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Global Parameter Optimization of ALM Using Sparse-Grid Based Surrogates

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Calibration of the ACME Land Model (ALM) is challenging because of its model complexity and large parameter sets. Here we use version 0 of ALM, which is identical in structure to the Community Land Model (CLM 4.5), and has a significant computational burden. Therefore, only a limited number of simulations can be allowed in any attempt to find a near-optimal solution within an affordable time. The goal of this study is to calibrate some of the ALM parameters in order to improve model projection of carbon fluxes. To this end, we propose a computationally efficient global optimization procedure using sparse-grid based surrogates. We first use advanced sparse grid (SG) interpolation to construct a surrogate system of the actual ALM model, and then we calibrate the surrogate model in the optimization process. As the surrogate model is a polynomial whose evaluation is fast, it can be efficiently evaluated with sufficiently large number of times in the optimization, which facilitates the global search. We calibrate eight parameters against five years of annual NEE, TLAI, and LH data from the U.S. Missouri Ozark (US-MOz) tower. The results indicate that an accurate surrogate model can be created for the ALM with a relatively small number of SG points (i.e., ALM simulations), and the application of the optimized parameters leads to a higher predictive capacity than the default parameter values in the ALM for the US-MOz site.