



Loss of Arctic sea ice indicates global risks from climate change

Strong warming in the northern high latitudes is causing Arctic sea ice to rapidly melt. It's one of several changes in the Arctic region, including increased melting of the Greenland ice sheet and permafrost in northern Russia and Alaska, which pose serious risks for the world as a whole.

Arctic sea ice

What we are seeing

The area and thickness of Arctic sea ice fluctuates from year to year, and is affected by weather patterns, ocean circulation and other natural influences. However, the ice on the surface of the Arctic Ocean has been diminishing for the past 30 years, in both area and thickness. Over the past 10 to 15 years, it has begun to disappear faster. This year has seen it fall to a record low (the previous record being in September 2007). Since 1980, the ice has roughly halved in area, and the volume of ice has dropped to just a quarter of what it was.

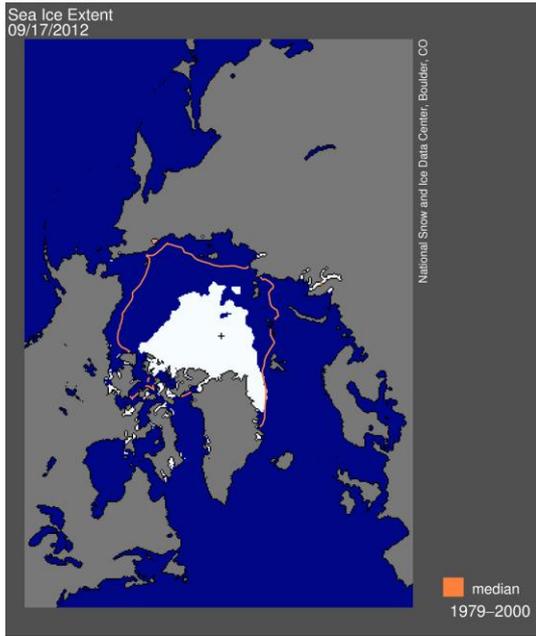
What it means

White ice reflects much more sunlight back to space than does ocean water, which absorbs incoming sunlight readily. As the area of sea ice decreases and the area of exposed ocean water increases, more sunlight is absorbed, heating the surface of the water and the atmosphere above it. This strengthens the Arctic region warming trend – average temperatures of the high northern latitudes are rising at double the global average temperature increase.

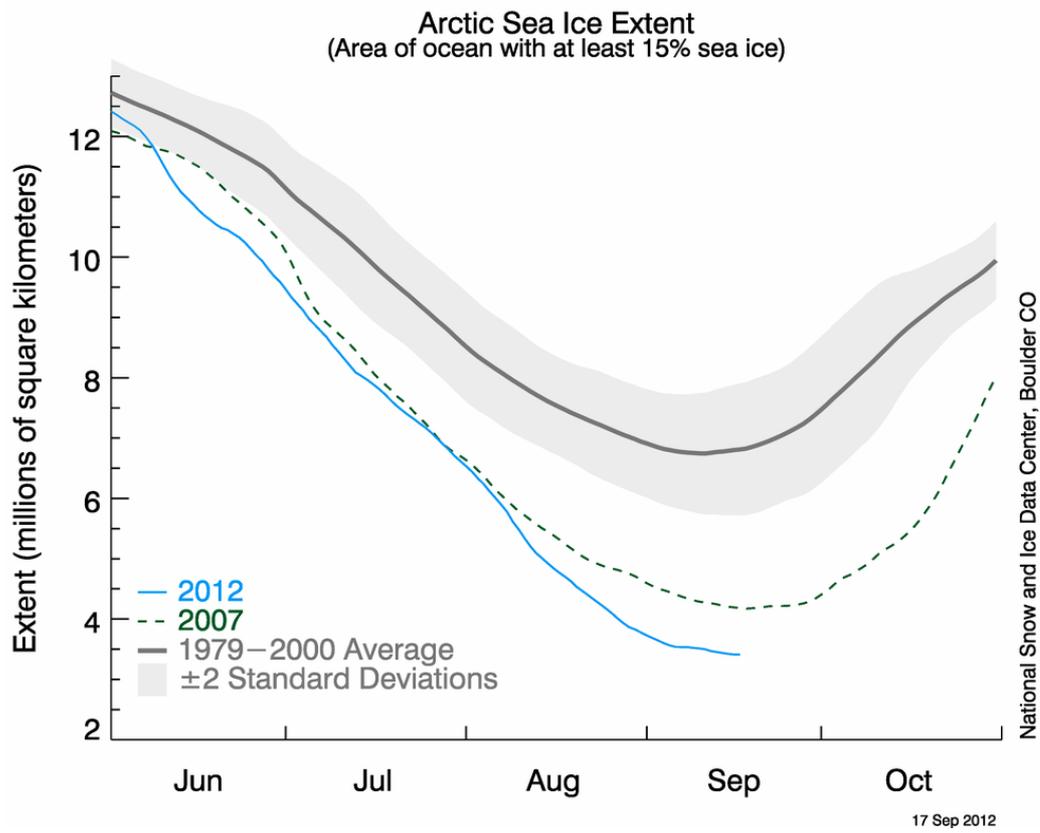
The Arctic sea ice is declining much more quickly than scientists expected only a decade ago. It is very likely that, with the continued decline in sea ice that has occurred over several decades, we've already crossed the point of no return and that we'll have an ice-free Arctic Ocean during summer at some point in the near future. Scientists now consider this could happen by 2030 or even earlier.

