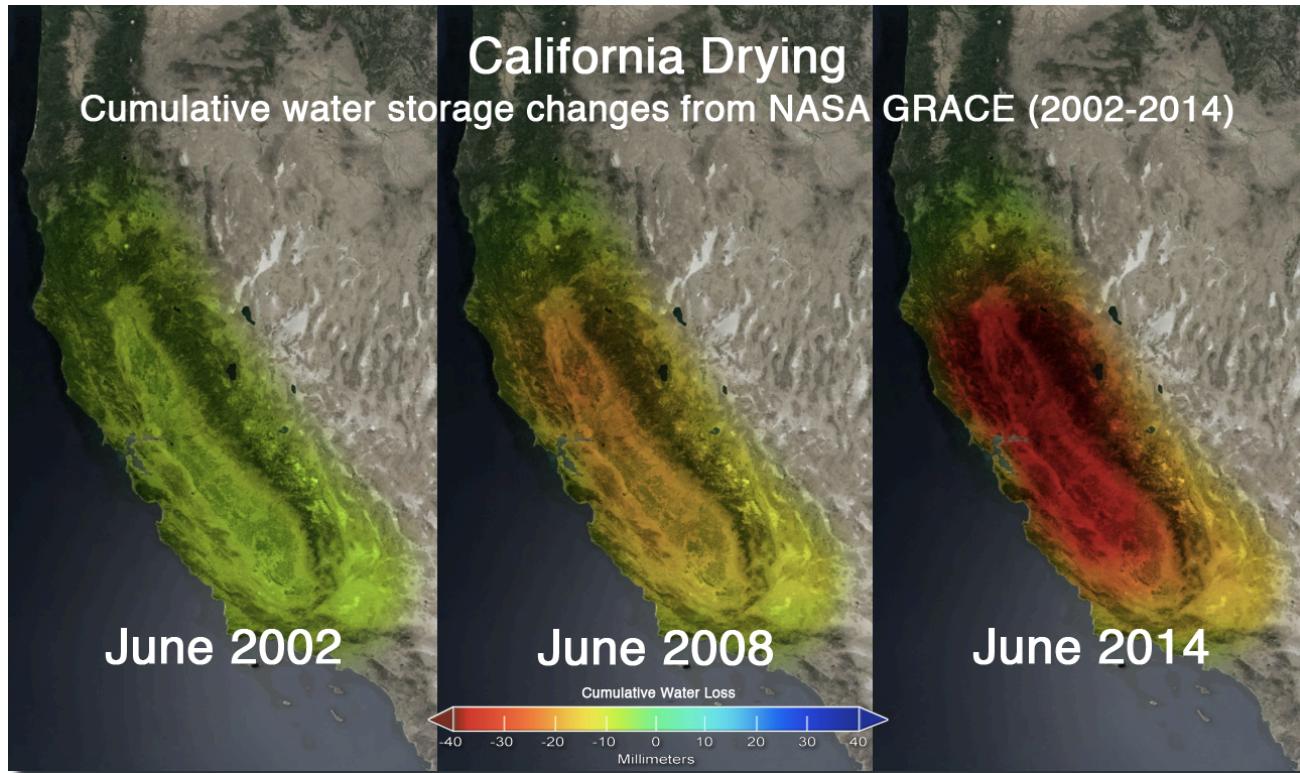


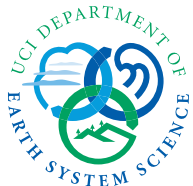
Satellite Observations of the Epic California Drought



Prof. Jay Famiglietti

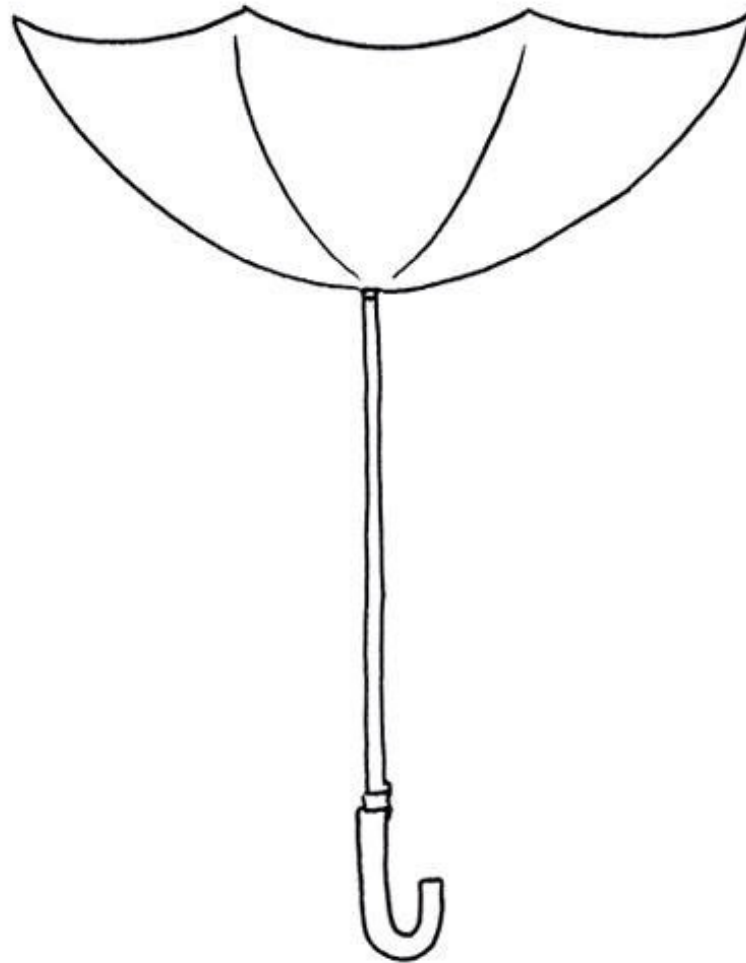
***NASA Jet Propulsion Laboratory, California Institute of Technology
Dept. of Earth System Science, University of California, Irvine***

