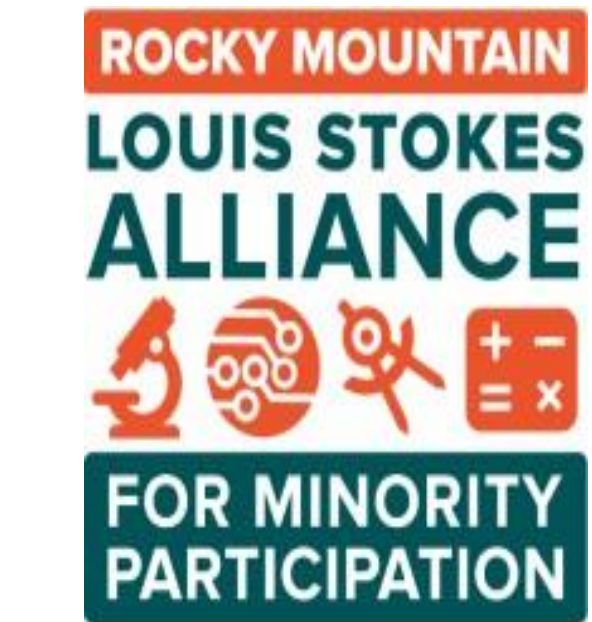


Quantifying the Aspect-dependent Impact of Wildfires on Snow Accumulation and Melt in Northern Colorado

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Background

- In recent decades, 70% of ecoregions in the western U.S. experienced significant increases in wildfire extent in areas where deep snowpacks accumulate¹.
- Previous work has shown post-fire impacts on snow, including changes in peak snow water equivalent (SWE) timing, faster snow melt rates and earlier snow disappearance dates².
- Many western states, including Colorado, rely heavily on snow water resources for municipal and agricultural water needs.

Research Topic

We evaluated post-wildfire impacts on snow accumulation and melt in northern Colorado using a network of timelapse cameras.

