Transforming Environmental Science with the Power of AI

IMPACT

Artificial Intelligence is accelerating environmental science - helping governments, businesses and communities build a greener, more secure future whilst delivering economic benefits and increasing productivity

Delivering environmental data at unprecedented scale and detail

Using AI algorithms and state-of-the-art sensors to observe and analyse nature - from satellites to microscopes.

Benefits

- ✓ more effective compliance and monitoring
- ✓ evidence-driven nature-based solutions
- ✓ improvements in biodiversity
- ✓ more productive businesses

Anticipating environmental change and natural hazards

Using machine learning across multiple data sources to provide more accurate and timely predictions.

Benefits

- ✓ lives and money saved
- ✓ resilience increased
- ✓ environment improved

Strong Foundations

All supported by NERC / UKRI strategic investments in unique long-term datasets, skilled people and compute infrastructure.

Understanding global environmental change

Predicting hazards in the environment

Upscaling biodiversity action

Enabling more effective disaster relief

Improving flood risk modelling

Informing environmental management

More information: NERC Digital Strategy

Increasing Resilience to Earthquakes & Volcanoes

Natural Environment Research Council

Machine Learning

Machine Learning is speeding up disaster relief – helping governments and humanitarian organisations save lives and reduce suffering

Contributing to:

- UKRI Strategic Themes – Building a green future & Building a secure and resilient world
- DfT & DSIT Areas of Research Interest
- UN Sustainable Development Goals

13 CLIMATE ACTION

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

Automatic large-scale processing of satellite data enables rapid modelling of earthquakes and volcanic activity – providing actionable information within a few hours, whereas previous methods took days. The service is provided by the NERC research centre COMET using the JASMIN supercomputer.

Example outcomes:

- Enabling faster, more effective disaster relief - Türkiye-Syria (2023) & New Zealand (2020) earthquakes, Icelandic eruptions (2020, 2014/15).
- Business growth - University of Leeds spinout, SatSense (est. 2018, 13 employees) has provided the services commercially to clients including Network Rail, United Utilities and the National Highways Agency.

Forward look:

- Over 200 million people live near volcanoes, whose activity can change unexpectedly. A University of Leeds-led team is seeking to use machine learning to forecast volcanic activity more accurately using satellite data.
- A Centre for Doctoral Training (University of Cambridge-led) is developing an AI-forecasting tool for slow earthquakes.

Improving Our Understanding of Biodiversity Health

Natural Environment Research Council

Image & Sound Recognition

AI-enabled sensing technology is delivering biodiversity data at unprecedented scale and detail, saving money and enabling more effective action on biodiversity

Contributing to:

- **UKRI Strategic Themes – Building a green future & Building a secure and resilient world**
- **Defra & DfT Areas of Research Interest**
- **UN Sustainable Development Goals**

