Impacts of Wildfire Reburn Events on Water Storage & Transport in the Washington Cascades

Katherine B. Swensen[1*] and Kevan B. Moffett[1]
[1]School of the Environment, Washington State University Vancouver | *Contact: k.swensen@wsu.edu

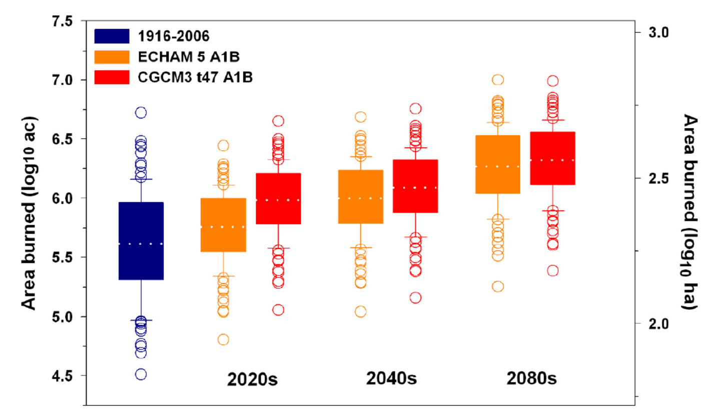
I. Background

Motivation

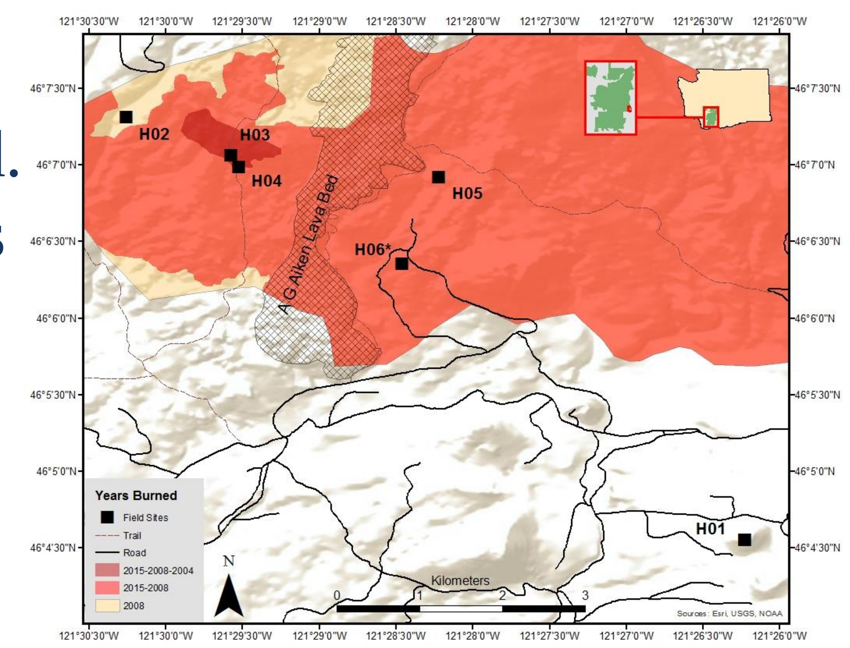
- Washington State water resources are stressed under increasing temperatures, earlier snowmelt, and declining snowpack.
- Increasing wildfire activity may further degrade hydrologic resources through sediment and nutrient loading from erosion; as-well-as changes to the timing and magnitude of water transport from montane headwaters to the lakes and rivers within the watershed.
- The impact of reburn events on hydrologic processes is relatively unknown, yet they have recently occurred in ecosystems with historically less frequent wildfire.

Aim

To quantify the impact of repeat, short-interval wildfire on hydrologic recovery (to pre-fire conditions) in a formerly moist, mixed-conifer forest in the Washington Cascades.



Projected increases in wildfire activity for the state of Washington (Littell et al., 2010)



Recurrent wildfire boundaries in Mt Adams region of the Gifford Pinchot National Forest

II. Approach

Field Sites

50m^2 plots on the south slope of Mt. Adams recovering several years after zero-three moderate/severe wildfires (consistent slope, aspect, elevation)

Unburned | 2008 | 2004/ 2008 | 2015 | 2008/ 2015 | 2004/ 2008/ 2015

Photos of representative unburned, single, double, and triple wildfire field sites on south slope of Mt. Adams, taken in summer of 2019

