

Modeling Forest Management Scenarios Under a Changing Climate in Northern Minnesota

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Portland State
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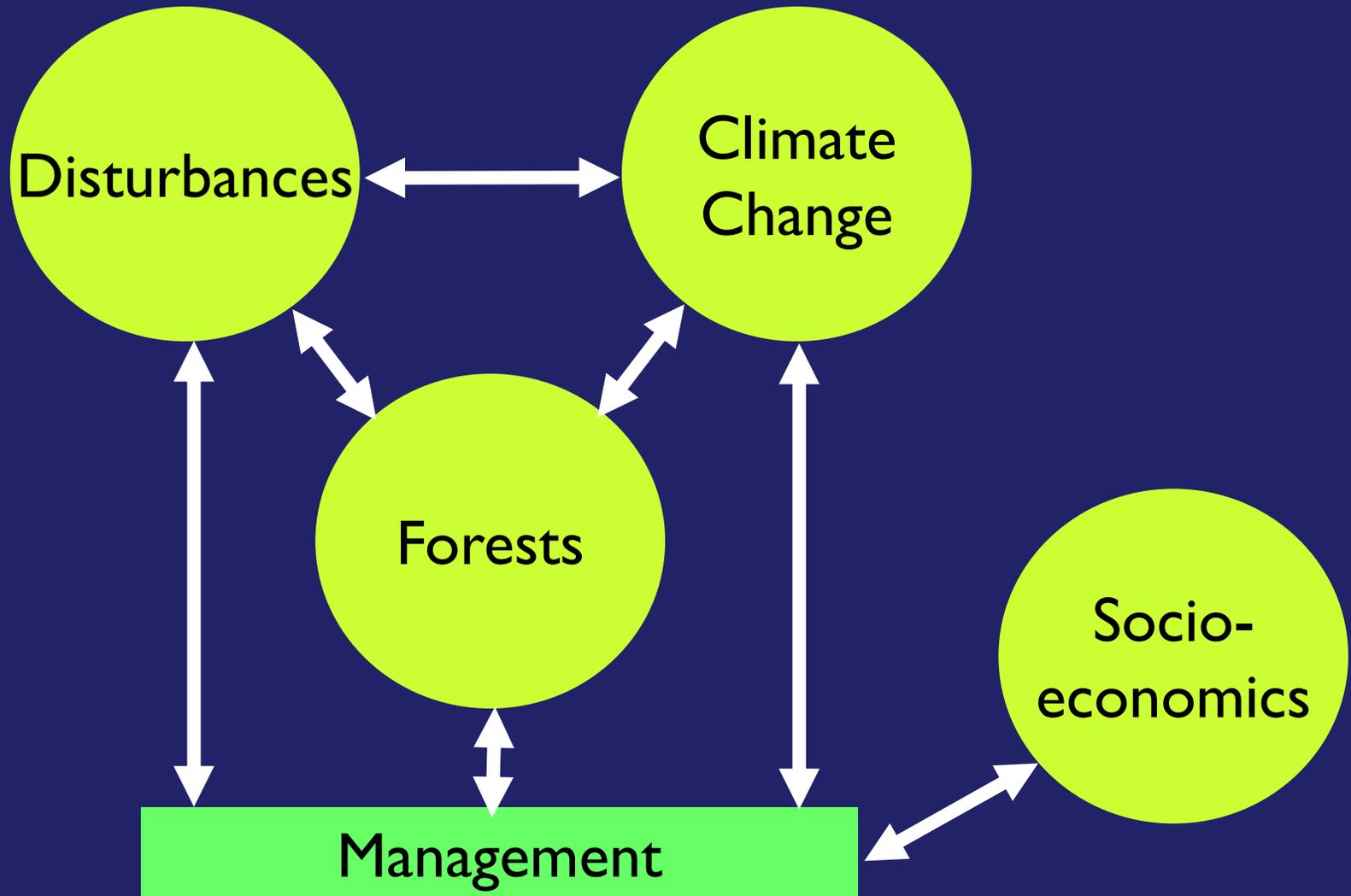
NASA-MSU

Introduction

- Landis II Modeling Framework
- Review previous modeling work- RNV, forest restoration and climate change
- North Woods Climate Change Response Framework- Vulnerability Assessment



Climate Change Effects on MN Forests



from V. Dale et al. BioScience 2001

Modeling-LANDIS-II

LANdscape Disturbance and Succession

Spatially Dynamic

- Emphasizes landscape processes
- Natural disturbance, management and dispersal

Life History Traits

- shade tolerance, drought tolerance, longevity, temperature, nitrogen, seed production-dispersal, fire tolerance, Veg. Reprod.

Typically 1000s – 1,000,000s of hectares, many decades

Global Circulation Model
Climate Change

USGS Geodata Portal
Downscaled 12 km

(Hayhoe 2011)

PnET-II
Ecosystem
Model

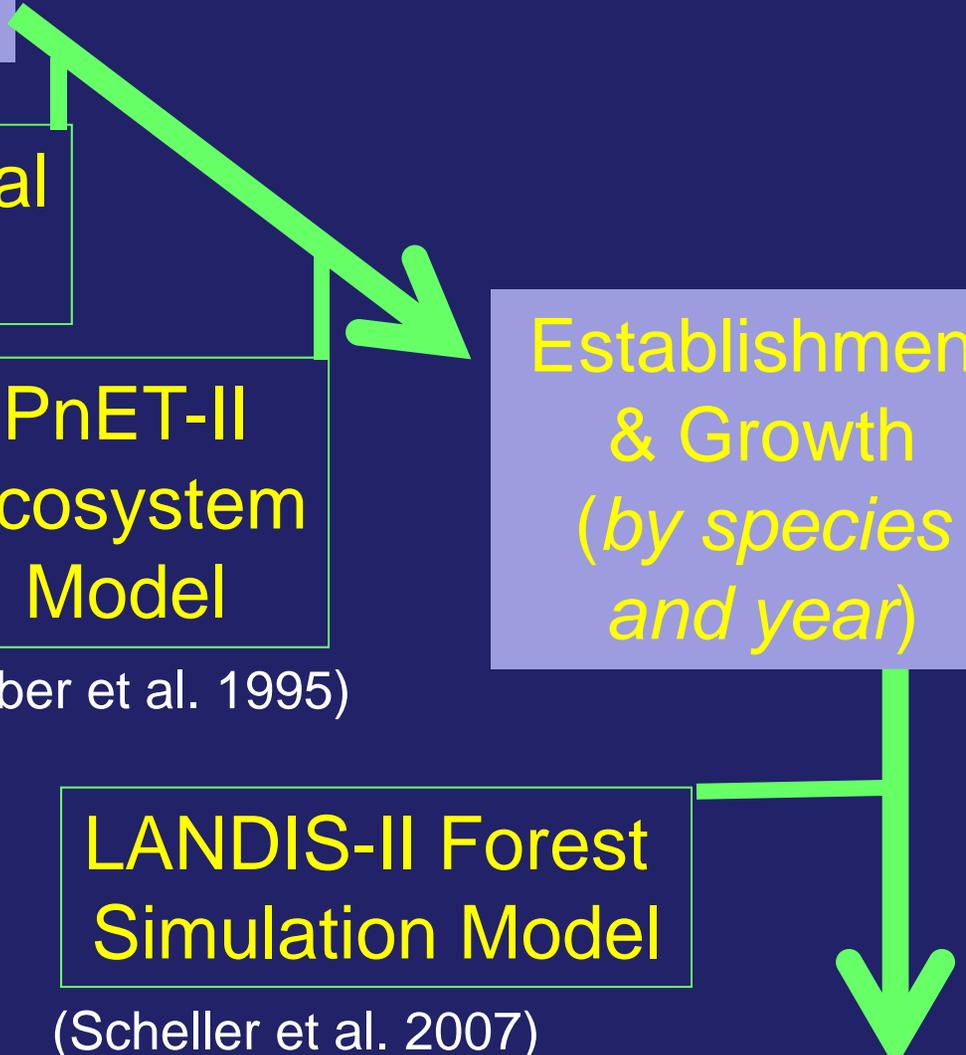
(Aber et al. 1995)

