

14th December 2007

**EU Consultation: Green Paper: Adaptation to Climate Change.
Response from the National Oceanography Centre, Southampton**

The National Oceanography Centre, Southampton welcomes the opportunity to respond to the EU Consultation: Green paper: Adaptation to Climate Change. The National Oceanography Centre, Southampton is a collaborative Centre owned by the Natural Environment Research Council (NERC) and the University of Southampton. Our mission is to be the national focus for oceanography in the UK with a remit to achieve scientific excellence in our own right as one of the world's top five oceanographic research institutions. NOCS delivers a diverse mission, which ranges from managing the national research vessel fleet and other major facilities, to programmes of strategic research for NERC, and academic research and education in ocean and earth sciences in support of the University's mission.

NOCS is pleased to support the response to the Green Paper, provided by the European Science Foundation (ESF) Marine Board.

The following responses complements those provided by the Natural Environment Research Council.

1. What will be the most severe impacts on Europe's natural environment, economy and society?

The following issues are likely to affect Europe's natural environment, economy and society:

- Acidification of the oceans and shallow seas;
- Impacts associated with sea level change;
- Potential ecosystem regime shifts as southern species move northwards;
- Potential for invasion of Pacific species into the Atlantic Ocean as the Arctic ice cover diminishes;
- Potential for rapid climate change relating to variability in the Meridional Overturning Circulation (MOC) of the North Atlantic. Currently, this is being investigated by the RAPID climate change programme, lead by NOCS (e.g. Cunningham, Stuart A., *et al.* (2007) [Temporal variability of the Atlantic meridional overturning circulation at 26.5°N. Science](#), 317, (5840), 935-938. and Kanzow, *et al* (2007) [Observed flow compensation associated with the MOC at 26.5°N in the Atlantic. Science](#), 317, (5840), 938-941.

2. **Which of the adverse effects of climate change identified in the Green Paper and its Annex concern you most?**

Marine Ecosystems;
Sea level rise.

Ocean acidification Although not a result of climate change per se, ocean acidification represents “the other half” of the CO₂ emissions problem and so has a common cause to climate change. To date ca. 400 billion tons of fossil fuel-derived carbon have entered the ocean as carbon dioxide diffusing in from the atmosphere; this has resulted in a decrease in ocean pH, compared with pre-industrial times. Caldeira and Wickett (2003) have calculated that a decrease in surface pH of 0.7 units will result by ca. year 2300, if fossil fuel emissions continue unabated. Long time-series data sets have already measured a decline in ocean pH and some studies have found detrimental impacts of acidification on marine organisms.

3. **Should further important impacts be added?**

Melting of Arctic Sea Ice will have a number of impacts in the Arctic Ocean and sub-polar regions which will have important implications for Europe and its economy.

- The **increase of fresh water in the North Atlantic** may alter the MOC which is a key component in maintaining a mild climate in western Europe.
- The **loss of summer sea ice cover** exposes the Arctic Ocean to wind forcing which may significantly alter the circulation within the Arctic and consequently, the transport of water, heat and salt in and out of the region. We know little of the consequences of such circulation changes and we are in effect creating an entirely new ocean.
- The opening of the Arctic is likely to result in **invasive species** entering the Atlantic from the Pacific which could have major impacts on North Atlantic marine ecosystems, which are unknown (it is at least 1 million years ago since this happened last).
- The opening of the Arctic is likely to lead to **significant human activity** in the region, such as hydrocarbon and gas hydrate exploration/extraction and an increase in fishing. These carry some short-term economic opportunities, but significant long-term risks to the fragile Arctic environment, with implications for Europe.
- The opening of trade routes between Europe and the Far East again represents an opportunity in terms of reducing travel time and fuel costs relating to traffic to and from Europe’s present and future major trading partners in the Far East (e.g. China). This could lead to important **port infrastructure and communication re-orientation of Europe** (i.e more northward-facing) with significant social and economic impacts that would benefit from horizon-scanning foresight. Any such expansion of traffic in

the Arctic, will expose an already stressed and fragile region to even greater risk of environmental damage.

Consequently the impacts of climate change in the Arctic region are likely to have major economic as well as environmental implications for Europe.

9a. How do policy priorities need to change for different sectors?

In line with the EU maritime policy, there needs to be a much greater emphasis on an integrated approach to maritime and marine affairs given the significant, though relatively poorly recognized, role of the oceans in climate change.

13. How should EU policy on public health take the impact of climate change into account?

Public health policy should recognise the number of ways in which the marine environment may be implicated.

- Ocean forecasting and coupled ocean atmosphere models are vital to improved medium and long term **weather and climate forecasting**. This will enable better prediction of extreme weather events including heat waves, as occurred in Europe in August 2003, for example, (already known to have had a significant public health impact). This will become increasingly important to provide advanced warning for public health care services.
- There is the potential that changing sea temperatures and water stratification together with invasive species might lead to more or different kinds of toxic algal blooms, with implications for public health (e.g. through shellfish poisoning).

23. Do the listed research areas address the most important knowledge gaps?

Generally, the roles of the oceans and the marine environment in driving and responding to climate change impacts are not well recognised. Research themes should ensure that there is full recognition and consideration given to marine processes and impacts.

24. Which are the five most important research areas that need to be addressed as a matter of priority?

In addition to the responses detailed by NERC under section 24, NOCS adds the following:

- In the context of point 23, improved ability to include ocean processes in climate models for improved prediction at regional space scales on time scales of years to decades.
- Understanding the impacts of climate change and ocean acidification on marine ecosystems and their ability, therefore, to deliver vital ecosystem services.

- Understanding the consequences of changes in ocean circulation, climate and ecosystems consequent on the loss of summer sea ice cover in the Arctic.
- Rapid climate change relating to the variability in the MOC.
- Long-term monitoring of the state of the oceans (given that much better knowledge decadal-scale variability) is at the heart of both the science and policy measures relating to adaptation.
- Obtaining greater certainty (e.g. through sea-level instrumentation, satellite altimetry and paleo-climate studies) on the bounds and rates of sea level rise in the 21st century.

There needs to be a much more effective way (e.g. through arrangements under consideration as part of the EU maritime policy) to ensure that the marine dimension to climate change and its impacts receives sufficient attention and visibility, given the relatively low recognition of the oceans in the climate system and in relation to many significant societal impacts. One mechanism could involve a more clearly articulated marine research strategy for Europe and more effective coordination of networks of marine science and policy expertise.

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