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Economic Valuation of Carbon Sequestration in Semi-Arid Mediterranean Climates

An Ecosystem Services Application to Chaparral Landscapes in National Forests

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Partners and Collaborators

Research Team

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- Partners and collaborators
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  - USFS (Nancy Grulke, Jose Sanchez, Nancy Molinari, Hugh Safford, Sarah Sawyer, Mark Metcalfe)

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  - Pacific Northwest Research Station/Western Wildlands Environmental Threats Assessment Centre

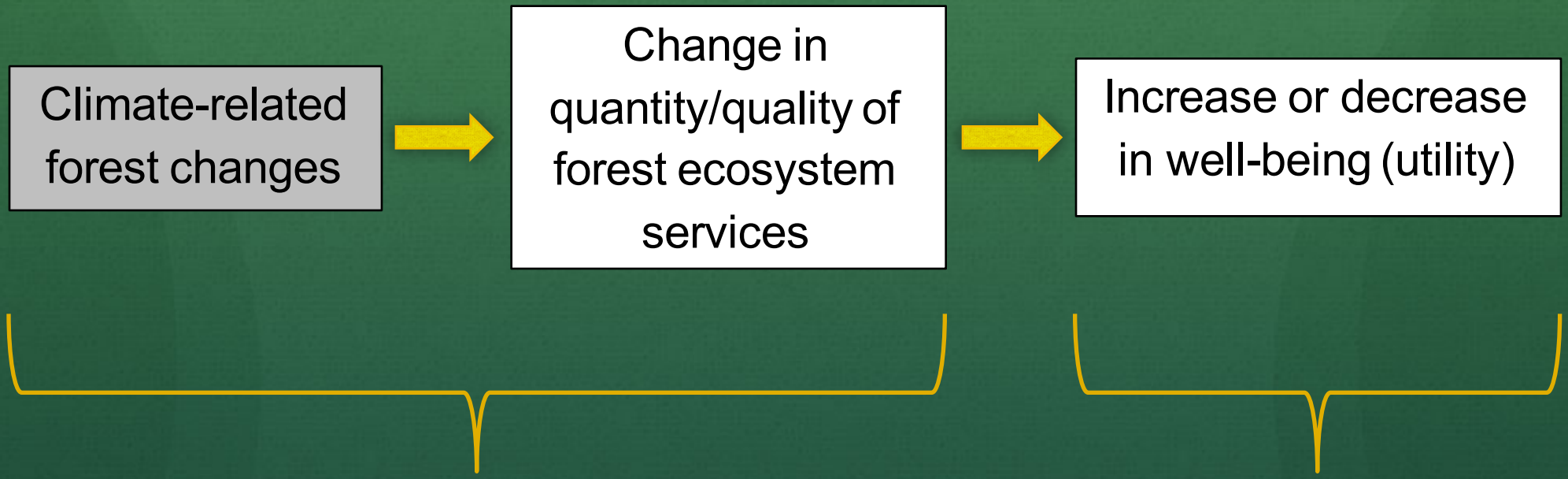
Outline

- Introduction
- Motivation
- Research Questions
- Study Area
- Ecosystem services studied
- Carbon Sequestration Methodology
- Conclusion and Policy implications

Introduction

- Socio-economic vulnerability assessment of Region 5
- This project will:
  - assess effects on people and communities
  - estimate economic value of a selection of ecosystem services
  - examine how these ecosystem services are affected by climate change
  - focus on four National Forests in southern California

An Ecosystem Services Approach



Motivation

- Need to evaluate trade-offs when making resource management and planning decisions
  - Can provide insight for forest planning and management
- Fill gaps in knowledge about:
  - Economic values of ecosystem services from national forests
  - How values for ecosystem services will change with a changing climate
- Aligns with ongoing efforts by USFS to manage resources in face of climate change

Research Questions

- What ecosystem services should be studied?
- What are their current values?
- How will climate change affect the underlying natural resources? How will these in turn affect generated ecosystem services?
- How do outcomes change due to fires?
- What is the economic value of these changes?
- How will these changes affect individuals and their communities?

Study Area

- Los Padres, Angeles, San Bernardino, Cleveland
- Highly urban, recent droughts, challenging air quality conditions
- Over 3.7 million acres, almost 30 million people
- Chaparral vegetation, semi-arid Mediterranean climate

Ecosystem Services

- Several ecosystem services highlighted as priority to the USFS:
  - Carbon sequestration
  - Water quantity
  - Air quality
  - Water quality
  - Recreation (MSU)
  - Aesthetic (MSU)
- Others:
  - Tribal cultural
  - Biodiversity

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Ecosystem services assessed in this phase of research from UC Davis

