# Empirical evidence of nitrogen, water, and phosphorus uptake as functions of fine root mass to inform next-generation terrestrial biosphere models

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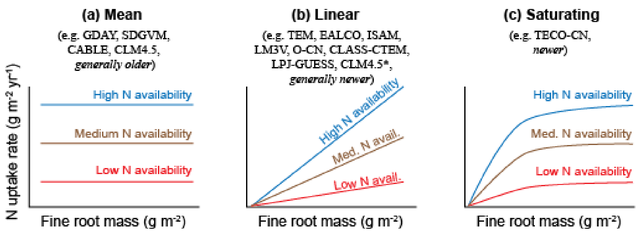
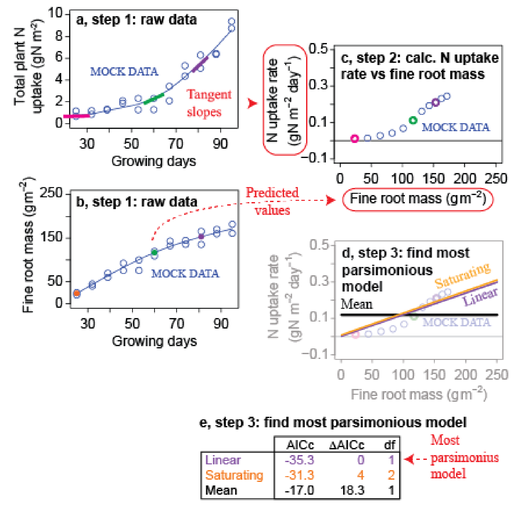
## Motivation

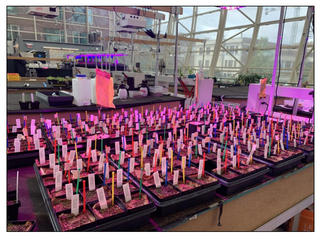
- Improve the representation of resource uptake mechanisms in terrestrial biosphere models
- Different models make different assumptions and until now there have been no empirical data to resolve the discrepancies