Water Resilience and Sustainability, Caltech, September 21, 2015



How bad is the California drought?

Dry Humor



California Umbrella

RAWF

Tuolumne River Basin, CA



Lake Mead



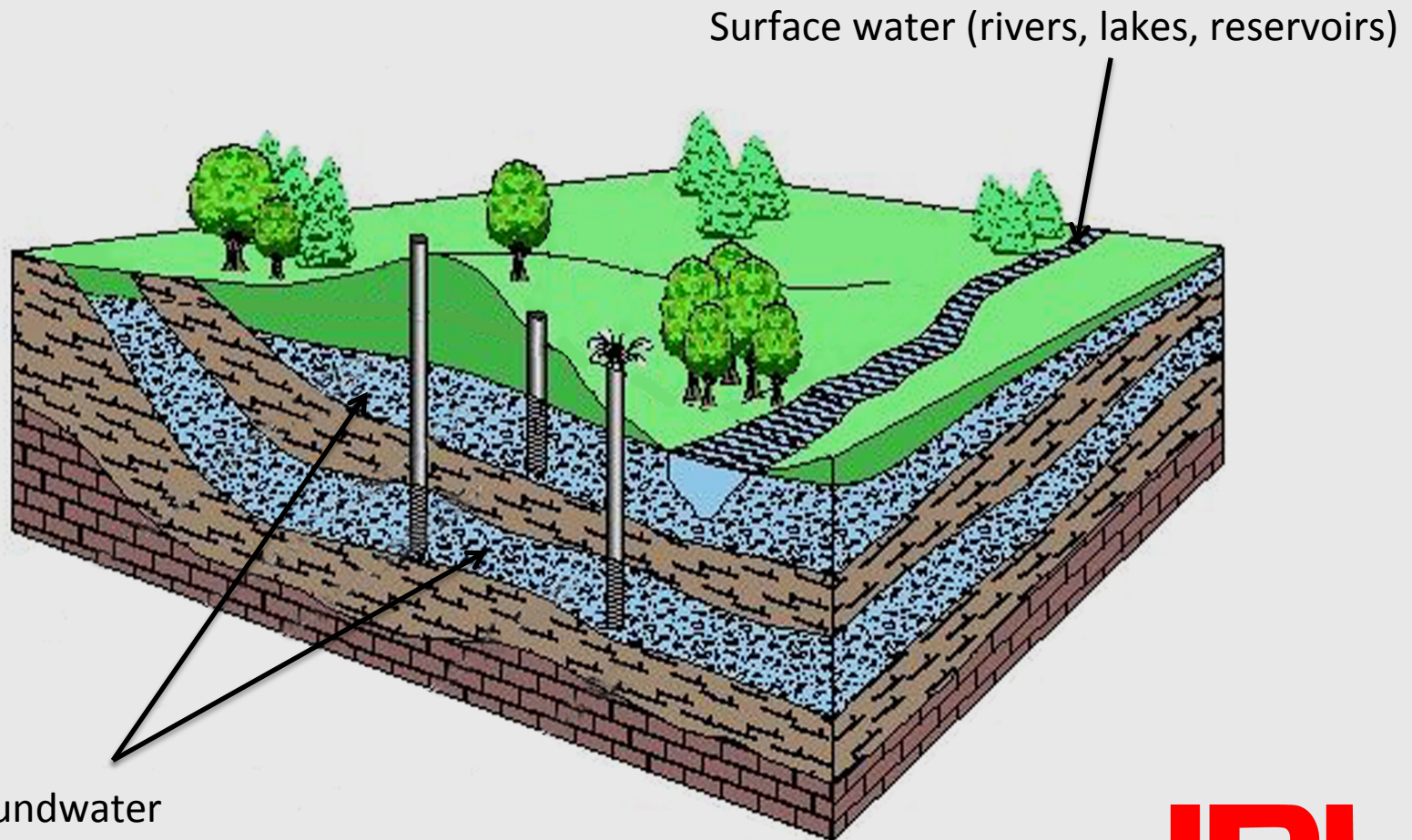
America's largest reservoir at record low earlier this summer!

