



NERC
IMPACT
AWARDS
2023

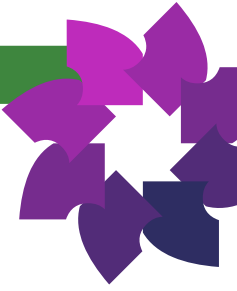
NERC Impact Awards 2023 Winners and Finalists



Natural
Environment
Research Council

Celebrating the people and environmental
science at the heart of the responsible
management of our planet.





Peter Liss

Professor Peter Liss
Interim Executive Chair
Natural Environment Research Council

Celebrating the impact of environmental science

The NERC Impact Awards shine a light on the environmental science at the heart of the responsible management of the planet, and help us to celebrate the people and ideas that are shaping our future. Research like this saves lives and prevents billions in flood damage through better weather forecasts. It propels us to make more sustainable choices and create new materials that don't harm our natural habitats. It sets us on the path to Net Zero.

Headlines celebrating scientific breakthroughs may grab our attention, but the reality is it can take a long time for research to make a difference in our everyday lives. To deliver impactful research relies on determination, innovation, collaboration and an understanding of how excellent ideas can be transformed into the solutions we need for the issues we face on a changing planet.

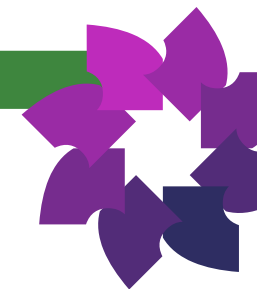
Five years ago, a team of researchers from across the South-West were named overall winners of the 2018 NERC Impact Awards in recognition of their work which has alerted the world to the effects of plastic pollution in the ocean. A combination of the research community's continued efforts, increased public awareness, and action from government and industry, is turning the tide on this global challenge. This effect demonstrates the power of individuals to use environmental science research and evidence to galvanise action and drive change for us all.

We received 42 entries this year, capturing the work of more than 200 people across a broad range of roles in the environmental science community – all supported by NERC's investment in research, innovation, infrastructure, training, public engagement and partnerships. I was impressed to see the collective effort of many teams represented in this year's entries, demonstrating the impacts that multidisciplinary collaborations can deliver for our society, economy and environment. The research of this diverse talent addresses some of today's most pressing issues, such as rapid biodiversity loss, natural disasters, climate change and the impact of the environment on human health.

I hope this year's finalists inspire you to think in new ways about how environmental science contributes to solving the challenges presented by our consumption of the planet's resources, and to consider what part you can play in helping us to develop sustainable solutions for our future.



Watch videos showcasing the impacts of all the finalists' research



About the Impact Awards

The NERC Impact Awards champion the impact of research from the NERC-funded environmental science community on our everyday lives, including our society, economy and environment.

People are at the heart of the science we fund, and the competition was designed to recognise and celebrate the wide range of people and roles in the environmental science research community who contribute to impactful research.

Entries were judged using the Research Excellence Framework (REF) impact criteria, namely the reach and significance of the impact achieved. **See pages 26 and 27** for details of the judging process and panels.

This year's Awards

In 2023, NERC is making the following awards:

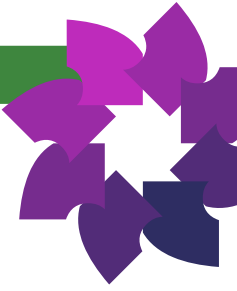
- Overall Impact Award (£20,000)
- Three impact awards (£12,000)
- One Early Career Impact Award (£12,000)
- Four finalists (£7,000)
- One Early Career finalist (£7,000)

About NERC

NERC is the leading funder of environmental science in the UK. Each year we invest public money in research, training and innovation in UK universities and research centres that deliver science that helps us sustain and benefit from our natural resources, predict and respond to natural hazards, and understand environmental change.

We work in partnership with business, government and civil society to deliver new ways of doing business, escaping poverty and growing economies, while living within Earth's limits.

NERC is part of UK Research and Innovation (UKRI), a non-departmental public body sponsored by the Department for Science, Innovation and Technology (DSIT).



Shaping England's new Biodiversity Net Gain policy

Dr Sophus zu Ermgassen's research has raised public awareness about England's Biodiversity Net Gain (BNG) policy – a strategy to develop land and contribute to the recovery of nature - and played a crucial role in shaping its design and implementation. Evidence from the research has influenced policy changes - including £8 million in increased funding by the government to local authorities – helping to ensure the necessary measures are in place to improve environmental outcomes.

The UK government plan to introduce a requirement for all new developments built under the Town and Country Planning Act to achieve a biodiversity net gain (BNG) in England.

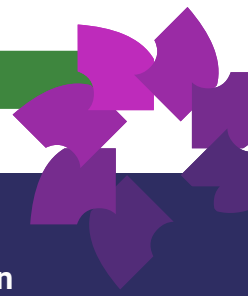
BNG aims to link new development with improvements in nature and make sure habitat for wildlife is in a better state overall than it was before development.

The new policy ties developers to demonstrating a 10% increase in biodiversity, using a standard metric. If they are unable to deliver the improvement on-site, they will be required to purchase 'off-site' biodiversity units on private land.

Dr Sophus zu Ermgassen's NERC-funded PhD and subsequent research identified the policy's potential weaknesses. His efforts have helped contribute to millions of pounds being made available to local authorities for monitoring and enforcement, and to deliver BNG across England. It provides key evidence underpinning the integrity of England's new emerging environmental markets.



Dr Sophus zu Ermgassen



Lower-than-expected demand for off-site

Before zu Ermgassen’s research, policymakers expected that developers would largely be unable to meet their BNG target within development boundaries, and would have to pay for off-site biodiversity units. This would have created a major source of private financing for nature recovery in England.

zu Ermgassen worked with six councils that were early adopters of BNG policies and found a clear mismatch between expected and real demand.

He said: “The government landowners and brokers are relying on a large demand for these off-site units to stimulate conservation activities on private land, and draw private finance into nature restoration. Defra estimated demand for off-site units would represent 25-50% of the policy.

“Our work showed that, without further policy changes, the demand for these units, and the associated revenue for strategic conservation actions, would be much smaller. Our sample showed a demand level of less than 10% in early adopter councils.”

Spotting chinks in governance

zu Ermgassen also uncovered a major governance gap at the heart of BNG policy that threatens to undermine its outcomes.

