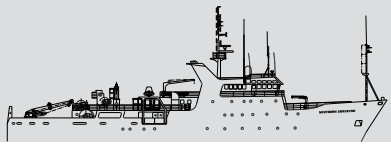

MARINE
NATIONAL FACILITY

2013 program

RV *Southern Surveyor*

CSIRO

voyage summary SS2013_t01

SS2013_t01

Voyage: Oceanographic Methods Training Unit

Voyage period

Start: 27/02/2013
End: 03/03/2013
Port of departure: Sydney, Australia
Port of return: Hobart, Australia

Responsible laboratory

Institute of Marine and Antarctic Science
University of Tasmania
Private Bag 129, Hobart, TAS, 7001, Australia

Chief Scientist

Dr Zanna Chase
Institute for Marine and Antarctic Studies
University of Tasmania
Private Bag 129, Hobart, Tas, 7001, Australia
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Scientific Objectives

The primary objective of this voyage was to expose students from the University of Tasmania's Master's of Marine and Antarctic Science course to oceanographic methods at sea, and to train them in the collection, analysis and interpretation of standard oceanographic data. The primary focus was methods of chemical and biological oceanography. This voyage formed the core of the UTAS unit, KSA724, Oceanographic Methods.

This transit voyage from Sydney to Hobart provided an opportunity to address a number of scientific objectives along with the training. This southern region of the East Australian Current (EAC) is an ecologically significant zone and one of the most rapidly warming parts of the ocean (Hill et al., JGR, 2011). It is an area of active eddies, referred to recently as 'Eddy Avenue' (Everett et al., GRL, 2012). Our research would contribute to understanding the impact of continued EAC extension, and potential alterations in eddy activity, on plankton biological productivity and diversity in this area. We also hoped to be the first to sample Bass Straight water from within a EAC warm core eddy (Baird and Ridgway, GRL, 2012).

Voyage Objectives

Operational objectives during the voyage were to:

- Occupy a series of CTD stations within different water mass types (warm-core eddy, cold-core eddy, background Tasman Sea water) and sample their chemical and biological characteristics.
- Use paired XBT (eXpendable Bathythermograph) – CTD (Conductivity, Temperature and Depth sensor) deployments to determine XBT fall rates for improved accuracy, as part of an ongoing CSIRO project
- Collect carbon chemistry and nutrient data from a depth transect near the Maria Island national reference station in order to calibrate the mooring and place the mooring data into a regional context
- Deploy the continuous plankton recorder to collect information on zooplankton abundance and diversity
- Deploy 4 ARGO floats

The main objectives from a teaching perspective were to have students (after completing this voyage) able to:

- Plan a scientific voyage at sea
- Describe how different scientific instruments work, their area of use, limitations, and nature of collected data
- Analyze, interpret and present data from a subset of oceanic instrumentation
- Write a scientific report
- Understand the working routines onboard a research vessel such as the *Southern Surveyor*

Results

Identification of the biological and chemical characteristics of eddies and different water masses along the southern extension of the EAC.

The voyage track was successful in sampling different water masses along the southern EAC. Stations 1 – 4 sampled across the axis of a warm core eddy southeast of Sydney, with station 4 being close to the centre of the WCE (see Figure 1). Station 5 sampled the southern edge of the WCE, while station 6 was located in Bass Straight, Station 7 was inshore of the core of the EAC, and stations 8 – 12 sampled Tasmanian shelf waters. Station 12 was fortuitously close to the centre of a cold core eddy.

During the voyage we sampled from a total of 12 Stations (Table 1), slightly less than the 15 stations outlined in the voyage plan, due to weather delays.

CTD profiles:

CTD casts to 1000 m or the bottom, whichever was shallower, were conducted at all 12 stations. The CTD was equipped with a fluorometer, PAR sensor, ISUS nitrate sensor, oxygen sensor and transmissometer. With the exception of the ISUS, the sensors appeared to work well. The ISUS data were quite noisy and may need to be post processed, but showed expected patterns including surface nutrient depletion and inverse relationship to oxygen. Calibration samples were collected for dissolved oxygen and salinity.

Up to 12 nutrient samples were collected per station, across all depths, for a total of 101 nutrient samples. These will allow us to confirm the ISUS nitrate profiles and compare nitrate with phosphate and silicate distributions.

We observed a clear transition from the coastal station 1 through to the centre of the WCE. The mixed layer deepened from 40 m at station 1 to 80 m at station 4, and the depth of the chlorophyll maximum also increased from 40 m at station 1 to 100 m at station 4 (Figure 2). The depth of nitrate depletion also deepened, from ~80 m at station 1 to 150 m at station 4. These results are consistent with expectations based on downwelling vertical circulation within a WCE.

Although we appear to have sampled very close to the core of a EAC WCE (Figure 1), it is not clear that this eddy contains a lens of Bass Straight Water (BSW) at its centre, as predicted by Baird and Ridgway (2012). This speculation is based on the preliminary CTD salinity data, which do not appear elevated in the depth range of 600 – 700 m (Figure 3). In contrast, and interestingly, the high dissolved oxygen between 600 -700 m at Station 4 is consistent with waters that recently left the surface, and consistent with Baird and Ridgway's glider-based observations of BSW.

Station 11, located offshore from Maria Island at ~1000 m depth, had a very interesting temperature, salinity and oxygen profile (Figure 4), revealing a series of 'steps'. A mixing process not observed at other stations appears to be producing localised mixed layers between 250 and 700 m depth.

Chlorophyll:

A total of 91 chlorophyll samples were taken over the upper 200 m at all 12 stations; typically at 9-12 depths per station. A preliminary analysis indicates the extracted chlorophyll matches well with the CTD mounted fluorometer. Chlorophyll profiles show very low chlorophyll and a deep chlorophyll maximum in the core of the WCE (Figure 2). The highest chlorophyll concentrations were found just off Sydney and at the station close to Maria Island.

Zooplankton Communities:

A total of 5 net tows were conducted across 12 stations (Table 1). Each tow was conducted for about 10 minutes, at the surface. Because flow rates were not monitored, the tows were not quantitative, but they do provide a qualitative picture of the zooplankton communities. The number of net tows had to be cut due to time constrains brought on by poor weather.

Between stations 1 to 4 copepods dominated the communities. In contrast, station 11 was co-dominated by krill *(Nyctiphanes australis)* and a particular species of calanoid copepod. Chaetognaths were also present in large numbers across all stations. Fish eggs and fish larvae represented 10-15% of the samples from the first 4 stations. Station 4 also had a lot of gelatinous material and tunicates (salps and larvaceans).

