PROJECT TITLE

WINDSOC: Westerly winds and the Southern Ocean CO2 sink

PROJECT DESCRIPTION

More than one quarter of the CO2 emitted to the atmosphere from human activities is absorbed by the oceans. Of these, the Southern Ocean accounts for 43% of the global oceanic uptake. The capacity of the Southern Ocean to absorb this CO2 has recently been limited (according to some studies) by an observed increase in the strength of the Southern Hemisphere Westerly Winds (SHW). These are causing turbulent mixing which is drawing the CO2 saturated waters from the deep ocean back to the surface, causing a net outgassing. This positive climate feedback between winds and CO2 means that the ocean may eventually cease to function as a net sink of CO2, driving up atmospheric greenhouse gases and accelerating rates of global warming. As observational records are limited to the last 100 years at most in the Southern Ocean, evaluating how the SHW have modulated the CO2 sink over longer timescales, and during naturally warmer phases in the past, is now a major priority for climate science (Saunders et al., 2018; Perren et al., 2021).
Recognising the urgency of this issue, we have been reconstructing the behaviour of the SHW across key climate transitions over the last c. 20,000 years by analysing dust, and sea salt aerosol proxies (e.g., diatoms, testate amoeba, mercury, iodine) preserved in lake and peat cores from sub-Antarctic Islands. Our main objective is to improve understanding of the future capacity of the Southern Ocean CO2 sink with the ongoing strengthening of the SHW. Using lake and peat deposits that have already been collected from several sub-Antarctic Islands and dated as part of the NERC-funded SHW and the Swiss Polar Institute-funded expeditions, this project will reconstruct past changes and the range of natural variability in the strength and position of the SHW in the Southern Ocean over the last c. 20,000 years. The applicant will be integrated into a diverse and expanding PICC team in BAS investigating past changes in SHW and its impact on the CO2 sink. They will also work with our existing collaborators from ANSTO/ANU (Australia) who are developing circum-hemispheric records of anthropogenic plutonium fallout from islands in the Southern Ocean and examining long-range toxic metal pollution in Australia and the Southern Ocean (with particular focus on transport and deposition of Hg on Australia's sub-Antarctic Islands).

SUGGESTED LENGTH – A 3 to 6-month period starting Sept/Oct 2021 to allow in-depth training and support. Part time/flexible working is possible.

JOB DESCRIPTION

The applicant will generate and/or undertake data analysis of physical or biological 'proxies' associated with increased wind strength (e.g., dust, grain-size, sea-salt aerosol geochemistry) during this flexible internship project. What the applicant does within the framework of the overall project can be tailored specifically to suit their interests and skills, with a strong emphasis on applicant career development and training as an independent researcher.

There are two potential options: 1) Lab project: Generate proxy data from lake and peat cores from the Southern Indian (Kerguelen Island) and Southern Pacific (Cape Horn) sectors of the Southern Ocean. Physical data generated will include cover at least one of the following proxies: grain size and geochemistry (dust), carbon and carbon-isotopes analysis. If the applicant has a biological or organic

geochemistry background, and is interested in biological processes and proxies, the project could focus on pigment or biomarker analysis. With support from supervisors, the applicant will also process and analyse data produced to publication standard;

2) Data project: If the applicant is interested in working with large geochemical datasets (or if BAS laboratories are unavailable for any reason), the project will focus solely on the calibration of already-measured geochemical dust flux data (core scan XRF and subsampled ICP-MS data). With support from supervisors, the applicant generate high resolution time series of geochemical and other physical proxy datasets to publication standard. Full training in laboratory and data analytical methods will be provided by the BAS supervisory team and the applicant will join regular meetings with the BAS-PICC team and our international SHW project partners.

WHAT ARE WE LOOKING FOR?

A background in physical, biological, chemical and/or earth sciences and an interest in environmental science in general would be beneficial for both projects. For the data project a computational, and mathematical background and/or some experience with coding (e.g., R) would also be desirable, though this is not necessary for either project as full training in laboratory and data analytical methods will be provided by the BAS supervisory team.