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A Bayesian inverse modeling approach to estimate soil hydraulic properties of a toposequence in southeastern Amazonia.

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Modeling is an important tool for better understanding and assessing land use impacts on landscape processes. A key point for environmental modeling is the knowledge of soil hydraulic properties. However, direct determination of soil hydraulic properties is difficult and costly, particularly in vast and remote regions such as one constituting the Amazon Biome. One way to overcome this problem is to extrapolate accurately estimated data to pedologically similar sites. The van Genuchten (VG) parametric equation is the most commonly used for modeling SWRC. The use of a Bayesian approach in combination with the Markov chain Monte Carlo to estimate the VG parameters has several advantages compared to the widely used global optimization techniques. The Bayesian approach provides posterior distributions of parameters that are independent from the initial values and allow for uncertainty analyses. The main objectives of this study were: i) to estimate hydraulic parameters from data of pasture and forest sites by the Bayesian inverse modeling approach; and ii) to investigate the extrapolation of the estimated VG parameters to a nearby toposequence with pedologically similar soils to those used for its estimate. The parameters were estimated from volumetric water content and tension observations obtained after rainfall events during a 207-day period from pasture and forest sites located in the southeastern Amazon region. These data were used to run HYDRUS-1D under a Differential Evolution Adaptive Metropolis (DREAM) scheme 10,000 times, and only the last 2,500 times were used to calculate the posterior distributions of each hydraulic parameter along with 95% confidence intervals (CI) of volumetric water content and tension time series. Then, the posterior distributions were used to generate hydraulic parameters for two nearby toposequences composed by six soil profiles, three are under forest and three are under pasture. The parameters of the nearby site were accepted when the predicted tension time series were within the 95% CI which is derived from the calibration site using DREAM scheme.