Norway's climate

Innholdsfortegnelse

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Norwegian greenhouse gas emissions have risen 4.2 per cent from 1990. We expect a long-term trend of a rise in total emissions towards 2020, unless new measures are implemented.

Greenhouse gases from human activities are accumulating in the atmosphere and causing global warming. The Herning CHP Plant in Denmark was originally coal-fired, then used natural gas, and is now a green biomass-fuelled power plant. Photo: Peter Rosbjerg, Flickr

A glacier in Svalbard viewed from the sea. The polar regions play a vital role in the global climate system, and changes here will have repercussions throughout the world. Photo: Kim Abel, Naturarkivet.no

To cut greenhouse gas emissions in Norway and the world as a whole, we must do more to replace fossil energy with renewables such as wind power. Photo: Windwärts Energie, Flickr

Flooding in Buskerud west of Oslo, autumn 2015. Norway's weather is expected to become wetter as the climate changes, and more frequent and more serious flooding is likely. Photo: Kim Abel, Naturarkivet.no

State

The mean temperature in Norway is increasing

In recent years, the mean temperature in Norway has generally been higher than normal. The exception was 2010, which was one of the coldest years since 1900.

The highest mean temperature was recorded in 2014 with 2,2 °C above average. Other years with high averages are 1934, 1990 2006 and 2011 and 2015 - with 1.8 °C above average.

In 2016, the temperature was 1,5 °C above average.

Read more about the data

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In the Norwegian Arctic, deviations from the average are greater than in the rest of the Norway. The largest deviation measured by Svalbard airport since 1920 was in 2016, when the average annual mean temperature was 6,5 °C above normal.

Higher temperatures lead to less snow and ice.

- Read more about climate change in the Arctic

Forward looking

The annual mean temperature is expected to increase by as much as 2.3-4.6°C by 2100. Temperatures will increase most in winter. The increase will be greatest in northern Norway. Precipitation levels will increase throughout the country, especially in winter. Summer precipitation in eastern and southern Norway is likely to decrease towards the end of the century.

Impact

We can already see effects on the Norwegian natural climate

Many changes, caused by climate change, have already been observed in the Norwegian natural environment, and major changes are expected to occur in types of habitat and species composition.

Forward looking

As the climate warms up, several species shift northwards, and new species will therefore reach Norway. Both indigenous species and ecosystems may be negatively affected, especially those that are already vulnerable and threatened. In large parts of the mountains forest cover will develop in the long run.

The growing season will be considerably longer. For many parts of the country, the growing season is expected to last another 1-2 months, and some areas may see it extended by 2-4 months in the period towards 2100. This may provide new opportunities for agriculture, the agricultural sector must, however, also prepare for more plant diseases and insect pests.

A warmer climate will also affect the potential for traditional recreational activities such as cross country-skiing, especially in the lowlands.

More frequent and intense precipitation can cause problems for agriculture and increase erosion. In general, floods are expected to rise in extent, however, there are great local variations. A wetter climate will have an impact on both buildings and infrastructure, and the risks for infrastructure failure will increase. Some areas of Southern and Eastern Norway may have more summer droughts. This may have consequences for agriculture.

We also see signs of acidification in Norwegian waters, caused by increasing concentrations of carbon dioxide. In the long term this may have serious consequences for organisms with calcareous shells.

Climate change and other pressures

The effects of climate change on Norway's natural environment cannot be considered in isolation from other factors. Climate change comes in addition to the destruction of habitat, the spreading of alien species, pollution and overuse of natural resources. In some instances, climate change can reinforce the negative consequences of other pressures.

Driving forces

Climate change connected to socio-economic development

Norwegian society has undergone considerable change in the last hundred years. Income from the oil and gas industry has resulted in a considerable increase in living standard in the last thirty to forty years, and is the main reason for Norway's favorable economic position. Norway has become one of the world's leading welfare states, and income and consumption levels have changed radically.

At the same time, oil and gas production has been the main cause of the increase in Norway's carbon dioxide emissions since 1990.

