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# Quantifying the influence of snow parameterizations on climate in the Canadian LAnd Surface Scheme (CLASS)

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Snow processes exert important controls on the surface energy and water balance, and are an important source of uncertainty in climate simulations with earth system models (ESMs). Yet, snow processes are typically subgrid-scale and must be parameterized in land surface models. Quantifying the importance of snow-related model parameters, and their uncertainties, may therefore lead to better understanding and quantification of uncertainty within ESMs. This remains challenging due to the high-dimensional parameter space, poor observational constraints, and interactions between parameters. In this study, we investigate the sensitivity of the global surface climate to uncertainty in nine snow microphysical parameters in the Canadian LAnd Surface Scheme (CLASS). An efficient statistical emulator of CLASS is constructed using machine learning methods to sample the influence of all parameters across their full range of empirical uncertainty. A skill score metric—referenced to available observation-based climate data—is used to constrain the plausible range for each parameter, and to identify the parameters with largest influence at global and regional scales. Sensitivity tests indicate that the most important parameters are a threshold parameter for snow albedo refreshment, and a parameter limiting the snow depth below which bare ground appears. The results suggest higher values (compared to the default) of these two parameters leads to reduced biases in simulated global surface albedo and snow water equivalent. The results also demonstrate a considerable reduction of the plausible ranges of many parameter values, and hence their uncertainty ranges, which could lead to a significant reduction in the overall uncertainty of global land surface simulations.