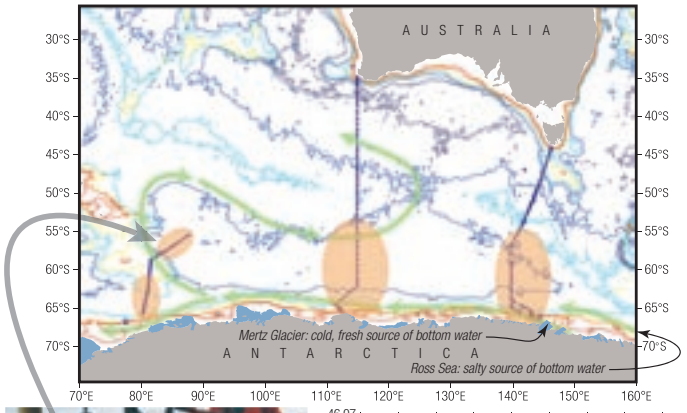
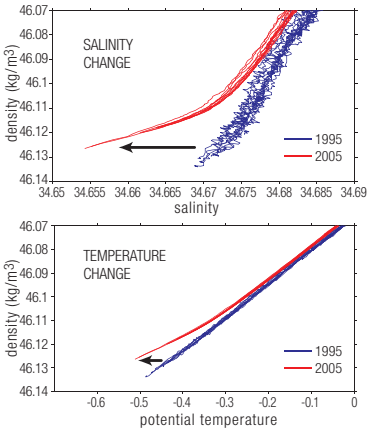
Southern Ocean studies reveal widespread changes

LOCATION OF SOUTHERN OCEAN MEASUREMENTS

The ellipses show where the deep layers of the ocean are cooler and fresher now than they were a decade ago. The green arrows show the path of the deep currents that carry the oxygen-rich bottom water away from Antarctica. The dotted lines indicate the sampling stations.



An array of oceanographic moorings was recovered in the region indicated on the map, adjacent to the Kerguelen Plateau, containing two years of information on current speeds, temperature and salinity.



PETER BOYER/ACE CRC/CSIRO

Schematic showing salinity and temperature change, movement of water, sample sites and mooring recovery.

A two-month marine science and oceanography expedition to the Southern Ocean in January this year, returned home with some surprising results – the deep waters of the Southern Ocean are cooler and less salty than they were 10 years ago.

At every station we sampled in the basin between Antarctica and Australia, the deep waters were 0.015 parts per thousand less salty and 0.1°C cooler than they were 10 years ago. While these changes might seem small, they are 50 times larger than the changes in waters near Perth.

We used to think the deeper layers of the ocean were very stable in their temperature and current patterns. But these new measurements – taken at 4000–5000 m depth – show that the movement of dense (colder and fresher) water produced around the periphery of Antarctica is changing rapidly.

There are two main sources of water supplying the basin – a salty source from the Ross Sea and a fresher source formed near the Mertz glacier in Antarctica. The new measurements suggest that the Mertz glacier may be making a greater contribution to the basin bottom water today, than it did in the past. This change could affect the global pattern of ocean current movement, sometimes called the 'ocean conveyor belt'. This conveyor belt influences climate by carrying heat around the globe, absorbing carbon dioxide and carrying oxygen to the deep ocean.

The challenge now is to understand why the movement of water between the warm, surface waters and cool, deep layers is changing. One possible explanation is that more glacial ice is melting in Antarctica, due to the impact of global warming. But it could also be a natural climate cycle. The next step will be to test our ocean samples to determine the content of glacial meltwater.

—STEVE RINTOUL

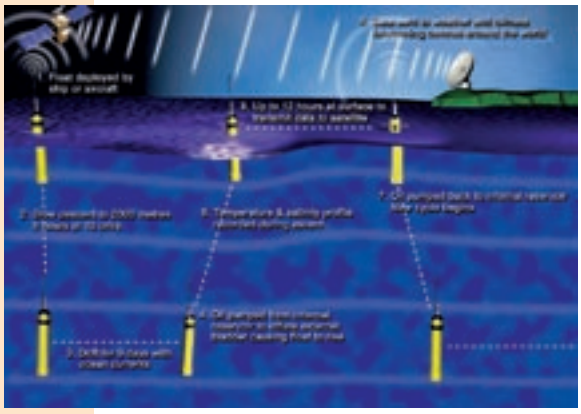
Antarctic Climate and Ecosystems Cooperative Research Centre and CSIRO Wealth from Oceans Flagship

Automated data collectors

Nineteen free-floating ocean robots known as 'Argo floats' were deployed during the Southern Ocean expedition, as part of an international ocean monitoring effort. The floats measure temperature and salinity throughout the water column, between the sea surface and 2000 m below, every 10 days. The information is relayed by satellite to scientists around the world, providing a continuous measure of ocean change; while the drift of the floats provides information on current speeds.

These automated systems will make a huge contribution to our understanding of remote and hostile regions like the Southern Ocean. On voyages like the one just undertaken, we work hard to obtain about 100 ocean profiles over eight weeks – all from one period of the year. The Argo floats will add an additional 190 profiles every 10 days, year-round, and will keep doing so for up to four years.

The expedition also successfully recovered a $1.5 million array of current-meter moorings, measuring the flow of a deep current adjacent to the Kerguelen Plateau. This current carries the dense water produced around Antarctica northward to the world's oceans, as part of a global network of ocean currents that influence the Earth's climate. The moorings had been anchored to the sea floor for two years, measuring current speeds, temperature and salinity. These measurements will allow us to calculate the transport of heat and fresh water for the first time.



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