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What wetlands in the Arctic have to do with global climate change

When hearing about "Arctic research" many people probably picture polar bears, glaciers and sledge dog expeditions. While these things are certainly a part of Arctic research there is another important part to it that affects us all: The Arctic is a key component of the global climate system. What happens in the Arctic has strong effects on how much and how fast the climate is going to change in the future.

Why is that? One reason is that Arctic soils contain a lot of carbon. It has built up from dead plants and animals for thousands of years, much of it in wetlands. When the climate gets warmer, decomposition will become faster and more carbon could be released into the atmosphere in form of greenhouse gases (mostly carbon dioxide and methane). This would further accelerate the warming. Additionally the warming happens faster in the Arctic than on the rest of our planet. In the past 30 years average temperatures in the Arctic have risen by almost 2°C, twice as much as the global average!

Earth system models – a tool to predict climate change

Many scientists all over the world are working together to predict the future rise in temperature under different greenhouse gas emission scenarios. This is a very difficult task because there are so many parts involved that work together and affect each other: The atmosphere, the oceans, soils, plants, human activity and many more. To make predictions, scientists build large and complex computer models of the earth system that include all of these components. Model simulations are then used for making reports to inform policy makers, like the IPCC reports. The models are constantly being tested and improved. Studies have shown that the role of the Arctic in the climate system is still a weak spot of earth system models.

Testing a wetland model

In my master thesis I worked with a model for wetland carbon cycling, called LPJ-GUESS-WHyMe, that could be used within an earth system model. It simulates plant growth of different kinds of plants, carbon uptake through photosynthesis and emission through respiration, hydrology and soil processes. I tested the model by comparing the results of different simulations to measurement data that was taken in a wetland in north-eastern Greenland. The measurement data included carbon dioxide and methane fluxes from the wetland, as well as information on the vegetation. As a result I found that the following components of the model should be improved as a next step to make its predictions better:

1. The model needs to take into account melt water coming from the mountains in the hydrology scheme. 2. The mechanisms of competition between grasses and mosses in the model need to be improved. 3. Grasses and sedges have a large impact on methane fluxes in wetlands. The model does take this into account, but currently underestimates the influence.

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