

FACILITY 6: Australian National Moorings Network (ANMN)

Australia's coasts are bound by strong boundary currents, the East Australian Current (EAC) off the East Coast, and the Leeuwin Current system off the West Coast. The interaction of these current systems with shelf processes and ecosystems is central to the scientific drivers of the IMOS observing system.

A series of national reference stations deliver long term monitoring at key sites; and regional mooring arrays designed to monitor specific oceanographic phenomena make up the network around the coast of Australia. The reference stations increase the number of long term time series observations both in terms of variables recorded, temporal distribution and geographical extent. The regional moorings monitor the interaction between boundary currents and shelf water masses and their consequent impact upon ocean productivity (e.g. Perth Canyon Upwelling; Kangaroo Island Upwelling) and ecosystem distribution and resilience (e.g. Coral Sea interaction with the Great Barrier Reef).

Mooring instruments

National Reference Stations

Three existing long term monitoring stations at Sydney (NSW), Maria Island (Tas), and Rottnest Island (WA) have been enhanced and six new sites have been established around Australia's coast. Traditionally the monitoring has been undertaken

by visiting the locations in small boats and collecting physical samples. Through IMOS, moored instruments are now being placed at these locations to collect continuous time series data in addition to enhanced physical sampling. Deployed in up to 100 m of water, the moorings record meteorological data and

information about the physical and biological properties of the water such as fluorescence and dissolved oxygen concentration. The basic mooring configuration is modified regionally to cope with the deployment challenges found locally, from cyclones to fish bite.

Ocean Colour Calibration

An ocean colour calibration site has been established on the Lucinda Cane Sugar Export Jetty, in Northern Queensland measuring above water radiance and in water optical properties. The calibration site will be used to provide satellite operators and data users with access to reliable calibration and validation data for the coastal and ocean colour satellite mission data sets. This in turn will allow global satellite imagery to be calibrated directly for Australian conditions, increasing the value of these sensors for use in Australian waters.

Passive Acoustics

Passive acoustic listening station arrays are deployed in the Perth Canyon, WA and Portland, SA. These stations provide baseline data on ambient oceanic noise, detection of fish and mammal vocalisations and detection of underwater events. An installation is being planned off Sydney, NSW.

while the EAC is getting stronger. Long term monitoring stations are essential to understanding the changes and variability in these systems.

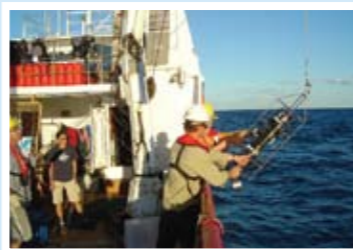
More than 25 moorings are deployed around the coast, these are regional networks designed to observe specific processes.

- In Queensland and Northern Australia, the objective is to observe the cross shelf exchange between the Coral Sea and the GBR.
- In New South Wales the objective is to provide long term monitoring of the continental shelf region up and downstream of where the EAC separates from the coast. As the most densely populated stretch of Australia's coast, issues such as water quality, waste disposal, shipping hazards, harmful algal blooms and recreation are interrelated.

- In South Australia the objective is to monitor the physical and biological properties of the shelf waters along the Eyre Peninsula and Kangaroo Island. In particular, the seasonal coastal upwelling.
- In Western Australia, the objective is to investigate variability in the Leeuwin Current off Perth.

Partners

- Australian Institute of Marine Science
- Defence Science and Technology Organisation
- Department of State Development, Trade and Innovation, Government of Queensland
- CSIRO Marine and Atmospheric Research
- Curtin University of Technology
- Flinders University
- South Australian Research and Development Institute
- Sydney Institute of Marine Science



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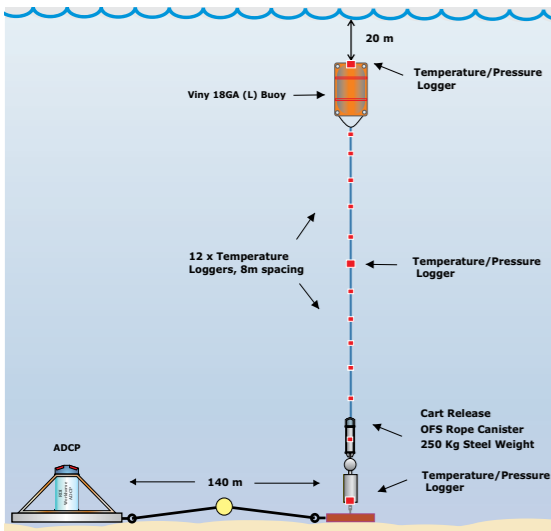


Figure 5. A schematic of the Port Hacking mooring system. Five of these will be deployed across the shelf offshore of Port Hacking, New South Wales.

More information

IMOS Australian National Moorings Network <http://imos.org.au/anmn.html>

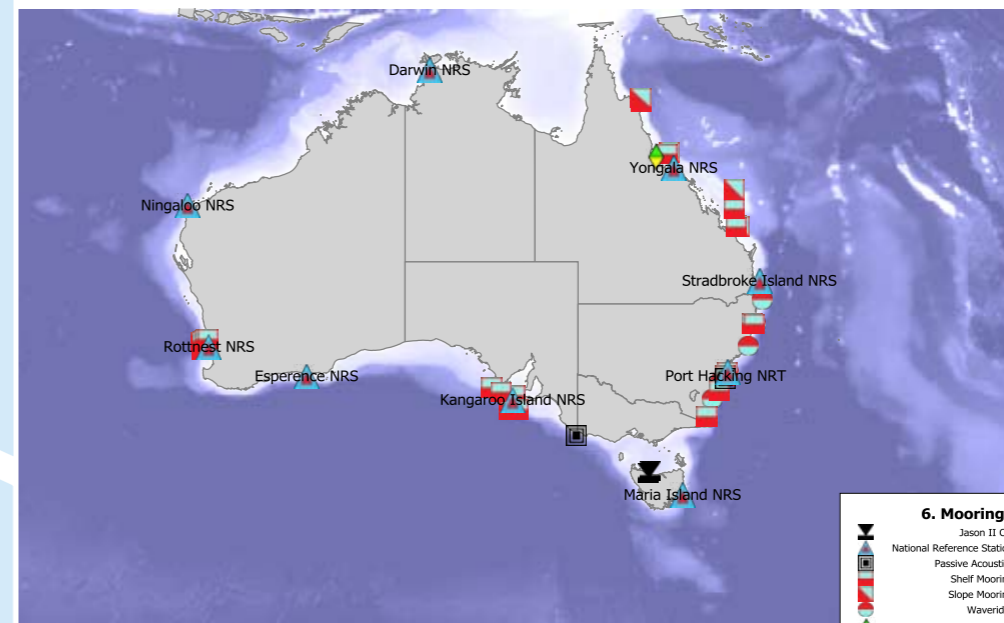
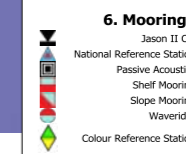


Figure 1. The mooring deployments around the coast of Australia.



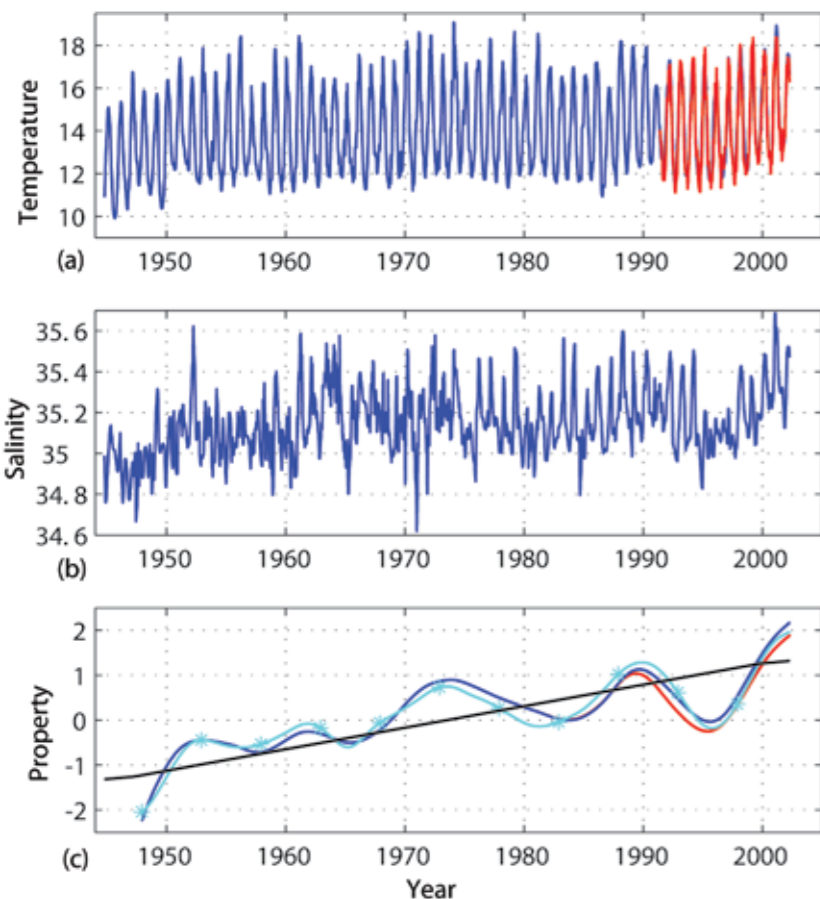


Figure 2. (a) Surface Temperature obtained at the Maria Island station. Temperature within the core of the EAC (148.6°E, 42.6°S) from a satellite composite is plotted in red. (b) The surface salinity (psu). (c) The decadal patterns of T and S at Maria Island (blue, cyan) and Satellite composite (Red).

Shelf/Slope Moorings

In total more than 25 shelf and slope moorings are deployed around the coast. The focus of ANMN has been to move from the purely physical characterization of the water masses to enable the study of the biological signals.

In Queensland and Northern Australia, four pairs of moorings are located north to south along the Great Barrier Reef (GBR). Each pair has an outer mooring on the continental slope in water greater than 200 m and an on-shelf mooring sitting on the continental shelf in shallower water around 30-70 m deep. Instruments include acoustic doppler current profilers (ADCPs) and WetLabs Water Quality Meters (WQMs) that measure current velocities, dissolved oxygen, fluorescence, turbidity, conductivity, temperature, and depth. Three of the four shelf moorings will also have surface buoys to measure meteorological and radiation observations in real-time.

In New South Wales, characterising the EAC and its movement away from the coast is the focus of the mooring array. To this end pairs of moorings will be deployed at Coffs Harbour, Sydney and South towards Eden. The moorings measure the temperature structure of the water column with thermistor strings, the current structure with ADCPs and the biological signature with WQMs.

In Southern Australia, six moorings are being deployed to monitor the large seasonal coastal upwelling of water that occurs along the continental shelf during summer. This upwelling is responsible for bringing cold, nutrient rich waters onto the shelf, boosting primary production and showing the results in increased fish catches. The moorings are a combination of one slope, four shelf and one National Reference Station, collecting a full suite of physical and biological parameters.

	In Situ (Real time)					Sampling-Biology					Light					Passive Acoustic		
	Temp	Conductivity	Fluorescence	Turbidity	Currents	Light Field	Meteorology	Phytoplankton	Zooplankton	pCO2	pH	Nutrients	Genetics	UW Radiance	DW Radiance		Solar irradiance	Sky irradiance
National Ref. Station	X	X	X	X	X	O	X	X	X	X	X	X						
Colour Ref. Station	X	X	X	X	X	X		X						X	X	X	X	
Great Barrier Reef	X	X	X	X	X		X	O										
Western Australia	X	X	X	X	X		O											X
New South Wales	X	X	X	X	X		X											X
Southern Aus.	X	X	X	X	X		X		X	X		X						X

Table 1. Summary of measurements being made by the Australian National Moorings Network. X = on all moorings, O = on some moorings.

In Western Australia, the array will consist of five moorings along the 'Two Rocks' transect from the 50 m to the 500 m isobath. Primarily these are thermistor chains allowing the structure of the Leeuwin current to be determined. Two of the moorings will also collect biogeochemical parameters. Around the Perth Canyon three moorings will be deployed to capture upwelling from the canyon. One, at the head of the canyon will carry biogeochemical sensors, the other

two on the sides of the canyon, are purely temperature and pressure sensors.

Moorings data

National Reference Stations (NRS)

The subsurface mooring provides continuous real-time measurements of temperature, salinity, dissolved oxygen, turbidity, fluorescence (using the WQMs). The weather station measures surface temperature, humidity, and wind speed and direction.