Phytoplankton Communities:

Phytoplankton samples were taken from 4 stations and an additional 2 surface collections taken whilst underway. The samples were taken from the depth that coincided with a peak in the fluorometer profiles. Samples were then wet mounted and examined for relative abundance (see appendix 3).

Using paired XBT-CTD deployments to determine XBT fall rates for improved accuracy, as part of an ongoing CSIRO project.

A total of 49 XBT deep blue probes were launched with 6 for each CTD deployment: 3 before the CTD descent and 3 during the CTD descent. Most of the deployments were successful but a couple failed. Possible reasons for failure are mainly due to software problems or wire failures, such as wire breakages, entrapments or rubbing on the side of the ship. XBTs were not deployed at stations 8-10 or 12 because of the shallow depth. The XBT data has been sent to Bec Crowley at CSIRO for analysis.

Collecting carbon chemistry and nutrient data from a depth transect near the Maria Island national reference station in order to place the mooring data into a regional context.

A total of 49 carbon chemistry samples (total CO_2 and alkalinity) were collected from station 7 onwards (see Table 1). This part of the voyage was very successful, as we sampled one station inshore of the Maria Island Mooring, we sampled the mooring site itself, and we sampled three stations along a transect moving offshore from the mooring site, for a 5-site transect. The samples will be further analysis at CSIRO Marine and Atmospheric Research, Hobart.

Deploying the continuous plankton recorder to collect information on zooplankton abundance and diversity.

The Continuous Plankton Recorder (CPR) was deployed during the voyage and we collected approximately 630Nm of data. The CPR collected zooplankton and phytoplankton from a depth of approximately 10 meters. For the majority of the voyage the CPR was deployed (Table 2). However, it was retrieved at each station while the CTD was being launched. On the voyage the silk was changed after sampling for 341 Nm. The samples collected from the voyage will form part of the AusCPR Survey, which is an IMOS monitoring project.

Deploying 4 ARGO floats

Unfortunately due to technical issues no ARGO floats where deployed during the voyage.

Instruction in oceanographic methods

The voyage was highly successful as a master's-level training unit. The nine UTAS students, all from the Master's of Marine and Antarctic Science course, were enthusiastic participants in all aspects of the voyage. They were split into two teams, an 'am' and 'pm' shift, and they took turns within their groups to ensure that each student had a chance to experience each role, be it CTD launching, sampling, operations room control, or chlorophyll filtering and analysis. Switching roles like this did make for somewhat inefficient use of time, but by the second day the students became more adept at all of the tasks, and well aware of the need minimise down time. A very valuable part of the learning experience was the opportunity to interact with MNF staff and with the crew. Students learned about echo sounding, swath mapping, navigation, and hydrochemistry. They all participated in analysing salts and oxygen, and learned about the nutrient analyses.

During the voyage the students wrote daily blog entries about their experiences. These show clearly that the students were engaged with the activities aboard, and that they appreciated and valued to opportunity to learn oceanography in such an immediate, hands on manner. Several students have expressed an interest in seeking employment with the MNF, as a result of this experience. One student will be using the voyage data as the basis of her master's research project.

Voyage Narrative

The main activities of the voyage consisted of occupying 1-4 CTD stations per day. At each station we aimed to a) conduct paired CTD-XBT comparisons, where we would drop 6 XBTs in conjunction with the CTD drop (3 XBTs while the CTD was at the surface and then 3 during the descent) b) sample the upper 1000 m with the CTD, taking discrete samples for chlorophyll and nutrients, and calibration samples for oxygen and salinity and c) conduct a surface net tow. Underway measurements included echosounder, swath mapper, CTD, fluorescence, meteorological measurements, pCO_2 and the Continuous Plankton Recorder (CPR), which was retrieved at each station.

27 Feb 13

Stations 1 – 4 were occupied as planned at approximately 13:00, 16:45 and 21:22 EDT. Zooplankton net tows were conducted after the CTD had been retrieved at stations 1 and 2 whilst traveling at 1.5 to 2 knots. At station 3 there was a problem with the CTD winch resulting in a delay of about 30 minutes, so no net tow was conducted.

28 Feb 13

Station 4 was occupied at 02:00 EDT, in the centre of a warm core eddy, followed by a net tow. In the morning, sea state deteriorated and only one station out of the 4 planned was conducted due to the slow progress of the ship. Station 5 was occupied at about 14:15 EDT (but without the net tow). Extracted chlorophyll samples from day 1 were analysed.

1 Mar 13

Station 6 was conducted at approximately 1400h EDT. On this date the CPR had reached approximately 300nm and was changed prior to its maximum distance of 450nm. The oxygen titrator was calibrated but samples could not be analysed due to a computer software problem. Salts were analysed by the students using the salinometer.

Station 7 was conducted at approximately 21:00 EDT. Six Niskin bottles were fired at 200 m and used to fill carboys for the CSIRO cal lab. The station has a bottom depth of 2650 m, but is less than 500 km from shore, so technically it does not meet the specifications of the cal lab, but it was deemed better than nothing. At this station samples for total CO_2 (TCO_2) and alkalinity were collected for the first time.

2 Mar 13

Five stations were conducted off the coast near Maria Island, Tasmania to calibrate the IMOS national reference station mooring. Alkalinity and TCO_2 were collected at these 4 stations. Starting with the inshore Station 8 at approximately 1600h EDT with a maximum depth of 45m. No XBTs were launched, due to the shallow depth. Station 9 at approximately 1700h EDT was the closest to the mooring and reached a maximum depth of 80m. Station 10 was conducted at approximately 1800h EDT with a maximum depth of 110m. Station 11 was conducted at approximately 1900h EDT with a maximum depth of 850m and 6 XBT's were deployed. Station 12 was conducted at approximately 2100h EDT with a maximum depth of 1000m.

3 Mar 13

No new sampling was undertaken, although swath mapping continued. The final chlorophyll samples were analysed and further analysis of the plankton communities was also undertaken between ship chores. We arrived in Hobart at 10:30 EDT.

Summary

The primary objective of the ss2013_t01 voyage was to give students the opportunity to learn about and practice a range of oceanographic methods while at sea. In this context, the voyage was an incredible success as all students had the opportunity to operate the CDT and XBTs, collect nutrient, oxygen, salt, carbon and chlorophyll samples, operate instruments for nutrient and chemical analysis, observe zooplankton and phytoplankton communities gathered in net tows and learn about the on-board instrumentation, such as the acoustic and swath mapping technologies.

