invasive species can be managed by ensuring compliance with international conventions such as the Ballast Water Convention from both UK trade and its international partners. Arctic biotopes are liable to substantial change; their current status requires mapping, and their change monitoring. It may become a complex issue to define what is a 'non-native species' when the physical characteristics of the environment has changed so completely.
>
> The recently adopted EU Maritime Spatial Planning directive (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.257.01.0135.01.ENG), which has a more Blue Growth focus, recognises the onus is on the State to develop such frameworks. Drawing from experience gained from existing Marine Spatial Planning, which have a more ecosystem based focus, will help enable responsible ocean governance. However due to the nature of the cross border activities that should be addressed by Maritime Spatial Planning there is a need for intra State cooperation and coordination. Such an approach to address the varying needs of Maritime Spatial Planning will have to include an element of marine scientific research, as well as taking into account the need to understand maritime jurisdictional issues, such as State boundaries, and obligations under national and international treaties and law, in order to ensure that responsible management of the marine estate is achieved.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to prevent **risks relating to the increasing human activity** in the European Arctic.

> Please see question 3.3 which focuses more specifically on off-shore natural resources.

Would you have ideas for further areas to protect the environment, improve adaptation to climate change and emergency prevention? Please also mention any further projects or ideas you might have.

The EU could also play a key role in facilitating scientific knowledge exchange and capacity development within the region by funding projects and actions with such a focus. Such work could be developed between the scientific community and:

1) Local communities dependant upon the region for their survival who may require information about the observed and predicted changes and impacts.

2) Companies and corporations wishing to exploit the economic opportunities in the Arctic. This could include advising those involved in new fisheries, telecoms ventures, oil and gas and other mineral extraction processes, shipping routes and coastal infrastructure etc. on potential environmental impacts, including monitoring needs and sustainability.

3.3 Reinforcing socio-economic, human and institutional development

According to you, how much of a challenge do these areas represent concerning socio-economic, human and institutional development in the European Arctic?

	Major challenge	Medium challenge	Minor challenge	No opinion
Trade*	○	○	○	◉
Off- and onshore natural resources*	◉	○	○	○
Competitiveness of economic sectors (agriculture, fisheries and aquaculture, industry and services, sustainable tourism)*	◉	○	○	○
Research and innovation*	◉	○	○	○
Jobs, education and health*	○	◉	○	○
Institutional capacity*	○	◉	○	○
Preserving Arctic identity/culture (including tourism)*	○	◉	○	○
The future of Arctic indigenous peoples*	○	○	◉	○

Would you have comments or additions here? Please specify any concrete actions or projects that could take place in the field of **on- or offshore natural resources** in the European Arctic.

See comments from question 1 on the challenge of access to the Arctic and the issues associated with extending rights to the continental shelf to 350nm particularly for offshore natural resources including minerals and oil and gas.

Oil and gas exploration and production, which is likely to become more active in the near future as sea ice extent continues to reduce and access to the region becomes easier. However society and the oil and gas sector will face formidable challenges in locating, containing and removing under-ice oil spills should they occur. The monitoring and detection of oil spills under ice is difficult due to the inability of satellite remote sensing to track spills and biological remediation processes are slower due to the lower sea temperature. As a consequence investment is needed into areas such as oil spill modelling which would ensure contingency and mitigation measures could be appropriately implemented in the event of an oil spill. Scientific research (through improved understanding of circulation, degradation and natural remediation rates and biogeochemical impacts in polar waters) and modelling capacity could help to better understand and predict the path of contamination in the region. There is considerable scope for mutually beneficial science-industry operations in the Arctic. For example the SERPENT Project (www.serpentproject.com) is an exemplar of this approach.

Furthermore, if heavy specialist equipment is not pre-positioned in the region there may be considerable delays in accessing the location of a spill, particularly in winter months, and personnel will need to be trained in oil spill removal techniques that are effective at low temperatures, and in the winter months would need to be undertaken in darkness. Therefore investment will also be needed in the infrastructure needed within the Arctic region to be able to quickly and effectively respond to an oil spill.

There is a counter argument that the most effective (i.e. least environmentally damaging) oil spill response is to do nothing. Experiments addressing the genuine environmental costs and benefits of oil spill interventions (specifically including the do nothing option) would be particularly sensible in the Arctic (given the high cost financial cost of intervention).

Prospecting for mineral wealth will likely become more prevalent over the coming years in the Arctic. Coupling prospecting activities with research and monitoring studies, which are robustly peer reviewed and independent scientific endeavours will help to ensure that such resources are sustainably managed in the long run. Such management will be reliant on a good understanding of Arctic seafloor ecology, that understanding is currently very limited, and that ecology now subject to rapid change.