The intention is for local authorities to be ultimately responsible for monitoring and enforcement of biodiversity units within development boundaries: according to zu Ermgassen’s data, this represents over 92% of the policy.

zu Ermgassen and colleagues highlighted the capacity constraints that councils face: recent surveys suggest only 40% have the ecological expertise required to assess or monitor BNG assessments.

They also demonstrated that a failure to deliver BNG wouldn’t trigger certain thresholds for councils to be able to take enforcement action. All of this combined meant the vast majority of the policy’s outcomes would be unenforceable and the policy would not achieve its aims or contributions to national environmental targets.

zu Ermgassen and team addressed this in an open letter to the Secretaries of State for Housing and Environment and the head of Natural England. In 2022, the government stated it would be investigating the team’s recommendations further. In 2023, funding for local authorities to prepare for and implement BNG increased from £4.8 million to £16 million - in line with zu Ermgassen’s recommendations.

Raising public awareness

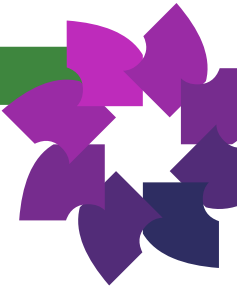
zu Ermgassen and team raised awareness about the unaddressed risks of BNG, generating media coverage in the BBC, Times and Guardian, among others. This led to the work being referenced in a House of Lords Debate, and in 2022 zu Ermgassen was named as one of the 100 most influential environmental professionals in the UK by the ENDS report for his BNG work.



Entry title:
**Shaping the design
and implementation of
England’s new Biodiversity
Net Gain policy**

Early Career entrant:
Dr Sophus zu Ermgassen,
University of Oxford





Whales and walrus from space: using satellite imagery for conservation

Dr Hannah Cubaynes from the British Antarctic Survey has developed a new way to monitor wildlife from space. The research has reduced the cost and risk of surveys and helped turn thousands of people worldwide into engaged citizen scientists - all to the benefit of wildlife including whales and walrus.

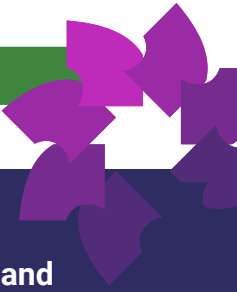
Whales and other marine mammals are difficult to monitor. Scientists need to conduct surveys to assess their abundance, density, distribution and health status. Traditionally this has been done by boat, plane or drone, or by watching them from land. These methods all have their own limitations and disadvantages.

Dr Hannah Cubaynes has developed new ways to monitor and study whales and walrus using very high-resolution (VHR) satellite imagery during her PhD and post-doctoral studies.

The impact has been felt across oceans. Her research has reduced the cost and risk of surveys and helped turn thousands of people worldwide into engaged citizen scientists - all to the benefit of whales and walrus.



Dr Hannah Cubaynes



Environmentally friendly, safe surveys

Dr Cubaynes said: "Traditional surveys, conducted to conserve the animals, can cause animals stress: walrus are known to be disturbed by boat noise, for example. Using satellite imagery to study wildlife is non-invasive and means scientists can gather essential information on sensitive species - disturbance-free.

"Using satellite data also reduces the financial cost of research in remote regions - the data is much cheaper than using a research vessel. It could also have a lower carbon cost, although whole-life calculations have yet to be made."

Importantly, Cubaynes' method eliminates the risk to humans, who can face danger when conducting manned aerial surveys.

Collaboration for conservation

Cubaynes has collaborated with government and commercial partners throughout her research. She is working through Geospatial Artificial Intelligence For Animals (GAIA), an innovation effort that includes Microsoft AI and the US Naval Research Laboratory, to create a platform that leverages the increased resolution of satellite imagery, proof-of-concept research, cloud computing advances and machine learning to monitor the world's oceans.

She has contributed to the Pelagos ship strike project, led by the Tethys Research Institute in Italy, to reduce collisions between whales and boats.

She has inspired British, American and Canadian government agencies, as well as German and Canadian companies, to invest millions in the further development and applications of the use of satellite imagery to study whales.

Watching walrus from space

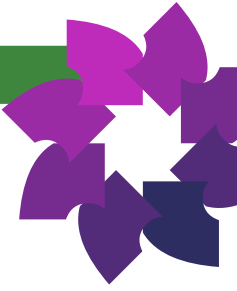
Cubaynes' Walrus from Space partnership with WWF and her eagerness to engage the public paid dividends. So far over 26,000 people from around the world have scoured nearly 500,000 VHR satellite images for signs of walrus, helping to validate her methods.

Cubaynes not only saw the potential for VHR to transform conservation methods but has worked continuously to improve and expand her methodologies to include new species and spark the public interest: the sky's the limit for this satellite research.



Entry title:
Monitoring whales and walrus from space: Reducing cost and risk; engaging citizens in conservation

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Early Career entrant:
Dr Hannah Cubaynes, British Antarctic Survey



Bringing together citizen scientists and regulators to monitor the River Wye and beyond

A team at Cardiff University has brought together citizen scientist groups, agencies and regulators to transform our knowledge of pollution in the River Wye. The project's methods have been adopted by over 180 citizen scientist groups who are providing samples of water across 15,000 sampling points in the UK. This data is freely available and used by regulators, helping to improve freshwater systems across the UK.

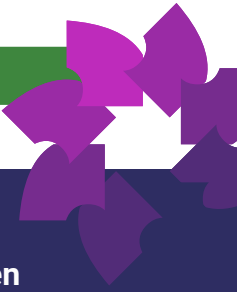
Local people who were concerned about pollution in the River Wye are now acting as the eyes and ears of environmental regulators.

Volunteers concerned about changes in ecosystems along the River Wye had become 'citizen scientists' by collecting chemical data to monitor the river's water health. But a lack of quality control meant regulators, agencies and others either couldn't use or didn't trust the data.

Dr Liz Bagshaw and her team at Cardiff University used NERC funding to bring together six citizen science groups, a local rivers trust (the Wye and Usk Foundation), Natural Resources Wales and the Environment Agency to make sure valuable data collected by volunteers wasn't going to waste.



Dr Liz Bagshaw



Proving volunteers' river data is accurate enough

Dr Bagshaw said: "Water monitoring capabilities in the UK have fallen over the past decade and, in tandem, citizen scientist collectives have sprung up to monitor their local rivers.