Establishment
& Growth
*(by species
and year)*

LANDIS-II Forest
Simulation Model

(Scheller et al. 2007)

Forest
Dynamics



Uncertainty: Modeling Forests under Climate Change

- Co₂ fertilization
- Deer, earthworms
- Climate models
- Ozone



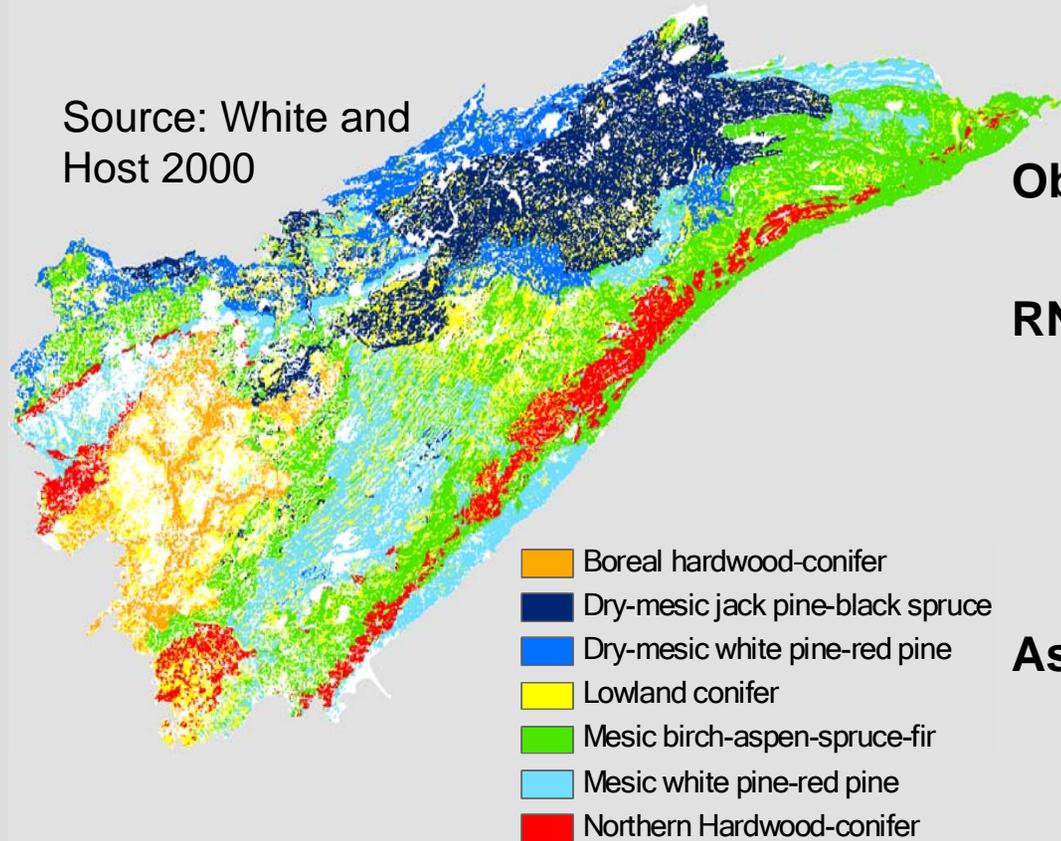
- Understand **relative** influence of climate and disturbance on regional species composition trends



MN, USA

Natural Variability and Forest Restoration

Source: White and Host 2000



Objectives:

RNV Reference forest conditions

- Species Diversity
- Structural Complexity
- Spatial Pattern

Assumptions: Species and Structural diversity maintain biodiversity and functioning forests

Approach: Use spatially dynamic model that incorporates climate, disturbance and seed dispersal

Forest restoration in a mixed ownership landscape under climate change

Ravenscroft, C., Scheller, R.M., Mladenoff, D.J.
White, M.A. 2010.. Ecological Applications.
20:327-346

