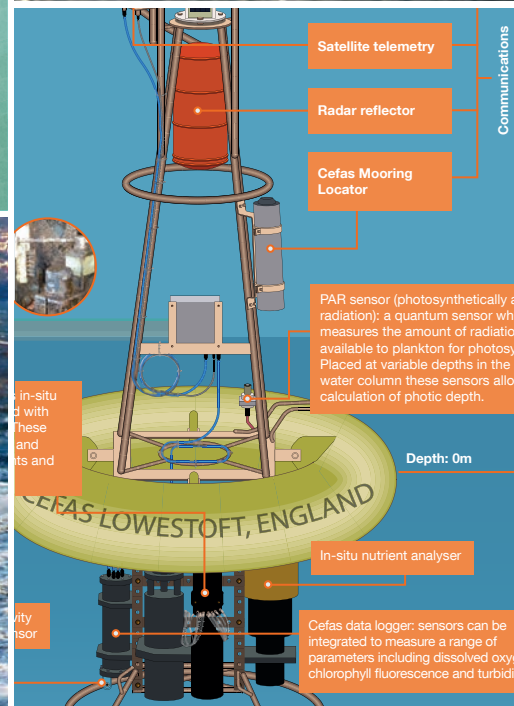
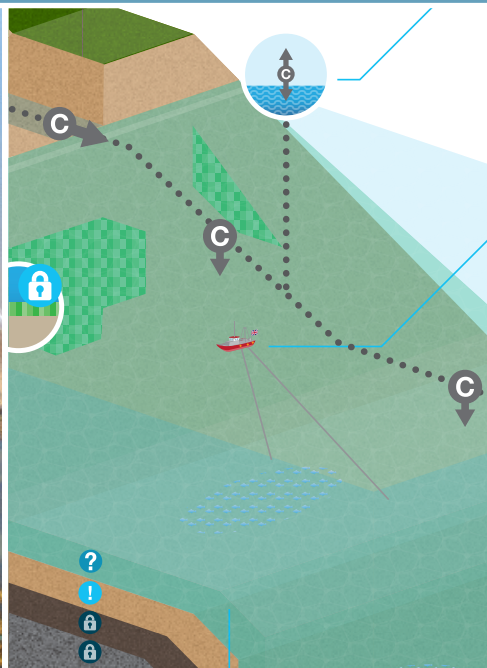


# Marine Knowledge Exchange Network

## Accelerating Impact



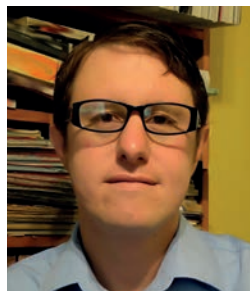


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Photo Credit: Cefas

## Note from the Director



Thanks for taking the time to read about our initiative. The vision for the Marine Knowledge Exchange Network (M-KEN) came about through my own experiences as a marine scientist and researcher, with the realisation that 'marine'

is so much bigger than just research. In East Anglia we are gifted with mile after mile of beautiful coastline enjoyed by thousands on a daily basis. We are also home to a world leading energy hub incorporating oil, gas, nuclear and renewables (on and off shore), two centres for excellence in marine research at UEA and Cefas, a considerable financial industry base and an ever growing network of SMEs and start-ups as well as vibrant tourist industry.

However, we also face considerable challenges as a region: Sea level rise as a result of anthropogenic climate change; the predicted increase in frequency and severity of storm surges such as the one that severely damaged our coastline and regional economy in 2013; coastal erosion with difficult decisions about coastal defences and the challenges of meeting future energy; and food production needs whilst conserving of our valuable marine environment, to name a few.

These are issues that affect all sectors of our society, from the inhabitants and visitors to our coastline to the insurance industry predicting the financial impact of increased flood risks. M-KEN is a new network aimed at bringing all of these marine stakeholders together, to work together to do better science, share it with those who can benefit from it and work together to better meet the challenges we face as a region, and more widely as an island nation.

In our first year we have worked with some fantastic researchers, artists, graphic designers, marine consultants, policy-makers and SMEs to realise some of the potential that a network such as M-KEN can deliver. This brochure gives you a flavour of what we have achieved – I hope you enjoy reading it.

We very much hope to secure additional funding to continue our work into the future, ensuring the delivery of real marine science impact to benefit our region and beyond. We'd love you to get involved – e-mail us at [mken@uea.ac.uk](mailto:mken@uea.ac.uk).

Martin Johnson, Cefas Lecturer in marine science, Centre for Ocean and Atmospheric Sciences, University of East Anglia, Norwich.

## What is the NERC Impact Accelerator Fund?

The NERC (Natural Environment Research Council) Impact Accelerator Fund is focused on enhancing the impact of NERC research by strengthening interaction between NERC-funded researchers and the user community. The fund specifically aims to generate, accelerate and amplify the impact of NERC science to deliver economic and social change through working with industry, business, NGOs and government bodies. With this focus, the scheme prioritises research translation

and utilization, by informing future strategic research directions to deliver defined and tangible impacts. Impactful outcomes may include: policy and/or regulatory improvements, enhanced business performance, new business opportunities or businesses, inward UK investment, improved societal and/or economic resilience, and shifts in public perceptions.