Unfortunately, poor weather conditions slowed us down and we had to forfeit some of our planned stations in order to prioritise the transect stations at Maria Island. This transect will provide valuable carbon data to assist with the calibration of a mooring station that is functioning as a National Reference Station for the Integrated Marine Observing System (IMOS). The XBT data that we have collected in association with the CTD data will be used to assist with calibration of the fall rate of the specific deep blue probe XBT batch that we used on the voyage. This will allow XBT data that is generated from this batch to be used in more precise climate studies.

Our voyage track took us into the centre of a large anti-cyclonic (warm core) eddy along the southern extension of the East Australian Current (EAC). Taking measurements of temperature, salinity, oxygen, chlorophyll *a* and nutrients to 1000m, will provide important data on these mesoscale environments and how they may affect the productivity of the EAC.

PRINCIPAL INVESTIGATORS

A. Zanna Chase, IMAS UTAS

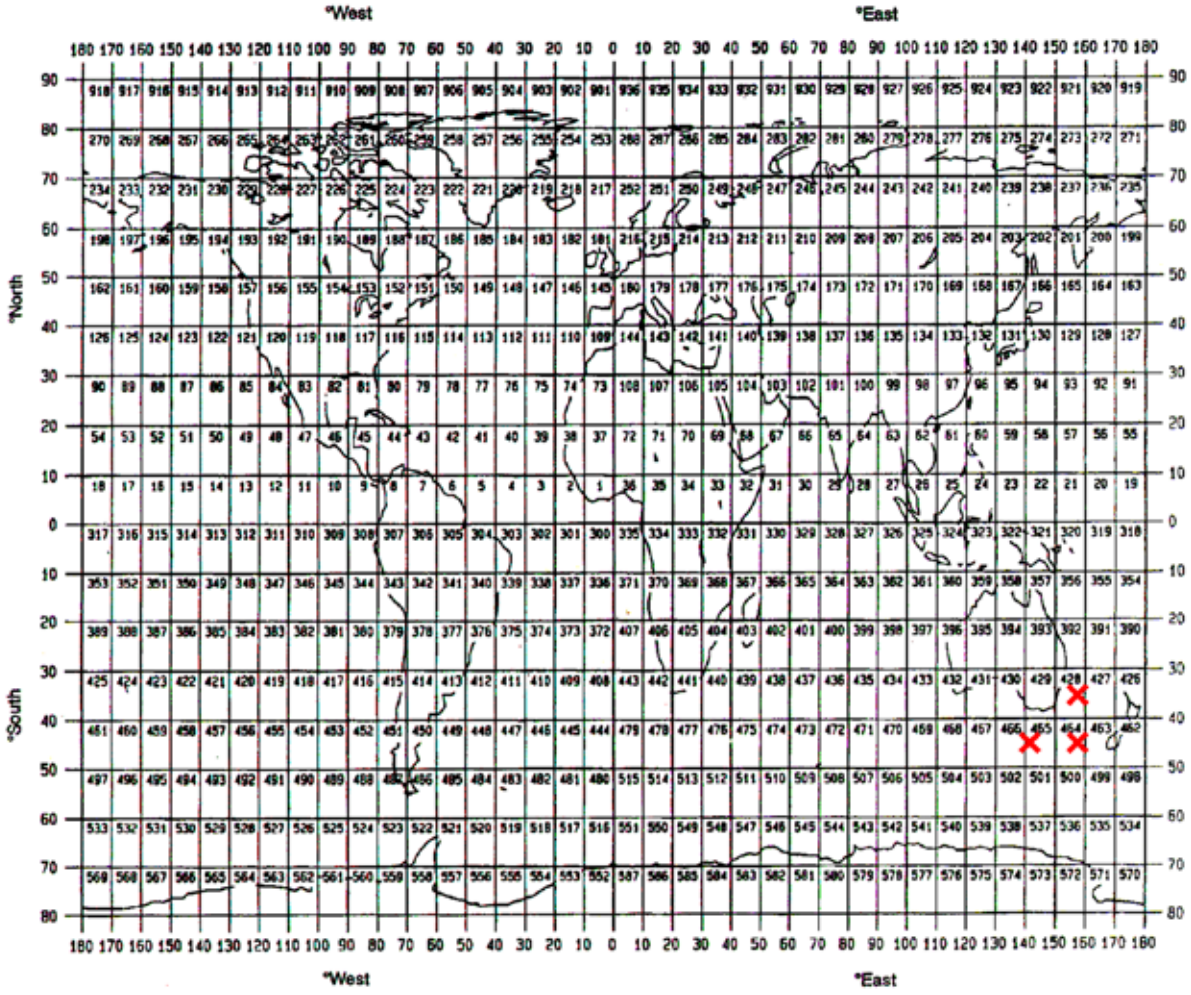
B. Patti Virtue, IMAS UTAS

C. Rebecca Cowley, Centre for Australian Weather and Climate Research (CSIRO and BOM), Hobart

D. Bronte Tilbrook, CSIRO

E. Anthony Richardson, CSIRO Brisbane

GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED



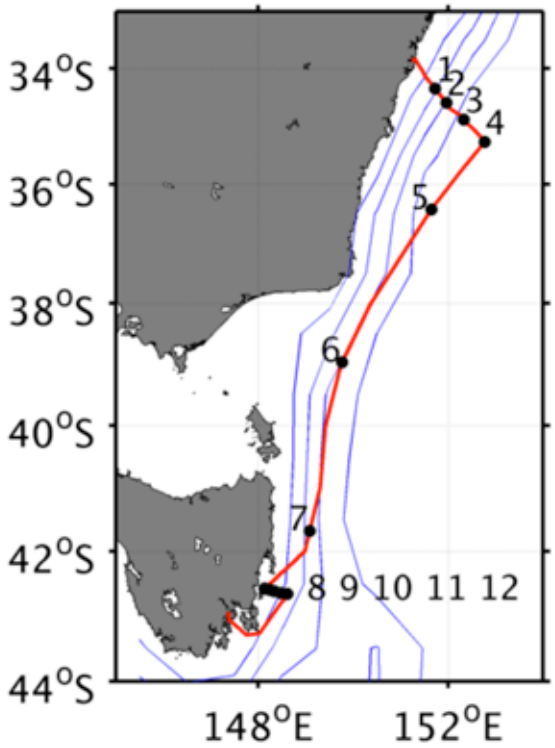
SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN					
Item No.	**PI**	**No.**	**Units**	**Data Type**	**DESCRIPTION**
1	A	644	nm	G74	Swath Mapping was continuous for the entire voyage track.
2	A	12	casts	H09, H10	CTD casts to 1000 m with up to 20 Niskin bottles sampled. For chemical, physical and biological characterisation of the water column
3	C	46	profiles	H13	XBT profiles will be compared with CTD data to improve the accuracy of the XBT fall rates.
4	A	644	nm	H71	Surface T and S are used for high-resolution mapping of station location with respect to eddy structure
5	A	644	nm	D71	Ship-mounted ADCP will be used to assess currents with respect to eddy location
6	A	12	casts	H16	Transmissometry will be used as a proxy for total biomass
7	A	12	casts	H17	Optical sensor attached to the CTD measured the PAR (photosynthetically active radiation) through the water column to obtain data on the amount of light that is available for photosynthesis. Light attenuation will also be used to calculate integrated chlorophyll.
8	A	12	casts	B02	Fluorescence will be used as a proxy for phytoplankton biomass
9	A	31	samples	H21	Discrete samples for dissolved oxygen samples were collected at 2-3 depths per CTD casts in order to calibrate the CTD oxygen sensor.
10	A	12	casts	H21	Oxygen profiles will be used to identify water masses and to assess the biological environment with respect to eddy position.
11	D	32	samples	H74	Total carbon dioxide (TCO_2) was sampled from the whole water column (or to 1000m) at stations 7 – 12. These data will be used to characterise the carbonate system and assess carbon uptake by the ocean, and will be compared with the autonomous surface pCO_2 measurements at the Maria Island mooring station.
12	D	644	nm	H74	Underway pCO_2

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN					
Item No.	**PI**	**No.**	**Units**	**Data Type**	**DESCRIPTION**
13	D	32	samples	H27	Alkalinity was sampled from the whole water column (or to 1000m) at stations 7 – 12. These data will be used to characterise the carbonate system and assess carbon uptake by the ocean, and will be compared with the autonomous surface pCO_2 measurements at the Maria Island mooring station.
14	A	105	samples	H25	Nitrate samples were collected at different depths by the CTD. This data will add to the understanding of the oceanographic parameters in the different water masses within the Eddy Avenue.
