



# How do changing water table levels and warming temperatures affect carbon fluxes from drained and undrained peatlands?

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## Importance of peatlands

Peatlands and other wetlands are vital to our society because they help prevent floods, filter water, help moderate temperatures, and provide habitat to many plants and animals. Peatlands can either be ombrotrophic (most bogs) or minerotrophic (most fens).

There are approximately 5 million km<sup>2</sup> of peatlands, which is 5 to 8% of the world's surface<sup>1</sup>. The accumulation of peat is due to organic matter production exceeding decomposition. Peat deposits in the world's wetlands, particularly in boreal and tropical regions, store substantial amounts of carbon. **Of the total storage of C in the earth's soils (1,400 to 2,300 PG-C (Pg = 10<sup>15</sup> g), about 20 to 30% is stored in peatlands.**

Peatlands produce methane by reducing carbon dioxide in anaerobic environments. Methane gets emitted to the atmosphere either by (1) ebullition (2) diffusion and (3) through the aerenchyma tissue of wetland plants

## Objective: climate change effects

**Our overall goal is to test the interactive effects of water table and warming manipulations on peatland carbon cycling.** The sites represent a gradient of long-term water manipulations. Plant communities will likely have a large effect on carbon cycling.

## SNWR - the site of the study

In the late 1800s, the Seney National Wildlife Refuge (SNWR) was heavily disturbed. Soils and harsh conditions inhibited it from being converted into agriculture and settlement. Due to human disturbance, the water table was lowered in some areas and raised in others.

## Running the experiment

6 sites will be studied (two wet, two dried, and 2 controls). Alternating weeks, carbon dioxide and methane fluxes will be sampled. Net ecosystem exchange (NEE) and ecosystem respiration (ER) will be measured using an Infrared Gas Analyzer (IRGA) in each plot. Then the gross primary production (GPP) is calculated as the difference between NEE and ER. Methane will be sampled and the concentration of methane will be determined using gas chromatography. Water table measurements will be hand recorded. Soil and air temperatures will also be recorded.

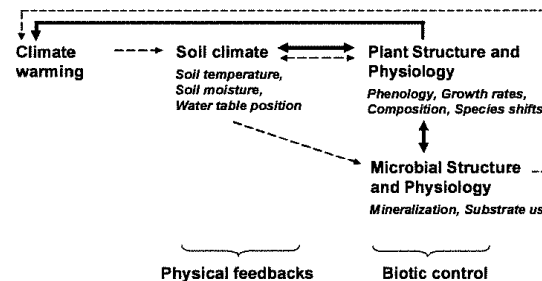
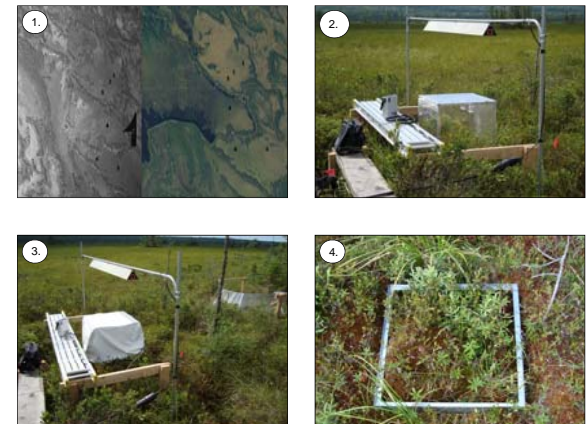


Figure 1

**Figure.1.** Schematic of physical, structural, and physiological feedbacks to peatland C fluxes that will be investigated. Fast and intermediate feedbacks (dotted lines) will be investigated using short-term, annual manipulations, while slow feedbacks (solid line) will be investigate in areas of historical (decadal) drainage.

## Predictions

- **Carbon fluxes** (from respiration) will be affected mainly by **temperature** with a secondary effect of water table level.
- **Methane fluxes** will be dependent mainly on **water table levels** and **plant productivity** with a secondary effect of temperature.
- **Drained peatlands** will have higher carbon fluxes than the undrained peatlands.
- **Undrained peatlands** will have higher methane fluxes, but lower carbon fluxes.



1. Notice the construction of the road in the early 1950's that dewatered sites 1-3, 5-6 and added more water to site 4. Also notice the tree invasion (light green in 2002 photo) in the now dried sites (1-3, 5-6).
2. Gross ecosystem photosynthesis measurement (GEP) under an infrared heat lamp.
3. A cover is placed over the chamber to block out daylight to record ecosystem respiration (ER).
4. Galvanized steel soil collar inserted into the peat used for placement of the chamber.

## References

<sup>1</sup>Wieder, R.K., D.H. Vitt (editor). 2006. *Boreal Peatland Ecosystems*, Ecological Studies 188, Springer-Verlag, Heidelberg, Germany. P. 1

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