

CHEMICAL CONTROLS ON CARBON SEQUESTRATION AND GHG FLUX ALONG A BOREAL TO TROPICAL GRADIENT

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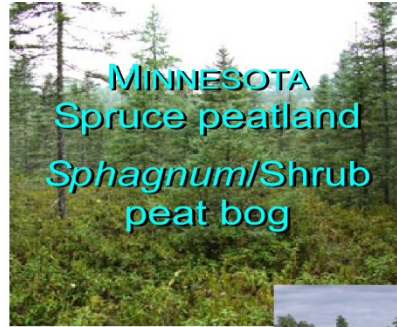
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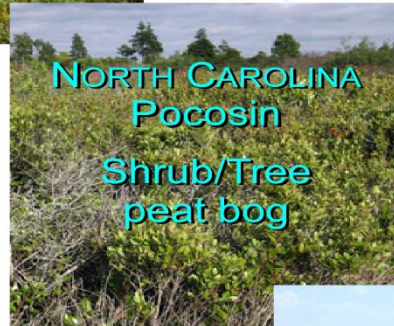
REGIONS

WETLAND SITES AND TYPES

Boreal
(47.503°N, 93.483°W)



Temperate/
Subtropical
(35.728°N, 76.489°W)



Subtropical
(26.417°N, 80.309°W)



Increase temperatures and evapotranspiration

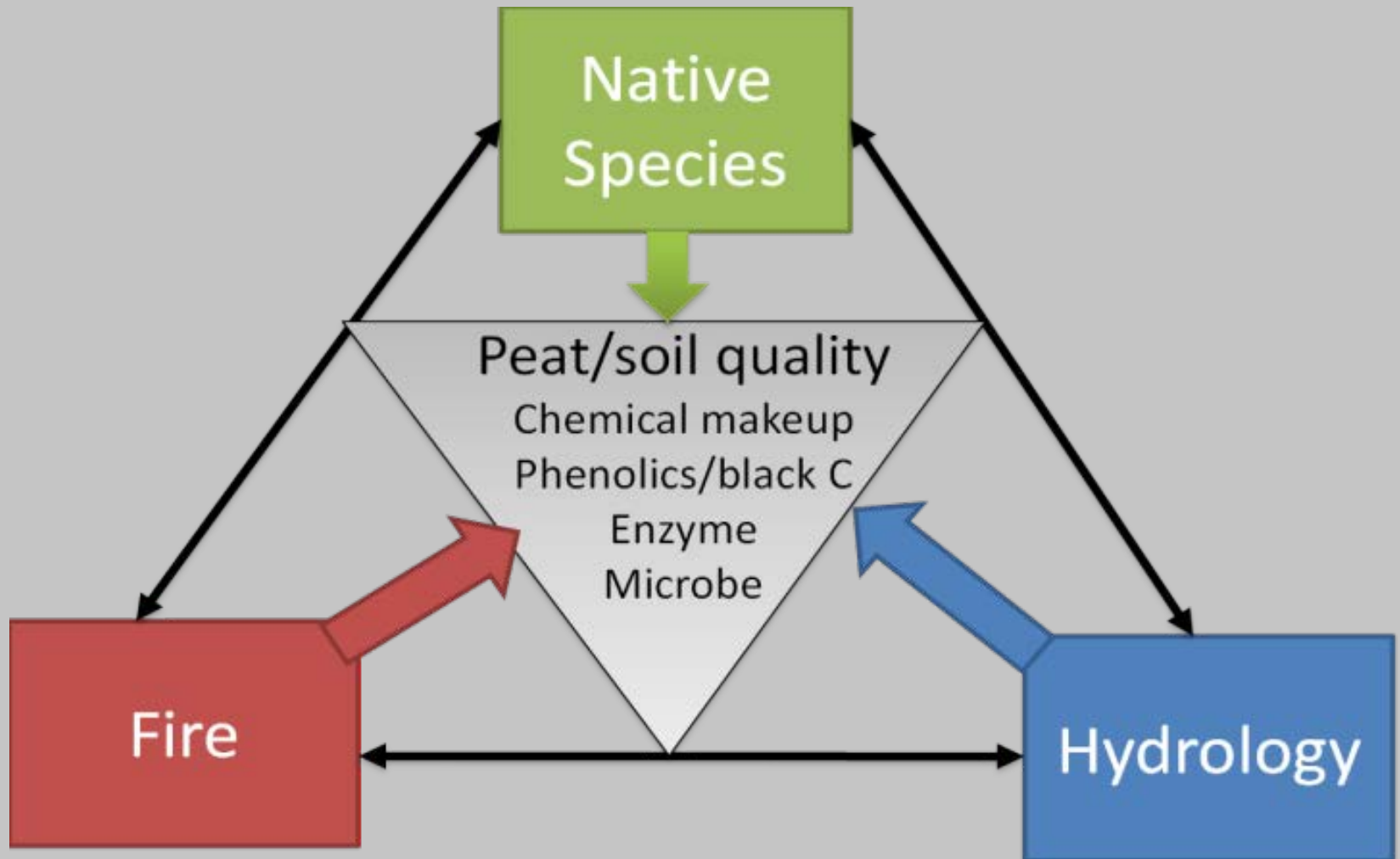
Tropical
(4.396°S, 74.267°W)

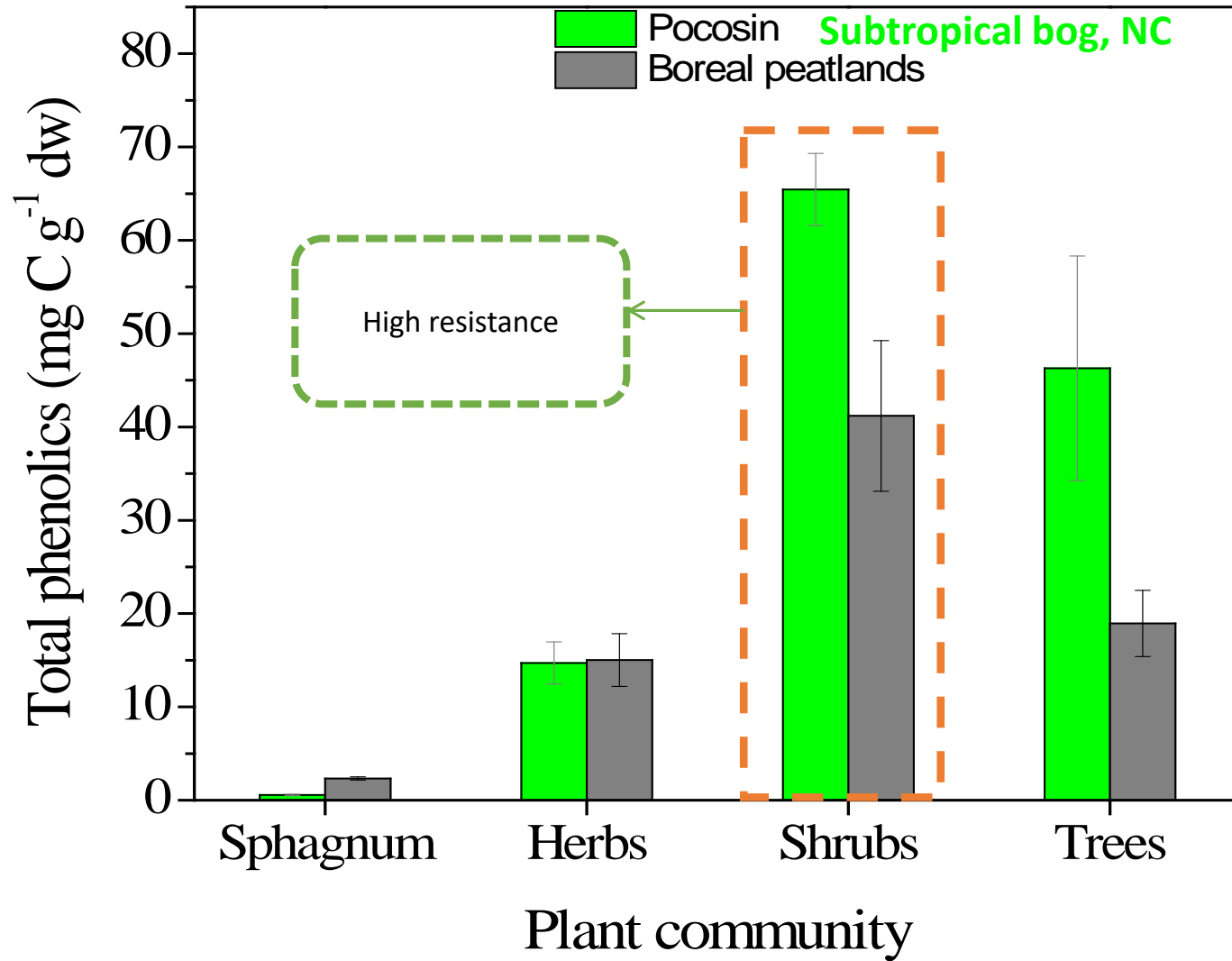


“Dual Latch Hypotheses”

