Peril and promise: groundwater overdraft & next generation monitoring

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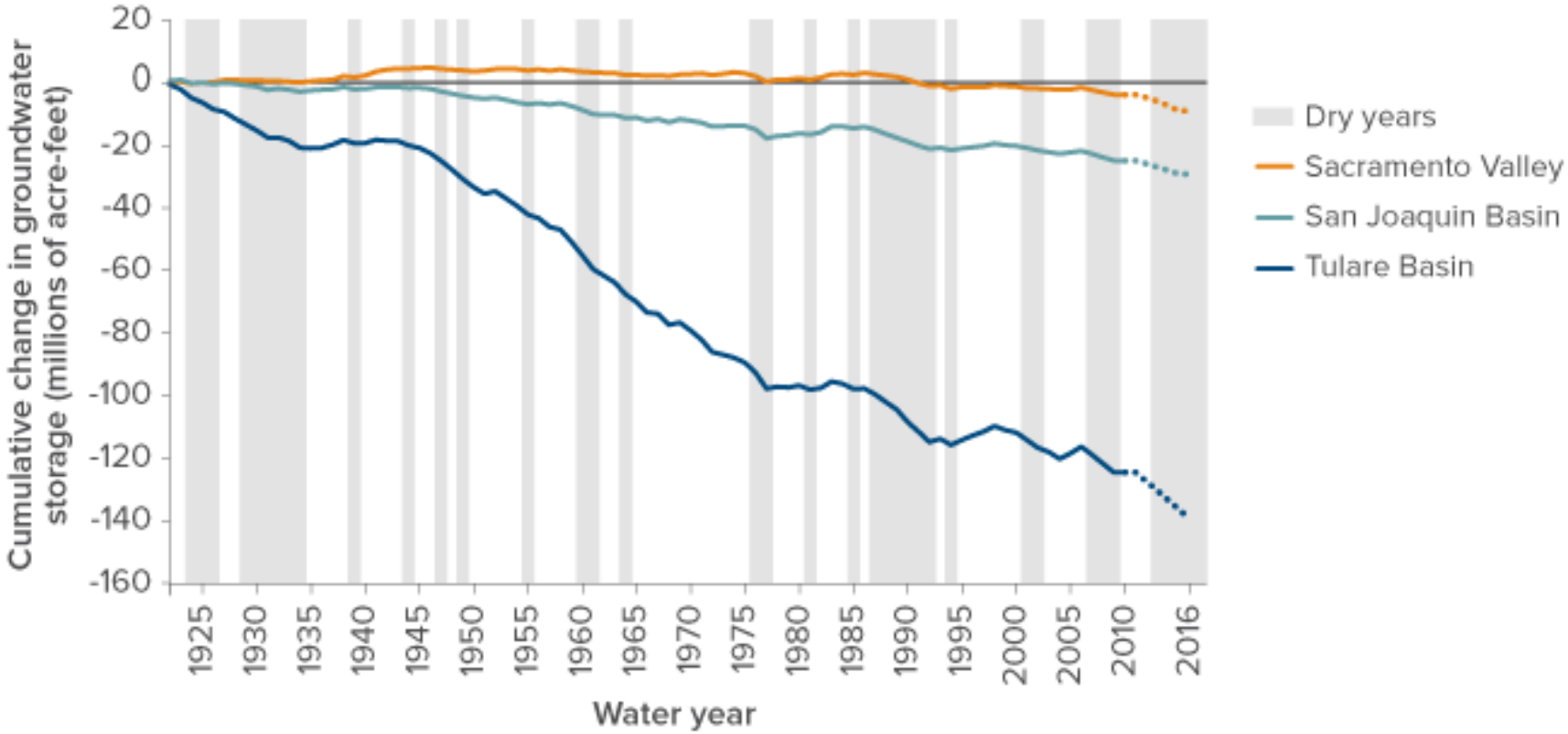
Key takeaways

- Groundwater overdraft, (i.e., running a deficit in your groundwater bank account), is highly undesirable.
- Extreme consequences of overdraft (e.g., land subsidence, arsenic leeching, well failure) are hard to undo.
- Data and models can provide risk mitigation and decision support.
- Data from next generation monitoring networks are providing real-time risk mitigation and decision support TODAY in many basins around California.

