Identifying Sources of Uncertainty to Improve the Simulation of Long Term Carbon Sequestration in Northern Wisconsin

Brett Raczka, Penn State University*

A significant portion of uncertainty related to climate change is attributed to the terrestrial system feedback upon the climate. The Ecosystem Demography Model (ED2), a terrestrial biosphere model (TBM), is uniquely suited to help diagnose, quantify and predict the net exchange of carbon between the atmosphere and land, thereby specifying the sign and magnitude of the climate feedback. ED2 uses size and age structured vegetation equations to capture the competition that a single tree experiences for light and nutrients. This gap-level competition is important for simulating successional growth and long term carbon dynamics that other 'big-leaf' models may miss. Here, we strive to identify sources of uncertainty that impact the carbon sequestration of a forest at centennial time scales including the impact of initial conditions, meteorology and the model's parametric uncertainty. To that goal we perform a 100 year simulation at Willow Creek, Wisconsin (1901-2010). In order to Initialize the model simulation we sample from witness tree observations from the year 1900 that define forest composition and structure. We create synthetic meteorology in which to drive the model by combining inter-annual variation in weather variables as defined by CRU-NCEP re-analysis data, and include sub-annual variation as measured by tower-based observation at Willow Creek. Initial findings indicate that the simulated carbon sequestration is sensitive to the type and temporal resolution of the meteorology (50% difference in cumulative NEE), as well as the initial forest composition and structure (25% difference in cumulative NEE). We find that the suite of parameters most consistent with present day observations at Willow Creek use identical density dependent mortality amongst all plant function types. We intend to perform a parametric sensitivity analysis based on carbon sequestration for 10, 50 and 100 year simulation periods. These findings will help guide future observational system studies.