

The Sierra Nevada snowpack is the primary water source for California's State Water Project and the federal Central Valley Project.



Sierra Nevada
Snowpack



Reservoirs



Sacramento –
San Joaquin Delta

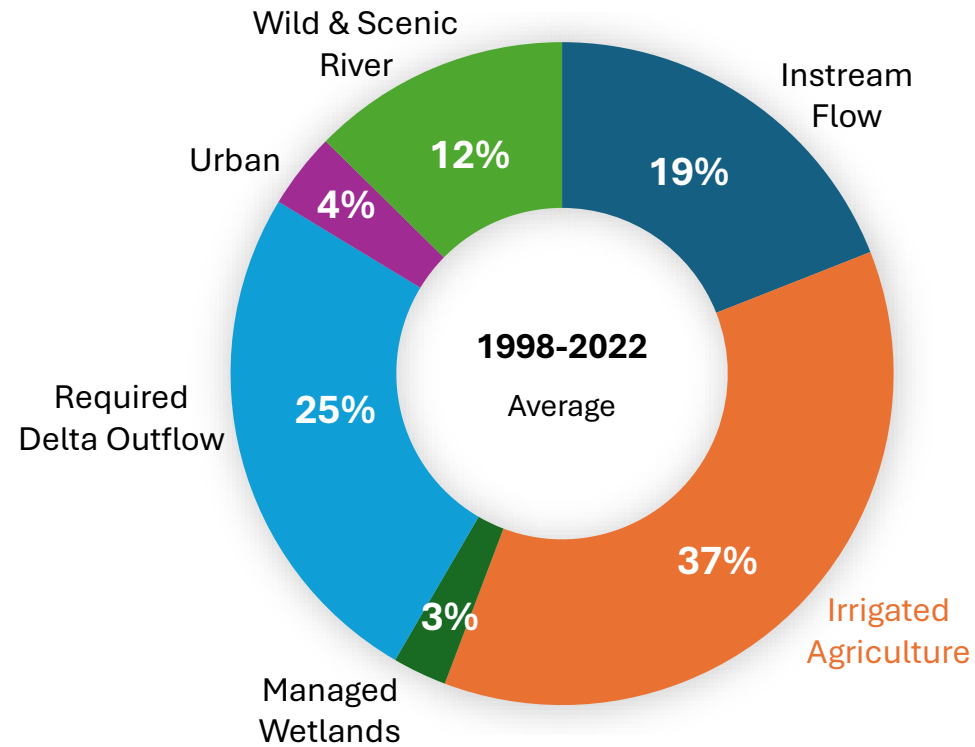


Irrigated Agricultural
Lands



Crop Production

Sacramento Water Use



Irrigated agriculture is the primary consumer of water in the: Sacramento (37%), San Joaquin (66%), and Tulare (83%) basins.



~Agricultural Statistics~

Nearly half of the country's vegetables and over three-quarters of the country's fruits and nuts are grown in California

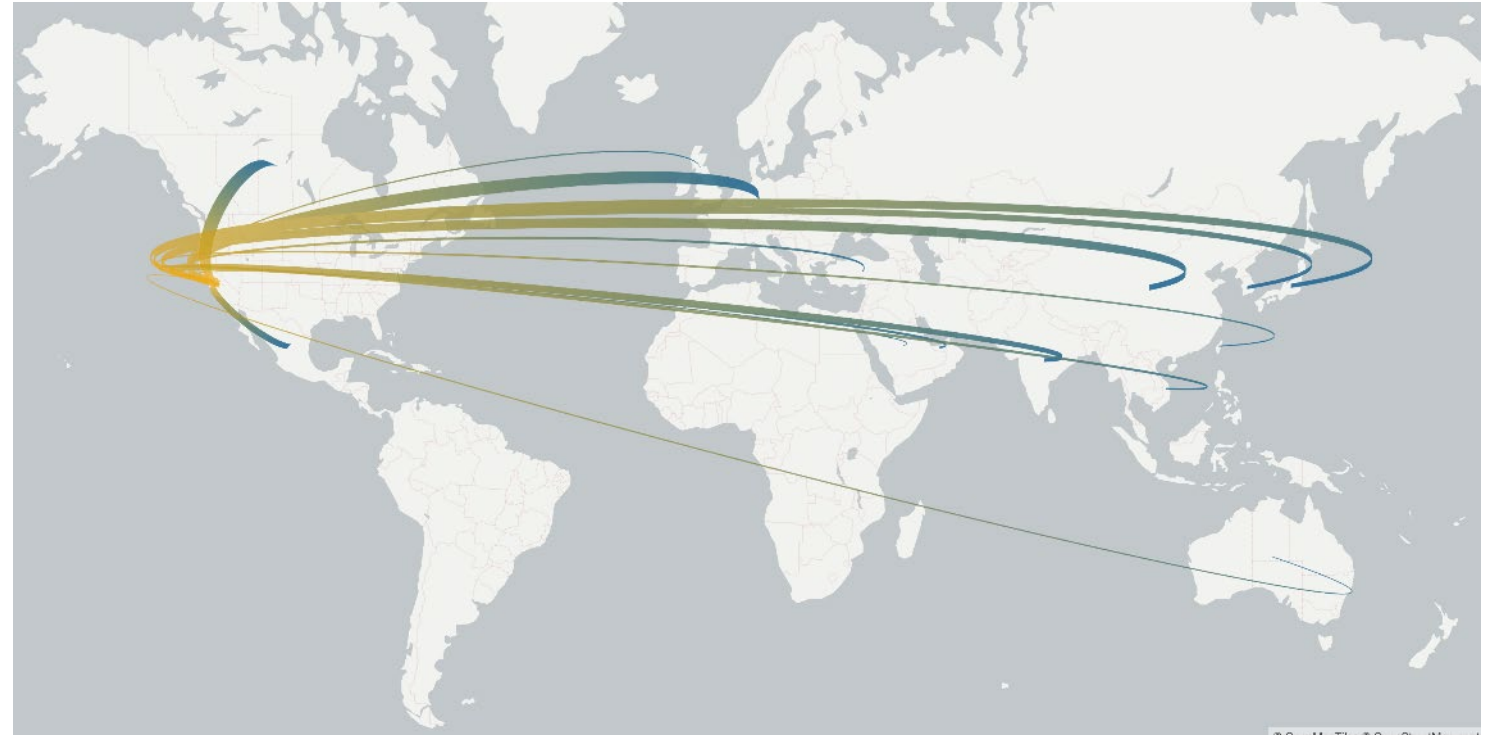
32% of U.S. organic production produced by California

1.2 million jobs supported by California's agricultural economy

~30% of California's agricultural production by volume is Exported

12.8% of total U.S. agricultural exports produced in California

\$59.4 billion earned (\$22.4 billion from exports)



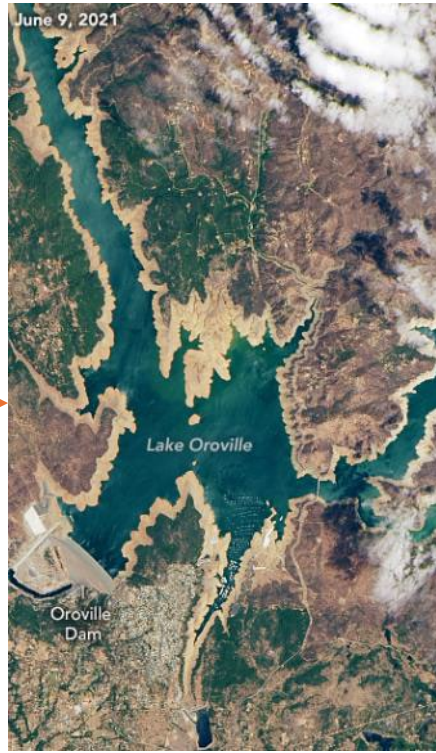
Major California Agricultural Exports to the Top 15 Destinations



What are the implications of warming-driven hydroclimate shifts on California's water resources and irrigated agriculture?



