Climate Change and Forest Science

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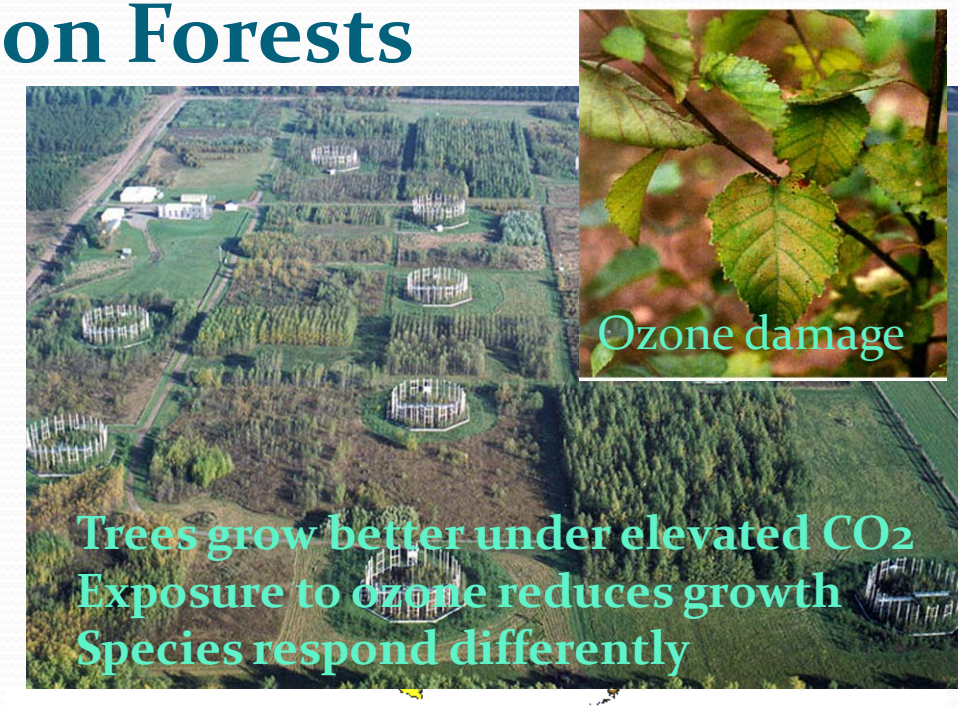
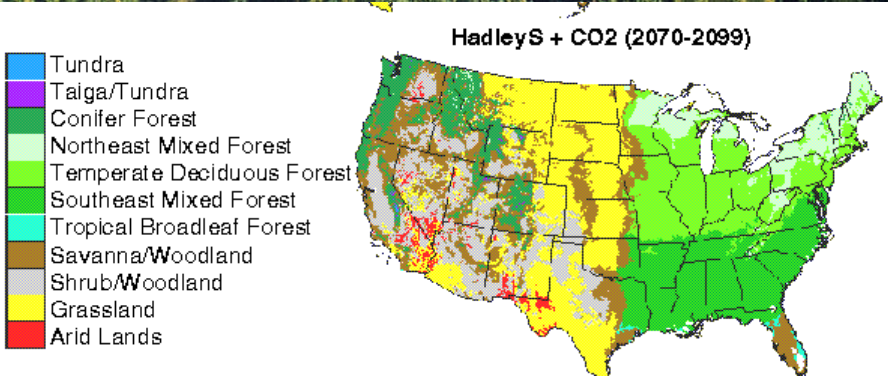
Forest Research on Climate Change