Would you have comments or additions here? Please specify any concrete actions or projects to improve **economic competitiveness** in the European Arctic.

One area where economic competitiveness is prevalent is the fishing industry. As the Arctic continues to change fish breeding and spawning grounds are observed to be migrating further northward towards the Arctic. As a result Marine Scientific Research is needed to underpin economic development and ensure that economic competitiveness does not result in degradation of ecosystems. A key example known today is the Mackerel fisheries in the North Atlantic. As a result of environmental changes in the North Atlantic, mackerel are now present in Icelandic EEZ, in sufficiently high numbers for Icelandic fishermen to start commercially fishing this species. This has led to economic competitiveness between countries in supplying mackerel to the food market. Without proper regulation this will result in long term overfishing of mackerel stocks and degradation of the ecosystem.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place for the benefit of **research and innovation** in the European Arctic.*

Marine Scientific Research (MSR) is necessary to ensure that development in the Arctic and Blue Growth is managed sustainably. High quality MSR will enable a more comprehensive understanding of climate change on decadal timescales, the timescale at which development in the region will be implemented over. MSR also provides a baseline against which any change to the environment, be it anthropogenic or developmental, can be measured and assessed. Development and funding of novel new technologies (e.g. marine robotics and microchip analysis technologies) will aid with the exploration of the Arctic. Some critical environmental data, particularly those related to biological stocks and diversity, will continue to require direct physical sampling for the foreseeable future – a continued ability to do so (e.g. polar research vessels) should remain equally high on the agenda.

In order to ensure that MSR is able to fully support the Blue Growth agenda more investment is needed in interdisciplinary projects like the EU-Access project (www.access-eu.org), where the Arctic environment is being investigated alongside the economic, social and political developments and changes in the region.

Furthermore, the EU needs to ensure that good working relationships are maintained with Arctic Rim countries and the governing organizations to ensure that access to the EEZ waters and Arctic facilities, particularly for research purposes can be maintained. For example ensuring a good working relationship between the EU, the Arctic Council (the major coordinating body for Arctic rim countries) and its members will be key for development in the Arctic region. Similarly, a good working relationship will be needed with the International Maritime Organisation (IMO) to ensure that future activities in the Arctic are properly regulated.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to ensure better **jobs, education or health** in the European Arctic.

Please refer to question 1.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to improve **institutional capacity** in the European Arctic.

> Undertaking work in the Arctic involves a high level of expertise and capacity. Improvements can be made in institutional capacities by promoting knowledge exchange and capacity building programs between institutes, which will facilitate access to research platforms and key expertise in Arctic research and development.
>
> Furthermore, ensuring that work is undertaken in close coordination with science coordination platforms such as the World Climate Research Programme (www.wcrp.org) and science policy organisations such as the European Marine Board and their relevant scientific programmes and position papers (e.g. Navigating the Future IV, the Rome Declaration and the publication “Getting ready for and ice-free Arctic”; http://marineboard.eu/publications/full-list).

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to preserve an **Arctic identity or culture** in the European Arctic.

> Tourism in and to the Arctic is dependent upon access via ship. With improved access to the Arctic (due to decreasing summer sea ice extent and thickness) there is likely to be greater tourism within the region. Despite this the region is still very likely to remain a harsh and volatile environment. As previously discussed in this submission, scientific evidence still had many uncertainties surrounding the environmental and climatic changes that the Arctic will undergo and as such tourist operators need to be aware of the dangers of working in the Arctic. (e.g. increased storminess, presence of sea ice which is thinner and more easily broken up and drifting away from the ice edge). As such science needs to support greater tourist activity in the region by providing operational oceanography products on the extent of the sea ice and weather patterns not only to trade industries but also the tourist industry operating in the Arctic.

Would you have comments or additions here? Please specify any concrete actions or projects that could take place to improve/to secure the future of **indigenous peoples** in the European Arctic.

> The expected changes will affect local populations in several ways including altering fisheries and climate and opening shipping routes and commercial activity. As such development in this region should be sensitive to the local populations and their long term needs and wishes.

Would you have ideas for further areas to reinforce socio-economic, human and/or institutional development? Please also mention any further projects or ideas you might have.

No Comment

Synergies, comments, further additions

If you have any further additions, please use the free text box below.

1,000 character(s) maximum

There needs to be a clear understanding of the extent of the European Arctic since many European countries do not boarder the Arctic region. Furthermore, efforts should be made to ensure that funding instruments and cooperation are extended between Europe and other international partners, particularly through bilateral agreements. Marine scientific research is an international pursuit and as such truly benefits from international cooperation.

This submission provides a collective response from NOC scientists as well as NOC delivery partners, including the Sea Mammal Research Unit (SMRU; www.smru.st-andrews.ac.uk/).

Thank you

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Contact

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