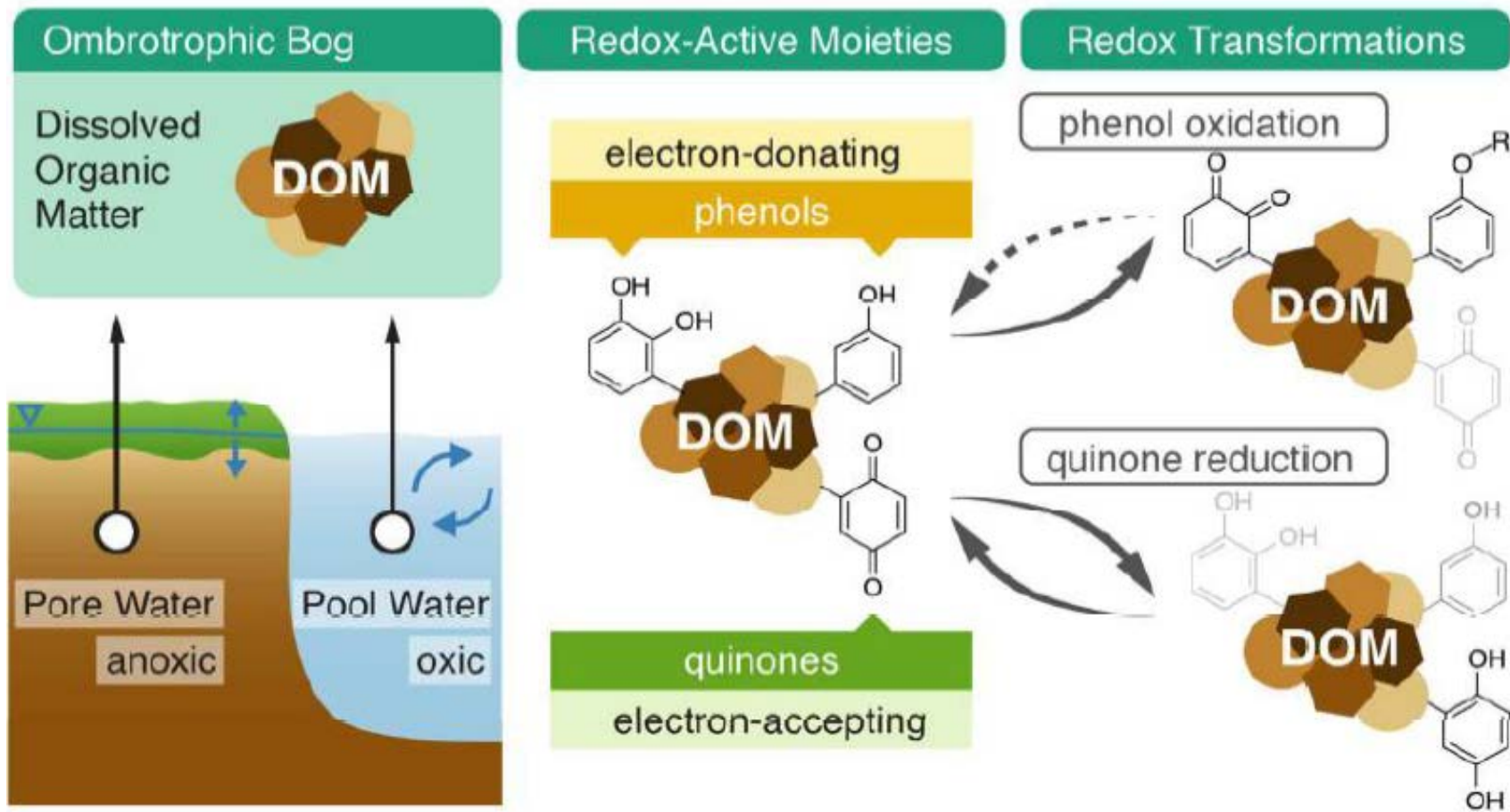
- *Subtropical and tropical fire-adapted tree/shrub communities produce higher phenolic and aromatic cpds and low-intensity fires higher black carbon (aromatic) peat than found in northern Sphagnum-Carex communities.*
- *Low-latitude peatland C decomposition is down regulated by higher production of phenolics and aromatic compounds than found in northern Sphagnum/Carex communities.*

Dual Latch Peat Decomposition Model





(Wang, Richardson and Ho, 2015, *Nature Climate Change*)



Electron-donating Phenolic and Electron-accepting Quinone Moieties in Peat Dissolved Organic Matter: Quantities and Redox Transformations in the Context of Peat Biogeochemistry

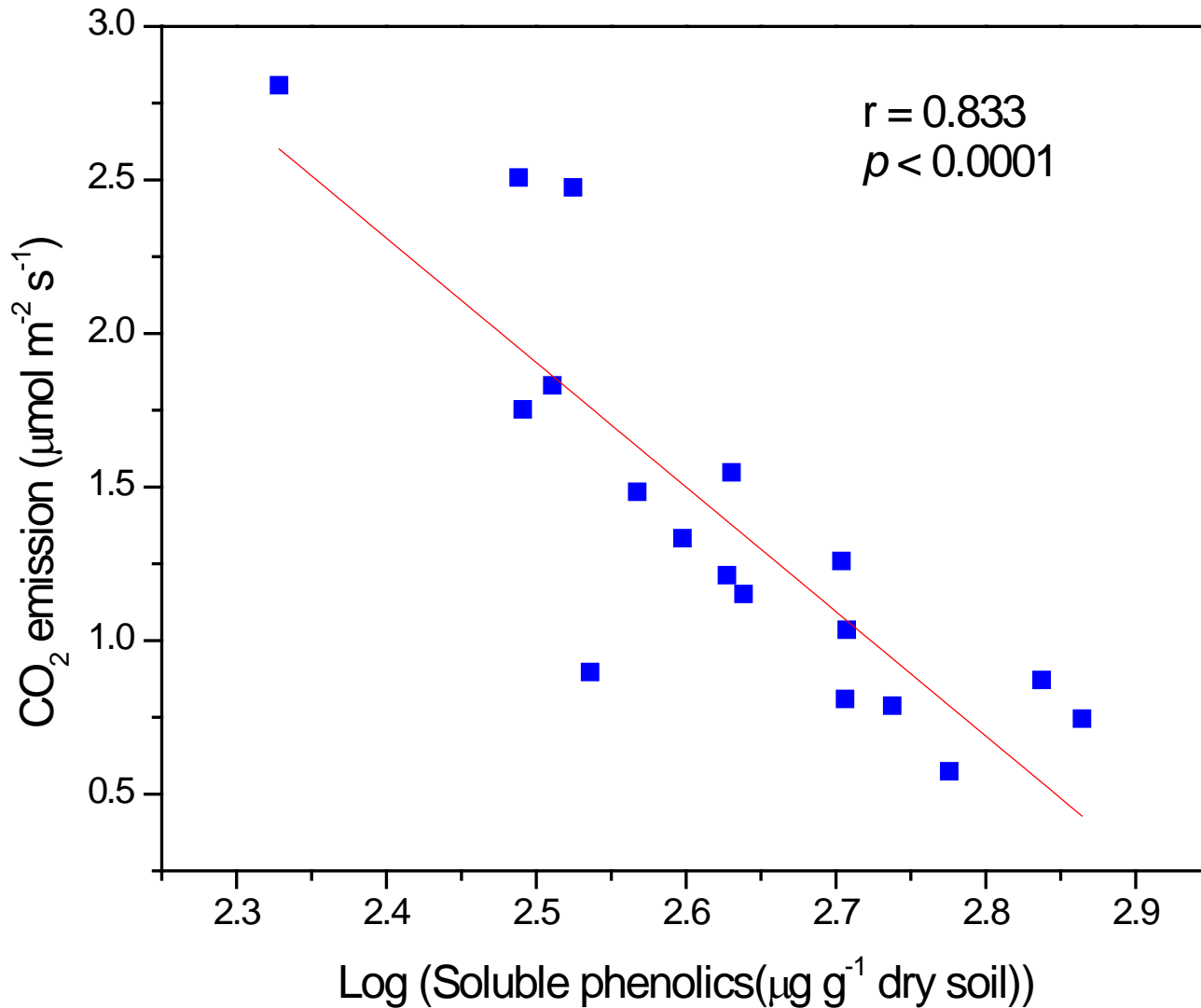
Nicolas Walpen, Gordon James Getzinger, Martin H. Schroth, and Michael Sander

Environ. Sci. Technol., Just Accepted Manuscript • DOI: 10.1021/acs.est.8b00594 • Publication Date (Web): 28 Mar 2018

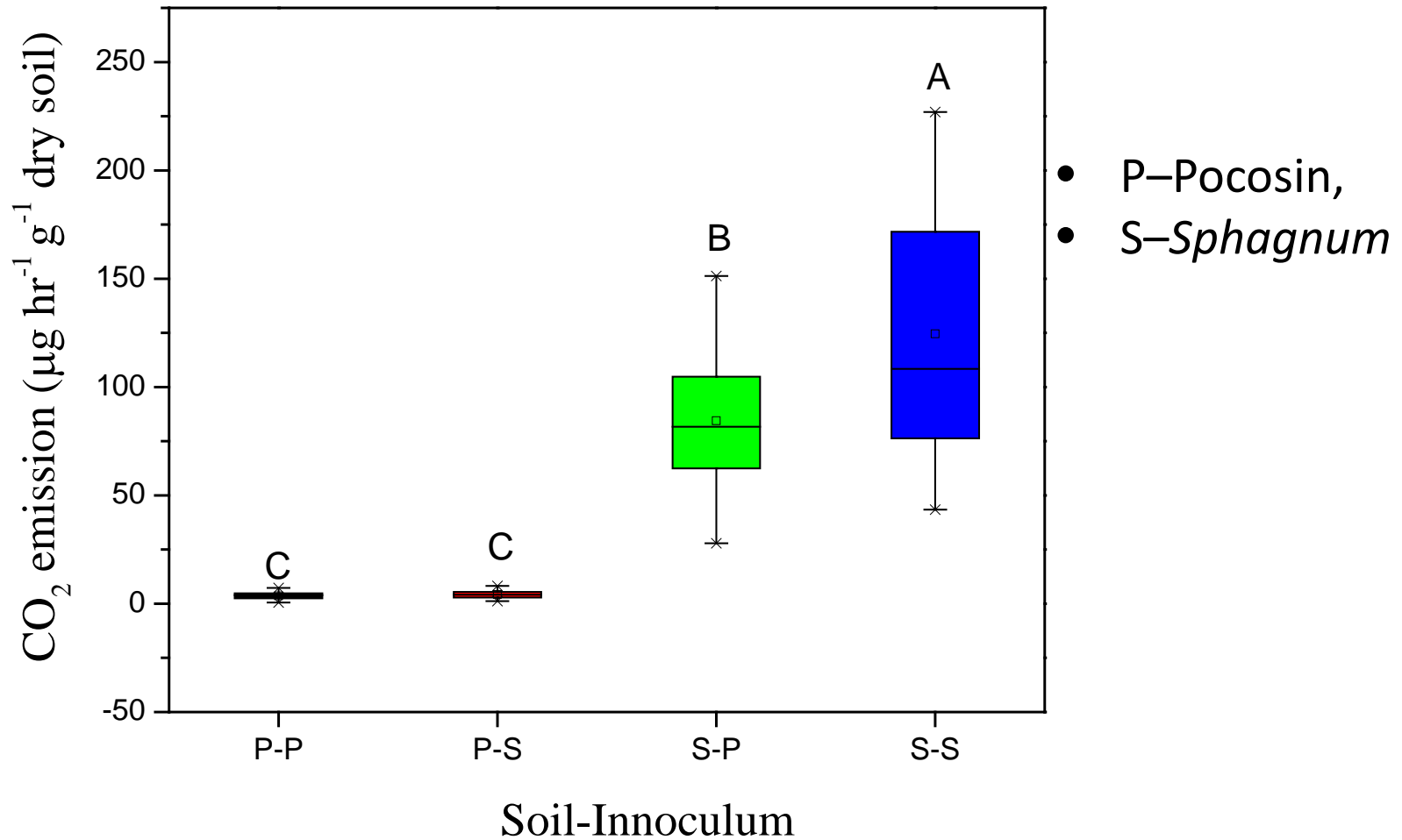
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Phenolics inhibit SR

