Building a Water Resilient West

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U.S. DEPARTMENT OF ENERGY

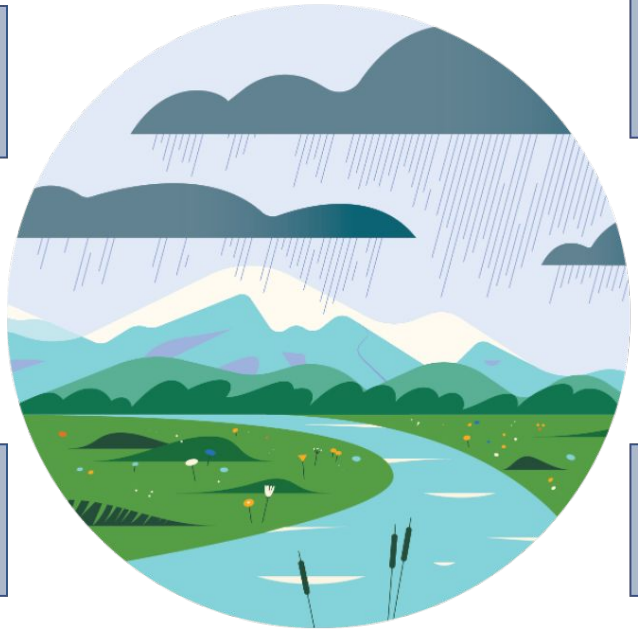
NAWI
National Alliance for Water Innovation

Water at the Berkeley Lab

Climate modeling

Natural and green infrastructure

Hydroclimatic modeling



Smart systems and resilient infrastructure

Integrated watershed science and management

Water reuse, recycling, desalination

Sustainable groundwater management

Water at the Berkeley Lab

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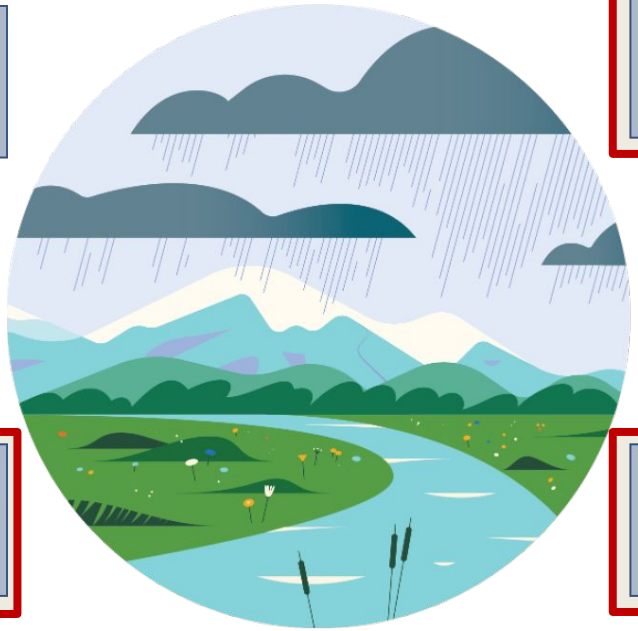


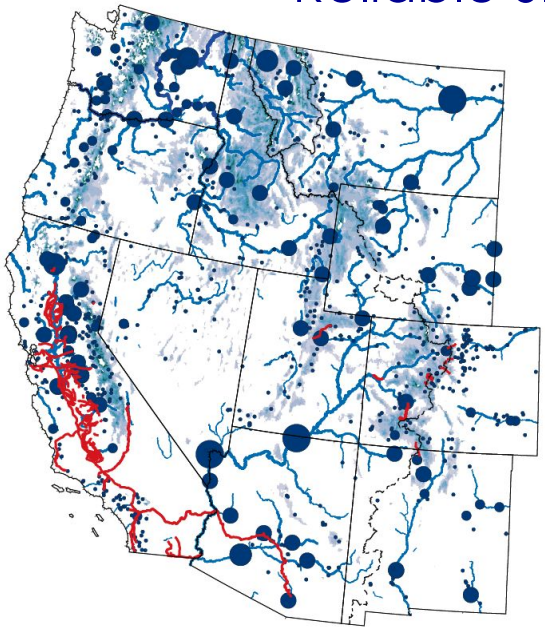
Smart systems and resilient infrastructure