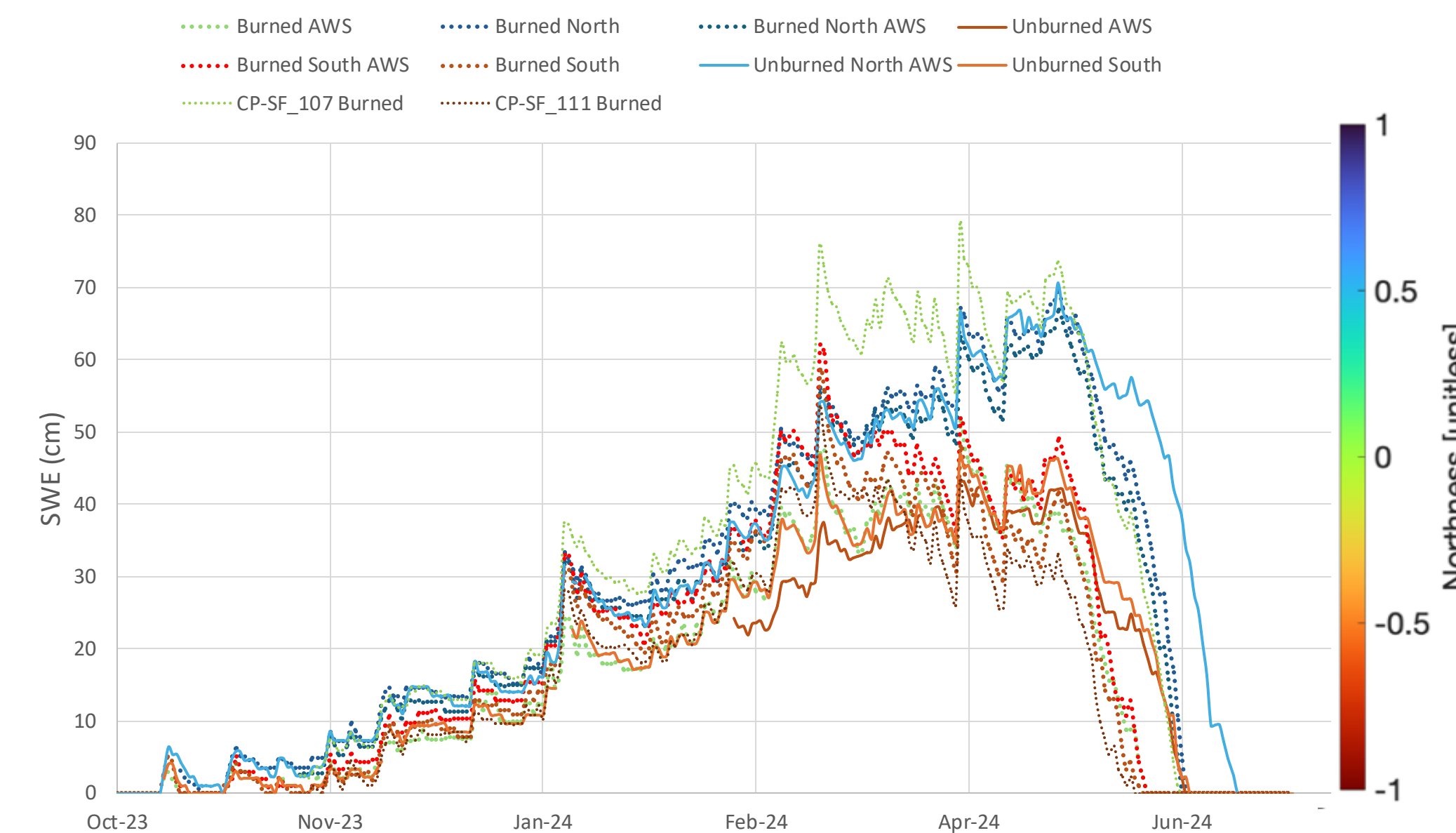


Figure 1: Time series of snow water equivalent (SWE) at all sites during the 2023-24 winter.

Study Area

Timelapse cameras were installed at 11 sites that spanned different topographic settings (north vs south) and burn conditions (burned vs unburned).