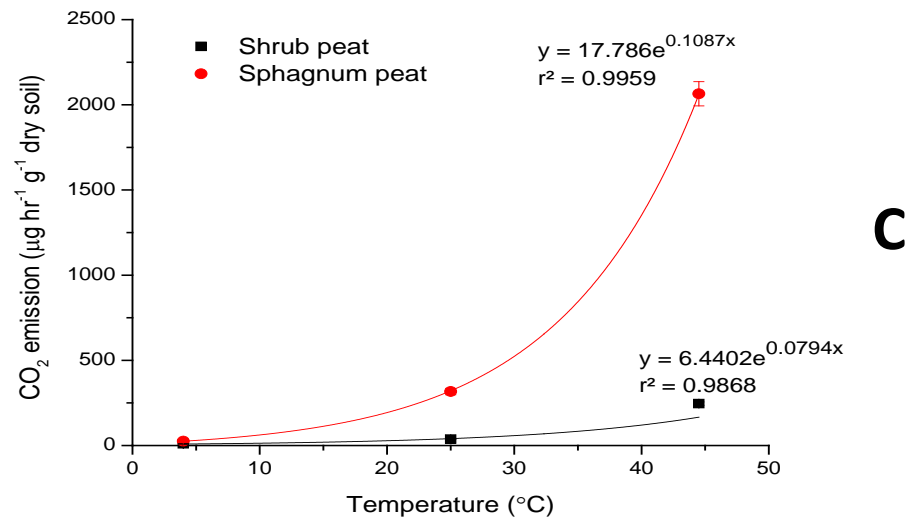
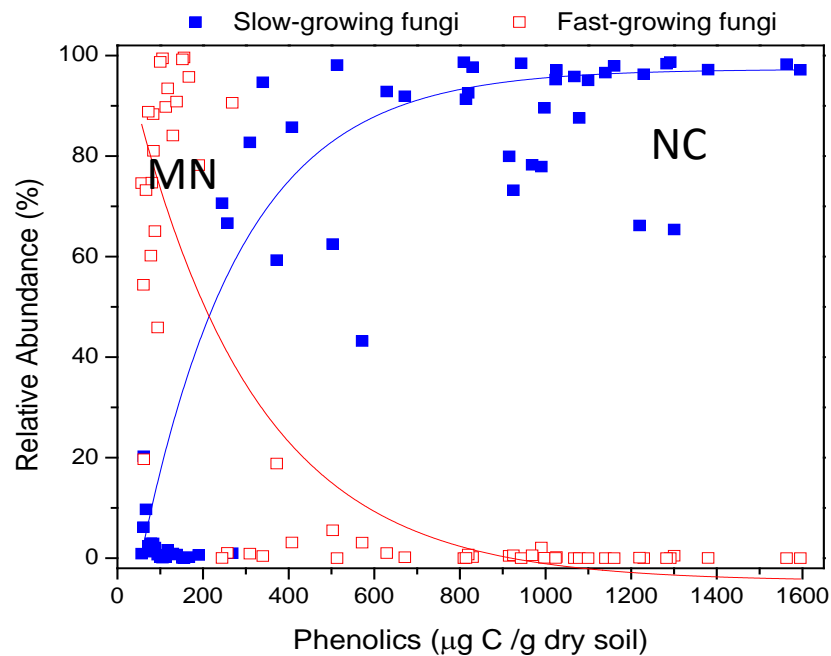
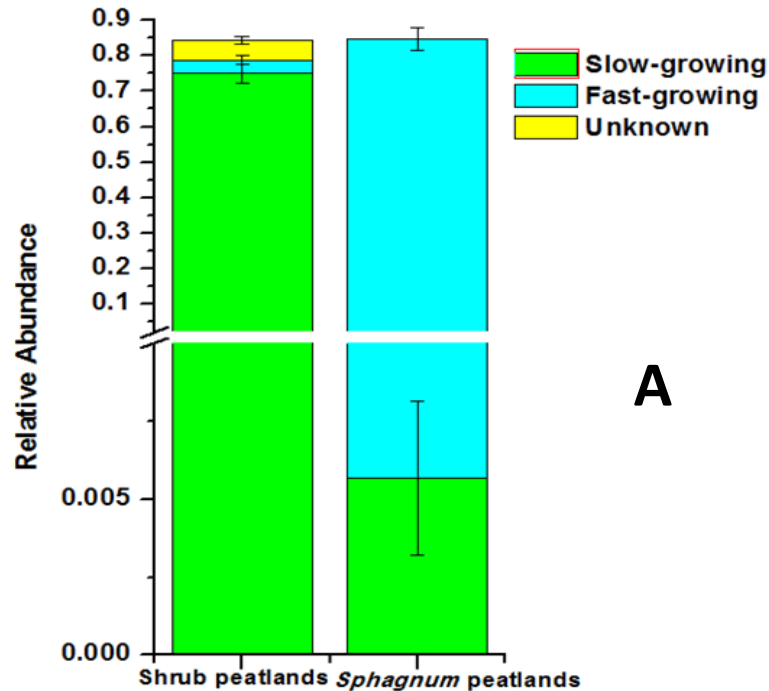
(Wang, Richardson and Ho, 2015, *Nature Climate Change*)



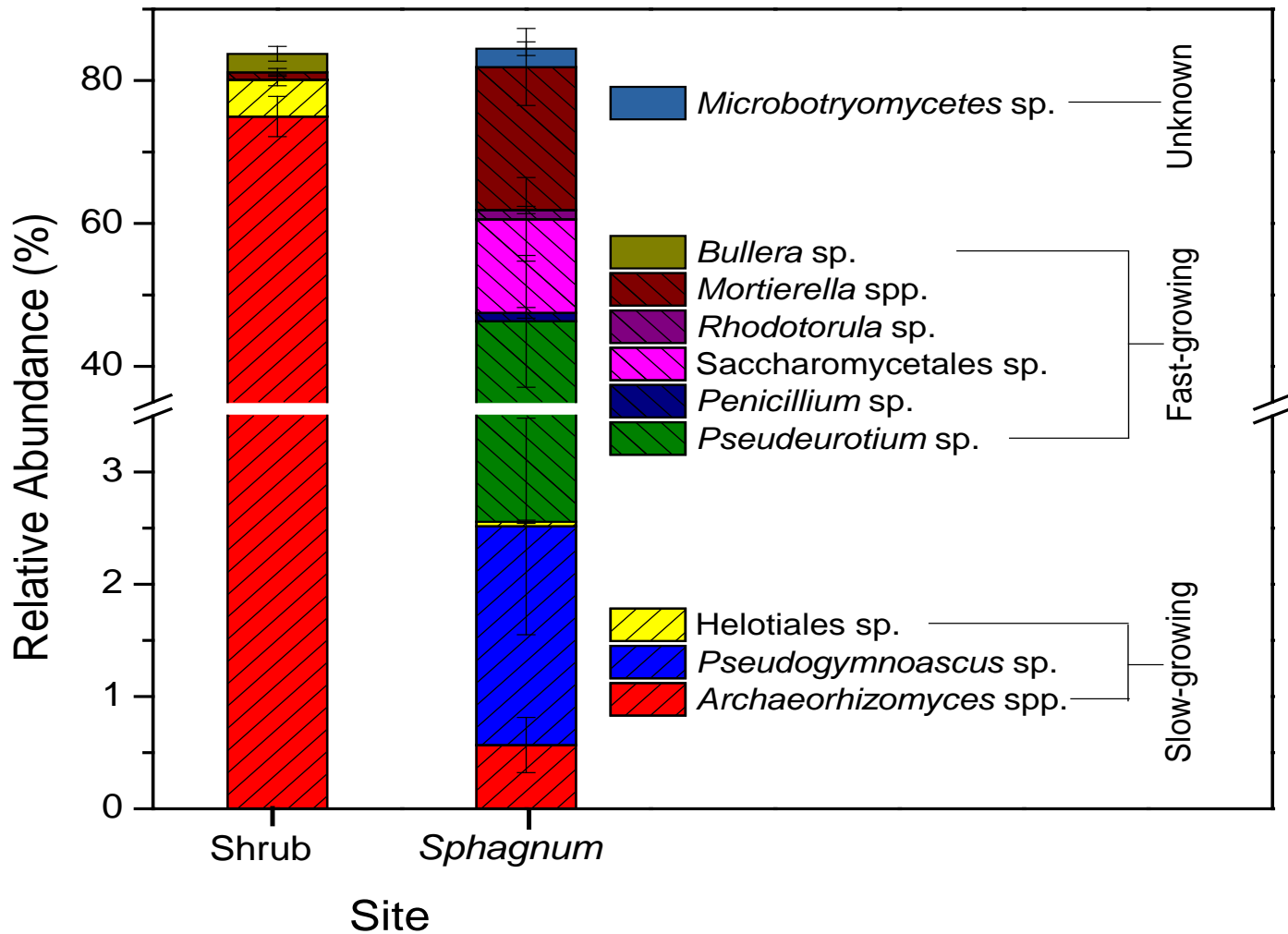
Phenolic Leachate Effects on Decomposition



(Wang, Richardson and Ho, 2015, *Nature Climate Change*)



(A) Slow Growing Fungi Dominate in Shrub Peatlands, (B) Phenolics Control Fungal Composition, (C) Lower Temp Sensitivity Lower Latitudes



Dominant fungal composition and relative abundance of slow-growing and fast-growing fungi in the subtropical shrub and the boreal Sphagnum peatlands. (submitted Science).