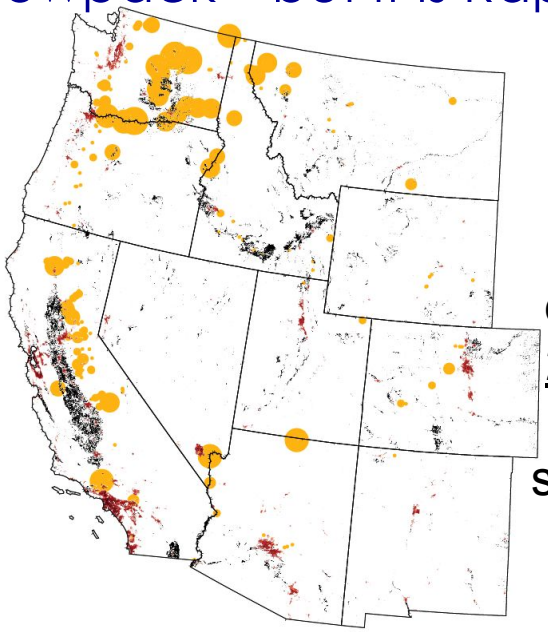
Integrated watershed science and management

Water reuse, recycling, desalination

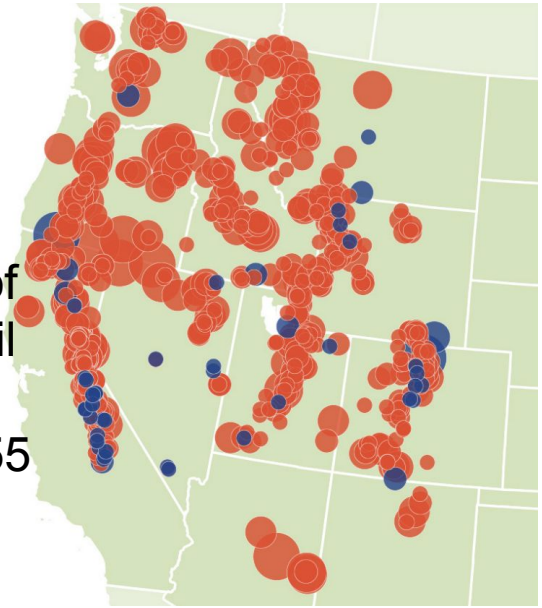
Sustainable groundwater management

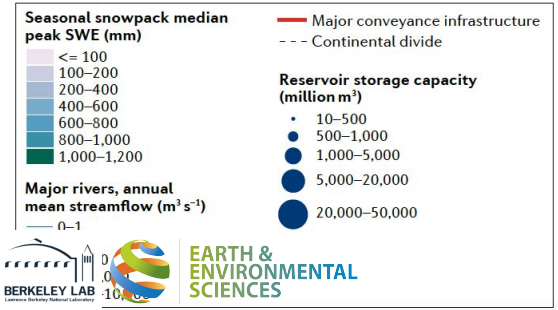
Water in the Western U.S. is Managed Based on the Assumption of a Reliable Snowpack – but it is Rapidly Disappearing!

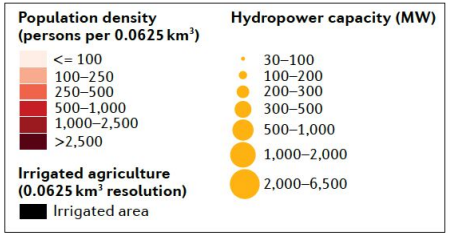




<u>90%</u> of stations report a decline of **<u>23%</u>** April 1 snow since 1955







