**Global Benchmarking of ELM v1: ILAMB and Beyond**

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The importance of carbon (C)-nutrient interactions to the prediction of future C uptake has long been recognized. The Energy Exascale Earth System Model (E3SM) land model (ELM) version 1 is one of the few land surface models that include both N and P cycling and limitation. Here we provide a global scale evaluation of ELMv1 using International Land Model Benchmarking (ILAMB) system. We show that the introduction of P limitation generally improves ELMv1 performance, particularly for simulated biomass, leaf area index (LAI), and global net C balance. We also show ELMv1 simulated spatial pattern of N and P cycling are in good agreement with data-driven estimates. We compared ELMv1 simulated response to CO2 enrichment with meta-analysis of observations from similar manipulation experiments. We show that ELM v1 is able to capture the field observed responses for photosynthesis, growth, and LAI, mainly due to the removal of instantaneous downregulation mechanism and introduction of a longer-term downregulation following nutrient limitation. We investigated the role of P limitation in the historical balance and show that global C sources and sinks are significantly affected by P limitation, as the historical CO2 fertilization effect was reduced by 20% and C emission due to land use and land cover change was 11% lower when P limitation was considered. Our simulations suggest that introduction of P cycle dynamics and C-N-P coupling will likely have substantial consequences for projections of future C uptake.