The IMOS Southern Ocean Time Series (SOTS) facility will provide high temporal resolution observations in the Sub-Antarctic Zone (SAZ) to address issues of ocean physics and chemistry, climate change, carbon cycling, and biogeochemical controls on marine productivity. The Southern Ocean is responsible for around 30% of the total global ocean uptake of human-induced CO_2 emissions. SOTS is focused on the SAZ because waters formed at the surface in this region, the Sub-Antarctic Mode and Antarctic Intermediate waters, slide under warmer subtropical and tropical waters and carry CO_2 into the deep ocean, out of contact with the atmosphere. This process also supplies oxygen for deep ocean ecosystems, and nutrients to much of the global ocean. The SAZ is changing with global warming but the potential impacts of these changes are not yet known.

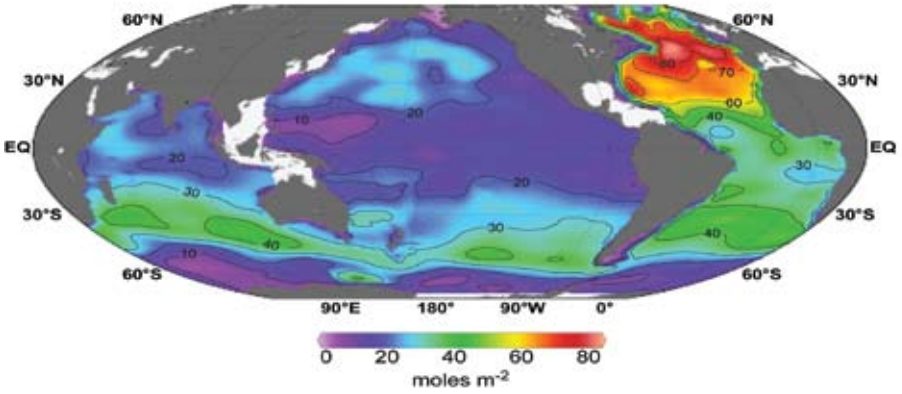

Figure 1. Column inventory of man-made CO_2 taken up by the ocean. Strong CO_2 uptake occurs in regions of formation of new water masses, such as the North Atlantic and the Southern Ocean (Sabine et al, 2004).

The SOTS Moorings

The SAZ is a particularly hostile place to install any infrastructure owing to severe weather, big waves and strong currents. SOTS is developing the engineering capability to sustain moorings carrying the latest technologies in sensors and water-samplers in this environment.

The SOTS Program observing platforms will be deployed southwest of Tasmania at a site in the central SAZ near 140ºE, 47ºS.

1. Southern Ocean Flux System (SOFS) Mooring

Measures real-time meteorological and oceanographic conditions at the sea surface, essential for climate change research.

2. Pulse Biogeochemistry Mooring

Measures surface ocean physical, chemical and biological properties that are important to air-sea carbon dioxide exchange and marine primary production, and their sensitivity to climate change.

3. SAZ Sediment Trap Mooring

Collects samples of sinking particles at several depths in the ocean interior (near 1,000 m, 2,000 m, and 3,500 m depths). These samples quantify the transport of carbon to the deep ocean in sinking particles, and thus the strength of the "biological pump" that removes CO_2 from contact with the atmosphere and stores it in the deep sea.

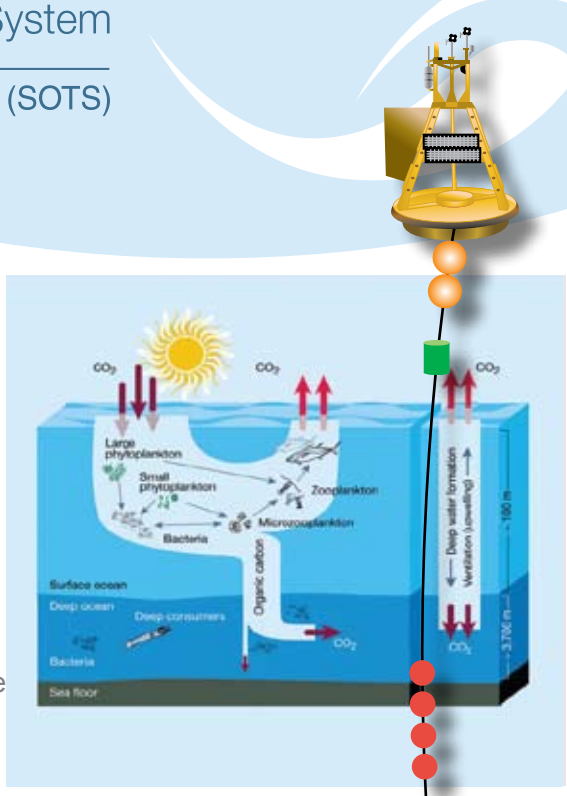

Figure 2. A schematic of the biological and physical pump, which draws CO_2 down from the surface and locks it in the deep ocean and sea floor sediments (Chisholm, 2000).

SOTS Data

SOFS will provide data on meteorological conditions, and air-sea heat and moisture fluxes. The mooring will also carry sensors to measure pCO_2, O_2, and phytoplankton fluorescence, to both extend and provide backup to the Pulse platform.

The Pulse mooring has sensors for temperature, salinity, oxygen, photosynthetically active radiation, phytoplankton fluorescence, and particle backscatter.