Low-to-no-snow



Reservoir depletion



Delta management

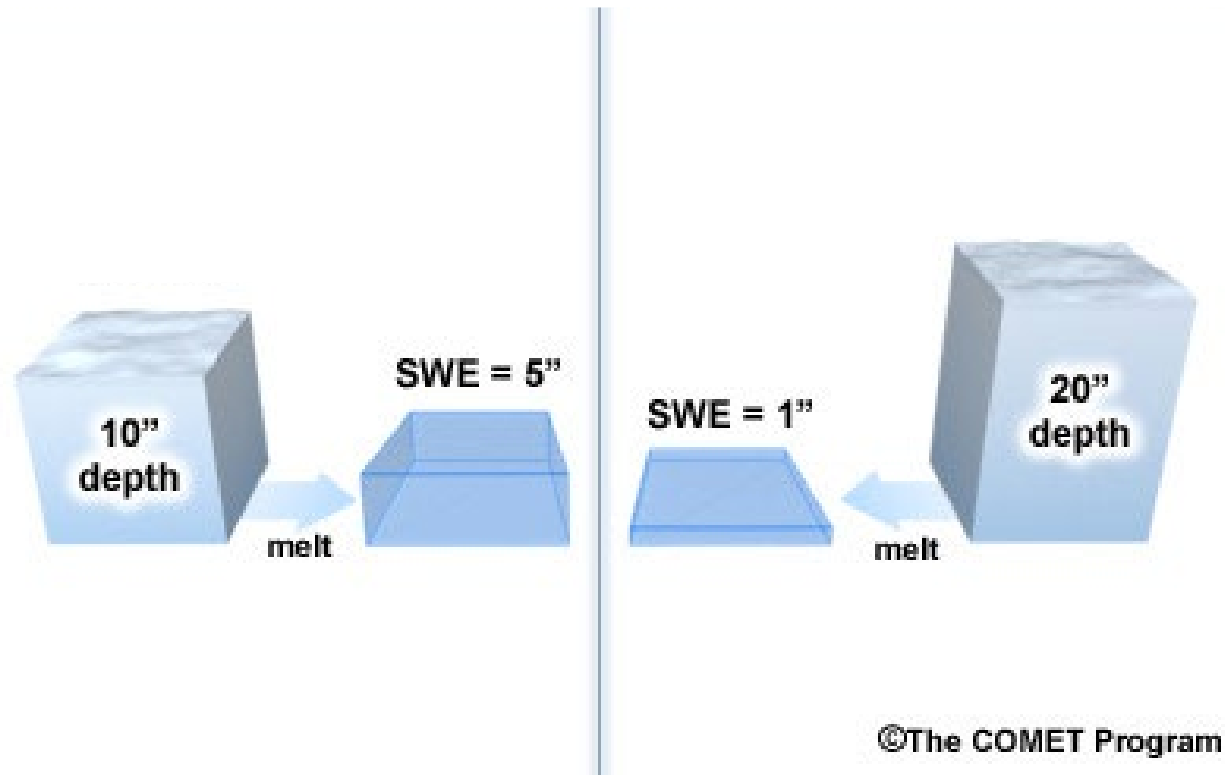


Water Gaps

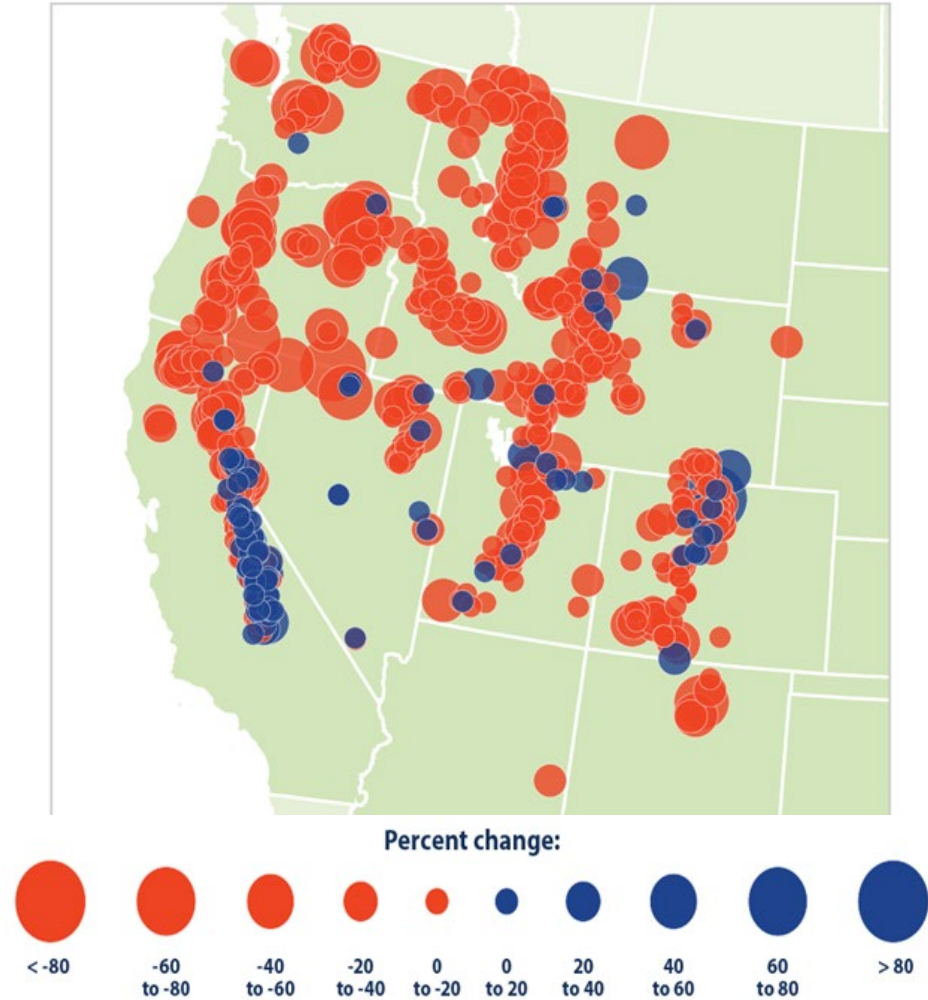


Crop Production

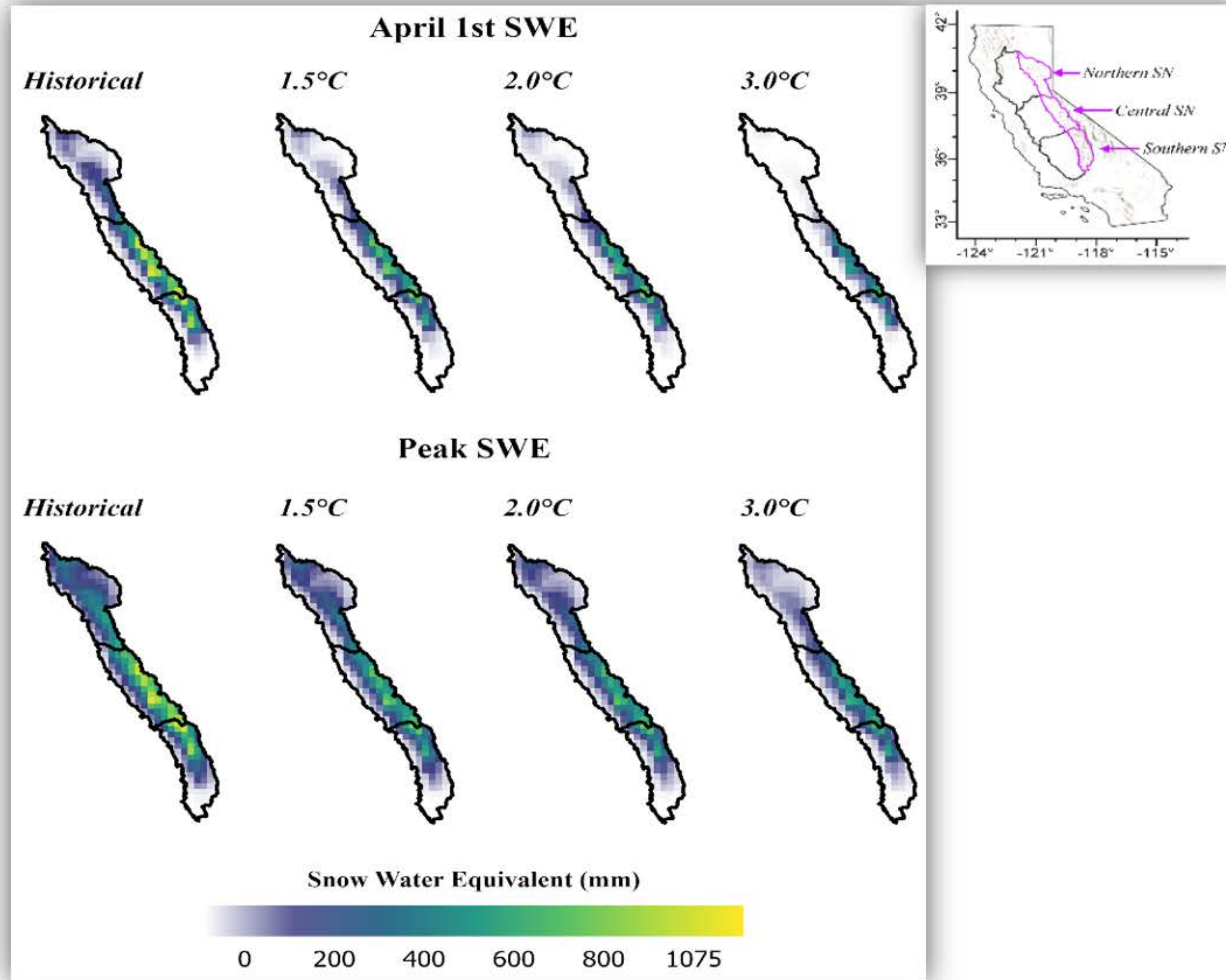
Sierra Nevada, on average, provides +70% additional natural storage compared to surface reservoirs through Snow Water Equivalent (SWE)