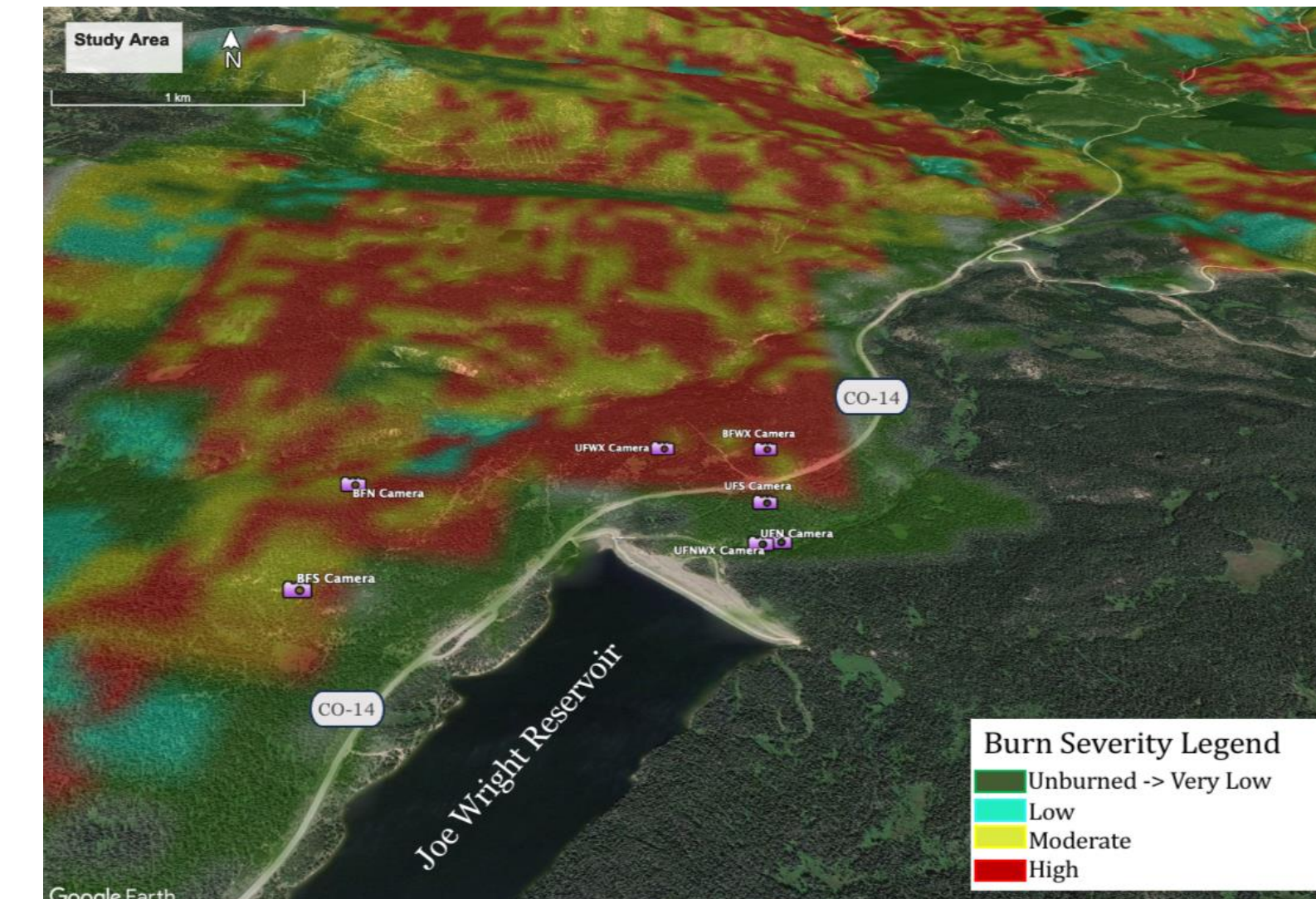


Figure 2: Google Earth map of study sites overlaid on burn severity.

Methods

- We extracted snow depth at daily resolution and converted to snow water equivalent using ~biweekly snowpit-measured densities interpolated to daily resolution.
- We analyzed peak SWE magnitude, peak SWE date (the timing of maximum snow water), Snow-off Date, and melt rate.

