Geophysical Research Abstracts
Vol. 18, EGU2016-7113, 2016
EGU General Assembly 2016

Integrating 'omic' data and biogeochemical modeling: the key to understanding the microbial regulation of matter cycling in soil

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Matter cycling in soils and associated soil functions are intrinsically controlled by microbial dynamics. It is therefore crucial to consider functional traits of microorganisms in biogeochemical models. Tremendous advances in 'omic' methods provide a plethora of data on physiology, metabolic capabilities and ecological life strategies of microorganisms in soil. Combined with isotopic techniques, biochemical pathways and transformations can be identified and quantified. Such data have been, however, rarely used to improve the mechanistic representation of microbial dynamics in soil organic matter models. It is the goal of the Young Investigator Group SoilReg to address this challenge.

Our general approach is to tightly integrate experiments and biochemical modeling. NextGen sequencing will be applied to identify key functional groups. Active microbial groups will be quantified by measurements of functional genes and by stable isotope probing methods of DNA and proteins. Based on this information a biogeochemical model that couples a mechanistic representation of microbial dynamics with physicochemical processes will be set up and calibrated. Sensitivity and stability analyses of the model as well as scenario simulations will reveal the importance of intrinsic and extrinsic controls of organic matter turnover. We will demonstrate our concept and present first results of two case studies on pesticide degradation and methane oxidation.