Simulation of the Community Land Model in a pine stand with $13CO_2$ and shading manipulations

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The Community Land Model is one of the most complicated and best-known Land Surface Models, in terms of its comprehensive parameterization of carbon, water and energy budgets for diverse land types and multiple temporal scales. The CLM has been traditionally evaluated against historical observations from a vast variety of sources, which has caused rapid progresses toward better model versions. Nevertheless, owing to the scarcity and short duration, few attentions have been paid to examine the CLM replication with the manipulative experiments, which are major means to explore the physiological and ecological impacts of artificial controls in environmental variables. The Partitioning in Trees and Soil (PiTS) field observations and manipulations at ORNL were conducted in a pine stand through implementation of adjacent shade treatments and the 13C labeling. It was specially designed to evaluate the modeled carbon partitioning and flux within plants and into soil, and the modeling relationships between these short-term carbon dynamics and the varying environmental drivers. In this study, we target to evaluate the performance of the version 4 of CLM in capturing the carbon and water dynamics observed in this site-level manipulation. Further, to focus on the understanding of modeling uncertainties, we calibrated the default CLM parameters against different stages of the PiTS manipulation by employing the parameter optimization techniques.