

## MARITIME MONITORING FOR THE CONSERVATION OF UK MARINE RESOURCES

*Through maps of ship density, Sentinel-1 provides the means for sustainable management and protection of UK waters and its fisheries.*

### The challenge

The Centre for Environment, Fisheries and Aquaculture Science (Cefas), with its mission to protect the seas and ensure safe and sustainable seafood, is collaborating with Cranfield University to establish an operational maritime monitoring system based on Sentinel-1 imagery and data from the Automatic Identification System (AIS). This solution responds to the need for a long-term and cost-effective system to protect marine ecosystems and food security from threats such as overfishing and pollution.

The monitoring system takes advantage of the Sentinel-1 constellation which generates an unprecedented volume of high-quality radar images capable of providing actionable intelligence about maritime activities in critical fishing regions.

### The space based solution

Radar images like those produced by Sentinel-1 are operationally used to detect ships as small as 20 m, even in cloudy conditions. In particular, Sentinel-1 can detect the ships which broadcast identification messages using their onboard AIS, but also those which do not use or have AIS, also referred to as dark ships.

Whilst Sentinel-1 predominantly provides positional information (longitude and latitude of the ships) and some indication on ship size, AIS messages have more detailed information (ship position, type, speed, destination ...). The system developed by Cefas and Cranfield University uses Machine Learning techniques and a large database of AIS messages to enrich the information provided by Sentinel-1. In practice, after detecting all the ships in a Sentinel-1 image, the system attributes the most probable ship type (for e.g. cargo, tanker, fishing ship) to each detected ship based on its estimated position and size.



Ultimately, the system provides maps of ship density (number of ships per month in a given area) for different ship types which can be further analyzed for trends and patterns.

### Benefits to Citizens

This Sentinel-1-based system improves maritime monitoring both in terms of cost and quality. In the past, Cefas mainly used commercial AIS data as a source of information. With this new monitoring method, AIS data are only needed initially to teach the system how to automatically recognize ship types based on their geographical position and size. Beyond this initial phase, the system relies solely on the free Sentinel-1 images, hence the long term reduction in cost.

Quality wise, Sentinel-1 also provides a more complete maritime picture by revealing even the dark ships. The continuation of the Sentinel-1 mission over the next decade will allow generating time series of ship density maps which reflect trends in fishing



Maritime traffic in the Strait of Dover highlighted by a mosaic of all the Sentinel-1 images acquired in 2017.

*Credit: Contains modified Copernicus Sentinel data [2017]*

Thematic Area



AGRICULTURE,  
FOOD, FORESTRY  
AND FISHERIES

Region of Application



NORTH  
SEA

Sentinel mission used



S1

Copernicus Service used



-

Usage Maturity Level



3

effort and potential pollution. With these maps, Cefas has access to reliable intelligence to sustainably manage and protect the UK waters and its fisheries which significantly contribute to food security, livelihoods, and the economy.

## Outlook to the future

The next step will be to adapt the system to monitor the waters surrounding the UK overseas territories which host globally significant biodiversity. Defining Marine Protected Areas for these territories is relatively straightforward, but monitoring and policing them is a challenge because of their large extent, remoteness, and the limited resources available. As Sentinel-1 reaches full operational capacity, routine images are becoming available over the overseas territories for which very little information was available in the past. Although the number of images is smaller than that over UK areas, the Sentinel-1 maritime monitoring system is anticipated to periodically enable the assessment sea compliance.



Distribution of AIS messages which are used to teach the system how to automatically recognize different ship types.

“This work has many useful applications across departments, agencies and administrations. At Cefas, we have seen immediate uptake for monitoring and observing UK waters.”

*Lauren Biermann, Cefas*

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The model cases focus on local and regional authorities who successfully applied Copernicus data in 8 major public policy domains. The views expressed in the Copernicus User Stories are those of the Authors and can in no way be taken to reflect the official opinion of the European Space Agency or of the European Commission.

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