The melting of Arctic sea ice does not directly affect sea level – the ice is already floating in water. However, the regional warming over the Arctic affects a number of other processes, as outlined below.

Sea ice also affects the movement of ocean waters. When sea ice forms most of the salt is pushed into the ocean water below the ice. This salty dense water then sinks, contributing to global ocean circulation. As the ocean covers about 70% of the Earth's surface, ocean circulation has an important influence on the climate we experience as it results in the movement of vast amounts of heat around the planet. Changes in the amount of sea ice can disrupt normal ocean circulation, thereby leading to changes in global climate.



Source: National Snow and Ice Data Center



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Greenland Ice Sheet

What we are seeing

Since 2000, the amount of land-based ice on Greenland (the Greenland ice sheet) has been declining. Ice is lost as it melts, and when large pieces break off and fall into the sea. The loss of ice since 2000 has occurred as the melting and discharge rates have increased more than the rate of snowfall. The rate of loss measured for the 2003-2008 period was 160 billion tonnes each year. This rate has increased over the past few years and is now estimated to be around 200 billion tonnes each year (imagine 200 massive ice cubes, each with sides one kilometre long).

What it means

Greenland is next to the Arctic Ocean and the rate at which it loses ice is increased by the higher rate of warming associated with melting of Arctic sea ice.

Loss of ice from Greenland affects global sea level, and therefore Australia. At present, Greenland and Antarctica together make up about 25% of the observed rate of sea-level rise but most of this is probably from Greenland. About 40% of observed sea-level rise comes from thermal expansion of the ocean and the other 35% comes from glaciers and ice caps on the continents. Melting of the Greenland ice sheet could contribute about 20 centimetres to global sea-level rise by 2100.

Permafrost

What we are seeing

Some areas of the permafrost (frozen soil) zones of northern Russia (Siberia) and Alaska are melting, releasing the greenhouse gases methane and carbon dioxide.

What it means

There is about twice as much carbon stored in the permafrost (about 1,700 billion tonnes) as the total amount that is currently in the atmosphere, so continued melting could lead to large releases of carbon into the atmosphere. If global warming occurs at the upper end of current projections, the equivalent of 30-63 billion tonnes of carbon dioxide could be released from permafrost by 2040. In comparison, fossil fuel emissions are currently about 10 billion tonnes per year.

The release of greenhouse gases from permafrost due to rising temperatures has a reinforcing effect by further increasing the rate of global warming.

Like the Greenland ice sheet, the location of permafrost zones near the melting Arctic sea ice, where the rate of warming is higher than in other regions, increases the risk of emissions from melting permafrost.

Learning from the past

Evidence from the past

The previous interglacial warm period in Earth history was about 125,000 years ago, before the most recent ice age. The global average temperature was about 1-2°C higher than the pre-industrial temperature of our present warm period. In comparison, global average temperature is now about 0.8°C higher than pre-industrial temperature and, with the momentum in the climate system, we are already committed to a rise of at least 1.5°C and much more than this if there is no action to reduce greenhouse gas emissions globally.

The last interglacial warm period can provide us with some important insights. During that previous warm period, the polar intensification effect was also present, and the average temperature of the northern high latitudes was two to three times greater than the global average. It is very likely that the Arctic Ocean was ice-free during the summer back then, and it is clear that a large portion of the Greenland ice sheet disappeared (as did much of the West Antarctic ice sheet). Global sea level was estimated to be six to nine metres higher than today.

What this means

The evidence from the past paints a consistent picture with model projections of where we're heading. The loss of sea ice in the Arctic Ocean is an indicator of much bigger changes that are underway in the far north. We're only seeing the beginning of rising sea levels; the real question is the rate – how fast will sea-level rise? This poses risks for coastal communities, infrastructure and ecosystems right around the world including in Australia.

Ultimately, the story is much bigger than the confines of the Arctic Ocean or the far north.