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Linkages between snowcover, fire, and vegetation in mountain watersheds of the Pacific Northwest, USA

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Snow cover is a key source of moisture in mountain ecosystems and has been shown to affect vulnerability to fire in the western United States. Wildfire disturbance also affects patterns of snow accumulation by reducing canopy interception, increasing turbulent fluxes, and modifying the surface radiation balance. Recent work documenting snow-vegetation interactions in burned and unburned forests show that burned forests experience increased snow accumulation but earlier and more rapid melt. In this presentation, we describe two fire-snow feedbacks that have been previously undocumented.

The first part of this investigation examines the role of snow in post-fire vegetation recovery. In a mountain watershed we use the MODIS snow cover product from 2000-2009 to map the frequency of snow cover during fall, winter and spring seasons for the coterminous United States. Snow cover frequency is defined as the number of times a MODIS pixel is classified as snow-covered relative to the total number of valid observations during each 3-month season. Seasonal MODIS-derived maps of Enhanced Vegetation Index (EVI, a measure of green biomass) were also created for the same period. Our study area is the Siskyou Mountains of southern Oregon where the Biscuit Fire of 2002 burned about 2000 km2 of forested wilderness. Prior to the fire, there was a weak, negative relationship between snow frequency and EVI but following the fire there was a statistically significant positive relationship between snow frequency and EVI, particularly for higher elevations that have a snow-dominant winter precipitation regime. This suggests that snow assists in post-fire vegetation regrowth.

The second part of this investigation explores the albedo effect of wildfire on subsequent years' snowpack. Traditional conceptions of snow-vegetation interactions are based on studies focused on forest harvesting, not on fire-affected watersheds and no study to date has examined the albedo effect. At the local-to-watershed scale, wildfire-derived black carbon sloughing from burned trees onto the snowpack has been suggested as an important forcing of earlier melt and anecdotal evidence suggests that snowpacks in the wildfire areas appear to be experiencing this forcing. Our study area is a mountainous, dense forest at an elevation of about 1750 m in the Oregon Cascades that was recently burned. Here we compare measurements of spectral albedo of snow that were acquired along transects through burned and unburned areas of the study site. We also measure surface energy balance using data acquired at meteorological stations within the burned and unburned areas. We present first results of the snow albedo and energy balance differences between burned and unburned areas.