SERVICES & FACILITIES ANNUAL REPORT - FY April 2014 to March 2015

SERVICE	FUNDING	AGREEMENT	ESTABLISHED as S&F	TERM
NERC Earth Observation Data Acquisition and Analysis Service (NEODAAS)	Block	Dundee - R8/H10/66 Plymouth - R8/H10/67	Dundee: 1981, Plymouth: 1995 Combined: 2006	8 Years

TYPE OF SERVICE PROVIDED:

NEODAAS is a dual node facility that underpins high-quality science in the NERC community through responsive mode grants, directed programmes, national capability and direct access. NEODAAS provides a comprehensive integrated service from satellite data reception to scientific product delivery. Dundee University's Satellite Receiving Station (NEODAAS-Dundee) provides direct satellite data acquisition, dissemination and archiving and the Plymouth Marine Laboratory (NEODAAS-Plymouth) provides data processing and analysis services. NEODAAS supports NERC users across most science areas with Marine, Atmospheric and Polar scientists forming the majority of the user base. Users undertaking their own processing and analysis can access data and image products direct from Dundee or Plymouth. The facility underpins NERC knowledge exchange activities by providing free web based access to information and imagery. Usage statistics show worldwide interest and wide use by the public, in education and to showcase facilities such as the SAC, Harwell.


FINANCIAL TIMES

Taming the Big Four

Rate rise unlikely before election, Carney signals

Red warning Fresh storm lashes UK and deepens misery for flood victims

Figure 1: NEODAAS image from 12th Feb 2014 widely used by the media.

NEODAAS-Dundee 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. The archive is increasingly important for long-term monitoring needs as it extends. It includes data from NOAA satellites (1978-present), NASA's Terra and Aqua (2000-present) and more recently MetOp and Suomi NPP. Archives of SeaWiFS (1997-2010) and CZCS (1979-86) data are also available. A secure offsite copy of all raw polar satellite data is stored at the NERC EO Data Centre. Geostationary satellite data are received and provide global observations. Users such as overseas researchers may purchase data, with income offsetting capital bids. The engineering expertise at Dundee ensures that the facility is operated, maintained and developed in a responsive and cost-effective manner.

NEODAAS-Plymouth undertakes scientific data processing providing many unique services and products to UK scientists. It can provide global near-real time data through subscriptions with NASA (MODIS and VIIRS) and NOAA (AVHRR) and global time series data through local copies of ESA, NOAA and NASA datasets. All Dundee data are systematically delivered to Plymouth for immediate production of ocean colour and sea-surface temperature data and rapid dissemination: this is vital for near-real time guidance of research aircraft and ships to optimise in situ sampling and maximise science. NEODAAS-Plymouth exploits the results of research undertaken within PML, funded by the EC, ESA and other NERC sources, notably NCEO. Hence, users benefit from a much greater range of products and developments than would be possible purely through service and facilities funding.

ANNUAL TARGETS AND PROGRESS TOWARDS THEM (NEODAAS OPMs)

In 2014, NEODAAS contributed to 71 peer-reviewed ISI papers (equal highest NEODAAS annual figure) and two PhD theses; there were 2217 ISI citations of papers supported by NEODAAS (and its predecessors DSRS and RSDAS). In FY 2014-15 there were ~290 days of cruise support including an estimate of 60 days on-demand service for BAS. Cruise support was severely impacted as a result of RRS Discovery being unavailable: e.g. postponement of much of the NERC SSB programme. There were 17 successful applications, and including on-going requests NEODAAS supported 29 projects via formal application with 164 users, including 21 PhD students, showing continued high demand for the service. There were 661 users of NEODAAS AVHRR data through the international GHRSST project. 4.2 million NEODAAS value added image products were requested from the website by registered users. Acquisition statistics for polar-orbiting satellite data were: Scheduled passes = 12105, Passes lost = 9, Success rate = 99.93%.

SCORES AT LAST REVIEW (each out of 5)			Date of Last Review:	March 2008
Need	**Uniqueness**	**Quality of Service**	**Quality of Science & Training**	**Average**
5.0	5.0	5.0	5.0	5.0

CAPACITY of HOST ENTITY FUNDED by S&F	Staff & Status	Next Review (Mar)	Contract Ends (31 Mar)
Dundee 100% **Plymouth 100%**	**Dundee:** S&F Funded – Parkes, 10% (Director); Lonie (Manager); Brooks & Bowyer (Software/Systems); Moonlight, Isabella & Doig (Technician) – All 100%; Crawford, 80% (Electronics/Comms. Engineer). **Plymouth:** S&F Funded: Groom, 20% (Director); Taylor, 53% (Manager); Miller, 14%, Shutler, 8% (Tech. mgmt); Taberner, 15%, Grant, 15%, Walker 28%, Loveday, 22% (Systems & development); Pardo,42%, Hoya 41%, Knappett, 24%, Clements 22%, Paxman 11% (User requests).	**TBC**	**2017**

