

## Sea Ice - Teacher Background

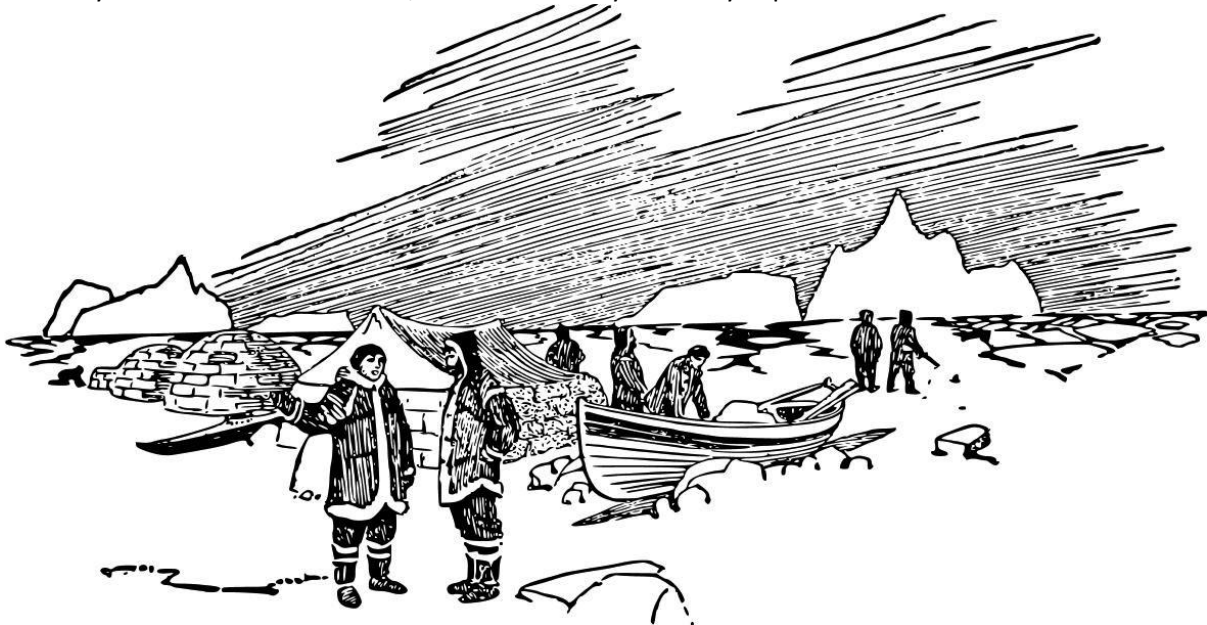
The cryosphere comprises of those parts of the surface of Earth where water is in the form of ice (Cryos = ice, sphere = ball).

Ice caps, glaciers, ice shelves and icebergs are considered to be land derived. They are the result of accumulated snowfall. Sea ice however is frozen seawater. Sea ice regulates exchanges of heat, moisture and salinity in Polar Regions. It insulates the relatively warm underlying seawater except where cracks (leads) permit loss. In the Arctic, sea ice can build up over many years and be well over 3m thick whereas in the Antarctic sea ice melts and reforms every year. Ice in the Antarctic Ocean averages only 0.5m in thickness.

“Global Conveyor Belt” activities (in the Ocean Currents section) explain how ice, cold winds, low air temperatures and increased sea salinity at the poles are drivers for the Global Conveyor Belt. This current transfers heat around the world through moving enormous quantities of water at depths of over 200m. Cold winds and water at the pole freeze out (almost) fresh water to form ice. When comparing Arctic and Antarctic sea ice, differences between land based ice (cap, glacier and shelf) in the east and western sea ice have to be factored in. In the Arctic, almost all ice is from frozen sea ice.

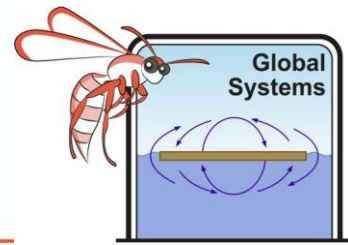
*Arctic sea ice covers between 14 and 16million km<sup>2</sup>  
Antarctic sea ice covers between 17 and 20million km<sup>2</sup>  
About 7% of the world oceans are covered by sea ice*

Because ice is less dense than water it floats. About 7% of the ocean or 23 million km<sup>2</sup> is covered by sea ice. Sea ice is not pure fresh water but can contain up to 0.5% salt, mostly sodium chloride. NOTE By international convention, seawater salinity is usually expressed without units.



Sea ice (pack ice) affects heat exchange between air and water. When it freezes, air is trapped within the interlocking ice crystals. This creates an insulating layer between the atmosphere and the ocean and prevents heat escaping from water. The ice in an Inuit's igloo is not only good construction material it is a good insulator also. Sea ice coverage varies with the seasons. In the Arctic pack ice averages 3m thick whereas in the Antarctic it is often between 0.5 and 1 m thick. This means that Antarctic sea ice is more sensitive to temperature change.

## Sea Ice - Teacher Background



In 2014 a study by the University of California and NASA suggested that a “tipping point” had been reached on the West Antarctic Ice Sheet and that progressive melting has now become unstoppable. Melting is the result of a change of winds that circulated warmer water farther under the ice shelves. The observed retreat of six glaciers, which feed this sheet, would cause a rise in global sea level of just under 1m by the end of this century and a total of about 4m over the next few centuries. A series of feedback loops mean that once started melting accelerates.

1. Warm sea water causes sea ice to melt
2. This melting thins the ice so that it melts faster and pulls the landward ice down slope after it.
3. This further thins and mobilises the landward ice.

Most of the information on rate of melt is gained from satellite photography.

These winds are also responsible for the recent parching of South Western Australia. The change of winds means the annual arrival of rain bearing depressions during winter along the south coast is becoming less frequent. “Antarctica is stealing more of Australia’s rainfall ... we get fewer storms chased up into Australia”, Dr Nerile Abram, lead researcher, ANU’s Research School of Earth Sciences. These researchers used annual seasonal data since AD 1000 recorded in Antarctic ice cores and South American tree rings