

The newsletter of Oceans 2025

2025

Welcome

Issue 8 features some of the outstanding achievements of Oceans 2025 scientists and engineers, using innovative technologies to address the research challenges of the marine environment. The first sea trials of Autosub Long Range have been completed by the NOC team in the North Atlantic; the new SAMS AUV has been used to investigate how the changing temperature of the West Spitsbergen Current may impact the climate of the Arctic Ocean; and PML

researchers are developing satellite-based models to predict the occurrence of harmful algal blooms. Such partnerships of science and technology are crucial to understanding the ocean and exploiting its resources in a sustainable way. They build on a long tradition of success: congratulations to the Continuous Plankton Recorder survey, which this year celebrates its 80th birthday!

Phil Williamson
Oceans 2025 Science
Coordinator

Next generation marine research

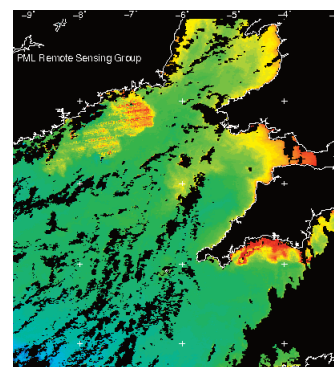
PML's Claire Widdicombe examined water samples collected from the Western Channel Observatory, off Plymouth, and confirmed the bloom was harmless. Claire explained: "We would normally expect the spring bloom to be several weeks later than this. *Skeletonema* all but disappeared from Plymouth Sound for many years, and its early appearance this year is therefore all the more unusual. The warm, sunny conditions in early March were almost certainly responsible."

Information on the timing and composition of blooms, directly-measured physical conditions, and data detected from space (by multispectral, hyperspectral and reflectance analyses) will together show how life in the ocean is being affected by climate change. Through Oceans 2025 support, PML has developed algorithms to distinguish different taxonomic groups in satellite imagery. Through support by the EU AquaMar project (www.aquamar-fp7.eu) this work is now being taken forward with a focus on harmful algal blooms – species that might pose a risk to fish, shellfish and humans.

Algae bloom early – but not harmful

Kelvin Boot, PML

This year spring came early to the Celtic Sea, with widespread algal blooms off Ireland, Cornwall and Devon. Satellite images showed very high chlorophyll abundance by mid-March, particularly in coastal areas. Such data are being used by PML to improve the predictability of phytoplankton bloom development, with emphasis on toxic species that can harm fisheries and (through shellfish) may also affect human health. In this case, direct sampling showed that the bloom posed no threat, comprising the filamentous diatom *Skeletonema*.



Satellite images of algal blooms in the Celtic Sea. Left, visible spectrum; right, chlorophyll a. PML

Oceans 2025 End of Programme event
A one day meeting is planned for Tuesday 13 December 2011 at the Institute of Physics in London - full details will be posted onto the Oceans 2025 website shortly.

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Oceans 2025 news and events

Ocean currents and the climate of the Arctic Ocean *Tim Boyd, SAMS*

The West Spitsbergen Current (WSC) carries relatively warm water of North Atlantic origin into the Arctic Ocean through the Fram Strait, the only deepwater connection between the high Arctic and the global ocean. SAMS researchers are interested in how the heat (around 50 TW) carried by this important – yet variable – current is transferred to Arctic Ocean water, sea-ice, and the atmosphere. Changes in heat transport by the WSC could dramatically affect the climate of the Arctic Ocean, with potential for wider feedbacks.

Aboard the RRS *James Clark Ross*, the SAMS team used a range of tools to characterise and quantify the heat loss from the WSC. These technologies included the REMUS autonomous underwater vehicle (AUV), a positively buoyant, propeller-driven robot that moves

along a pre-programmed subsurface path to measure the horizontal variations of ocean properties. The AUV was specifically designed to measure the amount of turbulent mixing in the ocean, to a maximum depth of 600 metres, for durations of up to 10 hours and distances of around 70 km, so was well-suited to the objectives of the final leg of cruise JR219.

The team focused on the amount of mixing in and around the inshore branch of the WSC, which hugs the edge of the continental shelf on the northwest corner of Spitsbergen (Svalbard), where they also deployed a mooring. Despite weather conditions that drove the team north of Spitsbergen and away from the primary sampling targets, AUV missions were run successfully at four open water locations over the western slope and northern shelf.



REMUS AUV. Photo: Laila Sadler, SAMS.