FINANCIAL DETAILS: CURRENT FY

Total Resource Allocation £k	Unit Cost £k			Capital Expend £k	Income £k	Full Cash Cost £k
Dundee: £332.00k	Operations Hour: £0.104k			£0k	£6.07k	£332.00k
Plymouth: £268k	Staff Effort	Data Quantity	Real-time support days	Plym: £100k	£0k	£267.99k
	£0.500	£1.000	£0.395			

FINANCIAL COMMITMENT (by year until end of current agreement) £k (*Actual Claimed, †At agreed NCEO rate)

NEODAAS Dundee	**2014-15**	*330.51k	**2015-16**	†327.80k	**2016-2017**	-	**2017-2018**	-	**2018-2019**	-
NEODAAS Plymouth	**2014-15**	†267.99k	**2015-16**	†264.60k	**2016-2017**	-	**2017-2018**	-	**2018-2019**	-

STEERING COMMITTEE	Independent Members	Meetings per annum	Other S&F Overseen
NEODAAS	7	1	None

APPLICATIONS: DISTRIBUTION OF GRADES (current FY — 2014/15)													
	10	**9**	**8 (α4)**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**R***	**Pilot**
NERC Grant projects*	0	2	1	0	0	0	0	0	0	0	0	0	0
Other academic	0	1	6	4	0	0	0	0	0	0	0	0	0
Students	0	0	2	1	0	0	0	0	0	0	0	0	0
TOTAL	0	3	9	5	0	0	0	0	0	0	0	0	0

PROJECTS COMPLETED (current FY – 2014/15)												
	10 (α5)	**9**	**8 (α4)**	**7**	**6 (α3)**	**5 (α2)**	**4**	**3 (α1)**	**2**	**1 (β)**	**0 (Reject)**	**Pilot**
NERC Grant projects*	0	1	1	0	0	0	0	0	0	0	0	0
Other Academic	0	1	7	2	0	0	0	0	0	0	0	0
Students	0	0	3	1	0	0	0	0	0	0	0	0

Project Funding Type (current FY – 2014/15) (select one category for each project)											
Grand Total	**Infrastructure**					**PAYG**					
	Supplement to NERC Grant *	**PhD Students**		**NERC Centre**	**Other**	**NERC Grant***	**PhD Students**		**NERC Centre**	**Other**
		NERC	**Other**				**NERC**	**Other**		
29[+]	5	4	1	9	10	0	0	0	0	0
Project Funding Type (per annum average previous 3 financial years - 2011/2012, 2012/2013 & 2013/14)										
Grand Total	**Infrastructure**					**PAYG**				
	Supplement to NERC Grant *	**PhD Students**		**NERC Centre**	**Other**	**NERC Grant***	**PhD Student**		**NERC Centre**	**Other**
		NERC	**Other**				**NERC**	**Other**		
40.67	9.33	3.33	2.67	7.67	17.67	0	0	0	0	0

[+]NB: The lower number of projects in 2014/15 compared to the 3-year average is due mainly to a change in counting methodology at NEODAAS-Dundee reducing the number of "Other" projects. RRS Discovery being out of commission also reduced the number of cruise applications.

User type (current FY – 2014/15) (include each person named on application form)				
Academic	**NERC Centre**	**NERC Fellows**	**PhD Students**	**Commercial**
78	**65**	**0**	**21[+]**	**29**
User type (per annum average previous 3 financial years - - 2011/2012, 2012/2013 & 2013/14)				
Academic	**NERC Centre**	**NERC Fellows**	**PhD Students**	**Commercial**
141.67	**83**	**0**	**21**	**30.33**

[+]Note the figure for PhD students include those on cruises – most of whom won't use NEODAAS data in their thesis yet benefit from NEODAAS support: this explains why the number of supported PhD students is much greater than those publishing NEODAAS data or acknowledging the service.

OUTPUT & PERFORMANCE MEASURES (current year)										
Publications (by science area & type) (calendar year 2014)										
SBA	**ES**	**MS**	**AS**	**TFS**	**EO**	**Polar**	**Grand Total**	**Refereed**	**Non-Ref/ Conf Proc**	**PhD Theses**
0	**3**	**44.82**	**46.65**	**3**	**10.33**	**2.17**	**110[*]**	**71[*]**	**37**	**2**

Distribution of Projects (by science areas) (FY 2014/15)							
Grand Total	**SBA**	**ES**	**MS**	**AS**	**TFS**	**EO**	**Polar**
29	**0**	**1**	**21.33**	**0.33**	**0.5**	**5.33**	**0.5**