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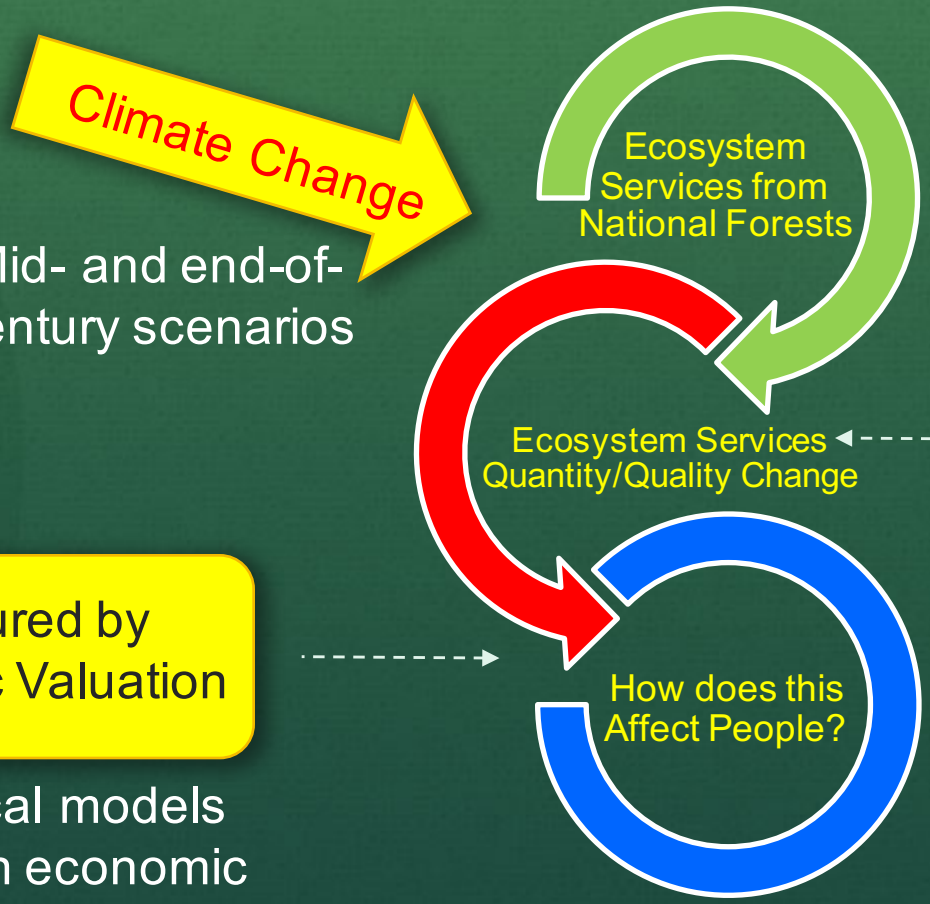
Ecosystem service will discuss today

Methodology

- Two parts to the valuation:



Mid- and end-of-century scenarios

Measured by Biophysical Models

Used as inputs for the economic models

Measured by Economic Valuation

Statistical models based on economic theory

Carbon Sequestration Economic Valuation

- For social cost of carbon, will use value estimated by U.S. government
- Undertaking economic valuation, so market prices insufficient due to externality
- Social cost of carbon:
  - Estimate of monetized damages associated with incremental increase in carbon emissions
  - Includes changes in agricultural productivity, human health, property damages due to increased flood risk, etc.
  - Interagency Working Group on Social Cost of Carbon, U.S. Government (2010)

Carbon Sequestration Economic Valuation

- Why this value?
  - Incorporates outputs from three major integrated assessment models
    - FUND, DICE and PAGE
    - Combine climate processes, economic growth and feedback between climate and global economy
    - Link physical effects to economic damages
    - Equally weighted
  - Updated regularly (2013 values used)

Carbon Sequestration Economic Valuation

- Based on average social cost of carbon values estimated from the three integrated assessment models
- Three discount rates used: 2.5%, 3%, and 5%
- Report values at above discount rates along with a fourth value to represent higher-than-expected economic effects
  - 95th percentile at 3% discount rate
- Estimated values for mid-century are given in 2007 dollars per metric ton of CO_2
  - Current (2015) average values range from $12 - $109
  - Mid-century (2050) values range from $27 - $221

Carbon Sequestration Economic Valuation

- For biophysical modelling, three opportunities:
  - Updated MC2 model (to study area)
    - Dynamic vegetation model
    - Annual stocks of carbon
  - EVI proxy for biomass (1999-2015)
    - Change in biomass before and post-fire
  - Project-specific model for study area
  - All above completed by USFS

Carbon Sequestration Economic Valuation

- Combine carbon sequestration model results with social cost of carbon
- Above ground and below ground estimates derived for present values
- $Present\ CO_2 = (Above\ Ground\ CO_2 \times SCC) + (Below\ Ground\ CO_2 \times SCC)$
- Combine forecasted carbon sequestration quantities with relevant social cost of carbon value
- $Mid\ Century\ CO_2 = (Mid\ Century\ Above\ Ground\ CO_2 \times SCC_{2050}) + (Mid\ Century\ Below\ Ground\ CO_2 \times SCC_{2050})$

Conclusions and Policy Implications

- How the findings can be used
  - Prioritize planning activities: Which projects yield greatest relative benefits for people?
  - Management to adapt to climate change: What are relative benefits of adaptations to ecological change?
  - Communicating how forests affect people and communities: How will ecological changes affect well-being?
  - Use in benefit-cost analysis to determine: Will action generate positive net economic benefits?

Thank you!

- Questions/comments?
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