

Changes in marine ecosystems

Ocean sustainability

PIONEERING

Living in a high CO₂ world

Energy & the environment

Socio-economic analysis

Solutions from the sea

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.

Conducting its research in association with a wide range of national and international partners, PML is recognised for delivering world-class science and developing relevant applications.

As a leading partner and key player in large national and international programmes, PML serves a range of clients including Research Councils UK, government departments and agencies, European Union, space agencies including ESA, NASA and JAXA, international agencies such as UNEP, and industry.

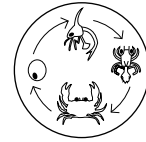
'By providing capability for observing, understanding, modelling and forecasting marine ecosystems, and focusing on their interactions with society, PML is working to achieve sustainability of the marine environment as a climate regulator, a source of food, renewable energy and livelihoods and a contributor to human well-being and prosperity.'

Professor Stephen de Mora Chief Executive

MARINE LIFE SUPPORT SYSTEMS

'We assess the health 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 Phil Nightingale Head of Science



SEA AND SOCIETY

'We understand the value of our precious resources'

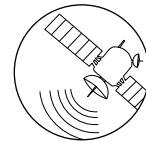
Dr Melanie Austen Head of Science



SEA FROM SPACE

'We see the big picture'

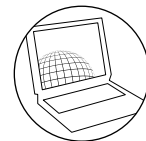
Steve Groom Head of Science



TODAY'S MODELS, TOMORROW'S FUTURES

'We project possible futures'

Dr Icarus Allen Head of Science



Dr Manuel Barange Director of Science

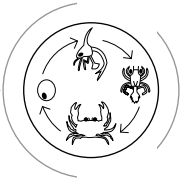
'Our science strategy, Marine Matters®, reflects the important role of marine science in our quest for sustainable oceans. Our science is delivered through 5 key science areas; keeping PML at the forefront of the challenges and opportunities ahead.'

MARINE LIFE SUPPORT SYSTEMS

'Understanding ecosystems is fundamental to UK Government policy, which aims to reach management decisions that balance social and economic uses of the marine environment with protection of species and habitats for future generations. This ecosystem based approach is immensely challenging to put into practice and PML's science will be an essential part of the expertise that policy makers will need to draw on.'

David Dawson
Director of Marine Programme, Department for Environment, Food and Rural Affairs

We assess the health 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
- Marine viruses
- Habitat mapping
- Biofouling

CYCLING IN THE SUNLIT OCEAN

'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 and Chair of the Royal Society's Global Environment Research Committee

We undertake research for greater understanding of our Earth system



Biogeochemical cycling, the oceans in climate science

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
- Mesocosm experiments - enclosed bodies of water or sediment kept under controlled experimental conditions, in the field and in a laboratory
- Co-ordination of large-scale international research cruises, such as the Atlantic Meridional Transect
- Future oceans - analysing the effects of change

SEA AND SOCIETY

'Boots considers that PML's research meets the needs of the Health and Beauty industries in many ways. PML has shown that micro-algae are a valuable source of new and effective raw materials and have identified potential scale-up processes that would allow sustainable, environmentally friendly commercialisation.'

Ed Galley
Open Innovation Advisor, Alliance Boots plc

We understand the value of our precious resources



Environmental, social and economic benefits from our seas

Human development, and indeed survival, is dependent on the exploitation of environmental and ecosystem goods and services. 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 goods and services quantification and valuation
- Socio-economics and stakeholder analysis
- Renewable energy
- Marine planning
- Marine policy
- Ecosystem indicators and forecasting
- Bio-economic modelling
- Ecosystem health, ecotoxicology and pollutant biogeochemistry
- Phytoplankton physiology
- Marine bacterial and extract culture collection
- Isolation of novel marine microbes (from 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

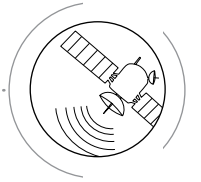


SEA FROM SPACE

'PML will play 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

As the world's population continues to grow and its impact on global ecosystems intensifies, 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, moorings and other platforms. Satellites can provide measurements of a number of variables including ocean colour, temperature, height and roughness of the sea surface.

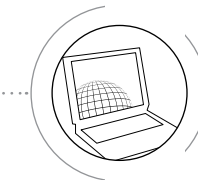
- Near real-time and archive processing of ocean colour and sea surface temperature data
- Airborne optical and LIDAR data
- Algorithm development for understanding marine processes such as the ocean carbon cycle
- Ocean front detection
- Water quality monitoring, harmful algal blooms
- Validation of ocean colour algorithms and methods
- Ecological indicators and long-term monitoring
- Web based data visualisation services
- Capacity building in developing countries

TODAY'S MODELS, TOMORROW'S FUTURES

'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 adaption and mitigation policy.'

Dr. Jason A. Lowe
Head of Mitigation Advice at the Met Office and AVOID Programme Chief Scientist

We project possible futures



Ocean observations and ecosystem models

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

PML scientists are developing coupled hydrodynamic ecosystem models combined with multidisciplinary observations of the coastal seas, such as the Western Channel, to provide real-time physical, chemical and biological measurements. Simulations of past, present and future ecosystem states are also being developed from these data.

- Ecosystem modelling
- Global monitoring of the coastal ocean
- Shelf seas modelling
- Marine biogases
- Impact of high CO₂: ocean acidification and climate change
- Operational oceanography
- Modelling uptake of contaminants
- Harmful algal blooms
- Data assimilation
- Plankton functional types
- Assessment of model performance

• 2010

• 2020

• 2030

• 2040

• 2050

• 2060

Hosted offices & services

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

Primer-E

A spin-out company from PML, Primer-E (Plymouth Routines In Multivariate Ecological Research) manages the development, distribution and support of the ecological and environmental studies software, PRIMER 6.

www.primer-e.com | admin@primer-e.com

PML Applications Ltd

Developing applications primarily from PML's marine research. PML Applications Ltd, PML's trading arm, offers consultancy, research and products across three broad sectors: Low Carbon Economy; Environmental Solutions, and Bioprospecting.

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
tjism@pml.ac.uk

For further information and latest news please visit www.pml.ac.uk

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Laboratory

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Relevant for today - ready for tomorrow

Delivering science with a deeper understanding
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