Listen to the ocean

Environmental, social and economic benefits from our sea
Monitoring change
Policy relevant projections and predictions
Energy and the marine environment
Assessing the diversity of marine systems
High CO₂ and the ocean
Understanding the ocean-atmosphere interface
Modelling future oceans
Earth observation science
PLYMOUTH MARINE LABORATORY
Delivering pioneering science
Relevant for today, ready for tomorrow
We live in a rapidly changing environment with the very nature of our seas being altered, resulting in many challenges to the UK and wider global communities.

These range from natural and human-induced climatic changes to the general sustainability of marine ecosystem goods, services and benefits.

Plymouth Marine Laboratory (PML) has been delivering pioneering research for over 3 decades to assist in addressing these complex challenges and help secure the well-being of future generations.

Recognized for delivering world-class science and developing relevant applications PML collaborates with more than 250 academic, governmental and industrial partners from 50 countries every year. In the UK PML is a designated National Capability Delivery Partner for the Natural Environment Research Council, providing a strategic research capability in marine science.

“Listen to the ocean is the working ethos of PML. Working together in an interdisciplinary way, people with differing expertise share a passion and commitment to understanding the stories that the seas have to offer. Pioneering research aims to unravel some of the mysteries of the sea, always with a view to providing societal benefits on the global stage”.

Prof Stephen de Mora  Chief Executive
MARINE LIFE SUPPORT SYSTEMS

'We assess the rich diversity of our marine systems'
Dr Stephen Widdicombe  Head of Science

CYCLING IN THE SUNLIT OCEAN

'We undertake research for greater understanding of our Earth system'
Dr Tim Smyth  Head of Science

SEA AND SOCIETY

'We understand the values people place on the precious resources our seas provide'
Dr Melanie Austen  Head of Science

SEA FROM SPACE

'We see the big picture'
Steve Groom  Head of Science

TODAY’S MODELS, TOMORROW’S FUTURES

'We project possible futures'
Prof Icarus Allen  Head of Science

Prof Manuel Barange  Deputy Chief Executive and Director of Science

'Our science strategy reflects the important role of marine science in our quest for sustainable oceans. Our science is delivered through 5 key science areas; keeping PML at the forefront of the challenges and opportunities ahead.'
“If the planet had lungs they would be the ocean. If the planet had a liver or kidneys they would be the ocean. If the planet had moods they would be the moods of the ocean. It would be very easy for us to lose sight of these important functions performed for us by something that is remote for most of our everyday lives. We must not forget the ocean: whenever it rains, or the wind blows, or when we take a deep breath of fresh air we should think of the ocean. The work of the scientists at PML helps us to see the part the ocean plays in our lives, to use it sensibly and to learn how to live our own lives in a way that will give the ocean a future and, with it, give us a future.”

Prof Ian Boyd FSB FRSE
Chief Scientific Adviser, Department of Environment, Food and Rural Affairs
We assess the rich diversity of our marine systems

Biodiversity, marine ecology and molecular science

We live in a rapidly changing environment where one of the great challenges is to understand, predict and mitigate the consequences of environmental change upon climate, biogeochemical cycles and use of natural resources.

Scientists at PML are studying the biodiversity of marine systems, from the basic building blocks of life (DNA, RNA and protein) to individuals, populations and communities, to give a unique insight into the role played by biodiversity in controlling ecosystem functioning and to help predict the impacts caused by human exploitation of the marine environment.

- Benthic and pelagic experimental and observational ecology
- High CO₂ and climate change impact studies and prediction
- Long-term observations of marine biodiversity
- Experimental design and data analysis
- Marine molecular biodiversity and genomics
- Tools for quantifying and describing biodiversity
- Polar research
- Techniques to estimate the effects of human activity on ecosystem goods and services
- Organism physiology
- Habitat mapping
- Biofouling
‘PML’s research on biogeochemical cycling of material within the surface oceans is of great importance for understanding the behaviour of elements in seawater. Also, gases formed in the oceans are significant for climate and air quality after their transfer across the air-sea interface. Over recent years we have collaborated very successfully with PML in projects including ocean acidification, iron fertilisation and the measurement of novel trace gases.’

Prof Peter Liss CBE, FRS
University of East Anglia
We undertake research for greater understanding of our Earth system

Biogeochemical cycling, the oceans in climate science and ocean observation

Scientists at PML are aiming to quantify key processes in the cycling of major elements in the surface oceans and coastal seas in order to predict how marine productivity and climate feedbacks between the oceans and atmosphere might alter in a changing world. This important area of science builds upon the concept that Earth can regulate its climate through changes to the chemistry of the oceans and atmosphere.

PML’s research focuses on the coastal environment and the surface oceans in open waters and applies an interdisciplinary approach as it spans the interface of biology, chemistry and physics.

- Carbon and nutrient cycling
- Biogenic gases (dimethyl sulphide, nitrous oxide, methane, halocarbons, ammonia and oxygenated volatile organic compounds)
- Ocean acidification
- Deliberate tracers to undertake in situ experiments in shelf seas and the open oceans
- Co-ordination of large-scale international research cruises, such as the Atlantic Meridional Transect
- Future oceans - analysing the effects of change
- Marine viruses
- Maintaining the Western Channel Observatory with over 20 years of data, studying the regional effects of ecosystem variability in the context of global climate change
'Researching links between ecosystem health and human benefits is important in understanding what needs to be done to protect ecosystem functions. We are already losing ecosystems with subsequent economic impacts on local communities and nations in the world as a whole. For the last decade, PML has been at the forefront of classifying economic benefits and linking these back to ecological science so we can begin to put values on these ecosystem functions.'