"We worked with the various groups to agree on standardised monitoring methods, equipment and an open-source data platform that all parties could use.

"We provided resources and initial training for volunteer coordinators that meant the groups could go on to train their own members."

As well as promoting regular monitoring, the team tested the effectiveness of the approach with three mass sampling events. The results of these demonstrated to agencies and regulators the level of accuracy that could be expected, and so improved understanding of the capabilities of citizen scientists' water quality data.

Six groups across the Wye now collect samples once or twice a week in 350 locations. They use standardised protocols and upload all data onto a central, open-access database. As of March 2023, the database had over 13,000 data points.

Upstream and downstream impact

The project means that the Environment Agency has access to water quality data from four times as many sites as they are able to directly monitor themselves.

It's also getting information more frequently - bi-monthly or weekly instead of monthly.

The project has had a ripple effect. The Environment Agency is now using the Wye's citizen science data in its own reporting and monitoring: a significant achievement for local people. Natural

Resources Wales has appointed a citizen science coordinator. The volunteers along the river are acting as early-warning sirens, alerting the local rivers trust and agencies to unusual events or potential pollution.

Effects flow beyond the River Wye

The impact of the project has flowed beyond the River Wye: the project's methods have been adopted by over 180 citizen scientist groups across the UK and online databases have over 15,000 data points freely available for regulators.

Dr Bagshaw points out that the connection between citizen scientists and the agencies and regulators has been the key to the project's success.

"By creating a model for how citizen groups and agencies can work together, we've ensured citizen science data can be put to real use in improving freshwater systems across the UK."

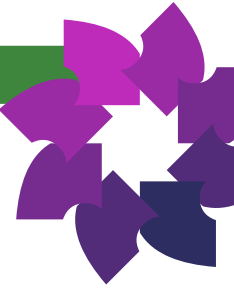
Environment Agency:

"Cardiff's collaborative monitoring project has helped us by providing standardised methods for our citizen science group partners to use, and has given us confidence in the relative precision and accuracy of the data. Since the commencement of the project, the West Midlands Area of the Environment Agency has made a commitment to use the citizen science data in its biannual River Wye Data Analysis Report."

Entry title:
Collaborative citizen science water quality monitoring networks for the River Wye and beyond

Team members:
Dr Liz Bagshaw, University of Bristol (formerly Cardiff University); Dr Roo Perkins and Elle von Benzon, Cardiff University





Protecting sensitive species and habitats in Antarctica and beyond

The British Antarctic Survey has provided critical expertise and evidence that has had a profound impact on conservation, sustainability, and climate awareness in Antarctica. This includes the designation of Marine Protected Areas covering 3,300,000km² - representing 12% of total marine area protected globally, identifying 204 important bird and biodiversity areas, and eradicating a non-native species of grass.

Earth's polar regions are under increasing threat from the effects of human activities and a changing climate.

Conservation research at the British Antarctic Survey (BAS) helps ensure the UK meets its international obligations - it shapes policy, drives conservation and helps protect Antarctica's unique ecosystem.

Establishing Marine Protected Areas

Marine Protected Areas (MPAs) aim to protect precious sea life and habitats from damaging activity. BAS scientists have made key contributions to the establishment and monitoring of MPAs in the Southern Ocean and the South Atlantic covering over 3,300,000 km² of ocean. This represents 12% of the planet's marine areas that are currently protected.

BAS research contributed to specific actions in these MPAs, such as the creation of no-fishing zones, seasonal protection for breeding birds and mammals, and areas to conserve sensitive biodiversity on the seafloor.



Professor Richard Phillips, Dr Susie Grant and Dr Kevin Hughes



Protecting and promoting biodiversity

Important Bird and Biodiversity Areas (IBAs) and Key Biodiversity Areas (KBAs) are places of international significance for the conservation of birds and other biodiversity, which are used to implement spatial protection and management.

BAS data and expertise helped identify many of the 204 IBAs for 20 bird species across the Antarctic. One IBA, near Rothera Station, which was subsequently designated as an Antarctic Specially Protected Area, holds over 10% of the global population of south polar skuas, which are predatory seabirds.

The team identified hotspots of foraging activity for seals and seabirds around South Georgia, which helped establish IBAs and KBAs, and closed the areas to all commercial fishing activity.

Eradicating threats and protecting vulnerable species

Antarctica is a fragile region, and non-native species pose a substantial threat to its native species and biodiversity.

The team is proud of its success in helping deal with several non-native species in the region.

“Over a four-year period, we worked with partners in Spain and Argentina to eradicate a non-native grass that was threatening the native species.

“Eradicating one species wasn’t enough. We developed a protocol endorsed by the international community that provides all parties working in Antarctica with the tools they need to minimise the risks posed by invasive species.”

BAS bird population data helps determine the global conservation status of penguins, albatrosses and other seabirds. BAS evidence led to policies that directly addressed threats to these species: for example, marked hooks are now required in some areas after BAS proved that hooks inside discarded fish were being fed to albatross chicks by their parents.

Humpback whales: evidence of hope

Since commercial whaling stopped in 1986, humpback whale populations have been recovering steadily in some areas, and less well in others. BAS scientist Jennifer Jackson conducted a global review to determine the conservation status of these populations. She explained:

“Four populations were endangered, one was threatened and nine, including all southern hemisphere populations, were no longer in danger of extinction.

“This work was essential, as it means resources and focus can be turned towards more conservation-critical populations.

“Identifying conservation successes also spreads hope: if we are determined, we can make great improvements and save vulnerable populations and species.”

UK leadership on climate change

For over 60 years, BAS’s research has supported the objectives of the UK Government in the Antarctic Treaty System (ATS) and international conservation agreements, and those of the governments of UK Overseas Territories.

Its research and expertise have enabled UK leadership on conservation and climate change, and as noted by the Foreign, Commonwealth and Development Office, it has “played a major part in highlighting the threats of climate change to the Antarctic region and globally.”

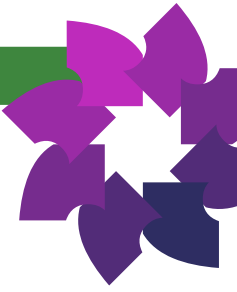


Entry title:
Protecting sensitive species and habitats in Antarctica and beyond
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Team members:
Professor Richard Phillips,
Dr Jennifer Jackson, Dr Kevin Hughes, Dr Susie Grant, all from the British Antarctic Survey (BAS)

Jane Rumble, Head of the Foreign and Commonwealth Office’s Polar Regions Department:

“The work of BAS clearly demonstrates how research outcomes can be taken up by policy and business decision-makers. The leadership of BAS scientists in key international roles is a major contribution to the UK’s ability to drive forward its objectives for conservation and environmental stewardship in Antarctica”.