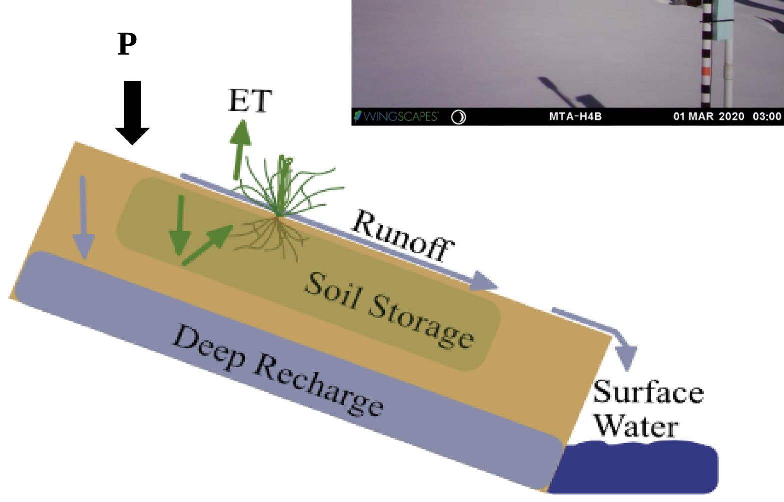
Methods

Snow Accumulation and Ablation Monitoring

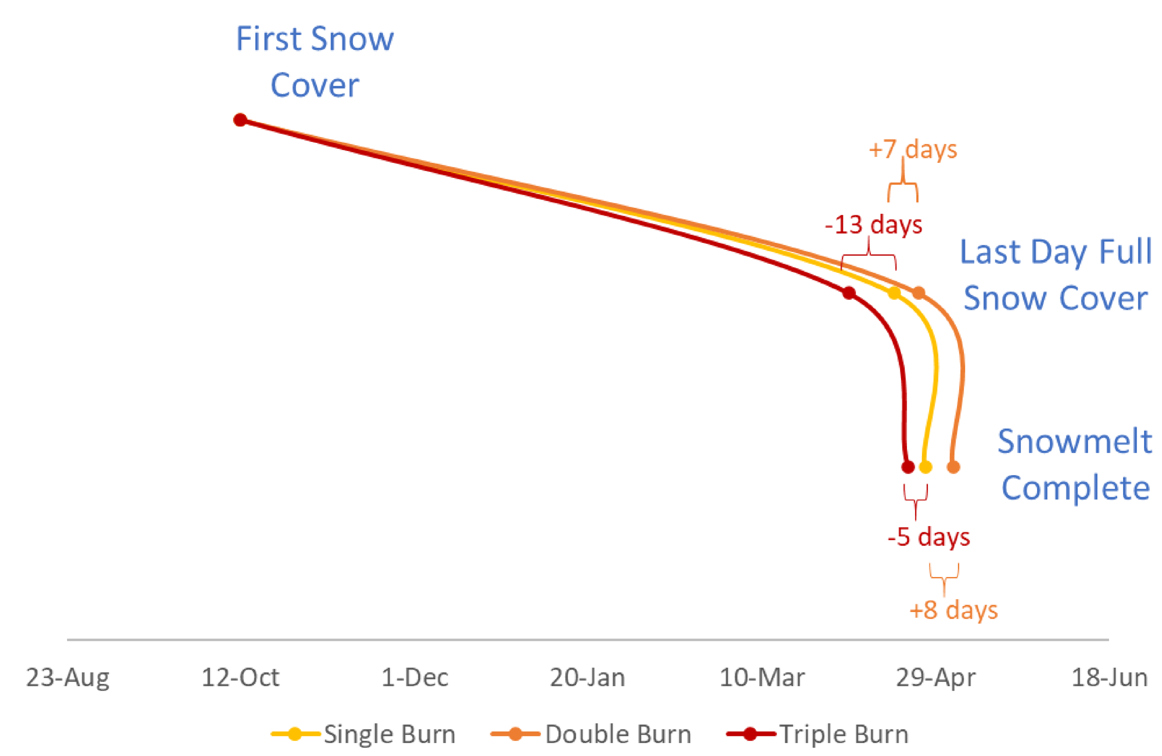
- Field measurements with snow depth poles/cameras
- Comparison of spring melt timing

Seasonal Plot-Scale Empirical Water Balances

- Field measurements of soil moisture, vegetation parameters, soil properties, and meteorological data
- Comparison of hydrologic fluxes and stores across wildfire history

