

Using Numerical Models to Test Hypotheses by Filtering out Model Parameter Uncertainties

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Abstract. Numerical models, containing uncertainties resulting from both model structures and model parameters, are mainly used for predictions after calibrating and validating these models against historical data or by using process-based model ensembles. In this talk, we will present a case study on how to design and use numerical models to test scientific hypotheses by filtering out model parameter uncertainties and how to help design physical experiments. Soil microbial respiration pulses (or “Birch effect”) in response to rainfall pulses were first observed ~60 years ago. However, there are many competing hypotheses to explain how the microbial activities may respond to changes in soil moisture to produce the Birch pulses. We designed five microbial enzyme models with different process complexities, each representing a hypothesis, to understand the mechanisms to generate the Birch pulses. We used model selection and averaging techniques to find the best model using the Bayesian information criterion (BIC). This study indicates that accumulation of degraded C in the dry zone of the soil pores during dry periods that may become immediately accessible to microbes in response to rainstorms is major mechanism to generate Birch pulses. This study also suggests that future physical experiments should focus on the mechanism inducing the greater accumulation of labile carbon during dry seasons.