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How Will Climate Change and Bioenergy Harvest Affect Carbon Storage in the Oregon Coast Range

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Portland State UNIVERSITY

Dynamic Ecosystems & Landscapes Lab

The Oregon Coast Range

The Oregon Coast Range contains highly productive forests across a diverse range of land ownerships and management regimes

Land Ownership
- Bureau of Land Management
- Forest Service
- State
- Other
- Private Industrial
- Private Nonindustrial
- Private Nonindustrial (reserve)

Oregon

Results are presented for the Panther Creek watershed, in the northern Coast Range

Panther Creek Watershed

LANDIS-II Forest Simulation Model

We used a simulation model to explore the impacts of varying scenarios of climate change and forest management on ecosystem carbon

Climate Scenarios

Current Climate
Climate Change
  Emissions scenarios
- Low (RCP 4.5)
- High (RCP 8.5)

Global Circulation Models
- CCSM4 ← warm
- CanESM ← hot, wet
- HadGEM ← hot, dry

Management Scenarios

No Harvest ← Maximize carbon storage
Harvest Rotation
- Current ← Continue current harvest practices
- Accelerated ← Increase harvest but maintain low harvest rates on federal & some private land
- Industrial ← Harvest all lands as private industrial forests (clear-cut forestry across all lands)

Harvest Intensity
- Conventional ← Remove bole only, leave slash on site
- Bioenergy ← Remove bole and slash