15	A	105	samples	H26	Silicate samples were collected at different depths by the CTD. This data will add to the understanding of the oceanographic parameters in the different water masses within the Eddy Avenue.
16	A	105	samples	H22	Phosphate samples were collected at different depths by the CTD. This data will add to the understanding of the oceanographic parameters in the different water masses within the Eddy Avenue.
17	A	12	casts	H90	The optical nitrate sensor (ISUS) measured continuous nitrate profiles at every station. After calibration against the discrete samples it is hoped that these data will aid in identifying water masses and biogeochemical properties of eddies.
18	A	92	samples	B02	Chlorophyll samples were collected from the upper 200 m. These were extracted in acetone and measured on-board. This data will add to the understanding of the oceanographic parameters in the different water masses within the Eddy Avenue.
19	B	8	tows	B09	Plankton net tows collected samples in the surface waters. Samples were identified to family level while under way where possible. Unidentified samples were preserved in formalin and stored at the University of Tasmania for further identification. Relative abundance analysis will be performed for insight into the distribution of zooplankton in the EAC, Bass Strait region.
20	E	630	nm	B90	The CPR (continuous plankton recorder) was deployed whenever steaming between stations. These samples will add to the AusCPR Survey, an IMOS project monitoring plankton in Australian coastal waters and the Southern Ocean. Specifically these samples will add to the understanding of the abundance and distribution of plankton in the EAC, Bass Strait region.
21	B	3	samples	B08	Phytoplankton samples were also collected from the surface underway system, and analysed qualitatively.

Curation Report

Item No.	DESCRIPTION
1	Archived at CMAR Data Centre
2	As above
3	As above
4	Archived at CMAR Data Centre, AODN
5	As above
6	Archived at CMAR Data Centre
7	As above
8	As above
9	As above
10	As above
11	Samples preserved with mercuric chloride, will be analysed at CMAR in Tilbrook laboratory. Data will be archived at CMAR Data Centre and AODN
12	Archived at CMAR Data Centre, AODN and SOCAT (Surface Ocean CO_2 Atlas)
13	Samples preserved with mercuric chloride, will be analysed at CMAR in Tilbrook laboratory. Data will be archived at CMAR Data Centre and AODN
14	Archived at CMAR Data Centre
15	As above
16	As above
17	As above
18	Samples were destructively analysed on-board. Data will be archived with Dr Zanna Chase, UTAS IMAS, and archived with the AODN
19	Samples in 4% formalin are stored at UTAS, IMAS. Data are archived with Dr Patti Virtue, UTAS, IMAS
20	Formalin-preserved silks processed by AusCPR, data archived with AODN
21	Samples preserved in Lugol's are stored at UTAS, IMAS with Dr Patti Virtue

Voyage track chart



Voyage track in red with CTD stations in black. Blue lines indicate the 1000, 2000, 3000, 4000 and 5000 m contours.

General ocean area(s): Tasman Sea, South Pacific Ocean

Specific areas: The southern extension East Australian Current, Maria Island transect, inside an anti-cyclonic (warm core) eddy.

Personnel list

Scientific Participants

Name	Affiliation	Role
Dr Zanna Chase	IMAS, University of Tasmania	Chief Scientist
Dr Patti Virtue	IMAS	Principal Investigator
Tamara Jane Bartholomew	IMAS	Masters Student
Cassandra Price	IMAS	Masters Student
Stacy Deppeler	IMAS	Masters Student
Robert Polmear	IMAS	Masters Student
Emily Panietz	IMAS	Masters Student
Sara Keltie	IMAS	Masters Student
Thomas Coad	IMAS	Masters Student
Russell Ayers	IMAS	Masters Student
Amelia Travers	IMAS	Masters Student
Brett Muir	CMAR	MNF Voyage Manager
Mark Rayner	CMAR	MNF Hydrochemist Support
Rick Smith	CMAR	MNF Swath Mapping Support
Lindsay Pender	CMAR	MNF Computing Support