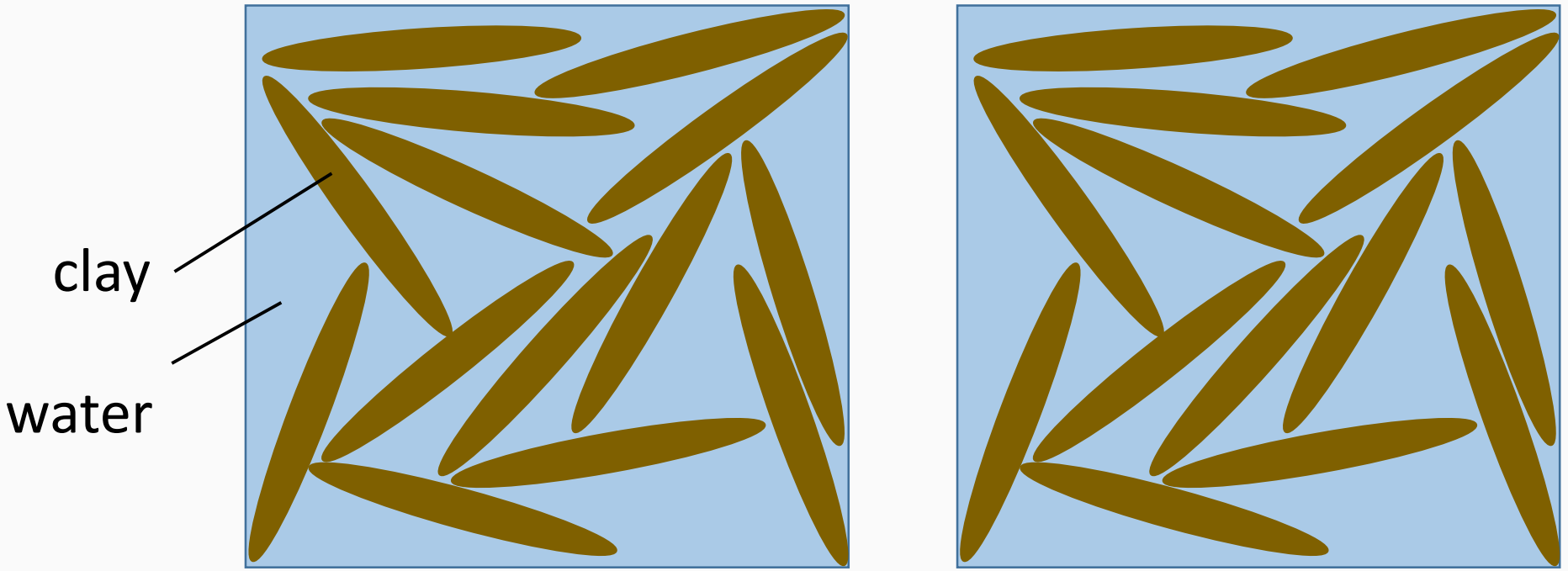
Groundwater Overdraft

- [Groundwater] extraction exceeds recharge

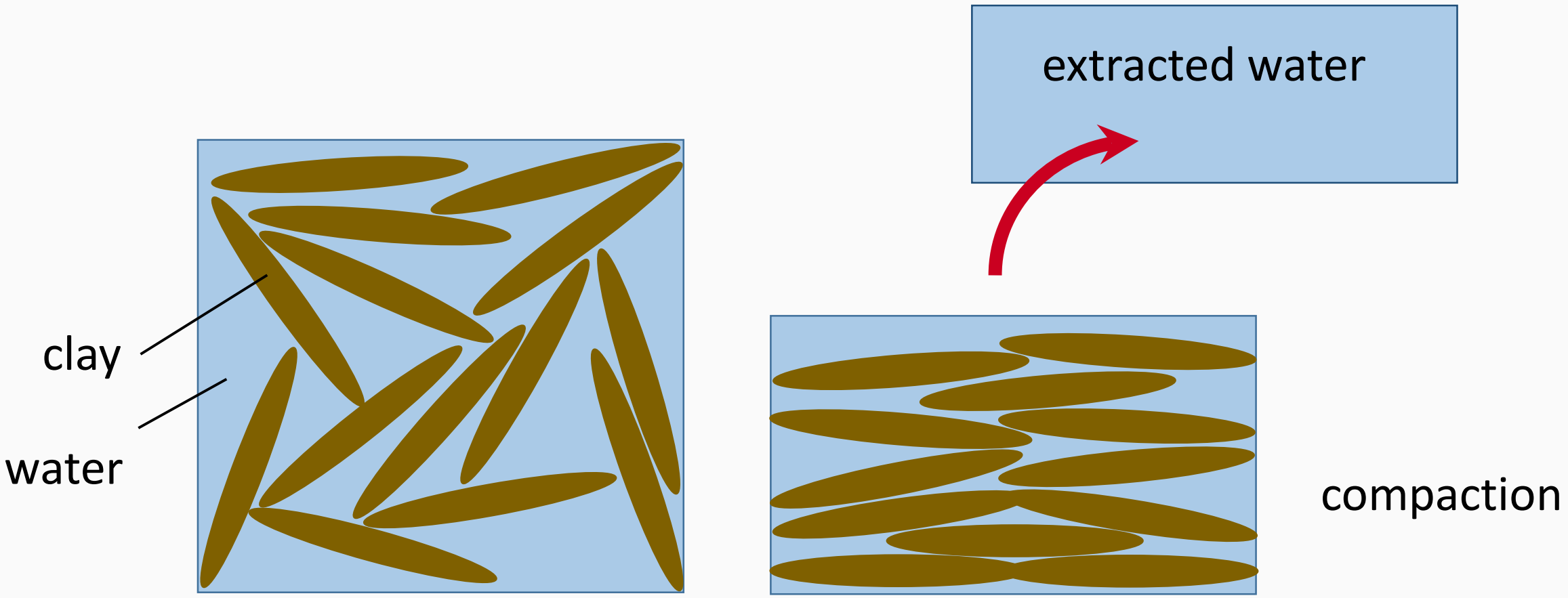


Ellen Hanak et al., *What If California's Drought Continues?* (PPIC, 2015), Figure 3, using data through 2009 from the California Department of Water Resources and author estimates thereafter.

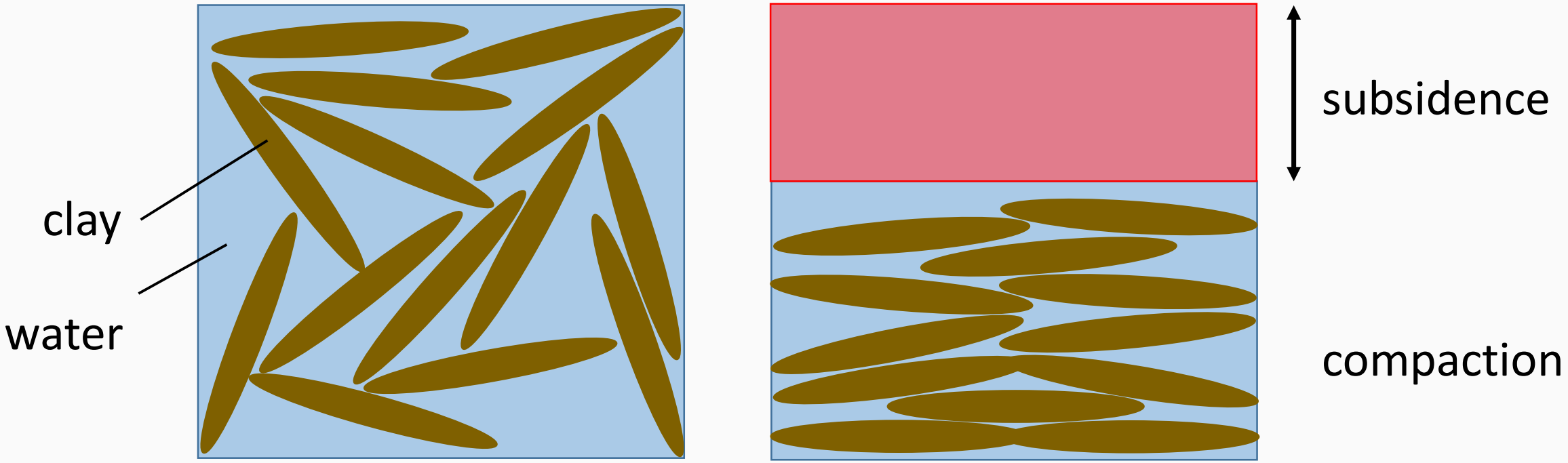
Extreme consequences of overdraft:
Land Subsidence

