Using Neural Networks To Model Land-Atmosphere Fluxes

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NORTH AMERICAN CARBON PROGRAM

Science Question

Measuring terrestrial carbon cycling is an important piece of the global missing carbon sink, but direct measurements of carbon cycling are time intensive and costly. Eddy covariance methods are a commonly used technique to measure carbon cycling at scales of ~1 km^2 and efforts to scale these measurements to the entire landscape would allow a better comparison of carbon measurements of global models.

Analysis

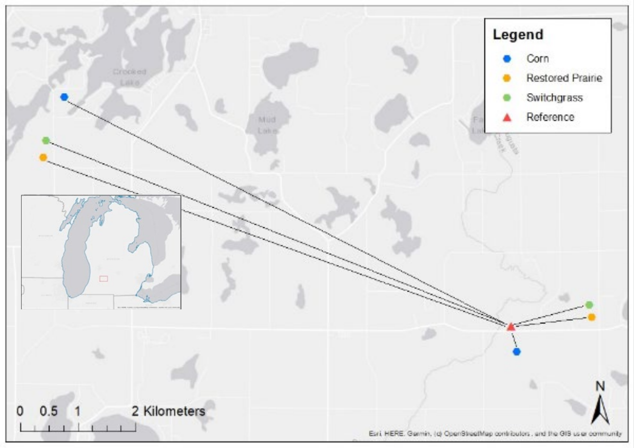
Data from 63 site-years of land-atmosphere fluxes were used to model annual and growing season sums of carbon fluxes from three paired land-cover type sites: corn, restored-prairie, and switchgrass

Results

- With as little as 2 years of data, ecosystem fluxes can be effectively modeled with neural network models
- Annual sums of net ecosystem exchange (NEE) of carbon, respiration, and photosynthesis can be modeled across similar land-cover type with an uncertainty of 20%, 22%, and 8%
- When modeling across the landscape, uncertainties of annual sums are NEE=83%, respiration =12% and photosynthesis =10%

Significance

We provide new insights to scaling up observations from one site to multiple land-cover types across the landscape. Carbon fluxes can be estimated with the same amount of uncertainty as the observations themselves. This is also true when scaling across different land cover types. One can extrapolate carbon cycling much farther from a single measurement location.



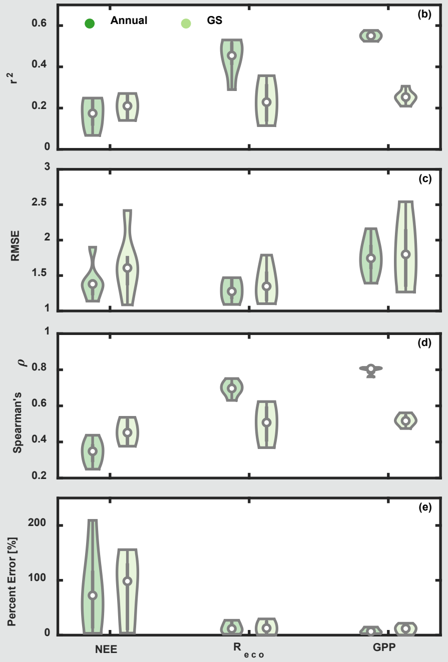


Figure Caption

Six separate flux sites, with three land cover types, are used to model fluxes at a unique site. Multiple model evaluation criteria are shown (r^2, root mean square error, Spearman's ρ, and percent error) for both annual and growing season (GS) timescales.

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