Siirila-Woodburn et al., 2021

Mote and Sharp, 2016; Mote et al., 2018

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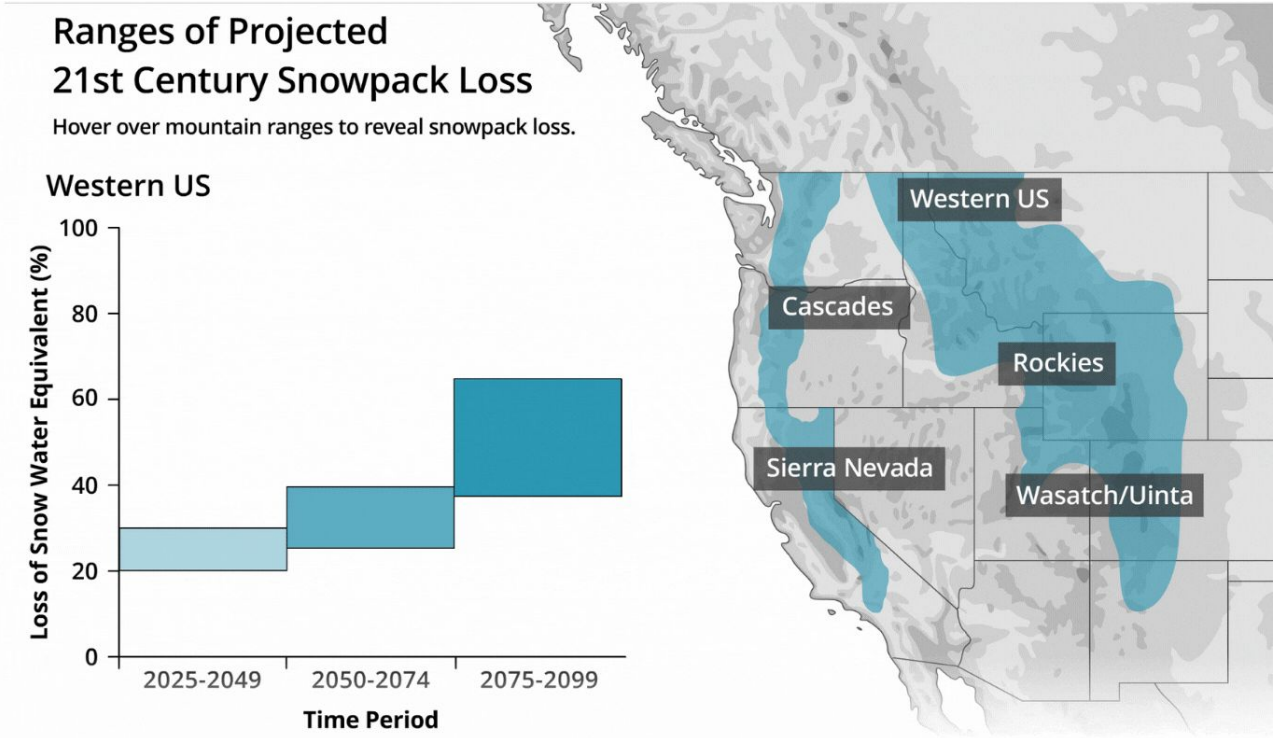
Climate Projections Reveal a Low-to-No Snow Future

Synthesis of >300 peer-review journal articles

Performed an analysis on the 18 studies which provided detail on the timing of snowpack disappearance

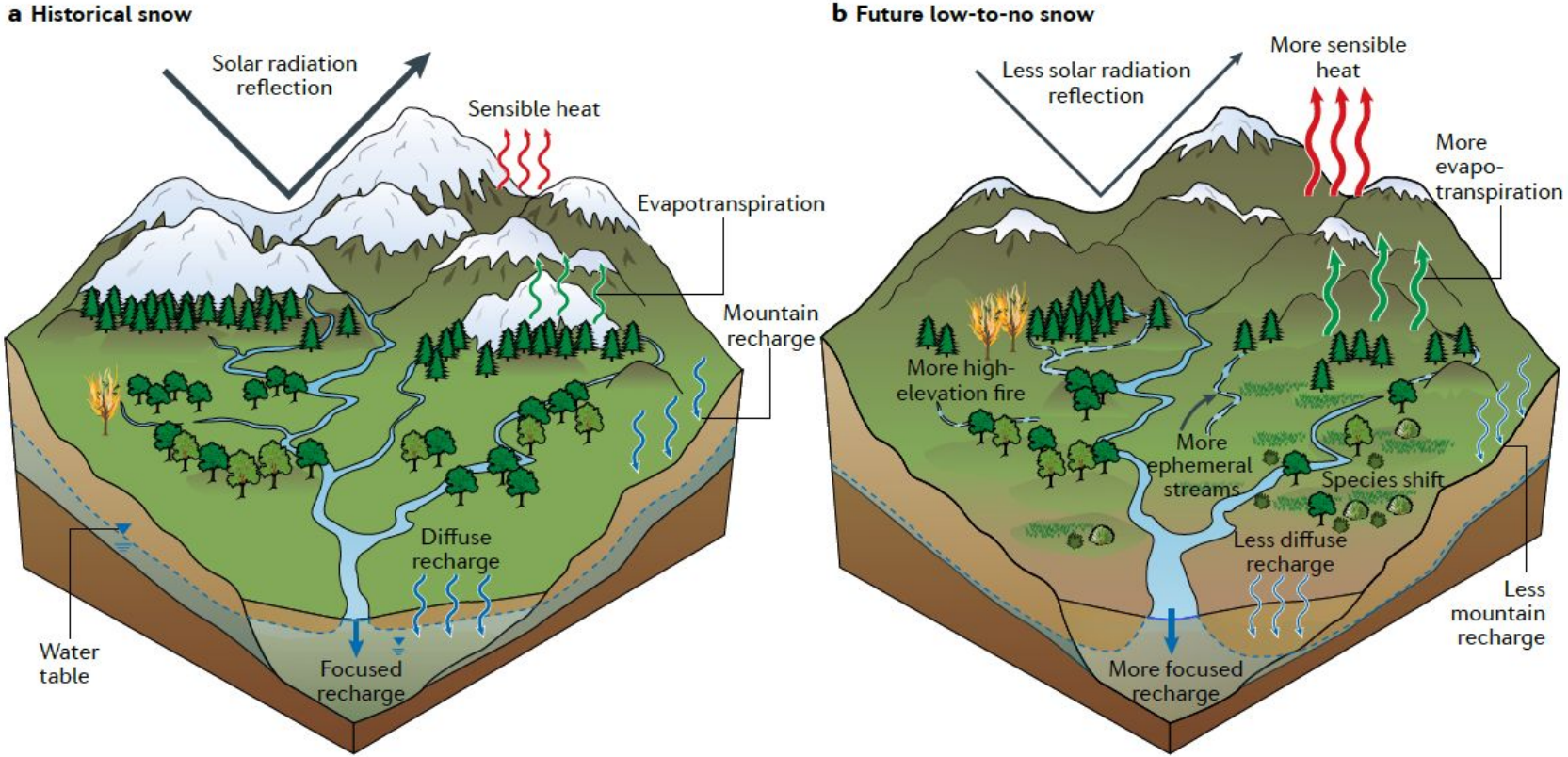
Results show regional differences, but generally predict WUS snow losses

