Heterogeneity in soil and landscape properties of Northern Forests

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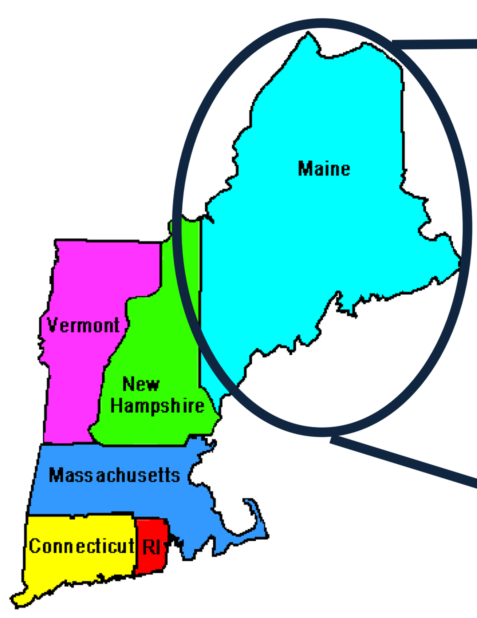
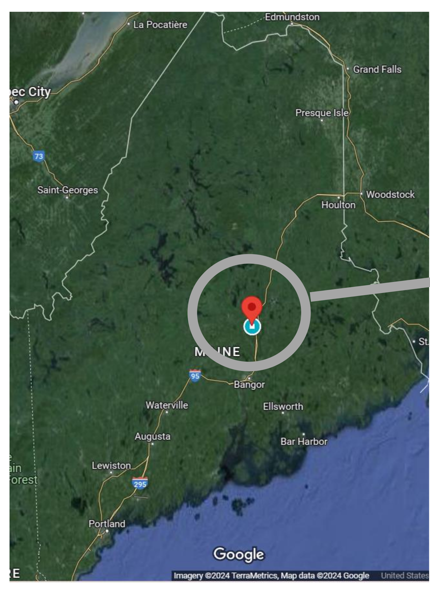
Highlights

Northern Forests are CH_4 consumers	Assessing spatial heterogeneity	Exploring soil properties	Studying CH_4 cycle processes to reduce uncertainty of CH_4 budget

Study Site



Source: University of Maine



Howland Research Forest
Central Maine

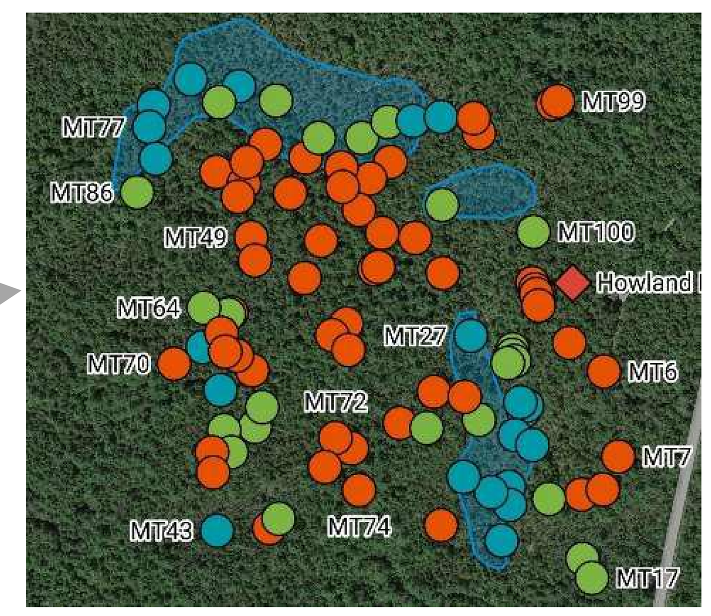
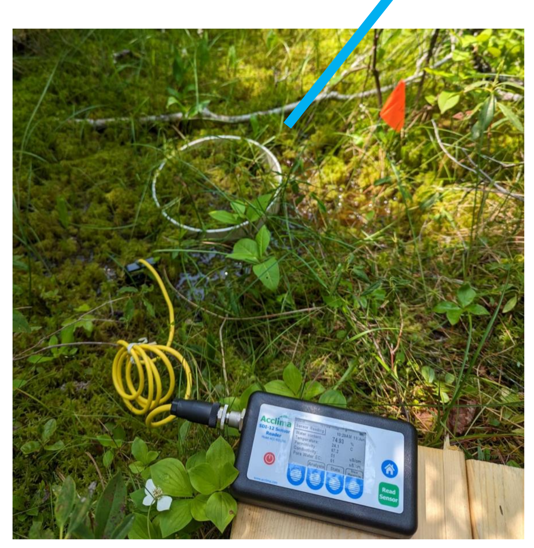
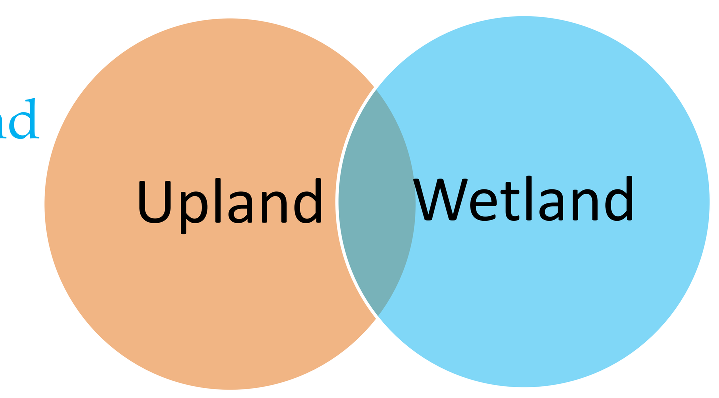
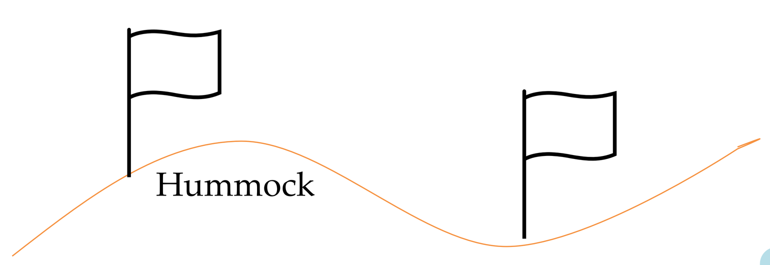


