Using DayCent To Model Ecosystem Dynamics In Managed Pine

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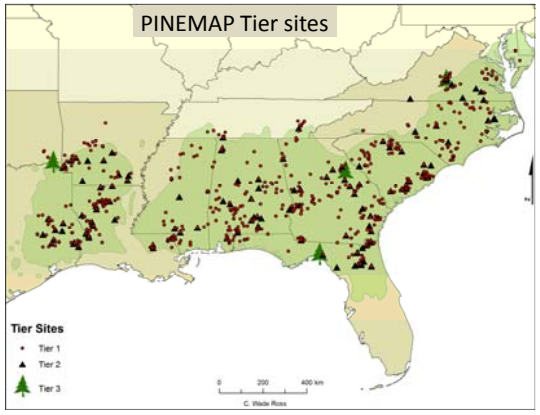
Rationale

Terrestrial ecosystems store substantial amounts of carbon in biomass and soils, approximately 5 times more than presently observed in the atmosphere. Because of this magnitude, relatively small changes to the terrestrial carbon pool could significantly affect atmospheric concentrations of CO_2, and therefore alter temperature and climate patterns.

In the Southeastern US, forested ecosystems are currently a large sink for atmospheric CO_2. This sink can be increased by increasing forest productivity through management activities, such as the use of nitrogen fertilizers.

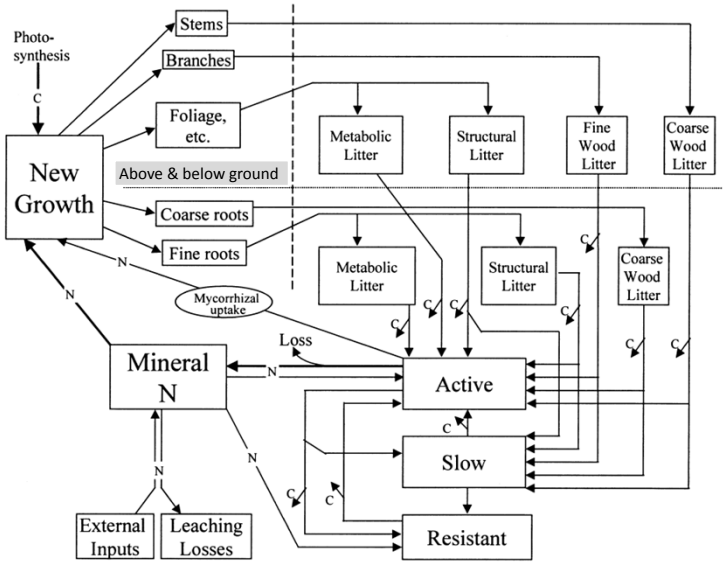
However, there are many uncertainties regarding the combined effects of climate change and management activities. For example, the use of fertilizers may help compensate for lower water availability in dryer climates, or it may exacerbate the effects of drought due to greater leaf area. Additionally, altered disturbance patterns driven by climate changes, such as wildfire, may alter productivity and carbon storage in forested ecosystems.

Results from this project will improve the understanding of terrestrial carbon dynamics and the potential effects of climate change in managed pine in the Southeastern US. This information will aid land managers in implementing best management practices to sustain productivity and the carbon sink capacity of pine ecosystems in a changing world.



The DayCent Model

DayCent is a biogeochemical model capable of simulating productivity, decomposition, soil water & temperature, and greenhouse gas (GHG) flows in a wide variety of ecosystems. Required model inputs include temperature, precipitation, soil properties, and land use. The conceptual diagram below illustrates the flows between various pools in DayCent. Short arrows indicate carbon loss due to respiration. Flows of nitrogen (N) are also indicated with arrows.



After Kirschbaum and Paul, 2001.

Data

Simulation output will be compared to various sources of data:

-Tier II and Tier III measurements
-Soil carbon: National Cooperative Soil Survey Characterization Data (NRCS)
-Rapid Carbon Assessment Project (NRCS)
-Florida Soil Carbon Project (Grunwald et al.)
-Land cover data (National Land cover Database)
-Biomass (National Biomass and Carbon Dataset)

Research Spotlight

Greenhouse gas emissions from agricultural soils

Agricultural soils can be a sink or source of atmospheric CO_2 and other GHGs. However, much uncertainty remains regarding the effects of climate change on managed soils.

How permanent is the soil carbon sink in managed soils under increased temperatures and drought conditions?

Objective 1:
Simulate GHG emissions under multiple scenarios of climate change in managed soils of southern pine .

Net primary productivity and carbon dynamics

Net primary productivity (NPP) is used to measure carbon exchange among ecosystems and the atmosphere. Climate change may alter NPP in many ecosystems, possibly inhibiting the mitigation potential of forested ecosystems.

Will increased temperatures and carbon-dioxide increase NPP, or will the effects of drought and increased water stress suppress NPP and carbon sequestration?

Objective 2:
Investigate the individual and combined effects of increased CO_2, temperature, and drought on NPP and carbon dynamics in managed southern pine using multiple scenarios of climate change in DayCent.

Wildfire and climate change

Increased temperatures and drought conditions may alter disturbance patterns, such as fire return intervals and/or fire severity.

How will altered fire regimes affect NPP and carbon dynamics in managed southern pine ecosystems?

Objective 3:
Use DayCent to investigate the effects of increased fire return intervals on carbon dynamics and NPP across the Southeastern U.S.

USDA United States Department of Agriculture National Institute of Food and Agriculture

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