EMRP Call 2010 – Industry & Environment

Topic number: SRT-08e

Title: Metrology for oceanic biodiversity monitoring as a climate change indicator

Abstract

Atmospheric concentrations of greenhouse gases are increasing, resulting in increased global temperatures. Questions remain as to the timing/severity of the warming, regional impacts and extent of feedback processes. Climate change affects biodiversity directly and tools are emerging for monitoring biodiversity to answer climate questions using microbial ecosystems as climate biosensors. Given the links between climate and biodiversity there is a need to develop a metrology infrastructure for climate change that includes biodiversity measurements. The EU Biodiversity Action Plan lists as a priority objective "Improving knowledge base by establishing common data standards and quality assurance procedures to enable interoperability of key national biodiversity databases". This Topic aims to support such strategies by developing a metrology infrastructure for measuring microbial biodiversity in oceans as ongoing indicators of climate change. This will link to wider climate metrology activities on oceanic parameters such as acidity, salinity and temperature.

Conformity with the Work Programme

This topic conforms to the grand multidiscipline metrology challenge of "environment" which identifies the requirement for detecting change and monitoring climate. This topic relates to the development of a metrology capability for monitoring climate change with a particular focus on biodiversity monitoring as a subtle climate change biosensor.

Keywords

Climate change, Biodiversity, Oceans, Ecosystems, Microbes

Background to the Metrological Challenges

At the present time, most scientists agree that the atmospheric concentrations of greenhouse gases are increasing, and this will increase the average global temperature. However, questions remain as to the timing and severity of the warming, its regional impacts, and the magnitude of feedback processes. Novel and emerging tools for monitoring microbial ecosystems and biodiversity may help to answer many of these questions. Biodiversity and climate change are closely linked. Climate change induced by increased greenhouse gas emissions has and will continue to affect biodiversity either directly or in combination with other drivers of change. According to the Millennium Ecosystem Assessment, climate change is likely to become the dominant direct driver of biodiversity loss by the end of the century.

The Convention on Biological Diversity (CBD) states that ocean acidification from CO_2 emissions is causing substantial irreversible damage to ocean ecosystems. A study undertaken in collaboration with the UNEP World Conservation Monitoring Centre (UNEP-WCMC) demonstrated that seas and oceans absorb approximately one quarter of the CO_2 emitted to the atmosphere from the burning of fossil fuels, deforestation and other human activities. As more CO_2 has been emitted in to the atmosphere, the oceans have absorbed greater amounts at increasingly rapid rates resulting in increased acidification of the oceans. They predict that by 2050, ocean acidity could increase by 150 %. This increase is 100 times faster than any change in acidity experienced in the marine environment over the last 20 million years and gives little time for evolutionary adaptation within biological systems.

EURAMET, EMRP-MSU
National Physical Laboratory
Hampton Road, Teddington,
Middlesex, TW11 0LW, UK

Phone: +44 20 8943 6666
emrpA169@npl.co.uk
www.euramet.org

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

Given the interlinkages that exist between climate change, water pollution and biodiversity, there is an urgent need to integrate biodiversity considerations and measurements into climate change monitoring plans. To do this a metrology capability for biodiversity monitoring will need to be developed in order to generate traceable, comparable, accurate and reliable data across Europe and globally. Integrating this data with other oceanic parameters such as temperature and acidity within a climate change metrology framework will provide a fuller picture of the impact of climate change.

The EU Biodiversity Action Plan (2006) has listed ten priority objectives including:

- Conserving biodiversity in the EU marine environment
- Supporting biodiversity adaptation to climate change
- Improving our knowledge base by:
    - Enhancing research efforts on the status, trends and distribution of European habitats
    - Establishing common data standards and quality assurance procedures to enable interoperability of key European and national biodiversity databases.

Molecular biological approaches are currently being proposed and developed to help understand and monitor the impact of climate change on biodiversity. Data can then be linked to measurements from sequence collection sites, such as pH, salinity, and water temperature, enabling trends and patterns to be observed.

One further initiative, the Baltic Sea Research Programme (BONUS-169) supported by the EC (under Article 169) aims to create a cooperative, interdisciplinary, well integrated and focused transnational research programme in support of the Baltic Sea region's sustainable development. Research programmes within this include "understanding climate change" and "protecting biodiversity". The metrology infrastructure proposed here in this topic would complement and support such research activities.

Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them, in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP-protocol.

This SRT addresses novel approaches for monitoring oceanic ecosystem biodiversity (with particular emphasis on microbial biodiversity) as climate change indicators. Metrology tools and methods need to be developed to enable robust and traceable biodiversity measurements to be made within the wider climate change metrology infrastructure. Specific technological objectives shall include:

1. Development of metrology infrastructure to enable accurate and traceable determination of the identities of microbes present in an oceanic sample
2. Development of metrology infrastructure to enable accurate and traceable quantification of the relative amounts of microbes present
3. Development of metrology infrastructure to enable accurate and traceable quantification of key "stress-related" biomarkers to monitor "health" of the microbiome e.g. oxygen/nutrient starvation, pollutant toxicity, increased temperature/salinity/pH response and how this changes over time

All measurements should be linked to temperature, pH, salinity, nutrients, pollutants, inorganic particulate and element isotope ratio measurements at the collection site.

Proposers shall give priority to work that meets documented stakeholder needs and may include measures to facilitate the development of European standards and Directives.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the "end user" community. This may be through the inclusion of unfunded JRP partners or collaborators, or by

including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (eg letters of support) is encouraged.

Where a European Directive or other authoritative document is referenced in the proposal, the relevant paragraphs identifying the need for the project should be quoted and referenced. It is not sufficient to quote the entire Directive or Action Plan *per se* as the rationale for the metrology need. Proposals must also clearly link the identified need with the expected outputs from the project.

In your JRP submission please detail the impact that your proposed JRP will have on the EU Biodiversity Action Plan, and also focus on the uptake mechanisms for the research results.

You should also detail other Impacts of your proposed JRP as detailed in the document “Guidance for writing a JRP”

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of 3 years duration.

Additional information

The expectation is that any JRP funded under this topic will be smaller, in terms of funding, than average for the Call.