The Autosub Long Range AUV completes its first sea trials

Steve McPhail, NOC



Autosub Long Range, after its successful trials. Top panel removed, to show the two main pressure spheres (forward – battery, aft – control system, ADCP). Members of the onboard engineering team: Alex Phillips, Maaten Furlong, Miles Pebody, Steve McPhail, Peter Stevenson, James Perrett, Mario Brito and Leo Steenson.

Hosted by RRS *Discovery*, Autosub Long Range, has successfully completed its first set of sea trials in the deep Atlantic Ocean, around 500 km south-west of the Canary Islands.

Autosub Long Range is the latest in the Autosub series of AUVs. By travelling slowly (0.4 ms⁻¹) and keeping a tight rein on the power available to its sensors, it will be capable of missions up to 6 months duration and a range of up to 6,000 km. It can dive to 6,000 m depth. It will also have the capability of powering down and hibernating while anchored to the seafloor, waking up periodically or when it senses an interesting event. These developments open up a wide range of exciting science mission opportunities, from long transects across ocean basins to very detailed and long term studies in a small area.

The sea trials on *Discovery* in January were the first time that Autosub LR has been operated in the ocean. The objectives of the trials were to confirm that Autosub LR could dive from the surface, control its heading and pitch accurately, and communicate with its operators at the sea surface (through radio links to anywhere in the world, using an Iridium satellite modem). The trials were a success in all of these respects: Autosub LR flew straight and level, with deviation in depth of only a few cm, and heading and pitch controlled to within 0.5 degrees. The Autosub engineering team, led by Steve McPhail, also obtained very useful data on the vehicle's hydrodynamic drag and control properties.



Autosub LR lowered into the water for its first deployment in the Atlantic Ocean.

Iconic scientific achievements remembered.....

CPR Survey celebrates!

This year marks the 80th year of the Continuous Plankton Recorder survey. To celebrate, SAHFOS is organizing an international symposium “Plankton 2011 Biodiversity and Global Change” to be held on 22 and 23 September 2011 at Plymouth.



Photo: SAHFOS

Further details:
www.plankton2011.org

Robert Falcon Scott

A number of events are taking place in the UK to commemorate the centenary of the British Antarctic (Terra Nova) Expedition, 1910-13, led by Captain Robert Falcon Scott.

www.scott100.org/events/2011/06

Oceans 2025 news and events

Undersea Gliders: ready to revolutionise ocean observation *Toby Sherwin, SAMS*

In January a SOFI workshop held at SAMS and convened by Toby Sherwin (SAMS), Karen Heywood (UEA) and Gwyn Griffiths (NOC) focussed on the role and management of gliders in the UK. Undersea gliders, remotely piloted from land, are making major advances in tackling an historic gross under-sampling in space and time of the ocean and coastal waters.

Gliders have replaced moorings at the eastern end of the 26°N RAPID Watch array and occupied the Ellett Line across the Rockall Trough in winter. Gliders have also been used to study a phytoplankton bloom in the Ross Sea ice retreat; upwelling on the Iberian margin; deep convection in the Mediterranean; and turbulence in the Irish Sea. In the Mediterranean, a fleet of gliders now provide real time data for assimilation in a regional forecast model. These missions share the characteristic of maintaining persistent and mobile high frequency real-time 3D sampling in challenging environments – difficult to achieve with ships, satellites or moorings alone.

Gliders have the potential to enhance many other areas of research. For example, monitoring of marine mammals; the inclusion of sensors for pH, pCO₂ and phosphate; and the detection of zooplankton abundance. The workshop gave an insight into the possible paradigm shifts in our understanding of ocean processes that gliders can offer.



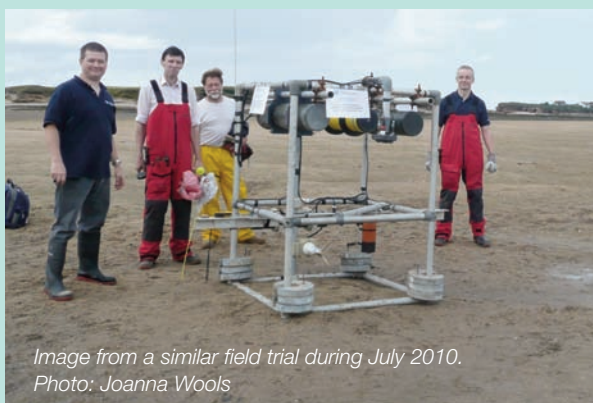
*SAMS Seaglider
Photo: Sean Rathbone*

In Europe, formal collaborations between institutions with gliders already exist and these links are being developed in an EU project (GROOM) to help integrate glider

fleets into the global ocean observing system. Delegates discussed ways to establish a coordinated UK national framework that will avoid fragmentation or duplication of effort, and encourage as many scientists as possible to take advantage of this important new platform.

