
A prospectus for UK marine sustained observations

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Preface



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A prospectus for UK marine sustained observations

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It takes a certain type of scientist to have the forethought and motivation to initiate a series of repeat measurements that may not show significant change throughout their lifetime. However, it is such records that we must turn to if we are to make informed decisions regarding long-acting issues such as the impact of climate change on human habitation, food supplies and ecosystem health. The UK has a strong history of such sustained observations and part of the motivation for this publication is to celebrate this fact. However, much more important is to gauge the continuing interest from the marine science community in instigating, maintaining and funding such measurements that inherently demand long-term financial and scientific commitment.

On 17 September 2013, a one-day meeting, organized by the Challenger Society for Marine Science and the UK Scientific Committee for Oceanic Research, was held at the Royal Society, London, to give the UK marine science community an opportunity to discuss sustained marine observations in an open forum. Seven early/mid-career scientists from a range of marine science backgrounds presented their perspectives on the subject with an introduction and international perspective provided by established scientists. Comments following each talk indicated high levels of scientific and applied interest in the long-term measurements being scrutinized. The meeting was followed by a panel-led discussion session where the panel members addressed questions posed by the audience.

This theme issue contains seven papers arising from the talks presented at the meeting with each paper

addressing the issues surrounding sustained observations relating to a particular branch of marine science: physical oceanography, marine biogeochemistry, ocean modelling and climate, geodesy, marine biodiversity and polar oceanography. Each paper in this theme issue contains the authors' assessments of sustained observations in their field and their vision for the future, as well as their personal view of the major scientific discoveries made using long-term measurements of the ocean. The meeting organizers felt strongly that the speaker line up should include key users of sustained observations, specifically, ocean and climate modellers and marine policy-makers. Developing marine and climate models requires a similar longevity of commitment and funding to sustained observing systems. The importance of sustained observations for drafting marine policy was highlighted by the stages that scientists go through to develop policy indicators (variables) that are easy to understand, can be accurately measured and are ultimately used to provide evidence to help manage our seas.

Despite the variety of scientific disciplines represented in this special issue, four broad themes emerged: changes in technology, ensuring data quality and availability, recognizing variability and challenges in securing funding. These themes are discussed in further detail below.

Sustained marine observations have historically consisted of time series from a single point (such as a mooring, tide gauge or biological sampling site) or a repeat transect (such as a line of hydrographic sampling stations or a Continuous Plankton Recorder tow route). As demonstrated by this publication, technological developments mean that current references to sustained observations also include near global coverage from satellite observations, or the ever-increasing quasi-global collection of Lagrangian floats, gliders, Autonomous Underwater Vehicles, etc., whose locations we may not have control over. In particular, the Argo programme is one example of having made a dramatic difference to sustained observations of physical (and increasingly biogeochemical) oceanography. However, the participants overwhelmingly felt that traditional sampling methods, upon which current long-term time series depend, such as tide gauges or ship-based marine science, remain key to progressing our understanding of ocean processes. Indeed, they are integral to underpinning and ground-truthing new technologies, as well as providing data to an accuracy that new technologies may not yet be able to achieve.

The second theme concerned the need for good quality datasets with continuity of methods, calibrations and coverage. Irregularity or gaps in time series can severely increase the length of monitoring that is required to detect a statistically robust change in the marine system. Particularly problematic are gaps or lack of sufficient overlap in data that can arise when instruments are replaced or new technology or protocols are applied. Networks of monitoring systems, both national and international, are highlighted in the papers that follow. These are most effective when they have suitable quality control systems in place and are collected using consistent standards. Ensuring good-quality data are made available in a timely manner is essential to keeping the benefits of a particular observing system alive, as this provides an incentive to use the data and proof of use can only help the case for further funding. This is particularly true if the data can be applied to policy and ecosystem management. Similarly, contributing data from a sustained observation programme to a large-scale international dataset makes data accessible to a much wider audience. However, near real-time global data access means that data may be used by anyone, not only those that fund or facilitate the observations. Thus, it becomes necessary to take a community or global perspective when considering the value of investing in sustained observations.

Most of the scientific highlights discussed are directly or indirectly related to climate change. In order to detect climate changes against a background of natural variability, multi-decadal sustained observations are required. Separating variability in a system from the climate change trend is essential in order to understand changes in marine systems and forecast potential future scenarios. The high temporal or spatial resolution of data from sustained observations, coupled with their methodological consistency, makes them particularly suited to comparison with the numerical models used to make future projections. Projections of the state of the

oceans are highly desirable from an ecosystem management point of view as adaptation and mitigation programmes have long lead-in times, particularly those with complex socio-economic interactions

Funding for sustained observations is inherently fragile and several funding models were discussed during the meeting, ranging from 5 year government grants to industrial partnerships to sponsorship from various sources. International partnerships are an excellent way to add value to funding for a long-term observation programme. On the one hand, there is a perception that funding is sometimes made available for long-term 'monitoring' efforts because of inertia. On the other hand, there is a perception that sustained observations are always down-weighted in preference to 'exciting new science'. Both of these arguments fail to recognize that sustained observations are not always simply monitoring, they should be hypothesis-driven programmes that produce some of the most exciting science of modern times. Sustained field programmes also provide platforms for novel, high-risk or opportunistic endeavours that, together, contribute more than the sum of their parts. A balance needs to be achieved. Worryingly, there is a concern that there is not currently enough funding to allow scientists to make use of data being created by existing sustained observing systems. This concern should be taken seriously to ensure the scientists involved with the observation programmes feel valued and are rewarded when others make use of their observations. In addition, the funders of such programmes need to feel they are getting value for money and should take pride in the international success of the sustained observation programmes they support.

The Challenger Society for Marine Science hopes that this open forum for providers and users of long-term observations of the marine environment has celebrated the triumphs of the UK's history and application of sustained observations as well as articulated the risks facing the future continuation of UK marine time series.