Pressure

Petroleum activities, transport and industry most important sources

CO2 emissions from petroleum activities, transport and industry are the main culprits in Norway. Other sources of greenhouse gas emissions in Norway are agriculture, shipping, fisheries, heating of households and landfills.

According to figures from Statistics Norway the Norwegian greenhouse gas emissions equalled 53.9 million tonnes of CO2 equivalents in 2015.

Emissions from the oil and gas industry increased by 83 per cent since 1990, and emissions from road traffic increased by 33 per cent. However, the emissions from manufacturing industries fell by 39 per cent.

Emissions from agriculture and landfills have also gone down.

Read more about the data

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Forward looking

Up to 2020, emissions from the oil and gas industry, industry and road traffic are expected to remain at about the current level. Emissions from the oil and gas industry are expected to decline towards 2030.

Response

CO2 tax and quota system most important instruments

There is a close relation between economic development, energy use and lifestyle and greenhouse gas emissions. The costs of reducing greenhouse gases can vary considerably from sector to sector. To a large extent the instruments are therefore a compromise between environmental and other interests.

Ninety per cent of emissions comprised by instruments

The CO2 tax introduced in 1991 is Norway's main instrument in environmental policy. In addition, a national emissions quota system for parts of the processing industry and the offshore sector, was introduced in 2005 and was expanded from 2013. This means that there are targeted instruments for approximately ninety per cent of Norwegian emissions.

Agriculture and fisheries not covered by instruments

Only agricultural emissions, which constitute approximately eight per cent of the national emissions, and fisheries, which amount to about two per cent of emissions, are not covered by any instruments.

1. Arctic Climate Change

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Global climate change is having a greater impact in the Arctic than in other parts of the world. Many species are dependent on the sea ice for their survival, and are experiencing dramatic changes in conditions as ice cover decreases. The extent of the sea ice in the Arctic reached a record low in 2012.

Jump to:

Juvenile Svalbard ptarmigan (Lagopus muta hyperborea). Photo: Stein Ø. Nilsen

All traces of human activity in Svalbard dating from before 1946 are protected as part of the cultural heritage. Photo: Stein Ø. Nilsen

Melting glaciers are one cause of rising sea levels. Photo: Stein Ø. Nilsen

Grey phalarope in colourful summer plumage. The English name refers to its grey winter plumage. Photo: Stein Ø. Nilsen

Walrus. Photo: Stein Ø. Nilsen

Adventdalen on the island of Spitsbergen in the February twilight. Photo: Stein Ø. Nilsen

Meltwater running off a glacier. Foto: Stein Ø. Nilsen

At the summit of Nordenskjöldfjellet, above Longyearbyen. Photo: Stein Ø. Nilsen

An ivory gull photographed in Ny-Ålesund. Photo: Stein Ø. Nilsen

State

Higher temperatures, less ice, more rain and snow

The Earth's climate is already changing, and the changes are particularly marked in the Arctic. But the impacts of climate change in the Arctic will be felt throughout the world, because changes in physical processes here influence the climate on a global scale. Processes of change in the Arctic can therefore provide a unique insight into the climate change that is already taking place and also act as a forewarning of the future regional and global impacts of these changes.

Rapid temperature rise

The annual mean temperature has been rising about twice as fast in the Arctic as in the rest of the world in the past few decades, though with some variations within the region. In general, temperatures are rising faster in winter than in summer. In Alaska and western Canada, the average winter temperature has risen by 3–4°C in the past 50 years.

One degree matters — Full movie from European Environment Agency on Vimeo.

Modelling using scenarios developed for the Arctic Climate Impact Assessment (ACIA) indicates that the annual mean temperature will continue to rise throughout the Arctic. The rise is roughly estimated at 3–5°C over land and up to 7°C over the sea by the end of this century.

Winter temperatures are expected to rise considerably more, by about 4–7°C over land and 7–10°C over the sea. Temperatures are likely to rise most over land close to sea areas where a considerable reduction in sea ice cover is expected, for example in northern Russia.