Dr Linwood Pendleton  
Director of Ocean and Coastal Policy, Duke University’s Nicholas Institute for Environmental Policy Solutions
Environmental, social and economic benefits from our seas

Human development, and indeed survival, is dependent on the exploitation of environmental and ecosystem services, quantification and valuation. The application of science is essential to ensure that our continued use of the marine environment is sustainable, efficient and equitable. PML's team of socio-economists works in close proximity with its natural scientists in all core areas of science.

- Ecosystem services quantification and valuation
- Socio-economics and stakeholder analysis
- Bio-economic modelling
- Support for marine policy and marine planning
- Contributions of marine systems to global food security
- Renewable energy
- Ecosystem and human health, ecotoxicology and pollutant biogeochemistry
- Ecosystem indicators and forecasting
- Microalgal and phytoplankton form and function
- Marine bacterial culture collection
- Isolation of novel marine microbes (algae, bacteria and viruses) for applications in drug discovery, biocatalysis, healthcare and bio-energy
- Screening capability for bioactivities and isolation of natural products and enzymes
PML is playing a significant role in the development of ocean colour as an Essential Climate Variable for the Global Climate Observing System through the Climate Change Initiative of the European Space Agency. PML’s considerable expertise and experience is ideally suited for this important activity. Likewise, PML is making invaluable contributions in advancing the use of satellite remote sensing observations in support of societal applications by leading projects such as SAFARI and the Chlorophyll Global Integrated Network.

Dr Paul M. DiGiacomo
Chief, Satellite Oceanography and Climatology Division, NOAA/NESDIS Center for Satellite Applications and Research
We see the big picture

Earth observation science and applications

Earth observation is an increasingly important and cost-effective tool for investigating and observing changes in the Earth’s environment.

Earth observation is a proven tool for providing repeated large spatial scale observations of the sea surface, complementing *in situ* sampling from ships, profiling floats, moorings and other platforms. Satellites can provide measurements of a number of variables including ocean colour, temperature, height, salinity and roughness of the sea surface.

- Near real-time and archive processing of ocean colour and sea surface temperature data
- Algorithm development for understanding marine processes such as the ocean carbon cycle
- Monitoring of water quality and harmful algal blooms in lakes and seas
- Ecological indicators and long-term monitoring from Earth Observation
- Airborne optical and LIDAR data processing
- Ocean front and surface current detection
- Web based data visualisation services
- Capacity building in developing countries
'PML is rapidly advancing understanding on a range of marine science issues. The interaction between PML and the Met Office Climate and Ocean Forecasting is laying a solid foundation for developing future climate and ecosystem projections. Their work on ocean acidification is helping to inform both climate adaptation and mitigation policy.'

Dr. Jason A. Lowe
Head of Knowledge Integration and Mitigation Advice at the Met Office
We project possible futures

Providing indispensable tools to deliver policy relevant projections and predictions

A major driver for ecosystem model development is the demand for tools to support ecosystem based management initiatives, answering questions concerning climate change, carbon mitigation strategies, marine resource management and prediction of future trends.

The PML European Regional Seas Ecosystem Model (ERSEM) is a world-leading marine ecosystem model and represents a unique capacity in the UK. The ERSEM model has generated many papers, involving collaborations with over 100 organizations from the UK, Europe, North America and Australia.

- Ecosystem modelling, assessment of model performance and data assimilation
- Global coastal ocean modelling developed to model (simulate) the world’s shelf seas
- Global ocean biogeochemical modelling
- Benthic biogeochemical and ecosystem modelling
- Modelling the production and fate of climatically active marine biogases
- Understanding the impact of high CO₂: ocean acidification and climate change
- Modelling uptake of contaminants in marine systems
- Supporting operational oceanography
- Advice to government, industry and society on environmental risks of carbon dioxide capture and storage
- Statistical modelling of ecosystem dynamics
- Modelling of higher trophic level interactions
- Modelling ecosystem and socio-economic drivers of fisheries
- Estimating plankton functional types and harmful algal blooms
PML is proud to host a number of national and international project offices and services. Below are some examples.

For a full overview please visit our website www.pml.ac.uk.

**Partnership for Observation of the Global Oceans (POGO)**
This partnership is dedicated to the advancement of ocean observations in various ways, including capacity building.

www.ocean-partners.org | pogoadmin@pml.ac.uk

**Airborne Research & Survey Facility - Data Analysis Node (ARSF-DAN)**
The ARSF-DAN undertakes processing of data from the ARSF hyperspectral sensors, topographic LiDAR and medium format camera. PML operates a helpdesk for data users.

www.arsf.nerc.ac.uk | arsf-processing@pml.ac.uk

**The Natural Environment Research Council (NERC) Earth Observation Data Acquisition and Analysis Service (NEODAAS)**
NEODAAS is funded by NERC to support UK research scientists with remote sensing data and information. This service is hosted at two sites; the ‘Sea from Space’ Group at the PML site provides the data processing.

www.neodaas.ac.uk | info@neodaas.ac.uk

**PML Applications Ltd**
PML’s trading arm works with developers, manufacturers and end-users on issues related to ballast water management, biofouling, marine renewables, bubble columns (algae growth techniques) and biodiscovery.

www.pml-applications.co.uk
forinfo@pml-applications.co.uk

**Atlantic Meridional Transect (AMT)**
A multidisciplinary programme that undertakes biological, chemical and physical oceanographic research during an annual passage from the UK; travelling the length of the Atlantic Ocean.

www.amt-uk.org | forinfo@pml.ac.uk

**Western Channel Observatory**
An oceanographic time-series and marine biodiversity reference site in the Western English Channel which has demonstrated excellence in marine monitoring for over a century.

www.westernchannelobservatory.org.uk
tjsm@pml.ac.uk

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