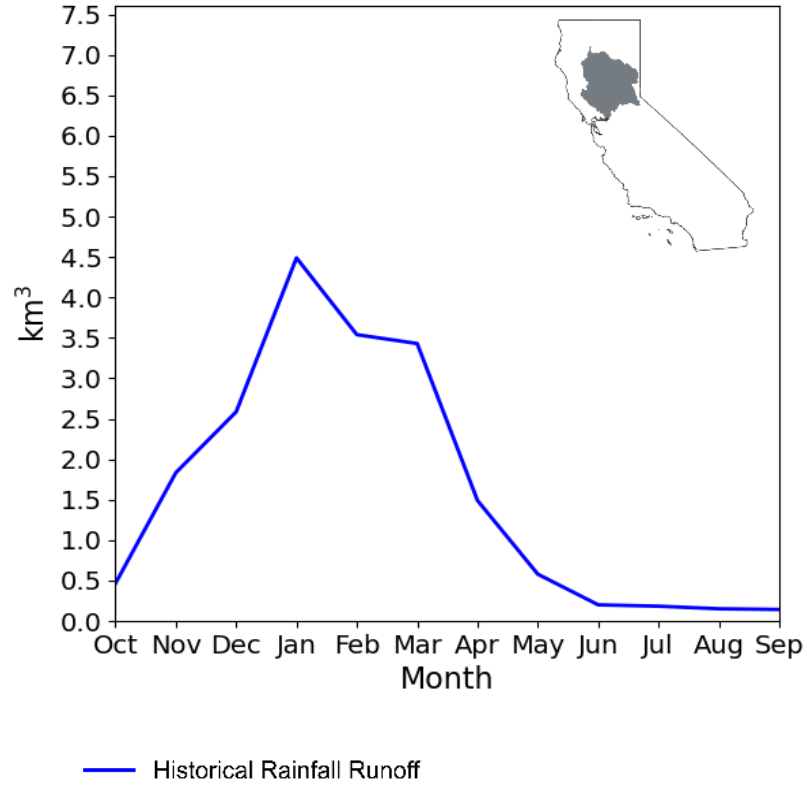
**SWE decline across 81% of stations (1955-2023)
with a 18% decline on average**

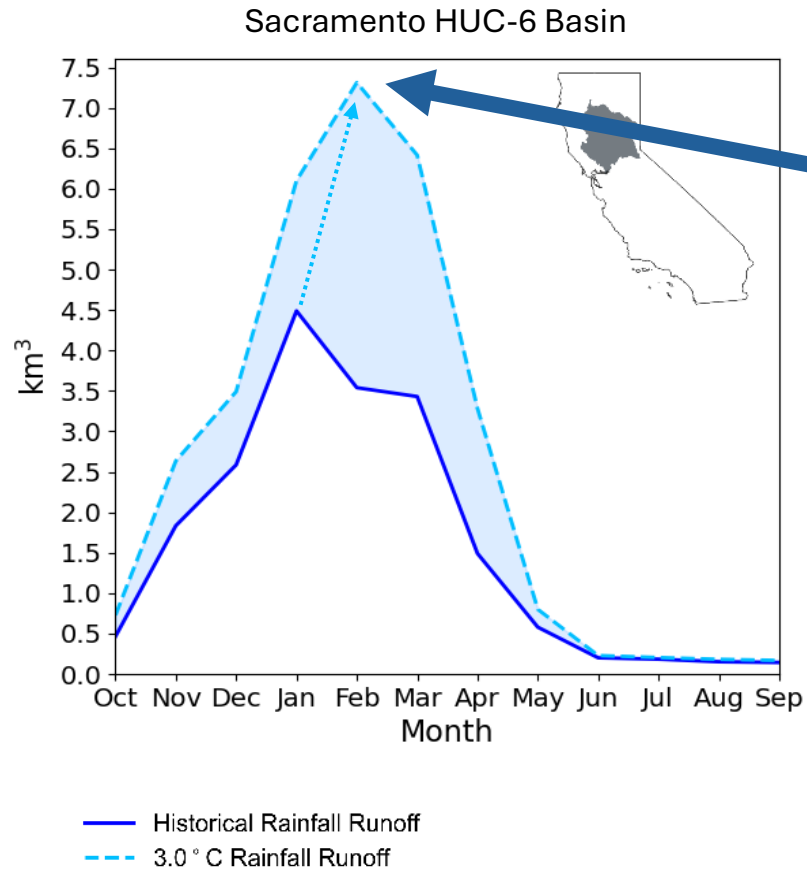


Future peak and April 1st snow water equivalent declines in the Sierra Nevada



Sacramento HUC-6 Basin





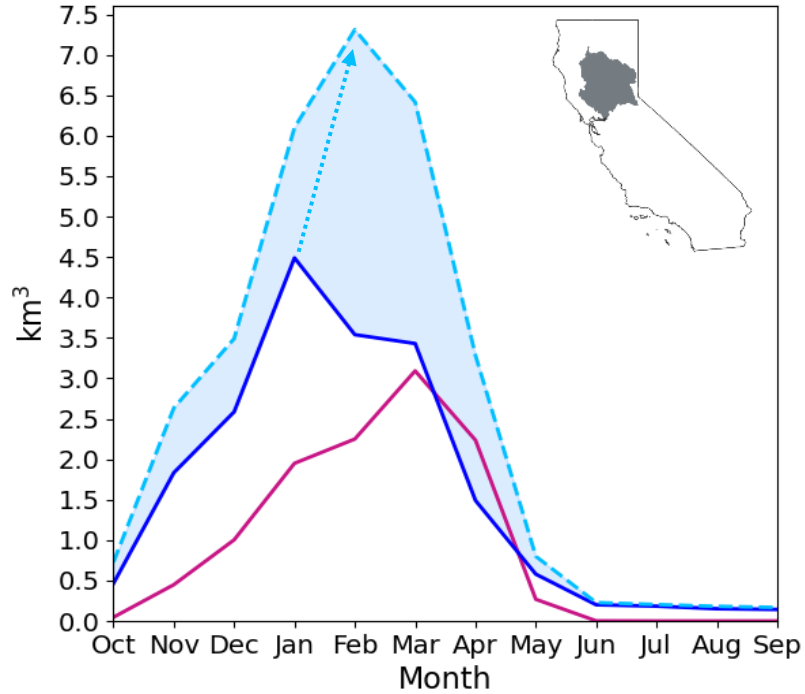
In a 3°C warmer future:



More runoff generated from rainfall, with peak flows occurring later.