BOREAL
Sphagnum/shrub



MINNESOTA
Marcell Exp. Forest

TEMPERATE
shrub/tree



NORTH CAROLINA
Pocosin Lakes NWR

SUB-TROPICAL
sedge/shrub



FLORIDA
Loxahatchee NWR

TROPICAL
pole forest



PERU
Nueva York

Nueva York

Dominated by short and thin trees. Dominant species: *Pachira insignis* and *Platycarpum lorentensis*



Miraflores

Very similar
vegetation to
Nueva York.
Woodier peat
(my first
impression)
compared to
Nueva York.



Sphagnum/Spruce MN



Everglades FL

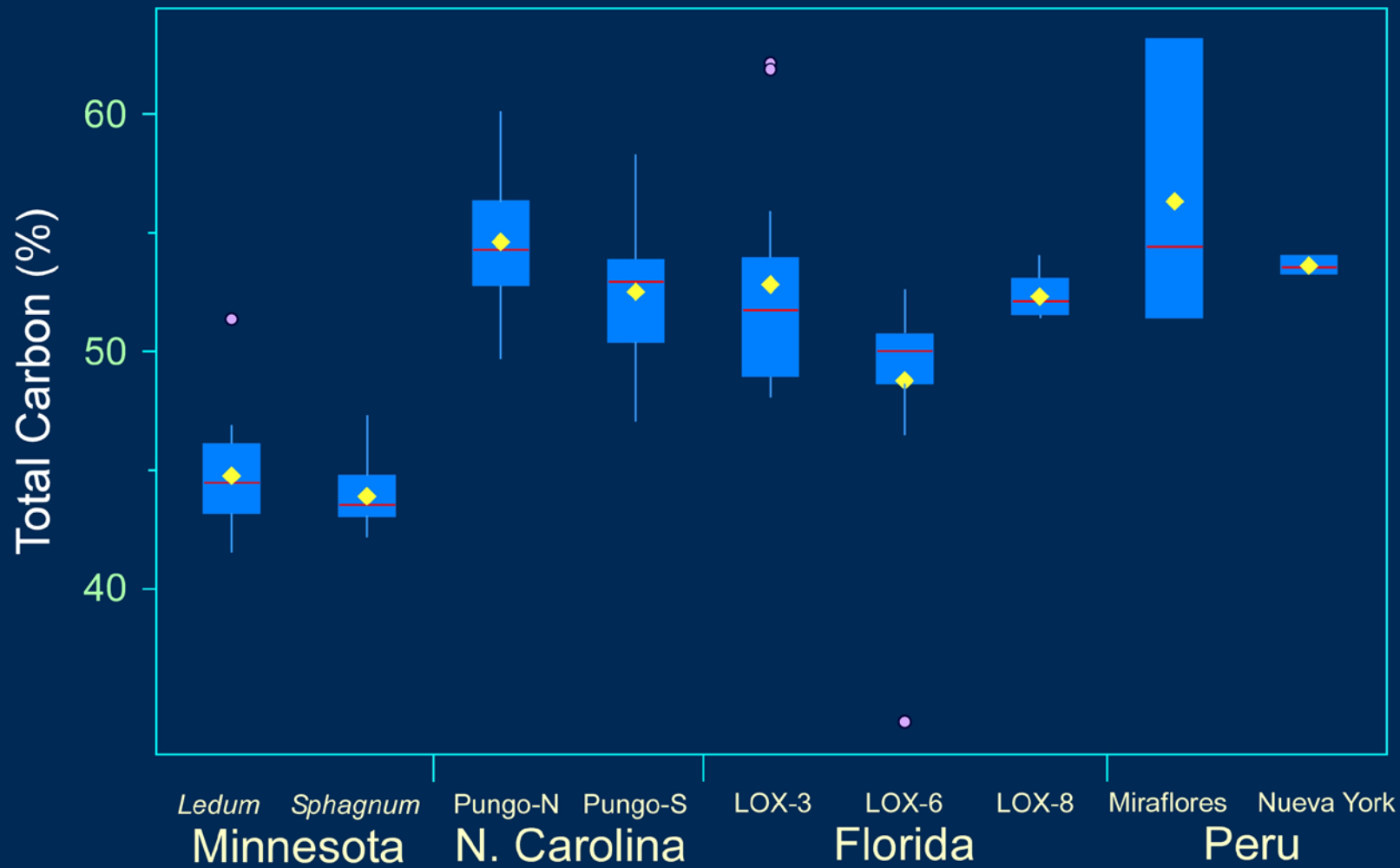


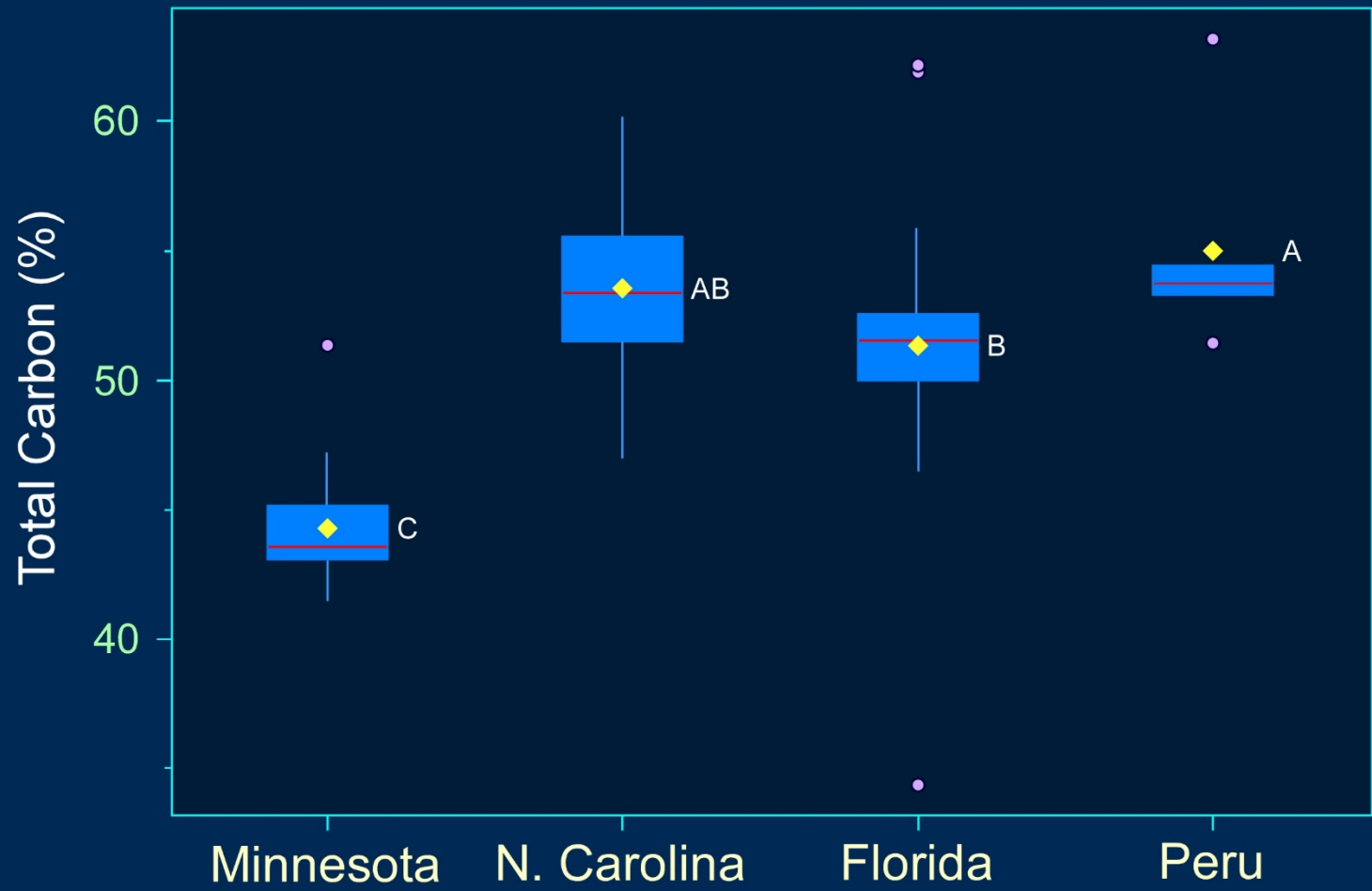
Pocosin NC

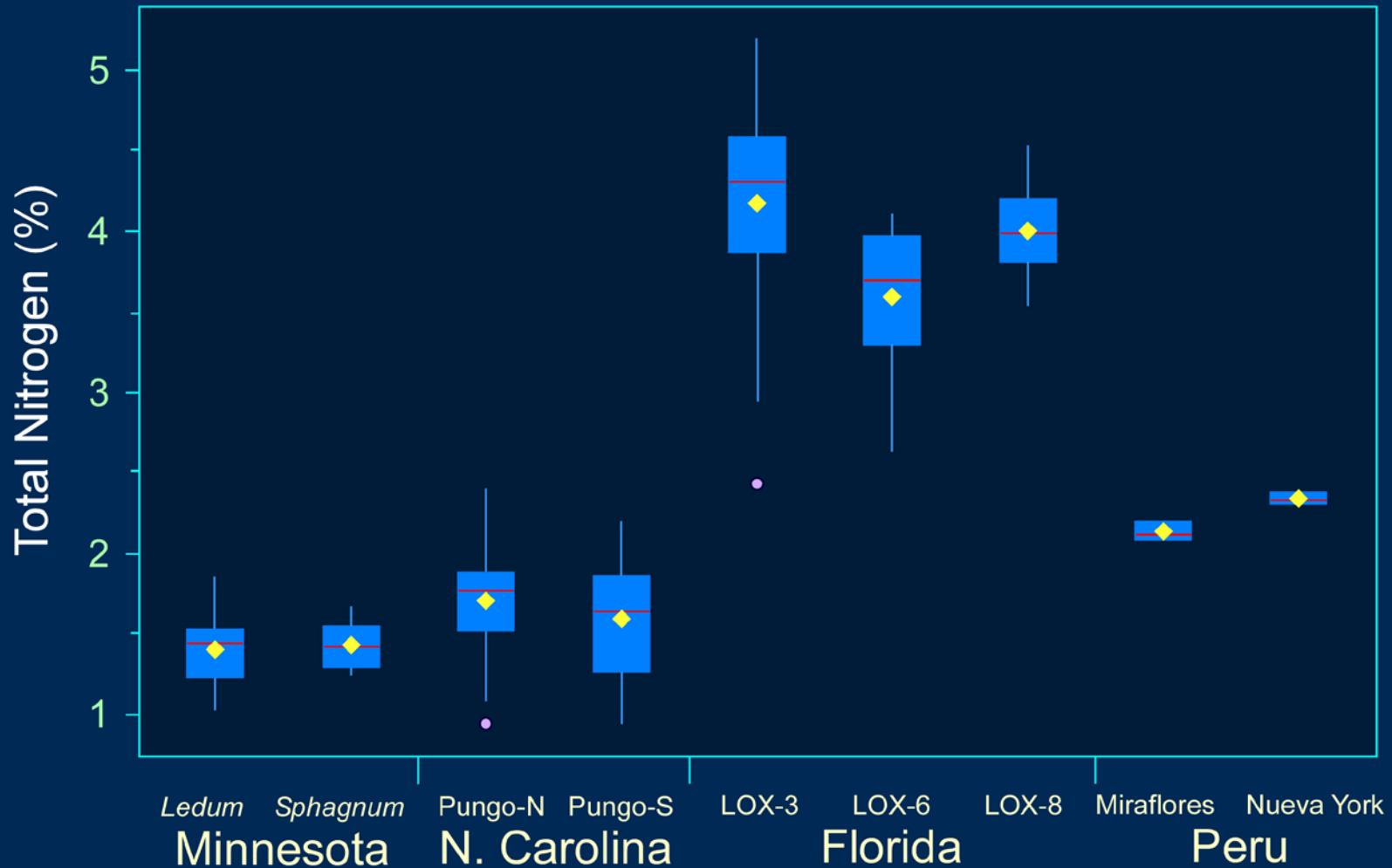


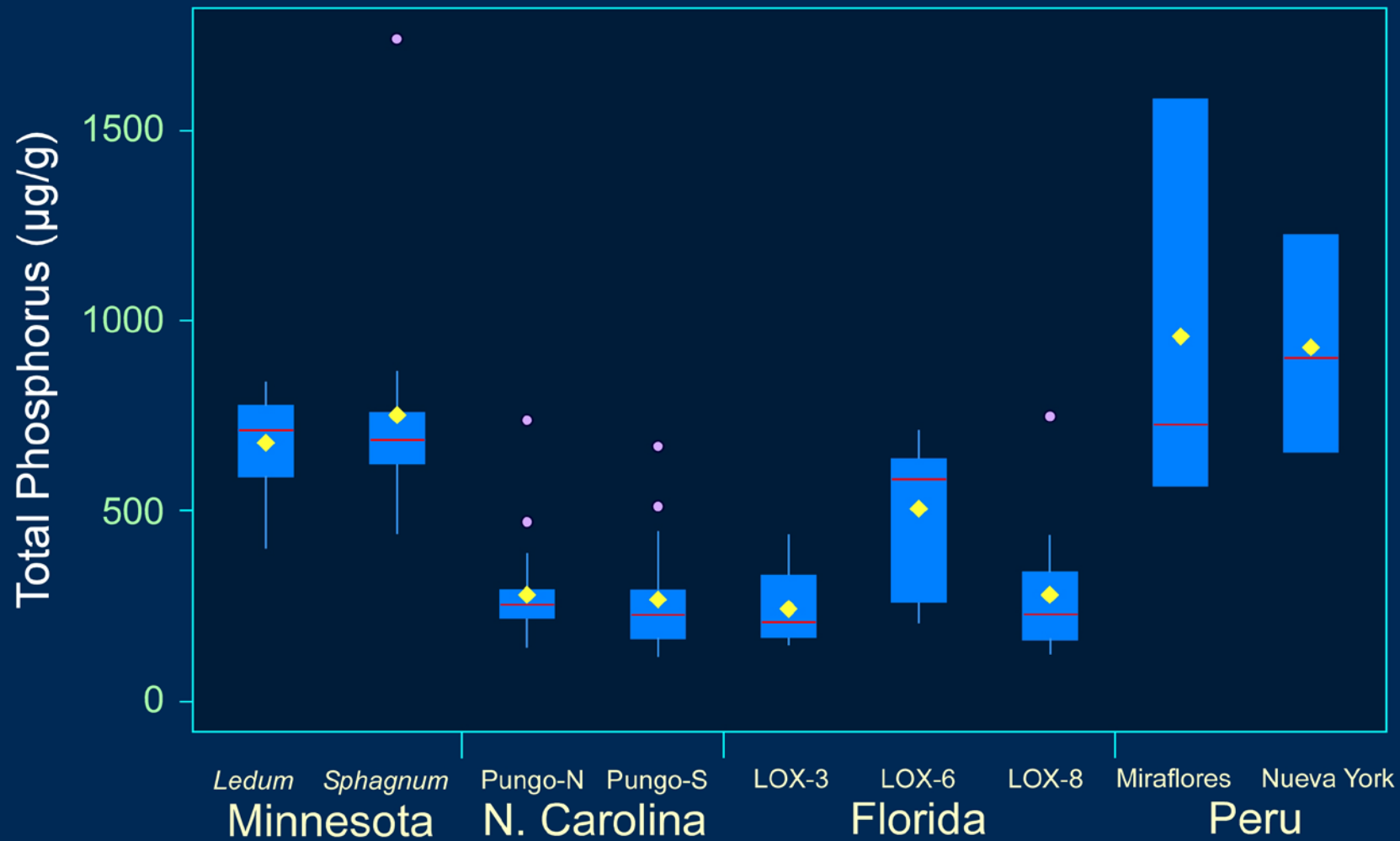