Early 1990's: Impacts on Forests

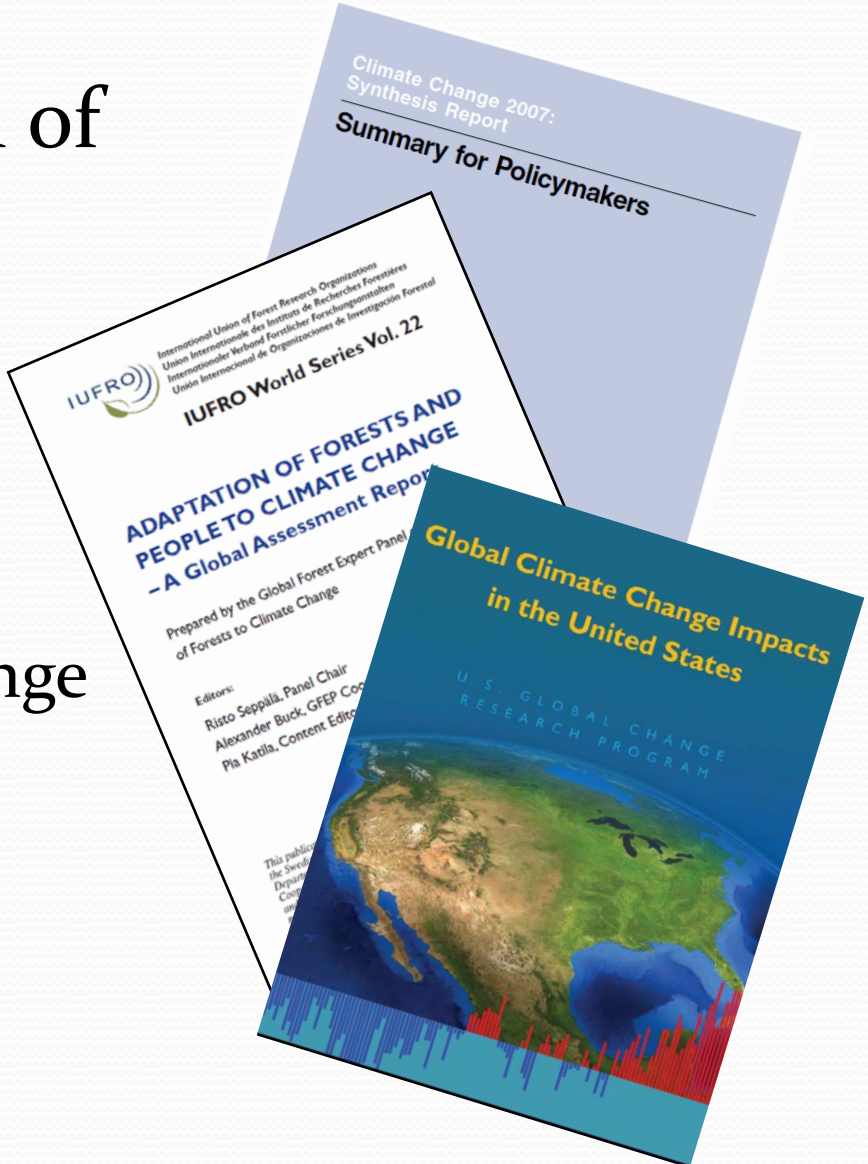
- First IPCC report
- Global change research programs being developed.
- Forest research focused in **Impacts**: of greenhouse gases on forests, on disturbance processes, tree species





Two Decades of Assessments

- Intergovernmental Panel of Climate Change Reports
- International Research Organizations
- Country Assessments
  - United States: National Assessment of Climate Change and Variability
- U.S. Forest Service
  - RPA Renewable Resource Assessment



Climate Change Impacts on US forests

- Likely to cause losses of ecosystem services
- But may also improve and expand some ecosystem services
- Any change in forests that affects water will result in a loss of ecosystem services
- Wildfire and insect outbreaks will increase
- Pulses of erosion, movement of sediment and flooding caused by higher precipitation intensity will increase
- Increased drought, especially in the Southwest.

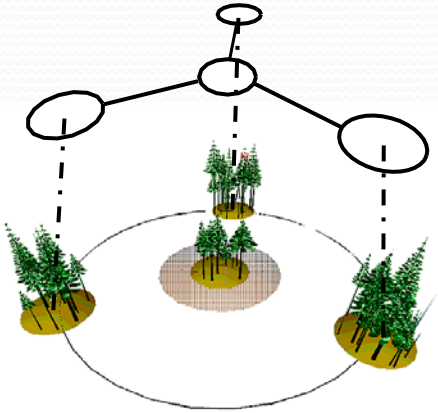
Vose and others 2012

Evolution of Forest Research - Mitigation

2000's Research Focus

- Continued research on the impacts of climate change on forests
- Forest Carbon cycle
  - Carbon dynamics of forests
  - Analyses of carbon policy
    - Focused on policy instruments and the carbon contributions of forests to mitigation
    - **Most analyses did not include the impacts of climate change on forests**

