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TITLE: Fire, Vegetation, Climate Interactions in the Greater Yellowstone Ecosystem: Tipping Points and Landscape Vulnerability

PRESENTATION TYPE: Assigned by Committee (Oral or Poster)

CURRENT SECTION/FOCUS GROUP: Natural Hazards (NH)

CURRENT SESSION: NH09. Wildfires on Landscapes: Theory, Models, and Management

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ABSTRACT BODY: The subalpine forests of the Greater Yellowstone Ecosystem are vulnerable to extreme fires under climate change but the consequences of repeated large fire events on vegetation dynamics and carbon (C) storage are unknown. Shifts in post-fire succession may represent fundamental changes in the potential of western forests to sequester atmospheric C. In this study, we ask whether the projected changes in climate and fire for the region are sufficient to significantly inhibit post-fire forest recovery. We hypothesize that vegetation communities contribute differentially to future landscape C flux because of different sensitivities to future climate and fire combinations, with largest changes expected for conditions that switch forest to grassland. Here, we used an ecosystem model (CENTURY v. 4.5) to forecast C storage among dominant vegetation communities in Greater Yellowstone 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 four global climate models (NCAR PCM1, GFDL CM2.3, CNRM-CM3, CCSM3) for three locations in Yellowstone National Park (Old Faithful, Lake Yellowstone, and Lamar) that represent current climate and vegetation conditions in the park. Results indicated that under historical climate and contemporary fire return intervals (172 yrs), cumulative C emissions from fire were greatest when fire severity was low, largely due to higher fuel buildup. Reductions in C storage under future climate were greatest when fire return intervals were less than ca. 80 yrs – the time needed to replace C stocks consumed by fire, and when climate conditions were more suitable for grassland versus forest, but were less sensitive to changes in fire severity. We conclude that landscape C flux is dependent on the interaction of climate-induced shifts in fire regimes with climate-induced shifts in vegetation, representing an important challenge to contemporary ecosystem models.

KEYWORDS: [0428] BIOGEOSCIENCES / Carbon cycling, [0466] BIOGEOSCIENCES / Modeling, [0468] BIOGEOSCIENCES / Natural hazards, [0439] BIOGEOSCIENCES / Ecosystems, structure and dynamics.

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Additional Details

Previously Presented Material:

Scheduling Request: