

RV Investigator Voyage Scientific Highlights and Summary

Voyage #:	IN2019_T03
Voyage title:	ORCA: Using the Investigator radar as a moving reference for the Australian operational radar network.
Mobilisation:	0800, Darwin, 22/12/2019
Depart:	0800, Darwin, 23/12/2019
Return:	0800, Henderson, 02/01/2020
Demobilisation:	0800, Henderson, 02/01/2020
Voyage Manager:	Matt Boyd
Chief Scientist:	Dr Alain Protat
Affiliation:	Bureau of Meteorology
Project name:	Microplastic in the food chain: impact on the microbial and planktonic organisms.
Principal Investigators:	Dr Sophie Leterme
Affiliation:	Flinders University
Project name:	Spatial and temporal variability in the distribution and abundance of seabirds
Principal Investigators:	Dr Eric Woehler
Affiliation:	Birdlife Australia
Project name:	Supplementary Cloud Radar, Lidar and Aerosol Measurements
Principal Investigators:	Dr Robyn Schofield / Dr Alain Protat
Affiliation:	University of Melbourne

Scientific Highlights

The Chief Scientist

Dr. Alain Protat, Australian Bureau of Meteorology



Alain Protat leads the "Radar Science and Nowcasting" Team at BOM. He uses radars at different frequencies and on different platforms (ground, ship, aircraft, satellite) to better understand cloud and convection (storms) processes. He then exploits this better understanding of clouds and convection to evaluate and improve the representation of clouds and convection in numerical weather prediction and climate models. He has co-authored 134 peer-reviewed papers on these research themes (as of December 2019).

His main contributions to this project will be to coordinate the comparisons between OceanPOL and ground-based radars and work on developing attenuation corrections at C-band for the operational radar network using a combination of the micro rain radar, disdrometers, OceanPOL, and cloud radar observations.

Title

ORCA (Optimizing Radar Calibration and Attenuation corrections): Using the Investigator radar as a moving reference for the Australian operational radar network

Purpose

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

1. To use the Investigator C-band Doppler dual-polarization weather radar (OceanPOL) and OceanRAIN ODM470 disdrometer as moving references to evaluate the calibration of selected coastal radars from the Bureau of Meteorology operational weather radar network
2. To assess the amount of plastics (micro through to nano in size) present in blue waters around Australia, to identify their impact on microorganisms at the base of the oceanic food chain and understand how they are distributed in oceans around Australia.
3. To quantify the variability in the distribution and abundance of seabirds in the marine environment around Australia and examine the relationships between physical oceanographic features and their use as seabird feeding areas

Contribution to the nation

The operational weather radar network is the main source of real-time information about severe weather and associated hail, heavy rain, and wind gusts for the general public and private industries. Providing such service in a quantitative way to the nation requires that radars be accurately calibrated. The dataset collected during this very successful voyage will allow for the operational tools developed by the Bureau to monitor the radar calibration to be validated using one single source of reference, the OceanPOL weather radar on RV Investigator. We have indeed been lucky enough to collect

collocated precipitation data for six out of the nine radars along the coast: Berrimah (Darwin), Broome, Port Hedland, Dampier, Learmonth, and Perth, which is a high rate of success given the low frequency of occurrence of precipitation along this coast and the hours allocated to this project. By launching radiosondes we have also been able to confirm for the first time with observations that the hot spot of Convective Available Potential Energy (CAPE, an indication of the potential for the atmosphere to develop deep convection) found in reanalyses is real.

By 2025, marine industries are expected to contribute > \$100 billion each year to Australia's overall economy. Marine ecosystems are affected by plastic intrusion, which impacts how these systems support our economy. Previous studies of microplastics in Australian blue waters were restricted predominately to surface waters. Research shows that plastics (generally buoyant in saltwater) act in a similar way as marine snow; in that as they age, fragments of plastic slowly sink down to the sediment. Currently we do not understand the vertical distributions of plastics in Australian waters. This is important as many animals feed, and aquaculture farms operate, below surface waters.

In addition to this, studies have been restricted to plastic fragments that are greater than 0.3 mm in size. During this voyage, small microplastics were measured for the first time down to the size of 0.2 µm (0.0002 mm). These data will provide increased knowledge on the microbial and planktonic communities in Australian waters, and we will assess the amount of microplastic ingested by zooplankton species at the time of sampling. This will allow us to predict how much is carried up the food chain and potentially ingested by fish. Through this study we will also determine the capability of microplastics to be vessels for the transport of invasive species and pathogens. The data collected on this voyage will be supplemented with data collected on several additional voyages spanning into 2021. The plastic quantifications will be used to develop a comprehensive model of how plastics move in ocean features and inform us of potential hotspots of plastic aggregations on our coastlines.

This voyage also provided an opportunity to undertake spatially-explicit detailed surveys of seabirds and marine mammals in remote areas of Australia's Exclusive Economic Zone. Few surveys of the EEZ between Darwin and Perth have been undertaken, so very few data are available on the distribution of seabirds and marine mammals for this area, approximately one quarter of Australia's coastline.

As a result of this voyage

1. We have collected collocated radar data for six out of the nine radars along the coast: Berrimah (Darwin), Broome, Port Hedland, Dampier, Learmonth, and Perth.
2. We have identified a mis-pointing of the OceanPOL radar, which will require more analysis and a reprocessing of the whole dataset collected since 2016.
3. We have demonstrated with observations that the coastal area near Broome is indeed a hot spot for CAPE.
4. We have a better understanding of the quantity of plastics in selected sites on WA coast and the vertical distributions, how much plastic is ingested by zooplankton, and of plastic quantities for sizes < 0.3 mm and > 0.0002 mm.
5. The seabird and marine mammal survey (sunrise to sunset daily) recorded 30 species of seabirds comprising more than 5800 birds and three species of marine mammals during 10 days of observations.
6. The arrival in Perth saw the project achieve a notable objective – a circumnavigation of Australia to collect data from seabirds and marine mammals at broad spatial scales from Australia's EEZ.