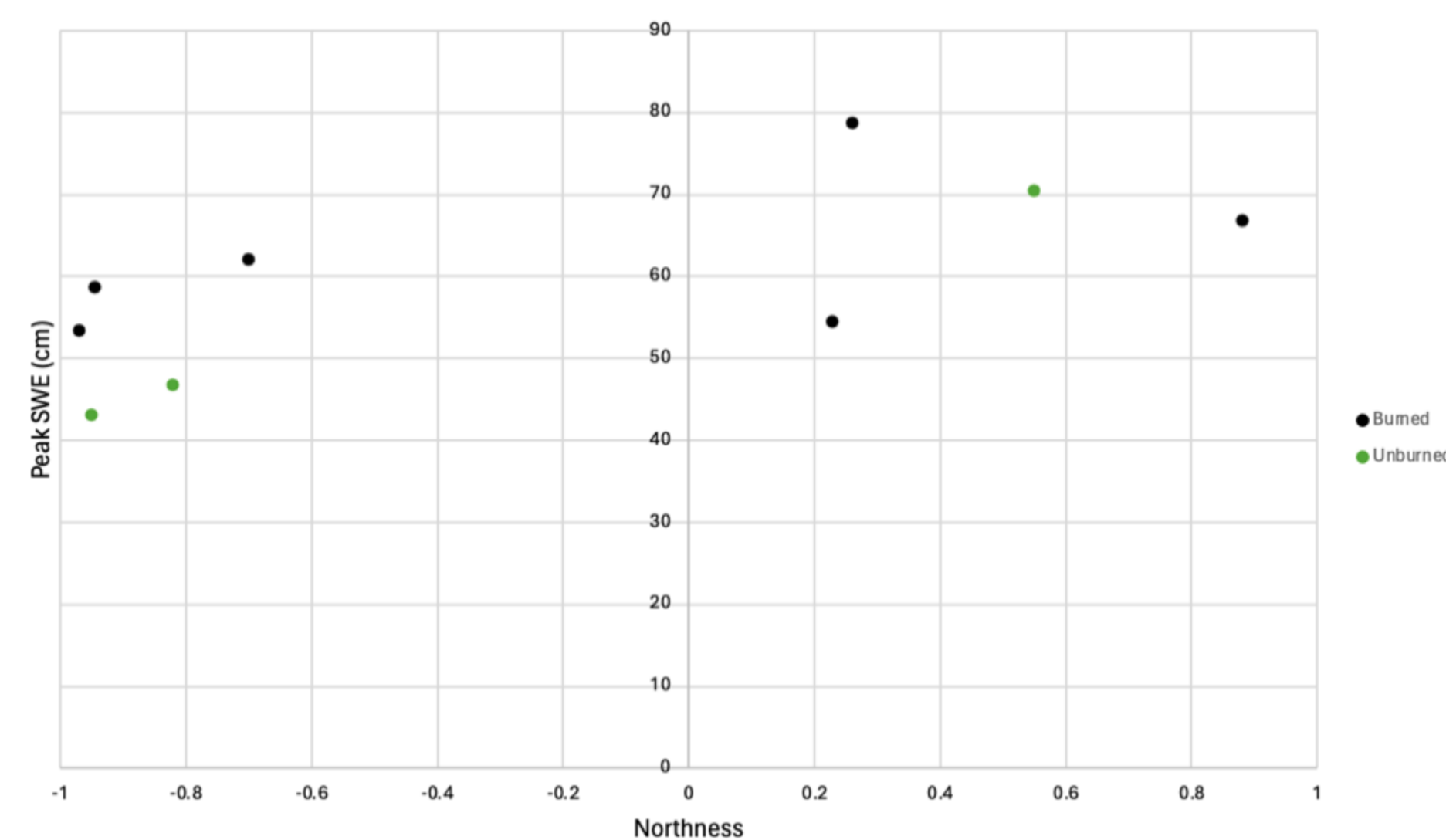


Figure 3: Example snow-free photos showing the unburned (left) and burned (right) north sites.

Research Questions and Key Findings

