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ABSTRACT TITLE: Modeling the terrestrial carbon cycle at regional to global scales: Parameter sensitivity and evaluation against benchmarks

ABSTRACT: Despite increased mechanistic complexity, terrestrial carbon cycle models continue to exhibit large variability in predictions of both present and future carbon fluxes. While a portion of this variability is a result of differences in model structure, both uncertainty and spatial variability in model parameters also play a large role. Model parameter calibration studies to date have primarily focused on improving models using observations from individual flux tower or experimental sites. While these studies re valuable for testing model response and for local model improvements, it remains unclear whether these optimized parameters can be used to improve predictions consistently over large regions. A wealth of observations at multiple scales from remote sensing and upscaled data products from observation networks are now available. These observations have the potential to greatly constrain carbon cycle model parameters and predictions. However, many of these datasets have typically been used so far for validations and not to explore structural and parametric uncertainty in a formal way. The Multi-Scale Synthesis and Terrestrial Mode Intercomparison (MsTMIP) project is beginning to answer questions about the impacts of model structure on the simulated carbon cycle using several of these global-scale datasets. Primary limiting factors for such global model analyses are high computational demand and complex cyberinfrastructure involved in performing multiple simulations and processing output. Here we present frameworks for global ensemble carbon cycle simulations using the Global Terrestrial Ecosystem Carbon (GTEC) model and the Community Land Model (CLM-CN) at 0.5 degree spatial resolution using standardized datasets provided by the MsTMIP team. We use these single model ensembles to explore uncertainty and model performance against the FLUXNET network, remotely sensed leaf area index (LAI), and biomass datasets. We also use the ensemble simulations to quantify uncertainties in key parameters and predictions.