Melting glaciers contribute to rising sea level

Since the early 1960s, most glaciers and ice sheets in the Arctic have retreated and their volume has shrunk. This trend became more marked in the 1990s. Satellite data show that ice melt has speeded up since 1979. Several of the glaciers in Svalbard have shown a negative mass balance every year since 2000; in other words, there is an annual net loss of ice, and they are shrinking in size.

As more glacier ice melts, a greater volume of water enters the oceans, raising the global sea level. Global models show that Arctic glaciers will make an increasing contribution to the rise in sea level over the next 100 years.

Dramatic loss of sea ice

The extent and thickness of the sea ice has been declining for several years, and there is now very little thick multi-year ice in the Arctic. The thinner, younger sea ice melts more readily.

In 2012, a record level of ice melt was recorded in the Arctic. There has never been so little ice cover since satellite measurements started in 1979. Observations showed 700 000 km2 less sea ice than at the previous minimum in 2007. This satellite image from NASA (NASA/Goddard Scientific Visualization Studio) shows the extent of the sea ice on 17 September 2014. The red line shows the average minimum for the last 30 years.

Arctic sea ice

- More information on NASA's website
- NASA satellite map comparing the situation in 1980 and 2012
- Daily updates of sea ice extent from The National Snow and Ice Data Center

Sea ice cover varies widely from year to year, and this variability is expected to continue. However, the rate of decline is expected to accelerate, and climate models suggest that it may only be a few decades until the Arctic Ocean is ice-free in summer.

The reduction in ice cover will affect the sea surface temperature. Snow-covered ice absorbs only 10–20 per cent of the incoming solar energy, whereas open water absorbs more than 90 per cent. The sun thus warms the sea water, and evaporation from the surface increases. This is an example of a positive feedback loop: greater

absorption of solar energy results in accelerating ice melt, which in turn results in even more absorption of solar energy.

Ocean circulation will be affected

Ocean circulation in the Arctic is controlled by the inflow of relatively warm Atlantic water with the Gulf Stream and the outflow of relatively cold, less saline water via the East Greenland current. Ice is mainly transported out of the Arctic Ocean with the East Greenland current.

Scientists have known for a long time that the Greenland Sea is an important area for bottom water formation, which may be one of the main forces driving the Norwegian Atlantic current. Water continuously sinks towards the bottom, and has to be replaced by surface water, which flows in with the Atlantic current. Climate change may influence bottom water formation and ocean currents, with further repercussions on sea ice extent and the climate in Arctic parts of the Nordic region.

It has been suggested that global warming may result in cooling at northern latitudes. The reasoning behind this is that weakening of deep-water formation could reduce the strength of the Gulf Stream, which maintains temperatures in Norway at a level 5–8°C higher than would be expected at these latitudes.

Studies of sediment cores from the seabed show that during and just after the last Ice Age, there were large, abrupt changes in temperature in the Arctic. It is estimated that the temperature changed by 5–7°C over a period of only 10 to 100 years. It is possible that this happened because the formation of bottom water ceased, perhaps during periods of rapid ice melt. It is uncertain whether we can expect the current rate of global warming to have such consequences, but recent research indicates that bottom water formation is unlikely to cease in the next 100–200 years.

Rainfall and snowfall expected to rise

Observations sugget that precipitation has risen by about 8 per cent in the Arctic as a whole over the past 100 years. However, this result is somewhat uncertain, both because of sources of error in the measurement of precipitation in a cold Arctic climate and because there is a lack of data from parts of the region.

In the Arctic as a whole, annual precipitation is expected to rise by about 20 per cent during the 21st century, most of this in the form of rain. The greatest rise is expected in coastal areas in autumn and winter. In these areas, an increase of more than 30 per cent is expected.

Impact

Major impacts on animals, plants and people

Climate change in the Arctic will have impacts on human society as well as on animal and plant life.