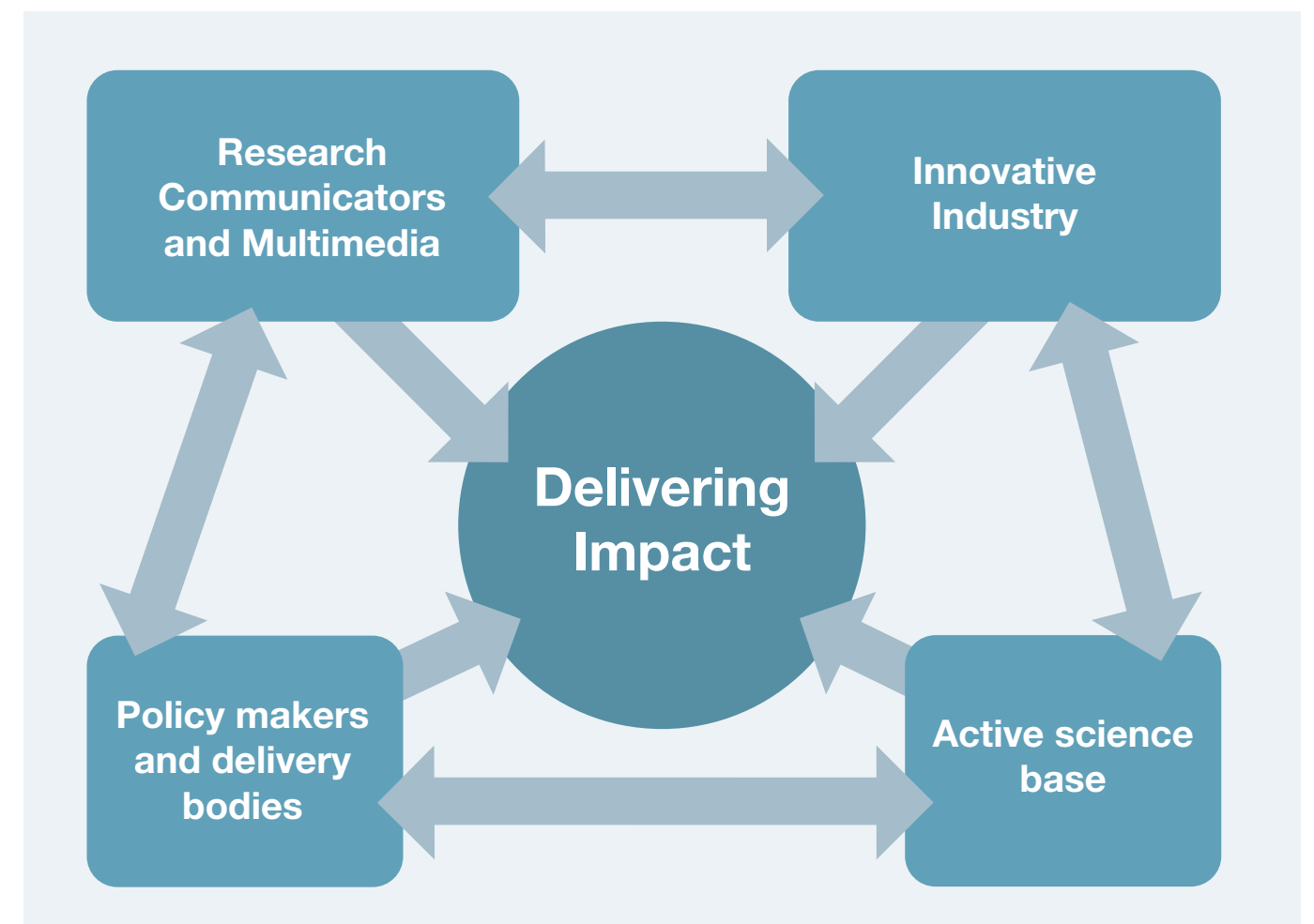
The NERC Impact Accelerator Fund supports M-KEN.

## About M-KEN

The Marine Knowledge Exchange Network (M-KEN) is a professional network that aims to create a research and impact community by connecting industry, SME, policy and NGO stakeholders with marine and coastal scientists across East Anglia. M-KEN hosts networking events and targeted workshops to heighten the impact of marine science and build capacity for future collaborative, stakeholder-relevant marine science. By capitalizing on the synergy between sectors, M-KEN

will increase and engender stronger industry-relevant marine science now and in the future.

To create impact, M-KEN uses specialist infographics, visual design, science communication and research commercialisation skills. M-KEN is the only existing network in the UK which targets cross-sector marine knowledge exchange and developing impact from marine science.





# Why focus on East Anglia?



Photo Credit: Cefas

M-KEN is focused on East Anglia for a number of important reasons. Marine industry is a significant contributor to the regional economy. Historically the region is a hub for southern North Sea offshore gas production and distribution, a focus for commercial fisheries, and the home to the major container, bulk cargo and passenger port facilities at Felixstowe, Harwich International and Ipswich. The area also forms a base for global leaders in the insurance sector. The East Anglian marine renewables market is burgeoning, with the region playing a leading role in offshore wind and offering strong future potential in 'blue growth' areas such as algal biofuel production.

East Anglia is also home to world leading research centres that are recognized for their excellence in marine sciences. The University of East Anglia is recognized globally for oceanography, and the Tyndall Centre for Climate Change is a multi-disciplinary research centre working to develop sustainable responses to climate change. The region hosts the Centre for Environment, Fisheries and Aquaculture Science (Cefas), the UK's operational Marine Agency with world-leading programmes in marine environmental and fisheries monitoring; and the British Antarctic Survey, responsible for World-leading research activities in Polar Regions.

These institutes provide leadership on a broad range of marine science topics, as well as developing and applying cutting edge marine monitoring and surveillance technologies, many of which have strong commercial applications.

The City of Norwich is perfectly positioned to develop as a National hub to build stronger links between world-class research and creative industries, to facilitate more effective science communication leading to impactful outcomes. M-KEN draws heavily on the city's vibrant digital and creative industries, the Norwich University of the Arts (specializing in art, design and media training), and a strong technology start-up presence (Norwich was recognized in the recent Tech Nation report as a nationally important and growing digital / technology cluster<sup>1</sup>), to facilitate links and collaborations between research, technology, arts and media. Bringing together these specialized areas, offers a rich combination of skills ideal for ensuring impact from research activities, and opens new opportunities for collaborative research in the future.

<sup>1</sup> [duedil.com/technation/2015](https://www.duedil.com/technation/2015)

## The key objectives of M-KEN

M-KEN aims to develop impact from the wide portfolio of NERC-funded coastal and marine science at UEA and Cefas particularly across the business and policy community. This is done via:

- Collaborative impact discovery and development between NERC-funded coastal and marine science at UEA and Cefas, with business, policy and third-sector stakeholders
- Communicating complex science with stakeholders through infographics and digital media
- Fostering new relationships
- Building strength in cross-sector marine science
- Supporting and guiding the development of collaborative funding proposals.

### The M-KEN community

The M-KEN community is growing rapidly. Already many researchers from different disciplines are engaged in its work. Offshore industry bodies, the consulting sector and specialists from a range of Government Agencies are also getting involved and influencing M-KEN. Looking to the future, there will be plenty of opportunity for others, to join in and further shape the network.

### The M-KEN partners

M-KEN is led by the University of East Anglia with key partners Blue Ltd, Cefas, MADE Agency and the North Sea Marine Cluster.

Blue Ltd.