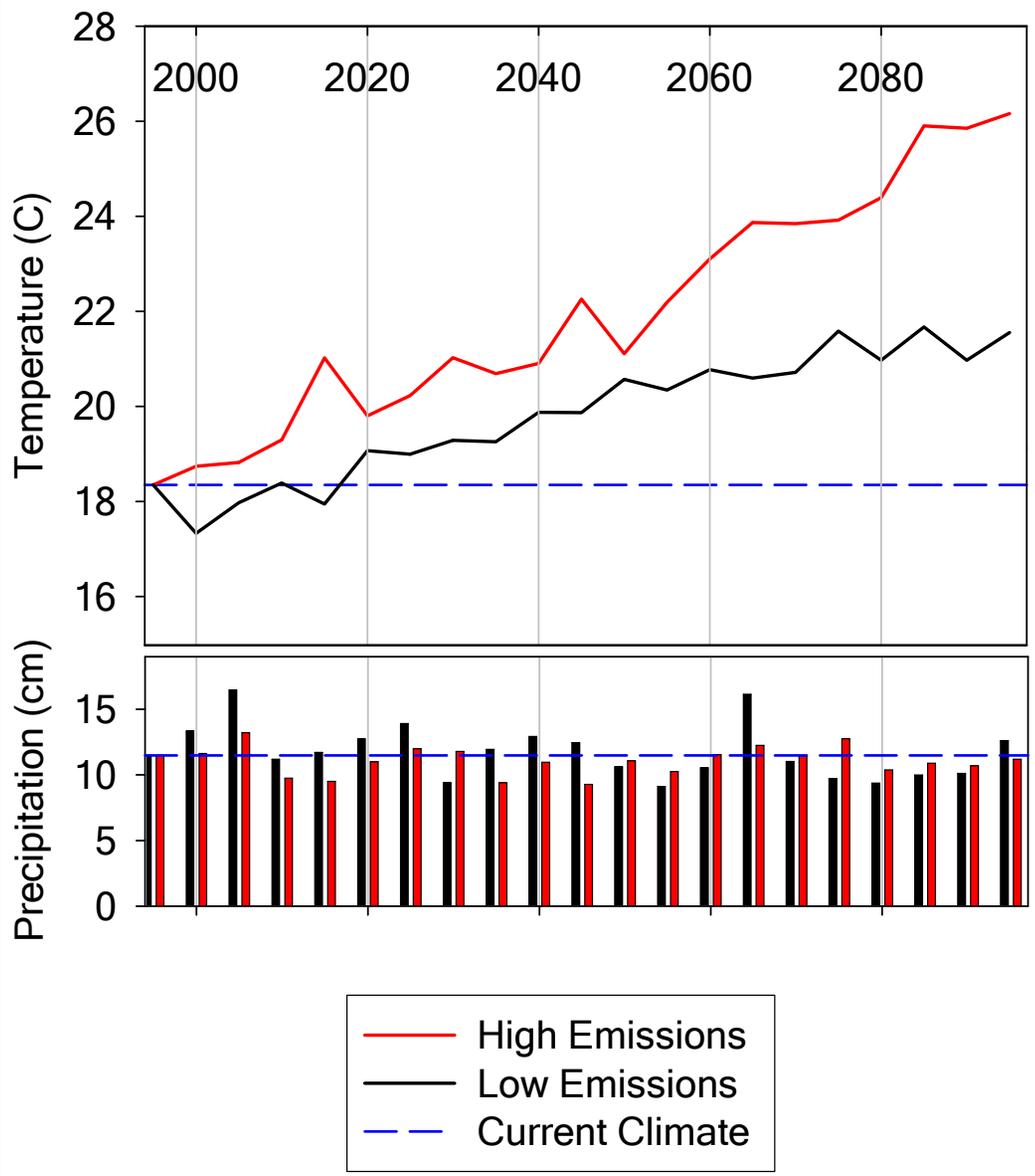


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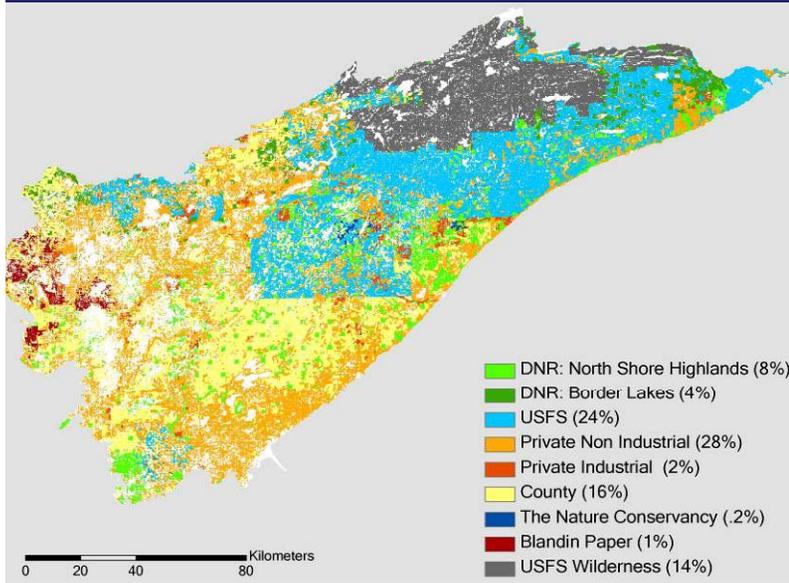
Mean July Temperature



Management Scenarios

CURRENT MANAGEMENT:

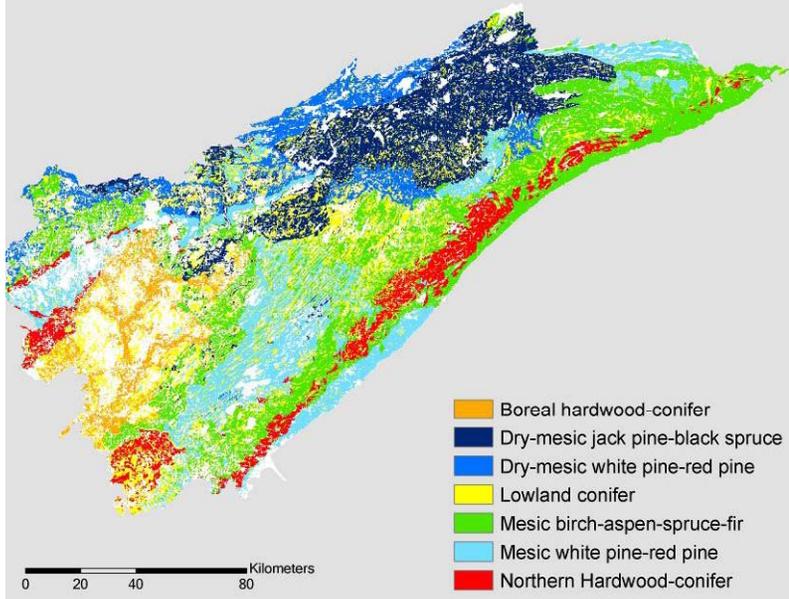
Management Units (10): Ownership



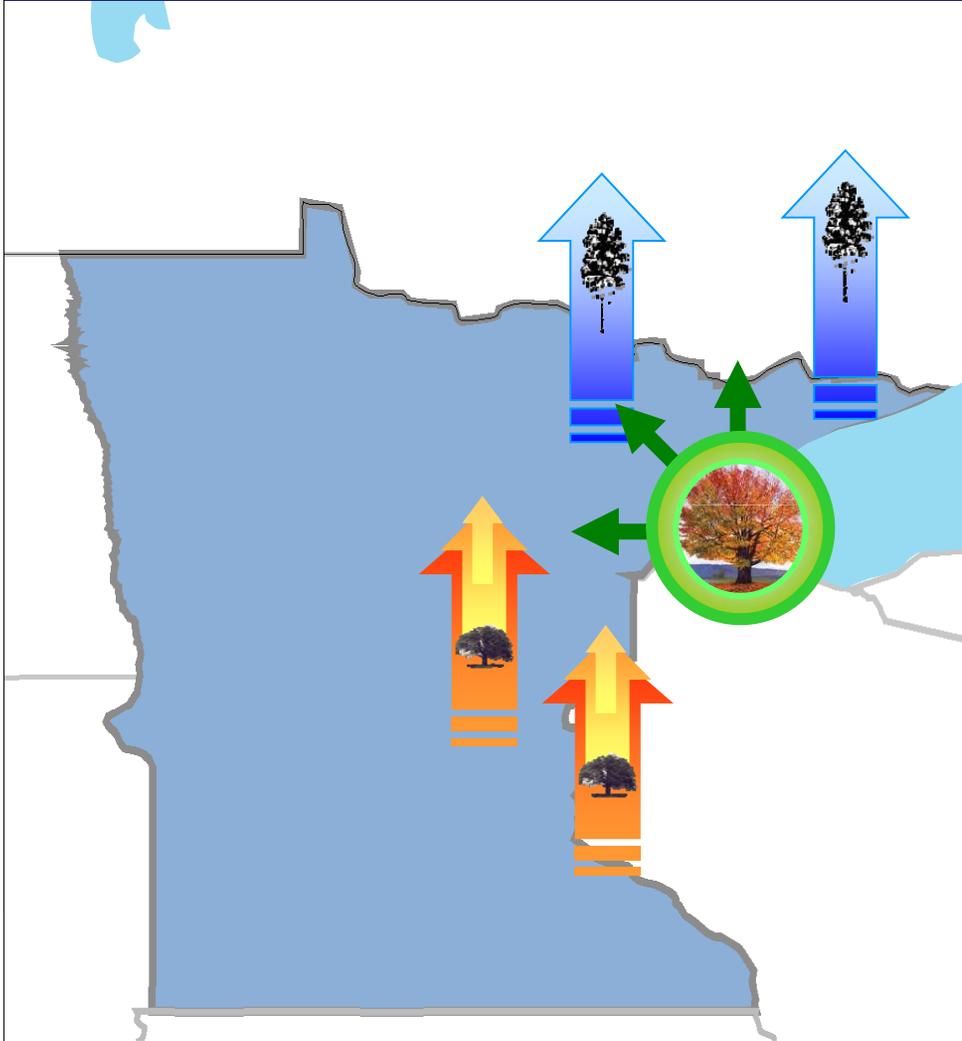
RESTORATION:

Management Units (7): Ecological land units

- RNV Based



Potential Climatic Changes



Boreal conifers shift north

Aspen-slow decline, birch
more rapid

Oak/hickory-dispersal limited

Northern hardwoods expand

White pine-potential increase

Next Steps-In Progress

- Climate Change Response Framework-Model Lake States forests using common data sets
- **Vulnerability Assessment**
- Model climate adaptive management
- Connectivity-forest reserves and resilience
- Funded by Landscape Conservation Consortium

Robert Scheller & **Matthew Duveneck**

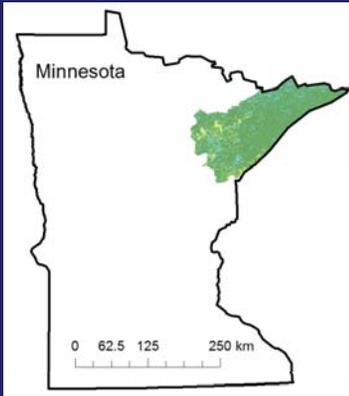
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Vulnerability Assessment-Northern MN Forests

Climate Adaptive Management

Connectivity

...