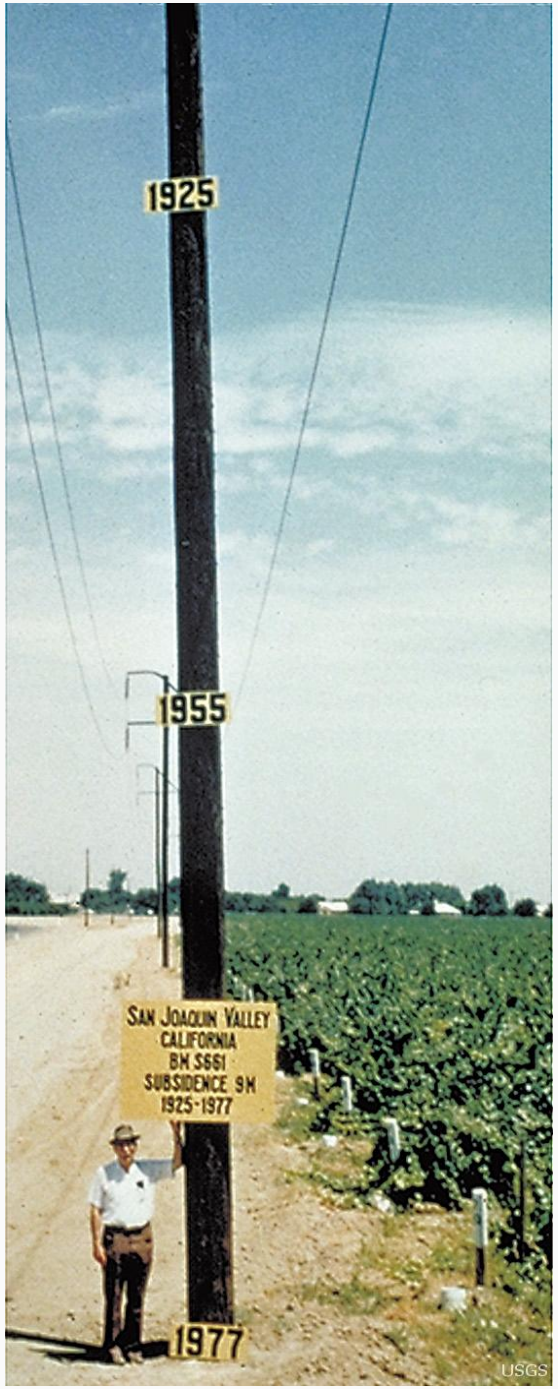


Water extraction causes clay compaction…



…resulting in subsidence and storage loss

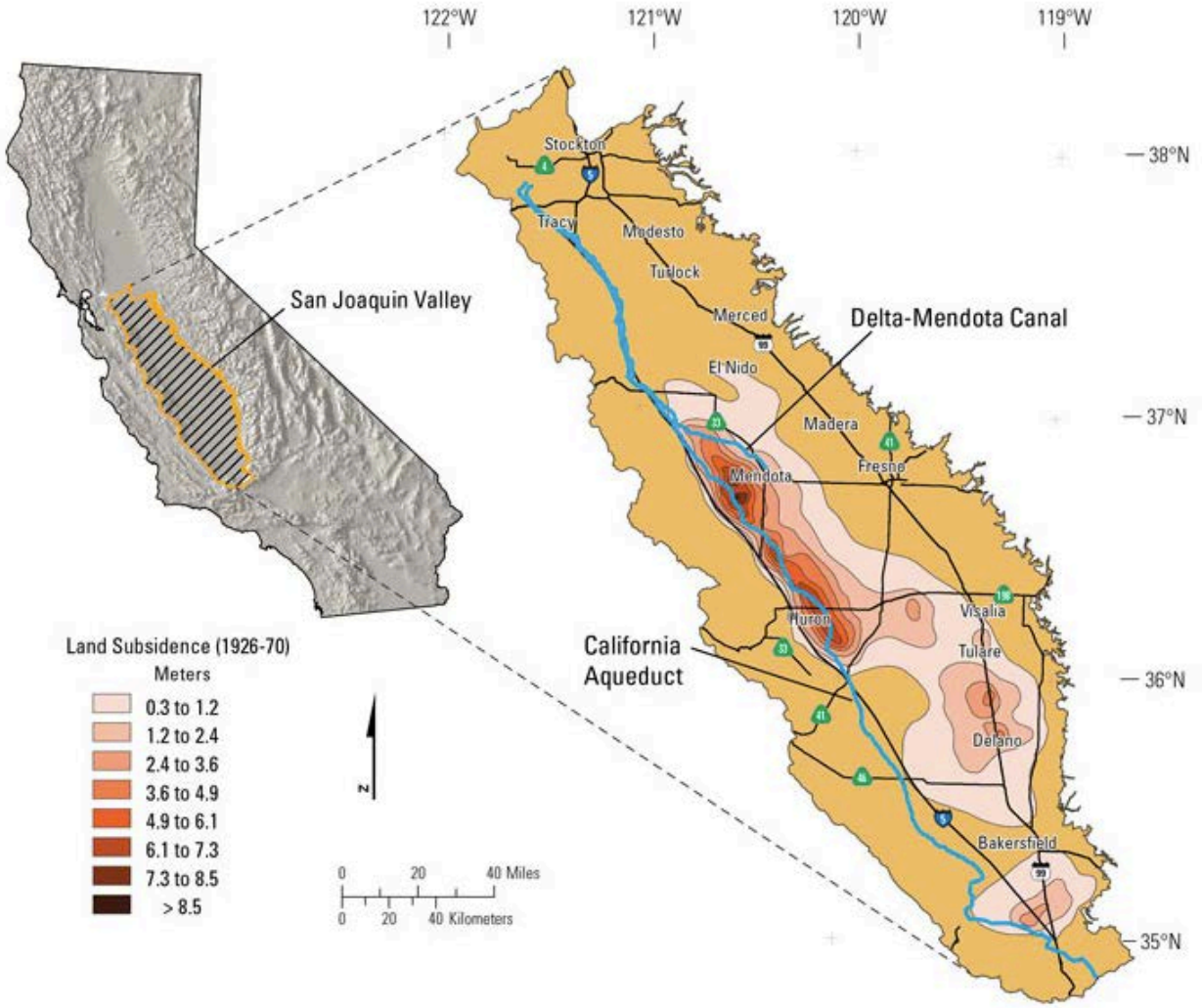



1925
1955
SAN JOAQUIN VALLEY
CALIFORNIA
BM S661
SUBSIDENCE 9M
1925-1977
1977
USGS


1988
SAN JOAQUIN VALLEY, CA
SUBSIDENCE 6.2 ft
1988-2016
Benchmark
USGS
2004
2008
2016

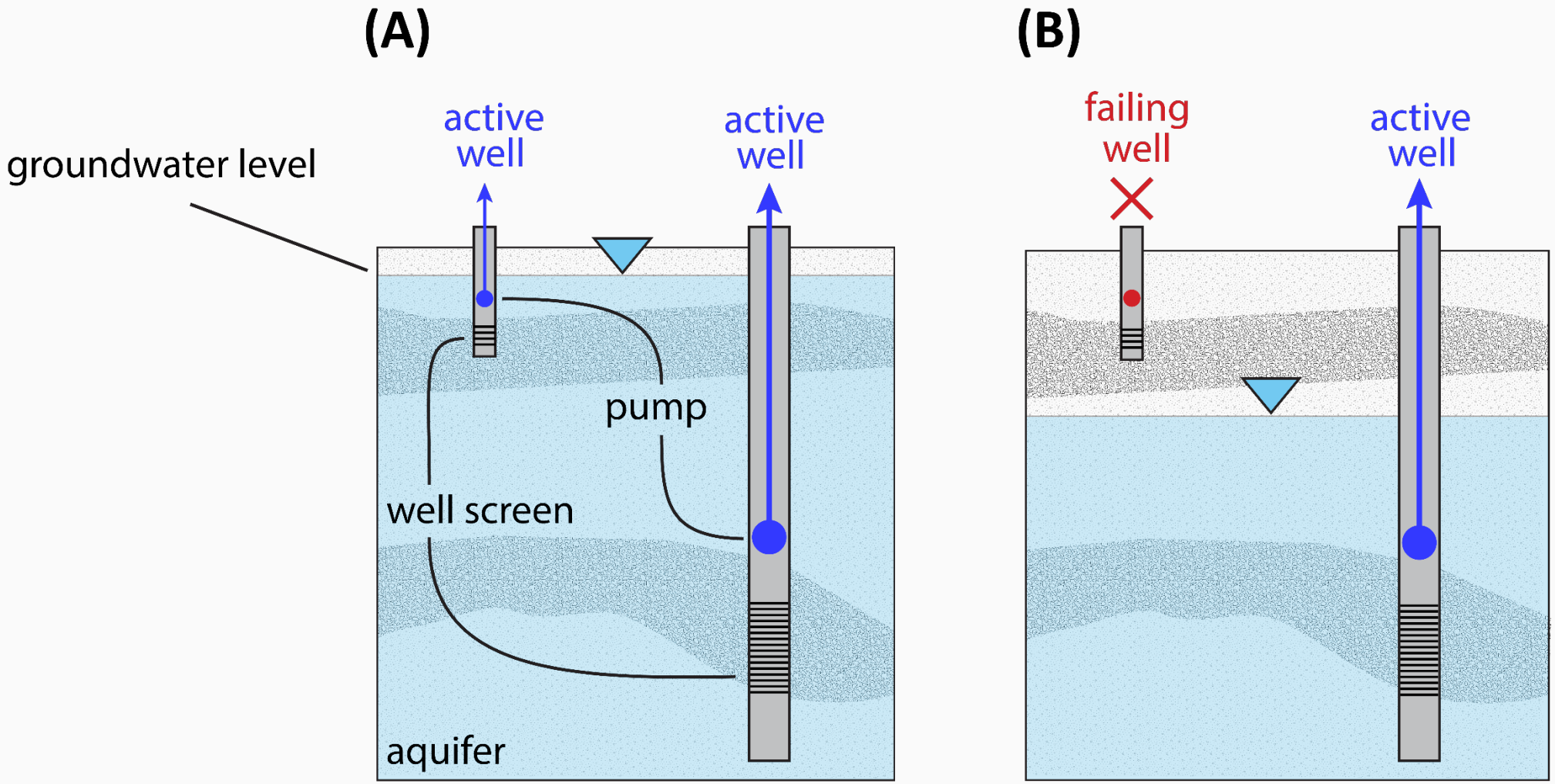
Infrastructure and water quality impacts

- Damage to buildings, aqueducts, well casings, bridges, highways
- Arsenic released from clays (Smith S., Knight R., and Fendorf S., 2018)



Land subsidence along the Delta-Mendota Canal in the northern part of the San Joaquin Valley, California, 2003-10: USGS Scientific Investigations Report 2013–5142