ADVP completes strong spring tide evaluation *Richard Cooke, NOC*

Developed at the NOC in Liverpool by Dr Richard Cooke, the Acoustic Doppler Velocity Profiler (ADVP), successfully completed another field evaluation in January 2011. The instrument was designed to take 3-axis, 1 cm resolution suspended sediment velocity profiles for a 1 m water column above the sea bed. It was deployed on the West Kirby sand flats in the River Dee estuary for a 48 hour period, with timing chosen to coincide with large spring tides. The aim was to evaluate ADVP performance against commercial reference instruments, under the more realistic and energetic field conditions associated with large tides and relatively rapid water flows.



*Image from a similar field trial during July 2010.
Photo: Joanna Woolls*

Analysis of instrument data post-field trial using MatLab scripts developed for the ADVP by Dr Paul Bell, showed that ADVP had performed extremely well, much to the delight of all. Correlation with a commercial ADV instrument was typically between 80 - 94%; however, only the ADVP is capable of giving the fine resolution data, and operating autonomously off battery power for up to 30 days.

The intention now is to deploy the ADVP as part of sediment transport monitoring experiments in the same area as the field trial, during second half of 2011 and maybe beyond.

Marine science students examine seabed 'holes' in western Scotland

John Howe, SAMS

The Firth of Lorn near Oban is noted for its rugged coastline and diversity of marine life. As a result of a recent multibeam survey, its underwater landscape has also been revealed, comprising numerous seabed craters and depressions. Students aboard SAMS' RV *Calanus* investigated these newly discovered seabed features, pockmark depressions that are about 100 m in diameter and 12 m deep. The pockmarks may be created by gas and or water seepage through the seabed – affecting the stability of marine structures, and therefore of significance to the marine renewables industry.

The students are studying a marine science degree offered by the newly accredited University of the Highlands and Islands and delivered by SAMS from its new state of the art facility.

Oceans 2025 funding enabled SAMS to acquire multibeam sonar surveying equipment for *Calanus*, making such

discoveries as the pockmarks possible. A remotely-operated video camera recorded benthic fauna, and gravity sediment cores of pockmark and non-pockmark sediment were analysed. Results showed a more diverse profusion of marine organisms including prawns, sea pens, fish, crabs and anemones within the pockmark. There were also tracks, trails and burrows indicating a complex community inside and around the pockmark.

Seabed sediment samples from inside and outside the pockmark were a uniform olive-grey colour and of similar composition. However, a key variation between sample sites was the presence of monosulphide, evident from both a distinctive smell but also as tiny gas pockets in the top metre of sample taken from within the pockmark, perhaps an indication of gas seepage or indeed greater biological activity and hence deposition of organic debris. This work featured on the BBC2 'Men of Rock' TV series, presented by Iain Stewart and broadcast in February 2011.

Stakeholder engagement through professional courses at SAMS

Keith Davidson, John Day, SAMS



SAMS engagement with stakeholders has been enhanced over the past six months through development and delivery of Continuous Professional Development (CPD) courses in algal cultivation, harmful phytoplankton, and the conservation of biological resources. The courses have been targeted at the emerging aquaculture and algal

biotechnology sectors with attendees coming from both academic and commercial organisations. In addition to the UK, delegates have come from Belgium, Denmark, France, Germany, the Netherlands, Hungary, Ireland, Israel, Italy, Mexico, Norway, South Korea, Spain and the USA, reflecting the global importance of these areas of science underpinned by Oceans 2025.



Oceans 2025 news and events

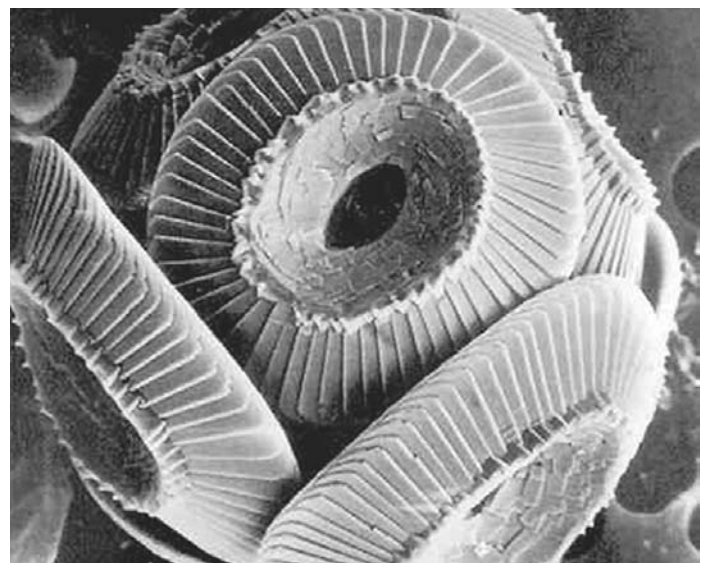
Proton channels – pinpointing a novel pH-sensitive mechanism in coccolithophores Guy Baker, MBA

