



Simulating loblolly pine soil carbon dynamics for two contrasting piedmont soils under different climate change scenarios



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FOREST PRODUCTIVITY COOPERATIVE



1. INTRODUCTION and MOTIVATION

CLIMATE CHANGE

• Human activities, especially the burning of fossil fuels and deforestation, have caused a substantial increase in the concentration of carbon dioxide (CO₂) in the atmosphere during the last 150 years. The CO₂ rise - from 280 to more than 380 ppm - is causing measurable global warming, jeopardizing both natural and urban systems.

FORESTS SEQUESTER C

• Forests of the northern hemisphere function as large sinks for atmosphere CO₂
• Partially mitigate the climate change effects

C storage in a forest ecosystem is difficult to evaluate

• Due to the large number of above- and below-ground compartments
• Also includes soil--the largest and most complex carbon storage:
- Soil C fluxes, very small relatively to soil carbon stock, very difficult to evaluate soil C changes.
- The likelihood to capture soil carbon accretion or losses is higher if soil carbon pools are evaluated between long periods

OBJECTIVE

• To evaluate the changes in soil C in two typical Piedmont sites: clayey and sandy
• To parameterize and calibrate the Century/Daycent model using the long-term data set
• To simulate the soil C dynamics under the effect of climate change scenarios

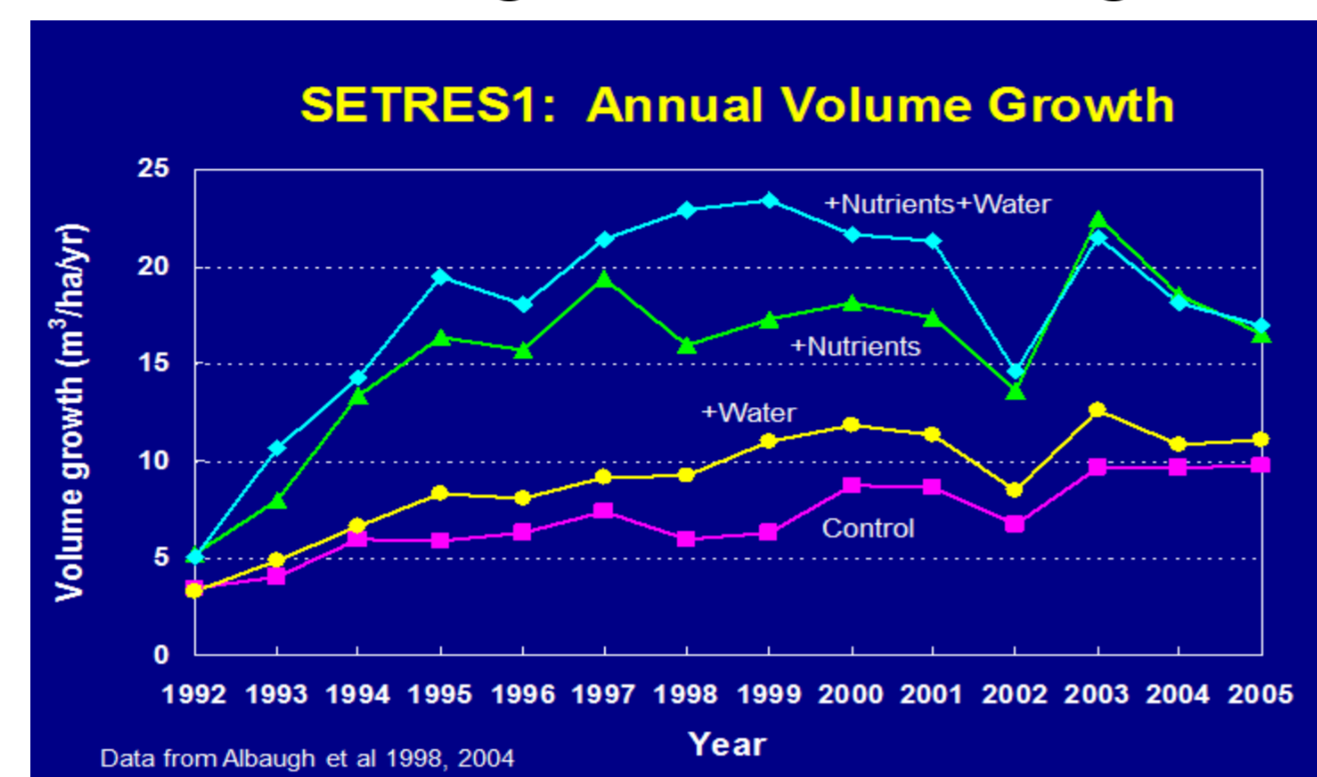
METHODS

• Sample two active 30-yr old loblolly pine studies in the Piedmont of NC that have archived soil samples
• Parameterize the Century/Daycent ecosystem models (Parton et al. 1998)
• After calibration we intend to run the model use the same calibration but under different climate change scenarios including distinct water and temperature regimes provided from global weather models.