Carbon and nitrogen cycling
- Soil texture
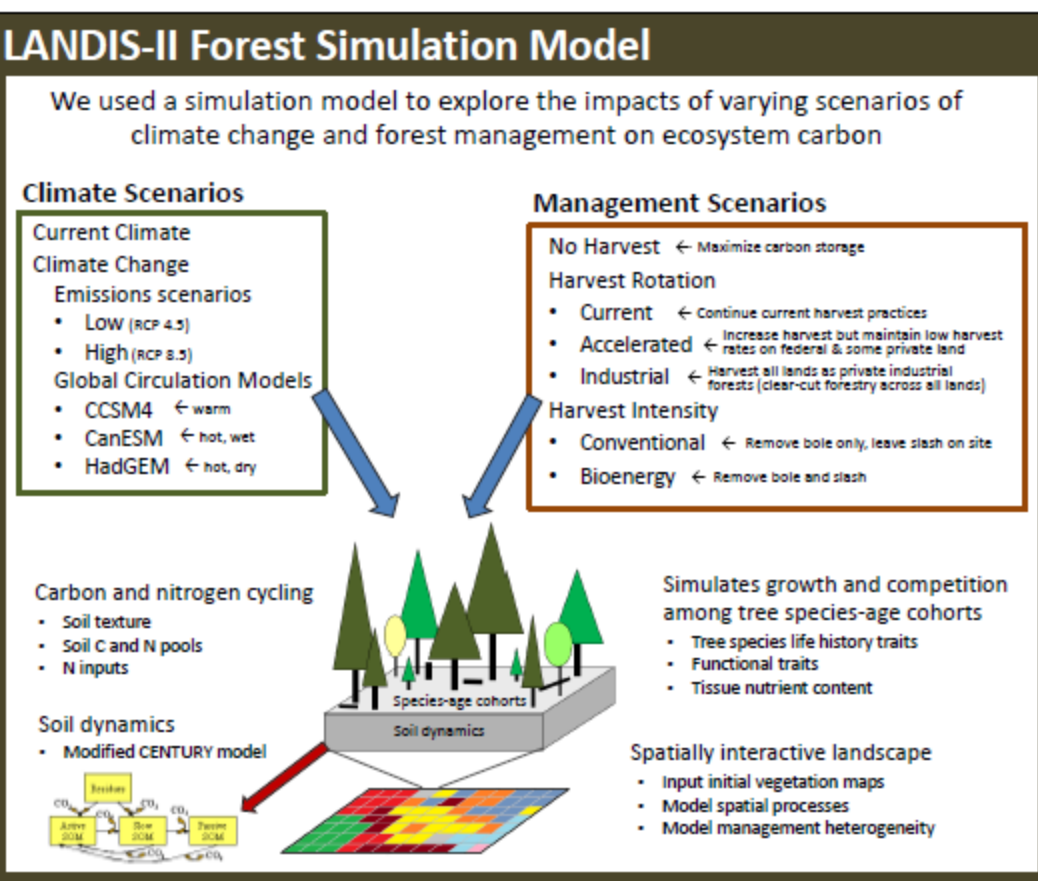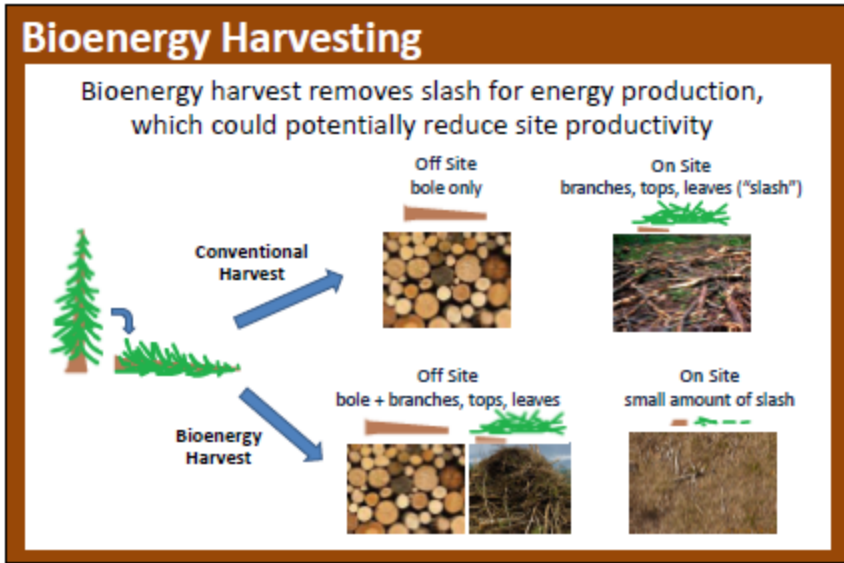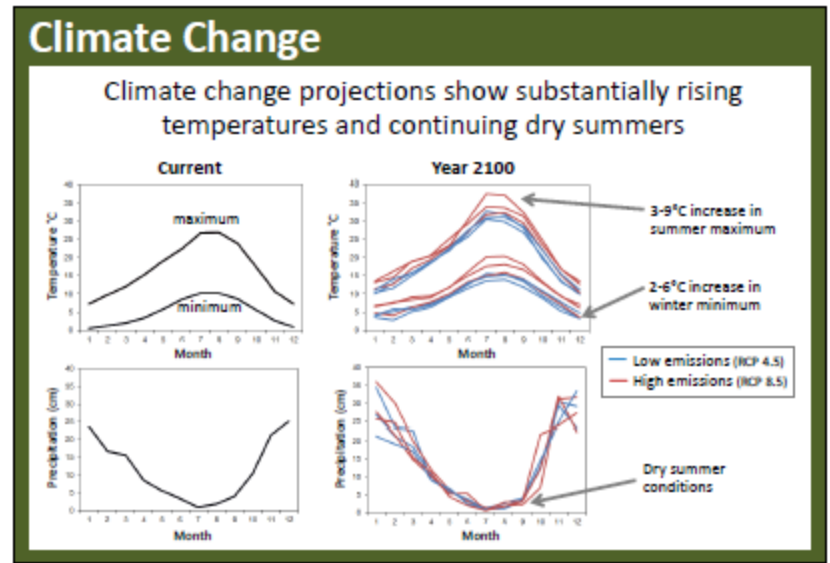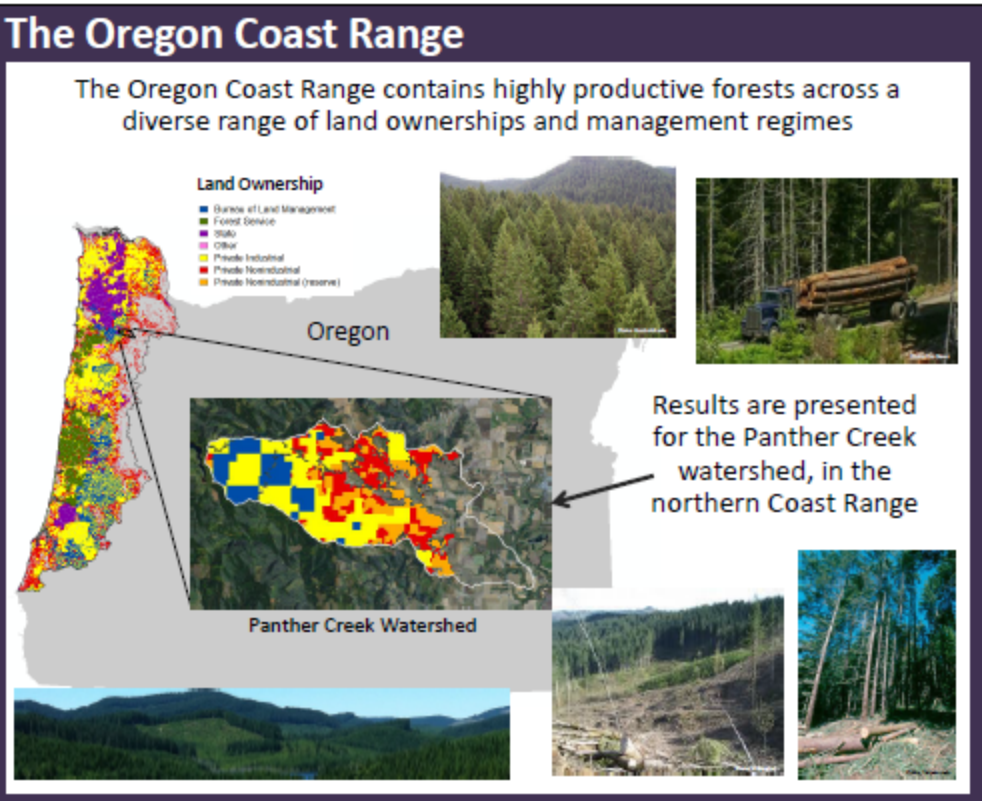- Soil C and N pools
- N inputs