Sacramento HUC-6 Basin



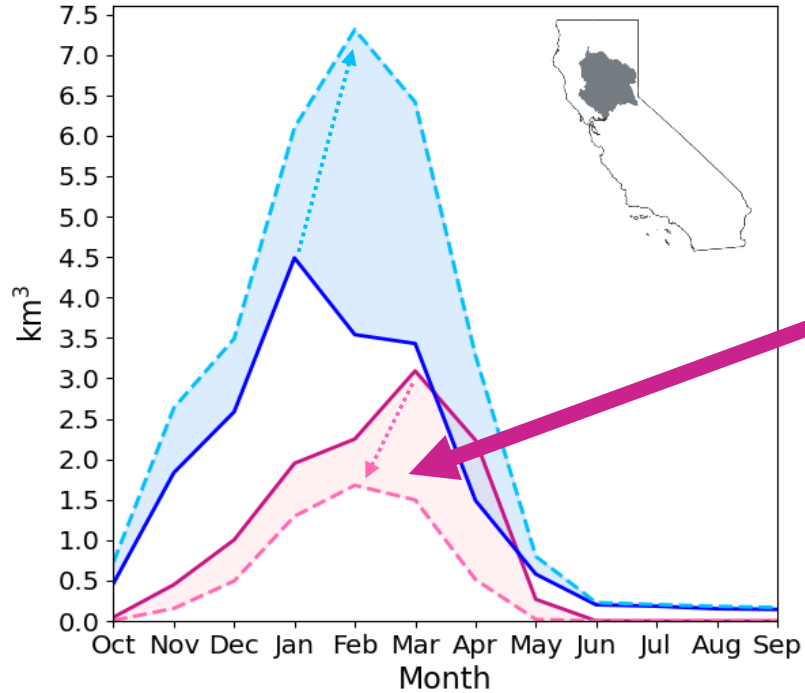
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Sacramento HUC-6 Basin



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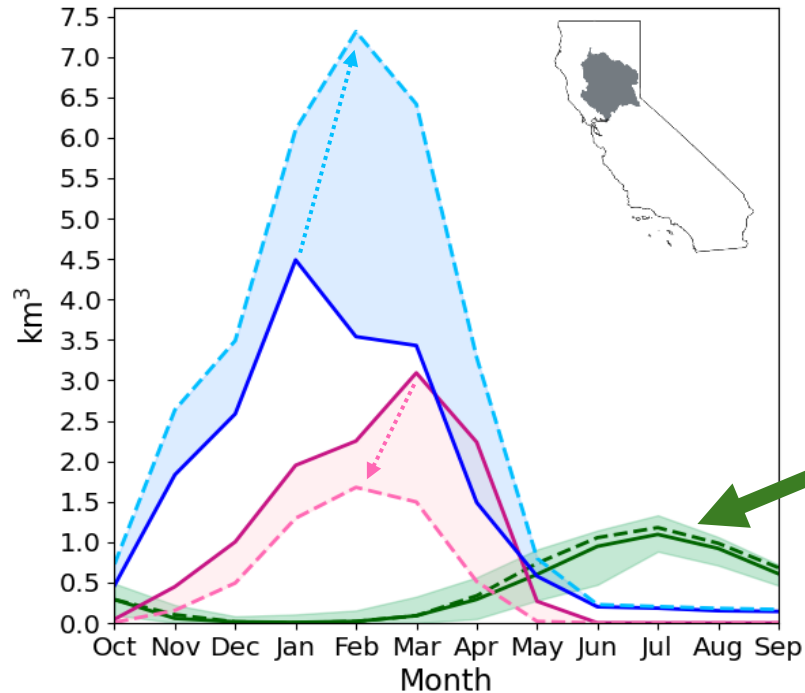


Snowmelt-derived runoff declines, with peak flows occurring earlier.

- Historical Rainfall Runoff
- - - 3.0 °C Rainfall Runoff
- Historical Snowmelt Runoff
- - - 3.0 °C Snowmelt Runoff



Sacramento HUC-6 Basin



- Historical Rainfall Runoff
- - - 3.0 ° C Rainfall Runoff
- Historical Snowmelt Runoff
- - - 3.0 ° C Snowmelt Runoff
- Historical Irrigation Water Consumption
- - - 3.0 ° C Irrigation Water Consumption

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Snowmelt-derived runoff declines, with peak flows occurring earlier.

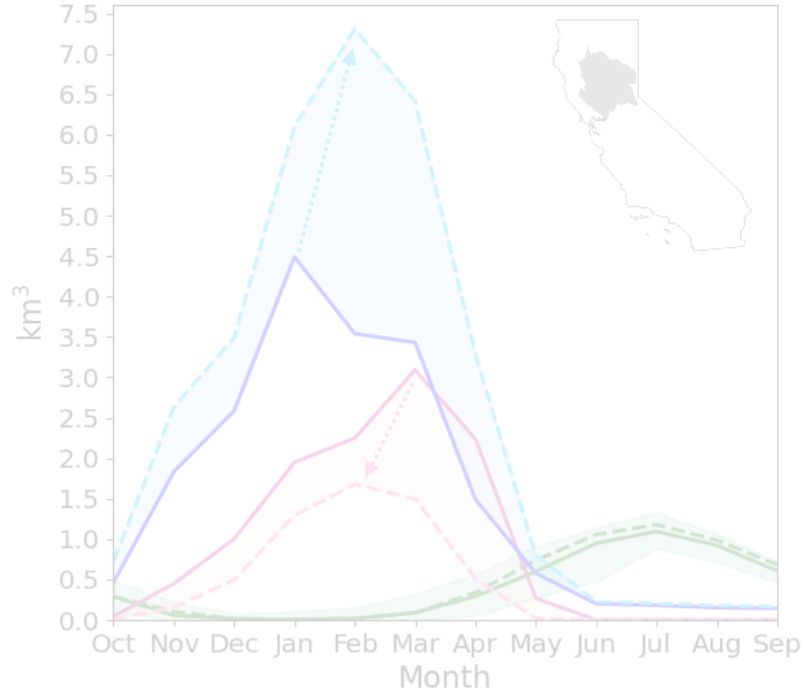


Shifts in runoff timing reduce summer water availability when irrigation water demand is highest, widening the water gap.

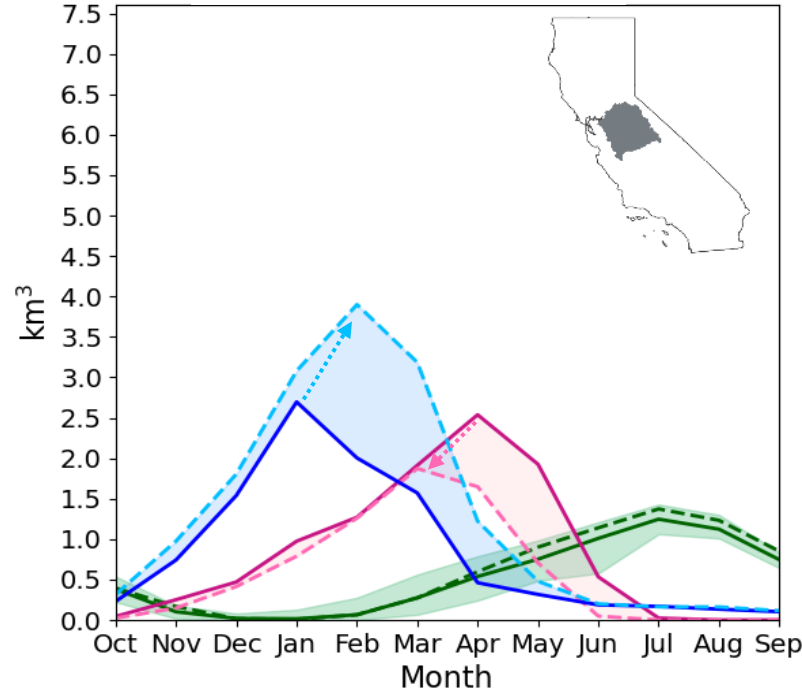
Water gap: the portion of irrigation water consumption that cannot be met by either rainfall runoff or snowmelt runoff.



