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Constraining the process-based land surface model ORCHIDEE by nutrient enrichment and forest management experiments in Sweden

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Understanding the coupling between carbon (C) and nitrogen (N) cycling in terrestrial ecosystems is key to predicting global change. While numerous experimental studies have demonstrated the positive response of stand-level photosynthesis and net primary production (NPP) to atmospheric CO_2 enrichment, N availability has been shown to exert an important control on the timing and magnitude of such responses. Forest management is also a key driver of C storage in such ecosystems but interactions between forest management and the N cycle as a C storage driver are not well known. In this study, we use data from N-fertilization experiments at two long-term forest manipulation sites in Sweden to inform and improve the representation of C and N interaction in the ORCHIDEE land surface model. Our version of the model represents the union of two ORCHIDEE branches; 1) ORCHIDEE-CN, which resolves processes related to terrestrial C and N cycling, and 2) ORCHIDEE-CAN, which integrates a multi-layer canopy structure and includes representation of forest management practices. Using this new model branch, referred to as ORCHIDEE-CN-CAN, we simulate the growth patterns of managed forests both with and without N limitations. Combining our simulated results with measurements of various ecosystem parameters (such as soil N) will aid in ecosystem model development, reducing structural uncertainty and optimizing parameter settings in global change simulations.