Kashian, Daniel M.[1]*, Michael G. Ryan[2], William H. Romme[1], Daniel B. Tinker[3], and Monica G. Turner[4]. [1]Department of Forest, Rangeland, and Watershed Stewardship, Colorado State University, Fort Collins, Colorado, 80523; [2]USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado, 80526; [3]Department of Botany, University of Wyoming, Laramie, Wyoming, 82071; [4]Department of Zoology, University of Wisconsin, Madison, Wisconsin, 53706. Effects of changes in climate and fire frequency on landscape-scale carbon cycling in coniferous forests.

The ability of ecologists to discern the effects of climate change on the global carbon budget is critical for predicting future impacts upon terrestrial ecosystems. Strong links between climate, fire regimes, and forest structure and development have been documented for coniferous forests, but we lack a solid adeptness in describing the interplay between these factors and carbon storage that characterizes forest ecosystems. Using empirical data collected from replicated chronosequences, biogeochemical modeling, and fire modeling, we examined how changes in fire frequency may alter the distribution of lodgepole pine forest age and structure across the landscape of Yellowstone National Park and how these changes, in turn, may affect the carbon balance of the landscape. Because carbon storage at the landscape scale is shaped by the aggregate behavior of individual stands, we note two important processes that regulate shifts in net ecosystem productivity (NEP) at landscape scales. First, the degree to which stand structures persist following stand-replacing fires is a strong driver of the long-term ability of the stand to store carbon. If the long-term distribution of stand structures on a landscape is altered by large fires, large disturbances – especially if they occur more frequently due to climate change - may alter the distribution of density classes across landscapes and drastically affect landscape-scale NEP. Second, more frequent large disturbances may shift the distribution of stand ages on a landscape, causing a shift in landscape NEP. Assuming the distributions of stand density and age classes do not change following large fires, fires like those in Yellowstone in 1988 create a landscape that acts as a strong but short-lived (< 50 years) source of carbon followed by a longer period as a moderate carbon sink. Preliminary results suggest that the current Yellowstone landscape, characterized by disturbances that occur over long intervals, has the ability to regain pre-disturbance levels of carbon storage. Climate change that reduces the fire interval, however, may result in a shift of the Yellowstone landscape towards a long-term carbon source.