Sacramento HUC-6 Basin



San Joaquin HUC-6 Basin

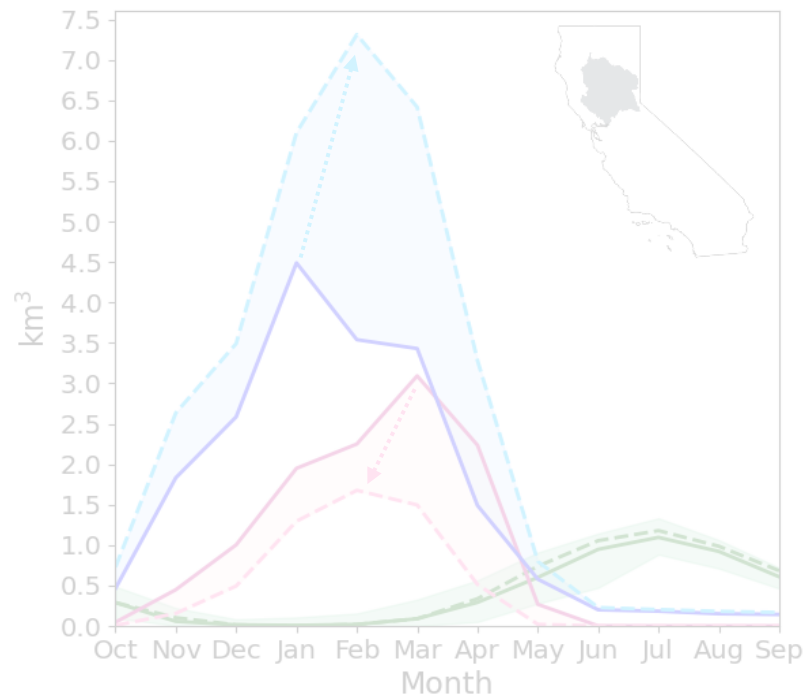


- Historical Rainfall Runoff
- - - 3.0 ° C Rainfall Runoff
- Historical Snowmelt Runoff
- - - 3.0 ° C Snowmelt Runoff
- Historical Irrigation Water Consumption
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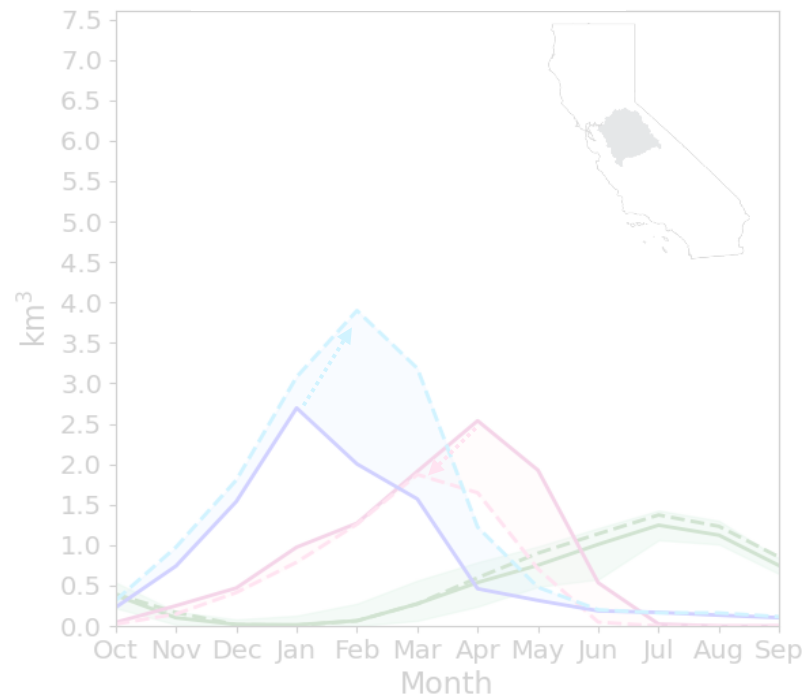


From Sierra Nevada to Sierra Lluviosa

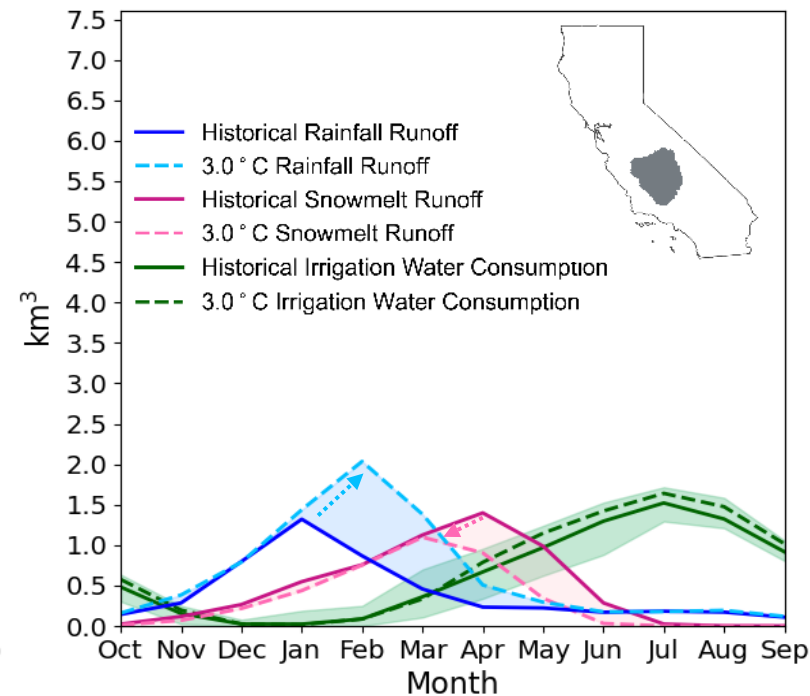
Sacramento HUC-6 Basin



San Joaquin HUC-6 Basin



Tulare HUC-6 Basin

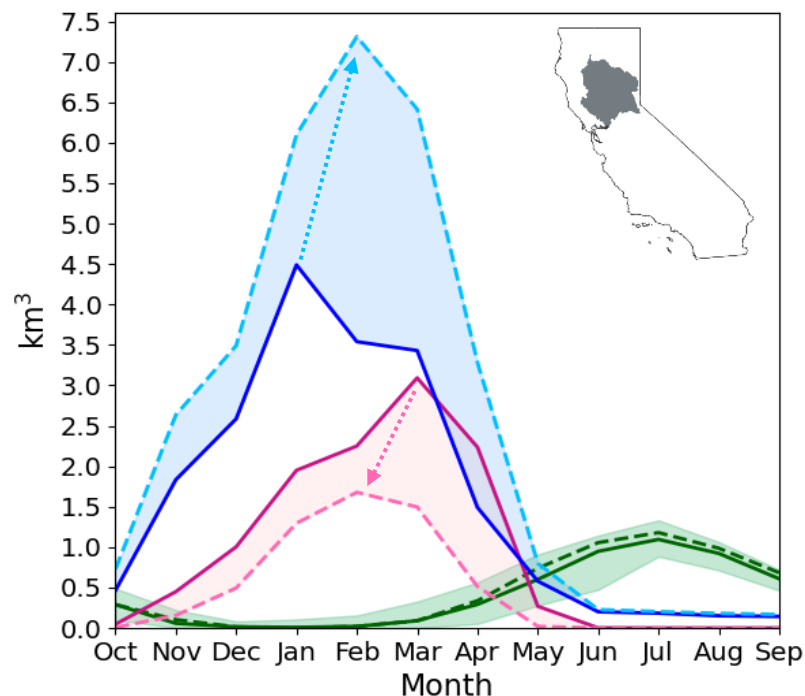


- Historical Rainfall Runoff
- - - 3.0 ° C Rainfall Runoff
- Historical Snowmelt Runoff
- - - 3.0 ° C Snowmelt Runoff
- Historical Irrigation Water Consumption
- - - 3.0 ° C Irrigation Water Consumption



