# Is Conifer Afforestation Economically Attractive in North America?

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## Introduction

Afforestation provides a viable cost-effective option to sequester atmospheric carbon given its large land base in Canada. Interests have been growing to look at quantitative assessment of afforestation. Plantation investments may now include market values of carbon sequestration. With the Kyoto Protocol ratified, the carbon benefits of afforestation could take on greater significance in Canada.

## Objectives

- To develop spatial productivity estimates that incorporate climate variability and carbon sequestration values
- To establish an economic model that considers both timber and carbon values

## Models and Data

- $\mathrm{CLASS-CTEM^{N+}}$
  - Nitrogen routines were incorporated into the coupled CLASS[1] and CTEM[2] models
- Historical Records (1901 – 2010)
  - Model simulated NPP from $\mathrm{CLASS-CTEM^{N+3}}$
  - Meteorological estimated from Canadian Forest Service
- Future Projection Records (2011 – 2100)
  - Meteorological estimates from Canadian Forest Service

## Results (1)

1. NPP Spatial Distribution

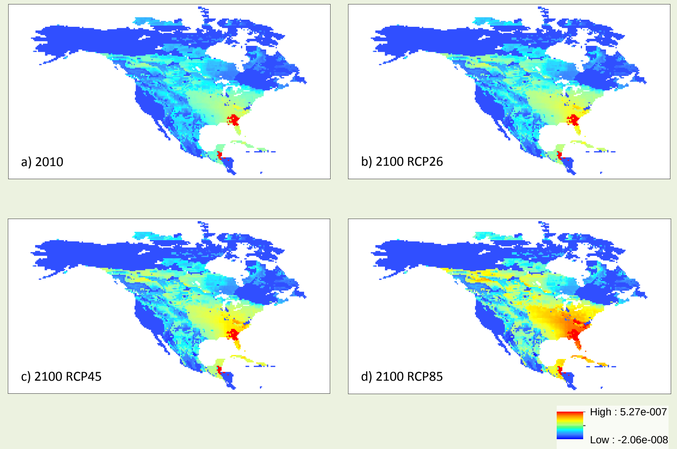
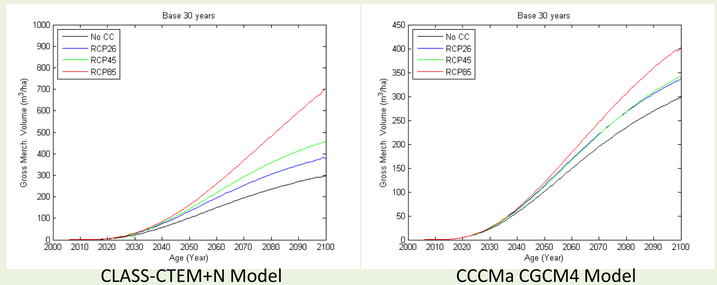



**Fig. 1.** $\mathrm{CLASS-CTEM^{N+}}$ driven NPP is distributed spatially under different future scenarios. (a) NPP estimated in 2010. (b) NPP estimates in 2100 under mitigation scenario (c) NPP estimates in 2100 under moderate scenario, and (d) NPP estimates in 2100 under extreme scenario. The results show that greater impact will be seen in the eastern and western Canada and the southern US.

2. Growth and Yield Expectations

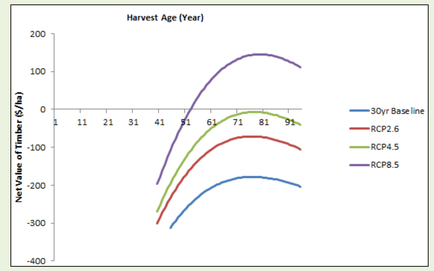



CLASS-CTEM+N Model CCCMa CGCM4 Model

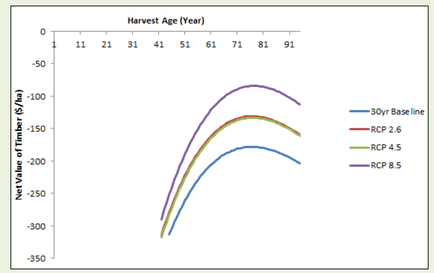
**Fig. 2.** Yield expectations of White Pine if plantation begins in 2010. Second model (CGCM4) is added for a comparison and/or a validation. The greatest yield is seen under extreme scenario due to higher precipitation rate and greater minimum temperature.

## Results (2)

3. Net Value of Timber




**$\mathrm{CLASS-CTEM^{N+}}$**
Based on the Faustmann approach, the optimal harvest age for White Pine is around 75 years but NPV indicates that White Pine afforestation is not going to be profitable except pathway 8.5




**CGCM4 Model**
Similar results are shown where optimal harvest age is around 77 years but again indicates that White Pine afforestation will not be economically attractive

## Summary

- We investigate the growth with model driven NPP, and try to make connections with practical growth and yield models and economic analyses of plantation under a changing climate
- Two models were used to compare and validate the results
- The Faustmann approach suggests that White Pine afforestation is **not economically attractive**
- Further research needs to take place to **include carbon sequestration value** to see if it could improve the overall investment value

References

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3. Huang S, Arain MA, Arora VK, Yuan F, Brodeur J, Peichl M. Analysis of nitrogen controls on carbon and water exchanges in a conifer forest using the CLASS-CTEMN+ model. *Ecol Modell*. 2011; 222(20-22):3743-3760.

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Future Information

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