Can representing leaf and root traits improve model predictions?

Objective:

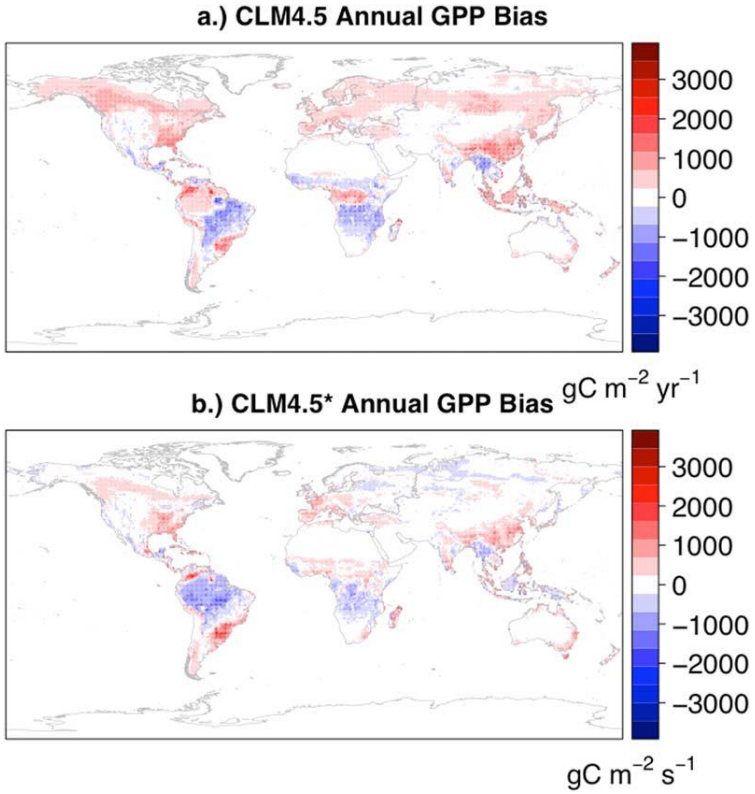
Understand if a more mechanistic representation of nitrogen limitation and root-scale uptake kinetics can reduce model biases.

Approach:

We developed a new plant nitrogen model for CLM4.5 that links leaf nitrogen and plant productivity and represents root-scale Michaelis-Menten uptake kinetics.

Results/Impacts:

- Model improvements led to global bias reductions in gross primary production (GPP), leaf area index (LAI), and biomass by 70%, 11%, and 49%, respectively.
- Water use efficiency predictions were similarly improved.
- Mechanistic representation of leaf-level nitrogen allocation and consistent treatment of competition led to global carbon cycle prediction improvements.



Spatial distribution of the annual GPP bias (model – reference) for (a) default version of CLM4.5 (CLM4.5) and (b) modified version of CLM4.5 (CLM4.5*) aggregated across 1995–2004. Predictions of CLM4.5* exhibited lower GPP bias compared to FLUXNET-MTE estimates than did CLM4.5, especially in higher latitudes.

Ghimire, B., **W. J. Riley**, **C. D. Koven**, **M. Mu**, and **J. T. Randerson** (2016), Representing leaf and root physiological traits in CLM improves global carbon and nitrogen cycling predictions, *J. Adv. Model. Earth Syst.*, 8, doi:10.1002/2015MS000538.