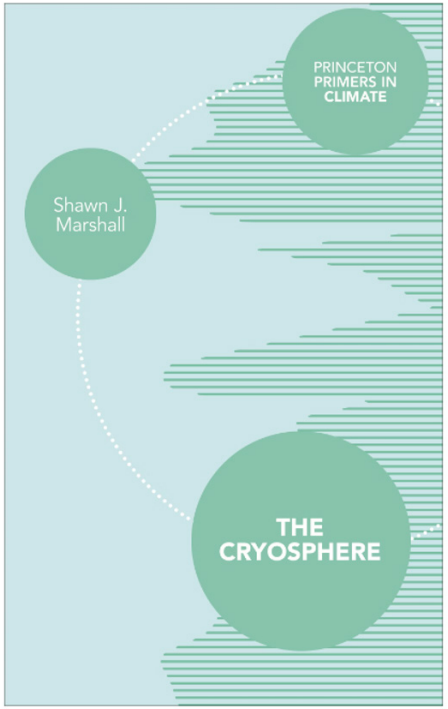
Seasonal Snow, Lake Ice, and Sea Ice

AOSC 680

Ross Salawitch

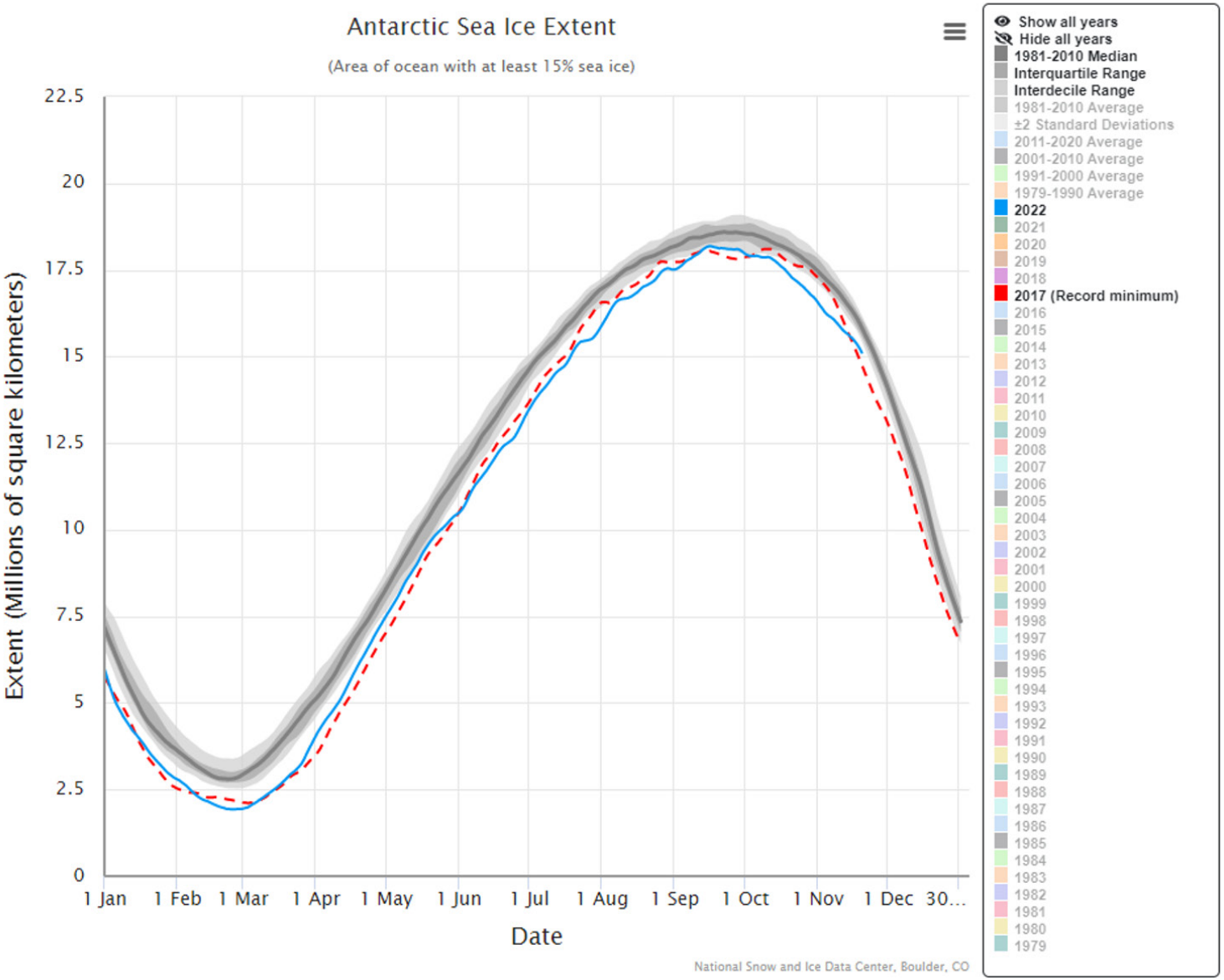
Class Web Sites:
http://www2.atmos.umd.edu/~rjs/class/fall2022
https://umd.instructure.com/courses/1327017