MADE



### What is this brochure about?

This brochure has a number of key aims. Firstly and at the simplest level, it is an opportunity to introduce M-KEN to a broad audience and to highlight some of the exciting opportunities presented by the cutting-edge marine and related research at UEA and partners. Secondly and more specifically, it provides the chance to demonstrate progress during M-KEN's first year – to showcase the impact work that has been completed, and highlight some case studies. Thirdly, it provides an opportunity to focus on the future of the network, how you can engage with UEA's marine science and get involved.

Photo Credit: Cefas



# Impacts of the December 2013 storm surge on the North Norfolk coast

In December 2013, an intense North Sea storm resulted in the “biggest UK storm surge for 60 years”, according to the UK Environment Agency. Not since the devastating floods of 1953 had flood waters been recorded at such high levels along areas of the Norfolk coastline. Fortunately, improved flood defences and emergency responses meant that loss of life during the 2013 flooding event was avoided, however there were still extensive impacts to the coastline, with damage to sea defences and property. As the frequency of large storm surges is expected to increase with rising sea levels, it is critical to improve understanding of the environmental and social repercussions of these events in order to develop more effective response strategies.

## Description of the research

The 2013 Norfolk storm surge provided a unique opportunity for researchers from the UEA School of Environmental Sciences, the Tyndall Centre for Climate Change Research and Cefas, supported by a grant from the Natural Environment Research Council (NERC), to investigate the environmental impacts, and social and policy responses to a severe surge event. The study focused on the area between Brancaster and Salthouse on the North Norfolk coast; this offered a range of different habitats (e.g. barrier beaches, freshwater marshes), settlements and institutions with ownership or decision-making responsibilities for the coast. The project focused on four linked research areas:

1. Produce high-resolution survey maps of coastal habitat changes using a Remotely Piloted Aircraft (RPA) fitted with ultra-high resolution imaging equipment;
2. Produce soil and sediment surveys to determine impacts to soil microbe community ecosystem function, carbon and nitrogen cycles and soil salinization;
3. Survey changes in vegetation, soil life and impacts on ecosystem services;
4. Research social and policy responses to flood damage and landscape change.

## About the research

### Research area 1: Aerial surveys

The aim of this research area was to determine the redistribution of coastal sediment as a result of the storm surge, using a RPA to map changes. Using the Cefas fixed-wing RPA the team were able to map changes affecting a wide range of habitats, including: sand and gravel sediments; beaches and coastal dunes; saltmarsh and mudflats. Damage to sea defences and impacts on vegetation were also surveyed using this technique. The new data will be used in combination with existing information to understand historical rates of coastal change. The UEA Virtual Reality suite will be used to visualise the changes and elicit stakeholder views on management responses.



### Research area 2: Soil surveys

This area of research focused on understanding how salt water from flooding events impacts soil life function and the extent of salt impact on different soils. Soil samples were collected in an area with no evidence of flooding (the control site), and compared to three sites with a gradient in extent and duration of flooding. Soil samples were tested to assess salinity changes, and microbe community functioning.



### Research area 3: Impacts on flora and fauna

The impacts of the storm surge on the North Norfolk coast flora and fauna was assessed by sampling in the Spring and Autumn, providing a snapshot of impacts to these habitats. Predicted recovery routes were then developed from these baseline survey data. Linking with research area 1, aerial (and ground) surveys were used to identify areas that were subject to sediment deposition, and temporary or permanent saltwater flooding. Data from research area 2 was used to identify areas where the impacts were not visible. The survey focused on freshwater marsh and pools, salt meadows and coastal lagoons, as these habitats are considered particularly at risk from flooding.



Photo Credit: Mike Page

### Research area 4: Social and policy responses

The social sciences component of the project engaged with members of the public, stakeholders, landowners and decision-makers around Blakeney, Cley and Cromer to explore and understand the social and policy responses to the event. Semi-structured interviews were held with key stakeholders, landowners and decision-makers involved in responding to the impacts of the storm surge, to explore the impacts of the storm surge on the coast (natural and human assets), the immediate responses enacted and the implications for future management of the area in regards to existing policy and adaptation options. Focus groups were undertaken with local community members to gather individual and community perceptions about management and response measures, and reflections on implications for future management in light of possible changes. Liaison and networking with key authorities and organisations involved in the management of this part of the coast, as well as other sections in Norfolk and Suffolk, is ongoing as a result of this research.

The experienced research team consists of twelve staff from across the UEA Centre for Ocean and Atmospheric Sciences (COAS), the UEA School of Environmental Sciences, the Tyndall Centre for Climate Change Research and Cefas, bringing together a broad and full range of specialist knowledge to assess the geological, ecological and social changes from the storm surge on this North Norfolk rural landscape.



## Storm surge - accelerating impact

M-KEN and the Norfolk Coast Partnership (NCP), partnered with the research team for a workshop held in Blakeney in November 2014 to discuss the preliminary results of the research with local stakeholders and community members. The research results and community feedback are being interpreted by a mixed creative / scientific team to produce a 3D infographic presenting a summary of the science and its impact.

Supported by the Marine Knowledge Exchange Network, this creative and novel component of the research project specifically involved community engagement between businesses, the participation of local early-career designers collaborating on research communication, as well as a unique 3D installation piece for public display. The installation will go on tour in Summer 2015.

For more information contact:  
mken@uea.ac.uk.

# SmartBuoy

## Description of the science

Cefas SmartBuoys are moored, automated, multi-parameter recording platforms. They make high-frequency measurements of parameters such as salinity, temperature, turbidity, oxygen, chlorophyll and nutrients, through in-situ sensors and automated water sampling. They are an invaluable tool to support the understanding of how our seas function and are changing and can easily be deployed with additional sensors. SmartBuoys have been deployed by Cefas and partners in various locations in UK waters and beyond to aid or provide:

- evidence used for water quality assessments
- improved understanding of environmental variability
- insights into ecosystem function and biodiversity
- improved numerical model validation and testing
- “ground-truthing” satellite observations of the marine environment

Collaborative work between Cefas and UEA has provided valuable insight into the transport of nitrogen from UK rivers across the North Sea, informing policy on trans-boundary pollution. This collaboration is ongoing and continues to deliver insight into nutrient transport issues in the North Sea.

SmartBuoys are currently being used as part of a year-long observation programme of the whole North West European continental shelf, funded under the NERC Shelf-Sea Biogeochemistry Programme. This programme is exploring the chemical, physical and biological functioning of our seas.