Flux tower



Forest Inventory Plot

Carbon Dynamics of U.S. Forests

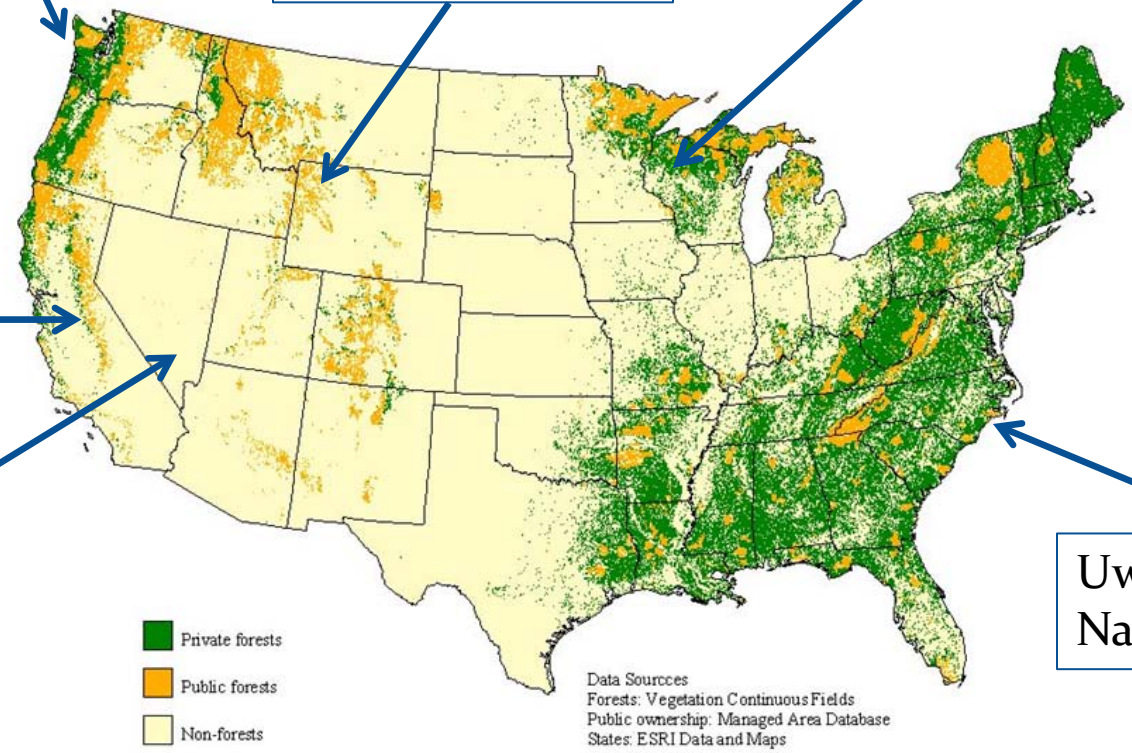
- Forest growth and afforestation in the U.S. currently account for a net gain in carbon storage and offset approximately 16 percent of the nation's fossil fuel CO_2 production.
- During the next few decades,
  - Eastern forests are expected to continue to sequester C through favorable response to elevated CO_2 and higher temperature,
  - while Western forests may begin to emit C through expanded fire and insect disturbance.

Vose and others 2012

Evolution of Forest Research - Adaptation

- 2007 IPCC assessment
  - Mitigation --- key issue
  - Expanded the understanding of vulnerability
  - Adaptation raised as an important management challenge
  - Identified the potential for interaction between adaptation and mitigation, especially with water

