Robust Representation of Multi-Nutrient Constraints in ALMv1

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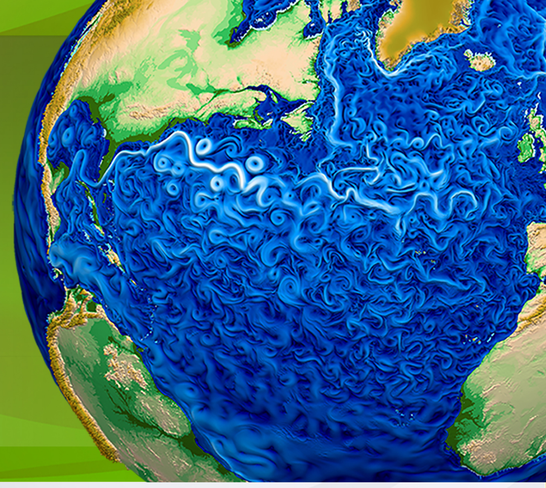


Objective

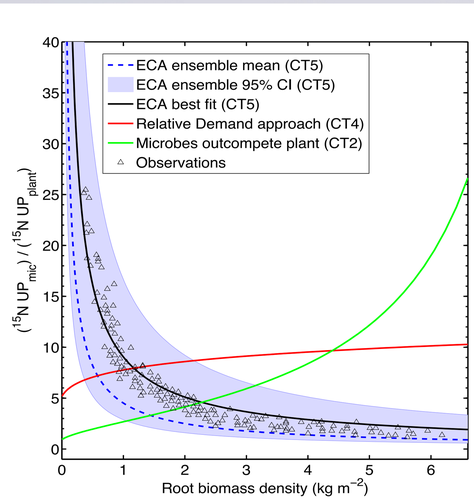
- Develop new ALMv1 for BGC Expt.
- Test current representations of nutrient limitations on the C cycle against observations
- Introduce a new nutrient constraint and competition approach based on ECA and integrated in ALMv1
- Benchmark model using ILAMB

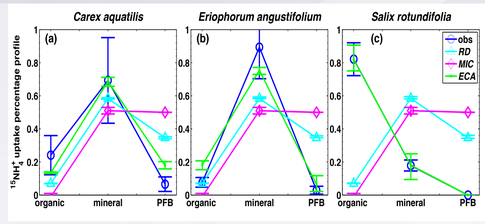
Approach

We integrated into ALMv1:

1. Recent theoretical advances in understanding multiple-consumer, multiple-nutrient competition
2. A generic dynamic allocation scheme based on water, nitrogen, phosphorus, and light availability
3. Prognostic treatment of nutrient constraints on C dynamics
4. Global datasets of plant physiology traits

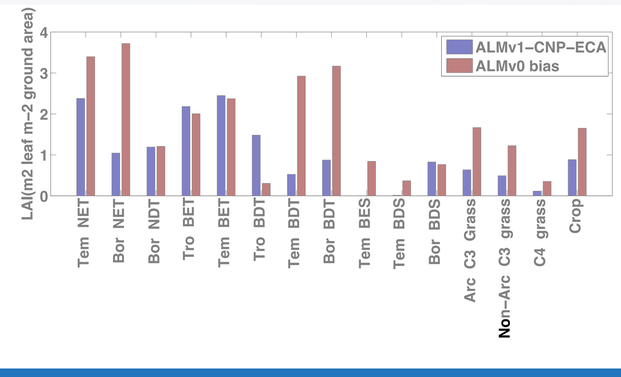
We also benchmaked the model using ILAMB





The ECA approach accurately predicts observed nutrient uptake between microbial and root competitors, while the Relative Demand and "Microbes Win" approaches do not. **Left:** Comparison in an alpine grassland; **Above:** Comparison at the NGEE-Arctic Barrow site.

Right: The new model, ALMv1-ECA, improved LAI, GPP, and surface energy budget predictions (Zhu et al. in prep.)



Impact

- We demonstrated in three systems that the ECA approach is superior to other nutrient competition methods
- Using ILAMB, we show that our implementation of ECA nutrient constraints improves predictions compared to observations and other model structures

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