Scenarios

CLIMATE

MANAGEMENT

		High		Low	
		Emissions (HAD A1FI)	Emissions (PCM BI)	Current Climate	
Current Management					
Alternative Silviculture					NA
Expanded Reserves- connectivity					NA

Management Scenarios

1. **Current Management:**

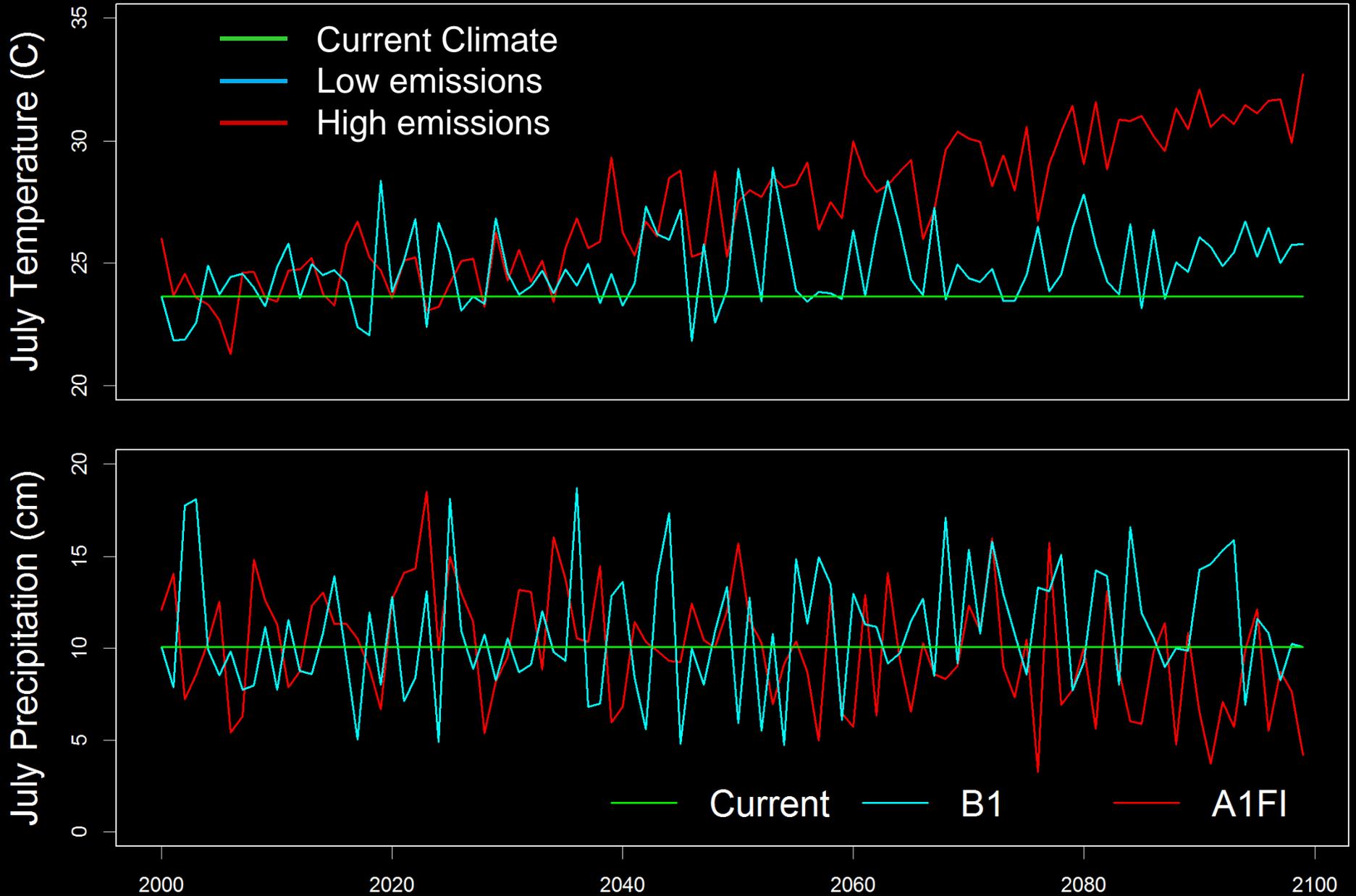
Agency specific management plans-2004-2006

2. **Climate adaptive:** Favor climate tolerant species, mix-uneven-even-aged, increase life history diversity, increase mid-tolerant species

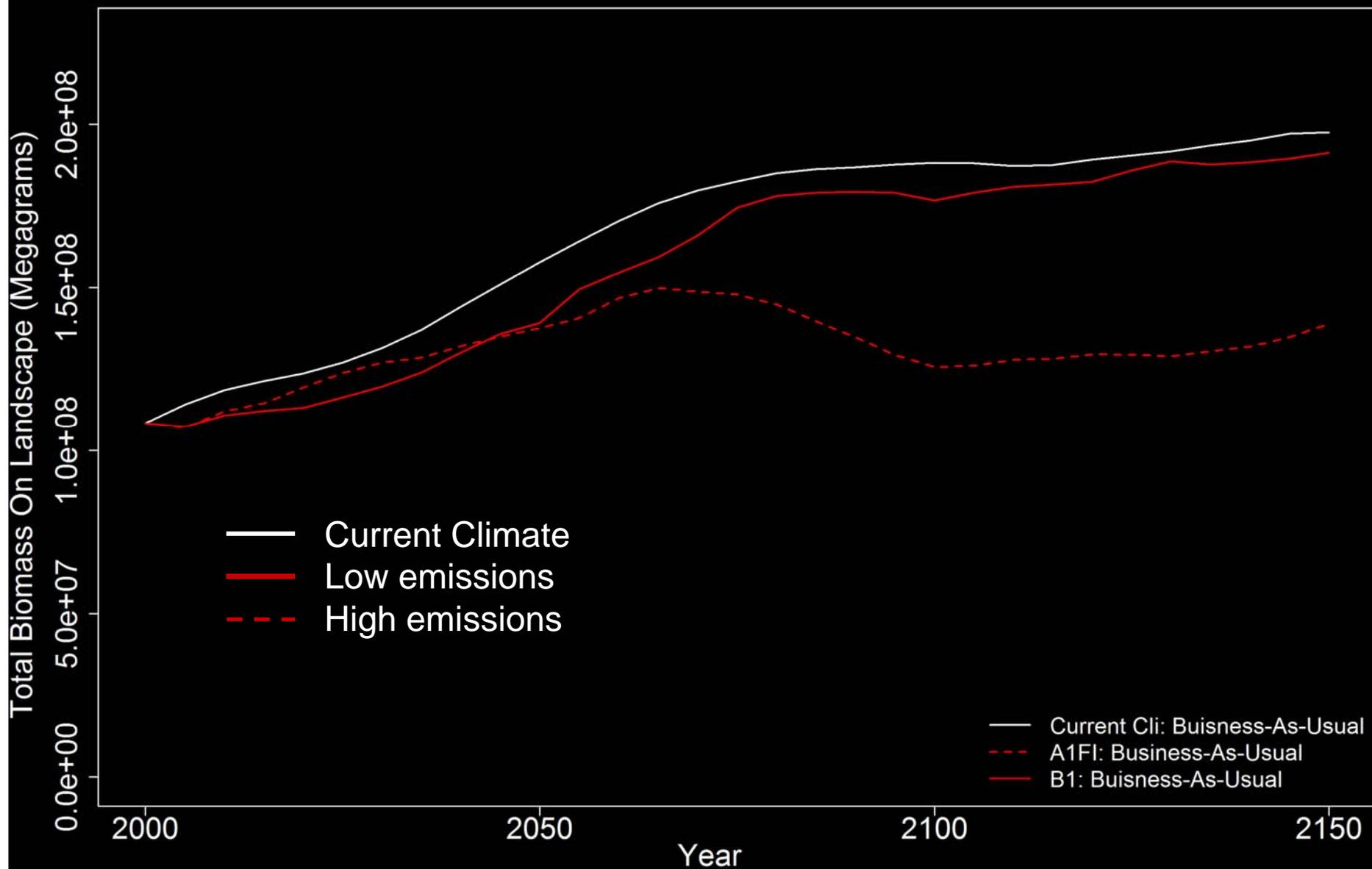
3. **Assisted migration:** plant southern oaks & hardwoods-overcome spatial -temporal barriers to natural migration.