U.S. Adaptation Case Studies using Science-Management Partnerships



Olympic National Forest and National Park

Shoshone National Forest

Northern Wisconsin

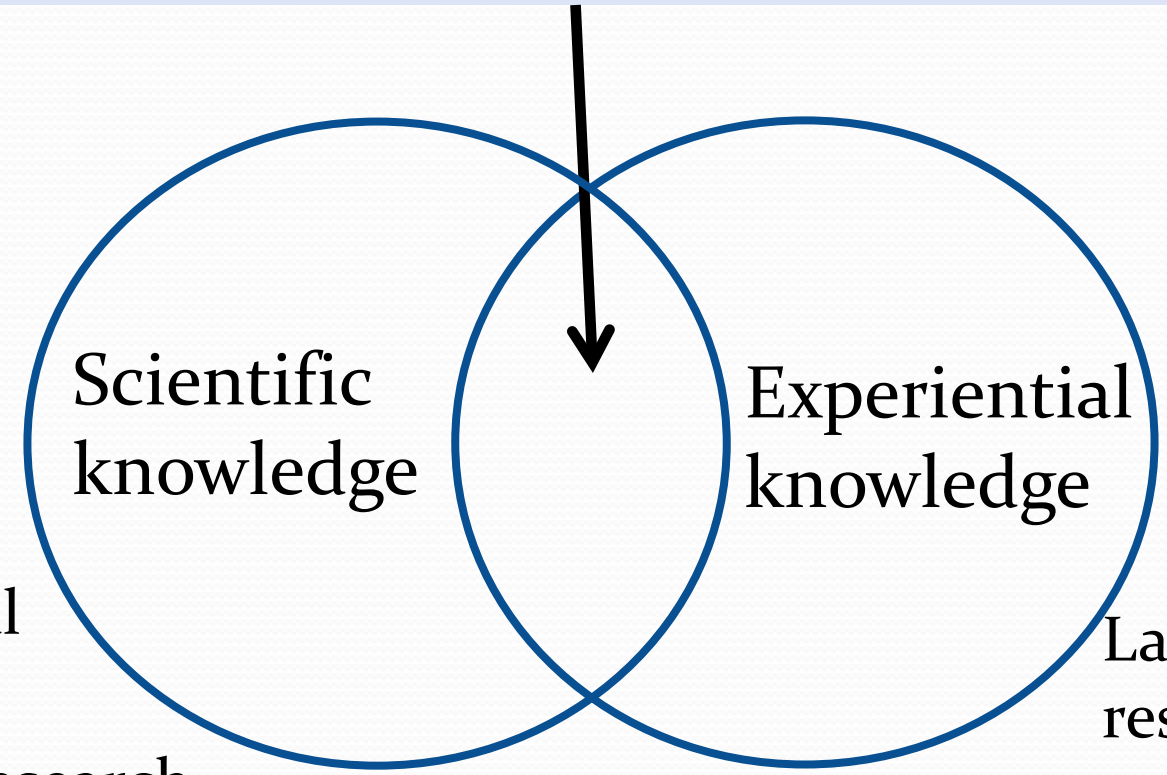
Inyo National Forest

Tahoe National Park

Uwharrie National Forest

Peterson and others 2011, Joyce and others 2008

Adaptation options developed at the Intersection of Scientific and Experiential Knowledge



Experimental research

Long-term research

IPCC reports

Land and resource management

Peterson and others 2011

U.S Forest Research and Management

Forest Service Research Focus

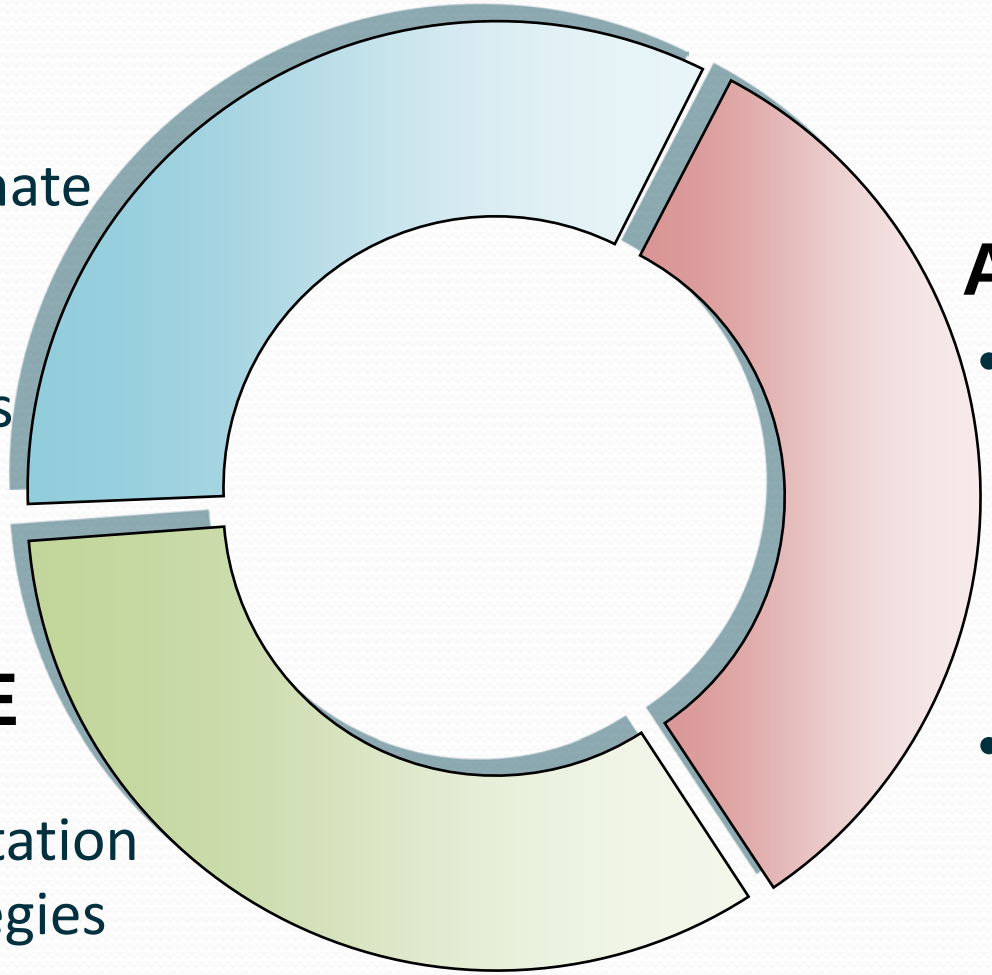
- Enhance ecosystem sustainability (Adaptation)
- Increase carbon sequestration (mitigation)
- Provide decision support for policy makers, planners, and land managers
- National resource assessment to include climate change scenarios