Speeding up climate change simulations to tackle global warming

A team at the University of Leeds have developed an ultra-fast computer model that has transformed our understanding of the connection between global temperatures and the amount of emissions we release into the atmosphere. This research has helped shape the discourse on tackling climate change; it has played a crucial role in informing international climate policies linked to the Paris agreement and helped nations to enshrine net zero emissions targets into law.

Countries including the UK, France, and New Zealand enshrined their net zero carbon emissions into law following the use of results from an ultra-fast computer model developed by NERC-funded research at the University of Leeds.

The research has had a global impact and shaped the discourse on tackling climate change.

Calculating climate change temperatures in under a second

Full-scale computer simulations of global warming can take months to run, even on the fastest machines.

The Finite Amplitude Impulse-Response (FaIR) emulator created by researchers at Leeds in collaboration with researchers at the University of Oxford can replicate the same global surface temperature projections in only a fraction of a second.



Dr Chris Smith

The FaIR model developed at Leeds incorporated the newest research on how multiple factors affect surface temperature, building on an earlier carbon-cycle model developed by the University of Oxford.

Getting involved at a global level

Piers Forster, professor of climate physics at the University of Leeds, said: "Tackling global warming can't be put off until tomorrow – time is of the essence and action needs to be taken today.

"Using the FaIR model, policymakers are now able to calculate the impact of climate change themselves in a trusted, open way. This allows them to make decisions more quickly, which in turn means financiers can make the investment decisions on developing the low-carbon technologies that we urgently need."

The research was supported as a NERC highlight project, which supports research on a defined subject area.

Forster and Dr Chris Smith's development of FaIR led to them working with the United Nations' Intergovernmental Panel on Climate Change (IPCC) on its "Special Report on 1.5°C" (SR1.5), which was published in 2018.

Sticking to the Paris Agreement

FaIR was among the tools used to identify how little remained in the global carbon budget – the amount of carbon that could be safely released into the atmosphere – if the world was to meet the promises made in the 2015 Paris Agreement to limit global warming to 1.5°C by 2050.

The co-chair of one of the IPCC's working groups highlighted the impact of the SR1.5: "The small margin of action identified in the assessment of remaining carbon budgets has also triggered numerous reactions, including by youth movements using this information to call for urgent climate action."

Figures generated by FaIR for the IPCC's SR1.5 were quoted by climate activist Greta Thunberg when she addressed the United States Congress on 19 September 2019.

Helping the UK to reach net zero

The SR1.5 led to the UK's Climate Change Committee (CCC) producing its net zero report in 2019, with input from Forster, who had been appointed to the committee the previous year in part due to his work with the IPCC.

The CCC's report led to the UK becoming the first major economy to set a date for its net zero target – 2050 – and was soon followed by France, New Zealand, and now much of the world.

Forster also served on an expert panel for NHS England – the UK's largest employer and the organisation responsible for 4% of the country's carbon emissions – to guide its net zero strategy.

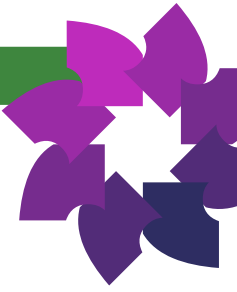
Chief Executive of the UK Committee on Climate Change:

"The SR1.5 assessment of net zero emission pathways and remaining carbon budgets produced by the FaIR model were important lines of evidence in the Committee on Climate Change's recommendation of a 2050 net zero date for the UK."

Entry title:
Informing international net zero emission targets and national legislation through physical climate model emulators

Team members:
Professor Piers Forster and
Dr Chris Smith, University of Leeds





Spurring global action against ocean acidification

Research led by a team at Plymouth Marine Laboratory has raised awareness of the potential consequences of rising ocean acidity, which impacts biodiversity, fisheries, aquaculture, food security, tourism, and marine-based economies. This work has driven international policy change and provided crucial data to the UK government to contribute to its compliance with United Nations ocean acidification goals.

At least one-quarter of the world's carbon dioxide emissions have dissolved into the ocean, fundamentally changing its chemistry.

Over the past 200 years, ocean acidity has increased by 30% - an unprecedented rate of change that does not allow time for all marine life to adapt. This change is contributing to marine biodiversity loss, which will impact fisheries, aquaculture, food security, tourism and marine-based economies.

A NERC-supported team at Plymouth Marine Laboratory (PML) has raised awareness and driven policy change and action on ocean acidification. Their work has had true global impact.

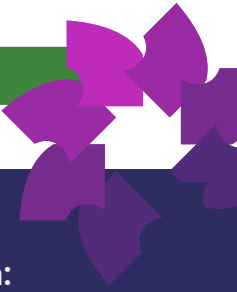
Biodiversity risk

PML has been raising awareness about the threat ocean acidification poses to marine life since 2004. The team's contributions to key reports and scientific assessments, as well as direct engagement with policymakers, stakeholders and the public, have led to global recognition and calls for action.

Professor Stephen Widdicombe, director of science at PML, said: "PML ensured ocean acidification was included in the Intergovernmental Panel on Climate Change (IPCC) Assessment Report for the first time in 2005. This was a key



Professor Stephen Widdicombe



milestone as IPCC reports inform the international community of the latest scientific understanding and influence climate change negotiations.

“This was a first step in combating this grave danger to marine life. Now, almost 20 years later, we’re still ensuring the latest ocean acidification science and understanding is reaching decision makers to inform positive action”.

Landmark global recognition

The PML team’s efforts led to the inclusion of ocean ecosystems in the landmark 2015 Paris Agreement, and the development of an ocean acidification target in the UN Sustainable Development Goals.

This highlighted ocean acidification as a major climate stressor, and the team’s input was valuable to climate negotiations and decision-making worldwide. Since 2015, the relevance given to the ocean in climate change negotiations has continued to grow, with stronger commitments agreed by all parties.