Lecture 22

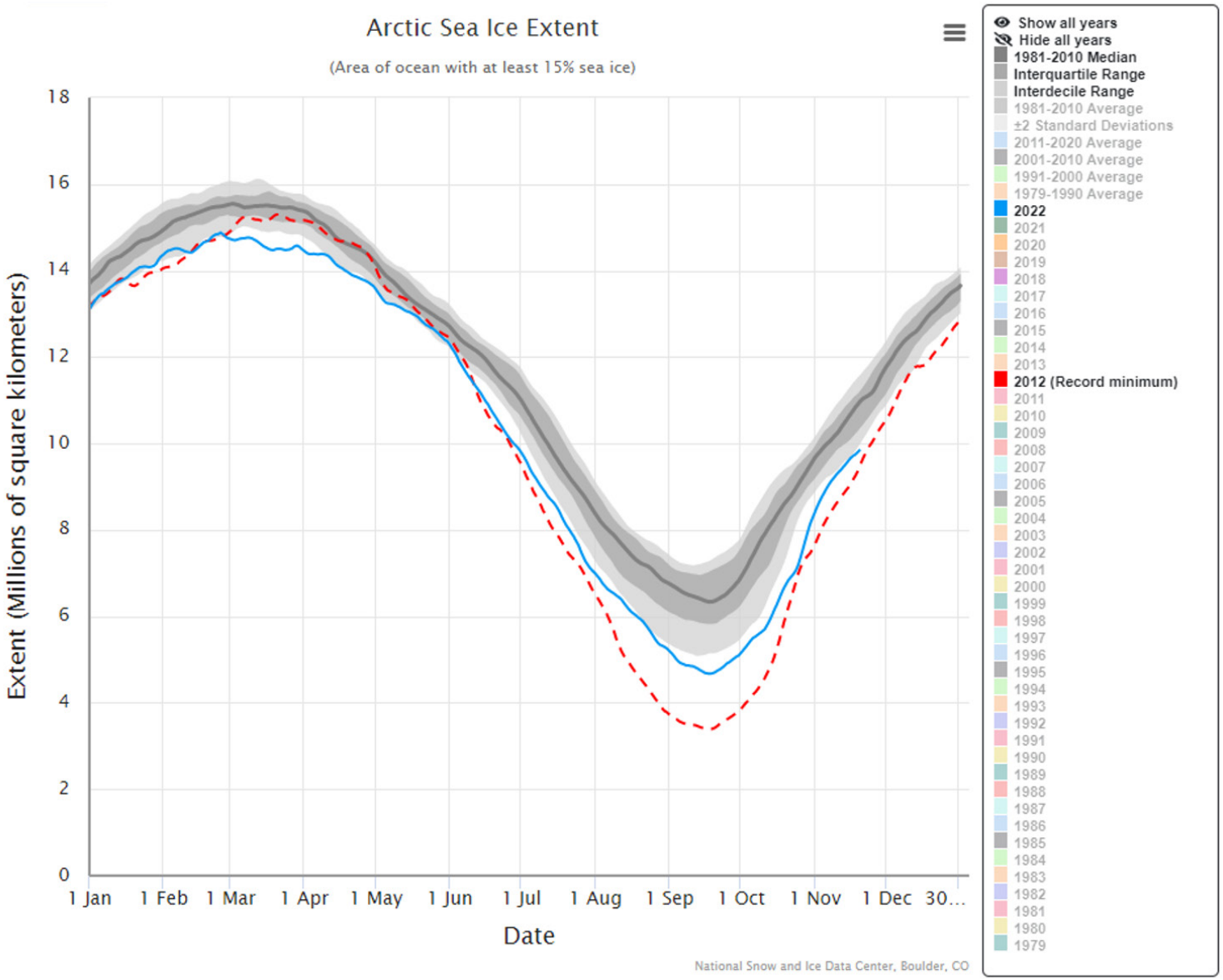
22 November 2022

Antarctic Sea Ice



https://nsidc.org/arcticseaicenews/charctic-interactive-sea-ice-graph