Solomon and others 2009

U.S. National Forest System Management
Climate Change Scorecard Activities

MONITOR

- Monitor climate impacts
- Monitor effectiveness



ASSESS

- Vulnerability of key resources to climate change and other stressors
- Carbon

REVISE
(or Amend)

- Adaptation Strategies

Forest Service Carbon Policy Principles
(proposed, in adoption process)

- Emphasize ecosystem function and resilience
- Recognize carbon sequestration as one of many ecosystem services
- Support diversity of approach in carbon exchange and markets
- Consider system dynamics and scale in decision making
- Use the best information and methods to make decisions about carbon management
- Strive for program integration and balance.

Evolution of Forest Research

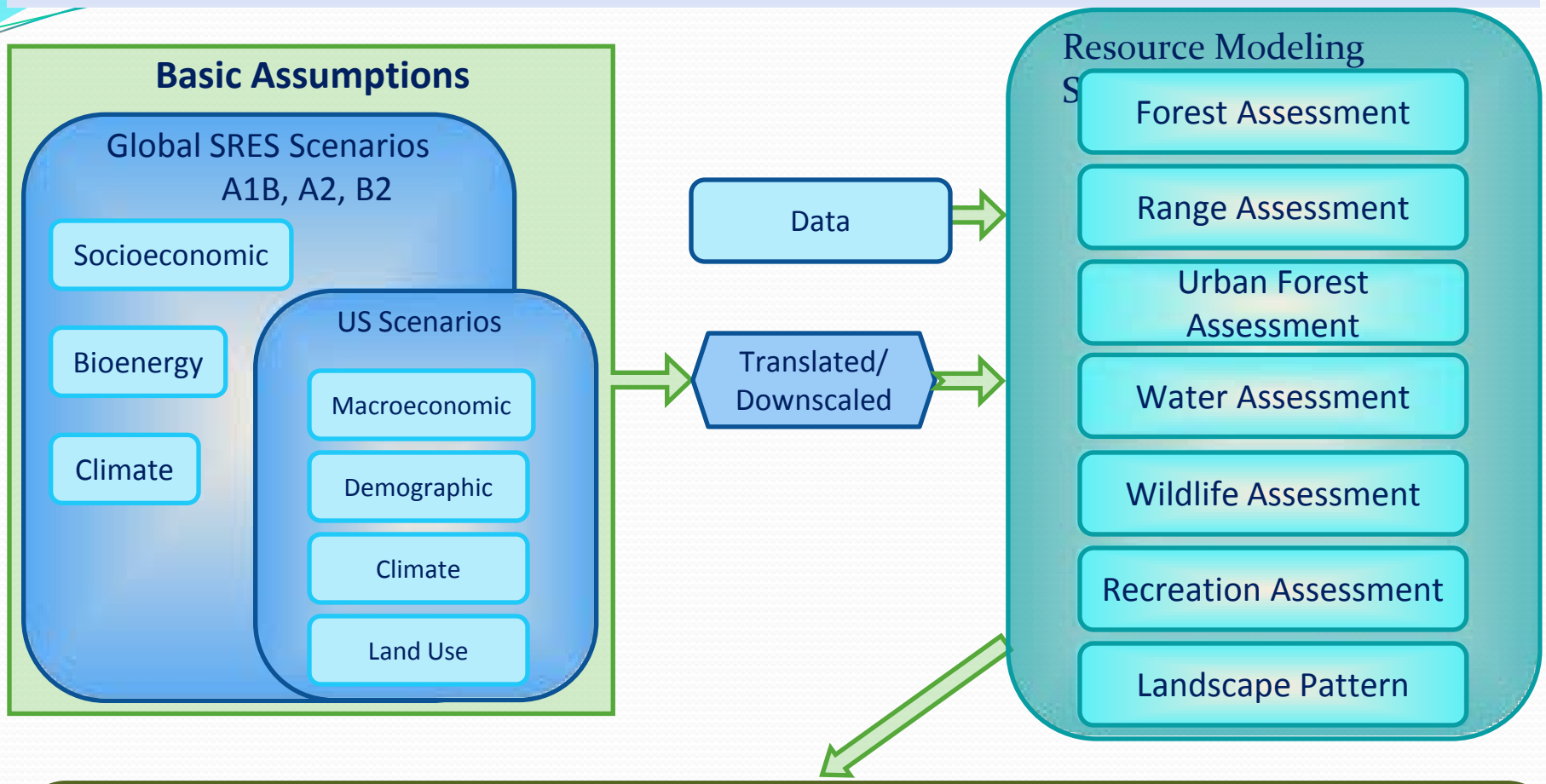
Future Challenges for Forest Research

Evolution of Forest Research

Linking

the analysis of adaptation and mitigation

Forest Service Renewable Natural Resource Assessment



Examples of Projected Ecosystem Services/Responses

Forest
- Wood Markets
- Carbon Sequestration

Range
- Forage Supply
- Condition

Urban Forests
- Tree Cover
- Carbon
- Canopy Change

Water
- Uses
- Supply
- Vulnerability

Wildlife
- Climate Stress
- Bird Diversity

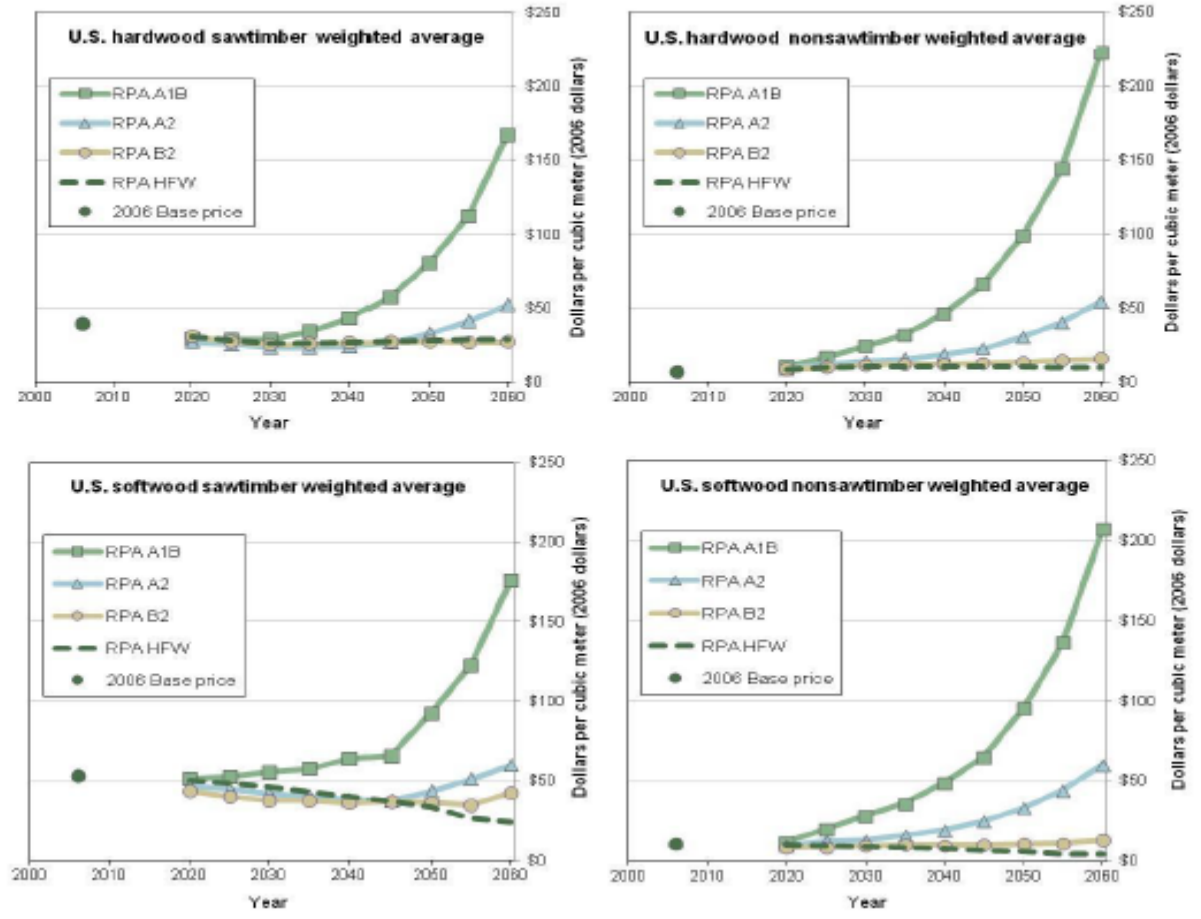
Recreation
- Participation
- Amenity Migration