Marine Crew

Name	Role
Michael Watson	MASTER
Simon Smeaton	2nd MATE
John Boyes	Chief Mate
Fred Rostron	Chief Engineer
Graeme Perkins	2nd Engineer
Lewis Coombe	Integrated Rating
Matt Streat	Integrated Rating
Jonathon Lumb	Integrated Rating
Nathan Arahanga	Integrated Rating
Mick O'Connor	Chief Steward
Bruce Maher	Chief Cook
Oliver Herlihy	2nd Cook
Tony Hearne	CIR

Acknowledgements

This voyage was funded through the Next Wave Transit Voyage program. The Master, Michael Watson, and the crew provided a great level of assistance and ensured the voyage ran smoothly, safely, and to plan. Brett Muir as voyage manager was extremely helpful during the voyage, again ensuring smooth operations and efficient use of ship time. The MNF support staff, Rick Smith, Lindsay Pender and Mark Rayner not only performed their official duties with a high degree of professionalism, they were also very generous in taking time to talk to the students about what they were doing. This greatly contributed to the educational aspects of the voyage. Don McKenzie and Aaron Shorthouse were instrumental in the early planning stages, and Don in particular was there throughout the whole process, a great help when so many variables changed. My co-PI Patti Virtue helped with all aspects of the voyage and was a pleasure to sail with. All nine students did a fantastic job at sea, working with enthusiasm and cooperation and attention to detail. Martina Doblin (UTS) kindly helped us sort out shipping to Sydney. Sam East (IMAS) created a blog for the voyage, and posted entries from students while we were at sea.

Dr Zanna Chase
Chief Scientist

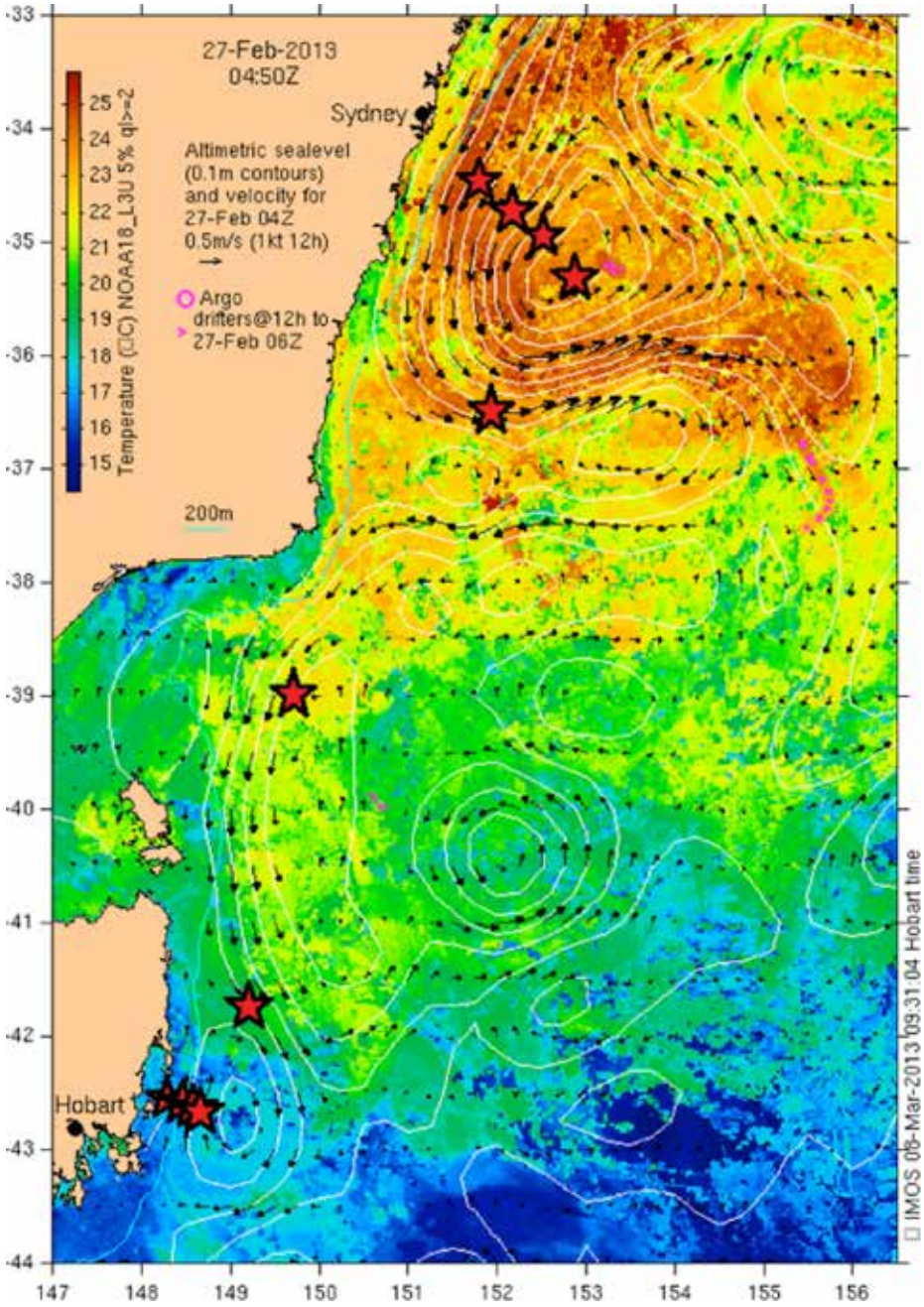


Figure 1: CTD stations plotted with respect to seasurface height at the start of the voyage.