Arctic Sea Ice



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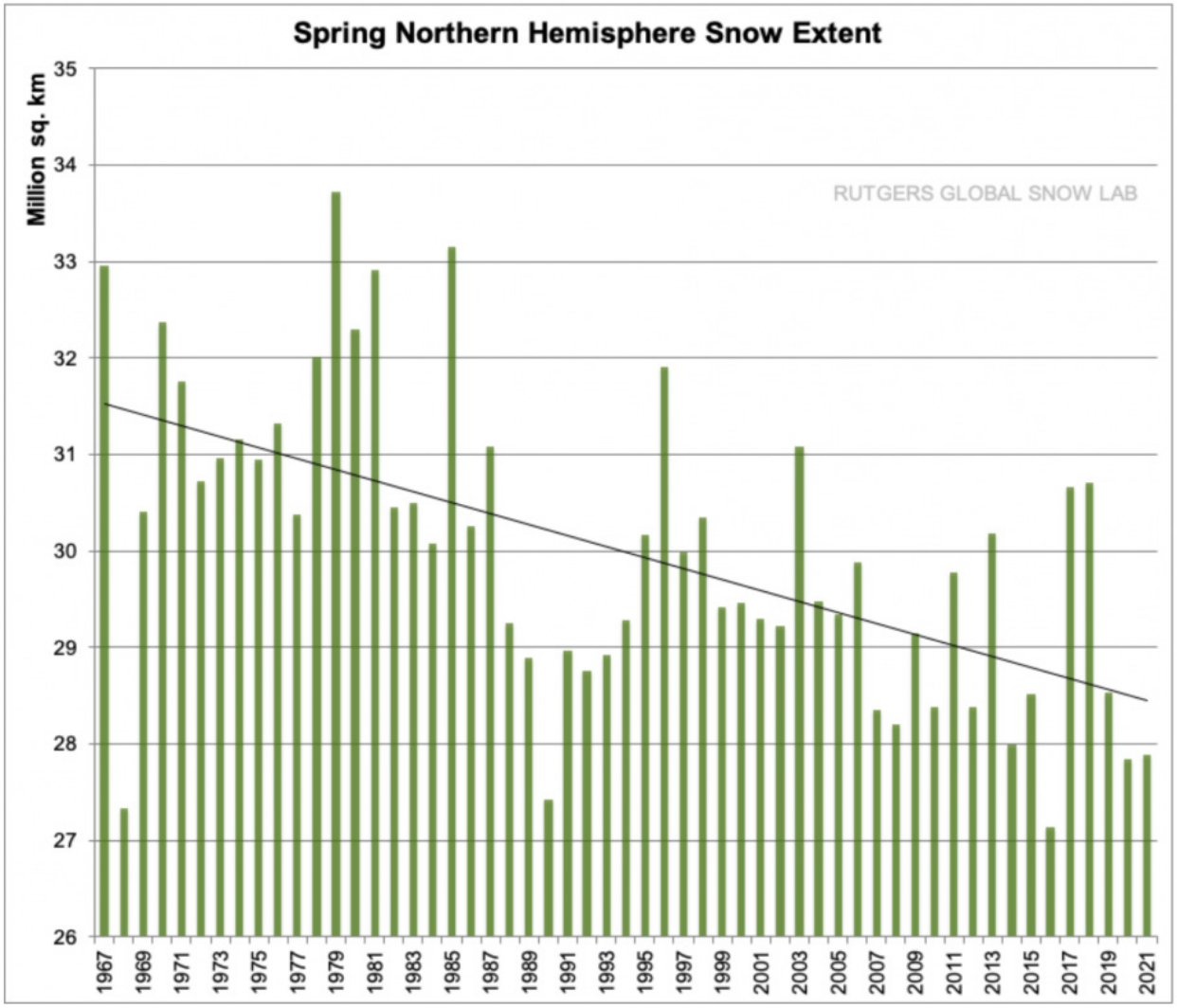
Seasonal Snow Trend