Recent discoveries from an MBA-led team, in collaboration with PML and the University of Wilmington USA have necessitated a re-think about how coccolithophores may respond to ocean acidification. Globally-distributed coccolithophores play an important role in marine geochemical cycling. They produce calcium carbonate-based scales, called coccoliths; when cells die, the scales sink to the ocean floor and may provide ballast for the removal of organic carbon from surface waters.

Coccolithophores produce coccoliths in an intracellular compartment and they are then secreted to the surface. This process relies on HCO_3^- and may potentially release an amount of H^+ inside the cell equivalent to the total calcium carbonate that is precipitated. In a paper soon to appear in the prestigious journal *PLoS Biology*, Alison Taylor and colleagues describe the discovery of ion channels in the cell membrane of *Coccolithus pelagicus* that allow H^+ to diffuse out of the cell, potentially providing a pathway for dissipation of excess calcification-derived H^+ . The amount of H^+ produced by calcification would cause rapid acidification of the cell if not removed quickly; whilst photosynthesis might remove some calcification-derived H^+ , it is more likely that cells prefer to lose H^+ . Analysis of intracellular pH has shown that

H^+ -permeable ion channels can remove all calcification-derived H^+ from the cell.

Rising levels of atmospheric CO_2 are leading to an increase in the acidity of the surface waters of the ocean. This may have implications for the wide range of eukaryotic species now known to use H^+ channels to facilitate a calcification process that is dependent upon pH.



A single cell of Coccolithus pelagicus covered with calcium carbonate (chalk) scales. Progress in understanding the unique physiology of these globally important organisms will help us to understand how they may respond to changing ocean chemistry.
Image: Plymouth Algal Culture Collection

Anthropogenic climate change in satellite records NOC

Stephanie Henson and co-workers at NOC in Southampton have investigated whether climate change signals were detectable in current records of satellite chlorophyll, now 13 years long. They discovered that we will actually need as much as 40 years of continuous data to detect the effects of climate change on phytoplankton. This is because the natural year-to-year variability is so large that it masks any global warming-driven trend. Stephanie's research paper won her the Early Career Researcher Award at the Science and Technology Symposium in April. www.noc.ac.uk/f/news/downloads/2011/Henson_etal_2010.pdf

Policy updates

Understanding grey seal ecology using photos *Paddy Pomeroy, SMRU*

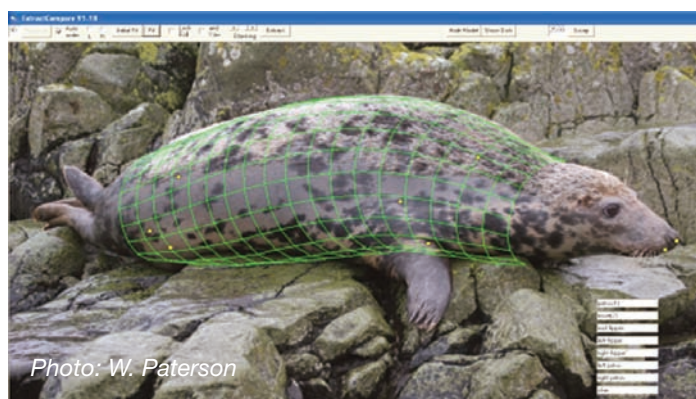


Fig 1. A visual grid is draped over a photograph of the seal, fixed at key points, to allow 2D pattern extraction from a 3D distorted image.