Emerging Threat: Climate Change

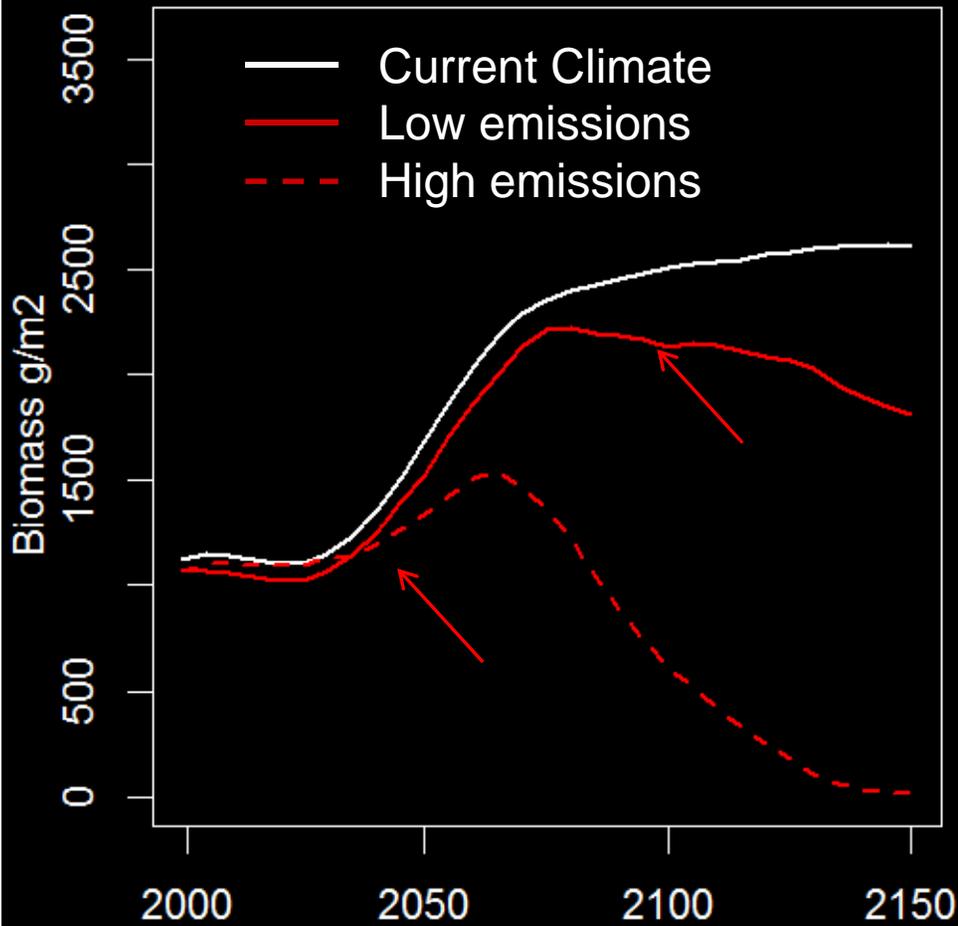


Total Biomass

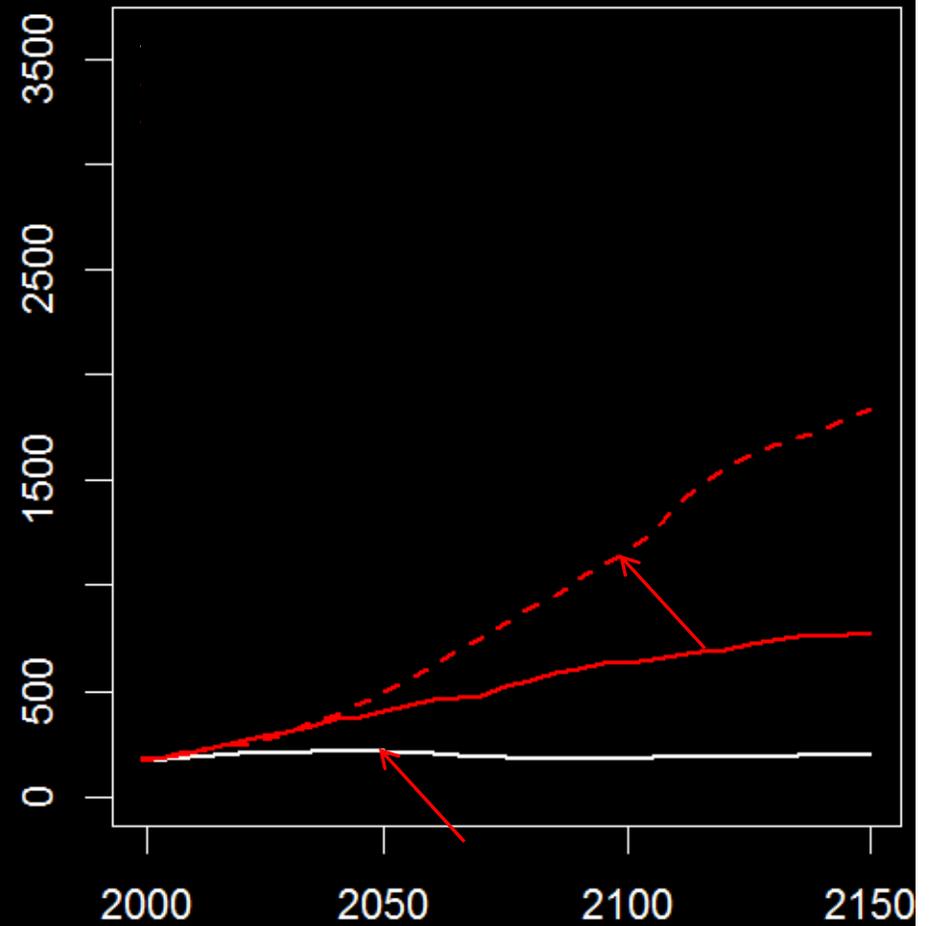