Miraflores Peru

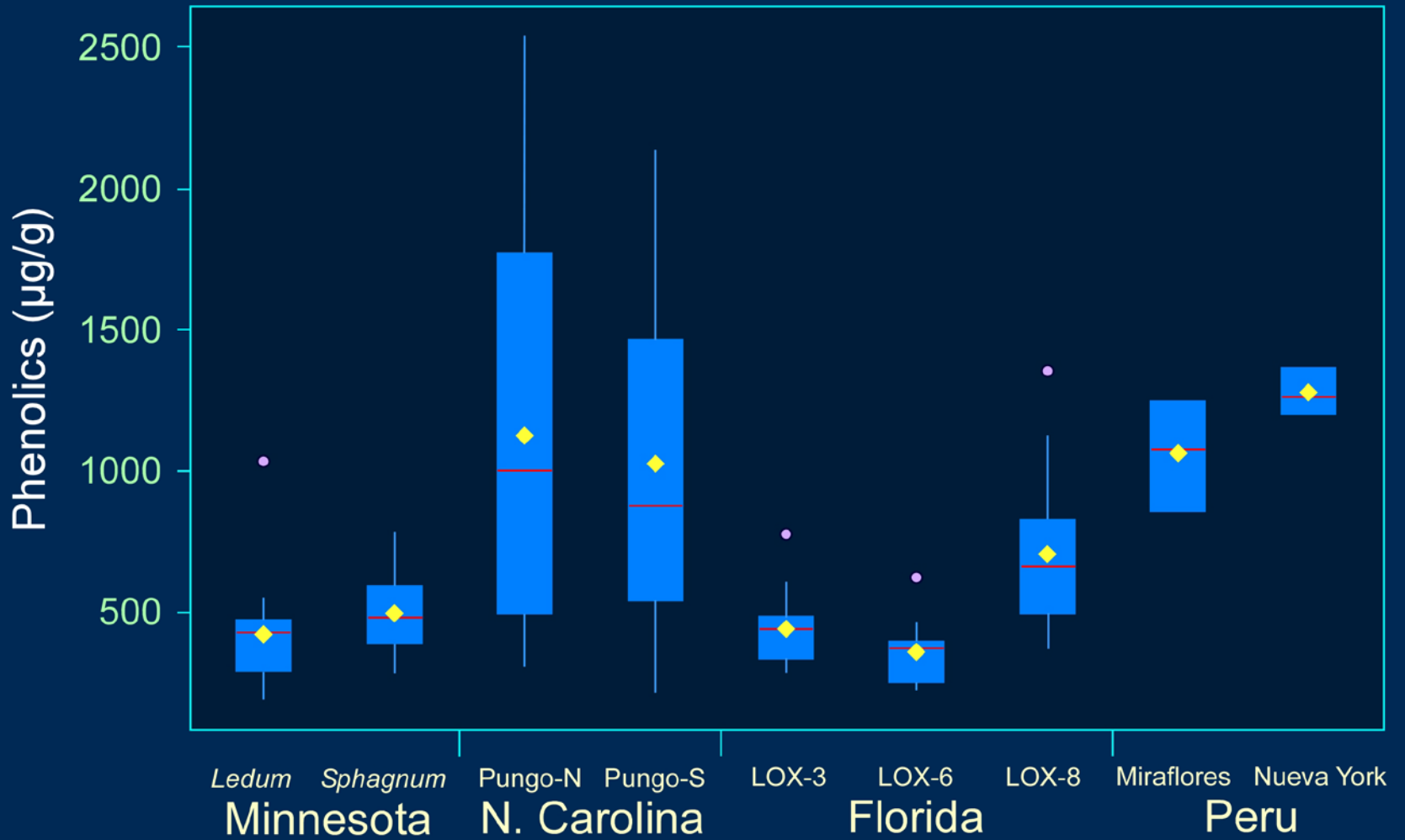


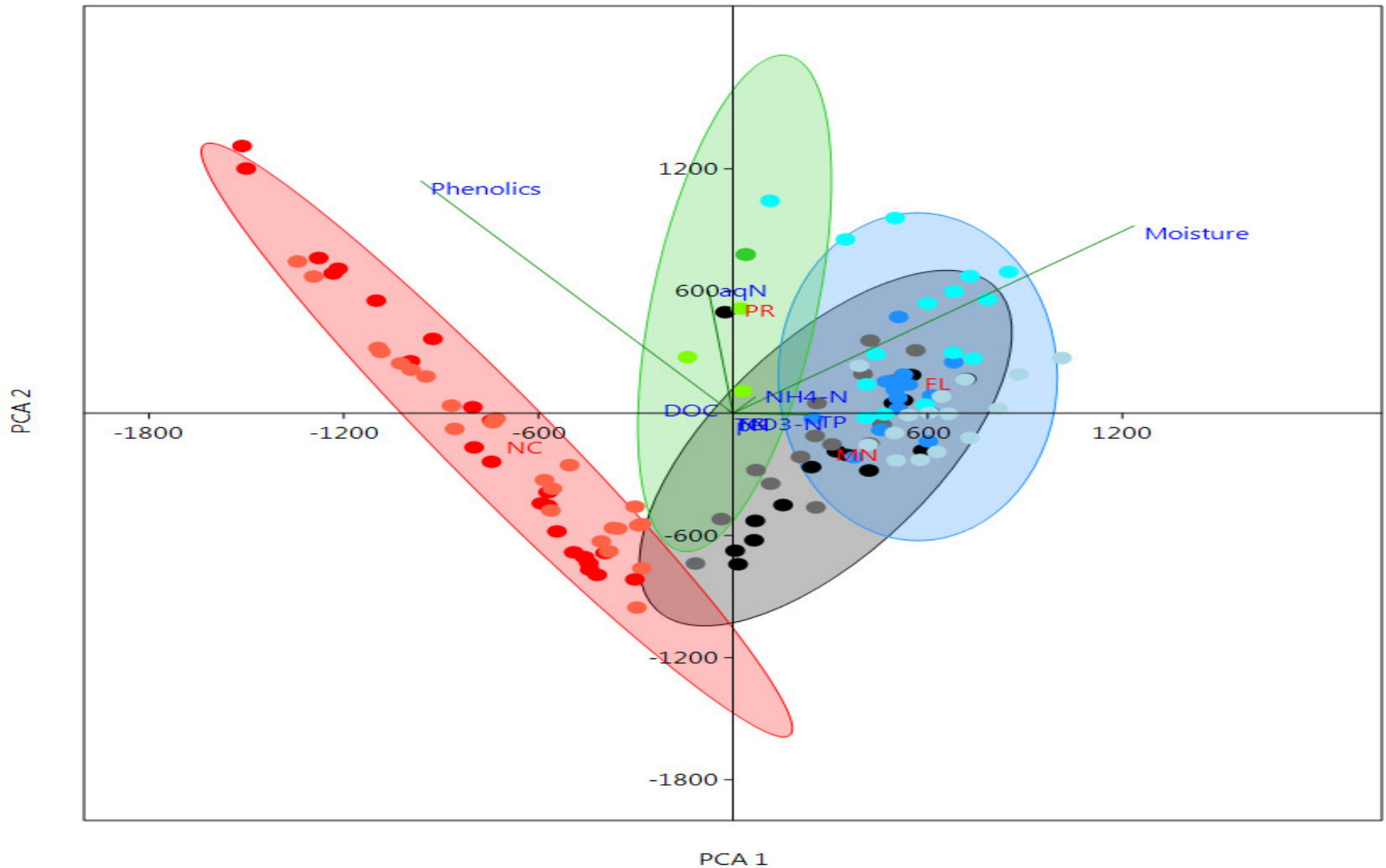




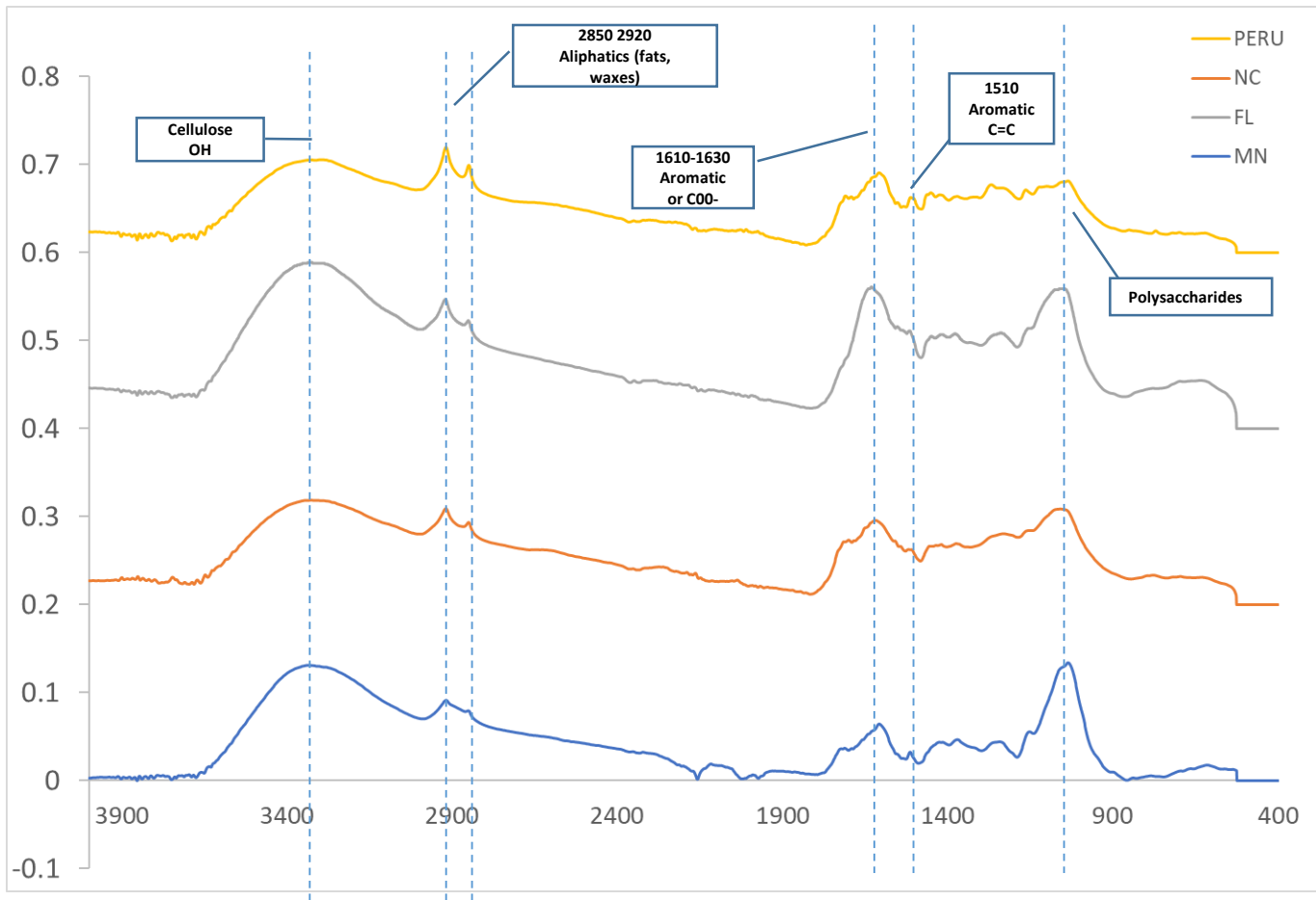




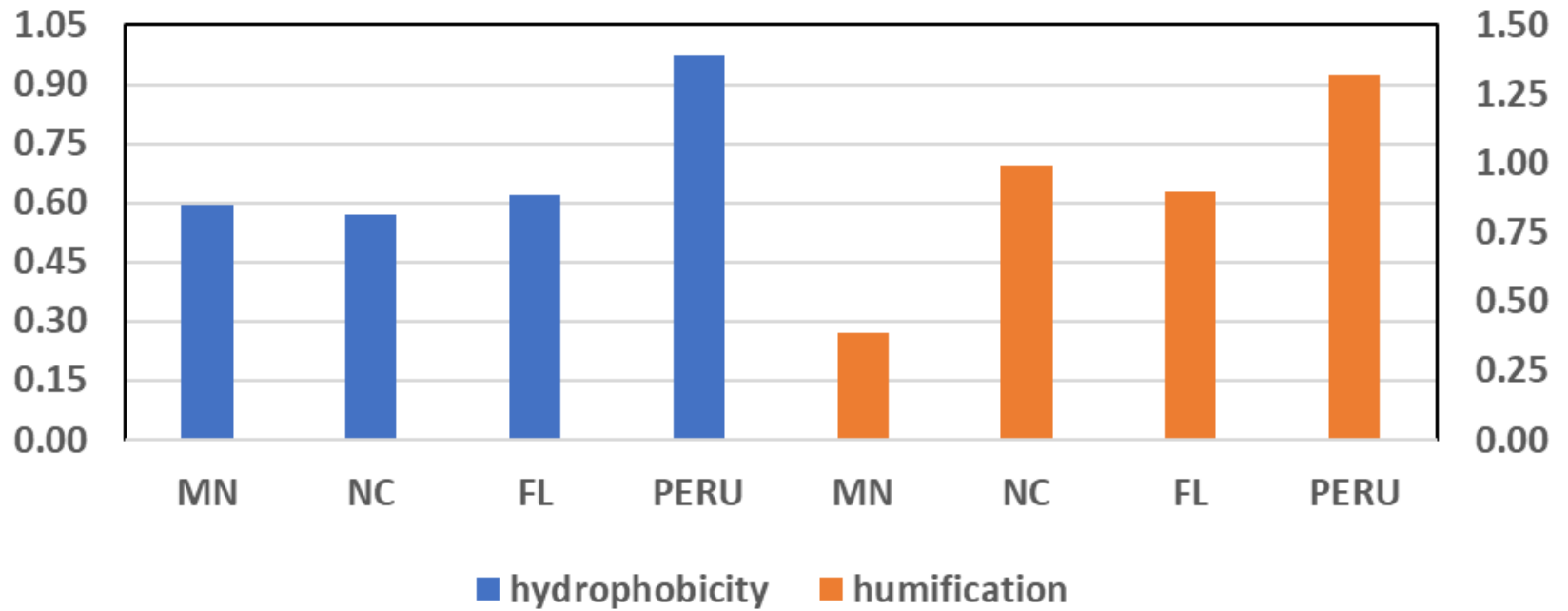




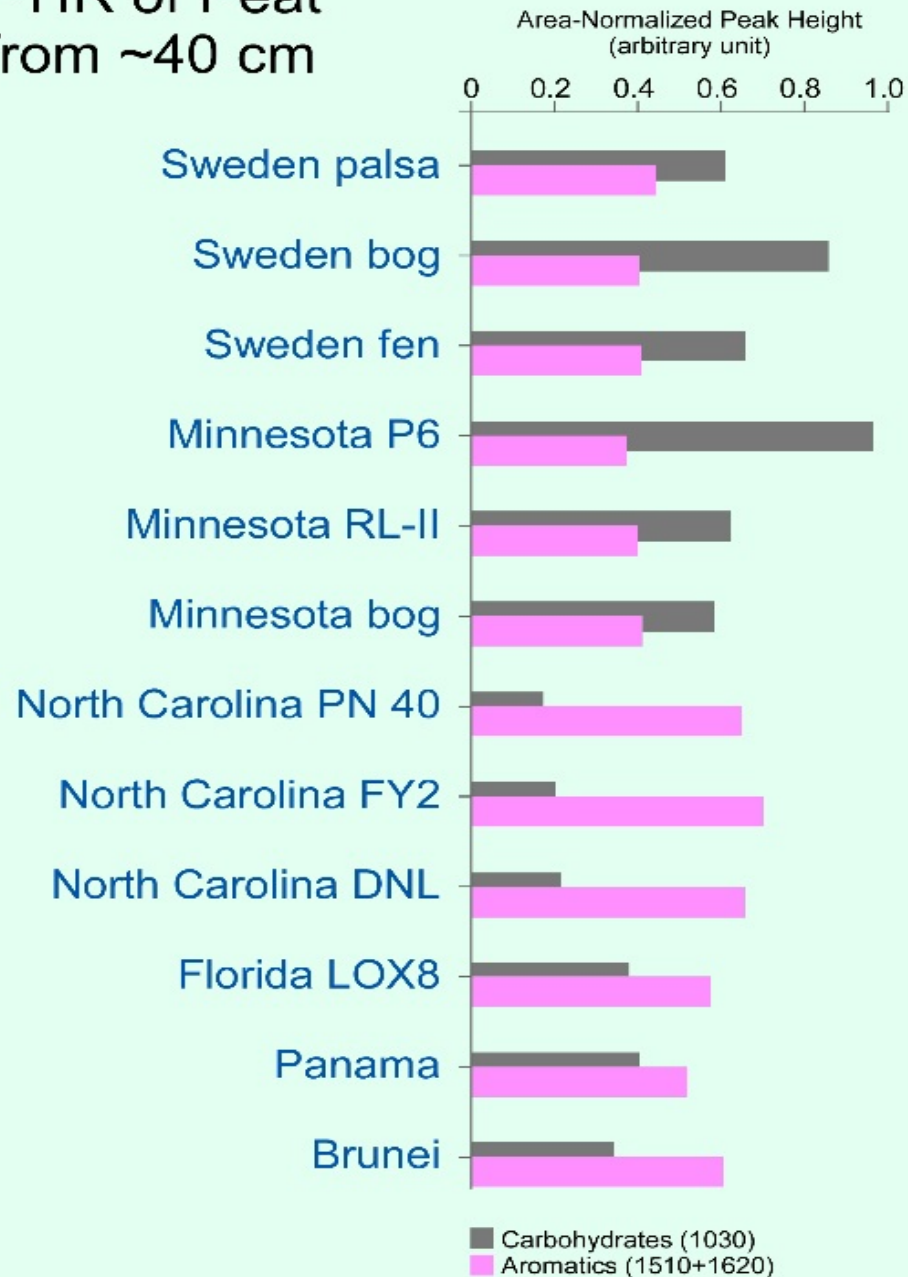
(Different shades of colors within each ellipse indicate different plot in the