In 2017 team member Dr Carol Turley MBE played a significant role at the UN Conference on Sustainable Development Goal 14, Life Below Water, as did Professor Stephen Widdicombe at the 2nd UN Ocean Conference in 2022. They also worked to ensure ocean acidification was included in the historic Kunming-Montreal Global Biodiversity Framework in 2022.

Peter Thomson, the UN Secretary General’s Special Envoy for the Ocean, said: “After listening to Carol Turley speak about ocean acidification in the Partnership Dialogue at the UN Ocean Conference in New York in 2017, the full seriousness of the issue was brought home to me.

“She does a great job of bringing the science of ocean acidification to policymakers, making them more aware of this key reason for greater ambition in reducing CO2 emissions and meeting the Paris Agreement.”

Hands-on science

As well as influencing global action on ocean acidification, the team provides crucial data to the UK government to contribute to its compliance with UN ocean acidification goals. The team delivers pH measurements through its monitoring platforms. As a founding member of Global Ocean Acidification Observing Network, the team ensures standard methodology for ocean acidification measurements for 12 countries across the northeast Atlantic.

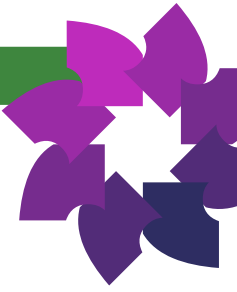
The team has also used NERC funding to build the longest-running and most comprehensive dataset of carbonate chemistry in the UK: vital to quantify long-term changes in ocean acidification.

Entry title:
**Ocean acidification:
ensuring national and
international decision
makers understand this
global threat to set targets
and inform international
agreements**

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Team members:
Professor Stephen Widdicombe,
Dr Jerry Blackford, Dr Helen
Findlay and Dr Carol Turley,
all from the Plymouth Marine
Laboratory (PML)





Protecting satellites with daily space weather forecasts

Space weather forecasts produced by a team at the British Antarctic Survey play a vital role in protecting satellites from the dangers of radiation high above the Earth's atmosphere. Ongoing research has also protected the UK's population and economy by helping the government understand the impacts of space weather and the risks it poses to daily life.

Professor Richard Horne and his team at the British Antarctic Survey (BAS) have developed a state-of-the-art model that forecasts the risk of damage to satellites from high-energy charged particles around the Earth. The model has been developed into an operational system that has been licensed to the UK Met Office for use in its national space weather forecasting service.

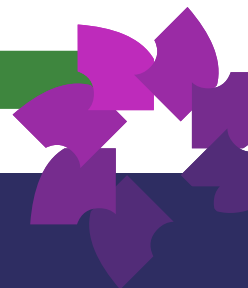
Satellite operators use the forecasts to reduce the risk of loss and damage. The archive of forecasts is used by satellite designers, space insurance and government to assess the wider impact of space weather and to develop more resilient systems.

Space weather occurs when charged particles and the magnetic field from the sun interact with the radiation belts inside the Earth's magnetic field and with the upper layers of the planet's atmosphere.

These geomagnetic storms can damage electricity networks on Earth's surface as well as satellites in orbit, which has a knock-on effect for communications and the Global Positioning System (GPS), an essential navigational tool for aircraft, ships, and online maps. The economic impact of a single severe storm could be as high as \$2 trillion.



Professor Richard Horne



Traffic light system warns of danger

Professor Richard Horne has led a series of EU and NERC-supported projects to develop a complex computer model that produces daily space weather forecasts.

Horne said: "Working with colleagues around the world, we've used data from satellites and from BAS's Halley research station in Antarctica to help produce a forecast of high-energy electrons in Earth's radiation belts.

"We display our information in a simple traffic light system to warn satellite companies about the threat from space weather together with the ability to drill down for more details."

Additional damage from radiation exposure

Horne's research identified a previously unrecognised threat to satellites that are slowly manoeuvred into position using a new technique called "electric orbit raising" (EOR) instead of being propelled directly into a geostationary orbit.

He calculated that the amount of radiation to which satellites are exposed during EOR is equivalent to 6.7 years operating in a geostationary orbit – a considerable figure for satellites that are designed to have a lifespan of around 15 years.

Understanding the impact of radiation damage on satellite components during EOR is now allowing designers to examine the shielding needed to protect equipment while it's being placed into orbit.

Taking the space weather threat seriously

Horne's work has also influenced public policy: space weather was added to the UK's National Risk Register of Civil Emergencies in 2012, along with heatwaves and emerging infectious diseases. In 2023 the impact level was raised to "significant".

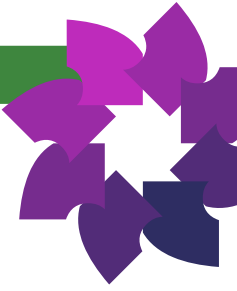
His analysis of the effects of space weather has helped to demonstrate that improved forecasting could lower the financial impact on the UK of a severe storm from £2.9 billion to £900 million.

Recognising the threat from space weather has led to further projects. Horne, for example, co-wrote the science case for the current £20 million space weather innovation, measurement, modelling and risk (SWIMMR) programme, which is funded through the UKRI Strategic Priorities Fund.

Entry title:
Reducing risks to satellites through daily space weather forecasts

Team members:
Professor Richard Horne, Dr Sarah Glauert, Dr Peter Kirsch, Dr Nigel Meredith, all from the British Antarctic Survey (BAS)





Protecting subsea global telecommunications networks

A team at the National Oceanography Centre has transformed how we protect the vulnerable network of subsea cables. The cables carry 99% of the world's data traffic including the internet, defence information, financial transactions and other services that underpin our daily lives. The research is already being used in national risk assessments, potentially helping entire countries to avoid isolation and saving hundreds of millions of pounds.

Subsea cables carry 99% of the world's data traffic, but are vulnerable to a range of natural hazards, such as powerful seafloor sediment flows called turbidity currents, which can damage or break them over large areas of the seafloor.

This can lead to countries being effectively cut off from the rest of the world, as happened to Tonga in 2022, or facing repairs that cost hundreds of millions of pounds.

Dr Mike Clare at the National Oceanography Centre (NOC) and his wider team have used NERC funding and facilities to transform how we assess the risks facing subsea cables, where we place them and how we mitigate against potential hazards.

Pinpointing where hazards begin

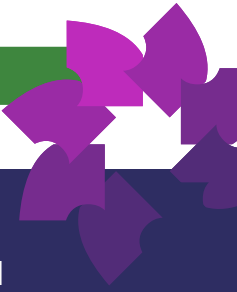
The team performed the first direct monitoring of turbidity currents in deep water, which led to breakthroughs in understanding.

