

## Trapping carbon in the ocean: physical and biological uptake and storage in the Southern Ocean and Southeast Pacific

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The uptake of carbon by the Southern Ocean plays a critical role in mitigating atmospheric CO<sub>2</sub> increases, but its magnitude and temporal and spatial variability are still subject to large uncertainties; this is due to the scarcity of observations and to uncertainties and mismatch with numerical models.

The Southeast Pacific Ocean is one such region where circumpolar deep waters upwell, when rich in nutrients and carbon, fuelling intense biological activity in summer; in winter, cold and fresh Subantarctic Mode Water and Antarctic Intermediate Water are formed and subducted, carrying with them a high content of anthropogenic carbon dioxide into the ocean interior. A multi-faceted study of the region (CUSTARD project: Carbon Uptake and Seasonal Traits of Antarctic Remineralisation Depth - <https://noc.ac.uk/projects/custard>) was undertaken to investigate the underlying processes driving the uptake of carbon from the atmosphere, how biology exported carbon from the surface, and the depths at which it was remineralised.

Following on from the CUSTARD project, we can offer a number of opportunities to add understanding in this region through interrogation of novel data sets, which can be combined and selected depending on the student's interests and skills:

- Laboratory analyses of samples collected in the region: dissolved inorganic carbon isotopes, which can be used as a proxy signal of carbon dioxide derived from human activities, essential for understanding how water masses are formed and how much anthropogenic carbon they are carrying when they lose contact with the atmosphere.
- Data analysis of processed samples to identify what drives the formation of biological glues: these glues mediate the sinking rate of carbon-rich particulates critical to understanding how carbon leaves the surface layers and where in the water column it remineralises.
- Analysis of different climate model outputs in the region and particle-tracking simulations: to examine how deep in the ocean the exported particulate carbon must get to, in order to remain out of contact with the atmosphere on decadal timescales.
- Investigation of data assimilation products (B-SOSE, ECCO-Darwin) and remote sensing products (ocean colour, temperature, photosynthetically available radiation and net primary production from SeaWiFS, MODIS-Aqua and VIIRS satellites): to place the study region into the larger Southern Ocean context.

The project can be carried out remotely, in a hybrid format (remotely with a final 1 or 2-week visit), or fully in-person at the National Oceanography Centre in Southampton, where the student will be able to gain experience working in the lab and to join seminars and meetings. This will enable the student to discuss their research results, both within the smaller supervisory team, and as part of the wider meetings of the Ocean Biogeosciences and Marine Systems Modelling groups.