

The Southern Ocean Observing System (SOOS)

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The Southern Ocean has a substantial influence on global climate, sea-level, biogeochemical cycles, and biological productivity. More of the excess heat and anthropogenic carbon dioxide stored by the earth system over the last 50 years has accumulated in the Southern Ocean than in any other latitude band. The Southern Ocean is warming faster, and to greater depth, than the global ocean average. Warming of the ocean may affect the mass balance of the Antarctic ice sheet: warmer ocean temperatures have been linked to increases in melt of floating ice shelves and glacier tongues, which in turn result in faster flow of ice off the continent into the sea and increases in sea level. Carbon and nutrients are exported to the deep ocean as organic matter sinks and decomposes in the deep ocean; upwelling in the Southern Ocean provides the primary pathway for the return of carbon and nutrients to the surface ocean. There is growing recognition that changes in the circulation of the Southern Ocean are likely to have been an essential ingredient in glacial - interglacial cycles and may contribute to climate feedbacks in the future. Recognising the significance of the Southern Ocean to issues of major relevance to society - including climate change, sea-level rise, and biological productivity - the international research community has developed a plan for sustained, integrated, multi-disciplinary observations of the region: a Southern Ocean Observing System (SOOS). SOOS has built on the legacy of previous research programs (e.g. WOCE, CLIVAR, IPY, GEOTRACES, CAML) to design a program of feasible, sustained observations. The most urgent science questions can be grouped into six overarching science challenges, each of which requires sustained observations to be addressed: 1. The role of the Southern Ocean in the planet's heat and freshwater balance 2. The stability of the Southern Ocean overturning circulation 3. The role of the ocean in the stability of the Antarctic ice sheet and its contribution to sea-level rise 4. The future and consequences of Southern Ocean carbon uptake 5. The future of Antarctic sea ice 6. The impacts of global change on Southern Ocean ecosystems The plan identifies the variables that must be measured on a sustained basis to meet each of these challenges, and the platforms that could provide these observations. Based on this analysis, the building blocks of the SOOS were identified, including repeat hydrography with full tracers; multi-disciplinary observations of the surface ocean and meteorology from volunteer observing ships; enhanced Argo float deployments; observations from instrumented marine animals; moored time series in key deep water outflows, boundary currents and fronts; and sea ice observations. The SOOS plan can be found at www.scar.org/soos.