Dr Clare said: "The monitoring revealed the timing, triggers, extent, magnitude and behaviour of the flows. This helped create new models to determine the best locations for cable routes across hazardous regions."

The research is already being used in national risk assessments.



Dr Michael Clare and Dr Isobel Yeo



Finding resilient cable routes

Working with Global Marine Ltd, a specialist commercial partner, the team analysed a global industry database of cable breaks to identify earthquake and cyclone-resilient routes in the deep sea. The work has enhanced the reliability of trading and communication links, reduced repair costs and was deemed “essential” by the International Cable Protection Committee, a global umbrella organisation for the subsea cable industry.

They also deployed novel sensors along the deep-sea Congo Canyon to improve our understanding of hazards in canyons.

The sensors allowed for rapid repeat seafloor surveys, shared in real-time with cable operators Angola Cables, Vodafone and BT, which meant cables could be rerouted to optimal locations.

Improving the resilience of remote island states

The 2022 volcanic eruption in Tonga was the planet’s most explosive eruption this century. Perhaps the most significant impact was the damage to the only subsea cable that connected Tonga to the rest of the world: Tonga was completely isolated.

Dr Clare and his team secured funding from the International Cable Protection Committee and a NERC Urgency Grant to conduct a crucial seafloor survey just three months after the eruption.

Real-time data sharing with the cable owners Tonga Cable Ltd, industry and government helped to diagnose the faults, select more resilient routes for the repaired cables, and provide lessons learned for cables in other hazardous regions.

Adapting to climate change

Dr Clare said: “There is growing concern that climate change will make cable-damaging events more likely and severe.

“Our team has synthesised existing models to identify high-risk areas under climate change, empowering the subsea cable industry and policymakers with essential evidence.”

The work has contributed significantly to the updated National Strategy for Maritime Security and has benefitted users such as the UK’s Telecoms Security & Resilience team and the International Cable Protection Committee.

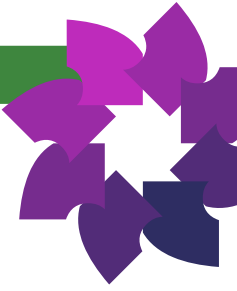
Andrew Hart, Technical Authority for Geohazards & Ground ModQuoteg, Atkins:

“The collaborative relationship between Atkins and NOC (e.g. through NERC Innovation projects) has successfully and significantly contributed to the knowledge base that now guides the development of offshore and seabed infrastructure. We hope very much that the excellent research being conducted at NOC and with their various research partners, and in turn the support to industry, will continue.”

**Entry title:
Ensuring the global subsea telecommunications network remains resilient**

Team members:
Dr Michael Clare, Dr Brian Bett, Dr Christine Sams, Dr Gaye Bayrakci, Dr Isobel Yeo, Dr James Hunt, Dr Jennifer Brown, Dr Lucy Bricheno, Dr Veerle Huvenne, Dr Yevgeny Aksenov, all from the National Oceanography Centre (NOC); Professor Ivan Haigh and Dr Esther Sumner, University of Southampton; Dr Edward Pope, Dr Matthieu Cartigny, Dr Megan Baker, Professor Peter Talling, Professor Christine Peirce, Durham University; Dr Sanem Acikalin and Professor Jeff Neasham, Newcastle University; Dr Steve Simmons, University of Hull; Professor Dan Parsons, Loughborough University





Tackling the human and financial cost of flooding

A team at the University of Bristol has pioneered the development of high-resolution flood prediction models, which has resulted in a spin-out company that is a global leader in water risk intelligence. This research has revolutionised decision-making for a diverse range of users, and protects infrastructure valued at over \$1 trillion, thanks to improved flood risk management in the UK and across the world.

NERC-funded research at the University of Bristol has helped to pioneer the development of high-resolution flood prediction models that have improved flood risk management in the UK and around the world.

This research reduced flood risks and losses while strengthening businesses and creating jobs.

It also led to the formation of Fathom, the start up company co-founded by Bates and colleagues Andy Smith, Chris Sampson and Jeff Neal in 2013.

Fathom now has 50 staff and is a global leader in water risk intelligence.

Fathom's global flood hazard and risk datasets have revolutionised flood risk management and decision-making for a diverse range of users including governments, regulators, NGOs, the insurance industry and blue-chip companies.

Professor Bates explained: "We provide robust, comprehensive data that these organisations can use to understand and integrate flood hazard and climate change data into their risk operations, build complete pictures of flood risk and avoid losses."



Professor Paul Bates



In-country alerts

The researchers' real-time forecasts are used by the UK's Foreign and Commonwealth Development Office (FCDO) to create flood risk maps ahead of cyclone landfall in southern and east Africa, helping to prioritise and direct aid.

Google used the research to establish its own flood forecasting model in India, sending flood alerts to millions.

Protecting assets, promoting development and boosting business

Microsoft uses Fathom's data to protect its global cloud infrastructure: a network that is worth over 15 billion USD.

The World Bank uses Fathom's data to consider the impact of flood disasters on new development projects and to make decisions on investments and loans for infrastructure and disaster resilience. Fathom's data contributed to the bank's disbursement of nearly 67 billion USD in 2022.

UK, US and Asian insurers use Fathom's data to price the flood risk for millions of assets worth at least 1.35 trillion USD. The data are also used by insurers and reinsurers to identify new markets and better understand their risk and exposure.

A commitment to research

Professor Paul Bates and his team have secured a range of funding from NERC over the years, from PhD studentships to major projects.

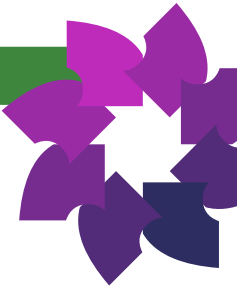
Awards from the University of Bristol's NERC Impact Acceleration pilot account and the NERC Strategic Research Impact programme were particularly important: they supported the proof-of-concept that led to the formation of Fathom.

Bates said: "Academic research remains as important to our team now as when we started. In the face of the increasing challenges posed by climate change, this commitment ensures we are providing our customers and partners with market-leading flood models based on the ever-advancing frontiers of scientific research."