https://nsidc.org/learn/parts-cryosphere/snow/why-snow-matters
https://climate.rutgers.edu/snowcover/

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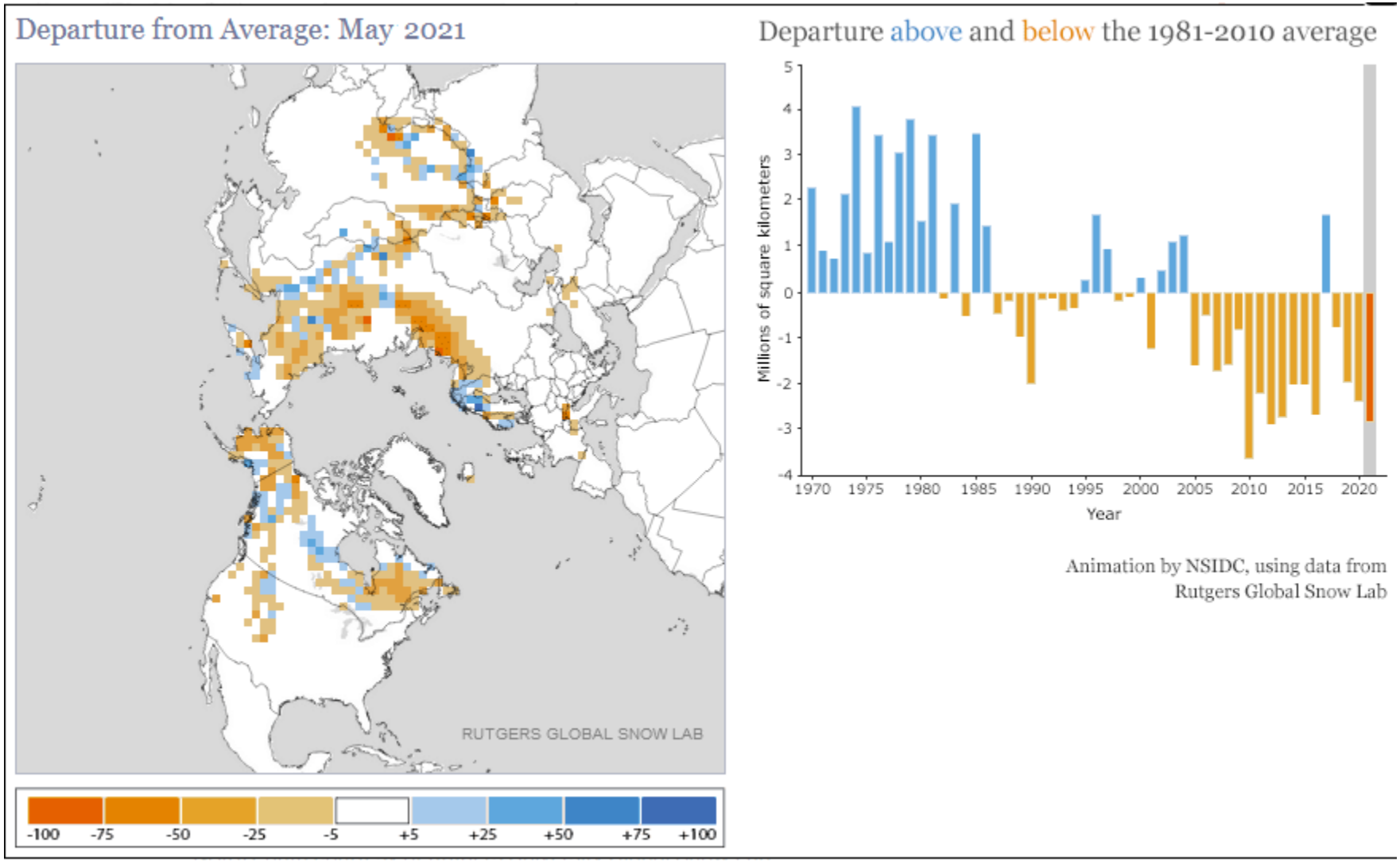