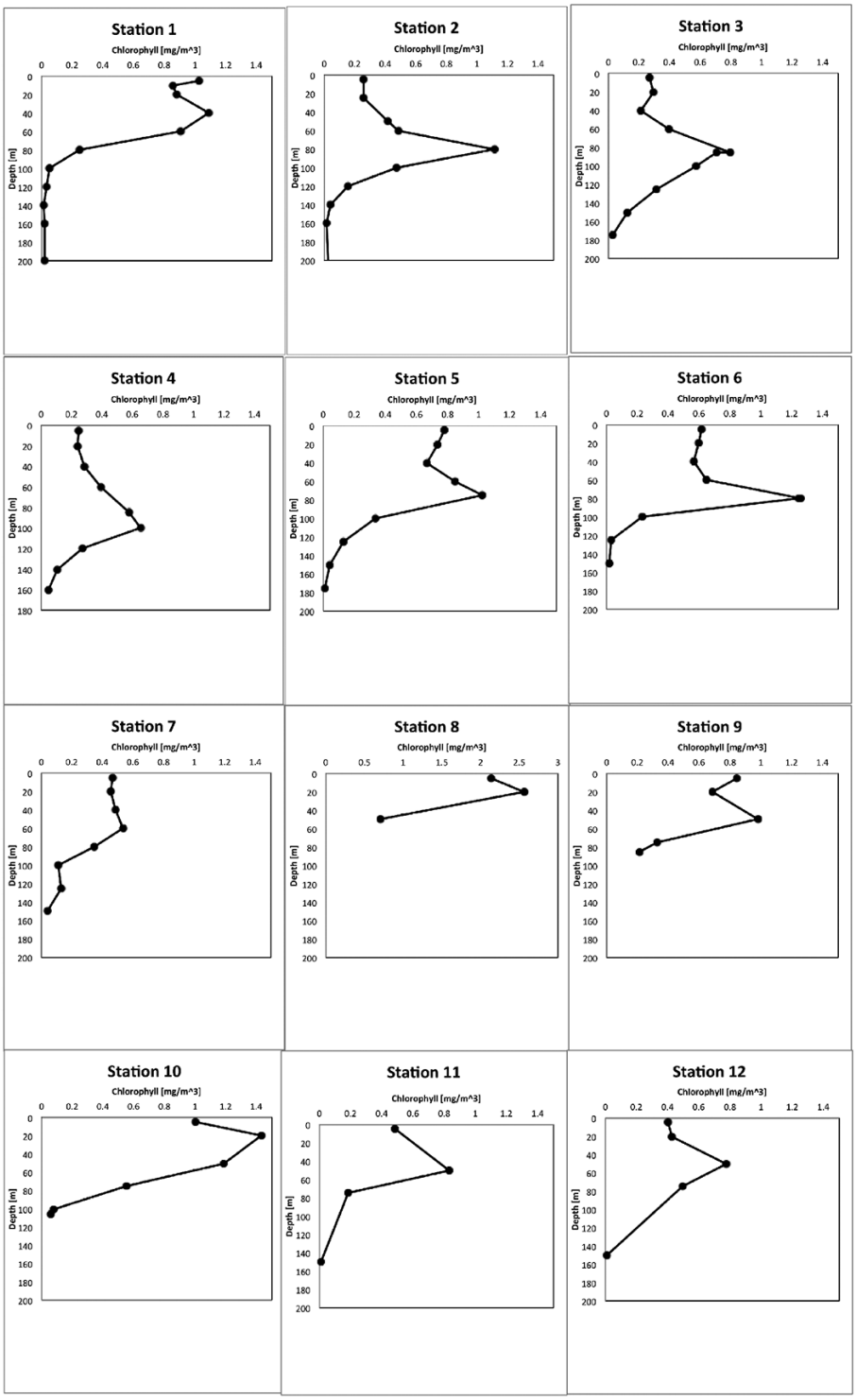


Figure 2: Chlorophyll *a* profiles. Note all plots have the same vertical axis and all but station 8 have the same horizontal axis scale.

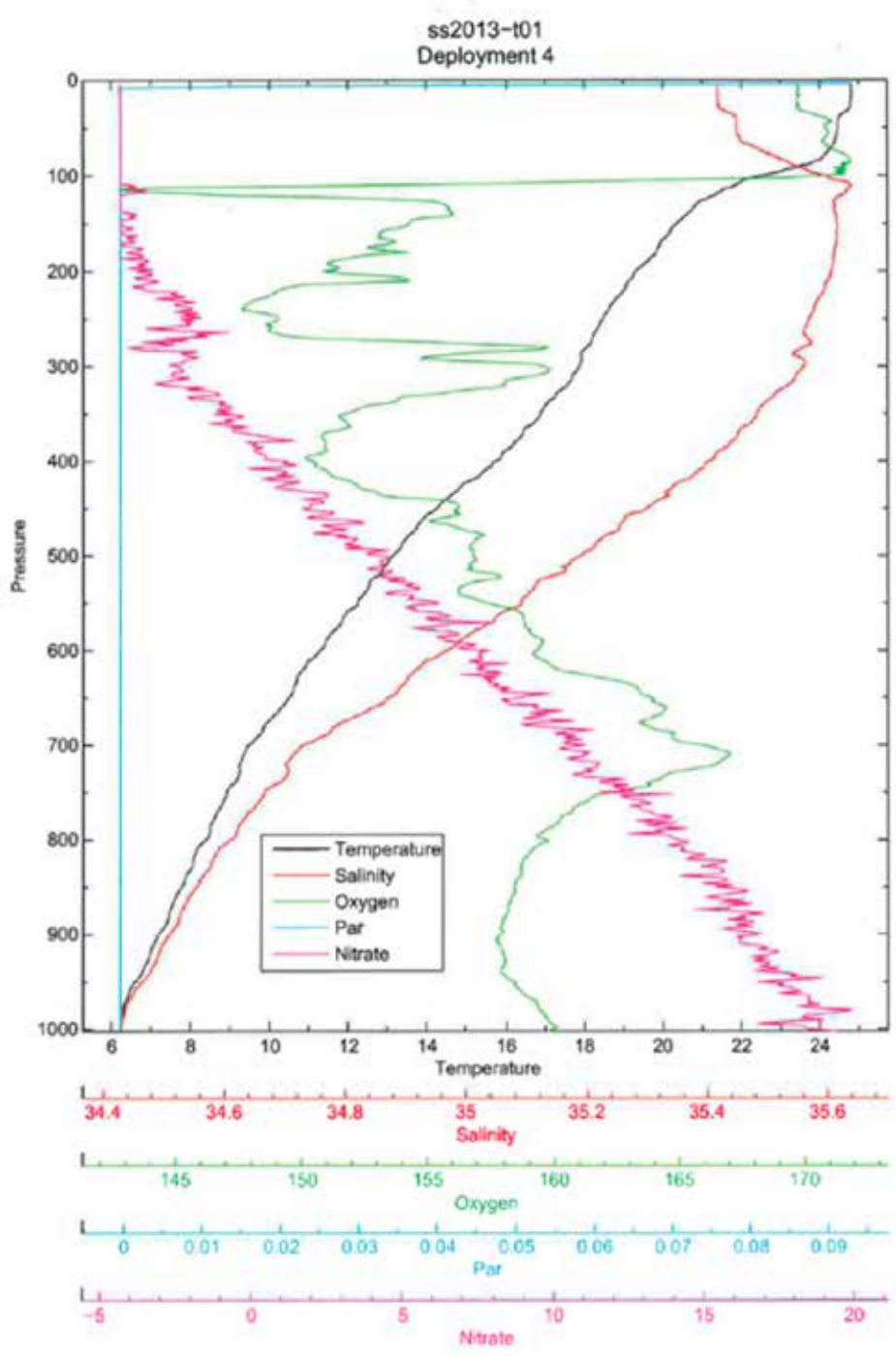


Figure 3: CTD data from station 4, at the centre of a warm core eddy. Note the deep mixed layer with high oxygen and depleted nitrate.