## SmartBuoy – accelerating impact

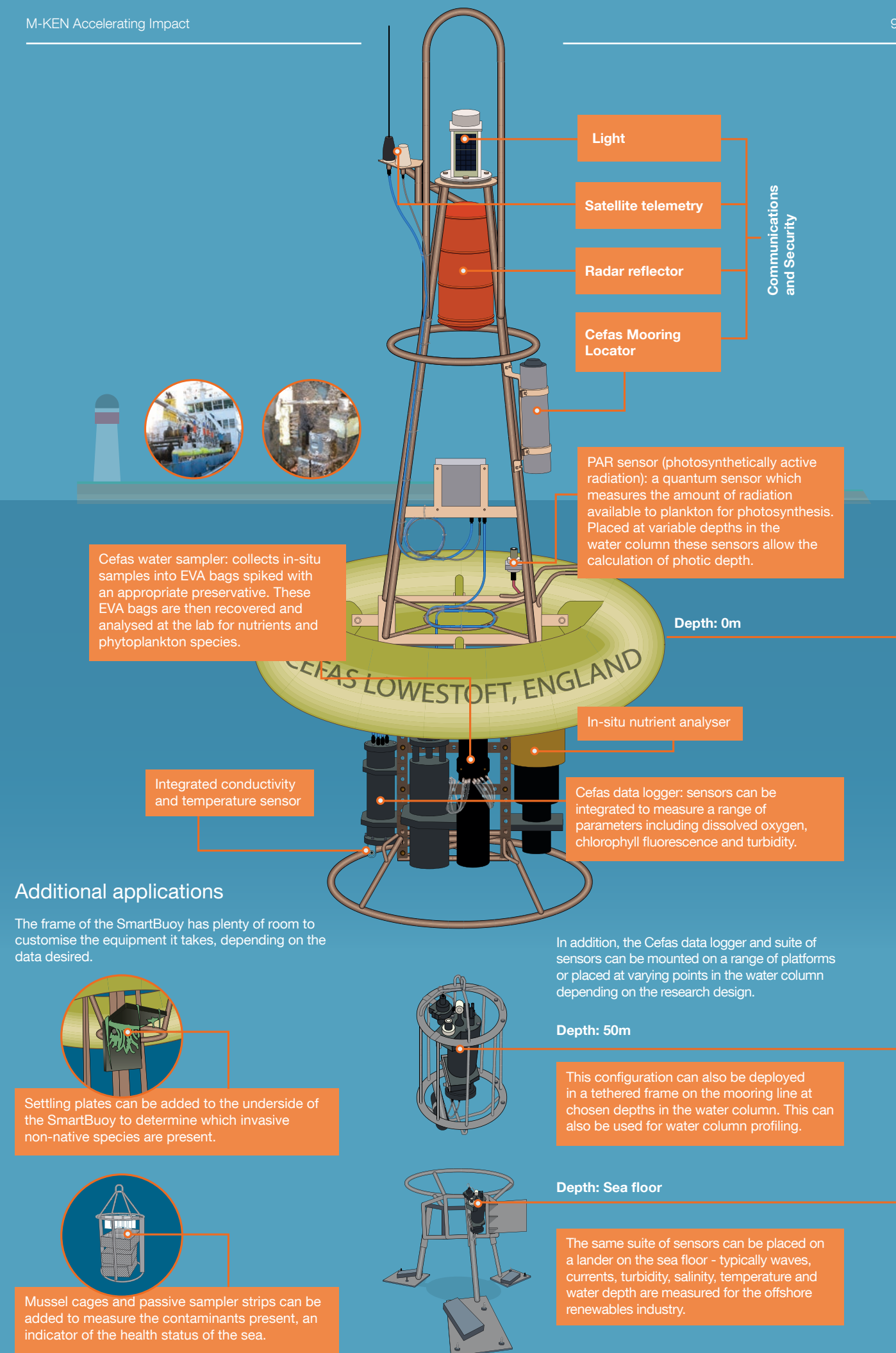
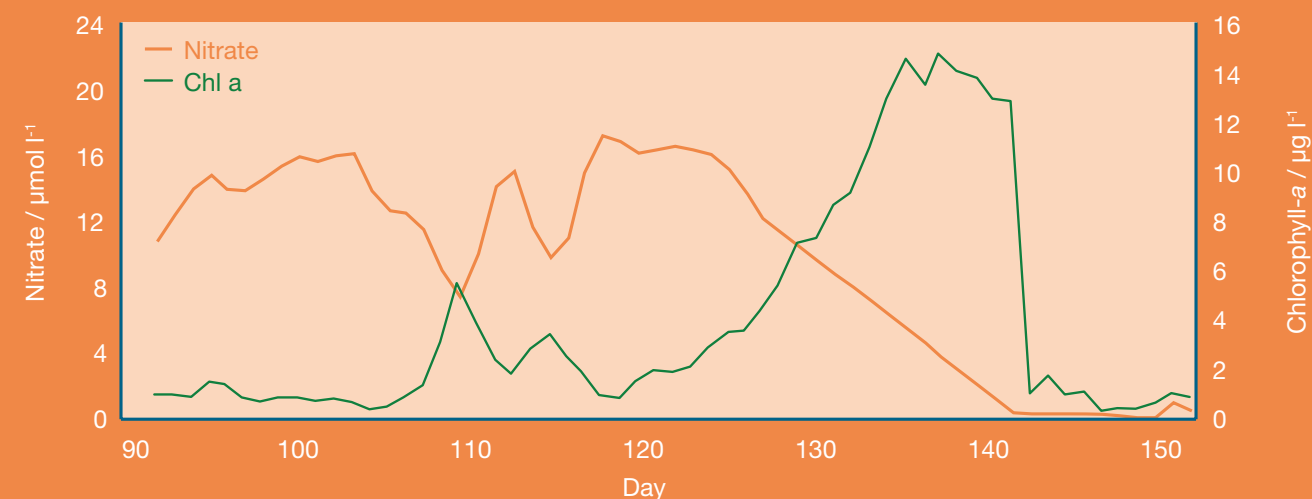
An infographic explaining the science and applications of the SmartBuoy was collaboratively developed by scientists, science communicators and graphic designers. The infographic was coupled with a video using augmented reality, developing new capacities within the team in film-making and interactive print technology.

