Fact sheet: The role of methane in peatland rewetting

State: November 2022

The greenhouse gas methane (CH_4) plays an important role in causing and combating the climate crisis. At the World Climate Conference in Glasgow in November 2021, 100 countries signed a CH_4 pledge, targeting a global reduction of man-made CH_4 emissions by at least 30% by 2030 compared to 2020. The reduction is to be achieved primarily by cutting on the main sources agriculture, oil, gas and coal production, as well as landfills and wastewater. At the 27th World Climate Change Conference in Sharm El-Sheikh, methane was again addressed. Here, the main focus was on improving the monitoring of CH_4 emissions and on implementing binding measures for rapid reductions in the energy sector. Wet peatlands also release CH_4. Rewetting of drained peatlands reduces carbon dioxide (CO_2) emissions very effectively, but at the same time leads to CH_4 emissions. Nevertheless, in general, rewetting is always good for the climate. Here, we summarise the most important aspects regarding "peatlands and methane exchange" for Germany.

Peatland state and methane exchange

Plants absorb CO_2 and store the carbon in their biomass. When they die, they are decomposed and the CO_2 is released again. In intact peatlands—called mires—anaerobic, reducing conditions prevail due to water saturation in the soil. Water saturation inhibits the complete decomposition of the dead plant material and the plant remains accumulate as peat. However, some decomposition does occur under anaerobic conditions, resulting in the production and release of CH_4. When a lot of iron or sulfate is present in the soil, CH_4 formation is usually much lower because of changes in microbial activity[1][2]. Once CH_4 has formed, it can enter the atmosphere via three pathways: by diffusion through the soil/water column, by ebullition of gas bubbles, and by gas flow through plant tissue[3].

CH_4 has a much stronger climate impact than CO_2, but it remains in the atmosphere for a relatively short time—11.8 years on average—before it is converted to CO_2. With a constant emission of CH_4, after a few years, a dynamic equilibrium establishes in which exactly as much CH_4 disappears from the atmosphere as is added, and the CH_4 concentration in the atmosphere and the climate impact do not increase any further. Natural, undrained peatlands almost always release CH_4, but—because they have existed for a long time—no longer contribute to warming. On the contrary, by constantly absorbing CO_2, undisturbed peatlands are permanent climate cooling machines and the global peatlands have cooled global temperatures by about 0.6°C over the past 10,000 years[4][5].

Globally, wetlands emit 149-194 million tons of CH_4 per year. By comparison, agriculture and waste management produce 206-227 million tons of CH_4 per year, and fossil fuel production and use produce 111-128 million tons of CH_4 per year. The increasing atmospheric CH_4 concentration is mainly caused by the increase in human-made sources[6][7][8].

In **drained peatlands** almost no CH_4 is released from the dry soil. However, large amounts of CH_4 are often released from drainage ditches. In addition, grazing by ruminant animals, which is typical in drained peatlands in Germany and elsewhere, can contribute significantly to the ecosystem's atmospheric CH_4 emissions[3][2][9][10].

Methane emissions from rewetted peatlands are usually comparable in magnitude to those from natural, undrained peatlands. However, higher CH_4 emissions may occur immediately after rewetting, especially in the case of permanent inundation. These emissions usually decrease rapidly in subsequent years to levels normal for wet sites. Once a closed mire-typical vegetation cover has formed after 5-10 years, emissions from rewetted peatlands resemble those of mires. Due to CH_4 emissions, the climate impact of a rewetted peatland often remains slightly climate warming, but overall it is much lower than in the previous drained state[5][10][11].

