

# The mires breathe!

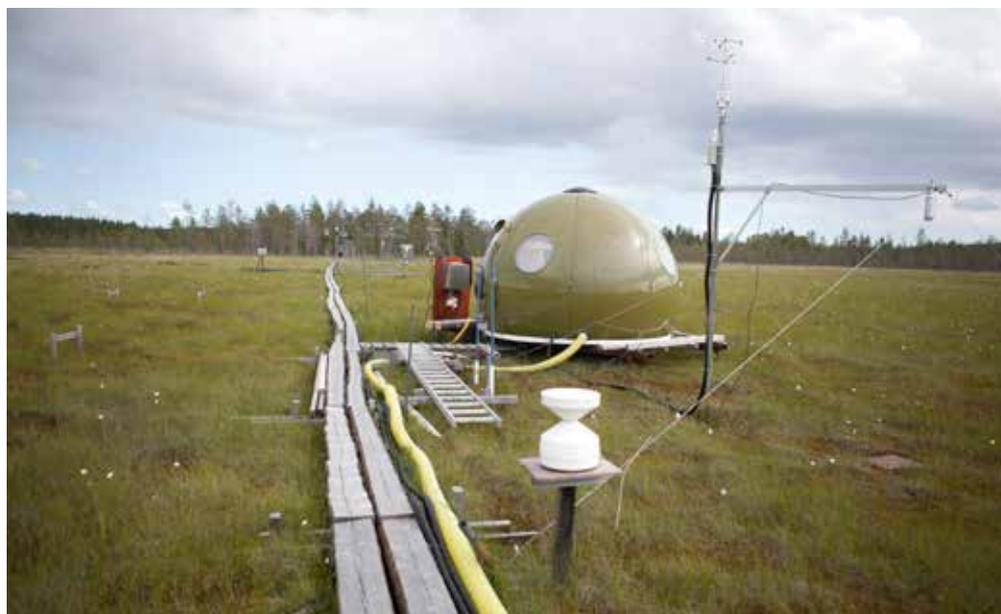


Photo: Jenny Svennås-Gillner, SLU

◀ Degerö Stormyr, a mire at Kulbäcksliden Experimental Forest in Vindeln, is equipped with several measuring instruments to monitor air currents and carbon dioxide, methane and water vapour levels. This enables researchers to study whether carbon dioxide is absorbed or released by the mire. Since 2012, Degerö Stormyr has been part of ICOS (Integrated Carbon Observation System), a European network of monitoring systems functioning as weather stations, but also monitoring greenhouse gas levels.

In the space of about 200 years, human activities such as fossil fuel extraction have increased atmospheric levels of carbon dioxide and methane. The greenhouse gases carbon dioxide and methane cause global climate change and affect temperature, evaporation and precipitation levels. Researchers are interested in finding out whether climate change will affect vegetation such that mire ecosystems will accelerate or slow the greenhouse effect, and whether the changes increase or decrease the formation of methane on mires.

## Greenhouse gases and mires

Human activity has previously had very little impact on the climate, but about 200 years ago major changes began taking place in the atmosphere. Fossil fuel extraction has increased atmospheric levels of greenhouse gases such as carbon dioxide and methane, which in turn affect the climate. It is even possible to see how much carbon dioxide comes from oil and coal, which had been stored in the bedrock for a long time, compared to the carbon dioxide currently absorbed and released by ecosystems.

Mires are particularly interesting to research because they absorb and release both carbon dioxide and methane. Researchers want to investigate whether mires reduce or contribute to increased atmospheric carbon dioxide levels. Much research is also under way into how mires affect atmospheric methane levels.

## Global climate change

Increased greenhouse gases result in a greater amount of energy in the atmosphere. We can compare global climate change to fitting a greenhouse with double glazing. In some parts of the world, greenhouse gases make the weather warmer, while in other parts they instead result in greater water evaporation, which in turn increases cloud cover and rain. Consequently, climate change can also entail lower temperatures in some regions.

Atmospheric carbon dioxide decreases during the summer because plant photosynthesis absorbs large quantities. In the winter, when there is no photosynthesis, carbon dioxide levels increase instead. These large natural variations occur every year, but we are also seeing how total atmospheric carbon dioxide levels are increasing. In the late 1800s, before widespread industrialisation, the carbon dioxide level

was 280 parts per million (ppm) of the total volume. In just 200 years, the level has increased by nearly 130 parts per million. Since the mid-1980s alone, the carbon dioxide level has risen from about 350 parts per million to 400 parts per million.