The resulting infographic illustrates the breadth of applications of this technology and the platforms that host it. The infographic will be used at future policy and business technology events.

For more information contact:  
mken@uea.ac.uk.

## An example of the data

This data from the East Anglian Plume mooring highlights the capacity of SmartBuoy to deliver high temporal resolution insight into the marine environment. Nitrate can be seen to decrease rapidly as chlorophyll increases during the spring bloom. This data (from 2000) was collected as part of a collaborative study between NERC funded scientists at UEA and Defra funded scientists at Cefas into the transport of nitrogen from UK rivers across the North Sea, informing policy on trans-boundary pollution. This collaboration is ongoing and continues to deliver insight into nutrient transport issues in the North Sea.





## Blue Carbon

The removal of carbon dioxide (CO<sub>2</sub>) from the atmosphere to the sea is a vital ecosystem service, currently globally responsible for taking up roughly half of the CO<sub>2</sub> emitted by human activity. The concept of Blue Carbon (carbon storage in marine habitats) has previously been associated only with coastal ecosystems such as salt marshes and seagrasses. The Cefas/UEA blue carbon project (2014-2018) is co-funded by NERC and Defra as part of the Shelf Sea Biogeochemistry Programme. The research is being developed by Cefas and UEA scientists, along with partners from the Carbon Trust, the National Oceanography Centre, University of Essex and the Met Office.

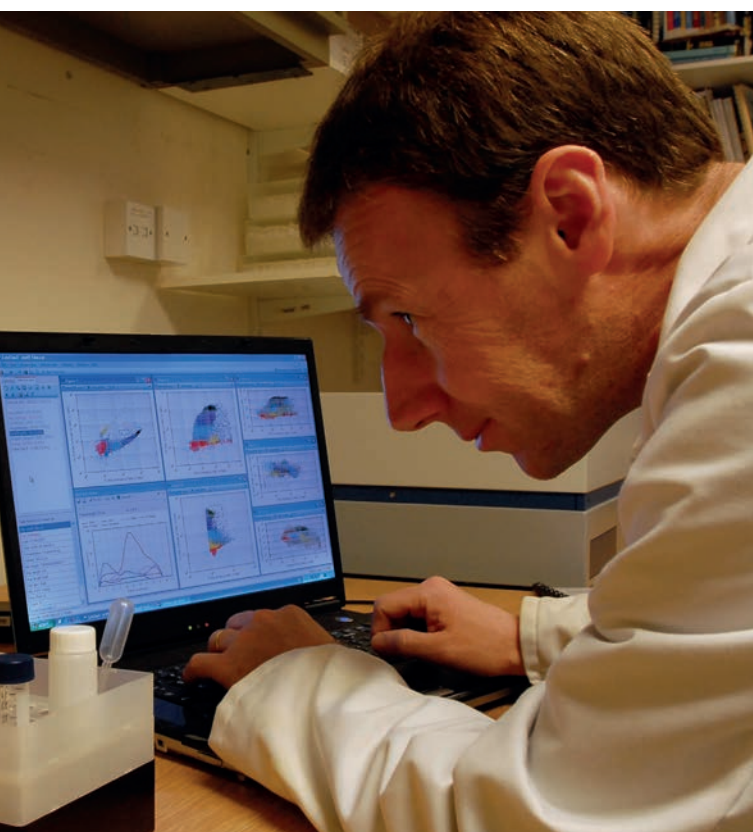
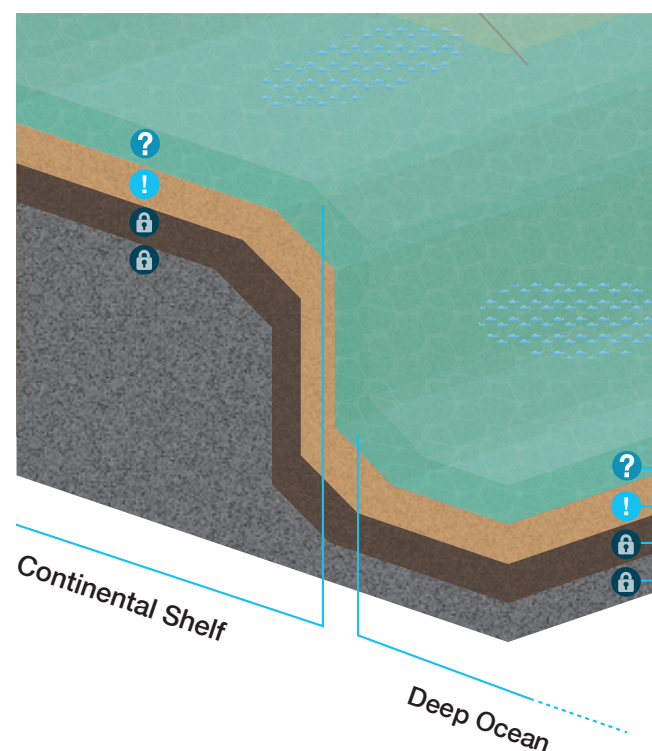


Photo Credit: Cefas

### Blue Carbon – accelerating impact

During the extensive discussions to find a common language and conceptual basis for the work on the project's first paper, a creative team was appointed from M-KEN creative industry partners MADE Agency, to participate in meetings to understand the science and the technical challenges the science team were grappling with. The philosophy behind this approach is to start to build capacity within the creative industries in Norfolk to understand the language of marine science to be able to better assist in the



The project is investigating Blue Carbon across the North West European shelf ecosystems, from storage in off-shore marine sediments to export to the deep ocean. The project connects biogeochemists with environmental economists to re-define blue carbon ecosystem services, and conduct accounting and valuation exercises for the UK's blue carbon sink. The possibility of applying carbon trading principles to these services – along the lines of those being used to protect forest ecosystems on land – are also being investigated.

