Forest Carbon in the Lake Tahoe Basin: Climate, Bark Beetles, Wildfire, and Management Interactions

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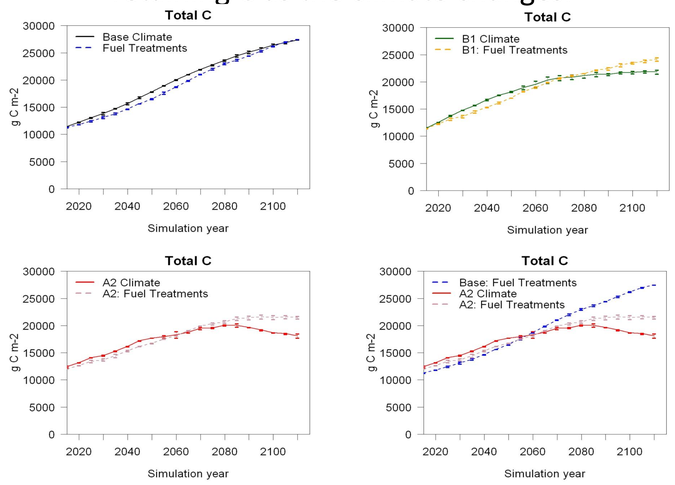
Lake Tahoe Basin

The Lake Tahoe Basin contains highly productive fire-prone forests and a high density of recreational infrastructure. Bark beetles are endemic and outbreaks are triggered by drought.

Common bark beetles include Jeffrey Pine Beetle, Mountain Pine Beetle, and Fir Engraver

Fuel Treatments and C Trade-offs

Fuel treatments become more effective at retaining C as the climate changes.

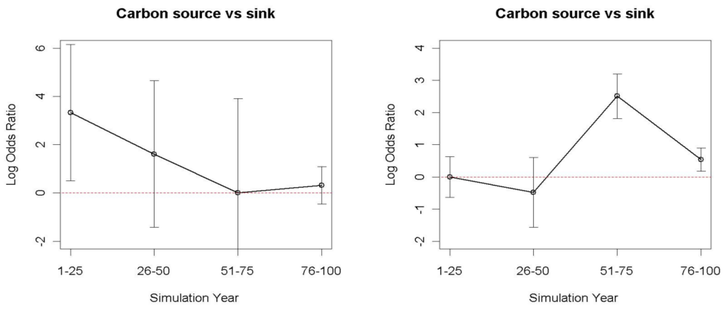


Bark Beetles and Carbon

Insects increase the probability of LTB of becoming a net C source (using Log Odds Ratio) *with* bark beetles compared to *without* bark beetles

Baseline Climate

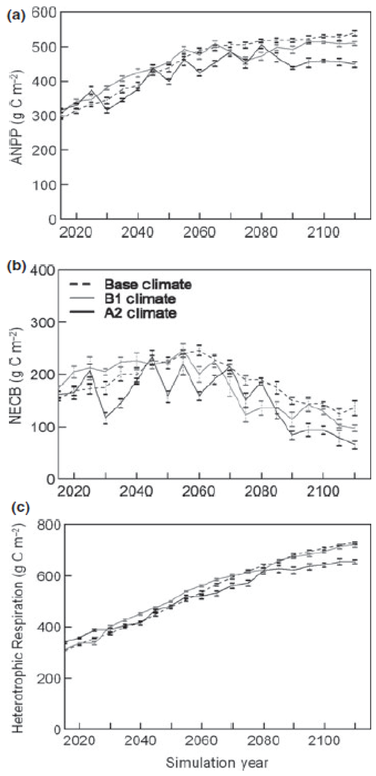
A2 Climate Change

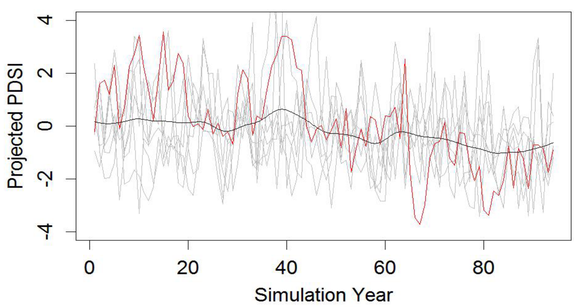


Projected Carbon Change in the Lake Tahoe Basin

- Land Use Change:
  - Past logging may have stronger short-term effect on C than climate change.
- Fuel Treatment Effectiveness:
  - Net C benefits depend on spatial arrangement and fuel treatment intensity.
- Climate Change Effects:
  - Fire regime will likely not increase substantially: suppression/treatments.
  - Drought will increase over time (measured as PDSI, below).
  - The distribution of tree species will shift across elevations.
  - ANPP and Rh decline relative to baseline climate. Generally, **indirect effects of fire and insects will be more important**.
- Bark Beetle Effects:
  - Insects may substantially reduce C resilience.

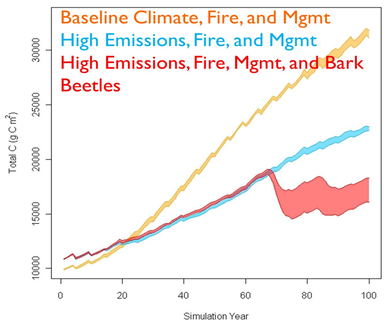
Loudermilk et al. 2013:





Scheller et al. in review:

Bark Beetles Reduce C and Increase Uncertainty



LANDIS-II Forest Simulation Model

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

Climate Scenarios

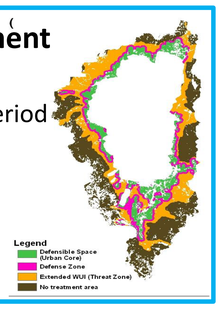
Current Climate

Climate Change Emissions scenarios

- Low (B1)
- High (A2)
- GFDL

Forest Management

- 3 Treatment areas
- 15 Year rotation period
- Light & moderate thinning
- Reduce fire hazard



Wildfire

- Fuels and Ignition
- Climate
- Topography
- Min Travel Time

Bark Beetles

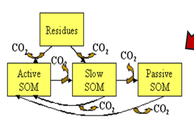
- Climate triggered (PDSI)
- Host density
- Dispersal

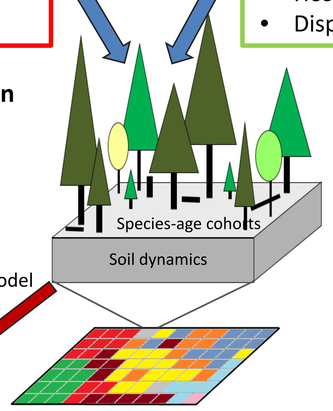
Carbon and Nitrogen

- Soil texture
- Soil C and N pools
- N inputs

Soil dynamics

- Modified CENTURY model





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

Published Work

Contact: rmschell@pdx.edu

Scheller et al. *In review*. Wildfire, drought and bark beetles: forecasting the effects of interacting disturbances in Western USA forests. PNAS.

Kretchun et al. *In review*. Stand to landscape level forest productivity: Using tree-cores and disturbances to model forest growth patterns. Ecosystems.

Loudermilk et al. 2014. Effectiveness of fuel treatments for mitigating wildfire risk and sequestering forest carbon: A case study in the Lake Tahoe Basin. Forest Ecology and Management 323: 114-125.

Loudermilk et al. 2013. Carbon dynamics in the future forest: Theimportance of climate-fire interactions and long-term successional legacy. Global Change Biology 19:3502-3515.

Acknowledgments

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