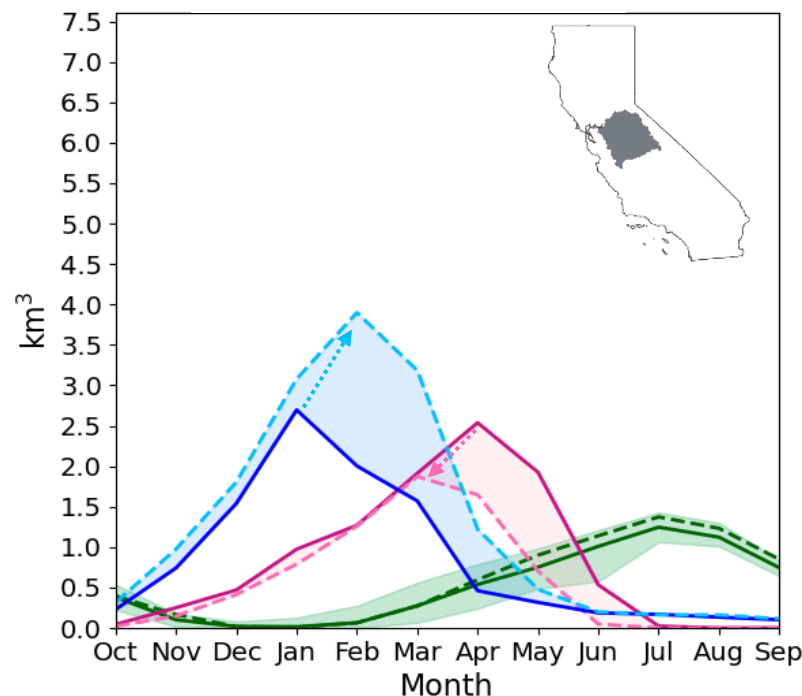
Agricultural water gaps

Sacramento HUC-6 Basin



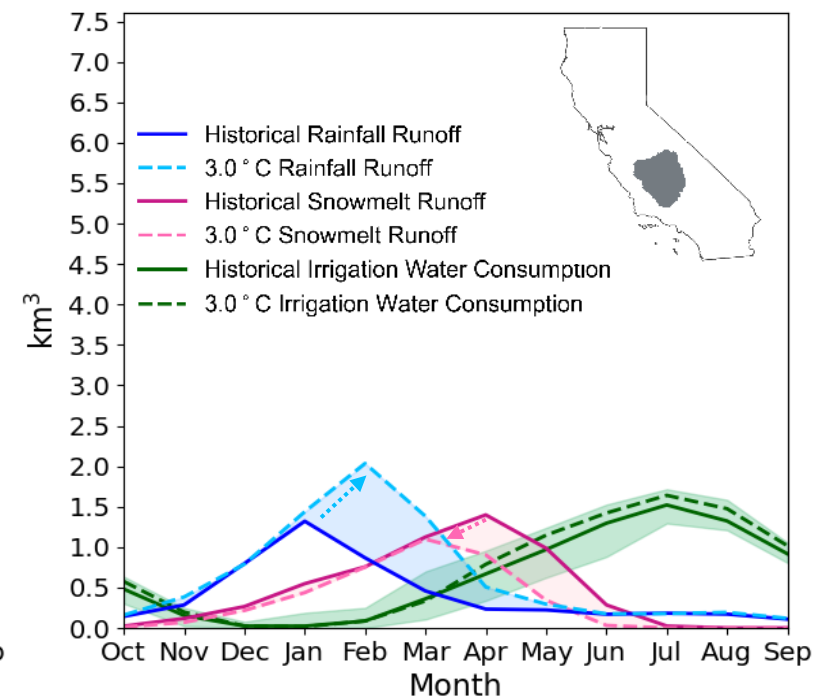
- From October to May, IWC requirements can be fully met by rainfall runoff.
- **Water gap: June - September**

San Joaquin HUC-6 Basin



- In June, the water gap increases from 29% to 78% of irrigation demand, and the ability of snowmelt runoff to meet that demand decreases from 53% to just 5%.
- **Water gap: June - October**

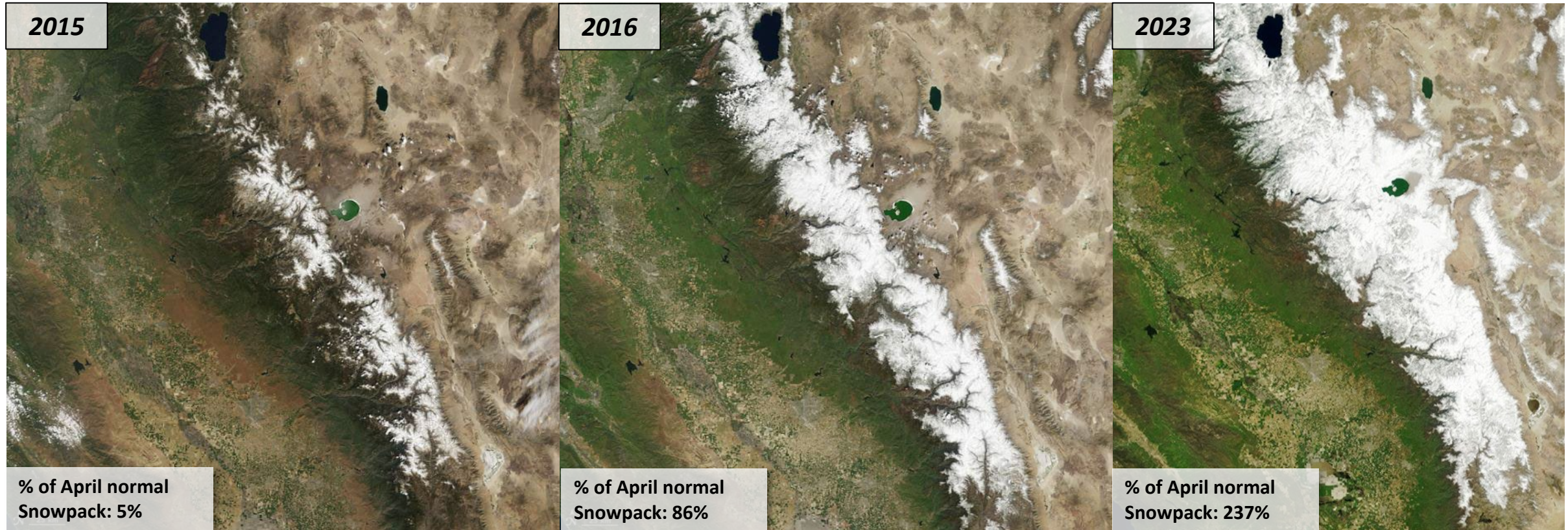
Tulare HUC-6 Basin



- Historically, the water gap begins in June. Under +3°C, it emerges a month earlier, in May.
- **Water gap: May - October**

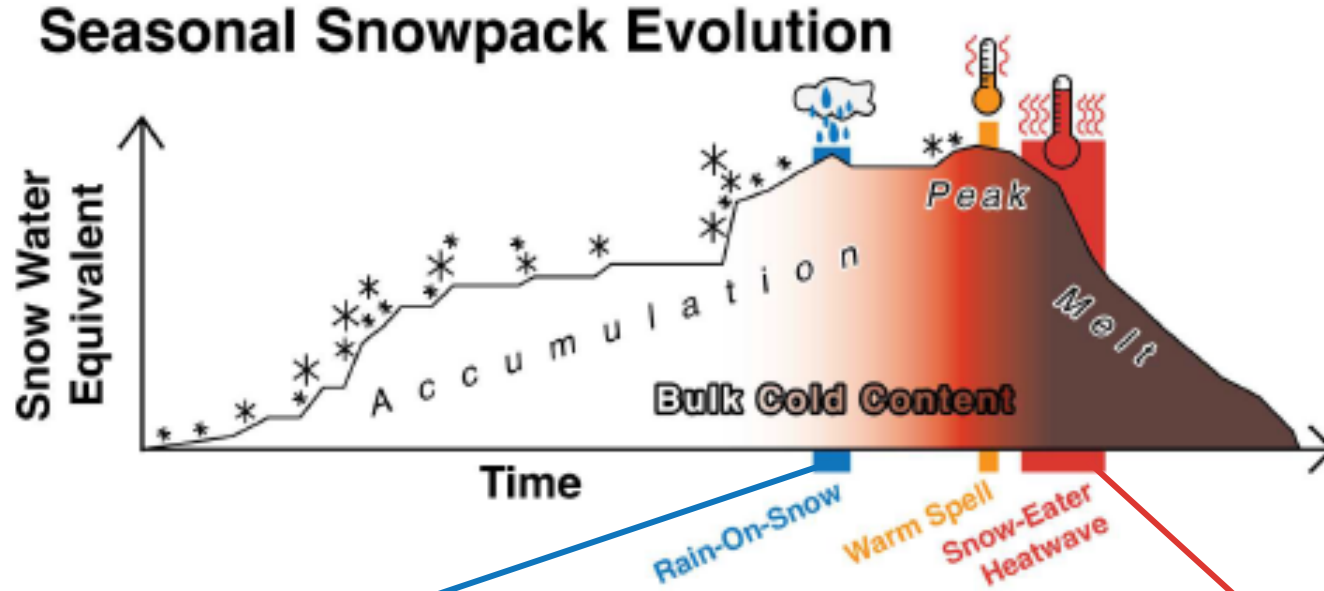


“...California must learn to derive more of its future water resources from less reliable snowmelt, fewer storms, and more punctuated floodwater...” (Gershunov et al. 2025)

