

*The Western Weddell Sea is rarely visited by Australian scientists. But in the summer of 2004-05, sea ice scientist Dr Anthony Worby and his field assistant Carl Hoffman, worked on a multi-national, multi-disciplinary, drifting ice station in the region. The Ice Station Polarstern (ISPOL) study was organised by the Alfred Wegener Institute for Polar and Marine Research in Germany and involved glaciologists, biologists, oceanographers and meteorologists from 12 nations. ISPOL and similar studies in the future will provide international scientific programmes with information about changes in sea ice over time and its effect on the global climate.*

The Western Weddell Sea is one of the few regions around Antarctica where the sea ice does not melt completely over summer. For 37 days between November 2004 and January 2005, the German icebreaker *Polarstern* was moored to an ice floe that drifted with the winds and currents. This drifting laboratory provided scientists with round-the-clock access to adjacent ice floes, where experiments were set up to observe changes in the physical and biological properties of the sea ice during the early summer melt season.

The ice station was set up in the same region where Shackleton's ship *Endurance* was crushed in heavy sea ice in 1915. Having experienced the particularly harsh ice conditions that can occur in this region first hand, it is not hard to see why the wooden-hulled ship suffered such a terrible fate. Even with four powerful engines and a strengthened double-steel hull, the *Polarstern* struggled at times to break through the sea ice, which in some areas was ridged up to 10 m thick.

While the large-scale ocean circulation in this region is well understood, a great deal is yet to be learned about the impact of forces such as wind, waves, currents and tides on the drift and deformation of the sea ice. This is important because the sea ice has a significant effect on ocean-atmosphere

interactions in the polar regions and is an important component of the global climate system. To learn more about the sea ice drift, we used helicopters to deploy a series of drifting sea ice buoys over a region of approximately 70 x 70 km. Each buoy reported its position hourly using the satellite Global Positioning System (GPS) and some carried air temperature and pressure sensors. The GPS technology enabled us to track the drifting buoys from the ship and to revisit them throughout the experiment. The buoys were deployed on ice floes of about 1.5-3 m thick, which is enough to safely land a helicopter on, despite the water below being more than 2000 m deep.

On clear weather days we took aerial photographs over the buoy locations so that we could monitor changes in sea ice conditions related to the drift and deformation of the sea ice. The photographs were taken with a high resolution digital camera that was mounted in an enclosed casing on the skid of the helicopter. The photographs were processed with computer software designed to identify different ice types and floe sizes. The mosaic of images (below) shows the ice station on 1 January 2005, with the ship clearly visible moored to an ice floe.

Analysis of the data has already shown how cyclical changes in wind speed and direction influences the drift of the ice, and how the onset of summer conditions changes the surface characteristics of the floes. The aerial photographs show the development of surface melt ponds as well as a reduction in average floe size and an increase in the area of open water between the floes. When combined with oceanographic and surface measurements, these data give us insights into the processes that dominate ice decay and breakup. This information is used to improve the way that sea ice is characterised in global climate models, which are the primary tools used to investigate possible climate change scenarios and to predict future climate.

Two of the drifting buoys were left on the ice at the end of the voyage. They have provided data right through 2005 and are expected to continue into 2006. One of these buoys drifted northeast in the Weddell Gyre (an ocean current), while the other drifted west through Drake Passage and south along the western side of the Antarctic Peninsula. These buoys were originally deployed approximately 70 km apart, and are now more than 800 km apart, providing new insights into the large-scale sea ice drift in the region.

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Below: This sequence of aerial photographs shows the sea ice conditions in the region of the ice station. The *Polarstern* was moored to an ice floe that drifted approximately 100 km northward during the 37-day experiment.



Anthony Worby deploys a buoy on a sea ice floe to gather information about sea ice drift.



The Ice Station *Polarstern*.



## Going with the floe