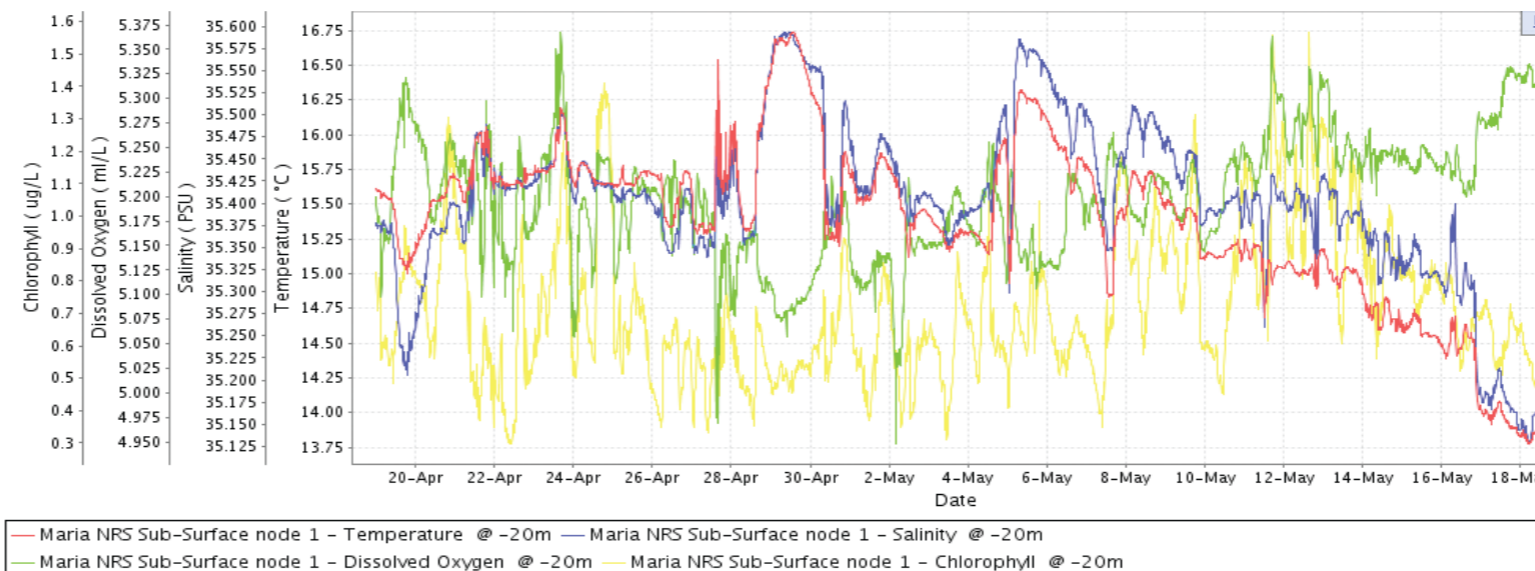


Figure 4. A graph showing a month of temperature, salinity, chlorophyll and dissolved oxygen measurements from Maria Island NRS. Prior to IMOS, measurements were only taken once a month at this site.

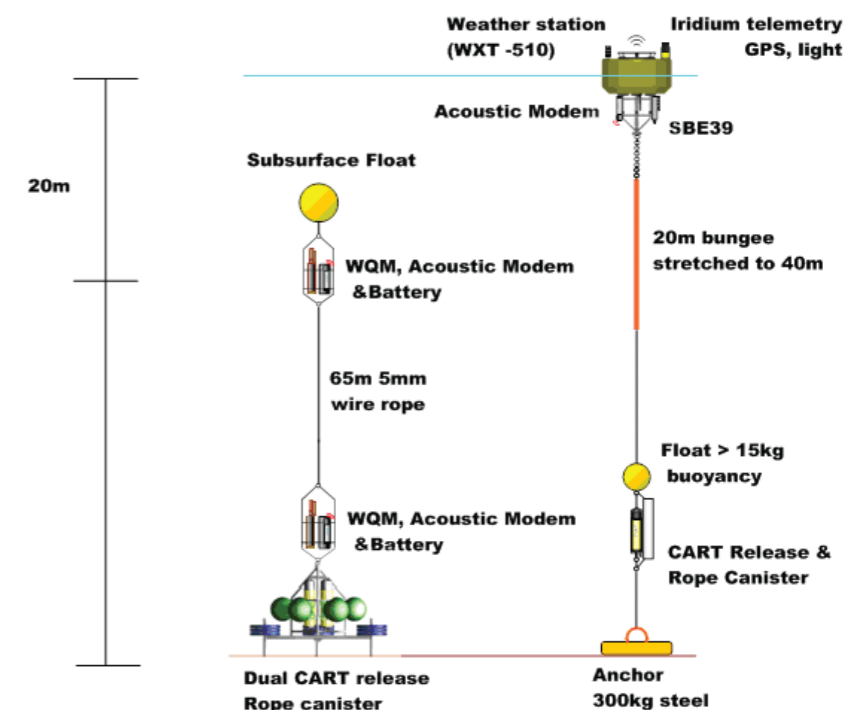


Figure 3. A schematic of Maria Island NRS mooring, one of 9 to be deployed nationally.

Physical sampling at these sites is undertaken monthly.

At Port Hacking the existing sampling site has been extended to five sampling locations across the shelf in an area just downstream of typical EAC separation from the coast which is often influenced by EAC eddies.

Shelf/Slope Moorings

As the shelf and slope moorings are designed to monitor specific processes, their design varies from site to site. Table 1 gives a summary of the data streams provided in different regions, and Figure 1 shows the locations of different mooring types.

Applications of data

Long time series of ocean data are important for distinguishing seasonal to decadal variability from long term trends.

Three of the National Reference stations (Maria Island, Rottnest Island and Port Hacking) are enhancements to existing time series. Ship based measurements have been made at these locations since at least the 1950s.

Temperature, salinity and nutrient data from these sites provide evidence that the two major boundary currents are changing. The Leeuwin is getting weaker,