Topic : Peak Snow Water Equivalent

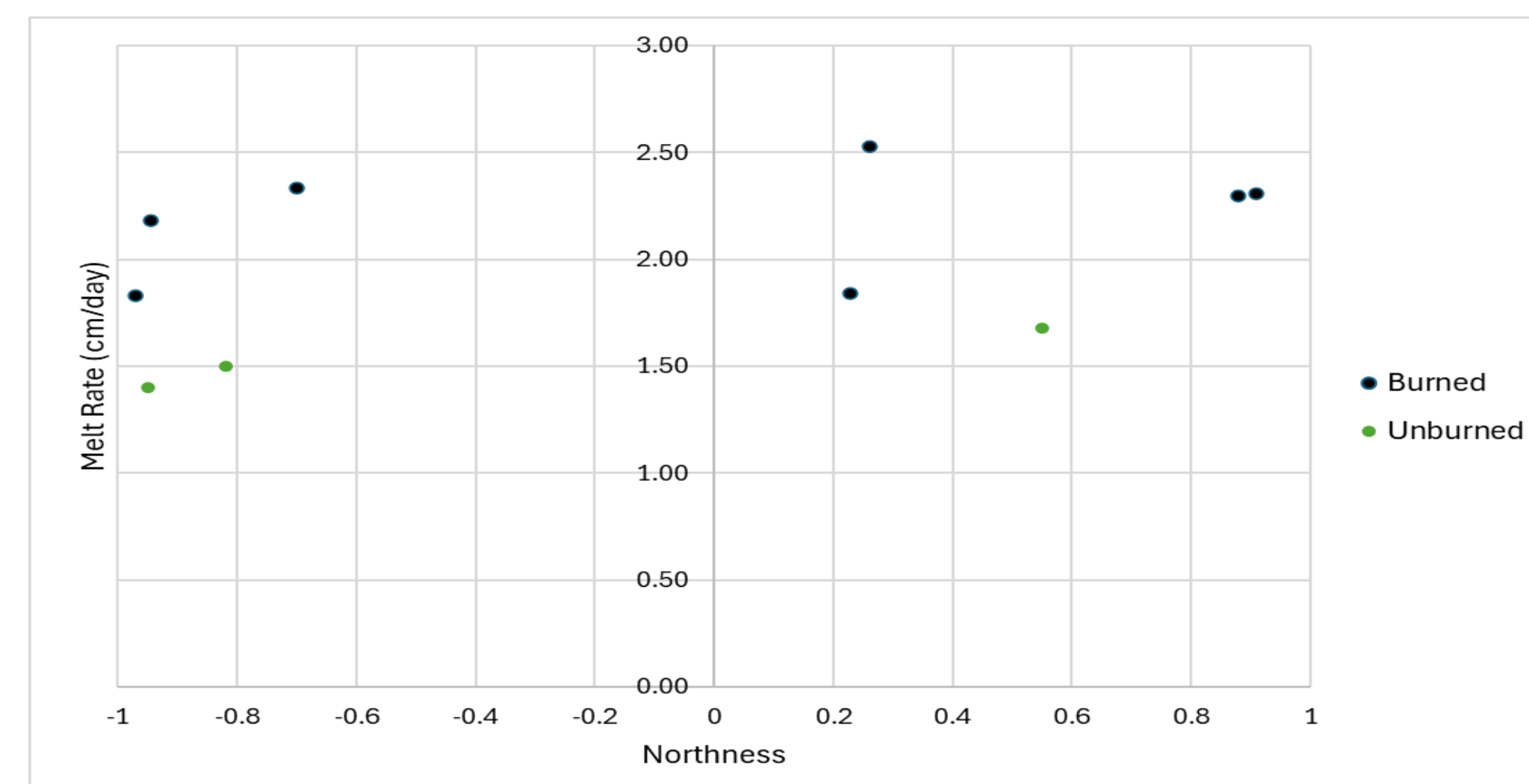
Q1: What is the difference in peak SWE magnitude and timing between burned and unburned sites?



