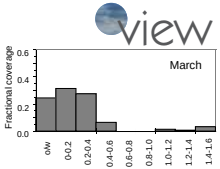
Seasonal development of Antarctic sea ice

The fractional coverage of the different ice types discussed below are from ship-based data collected from 18 voyages into the East Antarctic pack between 1986 and 1995.

By far the greatest seasonal changes in the ice thickness distribution of the East Antarctic pack are in the open water and thin ice categories. The amount of open water decreases from almost 60% in December to little more than 10% in August, and the thinnest ice thickness category (0–0.2 m) shows a 30% seasonal change between December and March. In contrast, the amount of ice greater than 1.0 m shows very little seasonal variability.

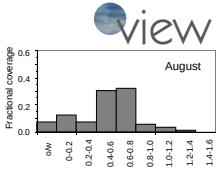
In March, at the beginning of the growth season, there is approximately 25% open water within the sea ice zone and an additional 60% of ice less than 0.4 m thick. This is indicative of rapid new ice growth over large areas of the Southern Ocean as the surface waters and air temperatures begin to cool, with very little differential drift between the new floes to form thicker ice by rafting.



March thickness distribution

As winter progresses the amount of open water within the pack decreases and new ice thickens quite rapidly due to the cold air temperatures and increased deformation. This leads to a decrease in the thinner ice categories and an associated

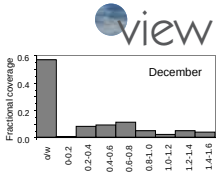
increase in thicker ice. In August the pack is quite consolidated and the open water fraction averages 12%. There is only a small percentage of ice less than 0.4 m thick and the ice between 0.4–0.8 m thick makes the largest contribution to the total ice concentration.



August thickness distribution

By October, two changes in the ice growth regime contribute to the flattening of the thickness distribution curve. First, as the air temperature begins to rise with the onset of spring, leads do not refreeze as quickly as observed earlier in the season, increasing the amount of ice <0.7 m. Second, the ice does not grow to the same thickness, primarily

because of increased incoming solar radiation. As a result, there is more open water and thin ice within the pack. New ice does not form as rapidly and the open water fraction increases, allowing more solar radiation to be absorbed by the ocean with a subsequent warming of the surface water. This is a positive feedback which further limits ice production, and results in ice melt. The distribution curve for December reflects this, showing the greatest open water fraction, no ice thinner than 0.2 m and a considerable decrease in the ice types thinner than 0.6 m.



December thickness distribution

Ice edge retreat begins in October, accelerates in December and continues throughout February along the entire East Antarctic coastline. By November, areas of open water within the pack are no longer exclusively sites of enhanced ice production; rather they become a focus for the uptake of solar radiation and contribute to the rapid decay of the ice. By this process the pack ice decays "from within" as well as by the retreat of the ice edge from north to south. Particularly rapid retreat occurs in regions where the ice edge extended furthest north at maximum extent, such as around 80°E and to the northeast of the Weddell Sea.