

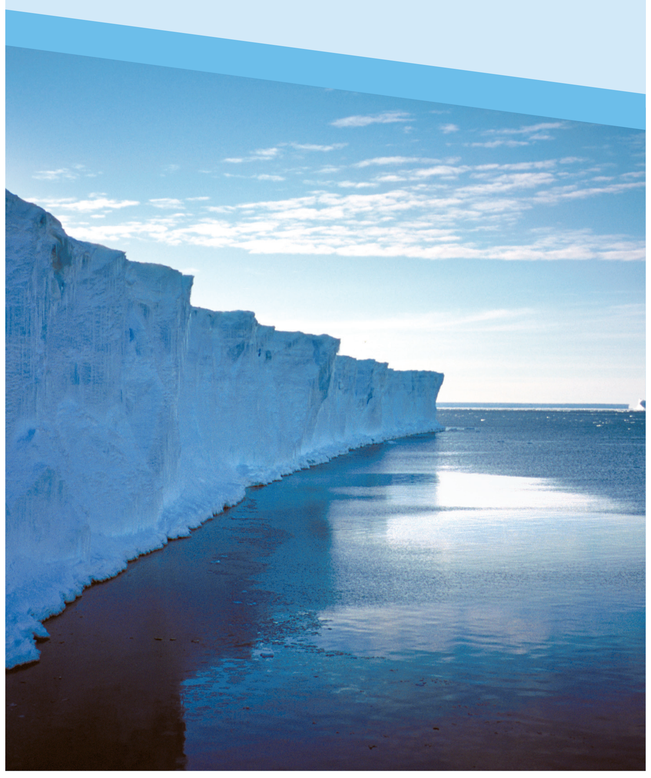
SOPHOCLES

Southern Ocean Physical Oceanography and Cryospheric Linkages

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SOPHOCLES is a new project focussed on how well the current generation of models represent the interaction between the cryosphere and the Southern Ocean. The first aim is to verify these models against the latest available observations and use the observations to constrain the choice of parameterizations used by different groups. Many cryospheric interactions are not represented in current global climate models and we may need different parameterizations to better represent the properties of Southern ocean sea ice. The project aims to develop new parameterizations of these cryospheric processes for use in global models or directly include these processes in regional focussed studies. The main aims of the project are to investigate:-

- How well do the models represent Southern ocean water masses, methods of formation/transformation, ocean mixing processes and dynamics of the major currents and thermohaline circulation?
- How can ice and ocean model parameterizations be improved to better represent the interaction between the ocean and the Southern Hemisphere cryosphere?
- How can we best use satellite observations and in situ data sets including those gathered during IPY and through SOOS to constrain the models?

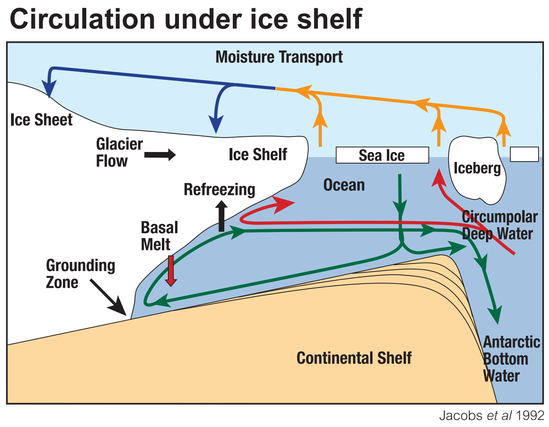


The cryospheric components that are covered by the project are the sea ice cover, the ice shelves, icebergs and the ice on the continental fringe that is in contact with the ocean such as in glacier tongues.

The project will be a collaboration between a number of international organizations and panels including CliC (Climate and Cryosphere project), SCAR AGCS (Antarctica and the Global Climate System), CLIVAR/CLIC/SCAR SOIP (Southern Ocean Implementation Panel), CLIVAR WGOMD (Working Group on Ocean Model Development), ASPeCt (Antarctic sea ice processes and Climate) and FRISP (Forum for Ice Shelf Processes).

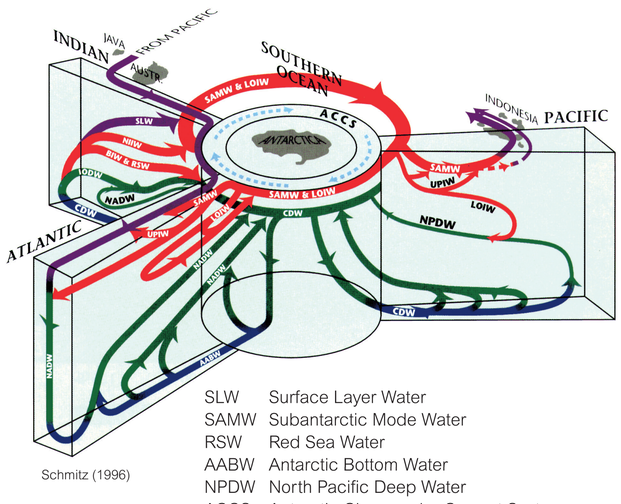
The project will include ice-ocean models that range in resolution from regional models, circumpolar models and global models so that the models can tackle a range of sea ice-ocean coupled problems on time scales from sea ice forecasting to climate change. The project will include the ice-ocean components of models used in the IPCC AR4 assessment, those being built for future assessments and ice-ocean models running the WGOMD CORE experiments. One advantage of also including regional models of individual basins at very high resolution within the project is that we can investigate in detail polynya formation, ice deformation, flows down the continental slope and explicit ocean convection schemes. Another potential project with the regional models is to include the interaction with the ocean in the cavity under ice shelves; the flux from these cavities alters the density structure on the continental shelves and changes rates of sea ice production.