Adult female grey seals typically have unique and stable patterns on their fur which allow them to be identified. Paddy Pomeroy's team at SMRU in St Andrews are using a novel pattern extraction and comparison programme specially developed by Lex Hiby of Conservation Research, Cambridge to examine life history and movements of UK grey seals. Funded by Oceans 2025, a NERC KE award and the Esmée Fairburn Foundation, the work involved taking photographs of seals from up to 200m away, thus avoiding the need to handle all catalogued animals. Images from 1996 to present are providing resighting information from a number of key seal sites. Many thousands of photos have been processed to provide

Scotland's marine atlas *Steve Hall, NMCO*

The European Marine Strategy Framework Directive is a major driving force behind the rapidly evolving world of marine spatial planning. The UK has introduced the Marine and Coastal Access Act 2009 (for England, Wales and Northern Ireland) and the Marine (Scotland) Act 2010. Now European Member States need to produce an initial assessment of the condition of their surrounding seas by July 2012. The publication of

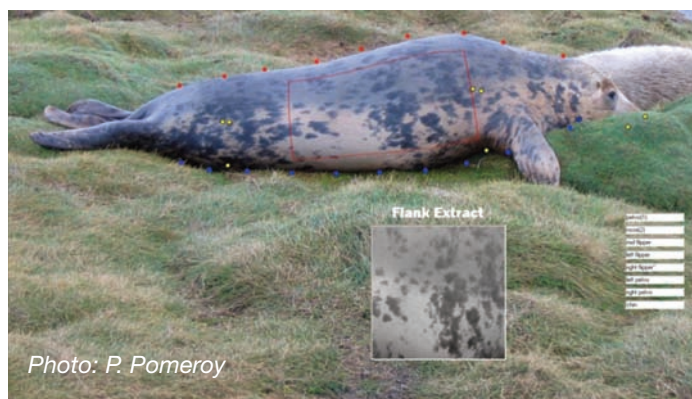


Fig 2. The pattern is extracted from the right flank. Up to 6 extracts can be obtained for a single seal (neck L/R, flank L/R, abdomen, chest).

the data required and although there are still plenty of images to do, analysis is producing tantalising results.

SMRU's aerial surveys show that pup production at North Rona in the Outer Hebrides has been declining over recent years, but has, if anything, increased on the UK's east coast, particularly at Fast Castle near the Isle of May. Early results from the resighting data indicate that adult survival appears to be lower at North Rona. The ability to identify individuals over their adult lives (females may live to 35+) should also allow the team to identify temporary or permanent movements between breeding sites, helping to explain colony dynamics.

'Charting Progress 2' and 'Scotland's Marine Atlas' address many of the initial assessment questions.

Scotland's Marine Atlas, published in March 2011, is available at:

www.scotland.gov.uk/Publications/2011/03/16182005/21

Marine policy update *Steve Hall, NMCO*

In March the Government published the first UK Marine Policy Statement, which provides the framework for preparing marine plans, ensuring consistency across the UK, and direction for marine licensing. It identifies the environmental, social and economic considerations that need to be taken into account in marine planning and provides guidance about the pressures and impacts which decision makers need to consider when planning for, and permitting development in, the UK marine area. www.defra.gov.uk/environment/marine/protect/planning

The UK National Ecosystem Assessment, just published, is the first analysis of the UK's natural environment in terms of the benefits it provides to society and continuing economic prosperity. Coastal and marine issues are covered on p 75-78 of the Synthesis of Key Findings and Chapters 11 and 12 of the full UK NEA report. <http://uknea.unep-wcmc.org/>

The Marine Science Coordination Committee met in March to assess its first year of operations, including the analysis of a decision support system for the funding of sustained marine observations, development of a communications strategy,

formation of a Marine Industrial Liaison Group, and 'science alignment' between public funding agencies.

Other news

New Chair for the Marine Management Organisation (MMO)

Sir William Callaghan has been appointed Chair of the MMO, the body responsible for managing England's marine resources. The MMO carries out a wide range of activities including marine planning, licensing, work related to conservation and fisheries management.

Closer links between Marine and Maritime

There is an emerging focus within the European Union to encourage better cooperation between the marine and 'maritime' (shipping, ports etc.) research communities as part of the move towards a European "marine research infrastructure". Future funding is likely to favour proposals which bring together the two sectors.

http://ec.europa.eu/research/mmrs/index_en.htm
see article dated 18 April.

SOFI workshops and reports

Workshops recently held:

- Marine Trace Gases: PML: 18 – 19 April 2011
- Omics for marine models: SAMS: 5 – 6 April 2011
- Undersea gliders: ready to rewrite marine paradigms: SAMS: 11 – 12 January 2011 (report available online)
- Delivering and using UK Marine Ecosystem Observations: NOCS: 23 – 25 November 2010

Online copies: http://www.oceans2025.org/SOFI_Workshops.php

Guidance for new applications:

www.oceans2025.org/PDFs/SOFI_workshop_guidance_March_2010.pdf

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A strategic marine science programme for NERC
www.oceans2025.org