Figure 1: Field site with 100 soil collars

Drainage Classes: Upland, Transitional, Wetland







Methods

Year 1: Field Campaign
- 100 soil collars for GHG fluxes
- Forest Inventory Assessments
- 250 soil samples from 75 collars

Soil Samples
- Organic (3 depths)
- Mineral (2 horizons)

Initial Soil Analyses
- Total Carbon
- Total Nitrogen
- Soil pH

Figure 2: Total C, Total N, and pH for the organic horizon samples across the three drainage classes

	Property	Drainage	Min	Max	Mean
A	Total C (TC) %	Upland	24.17	51.20	37.22
		Transitional	23.47	45.89	38.32
		Wetland	34.54	44.20	39.54
B	Total N (TN) %	Upland	0.42	1.79	1.02
		Transitional	0.37	2.09	1.14
		Wetland	0.83	2.70	1.62
C	pH	Upland	2.76	6.51	3.48
		Transitional	2.98	4.58	3.81
		Wetland	3.68	4.44	4.07

Preliminary Results

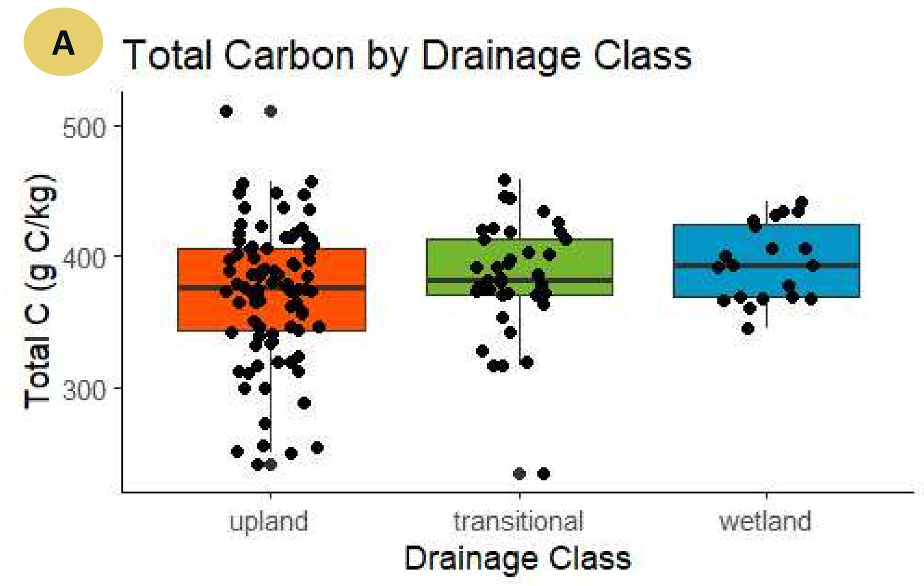


Figure 3: TC distributions of organic samples, n = 150

- For Total C and Total N, organic wetland samples had the highest average %
- Organic upland samples had the lowest average %

