RV *Investigator* Scientific Highlights

Voyage #:	IN2016_V05		
Voyage title:	The Great Barrier Reef as a significant source of climatically relevant aerosol particles		
Mobilisation:	Brisbane, 0800 Monday 26 September – 1700 Tuesday 27 September, 2016		
Depart:	Brisbane, 0800 Wednesday 28 September 2016		
Leg 1 Arrive:	Fitzroy Island, Tuesday 11 October, 2016		
Leg 2 Depart:	Fitzroy Island, Tuesday 11 October, 2016		
Leg 2 Arrive:	Magnetic Island, Sunday 16 October, 2016		
Leg 3 Depart:	Magnetic Island, Sunday 16 October, 2016		
Return:	Brisbane, 1700 Monday 24 October, 2016		
Demobilisation:	Brisbane, 0800 Tuesday 25 October – 1700 Wednesday 26 October, 2016		
Voyage Manager:	Lisa Woodward	Contact details:	Lisa.woodward@csiro.au
Chief Scientist:	Professor Zoran Ristovski		
Affiliation:	Queensland University of Technology	Contact details:	z.ristovski@qut.edu.au
Principal Investigators:	A/Prof Graham Jones – Southern Cross University Dr Alain Protat – BOM Dr Robin Beaman – James Cook University (Piggyback Project) Dr Robyn Schofield – University of Melbourne Dr Branka Miljevic – Queensland University of Technology* Dr Hiroshi Tanimoto – NIES Japan* Dr Justin Seymour – University of Technology Sydney* Dr Mike Harvey – NIWA, New Zealand* Dr Melita Keywood – CSIRO O&A* Sarah Lawson – CSIRO O&A*		
Supplementary Project			
Principal Investigator:	Karen Wild-Allen		
Project name:	Biogeochemical and optical properties of the Coral Sea and Queensland shelf		
Affiliation:	CSIRO Oceans & Atmosphere		
Principal Investigators:	Mark Baird – CSIRO Oceans & Atmosphere Lesley Clementson – CSIRO Oceans & Atmosphere* David Blondeau-Patissier – CSIRO Oceans & Atmosphere*		

*NB: * indicates participant was not on board during this voyage.*

Scientific Highlights

The Chief Scientist

Professor Zoran Ristovski is an atmospheric scientist with more than 20 years of experience in the general area of atmospheric aerosols. His research spans a wide area from studying pollutions sources (urban pollution, vehicle emissions) to studying pristine environments (Arctic, Antarctic, remote oceans). He is leading a group of more than 10 scientists, that are part of the Institute for Future Environments at Queensland University of Technology. His group has participated in a number of field campaigns aimed at understanding the role of natural sources (forests, oceans, bush fires, etc.) on atmospheric particle production, clouds and climate. He is a recipient of a number of grants both from the government and industry. He has been actively involved in establishing the atmospheric capabilities of the RV Investigator. His team has participated in several previous voyages and he was the lead scientist in the first trial voyage of the RV Investigator in 2015 (Cold water trials).

Title

The Great Barrier Reef as a significant source of climatically relevant aerosol particles

Purpose

Every cloud drop is formed from a microscopic aerosol particle called cloud condensation nuclei - CCN. In unpolluted environments the CCN particles originate from biogenic sources (forests, oceans, etc.). Determining the magnitude and driving factors of biogenic aerosol production in different ecosystems is crucial to the development and improvement of climate models as they determine the production of CCN and therefore cloud properties. This study will determine the mechanisms of new particle production from one of the biggest ecosystems in Australia, the Great Barrier Reef. It will aim to establish whether marine aerosol along the Queensland coast is coral-derived and show that this aerosol can affect the CCN concentration and therefore cloud formation and the hydrological cycle.

The main objective of the voyage is to acquire observations that will address four key science questions about the role of atmospheric composition in the GBR region:

1. Do marine aerosols along the north Queensland coast have a significant signature that is coral-derived?
2. How does this aerosol change its physicochemical properties, especially its capacity to act as CCN, as winds carry it from the reefs to the north Queensland rainforests?
3. What is the significance of this ecosystem as a source of aerosol particles and will potential degradation of the reef cause significant variations in particle number being generated over the reef.

4. Should changes in this aerosol, associated with reef degradation, be taken into account when modelling the radiative climate and rainfall?

Contribution to the nation

Considerable efforts have been made in recent years to estimate accurately the effects of aerosols on cloud reflectivity, one of the major uncertainties in the global radiation budget. To apply such an estimate to projections of global climatic change, potential climate feedback processes must also be identified. This requires knowledge of sources, physical and chemical properties of the aerosol and of atmospheric processes that alter those properties**.** This project will quantify the source strength of the GBR as a significant aerosol source on the regional level and will enhance our understanding of the biogenic sources relevant for the Australian continent. This would be the first time that an attempt is made to demonstrate that an ecological system, such as the GBR, can have significant influence on the climate and hydrological cycle over a large part of Australia

The knowledge created in this project will provide the scientific basis for the management of water and land resources in the north Queensland region that will lead to increased protection for key agricultural areas. It will also improve public policy on the protection of the unique environmental assets, the rainforests and reefs, of north Queensland.

As a result of this voyage

1. We have a better understanding of the atmospheric composition over the Great Barrier Reef and of the key processes that underpin new particle formation in this area.
2. We have found that the RV Investigator is an exceptional platform for studying atmospheric processes due to its high mobility and flexibility. A number of new methods (drones, tethersondes, etc.) have been evaluated for on-board use for the first time.
3. For the first time, in the GBR area, we have mapped the atmospheric particle characteristics (size, composition, CCN, etc.) as well as the changes in the DMS concentration (a key chemical responsible for new particle formation) both in the water column and air.
4. We have commenced a program of research, within a large international team, investigating the role of a large ecosystem, such as the GBR, on atmospheric particles, clouds and climate.

The voyage attracted significant media attention with an ABC crew filming on board for one week. This resulted in a number of live coverages from the RV Investigator as well as a number of articles both online and on ABC TV.

How the corals of the Great Barrier Reef affect Queensland's climate, The Science Show
http://www.abc.net.au/radionational/programs/scienceshow/how-the-corals-of-the-great-barrier-reef-affect-queensland%E2%80%99s-cl/8086844

Qld research raises fears a dying reef could impact weather patterns (PM Radio)
http://www.abc.net.au/pm/content/2016/s4555969.htm

Does coral create rain? ABC News
http://www.abc.net.au/news/2016-10-14/how-the-great-barrier-reef-coral-impacts-rainfall/7928714

Australia's Young Climate Scientists. ABC News
http://www.abc.net.au/news/2016-11-07/the-young-climate-scientists-aboard-the-rv-investigator/7997864