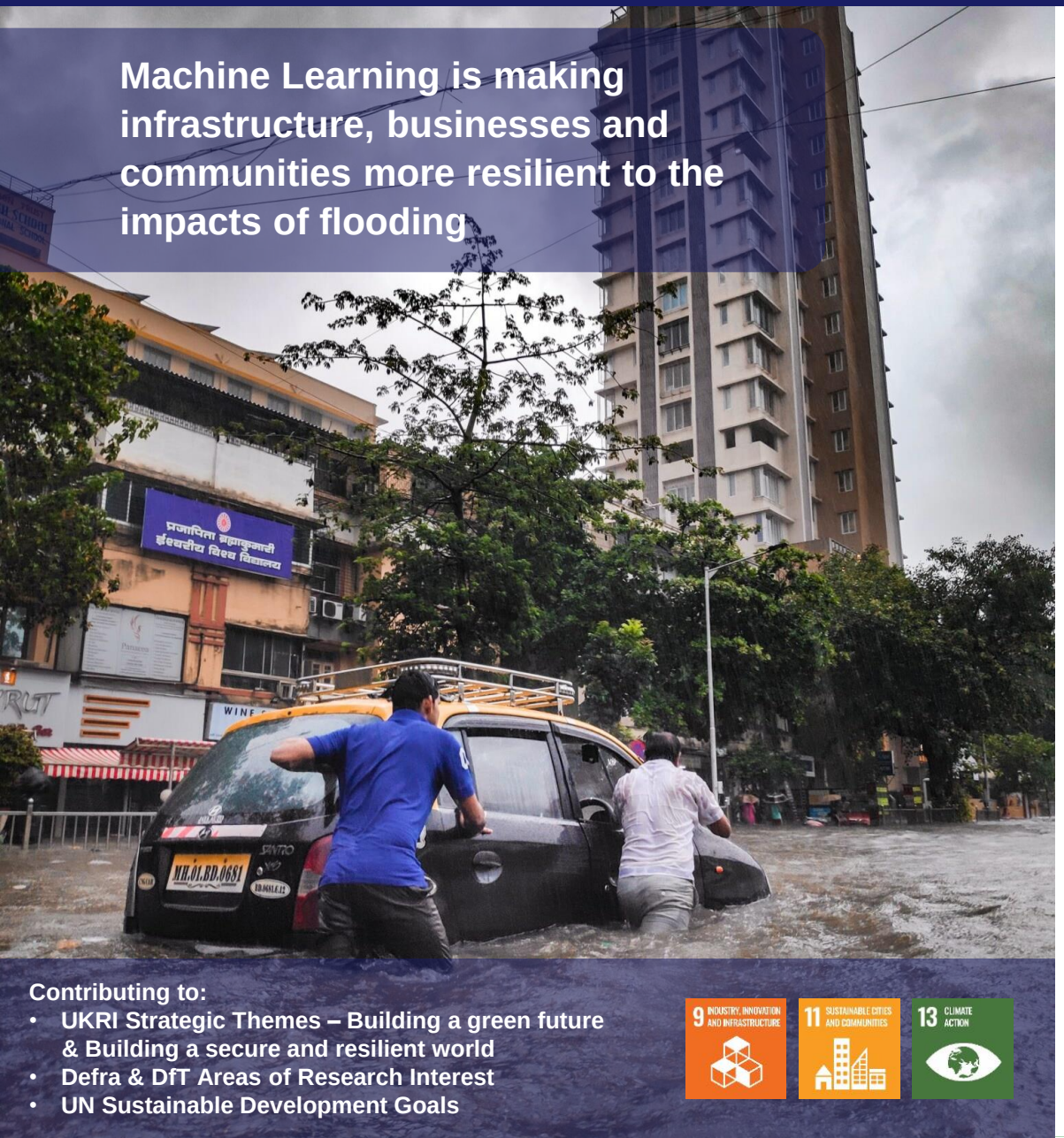
The Automated Monitoring of Insects (AMI) device is autonomous, continuous and unbiased. Developed by the UK Centre for Ecology and Hydrology (UKCEH), AMI is enabling government, businesses, communities and scientists to make better informed decisions on biodiversity.

Example outcomes:

- Measuring the impact of land management initiatives – AMI devices are measuring the biodiversity impacts of different peatland restoration and agri-environment interventions in real-time, providing detailed evidence that will inform our journey to net zero.
- Supporting biodiversity action across the world – UKCEH and the Alan Turing Institute are deploying AMI, with additional sound recognition capability, to baseline small animal populations (e.g. insects, bats, birds) in Africa, Asia and South America.
- Making trackside vegetation management cheaper and safer – with Keen AI Ltd, using similar technology to identify invasive and diseased plants from moving trains for Network Rail, one of the UK's biggest landowners. The work also provided the baseline for Network Rail's biodiversity strategy.

Reducing the Costs of Flooding

Machine Learning



Contributing to:

- UKRI Strategic Themes – Building a green future & Building a secure and resilient world
- Defra & DfT Areas of Research Interest
- UN Sustainable Development Goals

Fathom uses machine learning to fill in data gaps in its global flood and climate risk models - improving forecast accuracy, including for regions without detailed historical data.