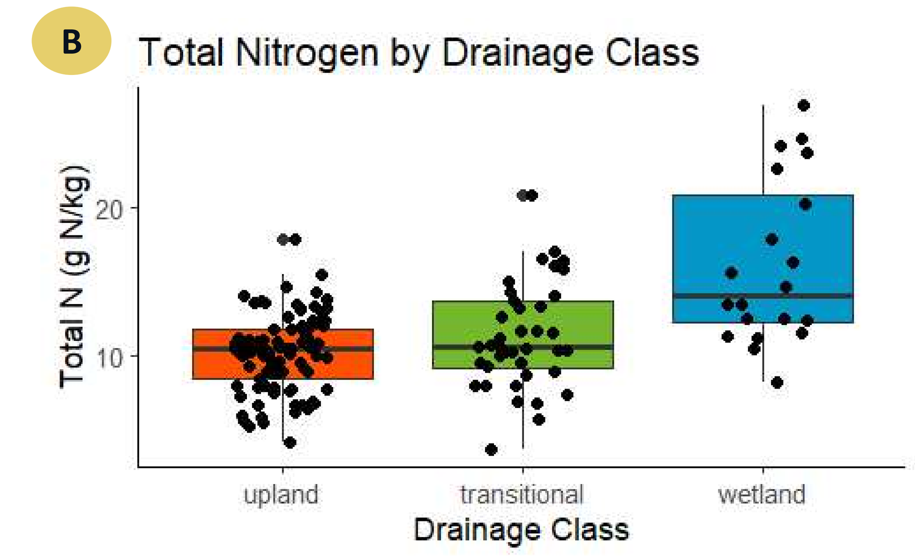


Figure 4: TN distributions of organic samples, n = 150

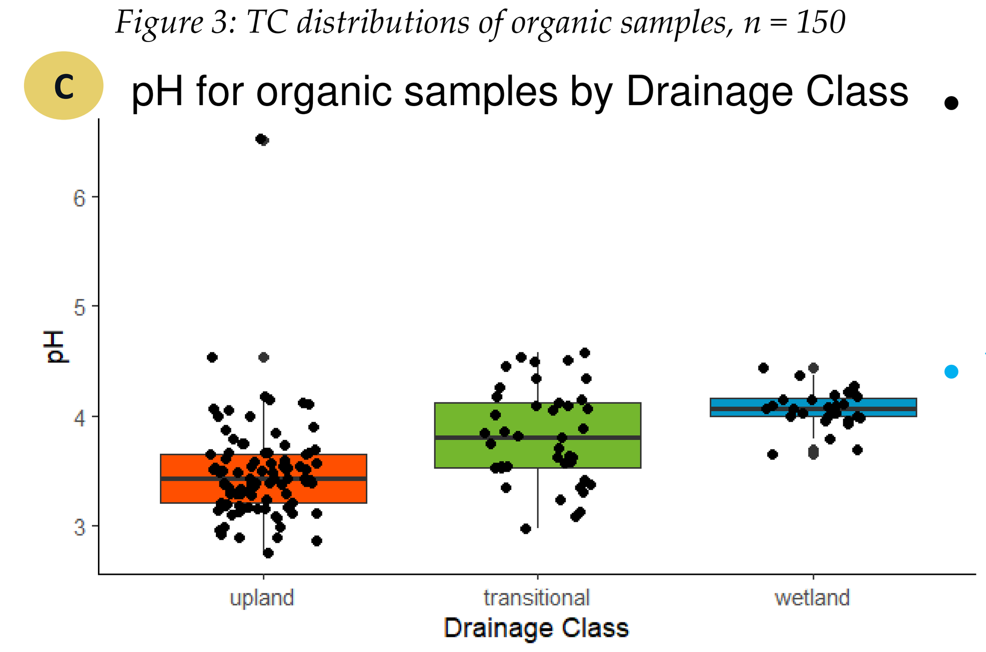


Figure 5: pH distributions of organic samples, n = 166

- Organic and mineral samples are acidic as expected for spodosols
- Wetland > Transitional > Upland