Landscape Pattern
- Fragmentation
- Mosaics

Linking climate, carbon, economics

- Recent US Forest Service analysis explores the interaction of climate impacts on forests, future bioenergy demand, and the wood products market

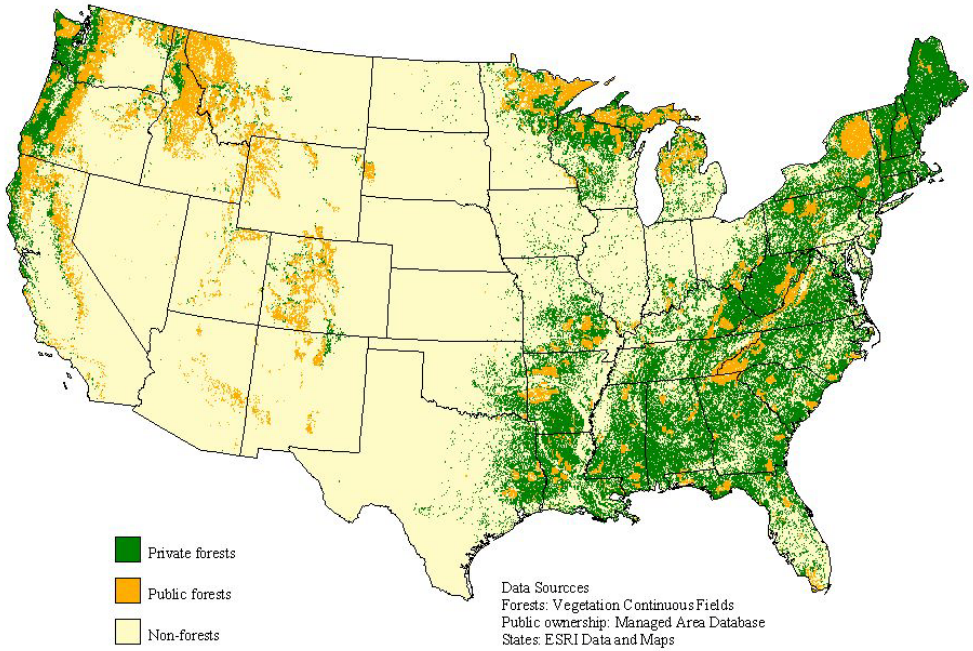
Figure 83. Projected average U.S. stumpage prices of hardwood and softwood sawtimber and nonsawtimber, by RPA scenario, 2020—2060, relative to 2006 prices.



Ince and others 2011, USFS 2012 (in press)

Forest Management – Multiple outputs, Forest managers, Risk perceptions

- Outputs: Wood products, Bioenergy, Wildlife, Water, Rare species, Recreation, Carbon Sequestration
- Forest Managers
  - Private land
  - Public land
- Risk Perception



Addressing Risk

- Perception of risk is often a factor delaying forest management actions, especially under climate change
- Recent FS analysis attempts to quantify the risk associated with carbon stocks.