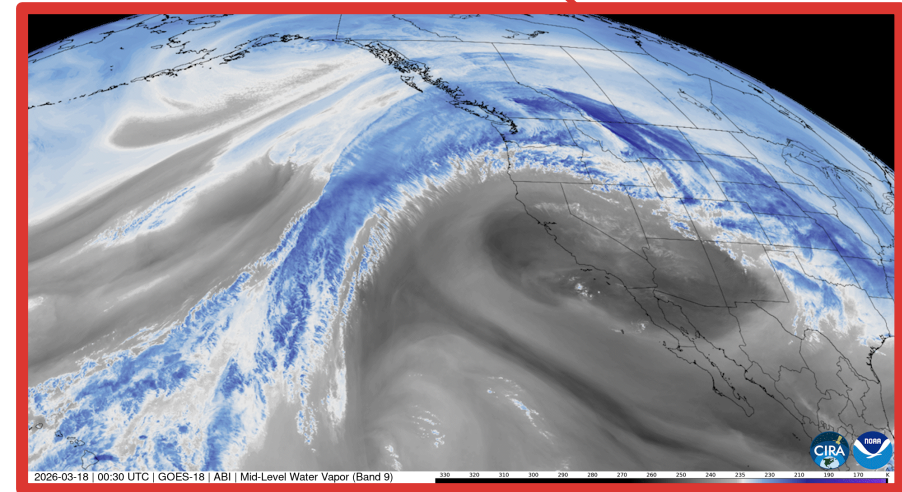
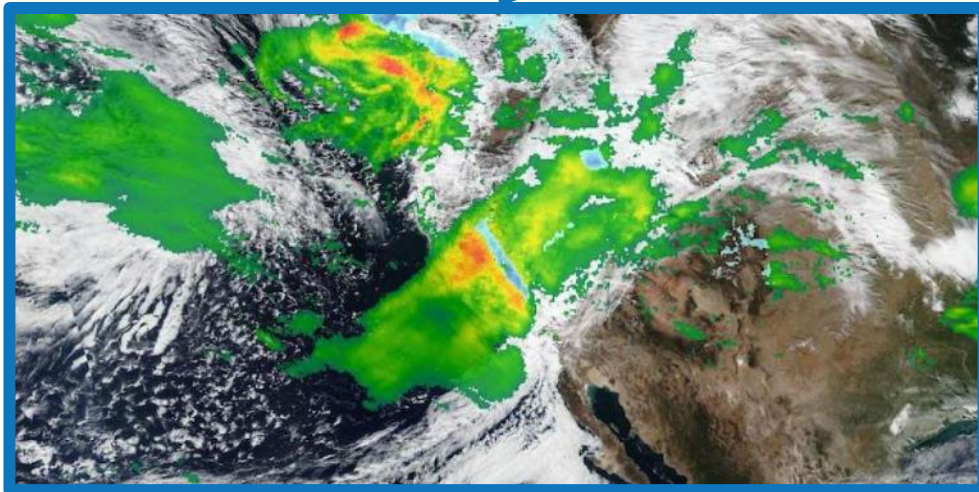


Rain-on-snow events are often caused by atmospheric rivers

Atmospheric rivers account for 84% of insured flood losses in the western US



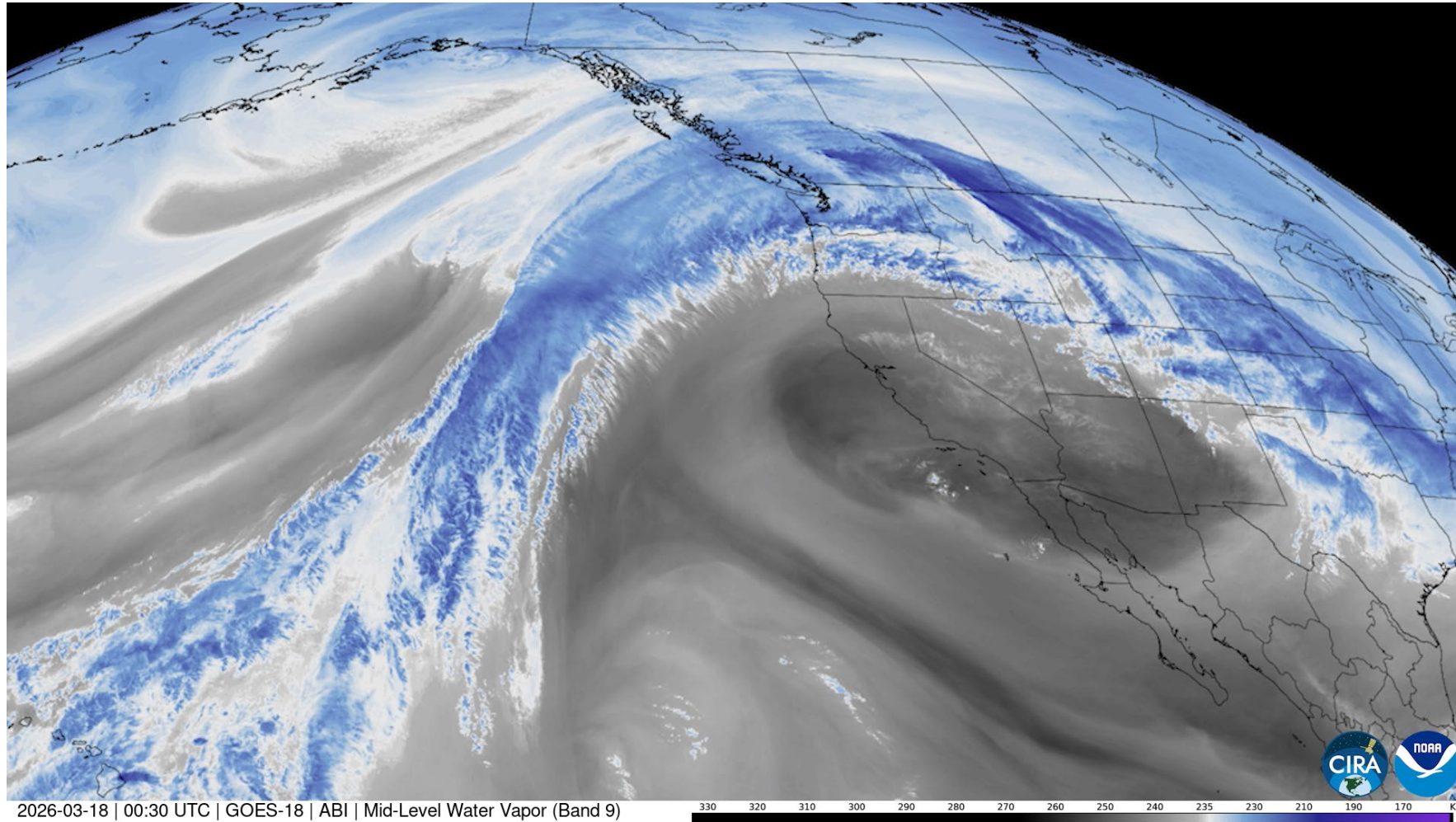
Snow-eater heatwaves double typical snowmelt and have been linked to major flood events in the western US



Snow-eater heatwave events have been found to double typical snowmelt

March 2026 snow-eater heatwave event

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Snow-eater heatwave events have been found to double typical snowmelt

February-March 2026 California Sierra Nevada

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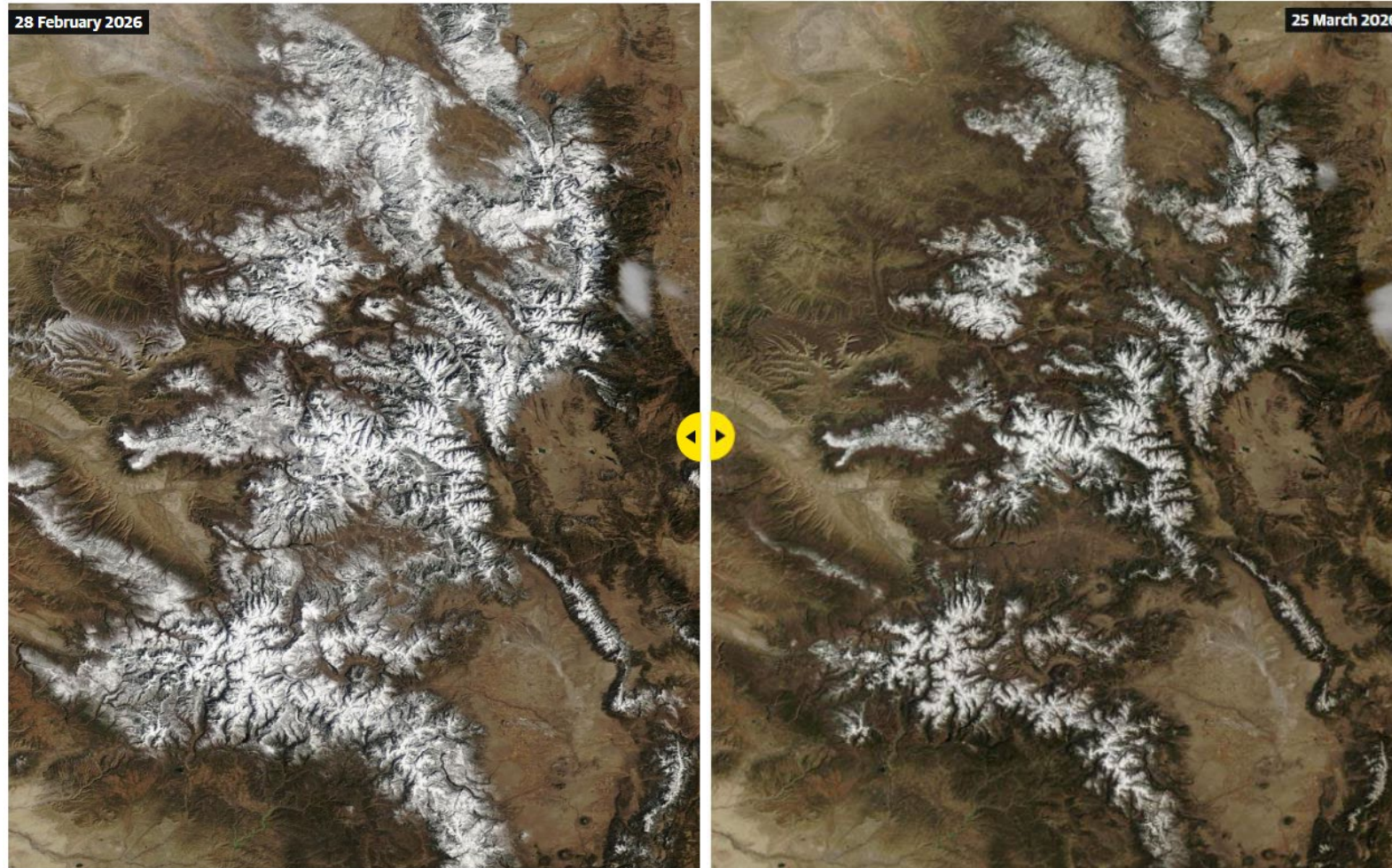
📷 Snowpack in California's Sierra Nevada. Source: Nasa.