2. EXPERIMENTAL SITE 1

SETRES (Southeast Tree Research and Education Site)

- Located in a droughty, nutrient-poor, very deep sandy site in the Sandhills, NC (34°54'N, 79°29'W)
- Planted loblolly pine (*Pinus taeda* L.) in 1985 after felling of the previous natural longleaf pine (*P. palustris* Mill.)
- Annual precipitation averages 1220mm/yr (40-year average). Average annual summer (June-August) temperature is 26°C, winter (December-February) is 7°C.
- 4 treatments:
Control, Irrigated, Fertilized, Irrigated + Fertilized



Annual volume growth of four treatments (Albaugh et al., 1998)



SETRES



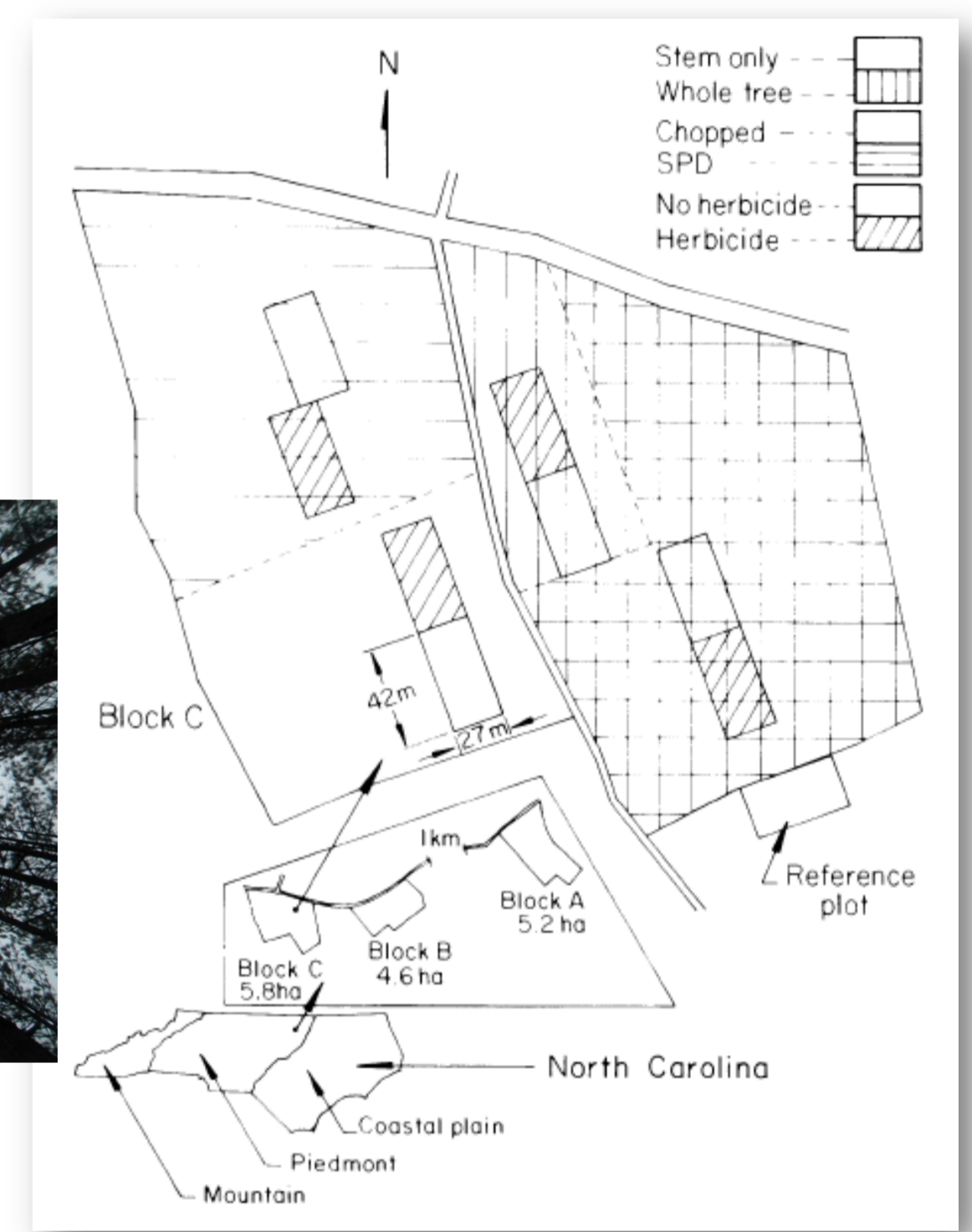
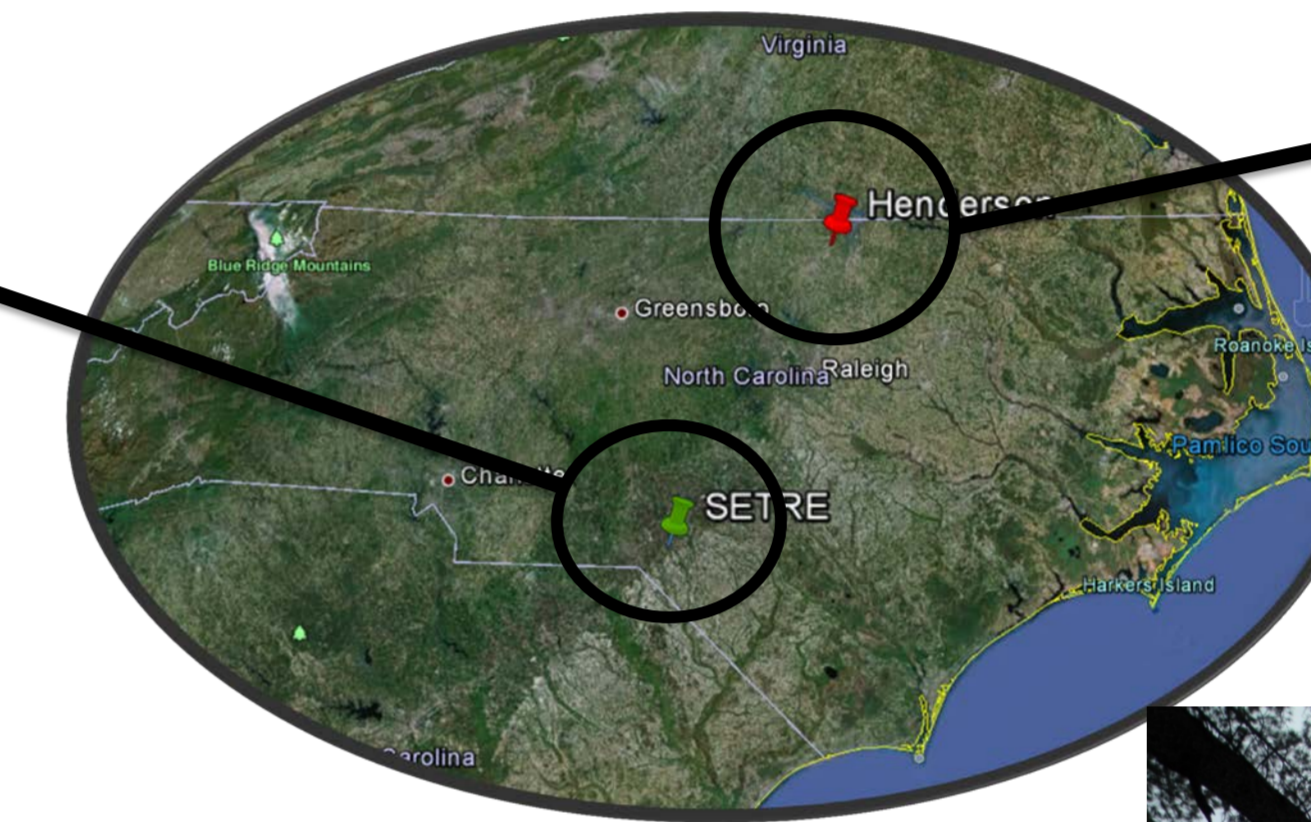
Control 2012

