

# **Isotopic characterisation of nutrient dynamics and deep water behaviour in the west Antarctic Peninsula sea ice environment**

## **Principle Investigator**

Sian Henley (University of Edinburgh, UK)

Contact: [s.f.henley@ed.ac.uk](mailto:s.f.henley@ed.ac.uk)

## **Other key participants**

Raja Ganeshram (University of Edinburgh, UK)

Mike Meredith (British Antarctic Survey, UK)

Hugh Venables (British Antarctic Survey, UK)

## **Project description**

The west Antarctic Peninsula (WAP) is the fastest-warming oceanic region on Earth, with increases in atmospheric and ocean temperatures accompanied by marked sea ice declines and glacial retreat in recent years. The WAP region may serve to predict changes elsewhere around Antarctica as climate change proceeds, since the processes and feedbacks at work are likely to apply throughout the Southern Ocean sea ice zone. As such, understanding the mechanisms of change here and their impact on the marine environment is a high scientific priority and has become the focus of a large international research effort.

Physical climate and oceanographic changes at the WAP are having a profound, yet complex impact on phytoplankton productivity. The overarching goal of this project is to quantify these biological changes and understand the nutrient budgets and cycling underpinning the interactions between physical change, primary production and biological uptake of CO<sub>2</sub>. To achieve this overarching goal, we will examine the polar marine nitrogen cycle in detail using a comprehensive suite of isotopic and biogeochemical measurements. A fixed nitrogen budget will be constructed for the WAP shelf on an annual basis, for comparison with sea ice, glacial meltwater, ocean temperature and deep water behaviour changes, in order to evaluate the physical controls on nutrient biogeochemistry. We will also investigate coupling between the polar marine nitrogen and carbon cycles in order to elucidate the implications of nutrient changes for air-sea CO<sub>2</sub> exchange and potential climate feedback scenarios.

Fieldwork will be conducted at the WAP over three years (2013-2016) and the observations will document changes in primary production, nitrogen cycle processes and carbon dynamics as well as the physical oceanographic and ice conditions associated with this variability. High-resolution time-series work will take place during austral summer seasons at the Rothera Oceanographic and Biological Time-Series (RaTS) to assess temporal changes in northern Marguerite Bay. Additional ship-board sampling across the WAP shelf will provide the regional context for the time-series study and allow a full assessment of spatial variability in nitrogen and carbon cycle processes throughout the WAP region. Together, these datasets will provide a unique insight into the nutrient biogeochemical changes underlying the relationships between primary production, biological CO<sub>2</sub> uptake and physical changes. Understanding these mechanistic linkages will be crucial in efforts to predict how future warming and ice losses will influence air-sea CO<sub>2</sub> exchange, nutrient budgets and

the functioning of marine food webs at the WAP and larger scales, with important consequences for global biogeochemical cycles.

The aims and objectives of this project fit well within the SOOS scientific strategy and are closely related to three of the six overarching scientific challenges targeted by SOOS. In particular, this project will make a strong contribution to addressing:

- The future and consequences of Southern Ocean carbon uptake
- The future of Antarctic sea ice
- The impacts of global change on Southern Ocean ecosystems

### **Project timeline**

June 2013 – June 2018

### **Key deliverables**

1. Time-series biogeochemical and physical datasets from time-series sampling in northern Marguerite Bay, austral summers 2013-2016
2. Spatial biogeochemical and physical datasets from research cruises across the WAP shelf, austral summers 2013-2015
3. Annual isotope-constrained fixed nitrogen budgets for the WAP shelf, austral summers 2013-2016

### **Funding**

This project is funded through a UK Natural Environment Research Council Independent Research Fellowship

### **Linkages with other programmes**

British Antarctic Survey Polar Oceans Programme

Palmer Antarctica Long-Term Ecological Research (Pal-LTER) project

Netherlands Polar Programme, Antarctica - Rothera

Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED)

### **Data management**

Data will be managed by the P.I. and Project Partners, and upon completion, will be submitted to the British Oceanographic Data Centre, from which it will be made available to the community via the usual channels.