Poster #1-52

Phosphorus Sorption to Tropical Soils with Relevance to Earth System Model Needs

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Plant growth in many tropical soils is thought to be limited by phosphorus (P), so considering these limitations will improve predictions of vegetative productivity and global climate. Mineral soils control the availability of P because they form strong bonds with orthophosphate (PO_4^{3-}). We recently used an existing archive of 24 tropical soils and performed equilibrium batch isotherm experiments involving 0.3 g of soil and 0.03 L of solution in concentrations ranging from 0 to 500 mg PO4-P per L. The nonlinear isotherms were quantified by fitting the data to the Langmuir isotherm using the parameters Q_{max} representing the maximum sorption capacity of the soil, and K representing a binding coefficient. Our Q_{max} values ranged from 734 to 3775 mg PO_4^- P per kg of soil (mg/kg) with a median of 2060 mg/kg; and K ranged from 0.015 to 0.285 L/mg with a median of 0.081 L/mg. However, we have concerns as to whether the high concentrations of added P necessary to fit the Langmuir equation are realistic for tropical forest soils. Additionally, the K parameter is more sensitive than Q_{max} in the ELM model. Consequently, we modified our sorption procedure to include more low P concentrations, which results in an approximately linear isotherm at initial P concentrations < 50 mg/L. We used Puerto Rican Oxisols and Ultisols from pastures and forests to generate nonlinear Langmuir isotherms, which were then truncated in order to isolate the linear portion of the isotherm ($R^2 > 0.90$) observed at low initial P concentrations. This linear portion was used to calculate the linear distribution coefficient (Kd). Although these experiments are still in progress, the Kd thus far ranged from 18 to 432 L/kg, and the Langmuir Q_{max} ranged from 1129 to 3069 mg/kg. It is of interest to compare alternative model formulations using either the Langmuir parameters or the linear parameters, which could greatly simplify the representation of P bioavailability in soils.