Tree regrowth impacts on high-resolution snowpack modeling in a Mediterranean montane catchment

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Abstract

Montane snowpack in the Sierra Nevada provides critical water resources for ecological functions and downstream communities. Climate change is reducing snow accumulation challenging water management and intensifying environmental water stress. Forest removal is one of the few means by which we can manage the snowpack in montane forests and mitigate the effect of climate. Decades of research have focused on understanding and quantifying the effect of forest removal on snow accumulation and melt, from empirical paired watershed experiments to high resolution snow simulations (e.g., 1-m). High resolution models typically do not include carbon cycling processes required to represent trees regrowth following forest disturbance, and thus, how it might affect the expected long-term snow accumulation and melt benefits from decreasing canopy sublimation. This research uses a 1-m resolution process-based snow model (SnowPALM) capable of representing small scale snowpack and trees interactions, coupled with an ecohydrological model (RHESSys) that resolves water, energy, and carbon cycling to simulates trees regrowth, to understand and quantify the effect of long-term trees regrowth on snowpack dynamics in the Sierra Nevada, California. Simulations are carried out on an 84 m x 234 m forested patch over a 40-yr period, where a virtual forest thinning and clearcutting scenario are analyzed. Results show how tree regrowth following disturbance affects the expected results from the same high resolution snow model with a static vegetation, where canopy interception and sublimation consistently increases as trees grow. This research is expected to shed light into the processes governing the coevolution of forests and snowpacks in Mediterranean montane systems, which can help informing forest restoration management in the Sierra Nevada.