Fertilized 2012

3. EXPERIMENTAL SITE 2

Henderson site

- Located in a typical clayey Cecil series soil (Typic Kanhapludults) site near the town of Henderson, NC (36°25'N, 78°30'W) in the physiographic region of the Piedmont.
- Plant loblolly pine (*Pinus taeda* L.) in 1982.
- Different harvest treatments (stem-only and whole-tree removal) and site preparation treatments (chop-burn and shear-pile-disk).
- Mean annual temperature is 14.8 °C (based on a 64-year record), with hot and humid summers. Mean annual precipitation is 1133 mm/yr. (Piatek and Allen 2001)

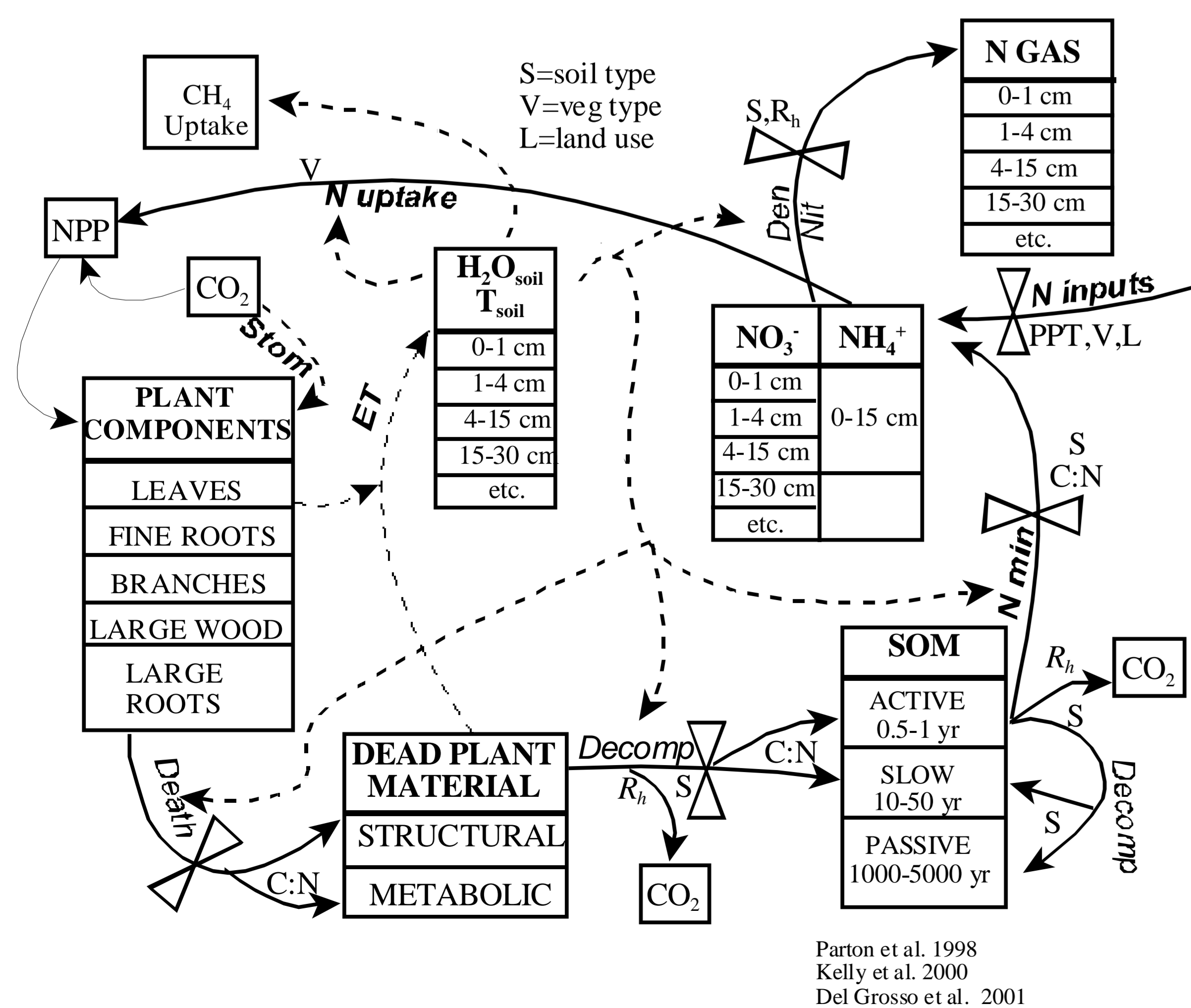


The experimental design



4. CENTURY/DAYCENT ECOSYSTEM MODEL

DAYCENT MODEL



Parton et al. 1998
Kelly et al. 2000
Del Grosso et al. 2001

The overview of DAYCENT - a processing based ecosystem model

5. DATA COLLECTION

- For both sites we have: forest aboveground growth (e.g. Diameter at breast height (DBH), Tree height (H)), some root assessments, initial soil characterization, and weather data.
- A new soil sample (2013) will add value to better calibrate the model towards the soil pool dynamics in these contrasting texture soils.



A litter trap used to collect litter fall



LECO-CN Analyzer



Soil sampling and soil horizon details

6. EXPECTED RESULTS

- We expected that the Daycent/Century model will be able to capture the long-term Soil C dynamics in both sites
- Our hypothesis is that a warmer and drier scenario will lead to a loss in soil carbon in the sandy site but not in the clay site due to the higher impact of drought on the forest net primary production (NPP) and the less protected recalcitrant carbon.

REFERENCES

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ACKNOWLEDGEMENT

This research is supported by the project of Pine Integrated Network: Education, Mitigation, and Adaptation project (PINEMAP), USDA National Institute of Food and Agriculture (NIFA) and Forest Productivity Cooperative (FPC).