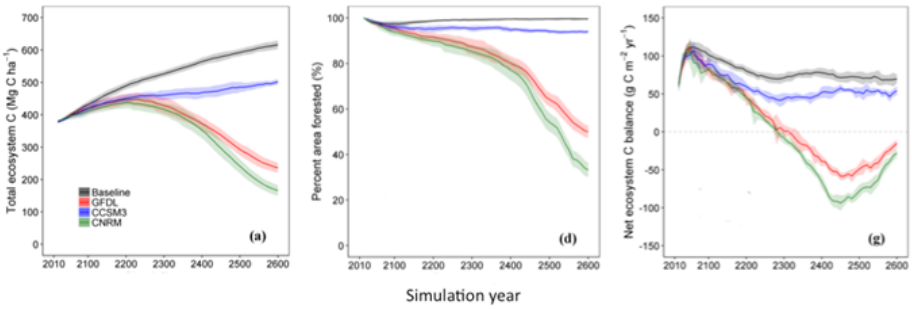
Earth Systems Ecology Lab



Changes in mean total ecosystem carbon, percentage of area forested, and net ecosystem carbon balance for baseline and projected climate and wildfire scenarios under three general circulation models over the 590-year simulation period in the northern Sierra Nevada. Shaded areas represent the standard deviations.

Projected Climate and Wildfire Decrease Forest Carbon Storage

Prevailing climate and natural disturbance regimes are projected to change significantly in the western US, which could negatively impact forest carbon storage. We ran simulations along a latitudinal gradient of the Sierra Nevada Mountains to quantify the potential impacts of future climate and area burned by large wildfires projected under a moderate-high emission scenario on long-term successional trajectory and forest carbon dynamics.

We found that the projected scenarios would drive a significant decrease of up to 73% in mean total ecosystem carbon relative to baseline across the landscape by the end of the 590-year simulation (see figure). As carbon stock declined, the retained live tree carbon was mostly maintained at higher elevations and in pine trees. Tree regeneration failure due to intensified growing season dryness and increased area burned resulted in as much as 65% reduction in forested area by simulation end. Delayed post-fire recovery under drier climate transitioned the landscapes into a net carbon source for the latter half of the simulation period.

Our simulations in the Sierra Nevada show that mean carbon loss from the forests under projected climate and wildfire could be as large as 663 Tg C, which is approximately 78% of the total aboveground carbon stored in terrestrial systems in California in 2010. The peak carbon flux to the atmosphere over the simulation period could amount to ca. 3% of California's 2020 emission reduction target (116 Tg C).

Management Implications

Large-scale vegetation type conversion from forest to non-forest types across the Sierra Nevada Mountains is possible beyond the 21st century.

Reduction in forest cover would be most extensive at mid-elevations, where these landscapes are expected to experience decreasing snowpack and the current forest communities are predominately comprised of drought-intolerant, fire-sensitive species.

Current climate buffering capacity of Sierra Nevada forests could transition to a liability if we maintain a business-as-usual emissions trajectory.

Publication:

Liang S, MD Hurteau, AL Westerling. 2017. Potential decline in carbon carrying capacity under projected climate-wildfire interactions in the Sierra Nevada. Scientific Reports 7:2420.

Funded by: USDA NIFA

Project: GRANT11023720

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