British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC GW4+ Doctoral Training Partnership

PROJECT TITLE: **Future climate and mass balance of the Antarctic ice sheet**

Lead Institution: **British Antarctic Survey (BAS)**

Lead Supervisor: **Dr Andrew Orr, Atmosphere, Ice and Climate team:**

Co-Supervisor: **Prof Tony Payne, School of Geographical Sciences, University of Bristol**

Co-Supervisor: **Dr Gareth Marshall, Atmosphere, Ice and Climate team, BAS**

Co-Supervisor: **Prof Richard Essery, School of Geosciences, University of Edinburgh**

Project Enquiries & Applications: **Dr Andrew Orr - anmcr@bas.ac.uk**

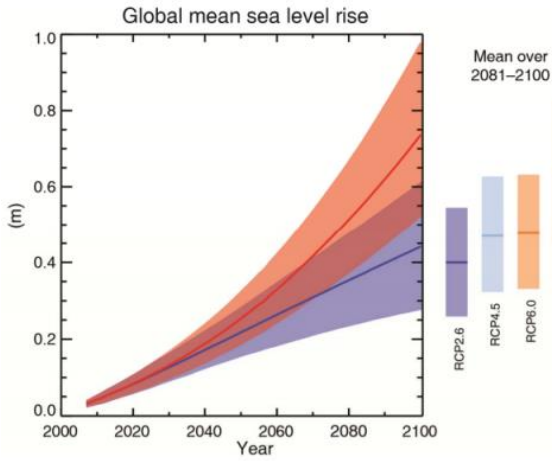

Image Caption: Global average sea level projections based on future scenarios of greenhouse gas emissions or 'representative concentration pathway' (RCP). The four RCPs range from very high (RCP8.5) through to very low (RCP2.6) future concentrations. Credit: IPCC Working Group I.

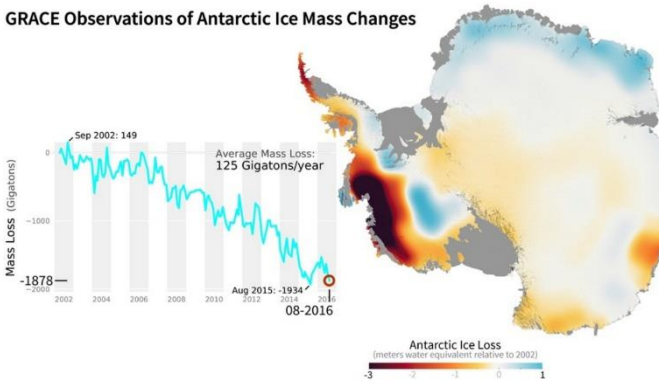

Image Caption: Changes in Antarctic ice mass since 2002, based on observations from NASA's Gravity Recovery and Climate Experiment (GRACE) satellite. Orange and red shades indicate areas that lost ice mass, whilst light blue indicates areas that gained ice. Between 2002 and 2016, Antarctica shed approximately 125 gigatons of ice per year, causing global sea level to rise by 0.35 millimetres per year. Credit: NASA's Goddard Space Flight Center.

Project Background

The Antarctic Ice Sheet (AIS) is the largest mass of ice on Earth, which would raise sea levels by 58 meters if melted entirely. The AIS has been shown to be highly sensitive to recent climate change. For example, parts of Antarctica are amongst the fastest warming regions on Earth, resulting in the collapse of several ice shelves, while accelerated glacier melting in West Antarctica is responsible for around 10% of global sea level rise. Although a warming atmosphere will result in increased snowfall over the AIS, which could potentially compensate for any ice loss, such changes are perhaps a troubling harbinger of more severe climate change in the coming century, resulting in a potentially catastrophic rise in sea level. Thus, a major emphasis of scientific research is to improve predictions of future climate change to help better constrain the evolution of the AIS, and reduce uncertainty in sea-level projections.

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC GW4+ Doctoral Training Partnership

Project Aims and Methods

The project will use regional modelling of the atmosphere to deliver projections of the climate of the AIS, including associated changes in surface mass balance and meltwater availability, which will be used as forcing for an ice-sheet model to explore the effects of climate change on the AIS evolution.

For the atmosphere, we will use the state-of-the-art UK Met Office Unified Model (MetUM) in its regional configuration to derive a variety of high-resolution projections for the whole of Antarctica. Importantly, the MetUM is able to resolve the narrow and steep coastal margins of the AIS. By making improvements to the multi-layer snow scheme used by the MetUM, these simulations will include a realistic representation of essential snow, firn and ice processes.

For the ice-sheet, we will use the BISICLES adaptive-mesh model applied to the whole of the AIS with sub-kilometre resolution for grounding lines and ice streams. These tools will be used to explore projections of the Antarctic climate and AIS to various scenarios of twenty-first century climate change.

The simulations will form part of the Polar-CORDEX (Coordinated Regional Downscaling Experiment) initiative, and analysis of the model output will contribute to the Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6), as well as the Intergovernmental Panel on Climate Change (IPCC) assessment reports.

You will be encouraged to pursue your own research interests under the general aims of the project.

Candidate Requirements

The candidate should be interested in climate modelling and have a strong interest in environmental change in the polar regions, as well as globally. They should have excellent numerical and computational skills, and be highly motivated and ambitious.

Training

The student will receive excellent supervision and training in climate and ice-sheet modelling, as well as meteorology and atmospheric and snow physics. The training will be through short courses and Summer Schools. In addition, a wide range of generic and personal transferable skills training will be available such as public speaking and interaction with the media. There may also be an opportunity to send the student to Antarctica for a month if they wish, so that they can gain experience in taking observations in polar regions, as well developing a fuller understanding of the environment which they are studying.

References / Background reading list

Cornford and others, Century-scale simulations of the response of the West Antarctic Ice Sheet to a warming climate, *The Cryosphere*, **9**, 1579-1600, doi: 10.5194/tc-9-1579-2015, 2015.

Trusel and others, Divergent trajectories of Antarctic surface melt under two twenty-first-century climate scenarios, *Nature Geoscience*, **8**, 927-932, doi: 10.1038/ngeo2563, 2015.

Fettweis and others, Estimating the Greenland ice sheet surface mass balance contribution to future sea level rise using the regional atmospheric model MAR, *The Cryosphere*, **7**, 469-489, doi: 10.5194/tc-7-469-2013, 2013.

Gregory and Huybrechts, Ice-sheet contributions to future sea-level change, *Philosophical Transactions of the Royal Society*, **364**, 1709-1731, doi: 10.1098/rsta.2006.1796, 2006.

Useful links

https://www.bas.ac.uk/

https://www.bas.ac.uk/science/science-and-students/nerc-doctoral-training-opportunities/

Interested in a project? Contact the lead project supervisor for more information.

To apply, please send the following documents directly to the project supervisor:

- A full CV
- Copies of transcripts and degree certificates
- A statement of interest (no more than 2 sides A4)
- Name/email address of two professional referees

For general enquiries: Contact Ali Teague alag@bas.ac.uk in the BAS Student Office

The application deadline is 1600 hours GMT Monday 7 January 2019 and interviews will take place between 4 and 15 February 2019. For more information about the NERC GW4+ DTP, please visit https://nercgw4plus.ac.uk.