Results: Species Biomass

Balsam Fir

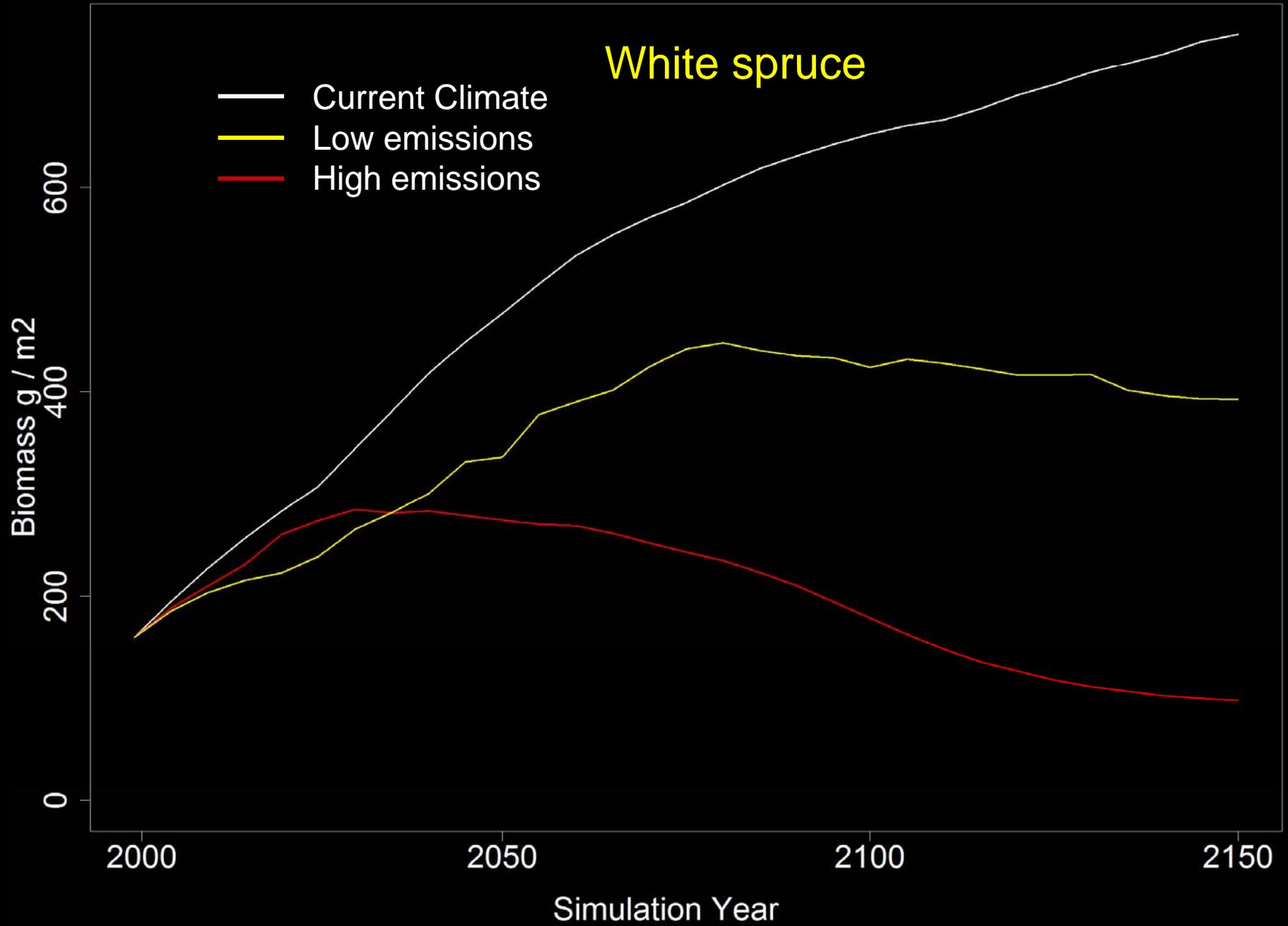


Red Maple

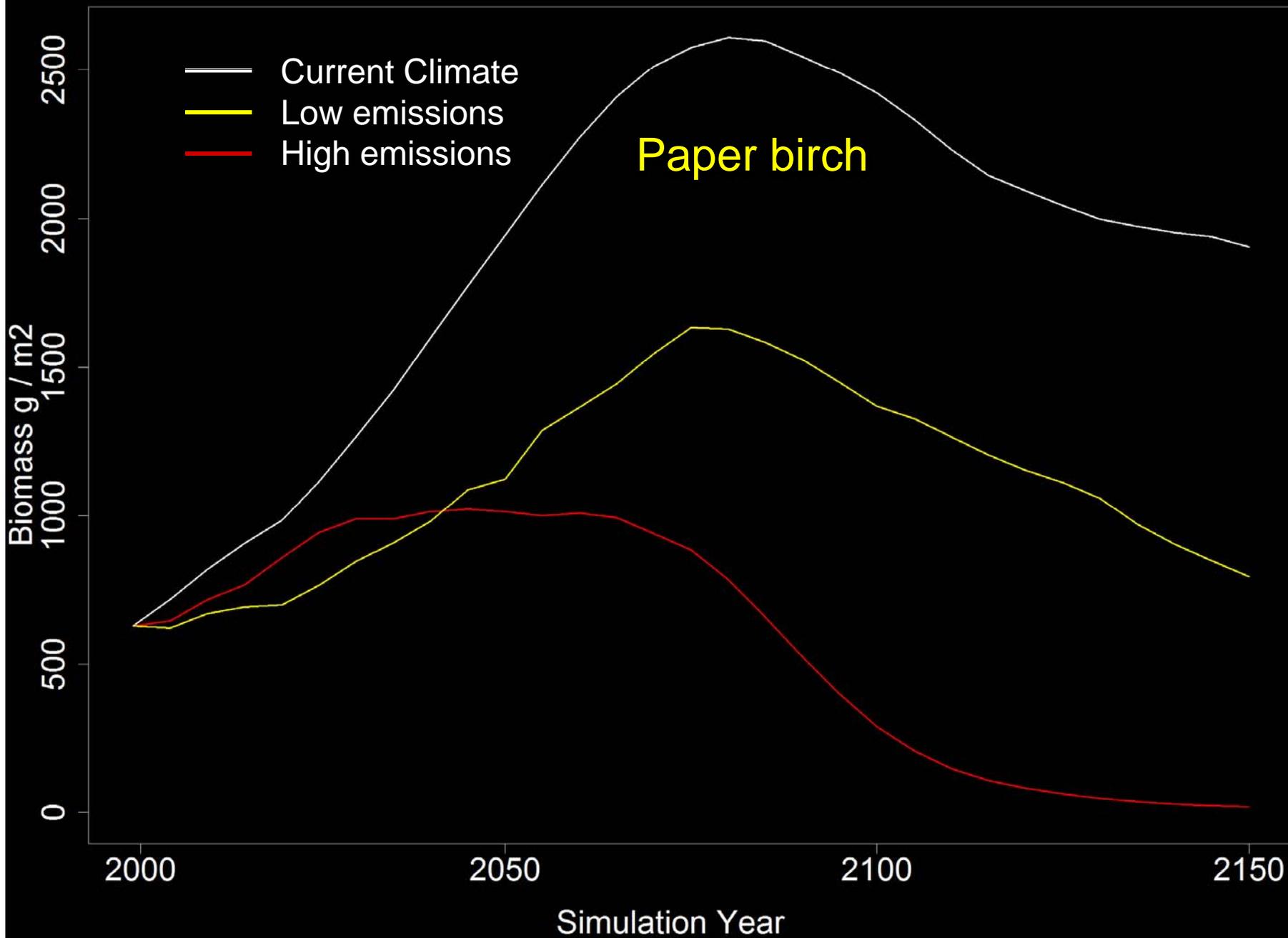


piceglau

White spruce