OUTPUT & PERFORMANCE MEASURES (per annum average previous 3 years)										
Publications (by science area & type) (Calendar years 2011, 2012 & 2013)										
SBA	**ES**	**MS**	**AS**	**TFS**	**EO**	**Polar**	**Grand Total**	**Refereed**	**Non-Ref/ Conf Proc**	**PhD Theses**
0.17	5.92	59.97	37.69	1.25	18.74	3.25	**127**	55.5	66.5	5

Distribution of Projects (by science areas) (FY 2011/2012, 2012/2013 & 2013/2014)							
Grand Total	**SBA**	**ES**	**MS**	**AS**	**TFS**	**EO**	**Polar**
46.67	0	1.22	31.87	3.15	0.78	7.92	1.72

[*]NB: The number of publications is an under-estimate since it excludes publications that benefitted from NEODAAS guidance of research cruises and did not acknowledge the facility, nor were flagged by the project PI.
Referred publications are found by searching journals and google scholar by NEODAAS staff and by contacting users.

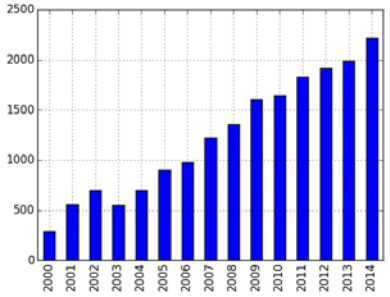
Distribution of Projects by NERC strategic priority (current FY 2014/15)							
Grand Total	**Climate System**	**Biodiversity**	**Earth System Science**	**Sustainable Use of Natural Resources**	**Natural Hazards**	**Environment, Pollution & Human Health**	**Technologies**
29	**5.58**	**7**	**9.08**	**4.5**	**0.5**	**1.17**	**1.17**

**Either Responsive Mode or Directed Programme grants*

NOTE: All metrics should be presented as whole or part of whole number NOT as a %

Citations to NEODAAS publications:

The number of citations to all NEODAAS supported papers (and predecessor services, RSDAS and DSRS) is shown in the figure right with a total of 2217 citations in 2014.



OVERVIEW & ACTIVITIES IN FINANCIAL YEAR (2014/15):

Data Access/Provision: We visited ISRO/Antrix in India for discussions on receiving Oceansat-2 ocean colour data at Dundee. With their support, we then focussed on test and development which confirmed our systems can receive from Oceansat-2 and we will not require Antrix hardware as originally proposed. This shows the benefit of using our own versatile receivers which we can adapt to work with other data. In addition to data reception/distribution rights, they will now provide their data processing software plus installation, testing, training etc. Antrix have updated the draft agreement to reflect clarifications and revised arrangements and Uo Dundee contracts department are reviewing this. Unique data from over 4000 SeaWiFS passes received at Dundee were delivered to NASA for its global archive (Fig. 2). SeaWiFS provided high-quality ocean colour data and these NEODAAS datasets are now available to international users as well as the NERC community. CSIR, South Africa operates a system to provide near-real time wildfire alerts for Southern Africa. NEODAAS is supporting a pilot to extend coverage to Europe using MODIS data received at Dundee and NASA's active fires algorithm has been implemented for Suomi-NPP VIIRS data.

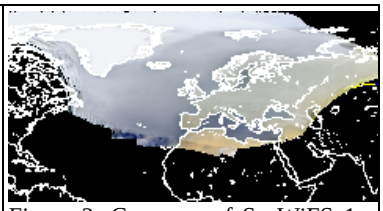


Figure 2: Coverage of SeaWiFS 1-km data received at Dundee and supplied to NASA.

Receiving Systems: In early 2014, two antennas were "off-air" after a tree fell during a storm and destroyed cables connecting them to the receiving station from their rooftop site on an adjacent building. Temporary arrangements were made to get them operational quickly, but we now have a permanent solution. A rooftop "garage" has been completely refurbished to create a dedicated room below the antennas in which our control, reception and other equipment is now installed. The antennas are remotely monitored/controlled and received data accessed in the station via network, which is a much better arrangement than before and with no vulnerable overhead cables. Both EUMETCast systems for receiving our geostationary satellite data have been upgraded with new hardware and software. One antenna and its RF front-end were also replaced. The upgrades have improved performance and ensure compatibility with the latest EUMETCast service.

Dundee Systems & Software: A cluster of new processing servers and web servers, funded by NERC capital, have been integrated into operations at Dundee. The processing machines are deployed as a mixture of virtual machine (VM) servers and application servers. These new systems are facilitating faster, more reliable data processing and shorter times to produce resulting products. This had become a problem with newer satellites such as Suomi-NPP and MetOp generating greater volumes of data, so processing times with our older systems increased significantly. The web servers replaced ageing machines and will support further website development and new products. We have redeveloped the system for remote real time viewing of imagery being received at Dundee. It is based around a Mac Mini and HD television, and runs in a browser accessing images and video clips on the station's web server. It has been extensively tested and modified to handle network problems found for different locations and is ready for use at other sites. So far, Dundee Science Centre and NERC Swindon are interested in displays. One of two systems for near-real time processing of Dundee data for Plymouth failed. A replacement was built in a virtual machine and runs in parallel with the remaining system.

