Earlier snowmelt may alter mountain water resources through the timing of plant growth

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Abstract

Earlier snowmelt in mountain watersheds is a manifestation of climate warming and increased dust deposition, the latter of which is associated with a sharp decrease in snow albedo. The date of snowmelt is a key driver of plant emergence phenology, i.e. the timing of first leaf growth. Advanced snowmelt can trigger some species to emerge earlier, leading growth to become decoupled from favorable atmospheric temperatures, nutrient pulses, and well-established biotic interactions. Ultimately, early summer emergence may leave plants vulnerable to foresummer drought.

In the East River watershed near Crested Butte, Colorado, our multidisciplinary team (http://watershed.lbl.gov/community-observatory) monitored green-up, flowering, and senescence of numerous plant species at six meadow sites along an elevation gradient (9100-11700 ft/ 2774-3566 m). Phenological observations in 2017 began shortly after snowmelt in early May (lower montane and lower subalpine life zones) and late June (upper subalpine and alpine life zones). Observations of individual plants for all species were coupled with plot-level microclimate and surface greenness monitoring across four sites. Species at montane and lower subalpine sites emerged 1-2 months earlier than at upper subalpine and alpine sites. These species and site specific measurements were compared to remote sensing observations of greenness and confirmed that earlier emergence exposes plants to longer periods of water scarcity between snowmelt and the onset of monsoon rains (foresummer drought).

In parallel, we are developing a DNA-based barcoding of plants in order to create an inventory for these species-rich mountain meadows as well as connecting above-ground plant traits with below-ground root traits. Our results from this year inform our understanding of leaf expansion and its relationship to first flowering dates. We will further develop insights by initiating early snowmelt manipulations at four of these sites in spring 2018. We predict that at lower elevation sites, snowmelt will shift plant growth and water use seasonally, decreasing the water resources typically available at these sites. Alternatively, higher elevation sites will be constrained by temperature and greater snow depth, limiting the effect of earlier snowmelt on plant growth and water use.

Biography

Chelsea recently graduated from Fort Lewis College with a degree in Environmental and Organismal Biology and has taken a special interest into the biogeochemical interactions associated with plants. She has been working as a research assistant for Heidi Steltzer in Crested Butte, Co for just over a year and hopes to carry the work she's been doing into a masters program.