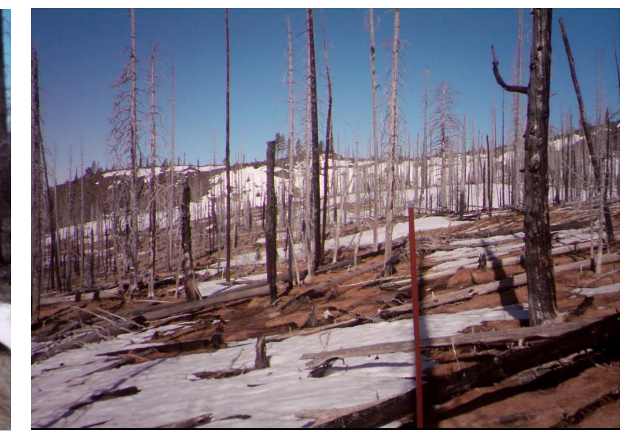


III. Results



Spring snowmelt occurs nearly two weeks earlier in triple burned plot, but one week later in double burned plot (than single)

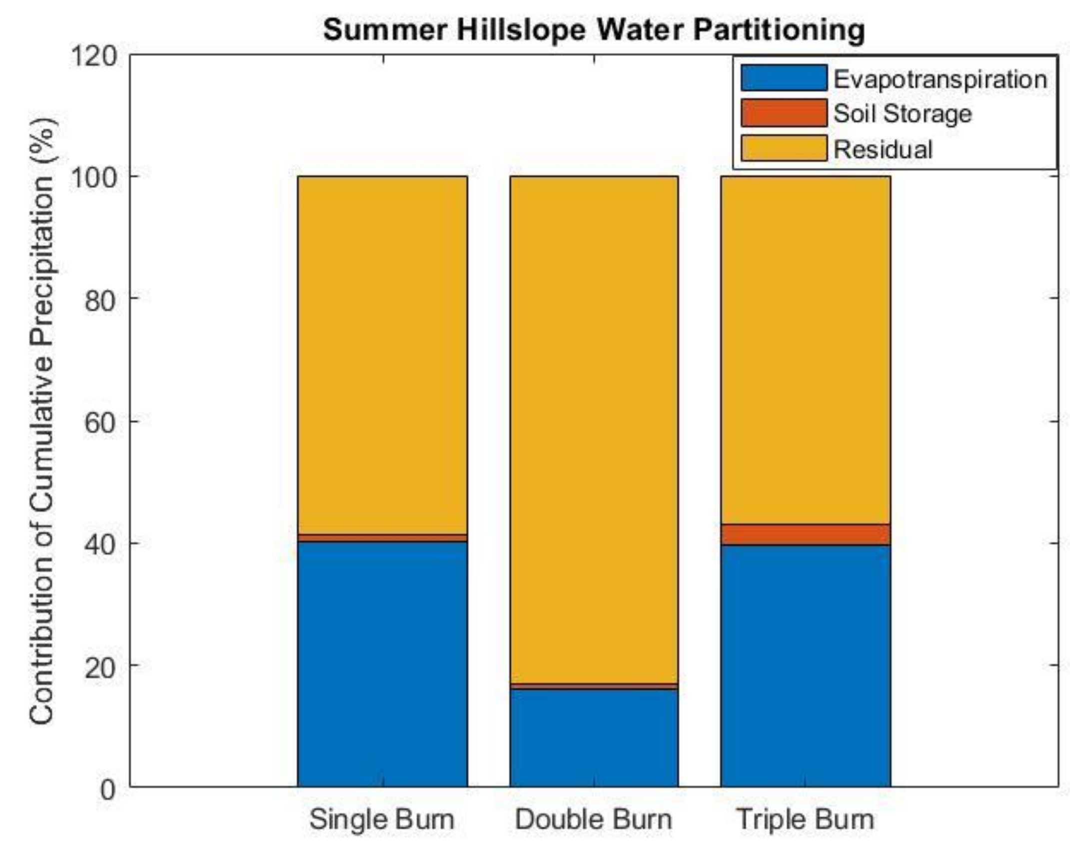
Single Burn Plot April 15, 2020



Double Burn Plot April 20, 2020

Large residual water fraction and low potential evapotranspiration in double burned plot suggests high hillslope outflow

Greater soil storage in the triple burn plot, along with evidence of rills four years after wildfire (right), suggests outflow may be dominated by runoff (over deep drainage)



IV. Implications and Next Steps

Implications

- The preliminary findings of this research provide evidence of early melting, prolonged runoff, and large outflows have implications for early season flooding and lower late season flows in watersheds burned in more frequent wildfire events
- Though outflows after snowmelt may be elevated, unburned coarse woody debris in a (once) reburned forest may partially counteract post-fire snowmelt acceleration

Next steps

- Incorporate physical hydrologic model for drainage (to further partition outflows)
- Utilize climate forecast model meteorological outputs to compare hydrologic fluxes across wildfire history under current and future climate conditions

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