Support for BAS Rothera station: On-going support is provided for the groundstation at Rothera, which Dundee supplied in 1992. Following the site visit in early 2014 for maintenance and upgrades, we have recently provided software updates and improvements plus guidance on diagnosing and repairing hardware faults.

Publicity: In 2014, our images were used in 6 books/e-books, 2 new TV programmes plus others rebroadcast, at least 14 printed or online articles by newspapers (e.g. Fig. 1) including The Telegraph, Times and Guardian plus many other websites including the Met Office. The 40th anniversary of the first dish based tracking antenna being installed at Dundee was covered by local media.

Plymouth systems: Our work was concentrated on transferring our GEOPS processing system to the JASMIN-CEMS high-performance facility at Harwell, with the aim of providing a resilient backup processing capability and significantly extending NEODAAS processing power towards intensive global processing. GEOPS is now working within a 'virtual machine' (VM) environment, so the remaining step is to upload the VM to JASMIN-CEMS for remote processing. A large amount of software development was required 'behind the scenes': to prepare our processing systems for a fundamental change to NASA's data delivery format from HDF to NetCDF; to consolidate our GEOPS processing chains to work identically for input data at Level 1 or 2; and to improve processing efficiency to maintain the timeliness of our near-real time commitments.

Ocean colour products: We have developed the expertise to acquire and process high-resolution (15-30m: Fig. 3) optical data from the Landsat-8 OLI instrument, to support the first application (of likely many). This builds upon collaboration between PML and the Royal Belgian Institute of Natural Sciences (RBINS). During the year the NOAA VIIRS sensor started to be used operationally as the increasing noise and calibration degradation affected Aqua-MODIS sensor data. Hence, we are implementing a processing chain for Level 0 VIIRS data received by Dundee to avoid waiting a day for Level 2 from NASA. We reprocessed the entire Aqua-MODIS archive 2002-present for the N Atlantic region, and completed operationalisation of the MedOC3 Mediterranean chlorophyll-a algorithm.

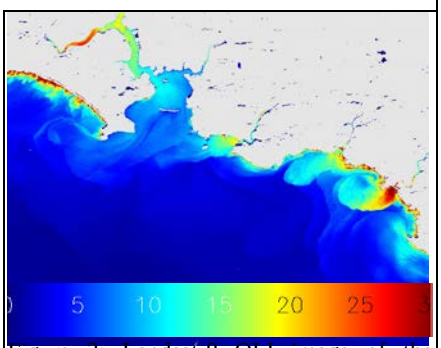


Figure 3: Landsat-8 OLI image of the Plymouth area 4 Nov 2013 showing suspended particulate concentration (mg/L).

Sentinel sensors: The first satellite in this series, Sentinel-1A, was launched in Apr. 2014 carrying the C-SAR synthetic aperture radar instrument. We have processed sample scenes using the Sentinel-1 Toolbox, and investigated the potential value to NEODAAS users of surface roughness data and value-added products such as ship detection, oil slick detection, and high-resolution wind speed and direction.

NEODAAS website: The main NEODAAS website (neodaas.ac.uk) has had a major redesign, to modernise and simplify the user's journey from discovery to data access. Included is a significant new facility for bulk download of Plymouth mapped time-series datasets: this will enable our 'power' users to extend the scope of their applications without further effort by NEODAAS staff. In addition, a WebGIS portal has been implemented, initially allowing a small subset of NEODAAS datasets to be visualised with pan/zoom/time controls as opposed to the traditional fixed map regions.

Synergy with the NERC National Centre for Earth Observation (NCEO): Discussions are in progress to formulate a procedure for transferring published NCEO algorithms to NEODAAS for wider dissemination and exploitation by operationalisation and application to our archive and near-real time processing chains. As a trial of this strategy, NEODAAS now supports a NCEO-developed algorithm to derive the phenology of phytoplankton (bloom start/end dates and duration) from a long time-series of global or regional ocean colour data (Racault et al, 2012 *Ecological Indicators*, 14(1), 152-163).

Data delivery guide: A semi-automated report generator was implemented, and has been applied to document each data delivery to NEODAAS-Plymouth users for the latter half of this year. This provides our users with a concise but comprehensive professional user guide customised for the requested products, together with essential metadata.

