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Vulnerability of Landscape C Fluxes to Future Climate and Fire in the Greater Yellowstone Ecosystem

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New hydroclimatic analyses indicate that the subalpine forests of the Greater Yellowstone Ecosystem (GYE) are vulnerable to extreme fire events under climate change. Large fires, as those in 1988, may represent the "norm" rather than the exception under future climate scenarios. The consequences of a climate shift of this magnitude on the fire regime, post-fire succession and carbon (C) balance of western forest ecosystems are well beyond what scientists have explored to date, and may fundamentally change the potential of western forests to sequester atmospheric C. We hypothesize that vegetation communities contribute differentially to future landscape C flux because of different sensitivities to future climate and fire combinations. Here, we used an ecosystem model (CENTURY v. 4.5) to forecast C storage among dominant vegetation communities in the GYE associated with different fire severities, regeneration rates, and climates: lodgepole pine, warm-dry and cool-moist conifers, aspen, and grassland/shrubland. The model was parameterized for each vegetation type using empirical data on post-fire C loss, recovery rates, and C storage potential. Vegetation types were run forward under future climate scenarios: downscaled (1/8 degree grid) A2 and B1 emissions pathways for three global climate models (NCAR PCM1, GFDL CM2.3, CNRM CM3). Results indicate that climate-driven shifts in recovery time are vegetation-type specific, and can lead to net C fluxes to the atmosphere if recovery time is less than the average fire return interval. Mapping the climate and fire conditions that lead to shifts in C balance helps to identify 'tipping points' of landscape C storage.