~25% ± 5% by 2050
~35% ± 10% by 2075
~50 ± 10% by 2100



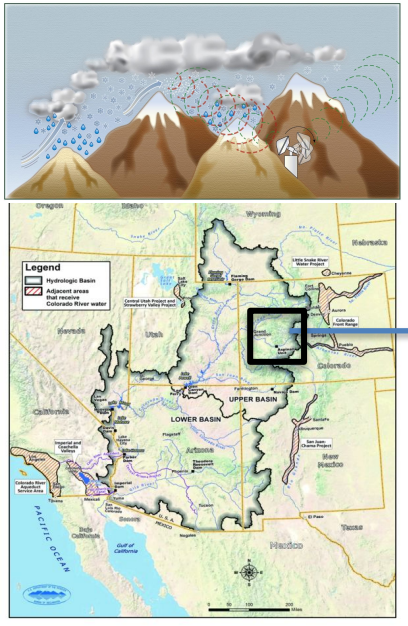
Siirila-Woodburn, Rhoades, et al., NREE, 2021

Translating Snowpack Loss to Future Water Resources is Difficult Due to Hydrologic Feedbacks

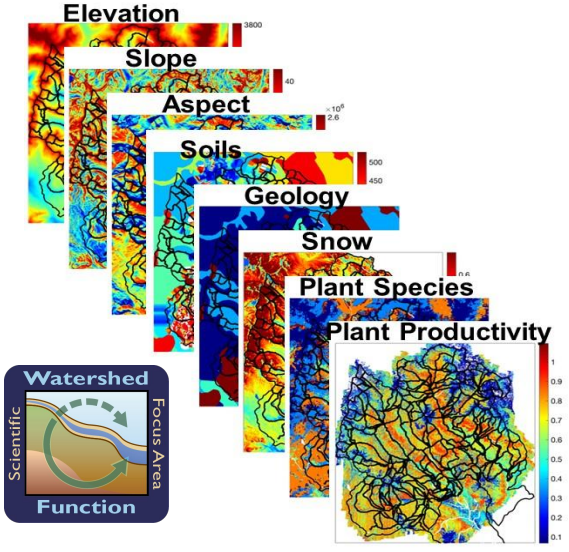


Siirila-Woodburn, Rhoades, et al., NREE, 2021

DOE is Supporting The World's Most Comprehensive Bedrock Through Atmosphere Observatory