Extreme consequences of overdraft:
Well failure



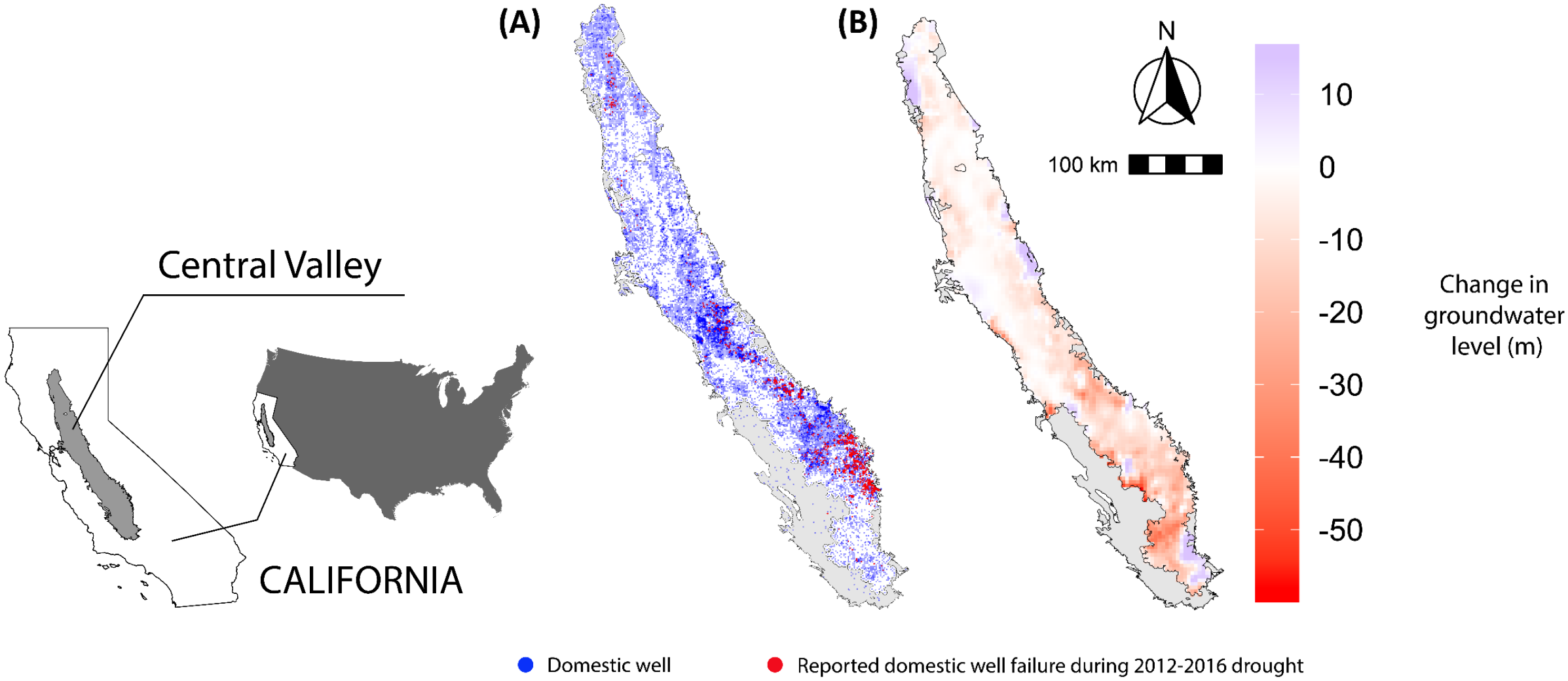
2012-2016 drought


Community Water Center


Community Water Center

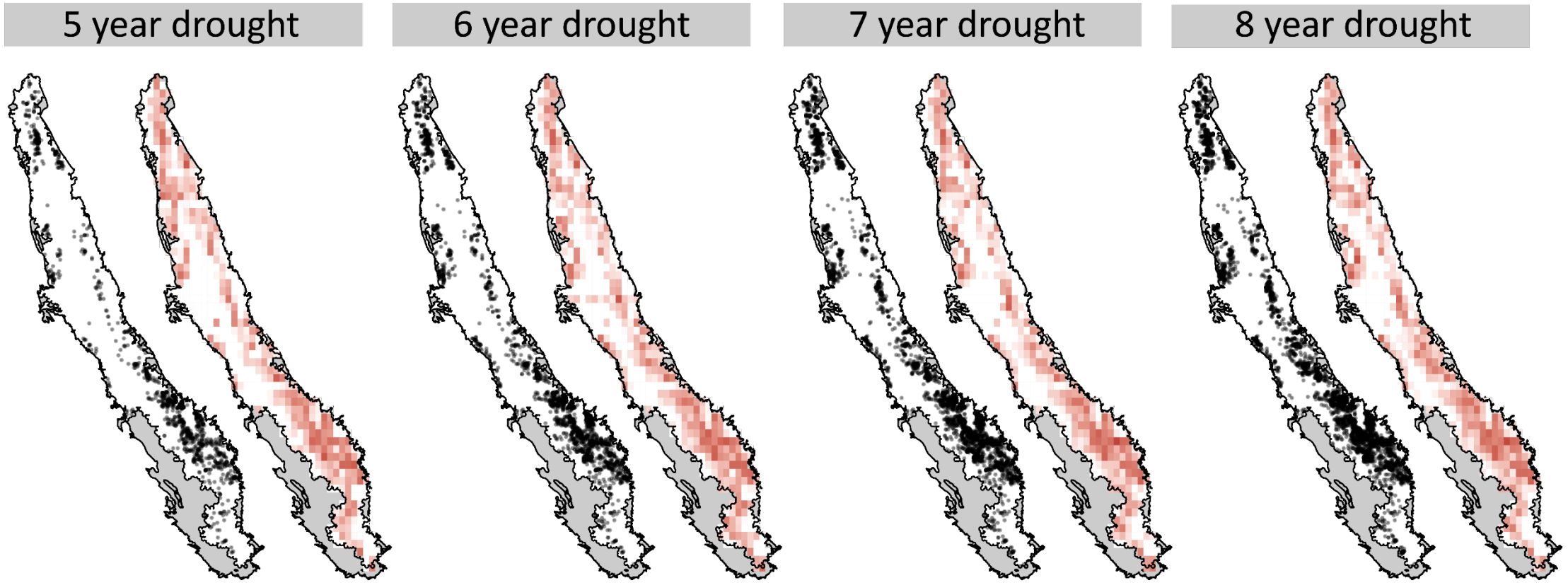

REUTERS/Lucy Nicholson

2,000+ well failures during 2012-2016

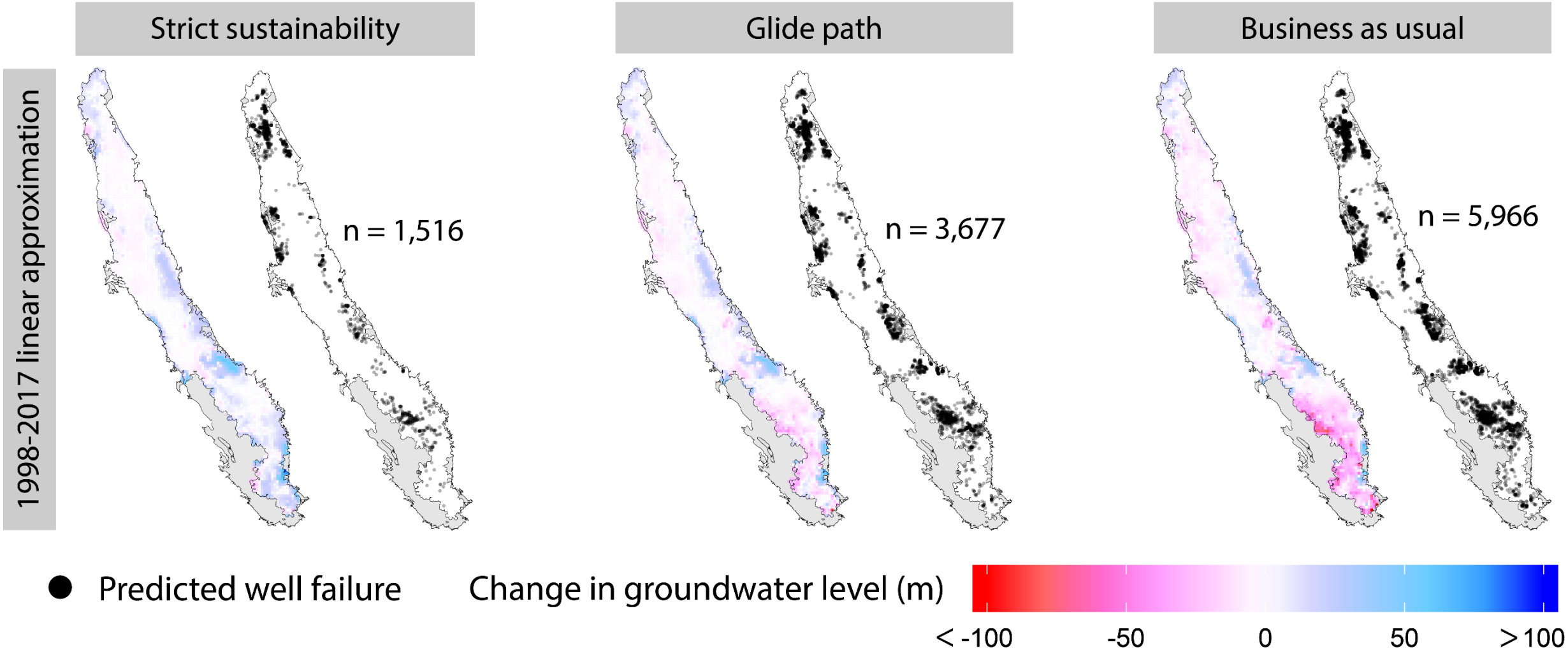


Pauloo et al. *Domestic well vulnerability to drought duration and unsustainable groundwater management in California's Central Valley*, Environmental Research Letters. (2020)

