Geophysical Research Abstracts
Vol. 17, EGU2015-15029, 2015
EGU General Assembly 2015

Catalytic efficiency of hydrolytic enzymes is related to microbial community structure and is constrained by resource availability

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The turnover of nutrients bound to organic matter is mediated by extracellular enzymes (EHEs) produced by soil microorganisms. We linked catalytic properties of extracellular enzymes to a set of environmental and microbial variables in soils of a land-use sequence ranging from undisturbed natural forest and pastures of different ages to secondary succession in the Andes of southern Ecuador. The sensitivity of substrate affinity constant (Km) and maximal rate (Vmax) – of six EHEs (β-cellobiohydrolase, β-glucosidase, N-acetylglucosaminidase, α-glucosidase, xylanase, acid phosphomonoesterase) to changing environmental conditions was approximated by Michaelis-Menten kinetics.
Microbial communities adapted to environmental changes, demonstrated high flexibility of extracellular enzyme systems (determined by Km) and selected for the enzymes with higher catalytic efficiency as compared with pure cultures. Our study showed that high turnover rates of starch, hemicellulose, and monophosphoesters was associated with Gram(-)-bacteria Land-use associated declines in microbial biomass and soil N strongly reduced the turnover of monoester-bound organic P in soils during long-term pasture-use and secondary succession. Our data further suggest an increase in turnover of microbial biomass leads to an increase of DOC concentrations, as a consequence of N-acetylglucosaminidase activity.