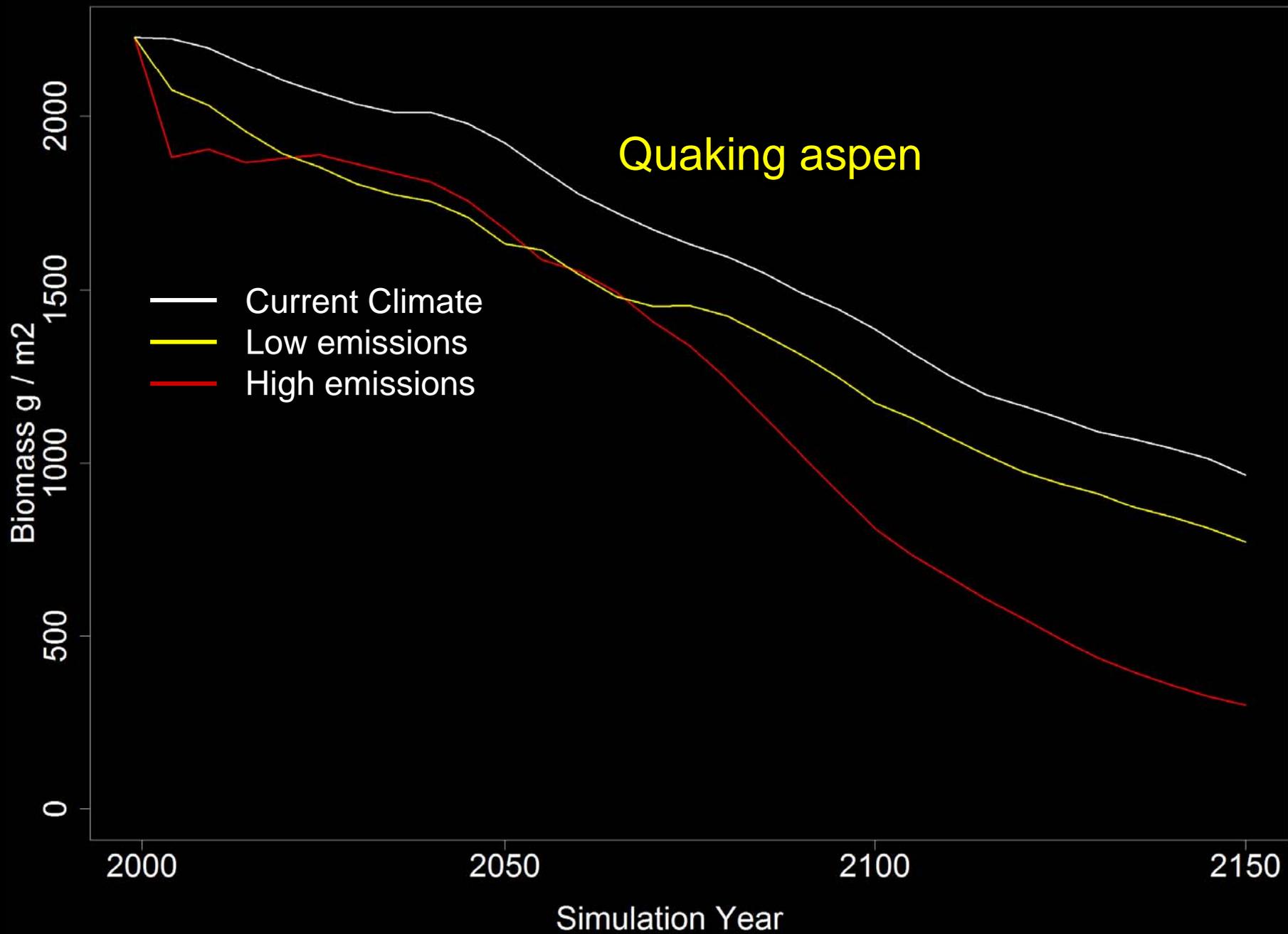
betupapy



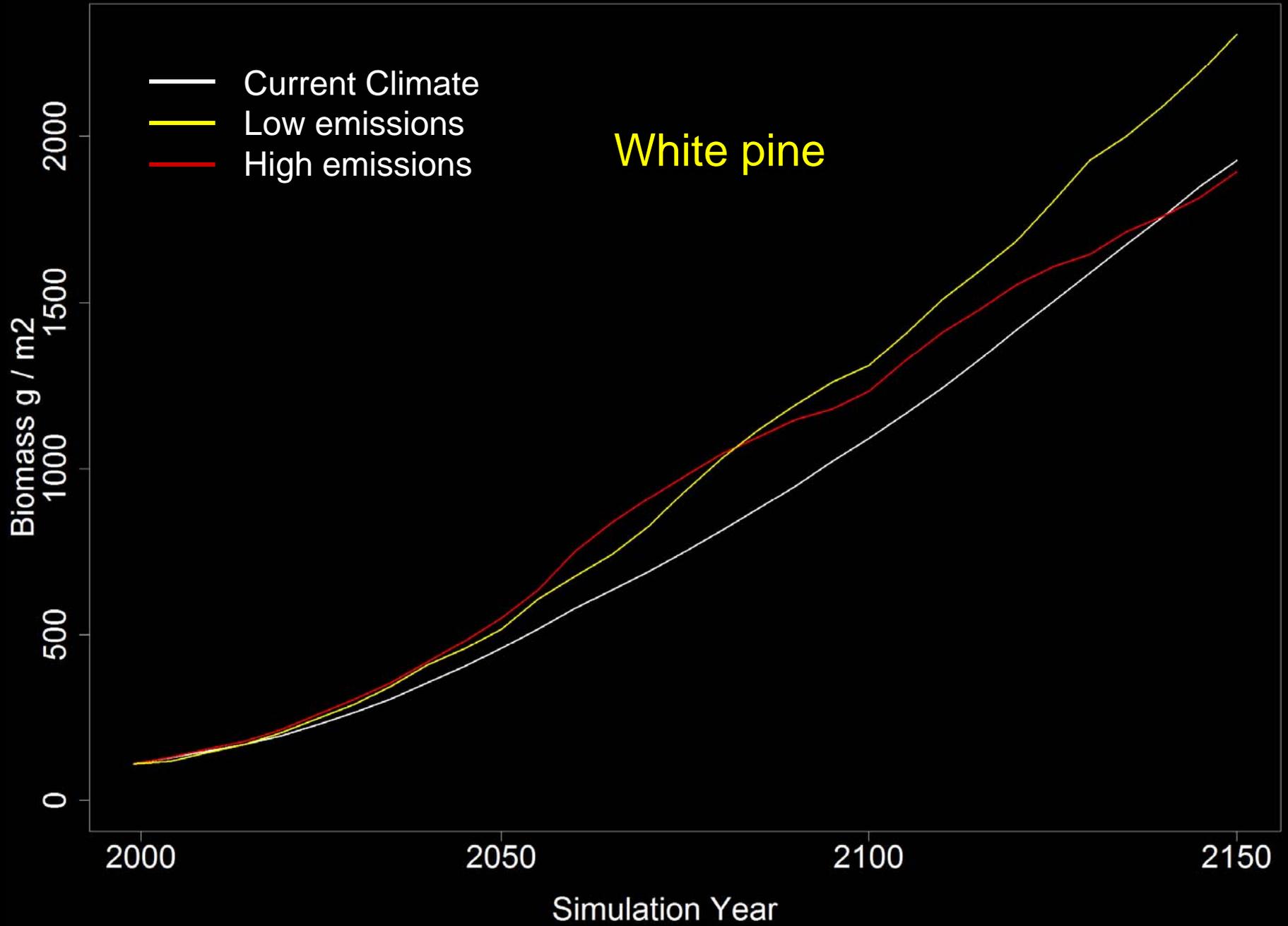
- Current Climate
- Low emissions
- High emissions