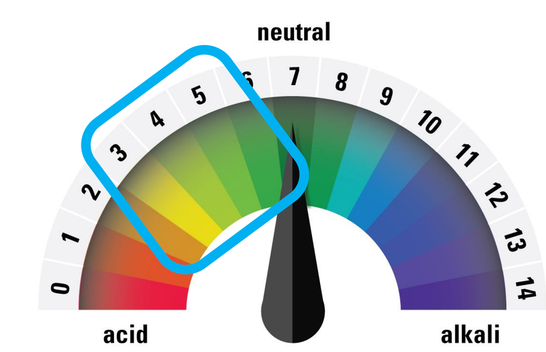


Figure 7: Spodosol = acidic (Source: USGS)

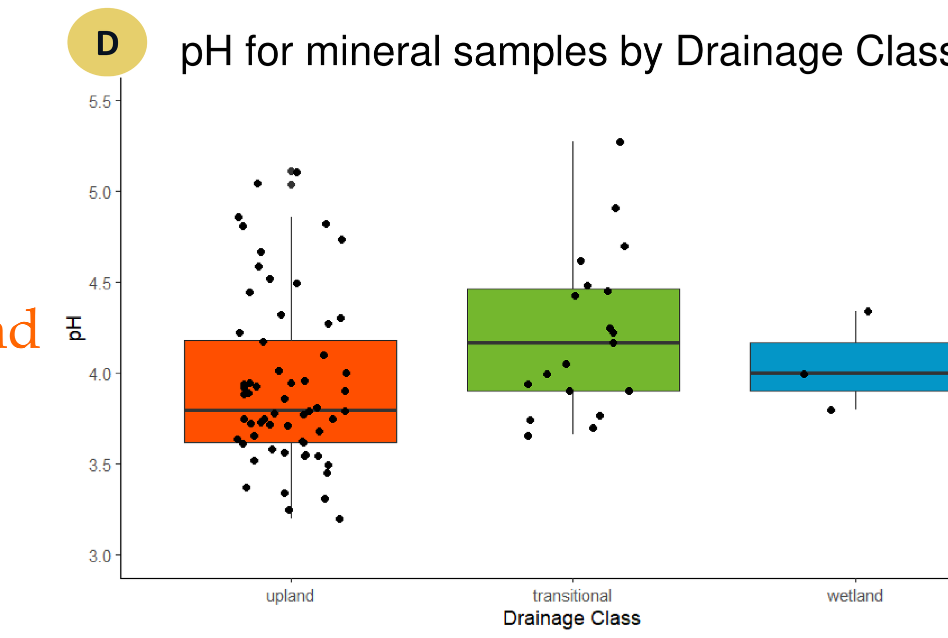


Figure 6: pH distributions of mineral samples, n = 84

Conclusions

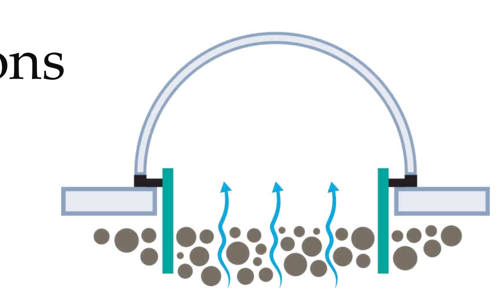
- Upland soils are interspersed with wetland (*Sphagnum* bog), and transitional soils along with hummock-hollow microtopography in Howland Forest

  → Result is a complex mosaic of microsites with sources and sinks of CH_4 subjected to change under future climate

- Understanding mechanisms behind CH_4 cycle can reduce the current uncertainty of CH_4 sink/source estimation in critical ecosystems (Lee, 2023).

Implications

- Soils = large GHG sink
- Short lifetime of CH_4 makes it more potent than CO_2 → Quantify biogenic CH_4 emissions
- In-situ fluxes + soil gas sampling for isotope dilution method
- Landscape-level estimations of CH_4 dynamics in Northern Forests



Source: LI-COR Biosciences

References

Hollinger, D. Y. Global Change Biology, 1999. Hollinger, D. Y. Journal of Geophysical Research: Biogeoscience, AGU, 2021. IPCC, 2023: Synthesis Report. Weil, Ray, R. Pearson, 2017. Lee, J., Nature Communications, 2023. Whiticar, M.J., Springer Nature, 2020.

Acknowledgments

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