Circulation under ice shelf



Jacobs *et al* 1992

The timing of the project was driven by discussions at an ASPeCt meeting in Hobart in July 2006 where the increase in available observational sea ice data both in situ and satellite led to the suggestion that we have a project to test the sea ice components of global models against new data and include additional data that will be obtained during the intensive field programmes of IPY. The project has expanded to encompass the wider needs of the Southern ocean community with a particular focus on the interaction between the ocean and the cryosphere. The aim is to provide models that will underpin and be used to synthesize research undertaken by a number of major international groups, e.g. CliC, CLIVAR and SCAR and provide improved representation of the cryosphere in models used in future IPCC assessments.



Schmitz (1996)

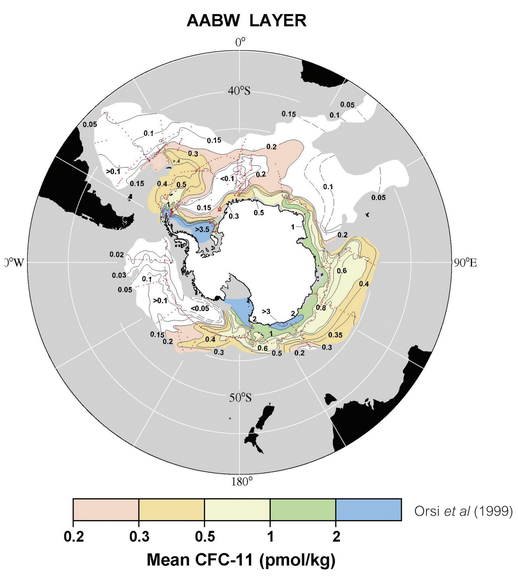
SLW	Surface Layer Water
SAMW	Subantarctic Mode Water
RSW	Red Sea Water
AABW	Antarctic Bottom Water
NPDW	North Pacific Deep Water
ACCS	Antarctic Circumpolar Current System
CDW	Circumpolar Deep Water
NADW	North Atlantic Deep Water
UPIW	Upper Intermediate Water, $26.8 \le \sigma\theta \le 27.2$
LOIW	Lower Intermediate Water, $27.2 \le \sigma\theta \le 27.5$
IODW	Indian Ocean Deep Water
BIW	Banda Intermediate Water
NIIW	Northwest Indian Intermediate Water

The ocean focus of the project, is to examine how well the ice-ocean models represent the Southern Ocean thermohaline circulation, and whether the air sea fluxes and ice processes are sufficient to form realistic volumes and density of Antarctic bottom water on the continental shelves which then flow into the deep ocean basins. Are the models able to transform circumpolar deep water into shelf water and intermediate waters of appropriate densities? The spreading of Antarctic Bottom water into the deep ocean has been tracked by CFCs and participating models should carry this tracer and other passive tracers that can represent the formation rates of Antarctic intermediate water and Sub-Antarctic Mode water masses.

The detailed plans of project approach will be discussed between the participating groups at the inaugural planning meeting; some of the issues that need to be covered include:-

- What additional analyses need to be performed on the IPCC AR4 simulations, what analyses are currently underway and can we co-ordinate efforts across groups.
- The first set of WGOMD ice-ocean experiments is now complete; how did the models perform in the Southern ocean region. Does the use of salinity relaxation overwhelm the ice-ocean fresh water fluxes in ice covered regions, and how well are the water masses and ocean current systems represented? Is the inter-annual variability of the ice and ocean components in the runs realistic when measured against limited observations?
- Do we need to design new experiments to focus in particular on Southern ocean issues, in particular a new CORE experiment, and develop a protocol for comparing regional models, and a framework for new parameterization development.

We intend to establish a data server to collect relevant model output and observations, to be used in the project through TPAC which maintains data libraries for Earth Systems Science and is based at the University of Tasmania, Australia.



Orsi *et al* (1999)

The inaugural planning meeting for participating groups in SOPHOCLES is to take place on 25th-26th August 2007 in Bergen, Norway. Anyone interested in participating in the project or in attending the meeting should contact **siobhan.ofarrell@csiro.au** for further information.

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