SCIENCE HIGHLIGHTS. ***To focus on economic and societal impacts and benefits where possible*:**

Polar Science: As part of NERC's TEMPEST project, Zappa, et al. (2014) studied the representation of N Atlantic polar lows in ERAI reanalysis and ECMWF operational analysis. Both were analysed against a polar low data set and the possibility of identifying and tracking the systems was investigated using a tracking algorithm. Around 70% of the observed polar lows were identified in the operational analysis compared to 55% for ERAI. Those not identified were mainly due to weak representation of their intensity. NEODAAS provided additional satellite observations of polar low events (Fig. 4). Luckman et al (2014) used Synthetic Aperture Radar (SAR) data from the NEODAAS archive (along with other data from ESA) to look at surface melt and ponding on the Larsen C ice shelf: unusually intense or prolonged surface melt and the presence of surface standing water is a common precursor to ice shelf disintegration, most notably that of the Larsen B Ice Shelf.

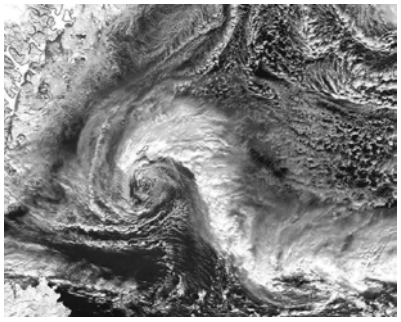


Figure 4: A polar low north of Iceland on 22nd Mar 2011, Zappa et al. (2014).

Marine Science: Marine science was the area with the most papers supported by NEODAAS. Seven papers investigated the relationship of animal behaviour to the environment: e.g. Pirotta et al. (2014) used 8-year time-series NEODAAS of chl-a, SST and thermal front maps (unique to NEODAAS) for eastern Scotland which were related to the presence of bottlenose dolphins indicated using C-POD passive acoustic moorings. They determined that the fine-scale fronts in tidal inlets are highly significant factor in the preference of foraging habitat for dolphins. This is an example of a growing number of publications using satellite thermal front maps to improve models for the distribution of various marine species, contributing to their management and conservation. Cruise support to the NERC UK Ocean Acidification programme resulted in eight papers. Krueger-Hadfield et al. (2014), also used NEODAAS data to show the temporal evolution of a coccolithophore bloom before, during and after the cruise sampling (see Fig 5). Prof T. Tyrell, NOC Southampton, reported that five papers he co-authored in *Biogeosciences* benefitted from NEODAAS support.

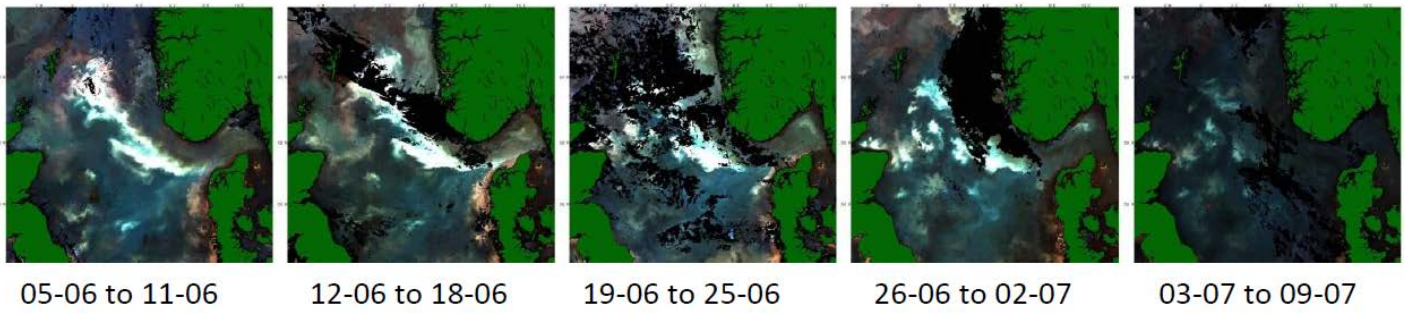


Figure 5: Time series of ocean colour (reflectance images) showing the development of a coccolithophore bloom in the North Sea in 2011 sampled during the NERC UK Ocean Acidification cruise (Krueger-Hadfield et al., 2014).

Atmospheric Science: Martínez-Alvarado et al. (2014) was one of three papers published by researchers at the University of Reading funded by NERC's Storm Risk Mitigation/DIAMET project. They used two numerical models to analyse processes in the warm conveyer belt (WCB) of a N Atlantic extratropical cyclone and found that the different schemes resulted in significant differences in WCB total heating. This has implications in assessing influence of WCBs and fits the suggestion that errors representing them may contribute to significant forecast errors. Our imagery was used to analyse WCB features at different stages of the case study. Following an earlier study off NW Australia, Birch et al. (2014) used 6 years of images from our Meteosat archive to identify wave-cloud lines over the Arabian Sea. These mark large-amplitude internal waves that can have a role in convection and may be a hazard to low-flying aircraft. Climatologies from the images and ERAI reanalysis were consistent and showed wave-cloud lines in all months outside summer monsoon. The formation mechanism was investigated by modelling a particular case and found to be associated with the sea breeze. The lead author was NERC funded. Réchou, et al. (2014) used radar, radiosondes and modelling to investigate inertia-gravity waves (IGWs) over N Scandinavia and identified the source as a jet-front moving across S Scandinavia with waves propagating north. IGWs with the short vertical-wavelengths found had not been reported to emanate from this region in previous studies. As gravity waves are important in atmospheric physics, understanding generation processes is also important. Our images were used to assess the synoptic situation and system progression during the case study. We also supported four papers by Met Office researchers and continued to provide imagery for a feature in each issue of the journal *Weather*, including several full papers covering topics such as UK climate, flood events and planning aircraft measurements.