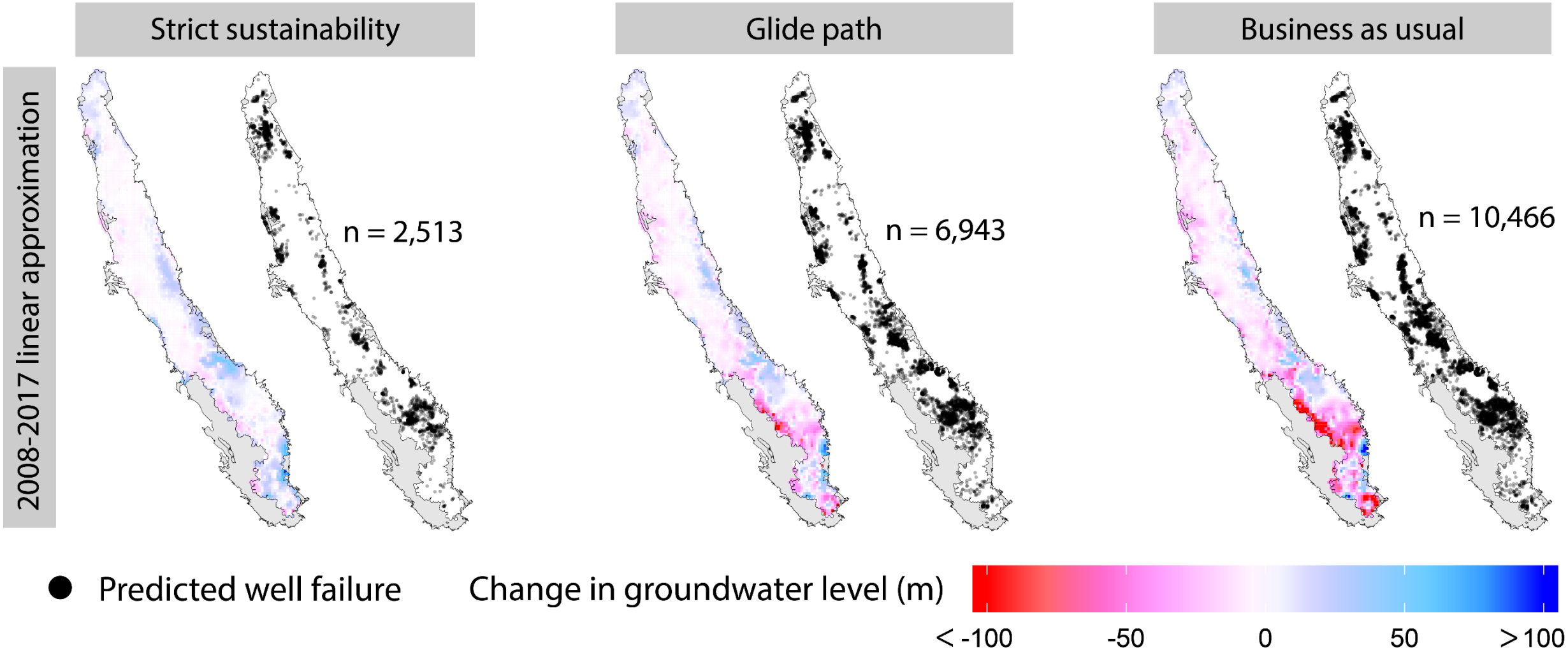
Data and models: forecast & mitigate risk



...including risk due to management choices



...and hydrologic uncertainty

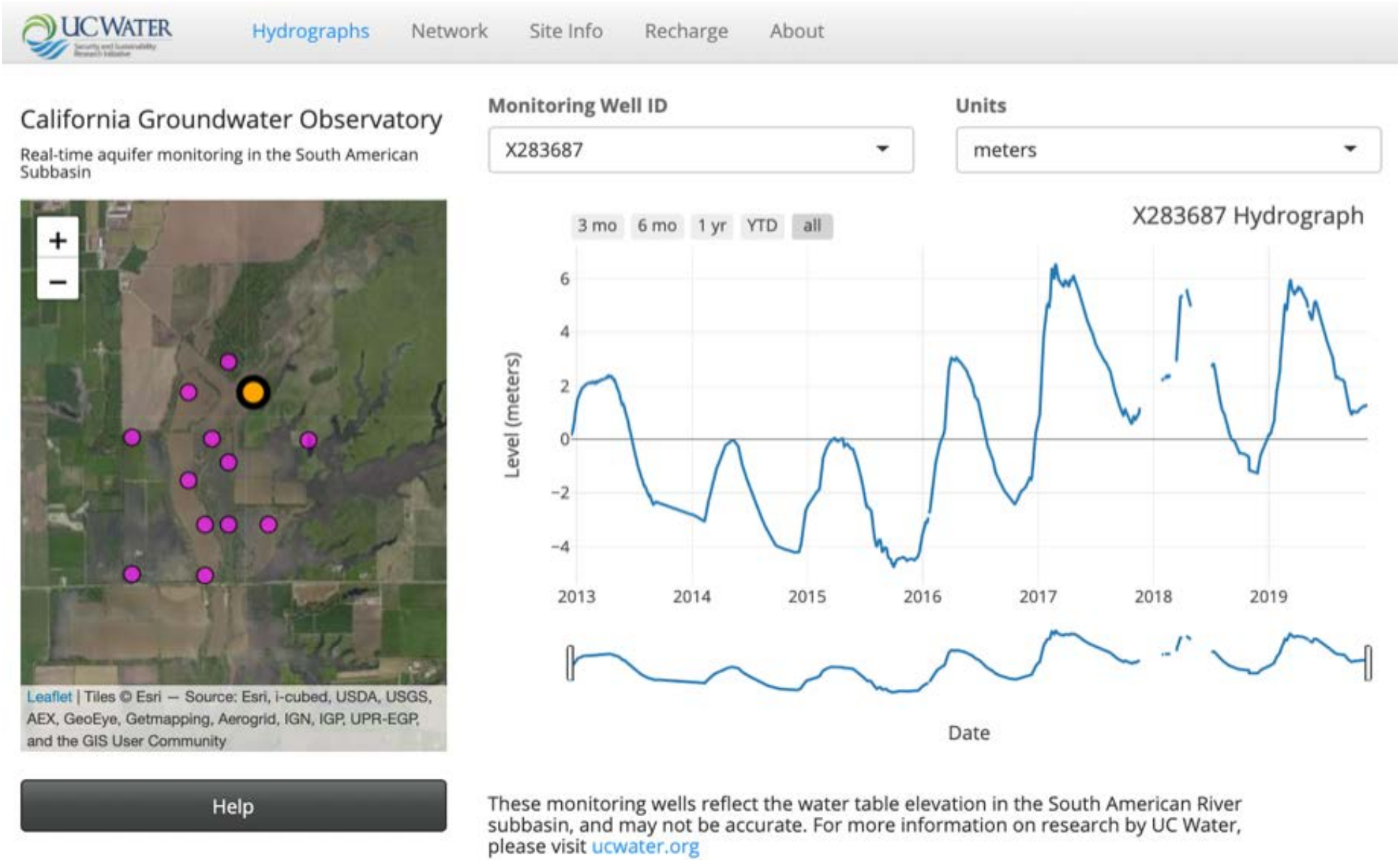



IN
DATA
WE
TRUST


IN
DATA
WE
TRUST

Next generation groundwater monitoring

Calderwood, A. & Pauloo, R. & Fogg, G. (2020), *A low cost, open source wireless sensor network for real-time groundwater monitoring*. Water. (in prep)