High-Resolution Surface and Subsurface Data Layers



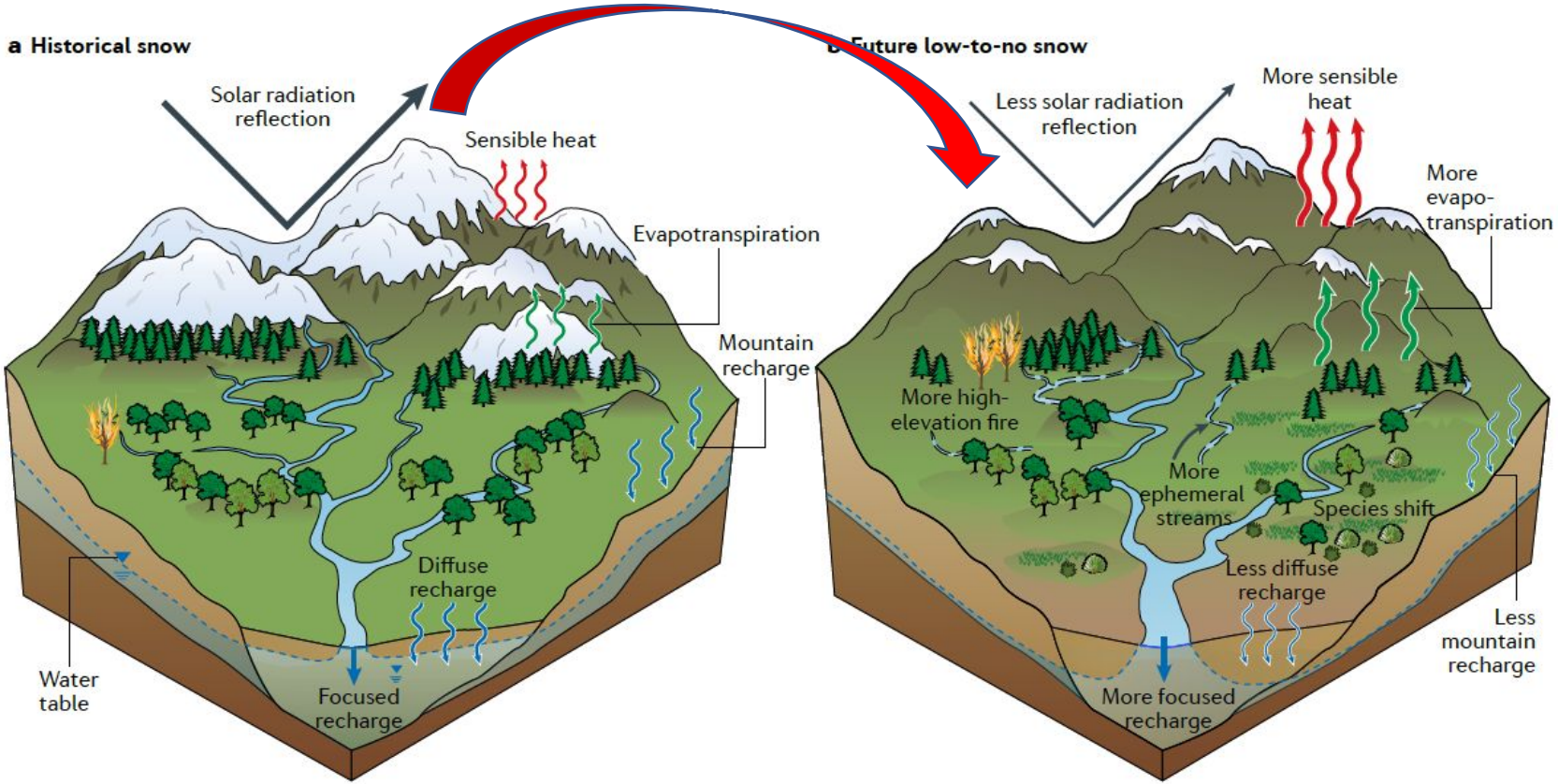
Upper Colorado:
Water Tower of the West

- **Water** to 1 in 10 Americans
- **Irrigates** over 4.5 M acres of agriculture
- **Hydroelectric** power to millions
- **USD 1 trillion per year** of economic activity

East River Watershed
Mountainous Headwaters Catchment

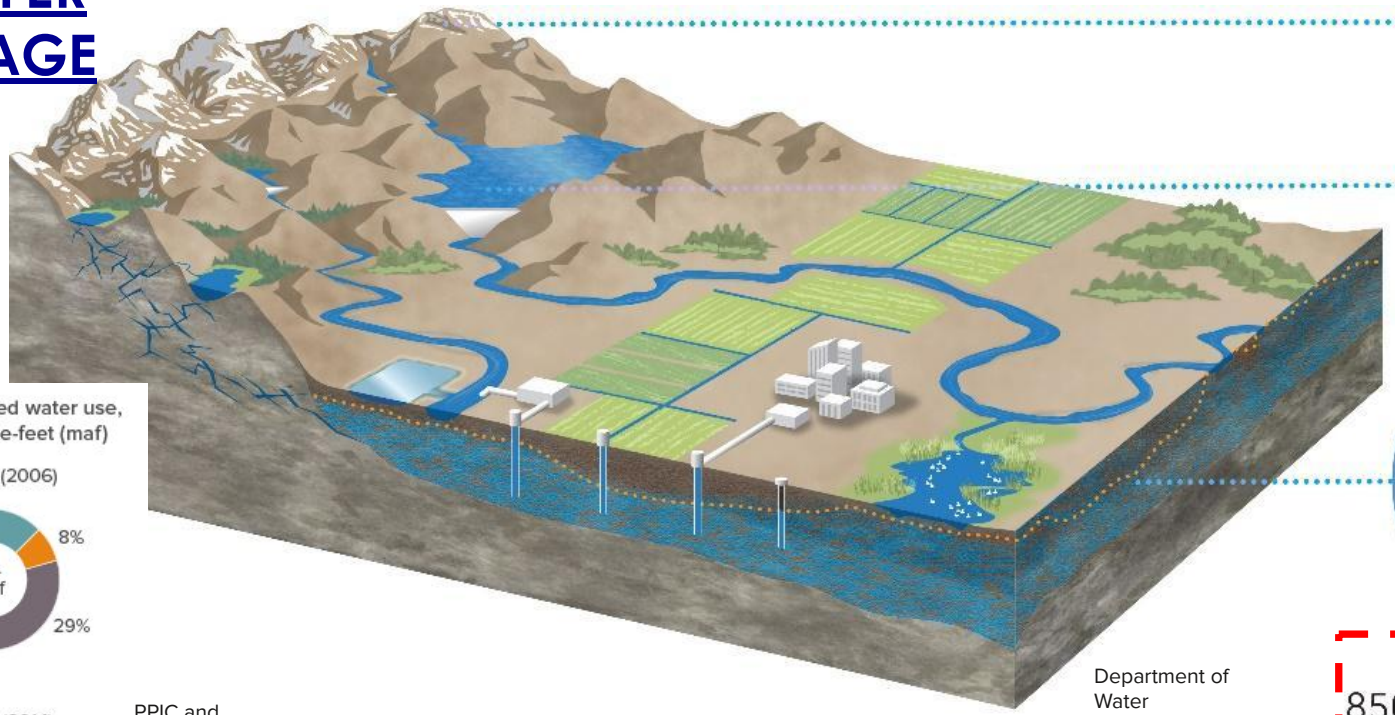
- **Location** Near Crested Butte, CO
- **Size** ~300 km2
- **Elevation** 2800 - 4000m
- **Historical Snowfall** 5-10 m/year

