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Review

Altered dynamics of forest recovery under a changing climate

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Abstract

Forest regeneration following disturbance is a key ecological process, influencing forest structure and function, species assemblages, and ecosystem–climate interactions. Climate change may alter forest recovery dynamics or even prevent recovery, triggering feedbacks to the climate system, altering regional biodiversity, and affecting the ecosystem services provided by forests. Multiple lines of evidence – including global scale patterns in forest recovery dynamics; forest responses to experimental manipulation of CO_2, temperature, and precipitation; forest responses to the climate change that has already occurred; ecological theory; and ecosystem and earth system models – all indicate that the dynamics of forest recovery are sensitive to climate. However, synthetic understanding of how atmospheric CO_2 and climate shape trajectories of forest recovery is lacking. Here, we review these separate lines of evidence, which together demonstrate that the dynamics of forest recovery are being impacted by increasing atmospheric CO_2 and changing climate. Rates of forest recovery generally increase with CO_2, temperature, and water availability. Drought reduces growth and live biomass in forests of all ages, having a particularly strong effect on seedling recruitment and survival. Responses of individual trees and whole forest ecosystems to CO_2 and climate manipulations often vary by age, implying that forests of different ages will respond differently to climate change. Furthermore, species within a community typically exhibit differential responses to CO_2 and climate, and altered community dynamics can have important consequences for ecosystem function. Age and species dependent

responses provide a mechanism by which climate change may push some forests past critical thresholds such that they fail to recover to their previous state following disturbance. Altered dynamics of forest recovery will result in positive and negative feedbacks to climate change. Future research on this topic and corresponding improvements to earth system models will be a key to understanding the future of forests and their feedbacks to the climate system.

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