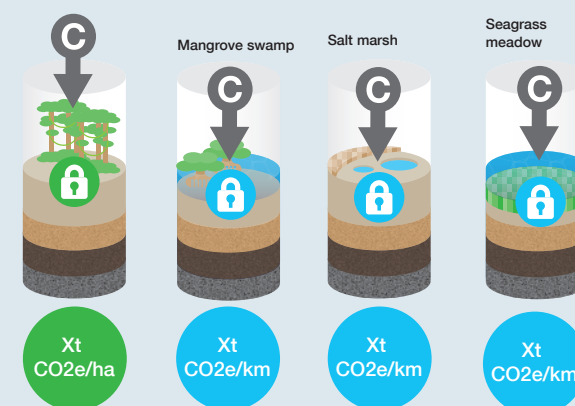
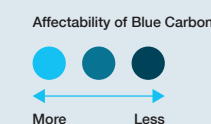
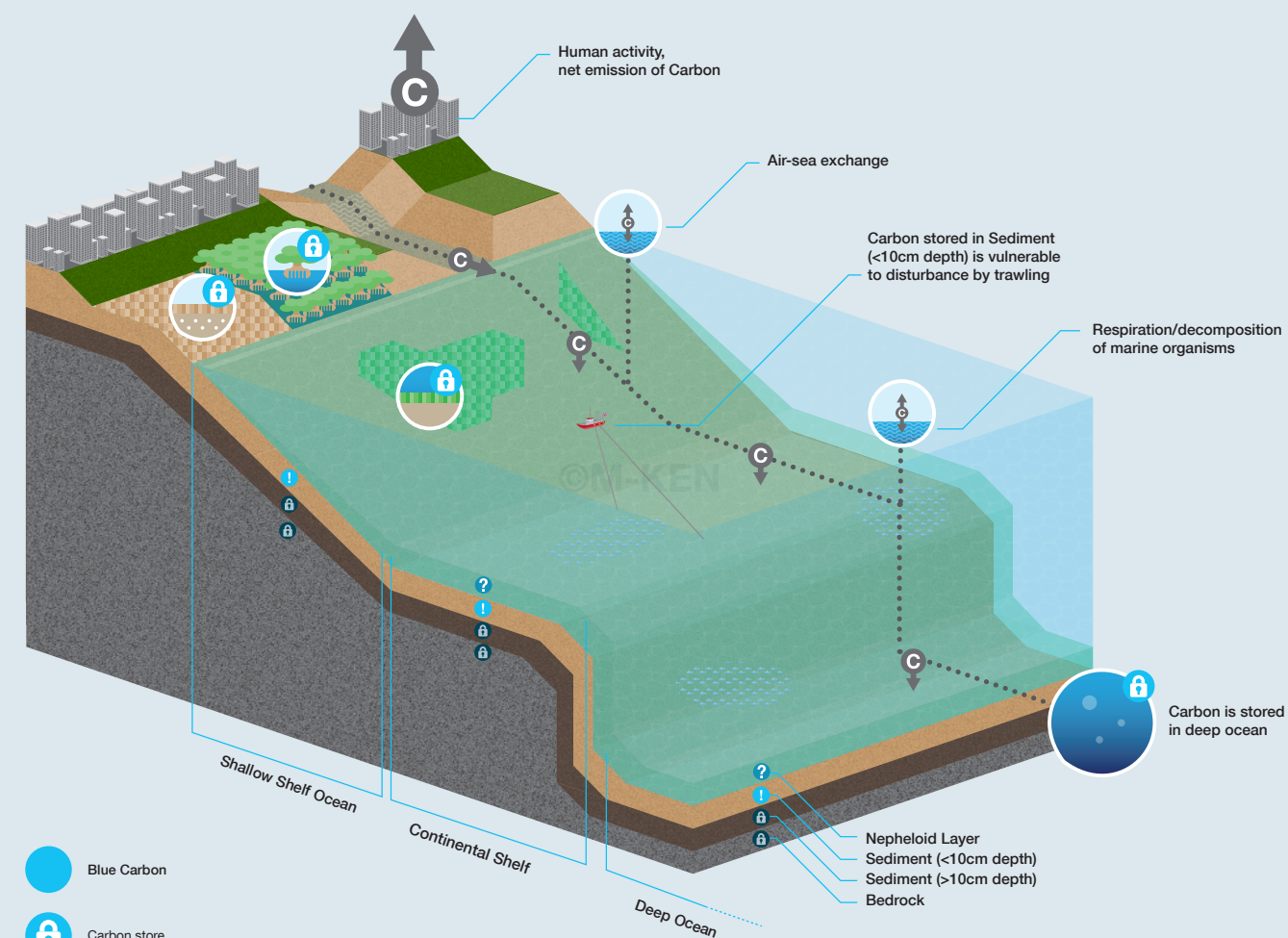
In the first phase of the project a conceptual framework for valuing whole-shelf blue carbon storage has been developed, together with an initial estimate of the key stores of carbon in the system.

communications essential for the realisation of long term impact around research outputs. The infographic serves multiple purposes. It:

- Aids understanding of biogeochemical issues by environmental economists;
- Provides strong visuals to feed into high impact scientific publications;
- Offers visual element necessary to engage senior policy and political stakeholders.

For more information contact: [mken@uea.ac.uk](mailto:mken@uea.ac.uk).

## Carbon budgeting in a fluid system



### Blue Carbon in progress...

Work on the Blue Carbon infographic is still in progress. Here you can see a working draft of our design.



## Scientists and designers collaborate at 'Infohackit'

**#infohackit** What an enterprising idea bringing science and design together to communicate ideas to the world!  
@gazelleFE @norwichcollege

M-KEN's Infohackit was an innovative 12 hour event bringing together researchers and PGR students from the University of East Anglia, design students from Norwich University of the Arts and professional graphic designers. Participants were grouped into three teams – a mixture of scientists and designers – and then briefed on research projects to inspire and inform infographics.



The event was hosted at the startup lounge at City College Norwich, which is well equipped with computers, ideation stations and space to collaborate. The whiteboard walls were a magnet for scientists and designers alike – everyone grabbed a pen – and proved one of the most effective ways of working together. Scientists, often masters of figures and words, can sometimes be daunted by the possibility of visual explanation, especially with the additional requirement of literacy in Adobe's Creative Suite. Likewise, designers may find it challenging to get their heads around complex science, and hide in vectors and jargon. By downing tools (Illustrator tools, that is), and getting down to basics, the teams were able to find a common ground and collaborate effectively. This spirit endured when the time came to open up software, with scientists making design suggestions and working with their own copies of Adobe Illustrator.

**Amazing to see the creatives on the teams getting to grips with the nitty gritty of the science #infohackit**



Photos and tweets throughout the day poured into a live Storify feed, recording the progress of the day for posterity.