How do we transition from relying on snowpack as a natural storage?



Siirila-Woodburn, Rhoades, et al., NREE, 2021

AQUIFER STORAGE



Snowpack
15 MAF

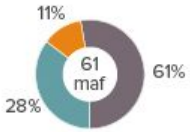
Reservoirs
50 MAF

Groundwater
850MAF to 1,300MAF

Statewide applied water use, millions of acre-feet (maf)

Wet year (2006)

Dry year (2014)



PPIC and Department of Water Resources, *California Water Plan Update 2018*

Department of Water Resources, *California Water Plan Update 2020*

For example, ***underground aquifers provide nearly 40%*** of the water used by California's farms and cities

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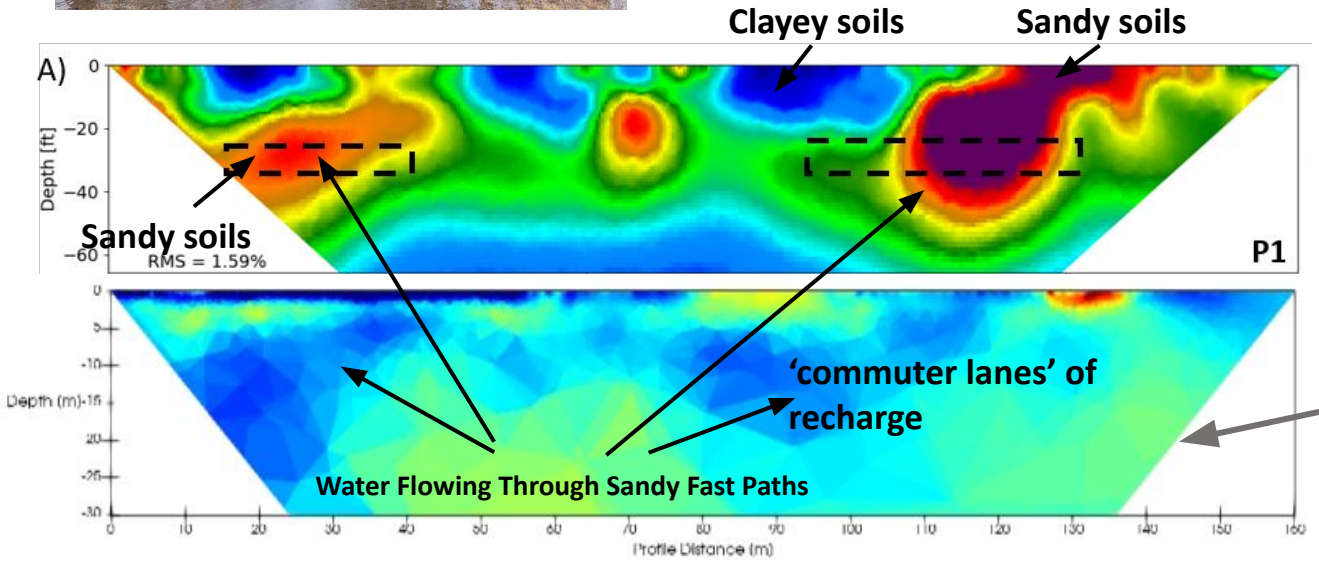
Technology to 'See' Where the Water Goes Across Scales

AgMAR

Almond Orchard

- Utilizes existing flood irrigation infrastructure to apply water across large acreages.
- Monitoring geophysics highlights optimal preferential flow paths for recharge.
- Large quantities of recharge can help improve nitrate levels through dilution.