### Climate change affects ecosystems

Climate change can also alter the boundaries between different climate zones, such as the Mediterranean climate and the boreal forest climate, which means that the vegetation found in these zones may change. Consequently, researchers are investigating whether climate change is accelerated or slowed by altered vegetation. The increase in atmospheric carbon dioxide is significantly less than it could have been because half of the carbon dioxide produced by human activities is absorbed by plants and seas. Vegetation absorbs one third of annual emissions from coal, oil and the cement industry. It has also been shown that plants have increased slightly in growth, enabling them to absorb more carbon dioxide than before.

### Carbon stored in peat

Under the peat moss of the mires we find peat, which is composed of rotting peat moss and other plants that have been decomposed into plant detritus. Peat is continually accumulated and has been stored since the mires were formed. The oldest mires are about 15,000 years old, while most are less than about 10,000 years old. By collecting peat samples, we can see how much carbon dioxide has been absorbed by the mire's vegetation in the past. Carbon is stored in the peat because the plants absorbed carbon dioxide and then decomposed.

The amount of carbon stored in peat corresponds to about one-third of the carbon currently found in the atmosphere. Half of the dry weight of peat consists



Photo: Jenny Svennås-Gillner, SLU

▲ So as not to affect the methane flows in the mire, raised walkways have been established at Degerö Stormyr.

of carbon from carbon dioxide. Accordingly, many researchers are concerned that climate change could lead to some of this extensive carbon store being decomposed and released into the atmosphere as carbon dioxide. If this happens, it will further exacerbate the greenhouse effect.

### Research at Degerö Stormyr

At Degerö Stormyr, a mire at Kulbäcksliden Experimental Forest in Vindeln, carbon dioxide and methane levels have been monitored for almost 20 years. The measuring instruments monitor the direct exchange of carbon dioxide and methane between the mire's ecosystems and the atmosphere.



As a greenhouse gas, methane is thirty times more potent than carbon dioxide, and the lion's share originates from human activity.

A measuring instrument with six small microphones monitors air currents moving up, down and sideways, while carbon dioxide, methane and water vapour levels are monitored using samples collected via a hose. The temperature is also monitored. Measurements are taken ten times per second and enable us, for example, to calculate how much carbon dioxide is released into the atmosphere and how much is absorbed by the mire.

### Mires and carbon dioxide levels

Do the mires absorb more or less carbon dioxide when the climate changes? Previously, many researchers thought that climate change would cause the mires to stop absorbing carbon dioxide.

By taking measurements for an extended period at Degerö Stormyr and analysing peat samples, we know that the mires absorb as much carbon dioxide today as they did 8-9,000 years ago when the mires were formed. Degerö Stormyr absorbs more carbon dioxide than is released from the mire, which means the mire removes carbon dioxide from the atmosphere.

### The mires create methane, which increases the greenhouse effect

In mires, lake sediment and wetlands, methane is formed when organic matter is broken down in an oxygen-poor environment. We can compare this to a plant in a flower pot that usually only absorbs and releases carbon dioxide. However, if the plant is watered too much, methane is also produced. Methane is part of something called marsh gas, and is also produced

by rubbish tips, paddy fields, fossil fuel extraction and ruminant animals.

As a greenhouse gas, methane is thirty times more potent than carbon dioxide, and the lion's share originates from human activity. Researchers are interested in finding out whether climate change is causing the mires to release more or less methane into the atmosphere.

### ICOS – Integrated Carbon Observation System

Since 2012, Degerö Stormyr has been part of a monitoring system called ICOS (Integrated Carbon Observation System) that is established throughout the EU. Sweden has a total of seven monitoring stations. ICOS is a permanent European research infrastructure comparable to weather stations, but which instead monitor greenhouse gases. They monitor three of the key greenhouse gases: carbon dioxide, methane and

nitrous oxide. The environment is being monitored for an extended period to follow the greenhouse gas balance.

The monitoring system increases scientific knowledge about greenhouse gases and the processes involved in their release and absorption. The data produced by the system is, for example, particularly important in determining whether EU countries are complying with their commitments to reduce greenhouse gas emissions.



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Project PINUS, a project for innovative experiences in managed forests, aims to gather the tourism industry, the forest industry and forestry academia in efforts to create opportunities for tourism in managed forests. Project PINUS began in August 2016 and runs until November 2019. The Museum of Forestry in Lycksele is the project owner.



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