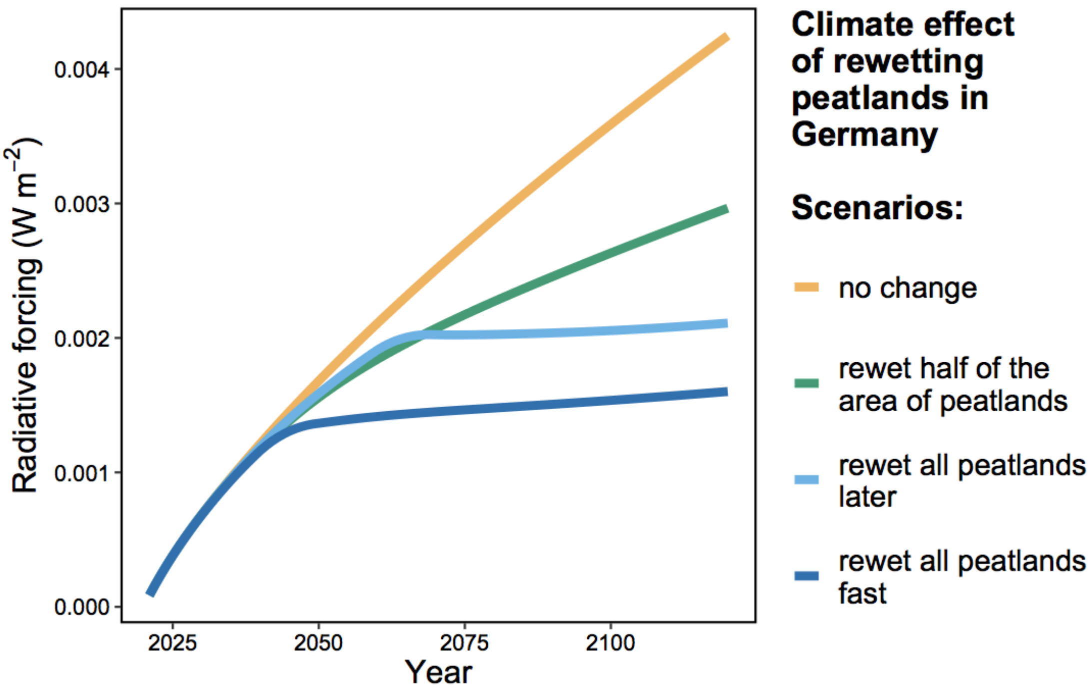
Peatland methane emissions and climate protection

To cope with the climate crisis, it is necessary to reduce the atmospheric concentration of all three greenhouse gases relevant for peatlands (CH_4, CO_2, nitrous oxide (N_2O)). However, the Intergovernmental Panel on Climate Change (IPCC) sees different targets for the different gases. For example, the emissions of CO_2 should be reduced to zero quickly and even become negative in the second half of the century; the emissions of CH_4 and N_2O should only be reduced significantly[6][12]. With rewetting, CO_2 (and N_2O) emissions from peatlands can indeed be reduced to zero, but CH_4 emissions cannot[9][10].

There are only two options: Either peatlands remain drained and continue to emit CO_2, or they are rewetted and then emit CH_4. Given that annual CO_2 emissions must be reduced to zero by 2050, while those of CH_4 are only to be reduced, and knowing that rewetting is always better for the climate in the long run than continued drainage, rewetting is always the right choice[5][11][13].

The figure below shows the contribution to warming (radiative forcing) of the total peatland area of Germany in different scenarios (see legend). The first scenario follows the reduction path designed in Tanneberger et al. 2021, in which (almost) all peatland sites are rewetted by 2050 at the latest; the second scenario also follows the reduction path, but the reduction starts 20 years later; in the third scenario, only half of the drained peatland sites are rewetted, but the reduction follows the same reduction path in proportion; in the fourth scenario, everything remains as it is[11][13].

Due to the longevity of CO_2 in the atmosphere, continued drainage leads to a continuously increasing greenhouse effect (yellow line in the figure). More than half of the radiative forcing —i.e. the warming effect—of this scenario in 2100 can be avoided if we quickly rewet all peatlands in Germany.



How to minimize CH_4 emissions from peatland rewetting?

These measures can reduce CH_4 emissions from rewetted peatlands:

- Remove aboveground biomass prior to rewetting;
- Remove 5-10 cm of topsoil prior to rewetting to remove belowground biomass and reduce soil nutrient availability[14];
- Avoid inundation and open water areas (including in ditches)[2];
- Use water with nutrient concentrations as low as possible;
- Raise water levels incrementally;
- Promote mire-typical plant species.

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Further reading:

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