The Effect of Climate Change on Methylmercury in Boreal Peatlands

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Peatlands hold large quantities of atmospherically deposited mercury and can be significant sources of methylmercury (MeHg). MeHg is a neurotoxin produced within peatlands and exported to aquatic systems where it bioaccumulates in the food web resulting in human health effects. Because peatlands are saturated wetland systems they provide ideal conditions for methylation, so much so that the percentage of wetlands in a watershed is positively correlated with MeHg concentrations in fish.

This study investigated how increased temperature and elevated CO_2 may impact net MeHg in peat porewaters and export to surface waters. Global models predict a 2–4.5°C increase in temperature with more drastic increases at higher latitudes, where most peatlands are located. Peatlands are expected to become drier due to reduced precipitation. The combination of these factors may turn peatlands from mercury sinks into mercury sources.

Samples were collected from 10 enclosures at the Spruce and Peatland Responses Under Changing Environments (SPRUCE) site located in Minnesota, USA. Each enclosure has above and below-ground heating, resulting in temperature treatments ranging from +0°C to +9°C relative to ambient. Each temperature treatment has a pair of enclosures, ambient CO_2 and elevated CO_2.

Porewater: Within the surface depths (0-30cm), where most MeHg transformation occurs, there was a significant difference between +0°C and +9°C for both total mercury (THg) and MeHg. Multiple linear regression identified the following factors as important for log10 transformed MeHg over the whole depth profile (0-150cm): Depth(-), pH(+), THg(+), iron(-), temperature(+), season, and CO_2 (+).

Outflow: There was a significant difference between +0°C and +9°C for both THg and MeHg flux. Multiple linear regeression identified the following factors as important for log10 transformed MeHg flux: Temperature(+), THg(+), iron(-), TOC(-), and season.

Our findings suggest that increased temperature will result in increased MeHg in porewaters and outflow and elevated CO_2 will result in increased MeHg in porewaters.