

Cefas support for NERC JSR: Improving understanding of shelf sea ecosystem function using integrated autonomous observing systems

Cefas is the UK's most diverse centre for applied marine and freshwater science and research, covering an unrivalled breadth of specialist areas to provide a fully integrated, multi-disciplinary approach to marine and freshwater science. Cefas employs around 530 people employed nationally between the laboratory sites in Lowestoft and Weymouth as well as our small, port-based offices in Whitehaven, Scarborough, Exeter and Newlyn.

Cefas is responsible for providing the UK government with comprehensive and wide-ranging statutory advice on fisheries, marine environmental quality and food safety in relation to legislative requirements that include the Common Fisheries Policy, the Marine Framework Strategy Directive, OSPAR, and the Marine and Coastal Access Act. We also work with UK Overseas Territories, international governments, public and private sector organisations, educational and research institutions, as well as non-governmental organisations. We work with industries across a range of sectors including aquaculture, fisheries, international government capability development, marine and coastal infrastructure, nuclear energy, offshore renewable energy, oil and gas and shipping.

Cefas fully supports the NERC-JSR call on Improving understanding of shelf sea ecosystem function using integrated autonomous observing systems. Cefas leads nationally on the delivery of marine monitoring programmes in support of UK and EU policy. The call will help develop tools and understanding that are in support of Defra's vision for the marine environment of clean, healthy, safe, productive and biologically diverse oceans.

Specifically, under this initiative, Cefas will be providing in-kind support to the call through provision of data from the SmartBuoy network, access to space on the RV Endeavour during marine monitoring or R&D surveys as appropriate (and dependent upon the availability of berths). Cefas will also contribute Cefas staff time and other resources in pursuit of the JSR call aims. Detailed information is provided below.

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Cefas capability relevant to the NERC JSR: Improving understanding of shelf sea ecosystem function using integrated autonomous observing systems

SmartBuoy Programme

Cefas has collected environmental and nutrient data throughout UK waters using instrumented buoys (SmartBuoy) since 1999 providing high frequency data from several key sites and supplemented by R&D programmes in various locations (<https://www.cefas.co.uk/cefas-data-hub/smartbuoys/>). Measurement of the following are routinely obtained:

- Temperature, pressure and conductivity
- TOxN (nitrate and nitrite) using an automated in situ nutrient analyser
- TOxN, silicate and phosphate using preserved samples collected by water sampler (up to 50 samples)
- Chlorophyll fluorescence
- SPM derived from measurements of optical backscatter
- Underwater light attenuation coefficient (K_d) from measurements of downwelling PAR irradiance, with at least 2 sensors spaced beneath the buoy in the water column
- Dissolved oxygen using optodes
- SPM and phytoplankton species composition and abundance, can be determined from preserved water samples.

New sensors can be integrated into the package by Cefas engineers and all the existing SmartBuoy locations have spare payload capacity for collaborator's sensors or instruments. Similar sensors to those on SmartBuoy are installed in a FerryBox on RV Cefas Endeavour which collects continuous surface water data during all monitoring or R&D surveys.

Vessel-based monitoring of UK seas

Our operational work includes monitoring programmes that we undertake for Defra using the R/V *Cefas Endeavour*, our purpose built ocean-going research vessel, to supply underpinning science to help Defra comply with national and international legislation. Some of this work is highly prescribed in nature with fixed point sampling e.g. fish stock evaluation but other programmes are more flexible. These monitoring programmes provide opportunities to scientists to undertake discrete work packages alongside monitoring effort, and to extend operational cruises by adding research modules.

Access to relevant data resources from our research

Past research programmes provide opportunities for data mining as baselines for new work or to address trends by adding new measurements. Cefas has carried out extensive work on carbon and nutrient flows and budgets, and has data for physical, chemical and biological parameters for the water column and the sea bed. We have compared the environmental regime at impacted areas, with those at largely undisturbed sites. Ongoing work includes research on climate change, sea-bed integrity, nutrient flux, plankton and fish dynamics, ecosystem structure and function, and the impacts of human activities.

The Cefas Data Hub <https://www.cefas.co.uk/cefas-data-hub/> is a rich source of historic data, and also hosts the Cefas SmartBuoy and WaveNet dataportals

Other facilities

Cefas is home to state of the art facilities, including:

- the very latest aerial and marine survey instrumentation and platforms, including in-house developed technology products and a range of autonomous vehicles.
- Laboratories in Lowestoft and Weymouth, which are dedicated to providing support, analysis and research for our customers' projects, as well as helping ensure that Cefas stays at the cutting edge of marine and freshwater science and technology.
- Our purpose built Weymouth laboratory houses a world-class biocontainment experimental tank facility. Adaptable to a wide range of environmental conditions, the facility can be designed to specifically meet customer requirements.