Terrestrial: NEODAAS data were also used in a study in the high-impact journal *Global Change Biology* (Otero et al. 2014) that analysed spatio-temporal variations in the dates of downstream migration in 67 rivers throughout the North Atlantic. They found that, on average, the initiation of the seaward migration has occurred 2.5 days earlier per decade, suggesting that Atlantic salmon migration is responding to the current global climate changes. A paper on microwave emissivity for different Indian subcontinent land surfaces (Antony et al., 2014) used NEODAAS images in identifying and removing cloudy pixels. The work is important to the use of passive microwave satellite data and assimilation in models. Summers et al., (2014) reported Canada as the origin of most Purple Sandpipers

migrating to Britain/Ireland. NEODAAS images were used with met data to describe the effect of N Atlantic weather on their routes.

Economic impact and societal benefit: Understanding severe weather processes to mitigate their impact is a key activity for many of our research users. In addition to the NERC Storm Risk Mitigation work cited above other recent examples include work by Grams et al., (2014) on flooding in Europe and Sibley et al., (2014) on flash-flooding in the UK. Other work utilised NEODAAS data as part of studies on Harmful Algal Blooms: e.g. Diaz et al., (2014) focussed on blooms of *Pseudo-nitzschia*, a genus with species that produce domoic acid which causes Amnesic Shellfish Poisoning (Fig. 6). NEODAAS near-real time support for research deployments can result in cost savings, for example, by guiding ad hoc research aircraft deployments and minimising flights time, or where a research cruise has a fixed duration by providing guidance that can maximise the science that can be undertaken within that time. NEODAAS data can impact on government policy: for example, Miller and Christodoulou (2014) described the impact of front frequency on assisting the delineation of offshore marine protected areas (MPAs). For example see "Scottish Natural Heritage. 2014. Further advice to Scottish Government on the selection of Nature Conservation Marine Protected Areas for the development of the Scottish MPA network. SNH Commissioned Report No. 780." NEODAAS data are likely to be used in the recently started BBSRC/NERC Sustainable Aquaculture programme "in the delivery of the strategic objectives of the Global Food Security programme" We provide data to overseas institutes, commercial companies and others that support operational activities. Examples this year include near-real time imagery for charting sea ice around Greenland / Iceland (Danish Met. Inst. and U. Iceland), wildfire Alerts covering Europe (by CSIR, South Africa), weather and forecast information produced by operations support staff (e.g. for UK MoD, Brazilian Air Force and Airbus Flight Test) and free online weather services (Weather Underground, USA). NEODAAS contributes to public engagement in environmental issues through our website attracting many public and educational users and through newspaper, TV and social media use of our images to illustrate severe weather and other events (e.g. Fig 1). Public use includes support for weather enthusiasts, astronomy, flying, sailing and other outdoor activities.

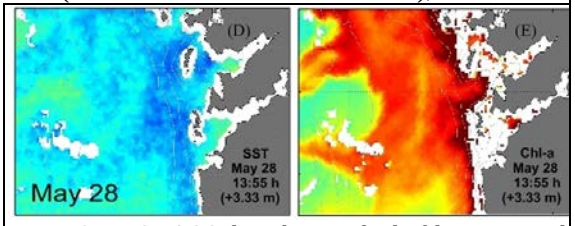


Figure 6: NEODAAS data showing high chl-a associated with cooler SST off the coast of NW Spain.

Cited Papers:

- Antony et al., (2014) A Detailed Study of Land Surface Microwave Emissivity Over the Indian Subcontinent. *IEEE Trans. Geo. & Rem Sens.*, 52 3604-12. (**IF 2.9**)
- Birch et al., (2014) Wave-cloud lines over the Arabian Sea, *Journal of Geophysical Research – Atmospheres*, 119 (8), 4447–4457. (**IF 3.4**)
- Diaz et al. (2014) Tidal and wind-event variability and the distribution of two groups of Pseudo-nitzschia species in an upwelling-influenced Ría. *Deep Sea Research Part II: Topical Studies in Oceanography*, 101, 163-179. (**IF 2.76**)
- Grams et al. (2014) Atmospheric processes triggering the central European floods in June 2013, *Nat. Hazards and Earth System Sciences*, 14, 1691-1702. (**IF 1.8**)
- Krueger-Hadfield et al (2014) Genotyping an E hux. bloom event in the North Sea reveals evidence of asexual reproduction. *Biogeosciences*, 11, 5215-5234. (**IF 3.8**)
- Luckman et al (2014) Surface melt and ponding on Larsen C Ice Shelf and the impact of föhn winds. *Antarctic Science*, 26(6), 625-635. (**IF 1.4**)
- Martínez-Alvarado et al., (2014) The dichotomous structure of the warm conveyor belt, *Quart. J Royal Met. Soc.*, 140 (683), 1809–1824. **(IF 5.1)**
- Miller & Christodoulou (2014) Frequent locations of ocean fronts as an indicator of pelagic diversity: application to MPAs. Mar. Policy, 45, 318–329 (**IF=2.6**)
- Otero et al., (2014) Basin-scale phenology and climate variability in anadromous fishes: global seaward migration timing of the charismatic Atlantic salmon (Salmo salar). *Global Change Biology*, 20(1), 61-75 (**IF 8.2**)
- Pirotta et al. (2014) Scale-dependent foraging ecology of a marine top predator modelled using passive acoustic data. *Functional Ecology*, 28(1), 206-217 (**IF=4.9**)
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- Sibley et al. (2014) Flash flooding in southwest England 29 May 2008. *Weather*, 69(6), 143-146. (**IF 1.0**)
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FUTURE DEVELOPMENTS/STRATEGIC FORWARD LOOK:

Data Processing: The new servers described above provide the capability to update our processing software and this is ongoing. They also provide scope to run additional processing. NASA's VIIRS active fire processing has already been implemented to support CSIR's fire alert system and the products could be made available to any users. Other products can be investigated, although more storage is needed to make them routinely available. Additional map projection options will be possible and mapping libraries are being considered that allow products to be merged and have features added.

Archiving: Tape drives for archiving our data are over 5 years old and will be replaced in the coming year. We will use the latest generation drives for higher capacity and faster speeds and redevelop our software so the same tape is used for data from different satellite instruments. This will provide a single, consistent approach to archiving all of our data and reduce tape/drive wear and tear due to regular tape changes.

Antenna Systems: One of our tracking antennas has been dismantled to investigate a mechanical backlash problem. The cause is gearbox wear, which cannot be repaired and a new unit is being procured. We will use the opportunity to service the system as far as possible, with operations being maintained using other antennas while this is ongoing. A similar problem has been noted for another antenna, but the backlash is significantly less and has not increased over several months, so the intention is to monitor this for now.

Met Office Support: Following a successful trial period, the Met Office is looking to arrange a backup data feed from Dundee for near-real time L-band NOAA and MetOp data. This would be available in case of problems with their own receiving systems at Exeter. It would deliver data as quickly as possible after reception and allow Met Office staff to start and stop the feed as required. An agreement has been discussed and can be set up subject to NCEO approval.

Capital Requests: There is a requirement to replace the storage system for all data received at Dundee and resulting products. It is central to operations for acquiring, processing, archiving and distributing data. The existing system is nearing end-of-life and failures

occur with increasing regularity. There is also a need for more storage as the archive extends and newer sensors produce more data. We have identified and costed a preferred solution and a capital request has been placed on file with NCEO/NERC. Higher value capital requests have also been submitted to improve capabilities at Dundee. A larger antenna would allow us to receive from more satellites and higher data rate satellites. It will ensure continuity of reception from follow-on missions to those we support now (e.g. MetOp 2nd generation, JPSS and Oceansat-3), as the existing antennas will not be suitable for some of these. It should also be possible to take data from additional satellites such as Landsat, which we cannot at present. A new antenna would, in time, also serve as a replacement for older systems. Similarly, our current receiver hardware supports data rates covering NOAA to Oceansat-2. Future missions such as MetOp 2nd generation will operate at higher data rates and new receivers will be needed to process these signals.

ESA Sentinels: This will be an exciting year for environmental remote sensing, with the launch of Sentinel-2A planned for 23 Jun. and Sentinel-3A on 31 Oct. 2015. The Multi-Spectral Instrument (MSI) on Sentinel-2A provides high-resolution optical data (10-60m), which together with Landsat-8 (and Sentinel-2B) will radically increase the repeat coverage of this quality of data. It is designed for terrestrial remote sensing, though there are also many potential coastal applications as it will be able to observe suspended sediment concentrations and certain dense phytoplankton blooms. Sentinel-3A hosts the Ocean and Land Colour Instrument (OLCI), to reinstate the critical provision of medium resolution (300m) ocean colour data that was lost with the demise of MERIS on Envisat in Apr. 2012. NEODAAS will be implementing processing chains for these instruments during 2015-16 as soon as they complete commissioning phase, in partnership with other PML projects and exploiting software toolboxes to be provided by ESA. We will begin operational processing/mapping of Sentinel-1 SAR data to indicate sea-surface roughness for the UK region.