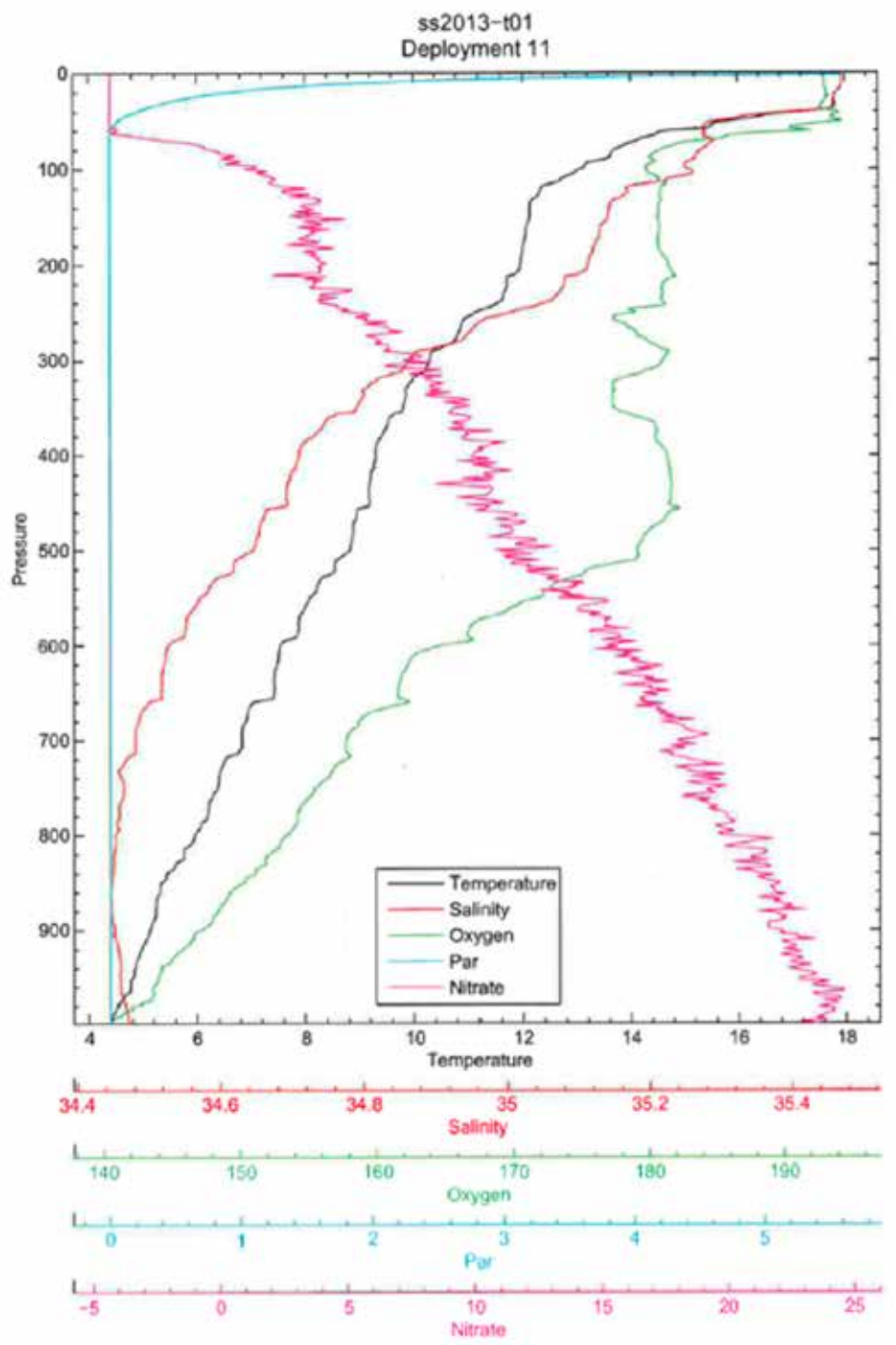


Figure 4: CTD data from station 11. Note step like features in T,S and oxygen data. These features were also seen in the XBT drop, indicating they are not a product of a faulty CTD cable, for example.

STATION LIST								
Station Date/Time	**Latitude**	**Longitude**	**Activity**	**Salinity**	**DO**	**Nutrients**	**CO2**	**Chl A**
Station 1 27-Feb-13 2:10 (UTC)	-34.3414	151.96311	CTD XBT Net Tow	3 @ 10 m 600m 1000m	3 @ 10m 600m 1000m	12 between 1000m to surface	0	11 from 200m to surface
Station 2 27-Feb-13 05:43 (UCT)	-34.59995	151.9631	CTD XBT Net Tow	2 @ 140m 1000m	3 @ 25m 599.5m 1000m	12 between 1000m to surface	0	12 between 265m to surface
Station 3 27-Feb-13 10:22 (UCT)	-34.87897	152.3355	CTD XBT Net Tow	2 @ 150m 160m	2 @ 40m 160m	12 between 1000m to surface	0	10 between 175m to surface
Station 4 27-Feb-13 15:44 (UCT)	-35.26745	152.7714	CTD XBT Net Tow	2 @ 160m 1000m	3 @ 100m 400m 1000m	12 between 1000m to surface	0	9 between 160m to surface
Station 5 28-Feb-13 03:19 (UCT)	-36.42515	151.6453	CTD XBT	3 @ 20m 800m 1000m	3 @ 20m 200m 1000m	12 between 1000m to surface	0	9 between 160m to surface
Station 6 1-Mar-13 03:06 (UCT)	-38.96612	149.7594	CTD XBT	3 @ 40m 600m 1000m	3 @ 40m 600m 1000m	12 between 1000m to surface	0	9 between 150m to surface
Station 7 1-Mar-13 21:10 UCT)	-41.67843	149.0792	CTD XBT	3 @ 40m 600m 1000m	3 @ 40m 600m 1000m	12 between 1000m to surface	12 between 100m to 0m	8 between 150m to surface
Station 8 1-Mar-13 05:36 (UCT)	-42.72607	148.1359	CTD XBT	0	20m	0	3 @ 5m 20m 50m	3 between 45m to surface
Station 9 2-Mar-13 06:55 (UCT)	-42.57843	148.2386	CTD XBT	0	2 @ 20m 75 m	0	5 @ 5m 20m 50m 75m 85m	5 between 150m to surface
Station 10 2-Mar-13 07:36 (UCT)	-42.57928	148.3407	CTD XBT	0	2 @ 20m 100m	0	6 @ 5m 20m 50m 75m 100m 106m	5 between 150m to surface
Station 11 2-Mar-13 08:37 (UCT)	-42.64495	148.4702	CTD XBT Net Tow	3@ 20m 400m 850m	3@ 200m 400m 850m	9 between 850m to surface	11 between 5 m to 1000m	5 between 150m to surface
Station 12 2-Mar-13 10:48 (UCT)	-42.6676	148.6052	CTD XBT	3 @ 10m 400m 1000m	3 @ 20m 600m 1000m	8 between 1000 to surface	9 between 5 m to 1000m	5 between 150m to surface