Paper birch

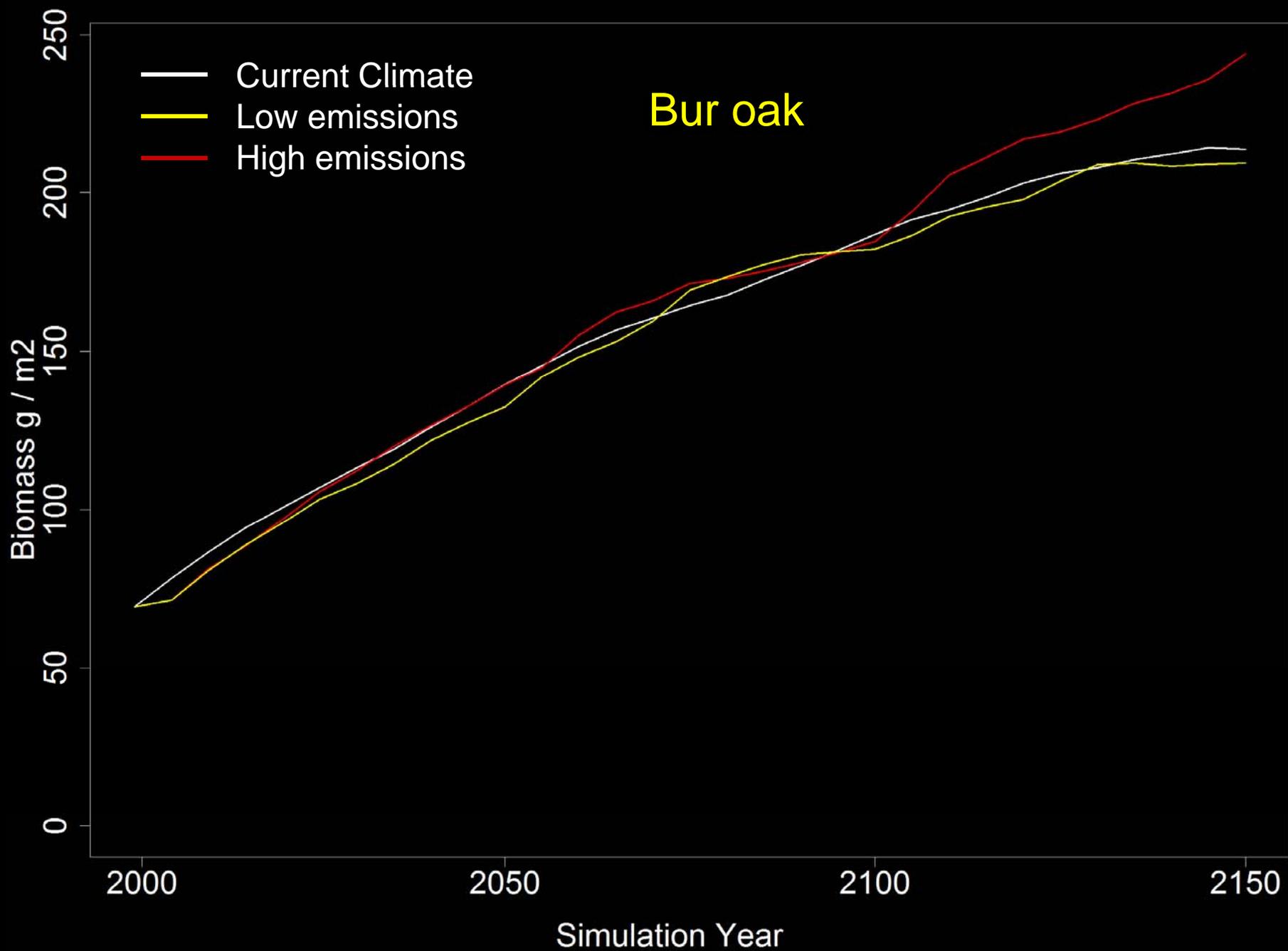
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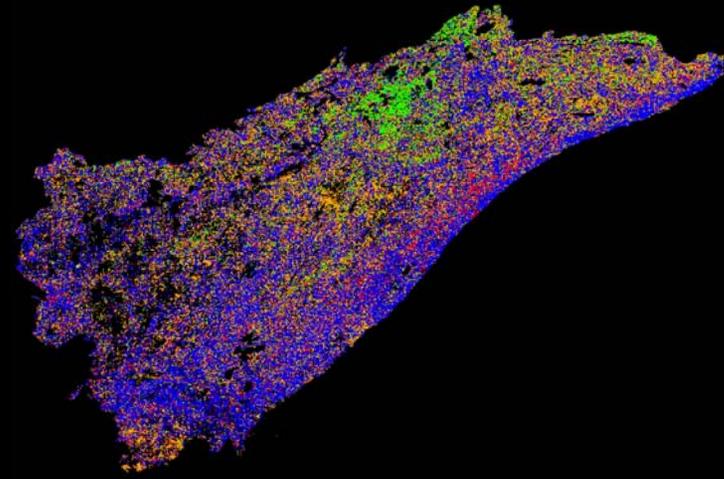


quermacr



Current Conditions

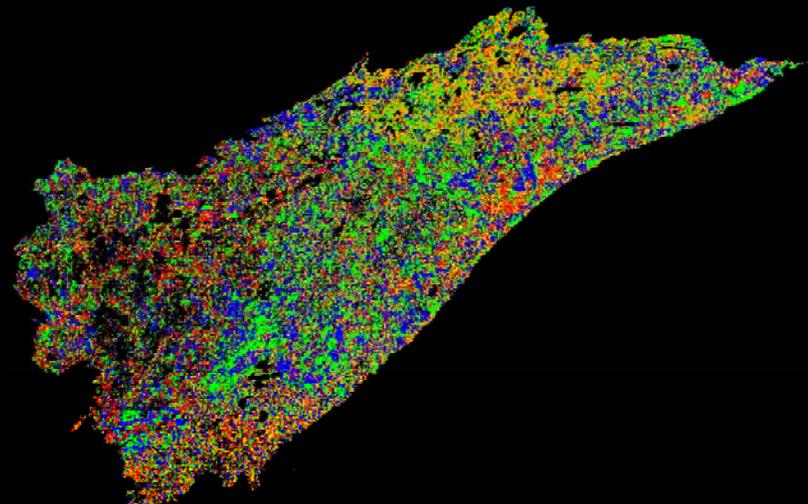
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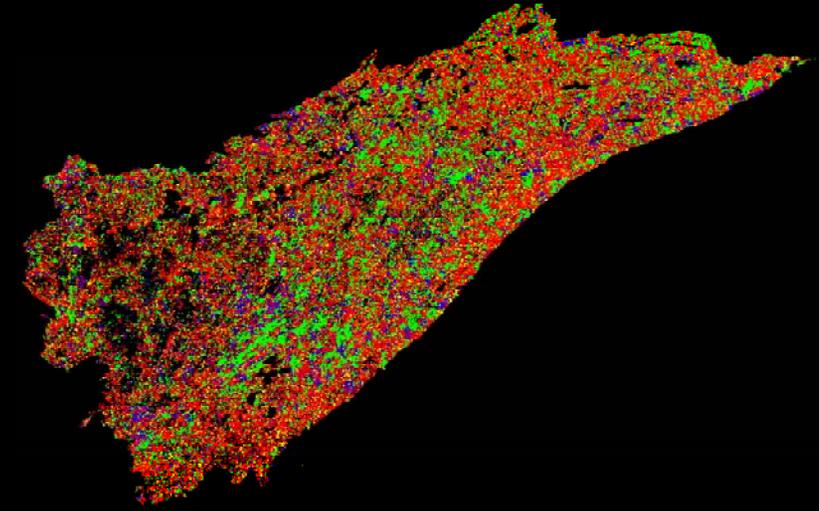
- Non-Forested or No-Data
- Spruce Fir Cedar
- Aspen Birch
- Pine
- Northern Oak
- Northern Hardwood

B1 (*Low Emissions*) Year 2150

A1FI (*High Emissions*) Year 2150



Current Management



Current Management

Summary-50-100 year Range

- Gradual loss of boreal species-
much greater in high emissions
- Increase in temperate hardwoods-
much greater in high emissions
- Over time-climate influence
increases-management decreases



Acknowledgements

- Rodney Johnson-Katherine Ordway Endowment
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