- The average maximum SWE for the burned sites was larger than the average max SWE of the unburned sites by 9.5 cm.
- The average peak SWE date for the burned sites occurred 16 days earlier than average peak SWE date for the unburned sites.
- When comparing burned north to unburned north AWS, we found identical peak SWE dates and a nearly identical maximum SWE.
- In contrast, the peak SWE date of the burned south site was 33 days earlier than the unburned south site and the burned south site had a larger peak SWE by 12 cm.

Topic : Snowmelt Rate

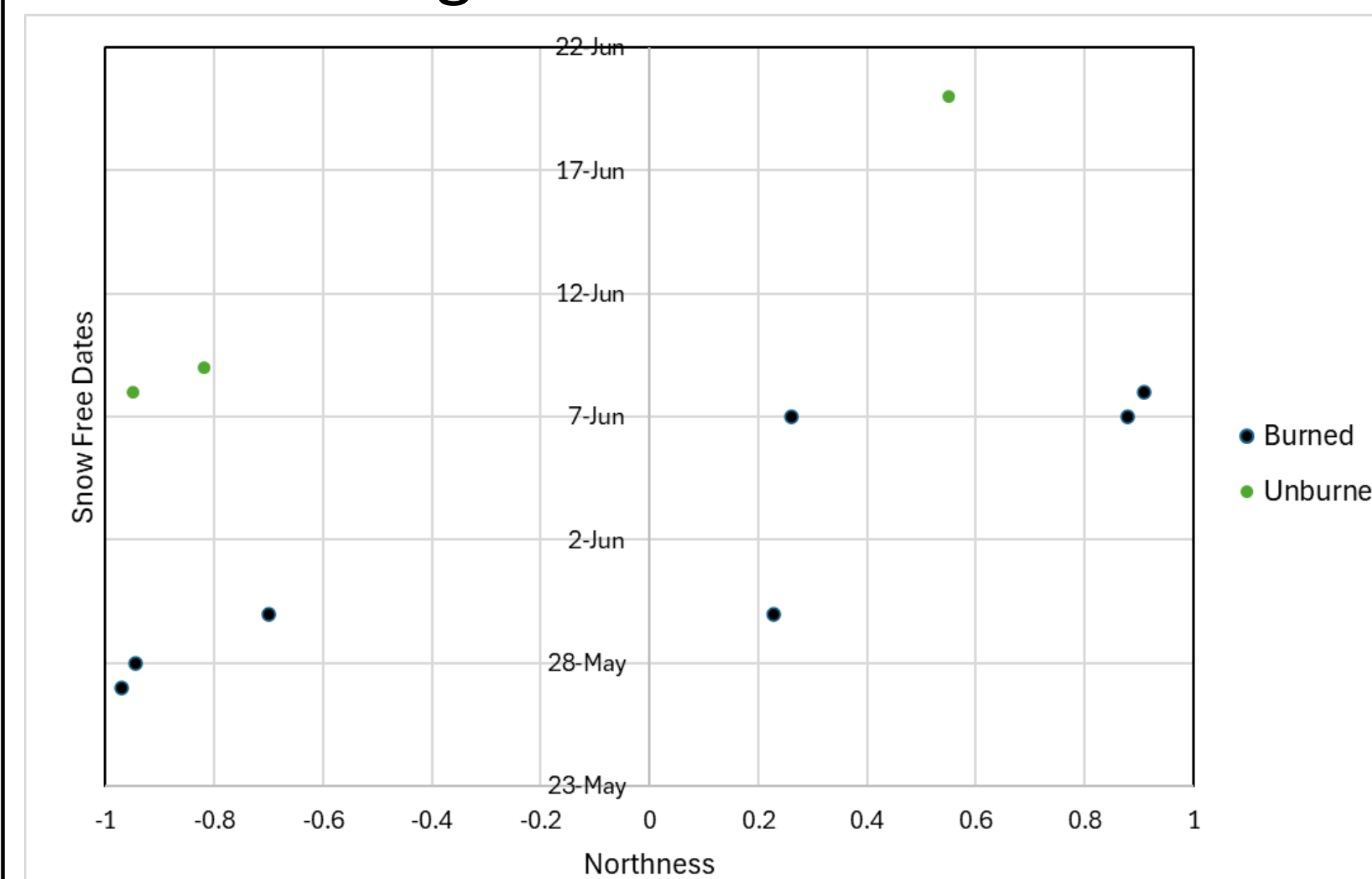
Q2: What is the difference in snowmelt rate between north-facing and south-facing burned sites, as well as north-facing and south-facing unburned sites?



- We calculated melt rates between May 9th (~peak SWE for many sites) to site-specific-snow-free-dates.
- On average, 2.2 cm melted per day for burned sites and 1.5 cm per day for unburned sites.
- This difference in melt rate was consistent across the range of northness values (burned sites with negative northness value melted ~67% faster than comparable unburned sites while positive northness sites melted ~55% faster than comparable sites).

Topic : Snow Free Date

Q3: What is the difference in snow-free dates between north-facing and south-facing burned sites, as well as north-facing and south-facing unburned sites?



- The average snow-free date for the burned sites occurred on June 1st, 11 days earlier than the unburned sites (June 12th).
- Although snow-free dates occurred earlier at sites with negative northness values (i.e., south-facing), the offset between burned and unburned sites was comparable.
- For example, the burned north site was snow free 13 days earlier than the unburned north facing site and the burned south facing site was snow free 12 days earlier than the unburned south facing site.

Discussion/Conclusion

- We found that the burned sites accumulated ~17% more snow than the unburned sites, but the snow melted nearly 50% faster at the burned sites. As a result, the burned sites were snow-free 11 days earlier than the unburned sites.
- These findings agree with the findings of Koshkin et al. (2022) who reported that "In burned forests, snow disappears 4–23 days earlier, and snowmelt rates increase as much as 57% during ablation."
- Although peak SWE was greater at sites with positive northness values, melt rates were comparable across all sites.

Acknowledgments

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References

- ¹ Kampf et al. (2022) Increasing wildfire impacts on snowpack in the western U.S. PNAS 119:39. doi:10.1073/pnas.2200333119.
² Koshkin AL, Hatchett BJ and Nolin AW (2022) Wildfire impacts on western United States snowpacks. Front. Water 4:971271. doi: 10.3389/frwa.2022.971271