Ocean colour: We will complete the switch from Aqua-MODIS to VIIRS for operational ocean colour, re-implementing all the Level 2 and 3 products and delayed-time refined processing. Significant effort will be expended to reprocess the entire archive of MODIS and VIIRS products for key regions according to the recent NASA recalibration (R2014.1); this is needed for a majority of user requests and the bulk download tool. NASA has just changed their recommended chlorophyll-a algorithm to OCI (Hu *et al.*, 2012); we will provide NEODAAS users with a quantitative analysis on whether this is appropriate for their applications.

Synergy with NCEO and wider: We will continue discussions within NCEO to identify priority algorithms for operationalisation and wider dissemination this year. A further venture will be in collaboration with a volcano monitoring group at Université Blaise Pascal, France, involving integrating their software for extracting lava effusion rates from our AVHRR and MODIS near-real time processing. We will incorporate EO and model data (e.g. metocean, surface currents) from projects such as the Copernicus Marine Environment Monitoring Service (CMEMS, latest phase of MyOcean) and the Ocean Colour Climate Change Initiative into our online and request data offering, acting as a downstream provider. PML involvement in a DEFRA-funded EO feasibility study has given us a useful insight into further products that NEODAAS could develop for applications towards environmental directives.

Data processing: We will shortly begin running NEODAAS software on the JASMIN-CEMS supercomputer facility, and will develop tools to exploit this both as a backup facility and to begin experiments on global EO data processing.

Dataset dissemination: We will work with other NCEO-EOIF members to consider instigating a digital object identifier (DOI) system for NCEO/ARSF/FSF/NEODAAS datasets to facilitate their citation in scientific literature.

Non-Mandatory Facility-specific OPMs

Web Statistics: Registered users can access information and value added image products through the Dundee Web pages. Received data are processed by the facility to produce geolocated, map overlaid and colour composite images, for example, for ease of user access and interpretation. The statistics below relate to these facilities rather than NEODAAS high level product services. They also illustrate the support for NERC outreach.

Registrations for the year	Total user registrations	Pages hit/images for the year	Image product requests for the year
4,274	375,502	Approx. 22.8 million	Approx. 4.2 million

Breakdown of all registrations by user categories:

NERC/UK HEI Project	Education	Research	Commercial	Personal Interest
17.4 %	11.3 %	7.8 %	2.9 %	60.6 %

Other Users: In addition to NERC supported users, others including international users receive support on a commercial basis or limited free support for non-commercial, research and educational activities. Some examples for the year:

- Near-real time AVHRR/MODIS imagery to monitor Iceland's ocean current boundaries, sea ice and volcanic activity – University of Iceland.
- High resolution images to evaluate mesocyclone & polar low representation in reanalyses, their climatology and variability – NCEO/Uo Reading.
- AVHRR data for a PhD study on cloud cover and radiation balance over Ireland due to aircraft-induced contrails – Univ. College Cork, Ireland.
- MTSAT geostationary satellite data for a study of offshore line squall events in SE Asia – OceanMetriX Ltd.
- Images for papers on Snowdonia mountain gravity waves and mountain waves observed by MST radar and AVHRR – Dr Richard Worthington.
- High resolution images to assess possible conditions to land a sea plane on a lake in East Greenland for a school expedition – Worksop College.

Research cruises supported in near-real time by Plymouth

Note research cruise support was severely impacted by RRS Discovery being unavailable during the year.

Start Date	End Date	Focus of the Cruise	Principal/NERC Scientist	Ship
2014-03-18	2014-04-11	Shelf Seas Biogeochemistry (Benthic)	Dr. Henry Ruhl, NOCS	Discovery 008
2014-07-18	2014-07-23	MarCRF - effects of marine renewables on primary production	Dr. Jacqueline Tweddle, Uni. of Aberdeen	
2014-09-08	2014-10-28	Atlantic Meridional Transect (AMT) 24, UK to Falkland Islands	Dr. Tim Smyth, PML	James Clark Ross 303
2014-10-10	2014-11-07	NERC Outer Hebrides process cruise	Dr. Stuart Painter, NOCS	Discovery 017
2014-11-05	2014-12-16	BAS Western Box Core cruise	Dr. Jonathan Watkins, BAS	James Clark Ross 304
2014-11-09	2014-12-02	Shelf Seas Biogeochemistry (Pelagic)	Prof. Jonathan Sharples, Uni. of Liverpool	Discovery 018
2015-03-01	2015-03-24	Shelf Seas Biogeochemistry (Benthic)	Dr. Malcolm Woodward, PML	Discovery 021
2015-03-25	2015-04-30	Shelf Seas Biogeochemistry (Pelagic)	Dr. Alex Poulton, NOCS	Discovery 029