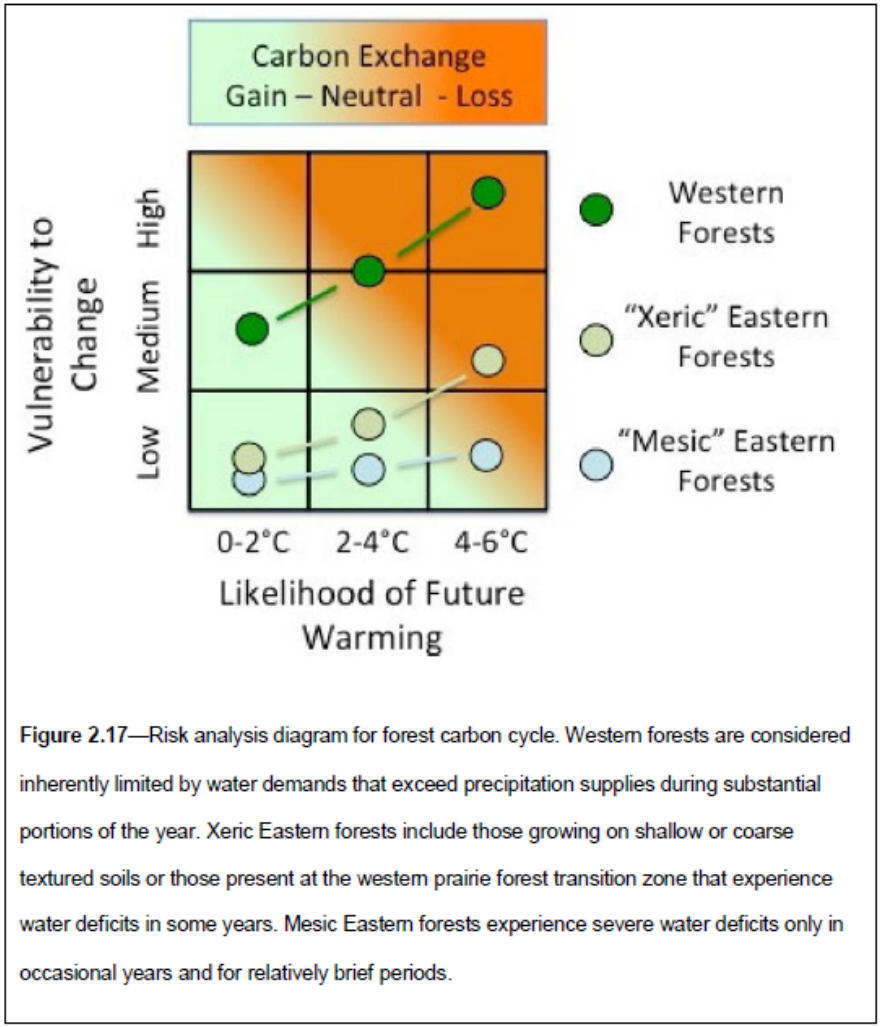


Figure 2.17—Risk analysis diagram for forest carbon cycle. Western forests are considered inherently limited by water demands that exceed precipitation supplies during substantial portions of the year. Xeric Eastern forests include those growing on shallow or coarse textured soils or those present at the western prairie forest transition zone that experience water deficits in some years. Mesic Eastern forests experience severe water deficits only in occasional years and for relatively brief periods.

Vose and others 2012

Evolution of Forest Research

Forest Research Challenges

- Assess the potential for policy and management to
  - Affect climate change impacts to forests (adaptation) linked with forest markets potential to incentivize adaptation and mitigation.
- Interactions of the domestic forest market and land use change with global forest and energy markets.

Evolution of Forest Research

Forest Research Challenges

- On-the ground resource management:
- Translating scientific information into a risk-management framework for resource managers
- Conduct field experiments to determine the degree that resource management can reduce the impacts of climate change on forests and sequester carbon
- Role of novel species in forest management

Climate Change and Forest Research

- Over the last 20 years, forest research on climate change has evolved to address scientific questions related to
  - Climate change impacts
  - Mitigation – role of forests in carbon sequestration and reducing emissions
  - Adaptation – adaptive capacity of forests and the role of management
- Forest research will need continue to evolve
  - Challenges today require an integrated approach to impacts, adaptation and mitigation.