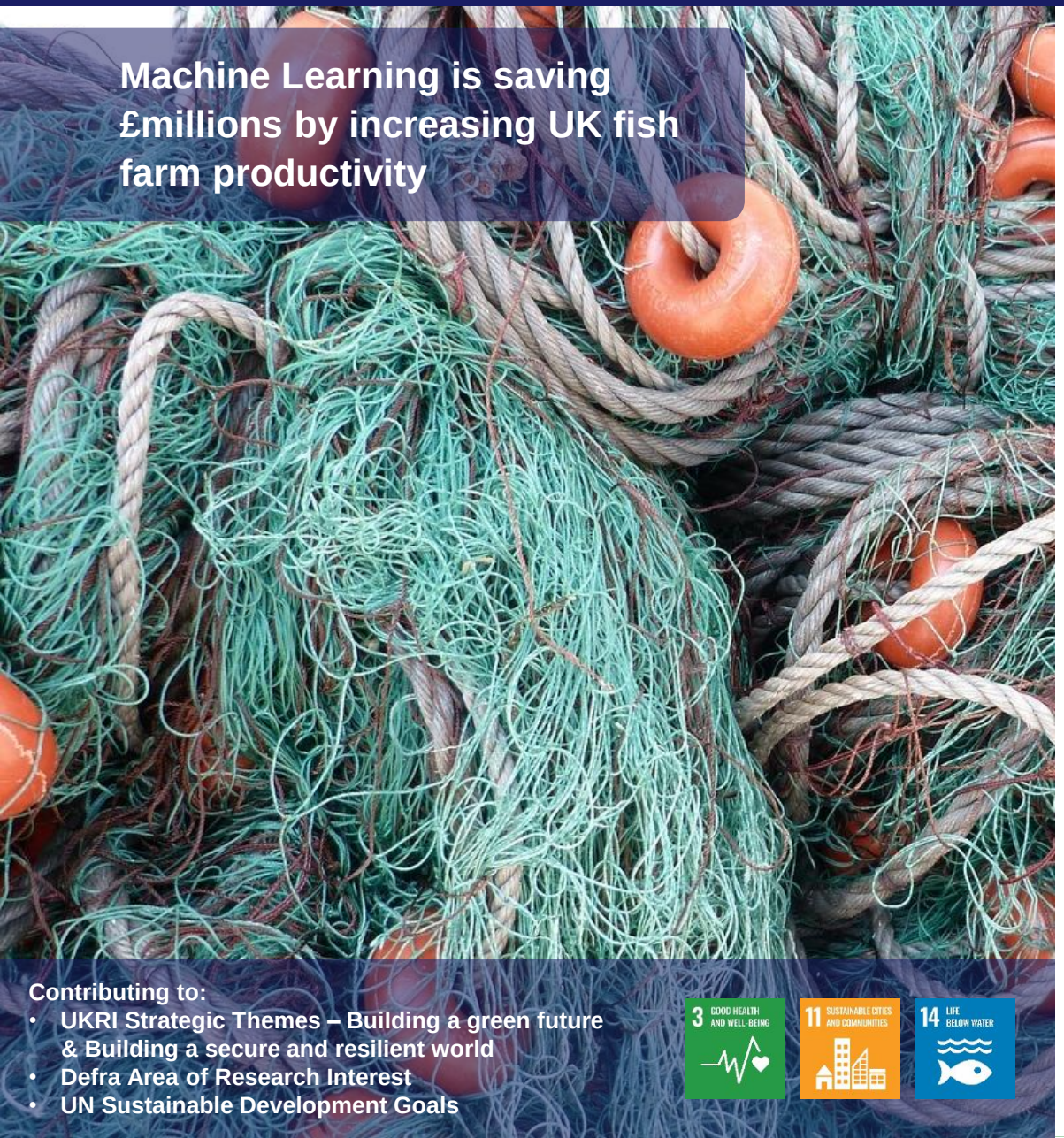
Example outcomes:

- Business growth – Fathom, a University of Bristol spinout company, now employs over 50 people, has an annual turnover of £4m, and was recently acquired by international reinsurance company Swiss Re.
- Reduced business risk – accurate flood risk mapping enables companies to more effectively plan infrastructure, price products and manage flood response. Fathom's customers include Microsoft cloud infrastructure (worth $15 Billion, used by over 400 million people) and global insurance companies who provide flood risk insurance on assets worth $1.35 Trillion.
- Support for the most vulnerable – enabling more effective disaster response and infrastructure planning in climate-vulnerable countries through partnerships with the World Bank and UK FCDO.

Supporting Coastal Economies

Natural Environment Research Council

Machine Learning



Machine Learning is saving £millions by increasing UK fish farm productivity

Contributing to:

- UKRI Strategic Themes – Building a green future & Building a secure and resilient world
- Defra Area of Research Interest
- UN Sustainable Development Goals

A system developed by Plymouth Marine Laboratory (PML) and partners analyses ocean colour data from satellites together with weather data (e.g. wind, rain, temperature) to provide earlier and more detailed Harmful Algal Bloom (HAB) alerts.

Example outcomes:

- Improved early warning system – the new system covers the entire English Channel for £37k p.a., significantly enhancing the established £2m-a-year system which covers only 6% of the channel.
- Increased productivity of the UK shellfish industry – HABs can produce toxins in shellfish fatal to humans if eaten. Accurate early warnings enable companies to suspend and restart harvesting at the right times. Historically, the South West's £7m shellfish industry has lost an estimated £2.5m annually to HAB contamination.