Impacts on animals and plants

Changes in the extent of the sea ice and glaciers will alter living conditions for many organisms. Tiny planktonic organisms are dependent on the ice edge for survial and reproduction, and polar bears use the sea ice to hunt for seals and feed their cubs. The sea ice has already retreated, and polar bears have lost much of their habitat. These are some of the changes that are expected in the years ahead:

- **The treeline** is expected to shift northwards and upwards, and much of the tundra will become forest. Tundra vegetation will gradually shift into areas that are now polar desert.
- **Vegetation** will probably become more productive and carbon uptake will therefore increase. However, as snow and ice melts the Earth's surface will become less reflective. This effect will probably outweigh the extra carbon uptake, resulting in greater global warming.
- Outbreaks of **insect pests and forest fires** are likely to be more frequent, more serious and more prolonged. This will make it easier for alien species to spread to Norway.
- Shrinking sea ice cover will drastically reduce the area of suitable habitat for **polar bears, ice-dependent seals and some seabirds**. Some species will be at risk of extinction.
- Climate change will alter the availability of food supplies and suitability of breeding areas and migration routes for **reindeer and other terrestrial species.**
- The distribution of many terrestrial and marine species is expected to **shift northwards.** New species will become established in the Arctic, which will affect species already present in the region.

Impacts on people and society

- As the climate changes, so do short-term weather patterns. **Extreme weather events** are likely to be more frequent, and new areas may become vulnerable to flooding, landslides and avalanches.
- The ice edge and parts of the **polar front will retreat northwards**, and the area where polar lows are liable to form will also move further north. There will be a lower risk of polar lows forming the coast of North Norway.
- Where the soil is suitable, a longer and warmer growing season will make **agriculture** possible further north. However, winter temperatures close to 0°C will be more frequent, which will increase the risk of winter damage to crops.
- **Health risks** are likely to increase because new species that spread to Norway may well be vectors for animal diseases that also affect people, such as West Nile fever.
- **Certain fisheries** in Arctic seas are of global importance and make a substantial contribution to the regional economy. Some of them will probably become more productive.

Response

Research and monitoring

Most global climate models predict more warming in the polar regions than in the rest of the world. A good deal of research is currently being done on what impacts this may have on the global climate system.

Long-term environmental monitoring

Long-term environmental monitoring is an important basis for a better understanding of the climate. Data should be collected on changes in sea ice cover, ocean circulation, heat balance and glacier mass balance. We also need to learn more about energy exchange process and ocean-atmosphere-sea ice interactions.

Following up the Arctic Climate Impact Assessment

The results of the Arctic Climate Impact Assessment (ACIA) were published in 2004. This was the first comprehensive assessment and analysis of climate change in the Arctic and its consequences for the region and for the world as a whole.

- ACIA documents are available here

The Norwegian authorities initiated a follow-up project, a Norwegian Arctic climate impact assessment (NorACIA). Its aim was to assess and analyse climate change and its impacts in the Norwegian part of the Arctic. It ran from 2005 to 2009, and a report (in Norwegian) was published in 2010.

- A brief report in English is available here (PDF)

International Polar Year

The fourth polar year, IPY 2007–08, involved field work and data collection from March 2007 to March 2009. Previous polar years were organised in 1957–58, 1932–33 and 1882–83. All the polar years have resulted in the collection of valuable material and data sets and led to advances in scientific knowledge. Analysis of the results continues for many years after the field work.

Climate change was the main focus of IPY 2007–08, which was an intensive, coordinated international and interdisciplinary research programme. The data and samples collected will make it possible to improve climate models and projections.

The Research Council of Norway allocated NOK 288 million to polar research in the period 2007–10. About two-thirds of the funding was for meteorological and climate research. The results of IPY 2007–08 are making an invaluable contribution to knowledge of climate processes in the Arctic and will provide us with a better basis for assessing the impacts of the changes that have already been observed.

- Read more about the Norwegian projects in IPY 2007–08
- Read the international IPY summary report