



Australian Government

**Department of the Environment,
Water, Heritage and the Arts**
Australian Antarctic Division

FACTS ABOUT SEA ICE

How is sea ice extent changing?

Satellite measurements show the average annual sea ice extent in the Arctic has declined by 2.9% per decade since 1979, while summer extent has decreased by 11% per decade.

In Antarctica the changes have been much more subtle and regionally variable. The western Antarctic Peninsula region has shown a decline in sea ice extent, particularly in the Bellingshausen Sea, consistent with the recent change to more northerly winds and surface warming observed there.

In contrast, sea ice in the Ross and Weddell seas is increasing. These changes involve both changes in sea ice extent and in the length of season during which sea ice is present each year.

The Intergovernmental Panel on Climate Change's Fourth Assessment Report (IPCC AR4, 2007) concluded that there had been no net change in Antarctic sea ice extent for the period of reliable satellite records (i.e., since 1979); however, recent results suggest a slight increase in maximum Antarctic sea ice extent.

What are the projections for the future?

Climate models predict that Antarctic sea ice will reduce by 24% in total extent and 34% in total volume by 2100. Such reductions will lead to changes in oceanic and atmospheric circulation and will impact on the ecosystems of the Southern Ocean including its wildlife, and open up areas previously inaccessible to shipping.

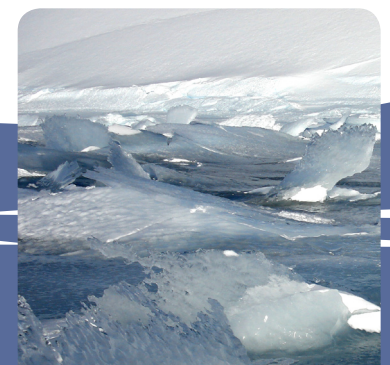
What impacts will changes in sea ice extent and duration have?

Reduced sea ice formation will potentially slow the global ocean overturning circulation and will result in increased absorption of the sun's heat by the ocean at high latitudes. It will also provide greater access for ships to the higher latitudes and may lead to a significant increase in tourist vessels in the Antarctic. This will have implications for Australia's search and rescue responsibilities as well as for resource management.



This autonomous underwater vehicle can measure sea ice thickness.

Photo: Klaus Meiners



What is driving the changes in sea ice?

In the western Antarctic Peninsula, sea ice decline has largely been driven by an intensification of more northerly winds during autumn-spring, leading to wind-induced ice compaction. The sea ice changes are also coincident with an increase in average winter air temperature of 5.8°C between 1950 and 2005, attributed to climate change.

In the western Ross Sea region the increase in sea ice has been attributed to both a strengthening of westerly winds and a more frequent southerly outflow of winds from the continent, associated with the persistence of a deep low-pressure anomaly in the Amundsen Sea.

Intensive research is continuing using both modeling and observations to better understand changes in the large-scale patterns of atmospheric circulation around Antarctica, their complex impacts on observed changes in sea ice, and possible feedback mechanisms involved, as well as connections with atmospheric processes in other parts of the world.

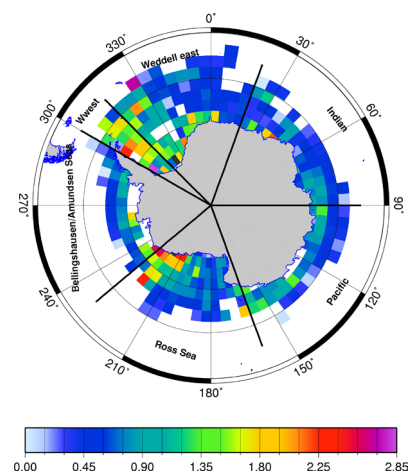
Does the ozone hole have an effect on sea ice?

Recent research published by scientists from the British Antarctic Survey suggests that the ozone hole is delaying the impact of greenhouse gas increases on the climate of Antarctica and contributing to the increase in Antarctic sea ice. As ozone levels recover towards the end of the century, however, sea ice is expected to decline.

How are we monitoring sea ice change?

Currently there are no means of accurately and routinely measuring and monitoring sea ice thickness over large scales, although satellite radar and laser altimeters show great potential. Most of our knowledge on the changes in Arctic sea ice thickness comes from de-classified sonar data from military submarines. No such data is available for the Antarctic.

However, Australian researchers have developed a technique for measuring sea ice thickness that has resulted in the first circumpolar maps of Antarctic sea ice thickness ever published. These data provide a valuable baseline for climate studies; however, ongoing monitoring of changes in Antarctic sea ice thickness requires more precise measurement techniques. These are currently being developed and implemented by scientists at the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) and include airborne laser and radar altimetry for surface mapping and under-ice sonar measurements using an autonomous underwater vehicle, to measure ice thickness. In addition, ACE CRC research validates satellite-derived information on the thickness of snow cover on sea ice. Data from these programs will be used to improve the interpretation of satellite data and will ultimately contribute to the production of more reliable global ice thickness products.



Circumpolar map of mean annual sea thickness (including ridged ice) 2008. Graphic: Andrew Worby

