European Commission

Science for Environment Policy

Higher temperatures increase methane release from northern European peat bogs

Higher temperatures being brought about by global warming are increasing methane emissions from the extensive northern European peatlands, a recent study has found. The researchers also say that future estimations of greenhouse gas emissions can be improved via better land-cover classification — i.e. determining how much peatland is fenland or bogland.

Large areas of northern Europe and Russia are made up of peatlands (land areas, such as bogs and fens, with a thick layer of organic soil made of partially decayed vegetation), which are among the world's most vital ecosystems. They store huge amounts of carbon but are also major natural sources of methane, a greenhouse gas (GHG) with a global warming potential 28 times higher than carbon dioxide over a 100-year timescale, and 84 times higher over a 20-year timescale.

Reliable estimates of methane emissions are needed to improve GHG inventories — both for the European Union area and for the Russian Federation area. These budgets help policymakers to ensure progress is being made towards emission-reduction targets. Western Russian peatlands are variously managed and unmanaged, but there are now much more extensive protection and restoration efforts than under the Soviet Union, when many areas were drained and excavated. GHG data is reported to the United Nations Framework Convention on Climate Change (UNFCCC); however, these UNFCCC reports only include anthropogenic (man-made) emissions and removals, and exclude unmanaged lands.

This study, which was partly funded by the European Commission[1], measured methane emissions from a boreal peatland in the Komi Republic, an unmanaged area of European Russian forest and wetland, from March 2008 to February 2009, and during the summer of 2011. In the summer months, the researchers collected methane emissions from closed-top chambers placed on the peat surface at 18 sites across the study area. The sites represented the two major types of peatland (bogs, fed by rainwater, and fens, fed by surface water or groundwater), as well as the main small-scale types of landform, such as small valleys called hollows and small mounds called hummocks.

The researchers periodically took air samples from the chambers, or from snow samples during the winter months, and analysed them for changes in methane concentrations. Using emissions from each site alongside land-cover data, they calculated the methane emissions for the entire study area. Using this data, they calculated methane emissions from all peatlands and other land types, such as forests and wetlands, in different ecological zones in Europe based on estimated emissions in previous research. Those estimations were based on a literature review and were weighted according the area of land occupied by each land use type.

Half of all summer methane emission rates were in the range 150–450 milligrams of methane per square metre of peatland a day (mg $CH_4/m^2/d$). These summer emissions are far higher than the average range of 5–80 mg $CH_4/m^2/d$ for peatlands in other boreal zones around the world. They are, for example, twice that for similar peatlands in Scandinavia and North America.

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Global warming threatens the stability of peatlands and higher temperatures may increase the amount of methane released from northern peatlands to the atmosphere. Here, total methane emissions across the study area were 30% higher during the summer of 2011, when the climate was warmer and drier than in 2008 (which had average summer temperatures).

The researchers list numerous reasons for high summer methane flux which have been cited in other studies, but also identify a further possible cause at their study site: ebullition. Steady ebullition (bubbling which has a regular pattern with constant accumulation and release of bubbles) is likely caused by a lowering of the water level due to high summer temperatures.

The researchers further identified that, at the local level, methane emissions increased during the warmer summer at bog sites, which rely on rainwater for their mineral content. However, the methane emissions decreased at the low-lying fen sites, which depend on the mineral content of the surrounding rock, suggesting that total methane emissions depend on the land cover characteristics of each peatland. The researchers therefore suggest that accurate calculations of the effects of global warming on future methane emissions will require a better knowledge of the geophysical formation of methane-emitting ecosystems.