Call for evidence: Shaping NERC's Priorities

Submission template

Responses should be completed on the evidence template and submitted via email to NERCevidence@nerc.ac.uk

The closing date for responses is **Monday 23rd March 2015**

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Q1 What emerging research and innovation opportunities promise to make the biggest impact on societal challenges?

1. **The scientific, technical, engineering and policy ability of UK to access the Deep Sea Frontier** – The UK is exceptionally well-placed to reap the benefits from our long-term investment in developing **scientific understanding of the ocean**, **advanced deep-ocean technology**, practical **engineering skill** and world-class **marine policies**. These are built upon decades of investment by the public and private sector, and the legacy of training and developing high quality personnel. Our geographic location and that of our Overseas Territories (see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/12249/ot-wp-0612.pdf) have placed the UK in an advantageous position to access the Deep Sea Frontier. The UK's marine estate is much larger than our terrestrial land area. We can capitalise on our improving ability to make sustainable use of **marine sources for energy** promising a long-term bounty of renewable and fossil energy supplies and access to **seabed minerals** including high-grade metal ores and rare-earth metals. Britain's technical leadership and legal/policy expertise led directly to Lockheed Martin's investment in UK Seabed Resources Ltd – see http://www.lockheedmartin.com/uk/news/press-releases/2013-press-releases/uk-government-sponsors-lockheed-martin-uk-subsidiary-for-licence.html
   The 3-dimensional space of the ocean opens the possibility of meeting future food demands through sustainable wild fisheries and the emerging field of deep-water **aquaculture** or 'marine ranching'. The skills we've developed extracting oil and gas from below the seabed can be used for **carbon capture and storage** to help protect us from dangerous climate change.
   The ocean is the medium through which the UK conducts the bulk of commerce, physically through **shipping**, and electronically through the network of **seabed cables**, and provides a space within which we are able to protect our strategic assets to maintain national security.
   Finally, London is home to a number of international marine-sector Professional Bodies, Learned Societies, Insurance Companies, Marine Law specialists and the Headquarters of the UN's International Maritime Organisation - the 'entry cost' for foreign competitors to enter this field at such a high level is prohibitive and time consuming – the presence of the London-based marine and maritime support sector gives Britain a major competitive advantage.

2. **Investment in continued Technology Innovation** – The UK is a global leader in the development and applied use of **autonomous underwater vehicles** (such as the Autosub family from NOC http://noc.ac.uk/research-at-sea/nmfss/nmep/autosubs) and **autonomous surface vehicles** (such as C-Enduro http://www.asvglobal.com/science-survey) for exploration, surveillance and commercial application, including developing the **legal and policy frameworks** required for safe and sustainable operations on the high seas or within exclusive economic zone. Britain's research sector and industry are developing new ways to use autonomous vehicles, learning their limitations and advantages and ensuring that operations are done in a safe and legal manner, working as required with the community to develop the tools needed. New techniques include 'swarming' control methodologies for fleets of autonomous vehicles, and the use of autonomous surface vehicles for environmental monitoring.
   To accompany this new generation of vehicles UK companies, universities and institutes are designing a range of innovative sensors, navigation tools and software products to enable the vehicles to deliver data a wide range of parameters, in support of industry, research and policy needs. For example autonomous systems will be a cost-effective

way to meet data demands for monitoring the 11 'Good environmental status' indicators under the European Marine Strategy Framework Directive – see http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm
Britain is a leader in subsea mining technology, with SMD Ltd (http://smd.co.uk/products/submerged-mining/list.htm) providing innovative machinery for the first commercial mining projects in the Bismarck Sea. Our strong community of trade bodies such as the Association of Marine Scientific Industries http://www.maritimeindustries.org/Marine-science-technology help ensure that SME-scale companies can reach markets and exhibit abroad.
Britain is ahead of competitors in demonstrating state of the art methods of decommissioning offshore hydrocarbon production infrastructure, and discovering novel uses of redundant production platforms and pipelines, e.g. see https://www.gov.uk/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines). British companies also have a very strong expertise in renewable marine energy such as http://www.tidallagoonswanseabay.com/ and http://www.tidalstream.co.uk/