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California Snowpack

California's Sierra Nevada watersheds key for climate resilience

The Sierra Nevada Conservancy's service area provides water to more than 75 percent of Californians and vast swathes of Central Valley farmland. Much of this water supply falls as snow across the high-elevation landscapes of California's Sierra Nevada and Cascade mountains where it is stored as snowpack through the winter and spring. As the heat of summer arrives, snowmelt makes its way into reservoirs where it can be allocated throughout the state during the dry season.

Snowpack conditions for 2021–22

The water year got off to a promising start with heavy October rains followed by December storms that built an early season snowpack 160 percent of average by the end of 2021. Unfortunately, as noted by Governor Newsom in his March 28 drought emergency executive order, the new year began with "the driest January and February in recorded history for the watersheds that provide much of California's water supply."

As a result, April snow depths, when snowpack is typically near its deepest, were a scant 38 percent of average.

https://sierranevada.ca.gov/californias-2021-22-snowpack-prelude-to-a-drought/

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Snow and Wildfires

Low spring snowpack raises fire and other risks for California forests

Worsening drought conditions are expected to exacerbate regional wildfire and forest health crises. The National Interagency Fire Center has predicted that California's potential for wildfires will increase to higher than normal in 2022 due to low snowpack and precipitation combined with high temperatures. CAL FIRE's 2022 outlook is similarly grim, forecasting lower than average fuel moisture levels leading to an increase in wildland fire activity.

Drought also makes trees more susceptible to mortality from other sources, like bark beetles, a combination that led to severe tree mortality (at least 35 per acre) across much of the Sierra Nevada south of Lake Tahoe between 2014 and 2018.

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Wildfires and Snow

RESEARCH ARTICLE | EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES |

Increasing wildfire impacts on snowpack in the western U.S.

Stephanie K. Kampf, Daniel McGrath, Megan G. Sears, +2, and John C. Hammond Authors Info & Affiliations

Edited by Monica Turner, University of Wisconsin–Madison, Madison, WI; received January 7, 2022; accepted August 10, 2022

September 19, 2022 | 119 (39) e2200333119

https://doi-org.proxy-um.researchport.umd.edu/10.1073/pnas.2200333119

Abstract. Wildfire area has been increasing in most ecoregions across the western United States, including snow-dominated regions. These fires modify snow accumulation, ablation, and duration, but the sign and magnitude of these impacts can vary substantially between regions. This study compares spatiotemporal patterns of western United States wildfires between ecoregions and snow zones. Results demonstrate significant increases in wildfire area from 1984 to 2020 throughout the West, including the Sierra Nevada, Cascades, Basin and Range, and Northern to Southern Rockies.

…

This loss of snow can reduce both ecosystem water availability and streamflow generation in a region that relies heavily on mountain snowpack for water supply.

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Discussion.

Postfire snow impacts will also vary regionally, depending on the relative importance of shortwave radiation in the snowpack energy balance. The importance of shortwave radiation for snowpack metrics is evident in the multivariate model of snow-free date for the Southern Rockies …The Colorado Front Range, where the Cameron Peak Fire burned, is a region where shortwave radiation is >40% of the net radiation during the snow season (34). With this relatively high proportion of shortwave radiation, a large part of the snowpack energy balance can be influenced by albedo change and greater shortwave radiation exposure after fire.
…

Within an individual region, locations experiencing the largest burn effects on the snowpack are likely to be those with greater solar radiation exposure (more south-facing slopes in the northern hemisphere) and large patches of high burn severity (38). Fire may change the spatial scale of variability by reducing local vegetation controls on snow depth, particularly in areas with high incoming solar radiation (12). Locations with high wind redistribution of snow may also experience greater effects postfire (39).