**Latest draft #infohackit figure**  
**Amazing what these designers can do @NercSSB @ueaenv**

10 hours and a significant amount of pizza later, the three teams presented their outcomes. All seemed to have embraced the spirit of the day, as teamwork was the watchword of each presentation. Independent judges were elected to give their verdict – the laurel wreath went to the 'A-Team', for their work on the biogeochemistry of the ocean carbon pump.



All who attended went away with an enhanced ability to collaborate, communicate, and a greater understanding of marine science and the scientific community.

**Only 43 minutes left for our teams to complete their #infohackit teams looking confident**

### Team: Two Options for managed realignment

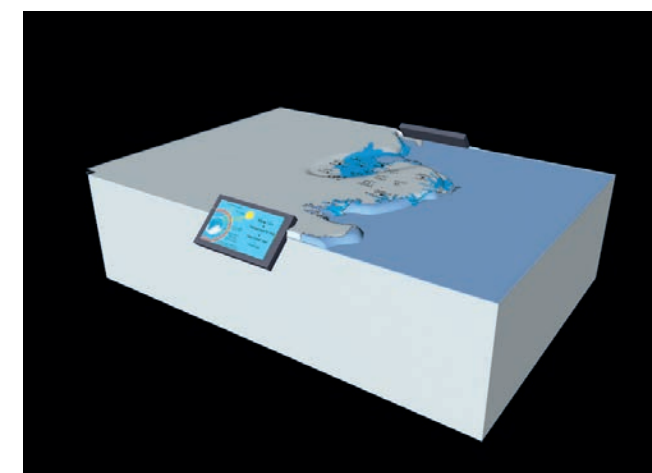
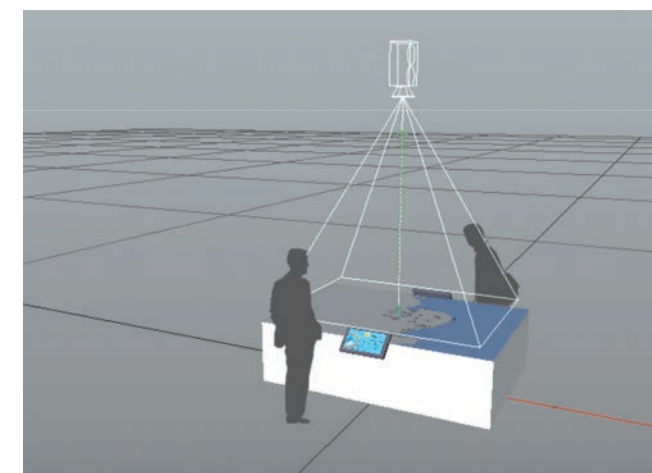
**The Brief:** As well as sea level rise due to global warming, the UK's rebound from the last ice age is also causing East Anglia to sink. Use the historical landscape of the Wash to communicate the need for adaptation in the face of rising sea levels.

**What we did:** The communication needs of our project were clear – however the delivery format was left entirely open. As this was a three dimensional problem, we decided the most engaging way to present this research to policy makers and the public would be through something physical, and something interactive.

We proposed a 3D map of East Anglia onto which the changing sea levels are projected. This would also incorporate an interactive interface, where users can skip backwards and forwards through time, to see how sea levels have changed in the past, and possible projections of the future under different management options.

Our scientists and designers worked in tandem to produce a presentation that would summarise the problem, and present several potential solutions: Defend, Abandon, or Adapt? All our graphics were produced on the day, with our scientists leading the way on theory and accuracy.

**Team leader: Andy Griib, Griib inspirational spaces**



### Team: Lonely Robots Seaglidors

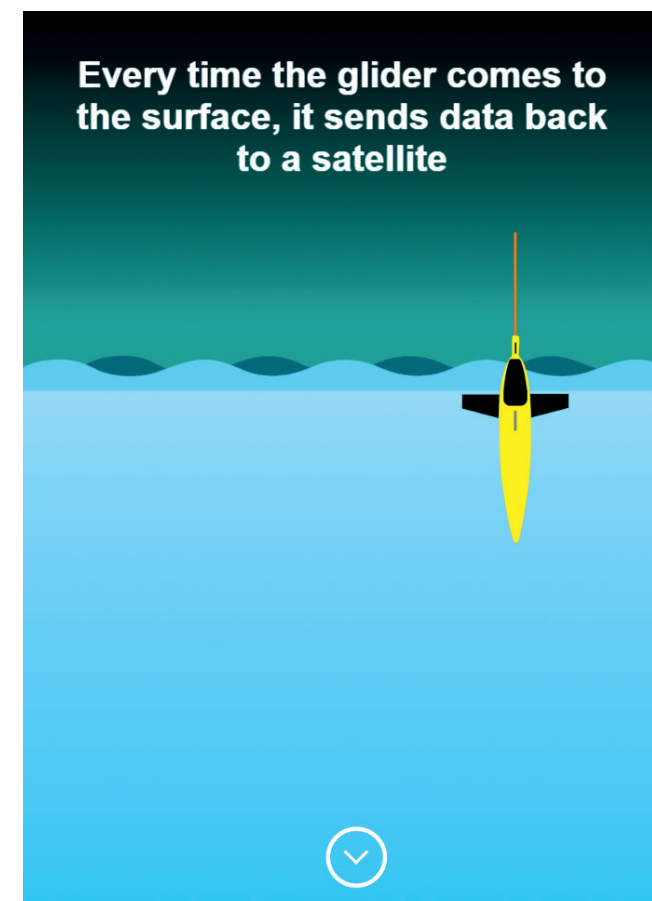
**The Brief:** Data from our open oceans can help us better understand our atmosphere. Ocean gliders are a new and innovative way of gathering this data that have many advantages over existing methods.

**What we did:** This project was an eye-opener for me. The extent of my scientific knowledge isn't much so getting to really engage with the research was great for me and the other designers in our team.

As our scientists explained the concept and operation of the ocean gliders to us, images of these lonely robots travelling through the sea immediately sprang to mind. We decided an animation would be the best way to show the ocean gliders in action, because robots are cool, and that's a good way to engage people.

Our scientists provided the content, storyboarding out a typical journey for an ocean glider, whilst our designers took to Adobe Edge Animate to make this a reality. The time constraint was the biggest challenge on this piece of work, but our team rose to the challenge – we were very proud of our collaborative effort.