Entry title:
Transforming global flood risk management for businesses, governments and people

Team members:
Professor Paul Bates and Dr Jeffrey Neal, University of Bristol and Fathom; Dr Andy Smith and Dr Chris Sampson, Fathom



Using wastewater to monitor the nation's health: onwards from COVID-19

A team at Bangor University used their expertise to monitor the prevalence of COVID-19, at one point covering 80% of the UK population through wastewater monitoring. The monitoring system played a crucial role in shaping national policy during the pandemic, and has since been adapted to measure many other diseases of public health concern in the UK and globally.

Before the arrival of COVID-19, Professor Davey Jones and his team had already proved that wastewater could be used to rapidly monitor human infections in a cost-effective, unbiased way.

The team applied for a NERC Urgency Grant in February 2020 to apply their expertise to the emerging public health emergency.

Their work, which involved government, regulators and the water industry, was used to monitor the prevalence of COVID-19 in cities and towns across the UK.

Its success led to the creation of a national wastewater monitoring infrastructure, and the team sees huge potential for wastewater monitoring in the future. For example, it is now being used to measure levels of flu, norovirus, pharmaceuticals and narcotics and has the potential to monitor the general happiness of a catchment population.

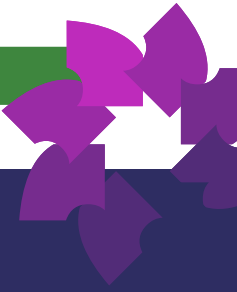
Impacting national policy during COVID-19

During the first wave of COVID-19, the research team demonstrated that viral levels in sewage provided an accurate reflection of the actual cases in each community serviced by the specific sewage works.

They developed virus surveillance methods that were adopted in the UK and internationally. The method for SARS-CoV-2 is going through accreditation by



Professor Davey Jones



the International Organisation for Standardisation (ISO) - which means it will become the gold standard.

Their work had real-time impact during the pandemic: at one point they worked with the Environment Agency to cover 80% of the UK population through wastewater monitoring. They developed protocols for sampling the wastewater from planes and the quarantine facilities used by those arriving in the UK from 'red list' countries.

Their weekly reports for the Welsh Government informed decision-making on multiple occasions, including the reimplementing of movement restrictions in December 2022.

Securing millions for national pathogen surveillance

The nationwide wastewater surveillance programme for tracing COVID-19 is still run by the UK Government via the UK Health Security Agency and devolved nations. Since 2020, over £100 million has been invested across the country.

The team used the initial grant to obtain two further Global Challenges Research Fund projects working with Development Assistance Committee countries in Africa to initiate wastewater surveillance work- the South African COVID-19 monitoring programme is ongoing.

Professor Jones said: "Our programme and data provided an evidence base to inform decision-making, such as weighing up the effectiveness of lockdowns.

"We also demonstrated the value of surge testing in the suburbs of major cities, where wastewater monitoring indicated a rise in the specific population.

"We've proved that human-derived wastewater provides a wealth of information on the health of the nation. Its usefulness goes well beyond COVID-19."

Adapting to emerging viruses and threats

The research team has grown from two research assistants to 50 staff over two years, in Wales alone. The research and impact have brought over £20 million in funding to Bangor University.

Jones says one of the greatest impacts of the work is making clear the potential for wastewater surveillance.

"We helped the government and public health agencies tackle COVID-19. We can use the protocols and infrastructure for all manner of insights at a community level. This could be the use of illicit drugs, anti-microbial resistance, new viral strains or even levels of serotonin-like compounds, which could be used to indicate the level of happiness within a community."

Dr Rob Orford, Chief Scientific Advisor, Health (Welsh Government):

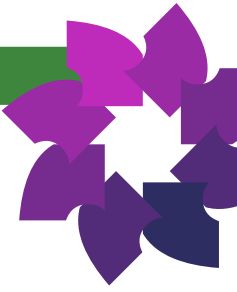
"The work that Davey, his colleagues and collaborators have led in Wales is world-leading. We have used this intelligence in the form of risk-assessments, which in turn informed risk management policies and ministerial decisions about COVID-19 in Wales, helping us to use evidence to reduce harm and act proportionately to the challenges we faced."

Entry title:
Wastewater-based monitoring: A new holistic approach for public and environmental surveillance

.....

Team members:
Professor Davey Jones, Dr Kata Farkas and Dr Shelagh Malham, all from Bangor University; Professor William Gaze, University of Exeter





We would also like to congratulate five entries specially commended by the shortlisting panel.

Commended

Advancing sea level understanding to protect millions from flooding worldwide

Research at the University of Southampton has transformed understanding of sea-level changes and coastal flooding, influencing policy decisions to address growing flood risks and climate change indicators. The work has been instrumental in protecting coastal areas and infrastructure, making the public more resilient to floods, and ensuring that climate change adaptation is a central part of policymaking and planning.



Entry title:
Rising tide: Informing management, planning and policy on acceleration of sea level rise, increased coastal flooding and changes in tide around the UK coast and globally

Team members:
Professor Ivan Haigh, Dr Matt Wadey, Dr Hagen Radtke, Dr Mark Pickering, Dr Robert Mawdsley, Addina Inayatillah, Sunke Trace-Kleeberg, Professor Robert Nicholls, all University of Southampton

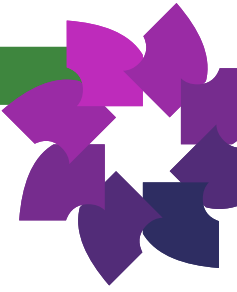
New ‘nowcasting’ technology creates a step change in surface-water flood prediction

The world’s first real-time street-level surface-water flood ‘nowcasting’ technology has led to significant improvements in surface-water flood forecasting capacity, enhancing resilience and helping to predict near future flood events – all while saving lives, property and money.



Entry title:
Surface water flood ‘nowcasting’: An international ‘first’ to reduce flooding impacts for business, governments, and humanitarian organisations

Team members:
Professor Dapeng Yu, Dr Andrew Pledger, Sarah Johnson, Professor Robert Wilby, Loughborough University
Dr Avinoam Baruch, Dr Mingfu Guan, Dr Vivian Camacho-Suarez, Dr William Johnson, Previsico
Professor Jie Yin, East China Normal University



Commended

Enabling sustainable fisheries management in the Southern Ocean

British Antarctic Survey (BAS) research has contributed to sustainable fishing practices in the Southern Ocean and protection of the region's biodiversity. Evidence from BAS's Ecosystems programme and long-term research on krill, birds and seals has influenced UK policy decisions, shaped international conservation regulations, and informed commercial fishing practices in the Southern Ocean worth \$1 billion.