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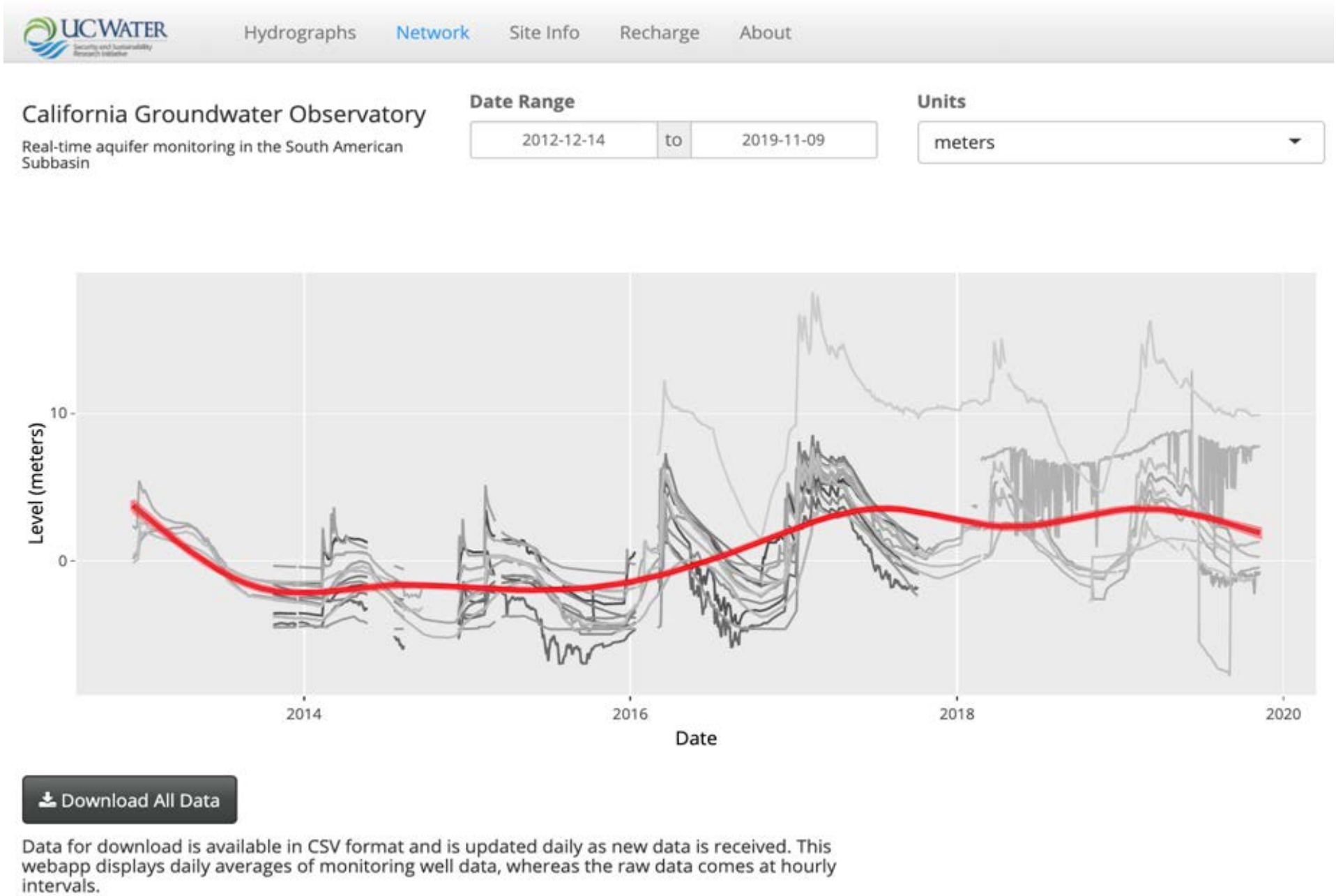

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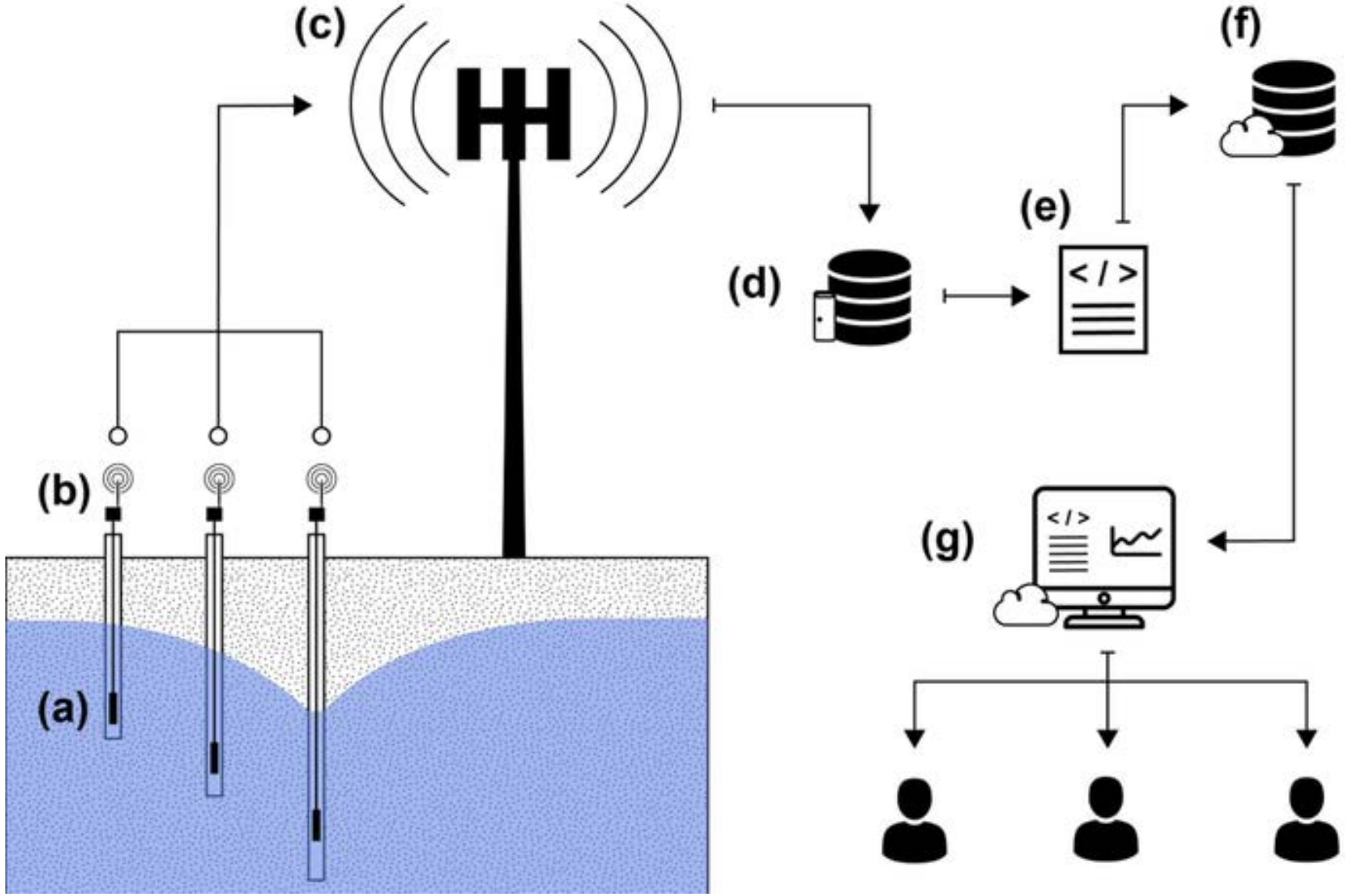


Calderwood, A. & Pauloo, R. & Fogg, G. (2020), *A low cost, open source wireless sensor network for real-time groundwater monitoring*. Water. (in prep)

Why monitor?