3. **Understanding the role of the Ocean** in the earth/ocean/atmosphere system. The ocean plays the dominant role in the **storage and transfer of heat and carbon** insofar as they affect the climate of the planet. Improved understanding of the processes, timescales and regional/local scale variability will enable policy makers, industry and citizens to adapt to changing climate and mitigate against dangerous levels of change. If in future **geo-engineering** solutions become necessary to combat global warming, they will only be effective if we fully understand how the whole inter-linked system works on a full range of scales.
It has become clear that we must have a better understanding of the **resilience** of ocean **physical and biological systems** to **cumulative impacts** from human activities and the ability to model and predict parameters on a regional or local scale such as sea level rise at 1km scale, or downscaling global climate change to a scale that serves farmers and infrastructure planners. These are key skills that must be further developed and improved so that society is able to benefit, in particular because some of the actions that humans need to undertake are time-consuming and expensive, such as relocation of major assets such as power stations and airports.
The UK is a leader in the development of **marine spatial planning**. The Marine and Coastal Access Act (2009) http://www.legislation.gov.uk/ukpga/2009/23/contents and Marine (Scotland) Act 2010 http://www.legislation.gov.uk/asp/2010/5/contents are among the first attempts globally to manage marine activities on a large scale, and include marine licensing systems and eventually the creation of Marine Protected Areas. In England & Wales the Marine Management Organisation https://www.gov.uk/government/organisations/marine-management-organisation leads on marine spatial planning, with Marine Scotland carrying out the role in Scottish waters. The European Marine Spatial Planning Directive http://ec.europa.eu/maritimeaffairs/policy/maritime_spatial_planning/index_en.htm will require all Member States to develop similar systems to the UK – scientific underpinning is essential if these systems are to work.

Q2 How should NERC ensure that our research and innovation investments deliver the most impact?
(See meaning and broad scope of impact above; max 200 words)

- NERC needs to invest in major specialist centres, allocating Knowledge Exchange money so that it is focussed on Centres of Excellence that sit within hubs of Russell Group Universities with large associated SME Clusters.
- NERC can obtain maximum benefit by concentrating on established groupings who are building innovation-driven programmes, such as the National Oceanography Centre's world-leading work on autonomous marine systems that are going to deliver faster, cheaper and higher-resolution data to marine managers, whilst maximising the return from investment in major assets such as ships, aircraft and remote bases. Science 'pull' is key.
- Curiosity-driven science can lead to major breakthroughs and should always be funded, but applied science that meets societal need is also key. The world needs solutions to meeting growing demand for food, energy, living space, fresh water and security without destroying underpinning natural systems. Providing decision-support science requires investment in affordable data acquisition through new ways of monitoring, smart & inexpensive sensors, reliable prediction tools plus the expertise to use them, and the means to pass knowledge to the user and policy community in the UK and overseas.

Q3 Given the priorities identified in your answer to questions 1 and 2, who are key partners NERC should be working with? (max 200 words)

NERC should work with existing world-class centres of excellence, plus private industry, trade bodies, associated government departments and the network of trade bodies, Professional Bodies and Learned Societies that support the marine sector, including:

National Oceanography Centre www.noc.ac.uk and NOC Association www.noc.ac.uk/noc-association members; Ministry of Defence, Defence Science and Technology Laboratory; International Seabed Authority; Marine Industries Leadership Council, UNEP; FAO; ICES; UK Trade and Investment; Industry Technology Facilitator www.itfenergy.com; Marine Industries Liaison Group of the Marine Science Coordination Committee; Society of Maritime Industries /Association of Marine Scientific Industries; Foreign and Commonwealth Office, DEFRA, DECC, Royal Navy; POGO; US Navy, NATO, Office of Naval Research; National Science Foundation USA, National Ocean and Atmospheric Administration NOAA; UN-Oceans; UN-ABELOS; UNESCO Intergovernmental Oceanographic Commission; Met Office; Operational Oceanography community; Subsea UK; Commercial downstream services, Institute of Marine Engineering, Science and Technology www.imarest.org , Society for Underwater Technology www.sut.org ; Insurance & re-insurance sector; Marine NGOs eg Global Ocean Commission + others.

Q4 How could NERC's research and innovation investments best support innovation and growth at a regional/local scale? (max 200 words)

- NERC can work effectively with industry on a private sector–led UK seafloor mapping programme, building upon MAREMAP http://www.maremap.ac.uk/index.html . Effective use of our marine estate requires much better knowledge about the nature and resources of our oceanic territory, as money permits this will also be required for the UK's Overseas Territories – many of which are located in regions where there is some evidence of substantial marine resources that could be sustainably harvested in future, but where at present we have little certain knowledge.
- NERC can focus KE money into fewer topics but at higher intensity. Work with Innovate UK to co-fund programmes that enable NERC capital to have a powerful impact such as the NOC/DSTL/Innovate UK success story on autonomous systems. Co-leverage UK industry into the EU's Horizon 2020 programme to promote growth.

Q5 Do you have any other comments about NERC's strategic investment priorities? (max 200 words)

- Rather than pitch 'environment', focus on tangible benefits to UK such as enhanced productivity, more competitive levels of resilience to environmental change than rival economies, the ability to feed ourselves, obtain energy and defend the UK against threats, including strategic threats.
- NERC's most expensive physical asset is the state-of-the-art fleet of Royal Research Ships. These are excellent platforms for multi-role science and we need to follow-through this investment in ships that are working alongside the new generation of robots to deliver step-changes in our ability to understand the ocean and obtain sustainable resources from our marine estate.
- NERC can capitalise on the UK's competitive advantage in ocean science – it is a very expensive field for new competitors to enter, with set-up costs comparable to a space programme, yet offers significant pay back to the host country if it follows-through on the opportunities for innovation, cooperation with industry, and export of services to parties that lack in-house expertise.