# NEODAAS Support for the Integrated Autonomous Observing Project

## Introduction to NEODAAS

The NERC Earth Observation Data Acquisition and Analysis Service (NEODAAS) is a dual node facility that underpins high-quality science in the NERC community providing a comprehensive integrated service from satellite data reception to scientific product delivery. **NEODAAS-Dundee** at Dundee University's Satellite Receiving Station receives data from many direct-broadcast polar orbiting satellites. It has a partially unique geographical coverage and wholly unique frequency of coverage and archive time-series. It includes data from NOAA satellites (1978-present), NASA's Terra and Aqua (2000-present) and more recently MetOp and Suomi NPP. **NEODAAS-Plymouth** at Plymouth Marine Laboratory undertakes scientific data processing providing many unique services and products to UK scientists. It has global coverage through local copies of ESA, NOAA and NASA datasets and global near-real time (NRT) capability through subscriptions with NASA (MODIS and VIIRS) and NOAA (AVHRR), with ESA Sentinel 2 and 3 in preparation. All Dundee data are systematically delivered to Plymouth for immediate processing and rapid product availability: this is a vital feature for near-real time guidance of research aircraft and ships.

## NEODAAS services Relevant to the Integrated Autonomous Observing Project

*Near-real time processing for cruise/deployment guidance*

A key area of support from NEODAAS is the near-real time guidance of research vessels or deployment of gliders and other autonomous vehicles for cost-efficiency and maximising science. EO data can be processed by NEODAAS within hours of reception, to show surface concentrations and location of highly dynamic biotic and abiotic phenomena such as algal blooms, fronts, eddies or coastal upwelling and filaments. Examples of support to cruises or glider deployments include:

- AUV deployments, for example, in MASSMO (Marine Autonomous Systems in Support of Marine Observations) in the Celtic Sea (Fig. 1a) where near-real-time and archived observations of fronts can optimise AUV strategy for hydrographic or ecosystem surveys.
- West of Scotland where daily satellite images of phytoplankton chlorophyll-a (Fig. 1b) and sea-surface temperature (SST) data were provided to identify features in the open water, which were then successfully sampled by sea glider (work in CANDYFLOSS - Carbon And Nutrient DYnamics and FLuxes Over Shelf Systems by SAMS).
- NERC programmes such as: Shelf Seas Biogeochemistry where EO data on sea-surface temperature and chlorophyll-a were provided daily to the research vessels; or SOLAS, where SST and chl-a were used to follow upwelling filaments off Africa.

New sensors from the European Space Agency will offer high-resolution observation pertinent to coastal regions: e.g., Sentinel 2 MSI launched in 2015 (down to 10m) and Sentinel 3 OLCI launched in 2016 (to 300m) or the US Landsat 8 OLI (to 30m) (Fig 1c)

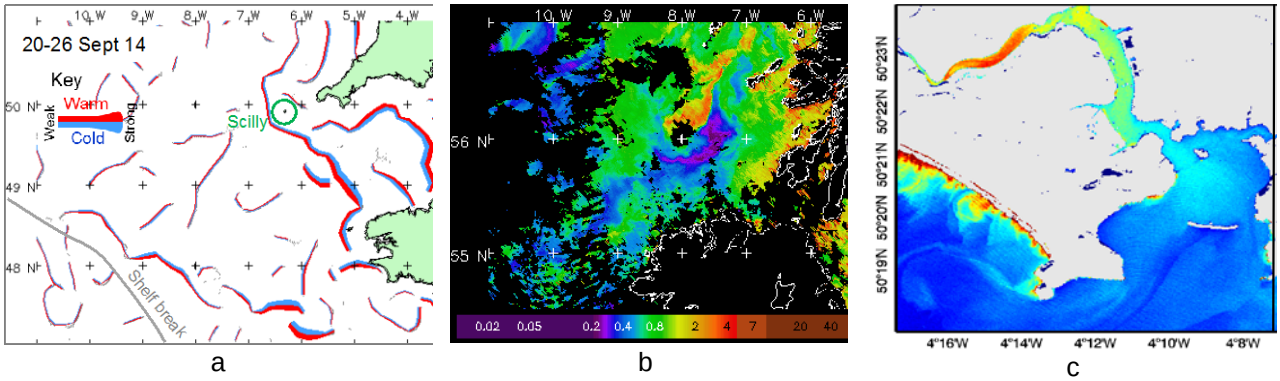


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Figure 1: a) 7-day (20-26 Sept. 2014) synoptic map of thermal fronts used in MASSMO project; b) VIIRS chlorophyll-a image from 3 July 2015 used to guide in situ sampling west of Scotland (using OC5 algorithm optimized for European waters); c) Landsat 8 OLI suspended sediment image Plymouth Sound, 4 Nov 2013.