Entry title:
Enabling Sustainable Fisheries Management in the Southern Ocean

Team members:
 Dr Simeon Hill and Dr Philip Hollyman with team from the British Antarctic Survey (BAS)

New green status of species recovery improves conservation efforts

A novel assessment framework has transformed how species recovery is measured. This work has provided a standardised approach to evaluating conservation success, and is helping scientists to plan future efforts with the highest return on investment for wildlife.



Entry title:
Enabling ambitious and effective species conservation action through delivery of a novel impact assessment framework

Early Career entrant:
 Dr Molly Grace, University of Oxford

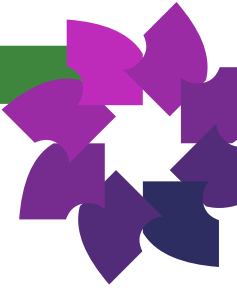
Minimising air travel disruptions during the Icelandic volcanic eruptions

Research at the University of Exeter had a significant impact on aviation safety and operational practices following the Icelandic volcanic eruptions. Changes in practice based on this research kept UK airspace open, preventing widespread disruptions and potential costs of £500 million.



Entry title:
Developing the Resilience to Icelandic Volcanic Eruptions (DRIVE)

Entrant:
 Professor Jim Haywood, University of Exeter



“Chairing the NERC Impact Awards panels was a wonderful opportunity to encourage, recognise and reward scientists across the complete spectrum of environmental research who take their science to the next level – celebrating the real reason many do their research: to improve our world.”

Kathryn Monk
Chair of the NERC Impact Awards 2023 panels

Judging this year's entries

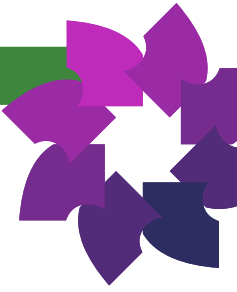
Many thanks to our shortlisting and judging panels who assessed this year's entries, and brought a variety of expertise and experience in assessing the impact of environmental science. The Impact Awards panels comprised a diverse set of representatives from research user organisations, including government and business; the research community; public engagement professionals; and NERC.

The chair of this year's judging and shortlisting panels was Kathryn Monk, Chair of the international Collaboration for Environmental Evidence and Honorary Professor at Swansea University.

To enable the panels to consider the full breadth of the impacts entered, entries were judged for the reach and significance of all of the impacts described. Once the winners and finalists were identified, the awards were named according to the major impact type (e.g. 'societal' impact).



NERC Impact Awards 2023 judging panel. Back (left to right) Damitha Adikaari, Alison Robinson, Rebecca Heaton, Kathryn Monk, Sonia Medina, Hannah Cloke, Ian Cheshire, Charlie McNichol-Fardon. Front (left to right) Doug Gurr, Robyn Thomas



Judging panel

Chair: Kathryn Monk

Chair of the international Collaboration for Environmental Evidence and Honorary Professor at Swansea University

Damitha Adikaari

Director of Science and Innovation for Climate, Department for Energy Security and Net Zero

Ian Cheshire

Chair of Land Securities plc, Chairman of Channel 4 and Chairman of Spire Healthcare Group plc

Hannah Cloke

Professor of Hydrology, University of Reading and member of NERC Council

Doug Gurr

Director, Natural History Museum

Rebecca Heaton

Director of Environmental Sustainability, Lloyds Banking Group plc and member of NERC Council

Sonia Medina

Executive Director Climate, Children's Investment Fund Foundation

Charlie McNichol-Fardon

Head of Sustainability, UK Hydrographic Office and chair of the NERC Future Leaders Council

Robyn Thomas

Deputy Director of Funding Services, UKRI

Shortlisting panel

Chair: Kathryn Monk

Chair of the international Collaboration for Environmental Evidence and Honorary Professor at Swansea University

Rubina Ahmed

Associate Director Systems Engagement, Stroke Association

Tom Chant

CEO, Society of Maritime Industries

Hannah Cloke

Professor of Hydrology, University of Reading and member of NERC Council

Mark Fletcher

Director of Global Water, ARUP

Alexandra Holder

Net Zero Buildings and Climate Change Lead, Department for Levelling Up, Housing and Communities

Kathryn Jeffs

Series Producer, The Americas, BBC Natural History Unit

Laura Bellingham

Government Policy Profession Unit Lead

Isobel Stephen

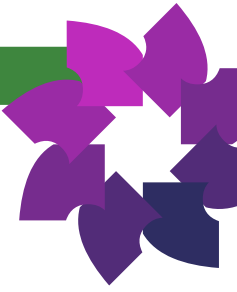
Executive Director of Strategy, Performance and Engagement, UKRI

Richard Swannell

Interim CEO, WRAP

Anna Turrell

Group Sustainability Director, Tesco



How you could help unlock the potential of environmental science

The NERC Impact Awards 2023 shine a spotlight on the UK environmental science at the heart of the responsible management of our planet. We hope the Awards not only highlight the transformative power of research but also prompt you to consider how you can use stories of research impact to make a difference.



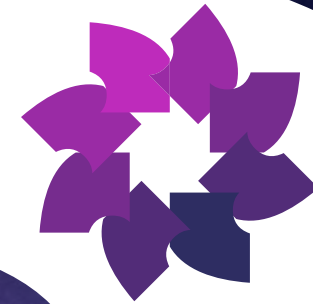
Read more about how the people and projects NERC invests in can make an impact on our lives and the world we live in



Learn more about NERC innovation, collaboration and partnerships

We invite you to join us in exploring the potential of environmental science. For example:

- Use NERC impact case studies to promote sustainable practices within your community and industry
- Inform stakeholders and partners about the positive outcomes of environmental research
- Leverage stories of research impact to shape policy and broader decision-making processes at your organisation
- Identify opportunities for commercialising innovations or concepts presented in research
- Use NERC impact case studies to inspire action and raise awareness through your social media channels
- Make a case for more collaboration with environmental scientists at your organisation, supported by impact case studies
- Consider if you are interested in tapping into academic expertise or exploring opportunities to access NERC resources and facilities
- Gain insights from impact case studies on collaboration and research opportunities aligned with your stakeholders' needs



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