

Has Antarctic ice loss altered the circulation of the Southern Ocean?

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Project description: Recent studies show that Antarctica is losing ice at a rate of approximately 75 cubic kilometres per year. While it is now recognised that ocean dynamics can enhance ice sheet melting, less well understood is the influence increased freshwater input from Antarctica – a process that occurs at relatively small scales – may have on the Southern Ocean’s large-scale circulation. Potentially, any change could either inhibit or promote further ocean-induced melting, with the latter positive feedback clearly the more troubling scenario.

This project seeks to combine the remote sensing expertise of the Bristol Glaciology Centre (BGC) with the polar modelling and observational expertise of the British Antarctic Survey (BAS) to first map and then understand the drivers of circulation changes in the Southern Ocean. The primary scientific question we wish to answer is: To what extent has Antarctic freshwater input over the last 20 years altered the Southern Ocean’s large-scale circulation?

The first step towards answering this question is to accurately map the Southern Ocean’s large-scale circulation. Hitherto, the ability to do this with sufficient resolution and accuracy has been limited by the paucity of suitable observational data. However, recent satellite launches – including GRACE, GOCE and Cryosat2 – and a growing body of in-situ observations, from Argo floats and the Global Drifter Program, mean that detailed mapping of the full circulation of the Southern Ocean is now feasible. Thus, the first goal of the project will be to develop a novel methodology for combining satellite and in-situ data to map the Southern Ocean’s changing circulation over the last 20 years, taking into account the seasonally varying Antarctic sea-ice cover. This mapping will include the calculation of several important characteristics of the circulation which it has not previously been possible to determine for the Southern Ocean, thereby delivering a unique dataset.

Having obtained this data, the second phase of the project will be to interpret the observed changes in the Southern Ocean’s circulation in relation to observed changes in the freshwater input from Antarctica. For this purpose, both BAS and BGC will provide time series of freshwater input derived from in-situ and remotely sensed measurements. A state-of-the-art numerical model of the Southern Ocean/Antarctic Ice Sheet system developed by BAS will be used to help partition the observed changes in the Southern Ocean’s circulation between those due to changes in the atmosphere and those due to freshwater input from Antarctica.



Icebergs in the Southern Ocean