*Synoptic context of in situ observations*

NEODAAS can provide re-analysed EO data (improved values, for example, through use of actual meteorological data to process data), subsequent to a field campaign, for integration with in situ data demonstrating combination of observations from different sources. Analyses can include comparison of location of features such as fronts, eddies, phytoplankton blooms or comparison of retrieved variables, such as sea-surface temperature, chlorophyll-a concentration or turbidity. It is also possible to model, from EO, various carbon cycle variables such as as primary production (e.g. Fig. 2b) for comparison with in situ data from gliders (e.g., Hemsley et al., 2015, *Environ. Sci. Technol.*, 49, 11612−11621).

*Time series analyses*

NEODAAS can provide EO time series analyses to place in situ campaigns in a temporal context with respect to interannual variations; furthermore, spatio-temporal characteristics from EO can be assessed in sites anywhere worldwide to demonstrate transfer of approaches and techniques to other areas, such as overseas UK territories. EO time series from SST are available from 1981, from ocean colour since 1997 and a variety of other variables are available from NEODAAS or sourced by NEODAAS from the Copernicus Marine project and other suppliers. Derived quantities include phytoplankton phenology, such as the onset, duration and peak magnitude of the spring bloom (Fig. 2a), size-fractionated chlorophyll-a (e.g., Fig. 2c) or the interannual variability in physical processes such as coastal upwelling or front location. NEODAAS supported scientists have used time series of fronts and other EO-derived environmental indicators, together with in situ data, to model parameters impacting upon megafauna distribution and behaviour, or invertebrate habitat selection, or to observe variability in proposed marine protected areas.

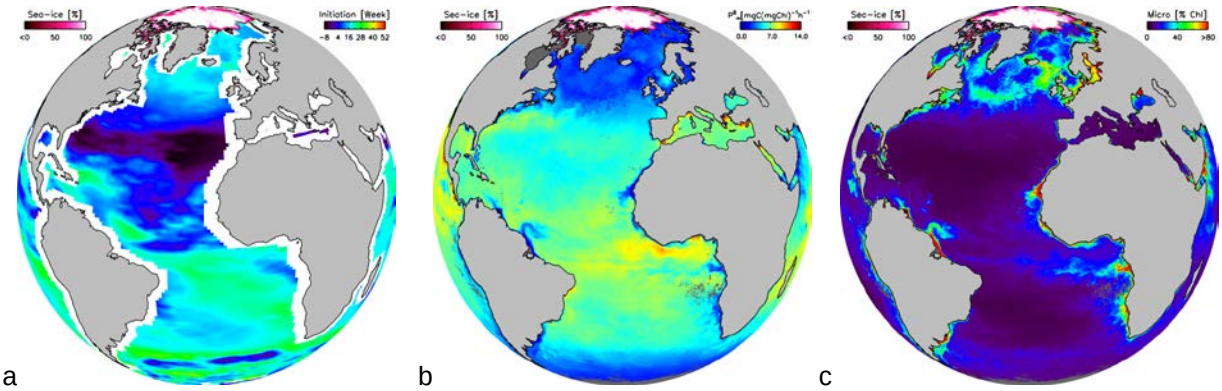


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Figure 2: Images of a) phytoplapnkyon phenology (bloom initiation) b) productivity and c) microphyoplankton fraction (courtesy Bob Brewin and Marie Fanny Racault, PML)

**Summary**

NEODAAS can provide services to support activities in the Integrated Autonomous Observing project, most notably to maximise the science that can be done on research cruises and optimising deployment location and tracking for autonomous vehicles such as gliders. NEODAAS can also supply time series of standard products to extend the in situ observation in time and space. The service costs need to be included in applications.

Finally, NEODAAS is a service and can only undertake limited research and development into new techniques or algorithms; such R&D activities can be undertaken through research partnership with PML or other EO groups in the UK.

**Contact**

More information about NEODAAS is available at https://www.neodaas.ac.uk/ or contact Steve Groom on sbg@pml.ac.uk.