Decision support

Risk mitigation

Facilitate modeling

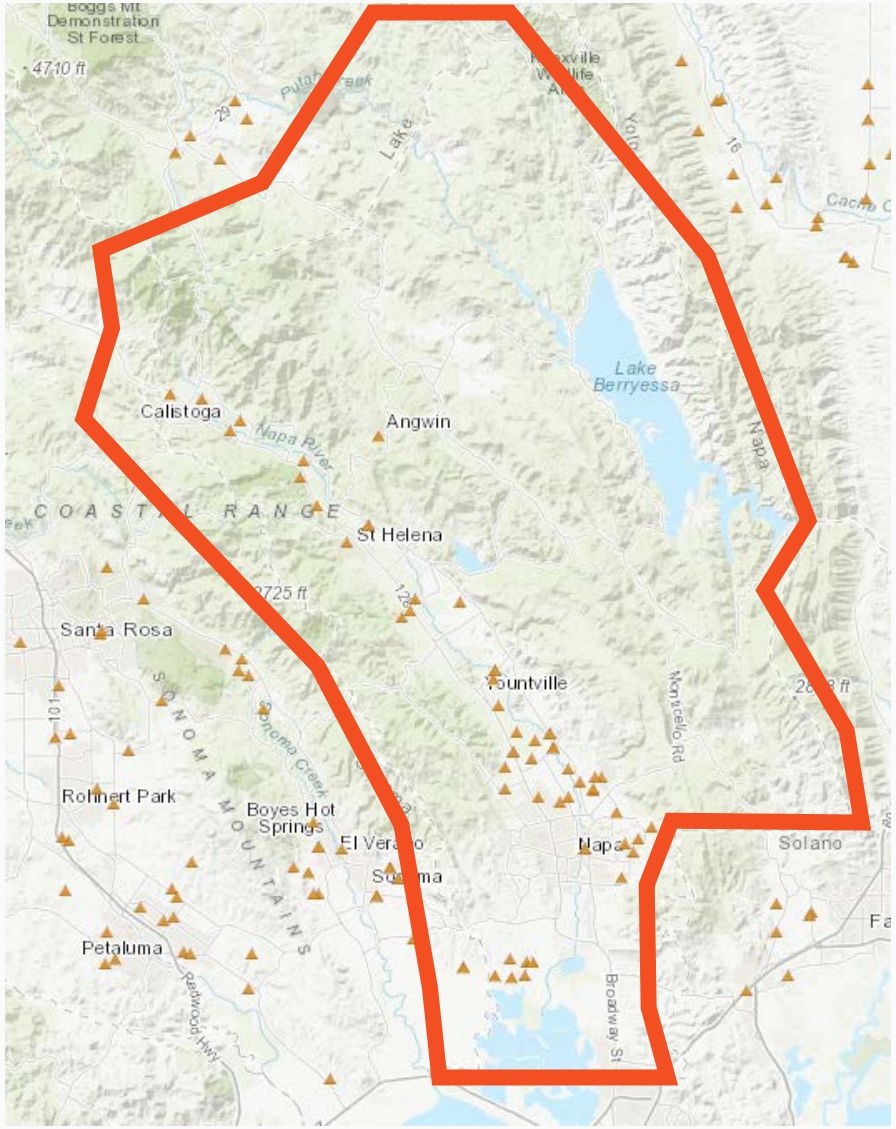
Understand history and steer towards a desired future

Napa's ambient groundwater monitoring

~ 30 – 40 biannual monitoring wells (CASGEM)

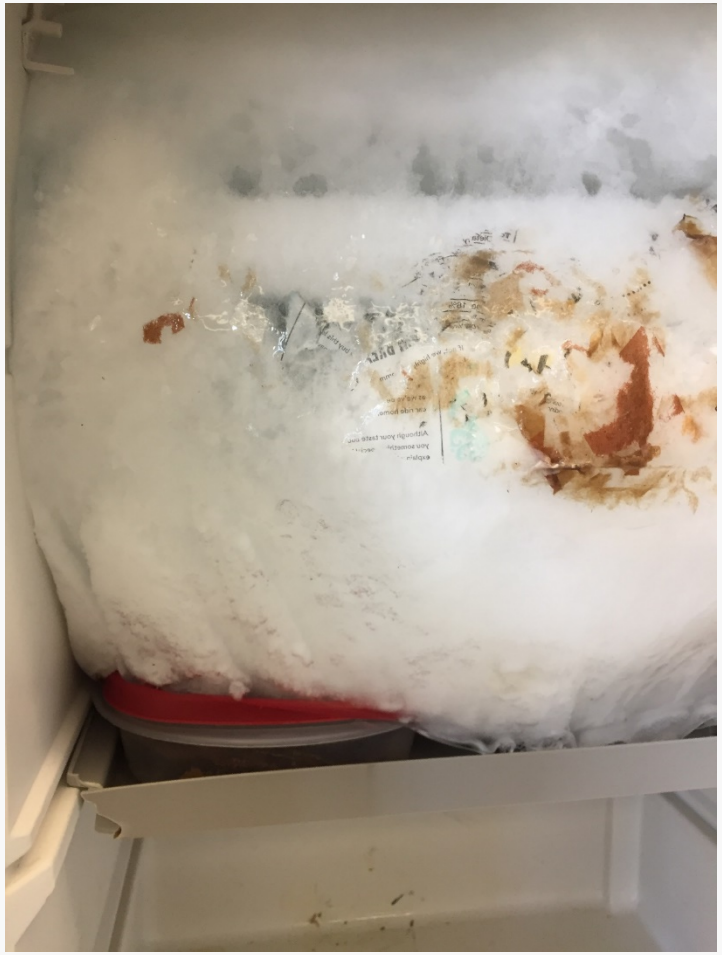
~ 60 – 80 annual samples

Napa's groundwater goals will define local monitoring efforts.



https://gis.water.ca.gov/app/gicima/

A farewell tale: the Veihmeyer 242 fridge



A farewell tale: the Veihmeyer 242 fridge

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Thank you

Slides: richpauloo.com/talk/napa

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