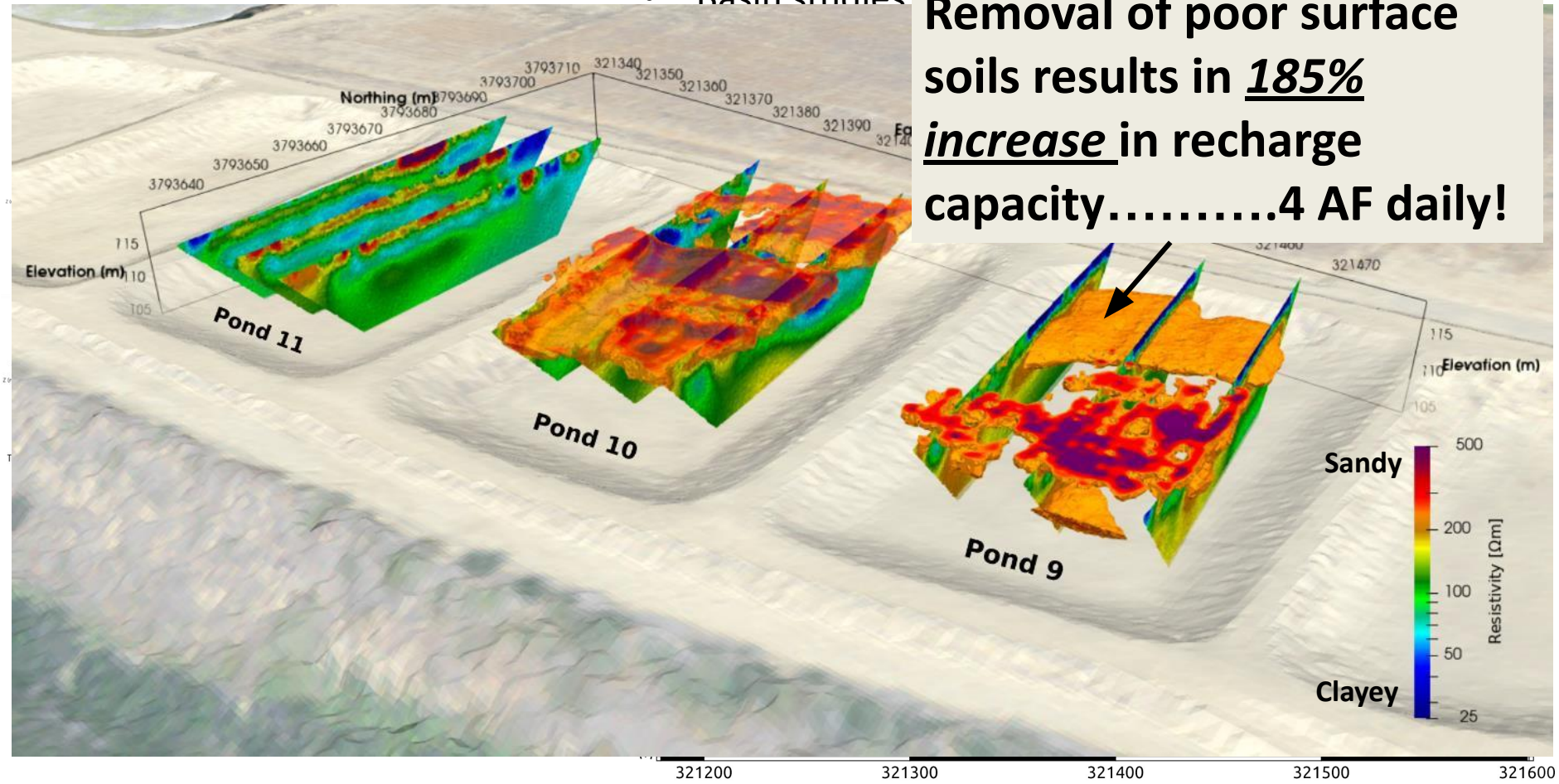


- Recharge observed down to aquifer at 50 ft.

Change in saturation over time.