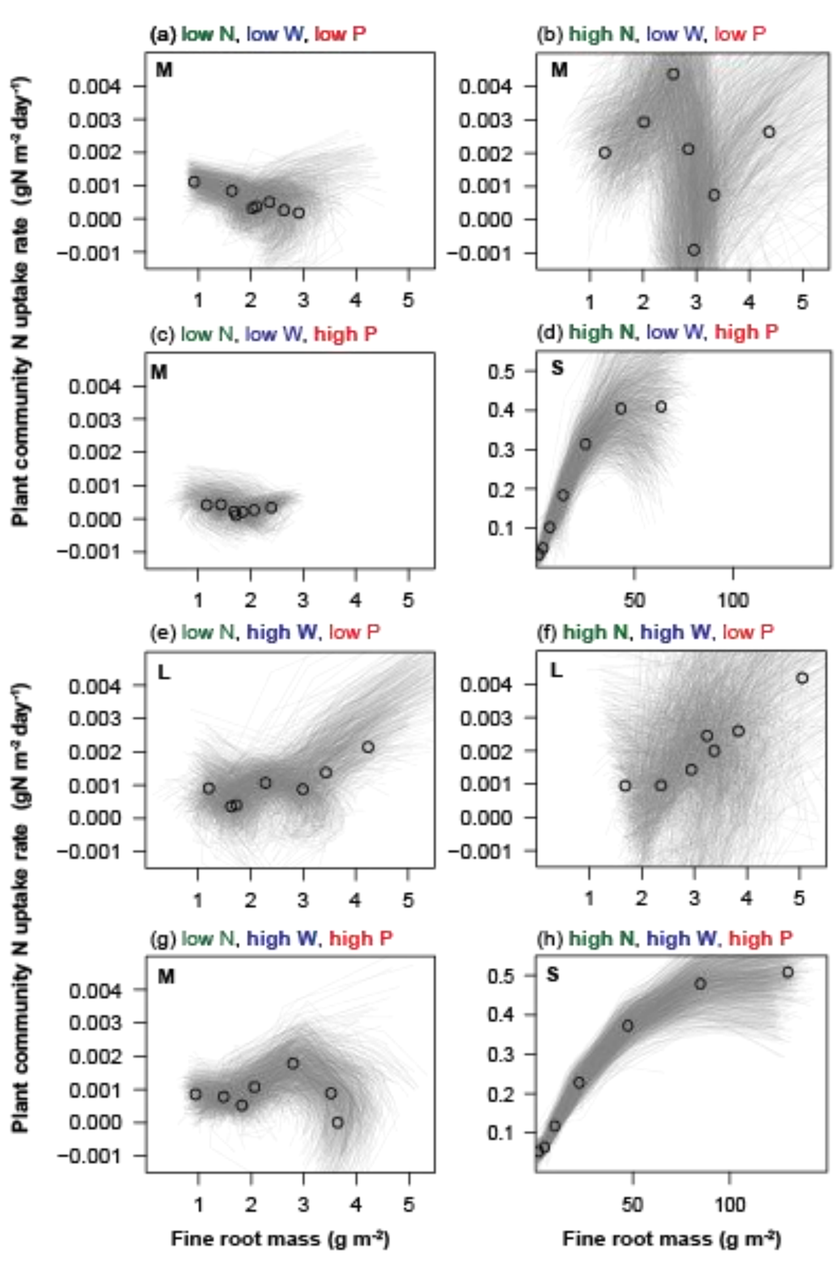

## Methods

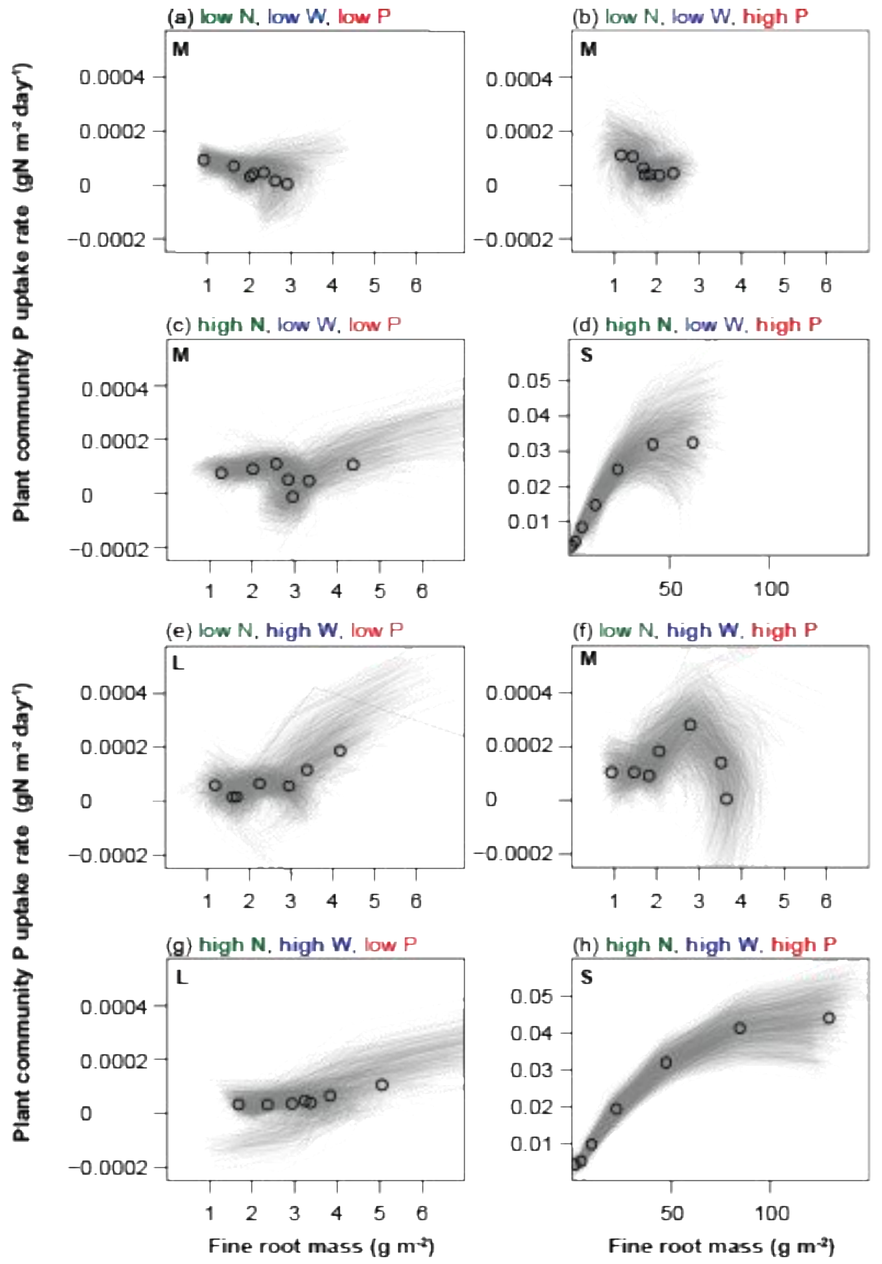
- Kentucky Bluegrass planted in two substrates: low nutrient sand and high nutrient soil
- High or low: water, phosphorus, nitrogen treatments
- Measured resource uptake and fine root mass



## Results




## Discussion

1. At low fine root mass, resource uptake was either linearly related to fine root mass ("L" or "S") or independent of fine root mass ("M")
2. At high fine root mass, resource uptake was independent of fine root mass ("S"), but these fine root mass values were still far below those of actual forests
3. In most cases, adding more resources did not result in significantly greater resource uptake, possibly due to limitations of other key nutrients

## Future Directions

- Analyze water data
- Measure nitrogen uptake occuring within intact forests at Morton Arboretum

## Literature cited and Acknowledgements

Dybzinski, R., Kelvakis, A., Mccabe, J., Panock, S., Anuchitlertchon, K., Vasarhelyi, L., McCormack, M.L., McNickle, G., Poorter, H., Trinder, C., Farrior, C. E. (2018). How are nitrogen availability, fine-root mass, and nitrogen uptake related empirically? Implications for models and theory. *Global Change Biology*. doi: 10.1111/gcb.14541

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- We have conducted a multi-factorial greenhouse experiment, aimed to improve the understanding of resource uptake mechanisms in terrestrial biosphere models. By measuring the biomass, nitrogen concentration, transpiration, and phosphorus concentration of Kentucky Bluegrass (POA pratensis), we analyzed the effects of full-factorial nitrogen, phosphorus, and water limitations. Our experiment took place from August to December 2019 in the IES Greenhouse. To analyze our data, our team is using R to run analysis and visualize our experimental findings. We hope that our data findings and subsequent research paper will be utilized by earth system modelers to better understand the ways in which plants receive and use nutrients.