Soil dynamics
- Modified CENTURY model

Species-age cohorts
Soil dynamics

Simulates growth and competition among tree species-age cohorts
- Tree species life history traits
- Functional traits
- Tissue nutrient content

Spatially interactive landscape
- Input initial vegetation maps
- Model spatial processes
- Model management heterogeneity

Climate Change

Climate change projections show substantially rising temperatures and continuing dry summers

Current

Year 2100

maximum

minimum

3-9°C increase in summer maximum

2-6°C increase in winter minimum

Low emissions (RCP 4.5)
High emissions (RCP 8.5)

Dry summer conditions

Bioenergy Harvesting

Bioenergy harvest removes slash for energy production, which could potentially reduce site productivity

Off Site
bole only

On Site
branches, tops, leaves ("slash")

Conventional Harvest

Off Site
bole + branches, tops, leaves

On Site
small amount of slash

Bioenergy Harvest

Projected Carbon Storage in the Panther Creek Watershed

Climate Change Impacts

Climate change leads to slower carbon accumulation in all pools

A

B

Current climate
Low emissions
High emissions

Climate change has minimal effects on tree growth

C

D

Soils are the largest carbon pool

Climate change primarily affects soil and detrital carbon by increasing respiration

Results shown under no harvest

Harvesting Impacts

Increasing harvest intensity for bioenergy only slightly decreases ecosystem carbon

Total ecosystem carbon storage could increase by 40% without harvest

Aboveground carbon is sensitive to harvest rotation but not intensity

Harvesting all lands as private industrial forests causes carbon decline

No harvest
Current–Conventional
Current–Bioenergy
Accelerated–Convent.
Accelerated–Bioenergy
Industrial–Convent.
Industrial–Bioenergy

Soil carbon is resilient to management impacts

Detrital carbon declines with increasing harvest rotation and intensity

Results shown under no climate change

Continuing Work

- Simulate entire Coast Range, including BLM, Forest Service, state, tribal and private lands
- Include climate change impacts on wildfire
- Simulate a wider range of management scenarios: current management, climate change adaptation, ecological forestry, economic growth, and watershed protection

Acknowledgments

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