Forward look:

- PML is developing a digital twin for HAB monitoring, combining observation data and marine system models to produce an agile framework that will support research, policy and commercial applications.

Empowering Biodiversity Action with Data

Machine Learning

Machine Learning is delivering a step-change in the availability of biodiversity data, enabling businesses and charities to take targeted environmental action

Contributing to:

- **UKRI Strategic Themes – Building a green future & Building a secure and resilient world**
- **Defra, DfT & DSIT Areas of Research Interest**
- **UN Sustainable Development Goals**

University of East Anglia spinout company NatureMetrics is using machine learning and satellite observations to fill in gaps and uncertainties in environmental DNA data, creating realistic estimates of animal, bacteria & fungi populations and enabling tracking of biodiversity changes over time.

Example outcomes:

- Businesses, researchers and charities are using this bioinformatics tool to improve environmental management practices worldwide and to meet growing environmental regulatory and legislative requirements.
- Unilever, for example, has partnered with NatureMetrics to measure soil and insect biodiversity in supply chain farms in Argentina, Canada, the UK and Europe - supporting its move to more climate-resilient farming.

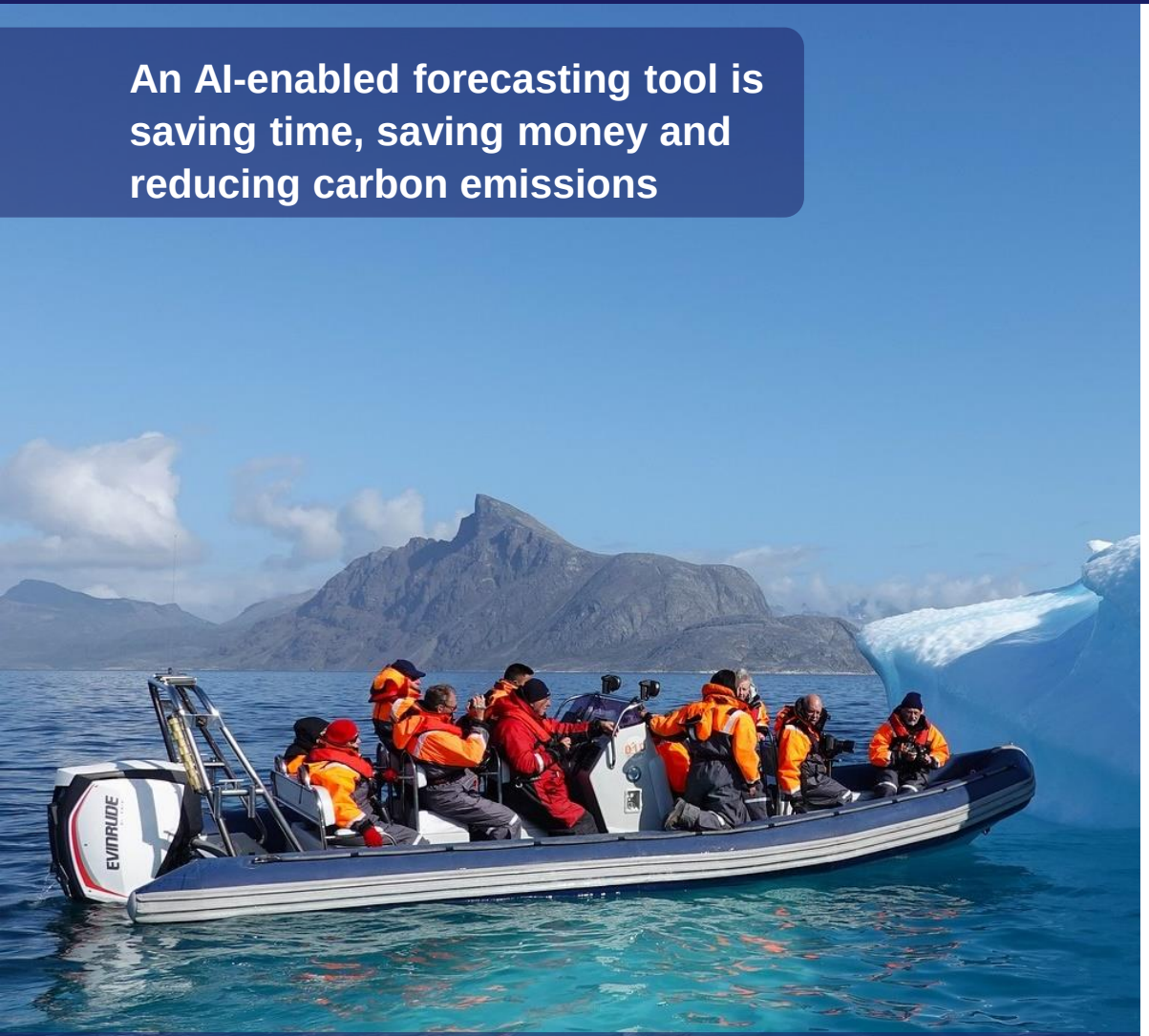
Forward look:

- NatureMetrics is working with partners to test methods to quantify biodiversity, to enable organisations to offset their environmental impact by investing in biodiversity credits governed by standards.

Safely Navigating a Changing Polar Climate

Machine Learning

An AI-enabled forecasting tool is saving time, saving money and reducing carbon emissions



Contributing to:
- UKRI Strategic Themes – Building a green future & Building a secure and resilient world
- DSIT & DfT Areas of Research Interest
- UN Sustainable Development Goals

‘IceNet’ rapidly analyses climate simulations with long-term satellite imagery to deliver forecasts of changing sea ice cover up to six months in advance. Developed by BAS and the Alan Turing Institute, IceNet is faster and more accurate than traditional models – particularly for extreme ice-loss events.

Example outcomes:

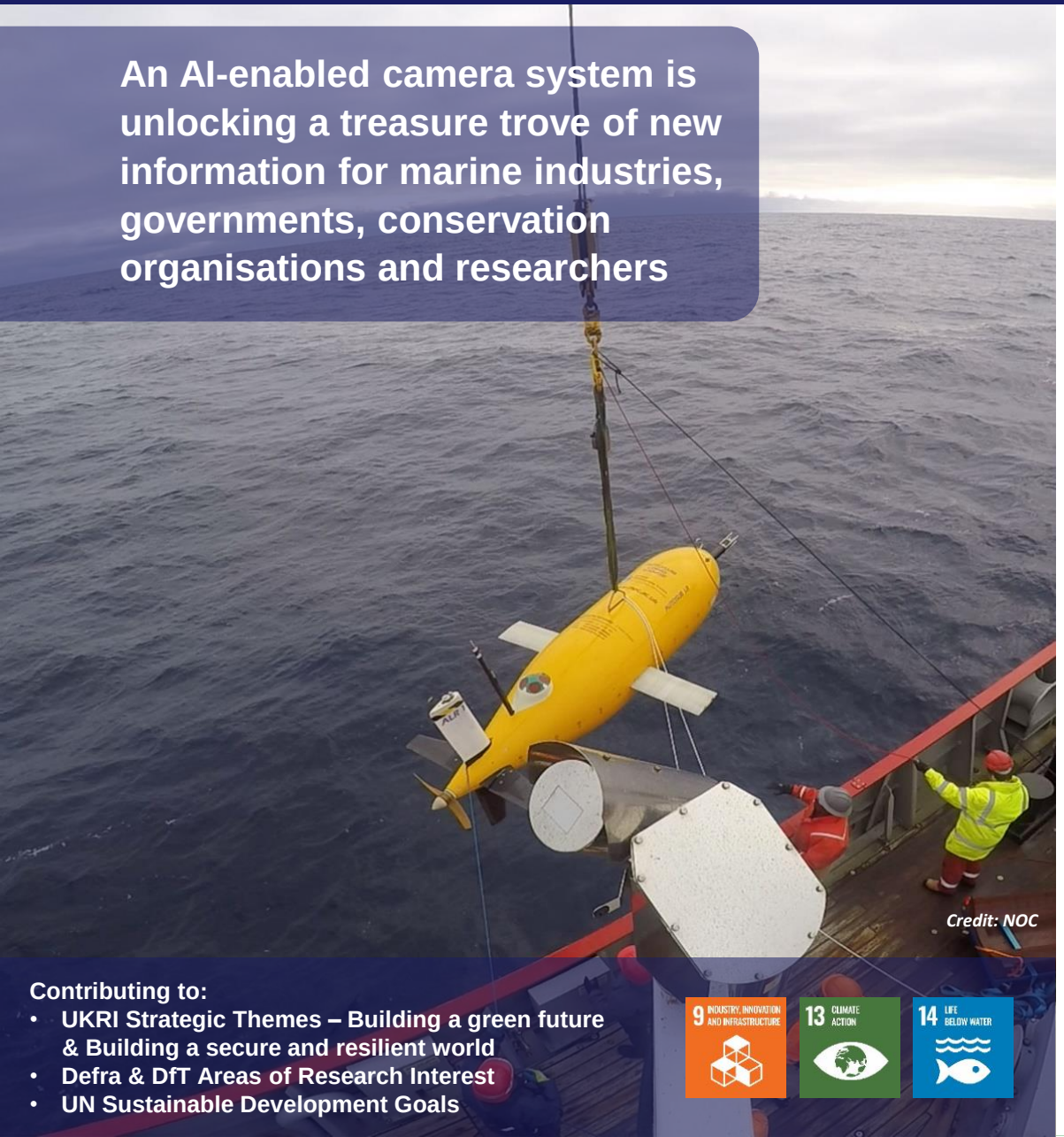
- Optimising research vessel route planning – by streamlining journey times the tool has reduced BAS’s operating costs and carbon emissions.