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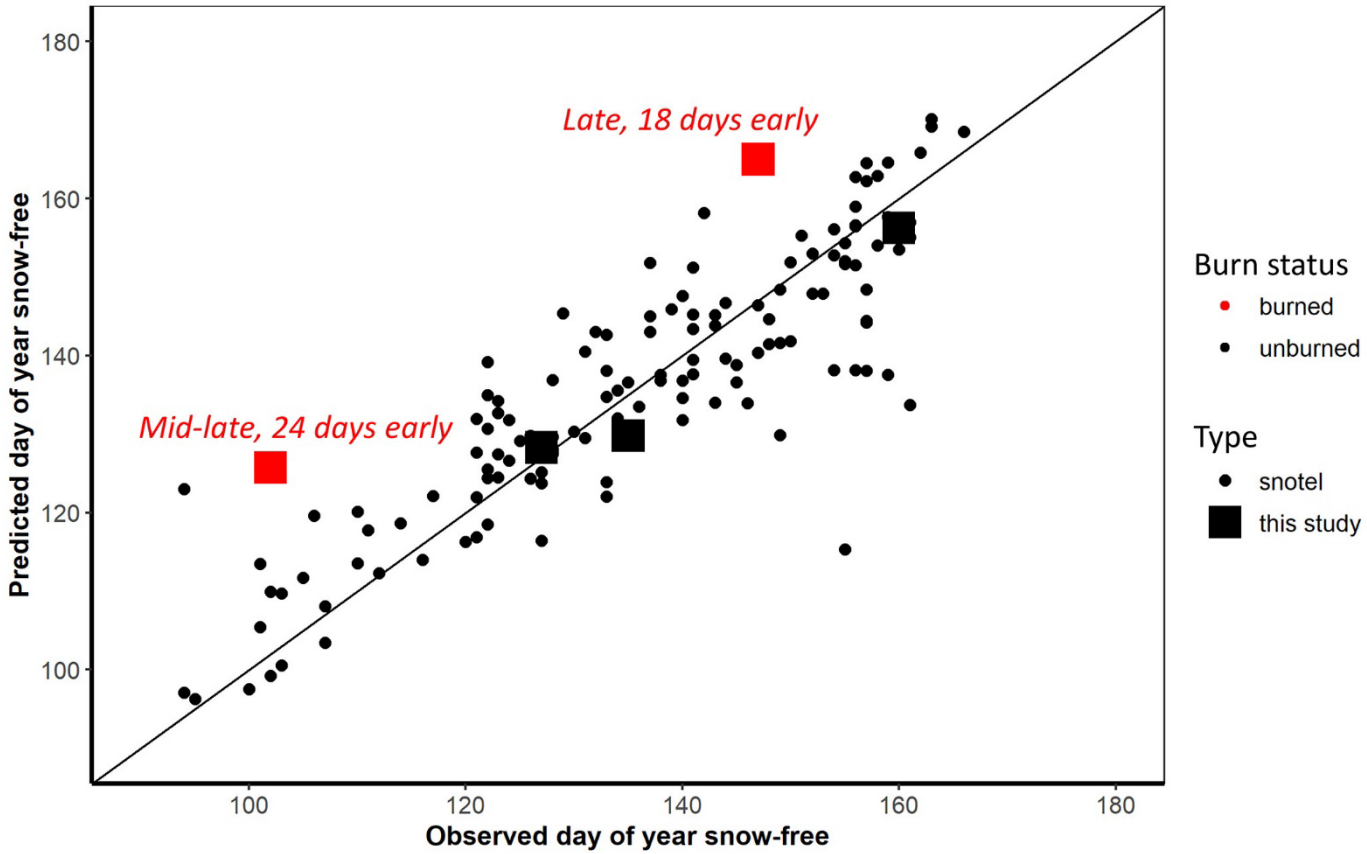
Snow and Wildfires



Observed versus predicted day of year snow free for 2021 at Natural Resources Conservation Service Snow Telemetry stations in the Southern Rockies ecoregion and study sites in and near the Cameron Peak Fire. The late snowmelt burned site was snow free 18 d earlier than predicted, and the middle-late zone burned site was snow free 24 d earlier than predicted.

https://www.pnas.org/doi/10.1073/pnas.2200333119