Plankton Net Tows

At stations 1, 2, 4, 7 and 11, a plankton net tow was performed in surface waters for 10 mins at 1.5 knots. A 300 micron mesh net was used, which captured the surface zooplankton and phytoplankton at each of these sample stations. Plankton samples were washed in seawater and stored at 4° C for the duration of the voyage and some analysis of the zooplankton samples was performed under a dissecting microscope on the ship. At the conclusion of the voyage, samples were split and half were preserved by the addition of formalin. Further analysis of the zooplankton samples was performed in the laboratory at the University of Tasmania, Sandy Bay.

All stations displayed a high abundance of calanoid copepods, chaetognaths, appendicularians and fish larvae. Other zooplankton taxa observed were polychaete worms (station 4), various crustacean decapod larvae (station 4), harpacticoida copepods (stations 2 and 4), and pteropods, gastropod larvae and the occasional echinoderm pluteus larva (station 1, 4 and 11). The sample from station 2 contained a large amount of floating pumice and algae that made the sample hard to analyse. This sample appeared to have a low diversity of zooplankton and was mainly composed of calanoid copepods. The station 4 sample was also quite thick, however, it displayed a large variety of zooplankton taxa, including some gelatinous organisms, such as ctenophores and salps. This station was located within the centre of an anti-cyclonic (warm core) eddy, which may account for the difference in zooplankton taxa, compared with stations 1 and 2, which were taken on the edge of the eddy and closer to the shore. The sample at station 11 was taken just off the shelf break near Maria Island and displayed a very different species composition. The most abundant species in this sample was krill, *Nyctiphanes australis*. Calanoid copepods, pteropods and appendicularians were also observed in this sample. The surface water at this station was 18°C, compared with a water temperature of 25° C at stations 1, 2 and 4, which may explain some of the differences in the zooplankton composition in each area.

Phytoplankton were sampled using a 50 micron net, using the underway surface water line. Diatoms and Dinoflagellates were the most commonly observed phytoplankton groups in the samples analysed and were present in all regions of the ocean sampled. However, their ratios were not always the same. Stations 2 and 4 also had a high abundance of Radiolaria and Acantharia.

CSR/ROSCOP PARAMETER CODES

METEOROLOGY

M01 Upper air observations
M02 Incident radiation
M05 Occasional standard measurements
M06 Routine standard measurements
M71 Atmospheric chemistry
M90 Other meteorological measurements

PHYSICAL OCEANOGRAPHY

H71 Surface measurements underway (T,S)
H13 Bathythermograph
H09 Water bottle stations
H10 CTD stations
H11 Subsurface measurements underway (T,S)
H72 Thermistor chain
H16 Transparency (eg transmissometer)
H17 Optics (eg underwater light levels)
H73 Geochemical tracers (eg freons)
D01 Current meters
D71 Current profiler (eg ADCP)
D03 Currents measured from ship drift
D04 GEK
D05 Surface drifters/drifting buoys
D06 Neutrally buoyant floats
D09 Sea level (incl. Bottom pressure & inverted echosounder)
D72 Instrumented wave measurements
D90 Other physical oceanographic measurements

CHEMICAL OCEANOGRAPHY

H21 Oxygen
H74 Carbon dioxide
H33 Other dissolved gases
H22 Phosphate
H23 Total – P
H24 Nitrate
H25 Nitrite
H75 Total – N
H76 Ammonia
H26 Silicate
H27 Alkalinity
H28 PH
H30 Trace elements
H31 Radioactivity
H32 Isotopes
H90 Other chemical oceanographic measurements

MARINE CONTAMINANTS/POLLUTION

P01 Suspended matter
P02 Trace metals
P03 Petroleum residues
P04 Chlorinated hydrocarbons
P05 Other dissolved substances
P12 Bottom deposits
P13 Contaminants in organisms
P90 Other contaminant measurements
B01 Primary productivity
B02 Phytoplankton pigments (eg chlorophyll, fluorescence)
B71 Particulate organic matter (inc POC, PON)
B06 Dissolved organic matter (inc DOC)
B72 Biochemical measurements (eg lipids, amino acids)
B73 Sediment traps
B08 Phytoplankton
B09 Zooplankton
B03 Seston
B10 Neuston
B11 Nekton
B13 Eggs & larvae
B07 Pelagic bacteria/micro-organisms
B16 Benthic bacteria/micro-organisms
B17 Phytobenthos
B18 Zoobenthos
B25 Birds
B26 Mammals & reptiles
B14 Pelagic fish
B19 Demersal fish
B20 Molluscs
B21 Crustaceans
B28 Acoustic reflection on marine organisms
B37 Taggings
B64 Gear research
B65 Exploratory fishing
B90 Other biological/fisheries measurements

MARINE GEOLOGY/GEOPHYSICS

G01 Dredge
G02 Grab
G03 Core – rock
G04 Core – soft bottom
G08 Bottom photography
G71 In-situ seafloor measurement/sampling
G72 Geophysical measurements made at depth
G73 Single-beam echosounding
G74 Multi-beam echosounding
G24 Long/short range side scan sonar
G75 Single channel seismic reflection
G76 Multichannel seismic reflection
G26 Seismic refraction
G27 Gravity measurements
G28 Magnetic measurements
G90 Other geological/geophysical measurements