same site. MN: *Ledum*, *Sphagnum*; NC: Pungo North, Pungo South; FL: LOX3, LOX6, LOX8; PR: Miraflores, Nueva York.)



FTIR INDICES



FTIR of Peat from ~40 cm



N

Boreal

S

Sub-Tropical

Tropical

A



B



Fire Effects on Aromatics

C



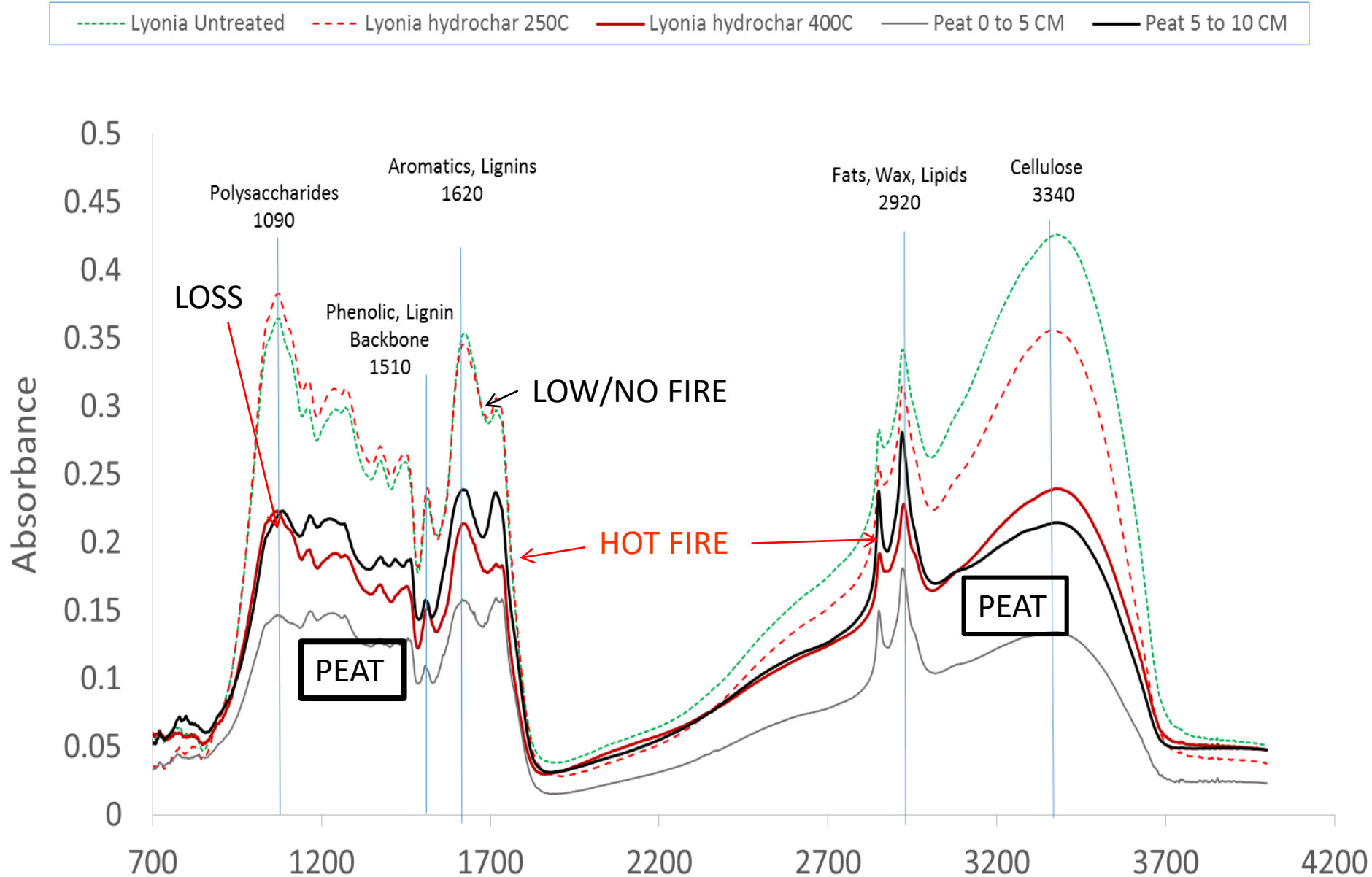
A prescribed burn at the PLNWR (3/2015)

