Flooding might help lower gas emission from wetlands

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River floods and storms that send water surging through swamps and marshes near rivers and coastal areas might cut in half the average greenhouse gas emissions from those affected wetlands, according to recent research at Ohio State University.

A study suggests that pulses of water through wetlands result in lower average emissions of greenhouse gases over the course of the year compared to the emissions from wetlands that receive a steady flow of water.

The study compared the emission of methane from wetlands under two different conditions, one with a pulsing hydrology system designed to resemble river flooding and one with a steady, low flow of water. The research showed that in areas of deeper water within the wetlands, methane gas fluxes were about twice as high in steady-flow systems than they were in pulsing systems. Methane emissions from edge zones, which are sometimes dry, were less affected by the different types of conditions.

Methane is the major component of natural gas and is a greenhouse gas associated with global warming. While the Environmental Protection Agency estimates that human activities are responsible for about 60 percent of methane emissions worldwide, wetlands are among the natural sources. Bacteria that produce methane during the decay of organic material cause wetlands to release the gas into the atmosphere.

The study by Ohio State University scientists is part of ongoing research comparing pulsing vs. steady-flow conditions in two experimental wetlands on the Columbus campus.

"Pulsing refers to a number of different conditions in wetlands – river pulses that happen on a seasonal basis, two-per-day coastal tides, and the rare but huge ones, like hurricanes or tsunamis," said William Mitsch, the study's senior author and director of the Wilma H. Schiermeier Olentangy River Wetland Research Park at Ohio State.

"Our point is that the healthiest systems and the ones with the lowest emissions of greenhouse gases are those that have these pulses and that are able to adapt to the pulses."

The research was published in a recent issue of the journal *Wetlands*.

Often called the "kidneys" of the environment, wetlands act as buffer zones between land and waterways. They also act as sinks – wetlands filter out chemicals in water that runs off from farm fields, roads, parking lots and other surfaces, and hold on to them for years.

The study examined methane fluxes over a two-year period during which researchers created two different kinds of conditions in two 2.5-acre experimental wetlands. In 2004, scientists used pumps to deliver monthly pulses to create conditions in the wetlands resembling natural marshes flooded with river water. In 2005, researchers pumped approximately the same amount of water but maintained a constant flow of water through the wetlands to mimic less dynamic hydrologic conditions. In addition to methane emissions, the study also investigated other processes such as denitrification, sedimentation, and aquatic productivity.

The pulsing hydrology experiment was maintained and methane levels were measured approximately twice monthly over the two study years by Mitsch, also an environment and natural resources professor at the Olentangy River Wetland Research Park, and study co-author Anne Altor, a former Ohio State graduate student who is now a consultant in Indianapolis. During both years, more methane was emitted during the summer than during other seasons in all portions of the wetlands, with emissions about four times higher during summer in the edge zones. Consistently wet areas released more gases in the spring than did edge zones under both conditions.

Methane is composed of carbon and hydrogen, and its emissions are expressed in terms of the amount of carbon released into the atmosphere. The emissions were at their highest during the summer of the steady-flow year, when the amount of methane released from the deepest part of the wetlands averaged 18.5 milligrams of carbon per square meter of wetland surface per hour. With these wetlands covering about 5 acres, the emissions amounted to an estimated 20 pounds of carbon per day. That level was twice as high as the summertime methane emissions measured from the deepest area of the wetlands during the year of pulsing conditions.

The average levels of methane emissions in the deepest water of the wetlands over the course of the study were 6 pounds of carbon per day in the pulsing year and almost 12 pounds of carbon per day during the steady-flow year.

The researchers suggested that slightly warmer soil temperatures and less fluctuation in water levels during the steady-flow year created conditions that promoted the production of methane.

A simultaneous study of carbon collection in the wetlands showed that the different water conditions had no significant effect on how much carbon was stored by the wetlands. Many experts suggest that the benefits of wetlands' carbon storage capacity offset any damage resulting from their methane emissions.

Mitsch noted that pulses from storms not only help dissipate one negative effect of wetlands, but also serve as a reminder of how wetlands function to absorb the surge.

"If we didn't have salt marshes and mangroves in subtropical and tropical coastal areas of the United States, it's safe to say these current storms would have even more damaging effects," he said.

"When you lose wetlands, you've lost a place for floodwater to go," Mitsch noted. "Mother Nature is better at withstanding these pulses than we are. Whether it's a flooding river or a hurricane, no matter what those pulses are, if there's a natural ecosystem to absorb them, then we as humans would be safer."

Source: Ohio State University

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