Forward look:

- BAS is developing a tool that will use AI and satellite data to track the changes in numbers, size and pathways of icebergs, to support safer ship navigation and research into rising sea levels.
- BAS is working with partners in Canada to use IceNet to predict when endangered caribou will migrate across sea ice, enabling authorities to warn ship operators and adapt conservation activities.

Uncovering the Hidden Depths of the Seafloor

Machine Learning



Contributing to:
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- Defra & DfT Areas of Research Interest
- UN Sustainable Development Goals

BioCam uses machine learning to produce high-detail, 3-D colour images of underwater structures. Developed by the University of Southampton, Biocam can produce detailed maps of up to 80 acres of seafloor a day: 40x faster than conventional imaging systems.

Example outcomes:

- Monitoring recovery of Scottish Marine Protected Areas – after bottom-trawler fishing was halted, in partnership with the National Oceanography Centre (NOC).
- Surveying 'end-of-life' oil rigs off the Shetland Islands – attached to the 'Boaty McBoatface' Autosub, assessing the value of preserving decommissioned structures as artificial sea-life havens.
- Commercial use – the technology has been licensed to Voyis Imaging, Canadian underwater survey specialists who work with the science, offshore energy, defence and civil infrastructure sectors.

Understanding Changing Marine Ecosystems

Image Recognition

Contributing to:
- UKRI Strategic Themes – Building a green future & Building a secure and resilient world
- Defra Area of Research Interest
- UN Sustainable Development Goals

Using automated imaging and classification technology, Plymouth Marine Laboratory (PML) is delivering almost continuous plankton monitoring - compared to past weekly sampling - enhancing the 30-year plankton dataset from the Western Channel Observatory (WCO) near Plymouth.

Example outcomes:

- International understanding of environmental change – WCO is one of the world's longest marine time series; used in international assessments to underpin climate and biodiversity action by providing a window on ocean and climate health.
- Observing short-term changes for the first time – by resolving sub-daily changes in plankton populations, the new capability delivers early warnings of threats to marine industries and ocean health, including the emergence of invasive species and Harmful Algal Blooms.

Forward look:

- PML is developing software to allow group-collaboration on classifying marine image data, as well as technology to detect invasive Pacific Oysters from drone footage and floating plastic litter from ship-mounted cameras.

Conserving Wildlife from Space

Image Recognition

Image Recognition is delivering more targeted conservation action, protecting endangered wildlife and saving money

Contributing to:
- UKRI Strategic Theme – Building a green future
- Defra Area of Research Interest
- UN Sustainable Development Goals

AI-processed satellite imagery is more accurate and wide-ranging than traditional survey methods – and more sustainable for the planet, safer for researchers and non-invasive for the animals.

Developed by the NERC British Antarctic Survey (BAS) and partners, it is now being used by governments and conservation organisations across the world.

Example outcomes:

- Conservation status of emperor penguins – more accurate population data led to status being upgraded from ‘Least Concern’ to ‘Near Threatened’.
- International conservation organisations – use this to monitor vulnerable species including albatrosses, seals and whales.
- Citizen science - BAS and WWF recruited 26,000 people to validate 500,000 satellite images of walrus populations.

Forward look:

- BAS is working with the Alan Turing Institute, Met Office and STFC to explore new ways of combining data from satellite and in-situ surface sensors to help improve our understanding of the changing polar environment.