7. The melting ice caps

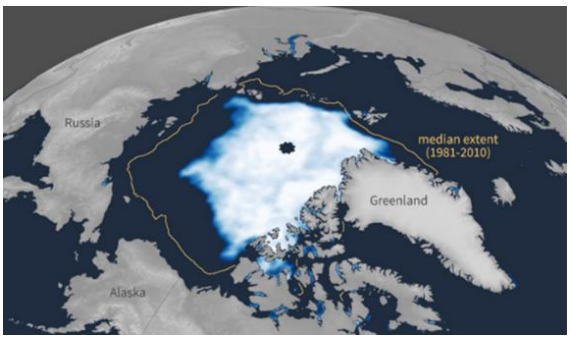
Over the past decade the Arctic has warmed by 0.75°C far more than the global average. The Albedo effect in relation to the melting ice caps is one of the climate change tipping points. As white snow and ice melt they no longer reflect sunlight back into space. As darker rocks and water are exposed, they absorb more of the sun's energy causing more warming and more ice to melt, which results in greater exposure of darker surfaces which absorb more radiation etc.

There is also concern that the melting of fresh water from Greenland into the ocean will eventually slow down the effect of the gulf stream. This is difficult to predict and not imminent, but researchers expect some weakening by the end of the 21st century.

Melting ice caps will impact on sea level, resulting in the need for populations to move and the loss of fertile coastal areas; melting glaciers are often the source for water and the irrigation of farmland many miles from the melting glacier.

The Arctic

Unlike the South Pole which is anchored on a continental land mass, the North Pole is located in the middle of the Arctic Ocean amid waters that are covered with constantly shifting sea ice.



Arctic sea ice increases its extent during the northern hemisphere winter, reaching its maximum in March before decreasing during the summer.

The annual minimum is recorded in September and the extent of Arctic sea ice in 2019 was the second smallest since satellite monitoring started in 1979.

Sea ice extent for July 2020 averaged 7.28M km^2, the lowest extent in the satellite record for the month. This was 2.19M km^2 below the 1981 to 2010 July average and 310,000 km^2 below the previous record low set in July 2019.

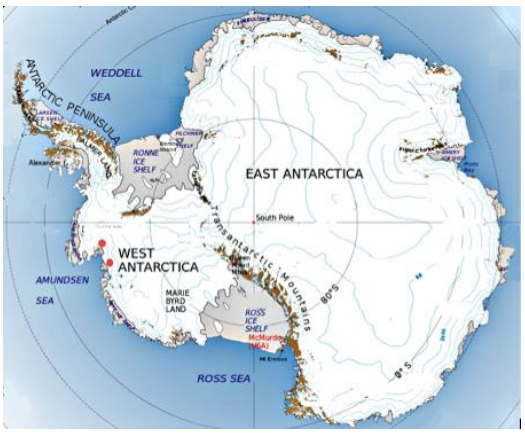
The global average surface temperature since 1880 has warmed about 1.1°C, while the Arctic has warmed by 2° to 3°C over the same period. Many global climate models predict that the Arctic will be ice free for at least part of the year before the end of the 21st century. Some models predict an ice free Arctic by mid-century and a recent Nature paper suggest this may be early as 15 years.

The Antarctic

The Antarctic ice sheet rests on a major land mass and covers about 98% of the continent, (14M km^2). It is the largest single mass of ice on Earth (26.5M km^3), holding ~ 61% of all fresh water on the Earth which, if it all melted, would be equivalent to ~ 58 m of sea-level rise.

Antarctica's melting ice has resulted in global sea levels rising by at least 13.8mm. over the past 40 years. This was originally considered to be primarily from the unstable West Antarctic Ice Sheet but new studies of 40 years of satellite images have found that the East Antarctic Ice Sheet may also be melting at an accelerating rate.

British and US Scientists have begun a major investigation into the melting of the Thwaites Glacier in West Antarctica. Over the past 30 years, the amount of ice flowing out of Thwaites and its neighbouring glaciers has nearly doubled. Already, ice draining from Thwaites into the Amundsen Sea accounts for about 4% of global sea level rise. A run-away collapse of the glacier would lead to a significant increase in sea levels of around 65cm (25 inches).



The Himalayas

The Himalayas stretch from Afghanistan to Myanmar and contain the largest store of fresh water outside the polar ice caps and the Greenland ice sheet. The glaciers are the headwaters of some of Asia's largest river systems including the Indus, Ganges/Brahmaputra, Thanlwin, Mekong, Yangtze, and Yellow Rivers. These rivers are the source of drinking water and irrigation supplies for roughly 1.5 billion people.

The glaciers are believed to be retreating at a rate of about 10-15m each year. Consistent loss in ice thickness was observed across the Himalayas during the periods 1975–2000 and 2000–2016 along the entire 2000km transect with the rate of loss doubling during 2000–2016.

WWF says India, China and Nepal could experience floods followed by droughts in coming decades. "The rapid melting of Himalayan glaciers will first increase the volume of water in rivers, causing widespread flooding followed after a few decades by a decline in river levels resulting in massive eco and environmental problems".

Rises in sea level are caused by the addition of water from melting ice sheets and glaciers and the thermal expansion of seawater as it warms. In 'The Ocean and Cryosphere in a Changing Climate' published by IPCC they indicate that in the past century sea levels rose by around 15cm but are currently rising twice as fast at 3.6mm per year. Estimates predict a sea level rise of 30 – 60cm by 2100 and if current rates of greenhouse gas emissions continue, they could rise by 1.1m by 2100. Higher sea levels mean that destructive storm surges will push farther inland than they once did. 680 million people live in low lying coastal areas which will experience rising peak spring tide levels, when they are at greatest risk from storm surges from tropical cyclones. A recent analysis suggests that the Greenland Ice sheet may have already passed a tipping point in 2000 due to the retreat of peripheral glaciers and may now be irreversibly committed to the net loss of some 100 cubic kms of water per year, contributing 0.28mm to global sea level rise per year from Greenland alone.

Research suggests that coastal communities, when developing adaptation strategies should not rule out the possibility of 21st-century sea level rise in-excess of two metres. Such a rise could result in land loss of 1.79 million km^2, including critical regions for food production, and the potential displacement of up to 187 million people. Other studies suggest that the instability of marine ice sheets amplifies and skews the uncertainty in making projections but their collapse could make worst case scenarios more likely.