

SHEDDING LIGHT ON CARBON SINKS

Oceanic phytoplankton (microscopic marine plants) are responsible for about 40% of the carbon fixed each year, through photosynthesis, by land and water plants.

Zooplankton (microscopic marine animals) eat phytoplankton and consume between 35% and 70% of the carbon fixed by the phytoplankton. Their faeces and some of the larger phytoplankton sink, providing a natural pathway by which carbon is transferred from the upper ocean into long-term carbon storage, or 'carbon sinks', in the ocean's depths.

We need to be able to find oceanic carbon sinks in order to study their effects on global carbon dioxide levels. Ocean colour satellites, such as the MODIS AQUA and SeaWiFs, help us monitor phytoplankton abundance or biomass by analysing the light reflected by the ocean. The quality of the reflected light is affected by the organisms and organic matter in the upper 50 m of the ocean, and ocean colour satellites can measure these quality differences. By understanding the biology that is responsible for changes in the quality of the light, we can identify regions that are rich in phytoplankton, areas of high primary production, and possible regions where carbon sinks may be occurring.

During the *Sub-Antarctic Zone Sensitivity to Environmental Change* voyage we aimed to rigorously compare bio-optical, biomass and primary production measurements made in the water, with satellite ocean colour estimates. Such ship-board measurements are labour intensive and expensive and allow only a small part of the ocean to be sampled. But the measurements enable us to evaluate the accuracy of ocean colour satellite data, which is used to estimate biomass and primary production in the sub-Antarctic and polar regions of the Southern Ocean.

Among the ship-based measurements made during the voyage were the inherent optical properties of the water – the absorption and scattering of light in water. These properties will



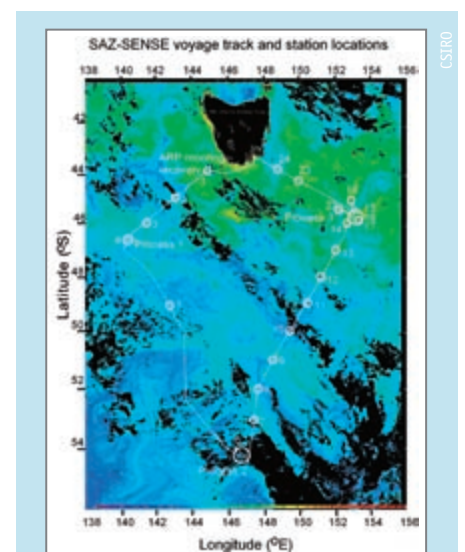
A WetLabs ac-s underwater spectrophotometer being deployed from the deck of the Aurora Australis.

vary depending on what is in the water, such as phytoplankton, suspended sediments and dissolved and particulate organic matter. We also measured primary production and the biomass of phytoplankton chlorophyll-a (a photosynthetic pigment used as an index of phytoplankton abundance), and examined the phytoplankton species composition using microscopy and pigment analysis. These measurements were compared to ocean colour satellite measurements of inherent optical properties, chlorophyll biomass and primary production.

The data collected during the voyage will be analysed over the coming months and used to improve regional algorithms to convert satellite measurements of light coming from the ocean, into biologically meaningful and useful measurements for the Southern Ocean.

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This ocean colour map shows the distribution of chlorophyll-a during the voyage, with the voyage track superimposed. Chlorophyll is very unevenly distributed in the ocean, with a strong north to south gradient and very low chlorophyll concentrations south of the sub-Antarctic zone, at about 49°S. The complex swirls are due to the underlying physical oceanography and show up warm and cold-core eddies and ocean currents.