A) Pre-fire
Pocosin plant
Community,

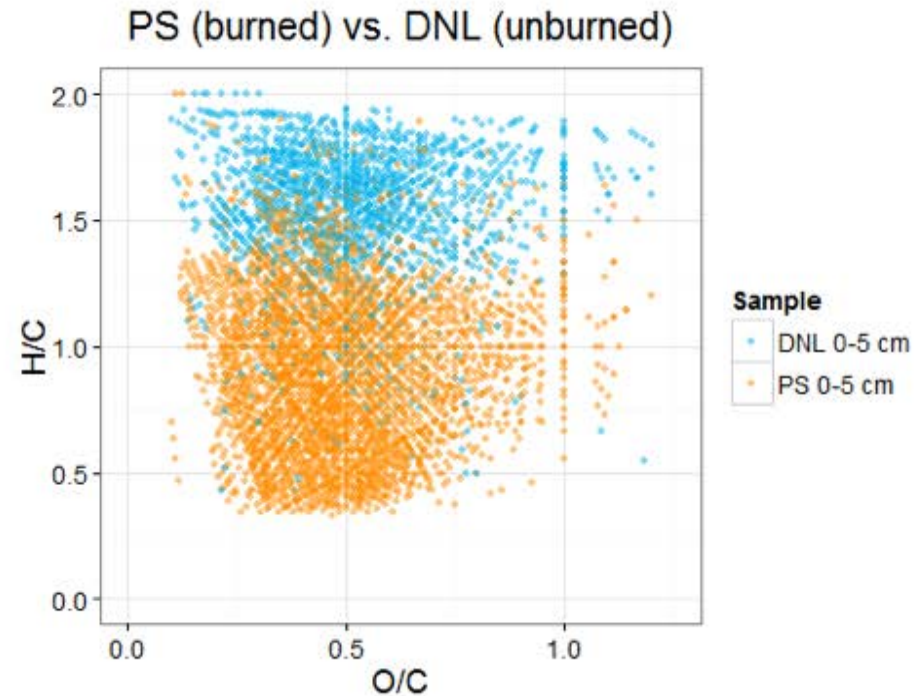
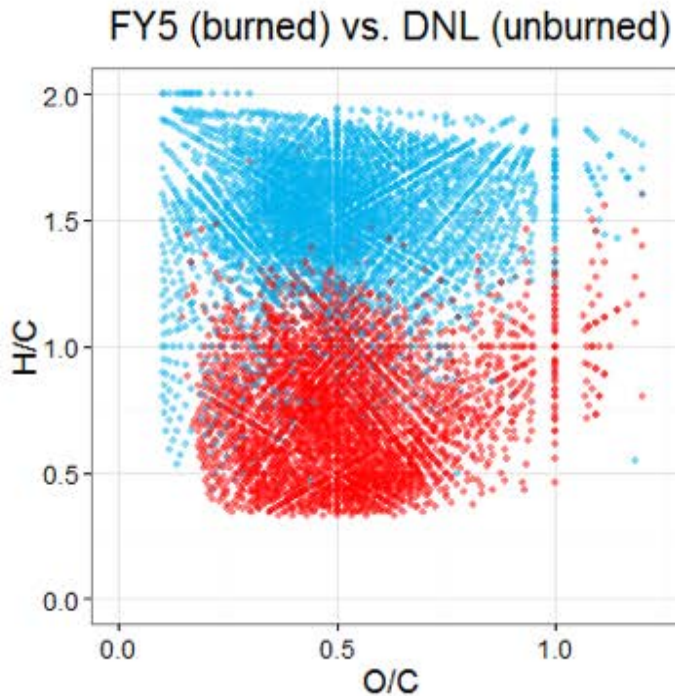
B) Active burn &

C) Pyrogenic
OM after burning

Comparison of Fire Temperature Effects on Plant & Peat Soil Chemistry

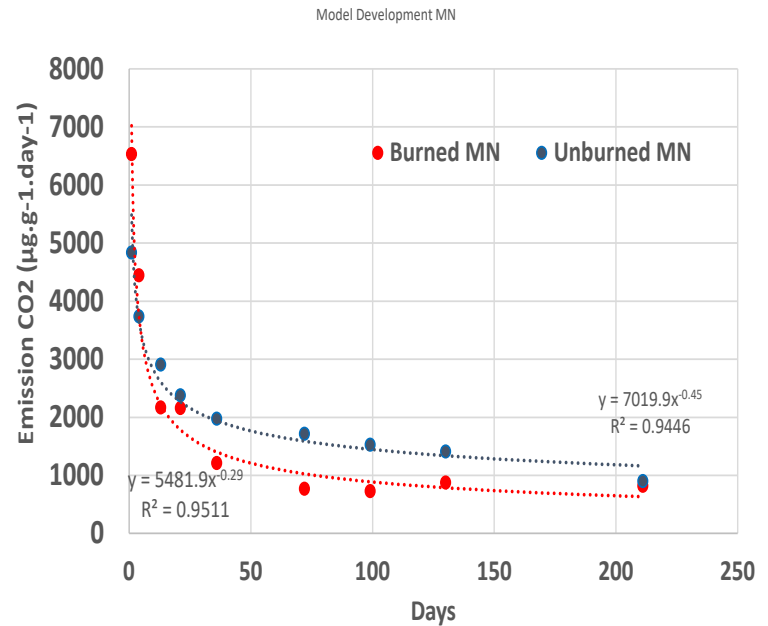
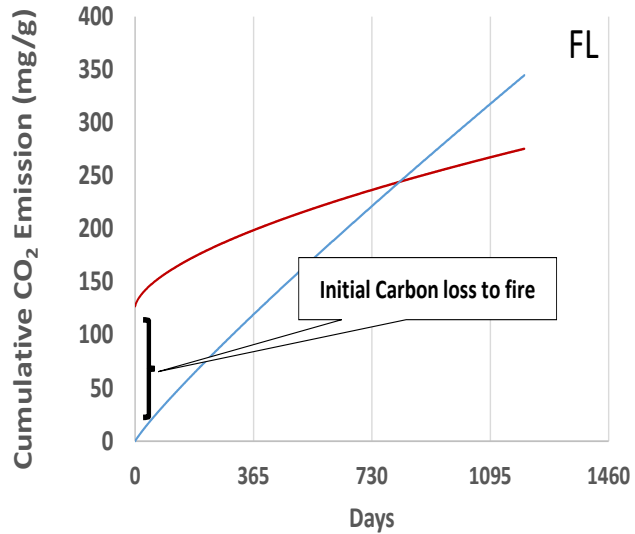
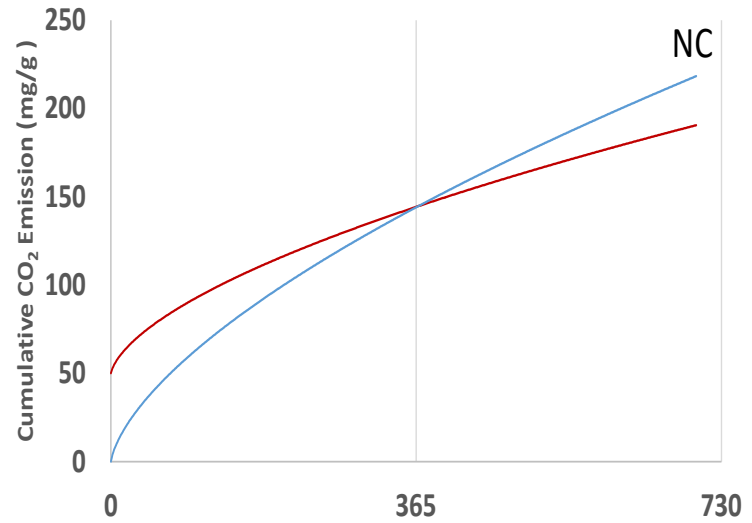
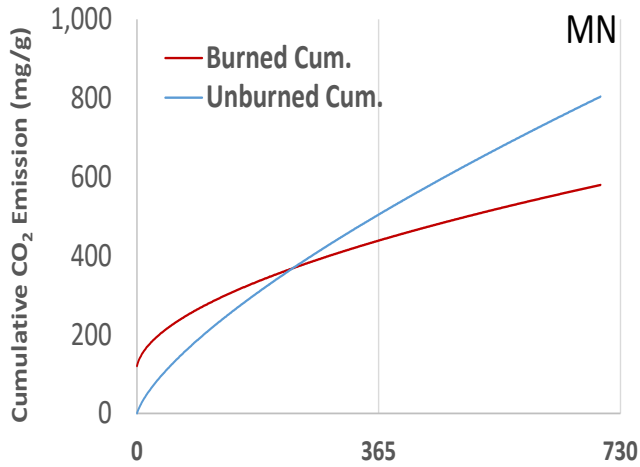


Burned and Unburned Peat Soil Hydrocarbons




FTIR MS shows the effects of fire on SOM from NC where recent and five-year prescribed fires occurred. Lower H/C ratio indicates more condensed hydrocarbons (i.e. recalcitrant) in SOM.

Light Fire Reduces Cumulative C losses in SOM over 2 Years



A) Minnesota, B) North Carolina, C) Florida, and D) Model developed from incubations.

Findings To-Date

- Our research supports the “*Dual Control Hypothesis*”: low-latitude peatland C decomposition is down regulated by higher production of phenolics and aromatic compounds than found in northern *Sphagnum/Carex* communities.
- Higher concentrations of phenolic/aromatic compounds = highly recalcitrant peat compounds, which inhibit microbial (fungal) activity.
- Recurring low-intensity fires =  aromatic C peat compounds, lower carbohydrates and losses to microbial respiration.

Acknowledgments

- C gradient Research is supported by the U.S. Department of Energy, Office of Science, Terrestrial Ecosystem Sciences, Climate and Environmental Sciences Division, Office of Biological and Environmental Research under grant award DE-SC0012272.
- Pocosin Funding: U.S. Fish and Wildlife Service, The Nature Conservancy of NC & Duke Wetland Center Endowment
- Wes Willis and Belen de la Berra for Lab analysis & many graduate students for field and lab work at the Duke University Wetland Center.

Questions??

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