RV *Investigator* Voyage Scientific Highlights

Voyage #:	**IN2018_V04**		
Voyage title:	**Constraining external iron inputs and cycling in the southern extension of the East Australian Current.**		
Mobilisation:	Hobart, Tuesday, 11 September 2018		
Depart:	Hobart, 1300 Tuesday, 11 September 2018		
Return:	Hobart, Monday, 08 October 2018		
Demobilisation:	Hobart, Monday, 08 October 2018		
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SCIENTIFIC HIGHLIGHTS

The East Australian Current (EAC) is the southward moving current along the eastern margin of Australia that influences regional climate and primary productivity. At the EAC's southern extent near Tasmania, the nutrient-depleted but iron-rich waters of the EAC mix with the cool, nutrient-rich, and iron-depleted Southern Ocean water. Where these waters mix, large spring phytoplankton blooms tend to occur. This voyage aim was to determine the sources and cycling of iron, and associated trace elements, during a springtime phytoplankton bloom and contrast this to waters where the spring bloom is muted.

During the voyage, we were able to:

1. Sample waters within a warm core eddy off the coast of New South Wales.
2. Record change in biogeochemical conditions for highly productive waters of the eastern tip of Australia
3. Determine, phytoplankton, nutrient and temperature gradients along the EAC as it flows southward along the east coast of Australia.
4. Characterise the nutrient and the trace metal status of pre-springtime bloom waters within the sub-Antarctic zone south of Australia.

Piggyback project: Spatial and temporal variability in the distribution and abundance of seabirds

The project seeks to quantify the distribution and abundance of seabirds at sea using standardised seabird survey protocols. Three dedicated observers collected real-time data on seabirds observed within 300m transect during daylight hours (sunrise to sunset) while the vessel was underway. Marine mammal observations were recorded concurrently. Incidental observations were collected whilst the vessel was stationary (CTD and TMR stations and while the vessel was recovering and deploying Triaxus etc). An IMAS Honours student was included in the survey team to allow her to collect data for her thesis studies.

The scientific highlight of the seabird program was the broad diversity of seabird species observed and in particular the diversity of seabird species breeding in the New Zealand region and foraging in the Tasman Sea close to the Australian EEZ. Southern Royal and Campbell Albatrosses are breeding species whose colonies are on subantarctic islands to the southeast of the South Island of New Zealand. High numbers of these and Westland Petrels were observed throughout the voyage.

The highlight of the marine mammal program was the close encounter with an estimated 28 Humpback Whales on migration to the Antarctic. The whales remained with the vessel over a period of several hours, frequently breaching and spyhopping. On many occasions, the whales were within 50m of the vessel. On the following day, the vessel encountered a pod of Long-finned Pilot Whales.

An observation of helium-filled party balloons c.250km east of the New South Wales coast prompted extensive media interest in the voyage. ABC News 24 undertook a live to television interview, and a number of radio stations conducted interviews over the satellite phone. The whale encounters were featured on the CSIRO blog.

Title

Constraining external iron inputs and cycling in the southern extension of the EAC.

Purpose

The East Australian Current (EAC) is a major western boundary current that moves southward along the eastern margin of Australia. This current is climatically and biologically important as it exercises control over heat and nutrient distribution. The EAC is nutrient depleted to the north, but as it travels south it entrains iron from a variety of sources – including riverine, sediment resuspension, eddies, lateral exchange of shelf waters, frontal jets and atmospheric dust inputs thereby elevating the concentration of dissolved iron. When the EAC reaches its southern extent, it breaks up to form eddy-like structures that become incorporated into the Subtropical Front (STF). The STF forms the boundary between warmer nutrient-depleted subtropical water and cool nutrient-rich Southern Ocean water. The waters southwest of Tasmania are nutrient-rich but depleted in dissolved iron, which is a typical characteristic of High Nutrient Low Chlorophyll (HNLC) regions within the Southern Ocean. In springtime, large phytoplankton blooms can be seen associated with a mingling of nutrient-depleted EAC waters with nutrient-rich, but iron depleted Southern Ocean waters in the vicinity of the STF east of Tasmania. Therefore, changes to the EAC caused by climatic shifts will have implications on elemental cycling, production, and local climate. We assessed the relationships between production and nutrient supply with the hope of improving our understanding of what drives productivity at the southern extension of the EAC

The voyage consisted of four main projects with the following objectives:

- Assess the sources of external iron to the southern extension of the EAC;
- Compare and contrast the biogeochemistry of EAC waters with HNLC waters located southwest of Tasmania;
- Determine the role of 'new' (externally sourced iron) versus 'recycled' iron in regulating springtime productivity across the STF;
- Test the sensitivity of neodymium and thorium isotope sedimentary records to local sedimentary processes.

As a result of this voyage

1. We have a better understanding of factors that drive primary production in the southern extension of the EAC. A springtime phytoplankton bloom was characterised in the southern extension EAC showed spatial and temporal changes.
2. We have found that the EAC is dynamic with a significant north-south and east-west nutrient, chlorophyll and temperature gradients. We sampled a large phytoplankton bloom east of Tasmania during the voyage.
3. We have characterised the nutrient and the trace metal status of pre-springtime bloom waters within the sub-Antarctic zone south of Australia. This will provide us with an understanding the biogeochemical status immediately for the spring bloom is initialled.
4. We have mapped new undiscovered sea mountain and collected sediment core the sides of these mountains. These cores show remarkable changes in texture and composition and providing a window into past conditions in the region.