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February-March 2026
Colorado Rocky Mountains



The snowpack in the Colorado Rocky Mountains. Source: Nasa.

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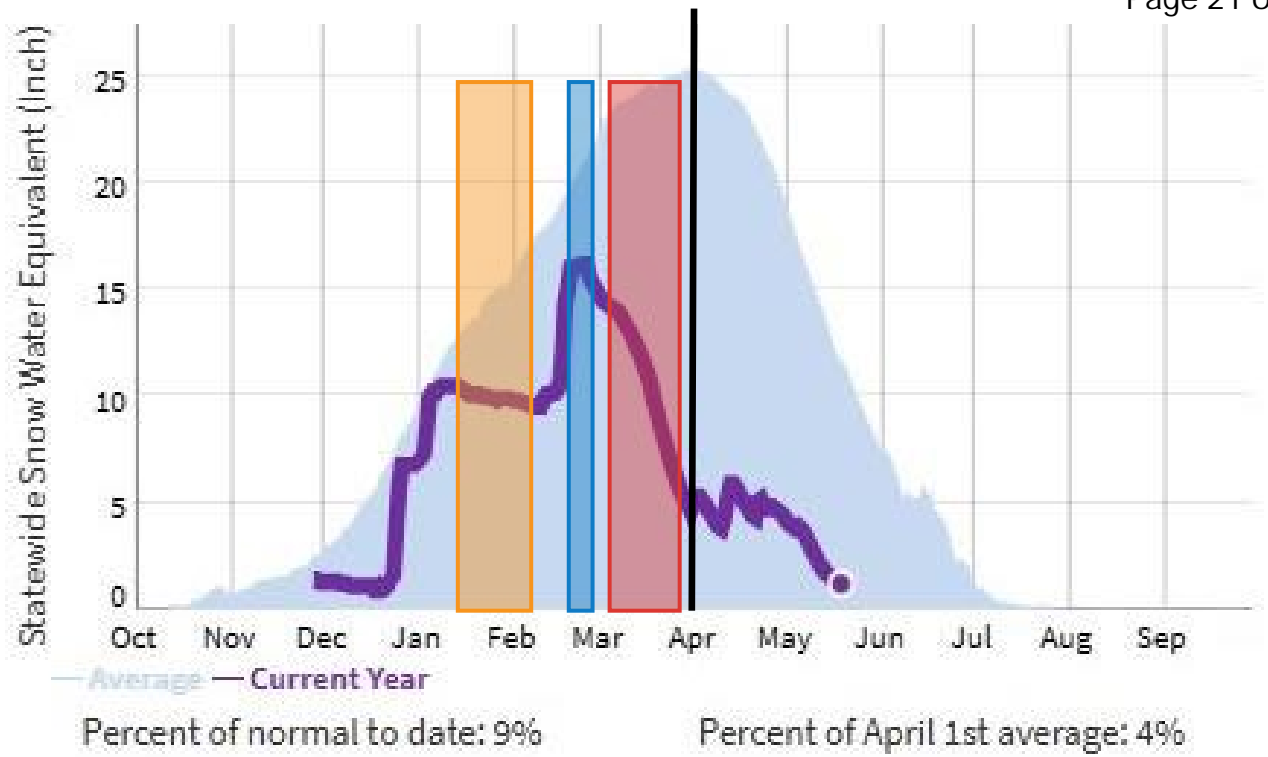
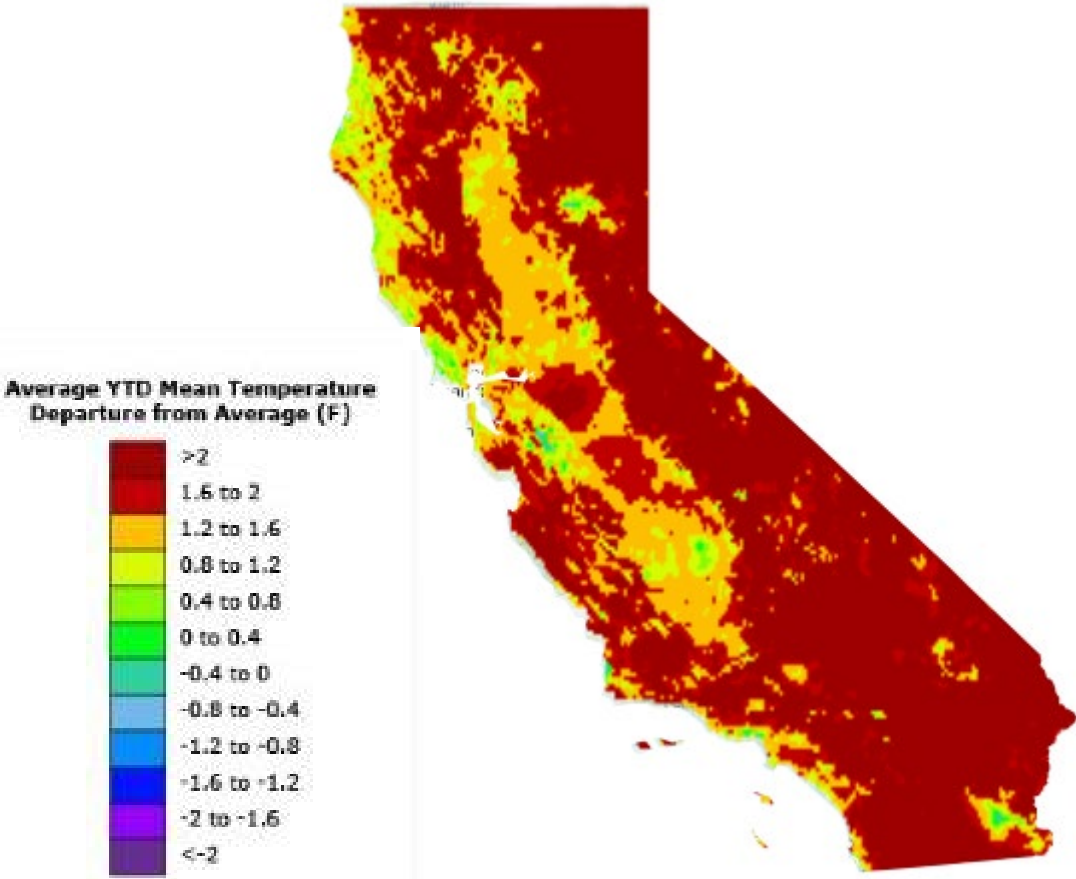


Water year 2026 could be an object lesson for the next few decades

Above normal precipitation, anomalously high temperatures, low-to-no snow

Extreme events (warm spells, rain-on-snow events, and snow-eater heatwaves) disrupt normal snow behavior

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“...California must learn to derive more of its future water resources from less reliable snowmelt, fewer storms, and more punctuated floodwater...” (Gershunov et al. 2025)



What can we do to be proactive rather than reactive?

- Maintain and expand monitoring networks and remote sensing
- More nimbly manage infrastructure
- Bank water more regularly in the ground
- More efficiently utilize water and generate “new” water
- Foster more partnerships between academia and management

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