Technology to 'See' Where the Water Goes Across Scales

- Basin studies

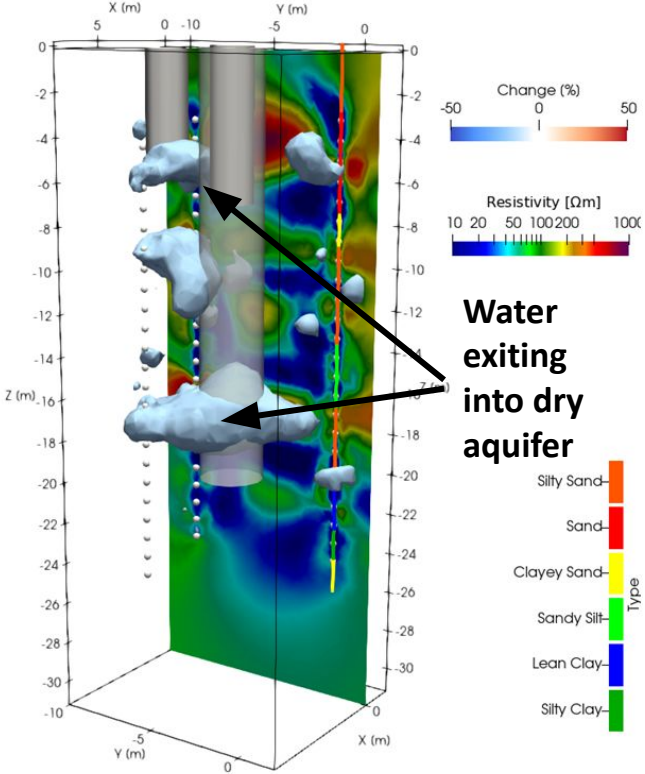


Technology to 'See' Where the Water Goes Across Scales

Green Infrastructure

Small Scale

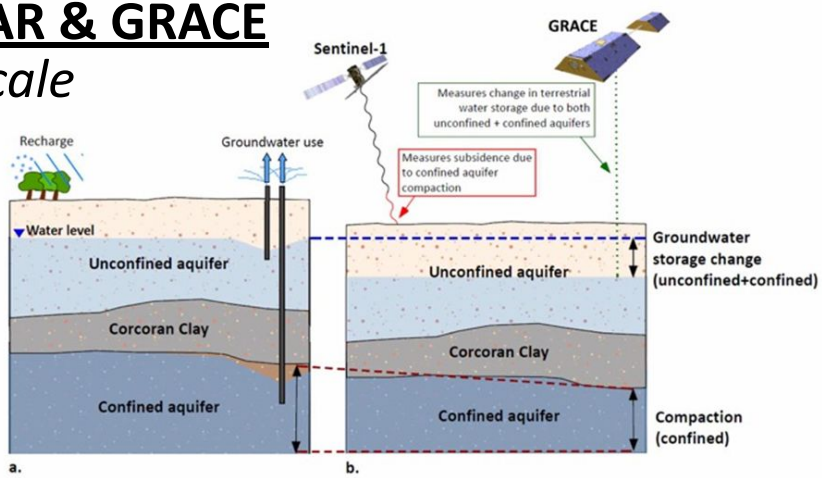
- Monitoring drywell = under performance from inlet design.



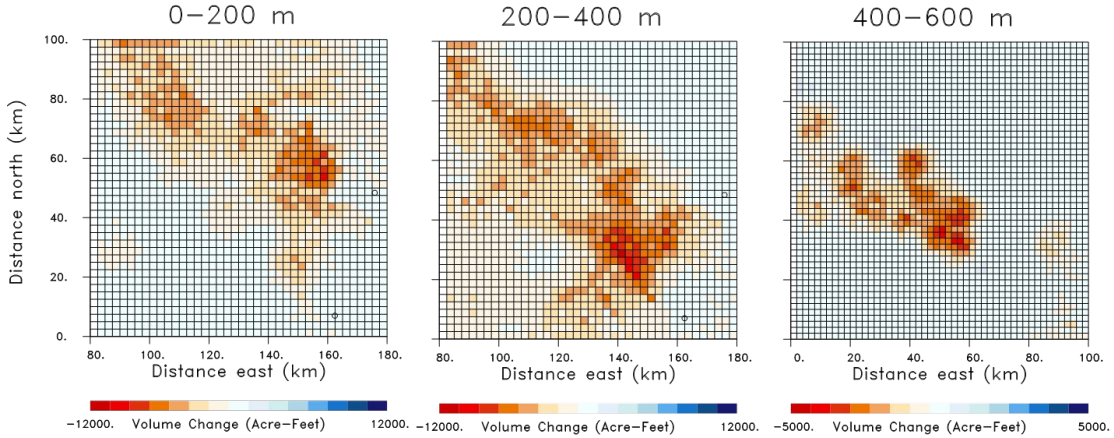
Satellite: InSAR & GRACE

Large Scale

- Satellites can be used to monitor at full basin scale!



- Observe pumping effects at discrete depths!



Roadmap to Achieving Water Resiliency