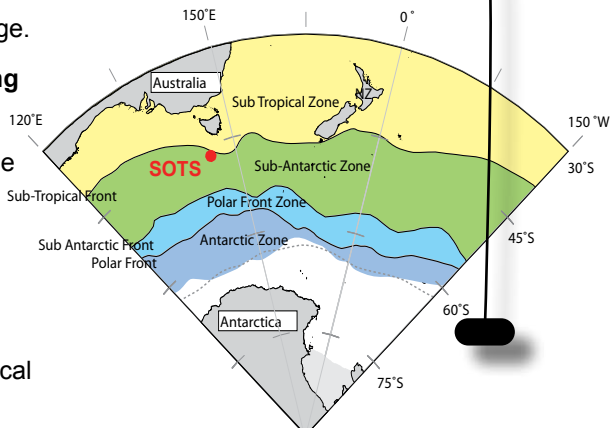

Figure 3. Fronts and regions of the Southern Ocean, south of Australia. The SOTS (140ºE, 47ºS) location is marked.

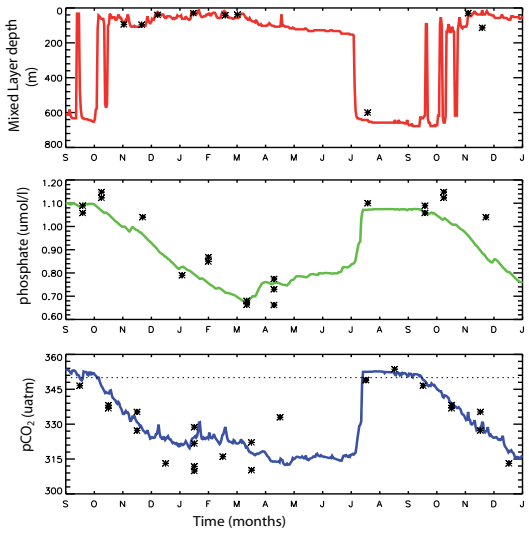

Figure 4. Modelled seasonal cycles of nutrient consumption and drawdown compared to 9 years of observations. Ships cannot provide sufficient observations to characterise seasonal cycles, or allow use of interannual variability to help understand future changes in response to climate change.

It will also collect water samples at approximately weekly intervals for measurements of nutrients, CO_2, alkalinity, concentrations and identification of phytoplankton functional groups.

Samples from the sediment traps are available now for studies of carbon flux to the deep ocean.

Applications of the data

The ocean-atmosphere processes in the SAZ, in particular biogeochemistry and surface fluxes of heat, momentum and fresh water, are virtually unknown. The new streams of data will support efforts to improve the performance of climate change models in this critical region. The moorings provide cost-effective observations and overcome the infrequent availability of ships in the region.

The SOTS moorings are an integral part of the ocean observing system. They complement satellite imagery, Argo profiling float data, and ships of opportunity data.

Continuous time-series are particularly important because many of the processes that control heat and CO_2 exchange with the atmosphere, as well as carbon and oxygen transfer to the ocean interior show variability on a wide range of timescales – from diurnal to seasonal and longer.

Focus and priorities

In the first stage of IMOS (2007 to 2011) developing the engineering capability to place sophisticated instruments in the hostile environment of the SAZ is the highest priority. The engineering tests will provide time-series measurements of key climate-processes that have never before been continuously measured in this region.

Partners

- Antarctic Climate and Ecosystems Cooperative Research Centre
- Bureau of Meteorology
- CSIRO Marine and Atmospheric Research
- University of Tasmania

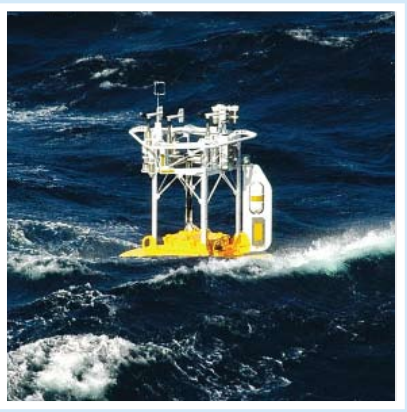

Figure 5. A picture of a Flux mooring, similar to the IMOS SOFS Mooring. Deploying a large surface mooring in the Southern Ocean is one of the big challenges facing IMOS.

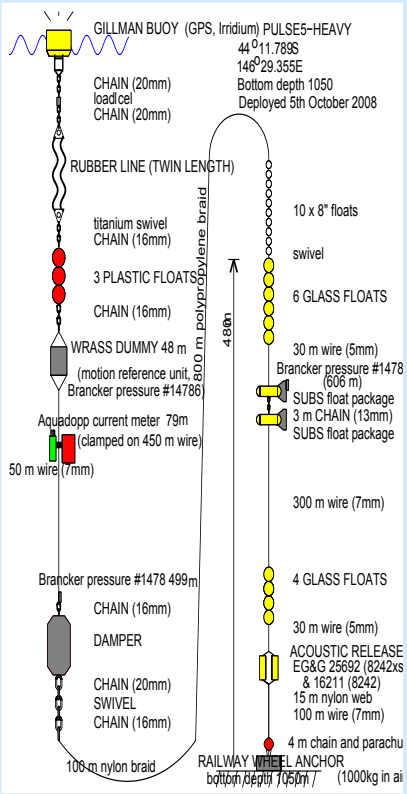

Figure 6. A schematic of the Pulse mooring system. This is one of three complementary moorings to be deployed in the same region.

www.imos.org.au

More information

IMOS Southern Ocean Timeseries (SOTS)
http://imos.org.au/sots.html

International OceanSITES ocean timeseries project www.oceansites.org

IMOS Integrated Marine Observing System

An Australian Government Initiative
National Collaborative Research Infrastructure Strategy

IMOS is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.