**Team leader - Darren Leader, Darren Leader Studio**





## The A-team - Biological carbon pump

Well done the A Team :-) great teamwork = great image #infohackit

**The Brief:** Communicate the biogeochemistry of the ocean carbon pump – conveying information on a cycle of nitrogen, phosphorus and carbon in the ocean, integrating various organisms, inputs and outputs.

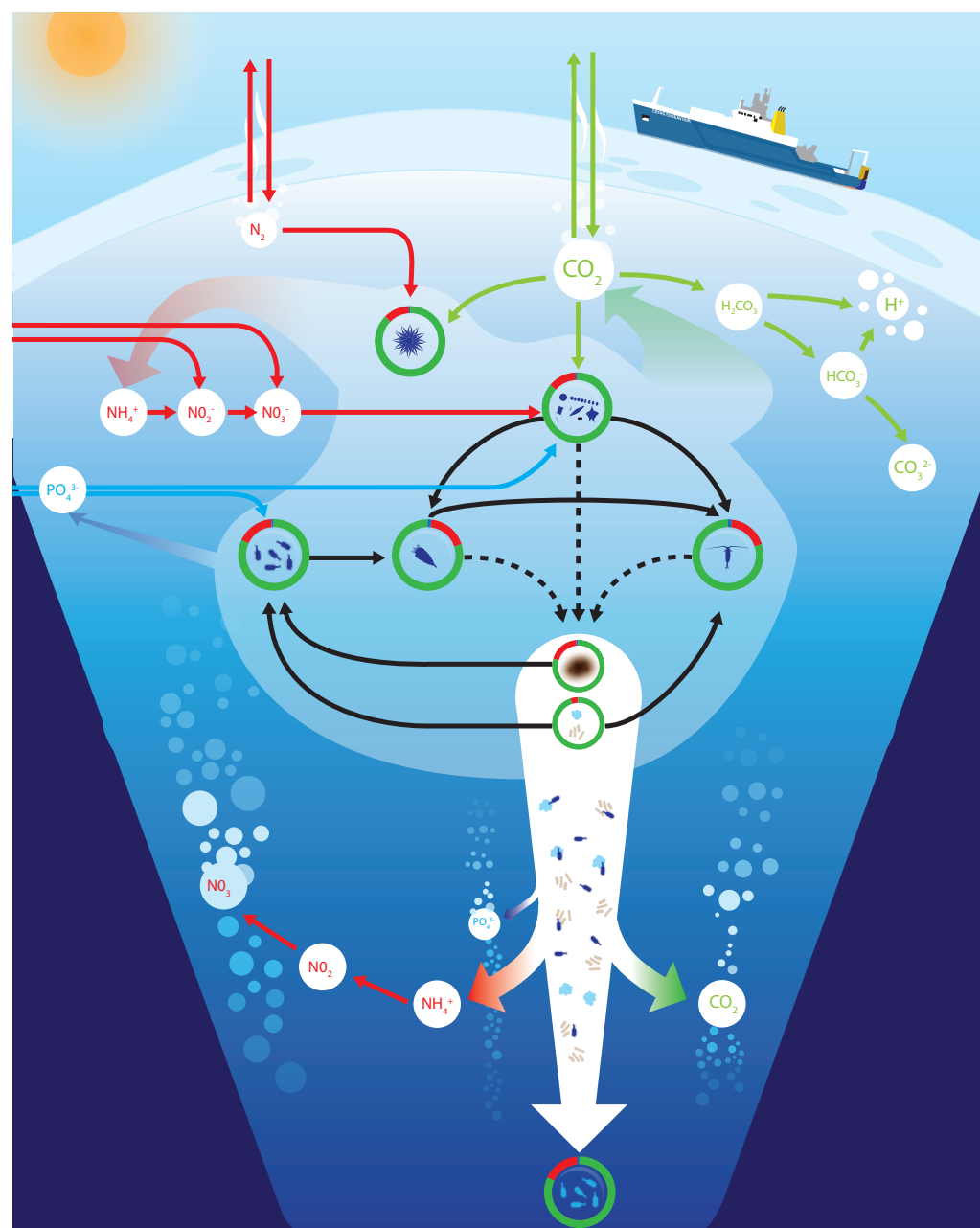
**What we did:** Our first goal was to understand the science – we worked with our researchers to get all the science for the diagram on to a single bit of paper. From here was a process of distillation. We discussed how we could trim down what we had into something more workable, focusing on the level of detail required, the relationships between information and most importantly: scientific accuracy.

And the winners are ..... The A-team #infohackit

The whiteboard was our main port of call throughout the day. The scientists and designers worked alongside one another to refine and reproduce all the information needed, in ever-increasing levels of efficiency.

By the end of the day, designers were pointing out where the science was wrong, and scientists were producing vectors and refining the graphic styles. The final diagram (or as final as it could be made in a single day), came together really well. Everyone in our team felt involved, loved the experience and took a lot of value from it.

**Team leader - Chris Bennett, The Genome Analysis Centre**



## Get involved

Over the course of its first year the benefits of M-KEN as a useful model for delivering science research impact have become very apparent. M-KEN acts as the channel for marine science translation, dissemination and in turn impact. In doing this M-KEN;

**Listens** to the needs of the researcher and works to understand which scientific findings are most likely to be relevant to the wider world, why and to whom, making sure that all Research Council impact-reporting requirements are met smoothly and in concert with wider results preparation and publication;

**Focuses** on the knowledge needs of marine industry and policy and matches this need with the aspirations and future direction of the researcher;

**Builds** effective bridges between industry, policy and science via a wide variety of media, positioning all parties for effective technical and commercial knowledge based growth.

Anchored and led by UEA, the M-KEN SME based delivery team provides a highly agile supply chain to UEA and future M-KEN partners. Offering professional services in arts integration, infographics, engagement, business development, research commercialization and more.

Looking to the future M-KEN will become the launch pad for major new collaborative marine and coastal research funding opportunities.

Please contact the team for further information, and with ideas, comments and suggestions. Get in touch. M-KEN will respond to every single enquiry and put in place the best ideas. Over to you!

Visit [www.marineknowledge.org.uk](http://www.marineknowledge.org.uk) and join the network.

Contact us at: [mken@uea.ac.uk](mailto:mken@uea.ac.uk).

Photo Credit: Cefas



Blue Ltd.



MADE



[www.marineknowledge.org.uk](http://www.marineknowledge.org.uk)

#### Acknowledgements



BUSINESS  
SCHOOL