Lake Shasta



Groundwater

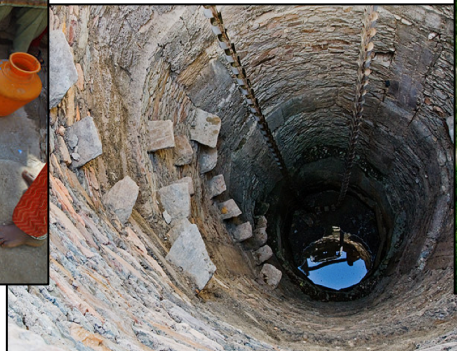
The water stored in the saturated zone in the soils and rocks layers (aquifers) beneath Earth's surface



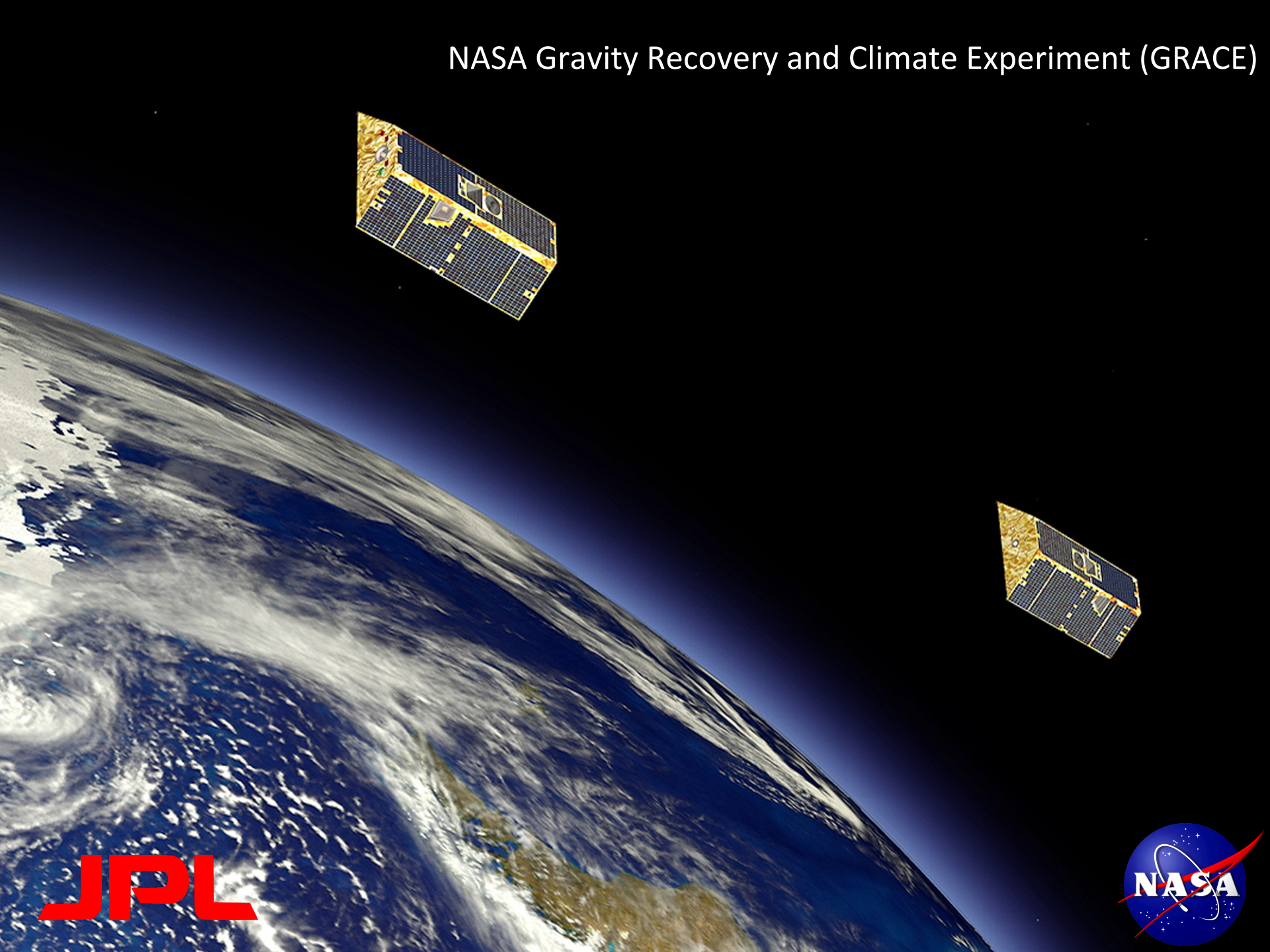
Groundwater and sustainability

- 96% of the world's unfrozen fresh water is groundwater
- Groundwater accounts for as much as 33% of water withdrawals worldwide
- Over 2 billion people rely on groundwater as their primary water source
- Half or more of irrigation water is supplied by groundwater
- Groundwater provides the key 'strategic reserve' for water supply during prolonged periods of drought

Ironically, groundwater is poorly managed and monitored in many regions around the world, so that regional and global water security is at far greater risk than is currently acknowledged.



NASA Gravity Recovery and Climate Experiment (GRACE)



JPL

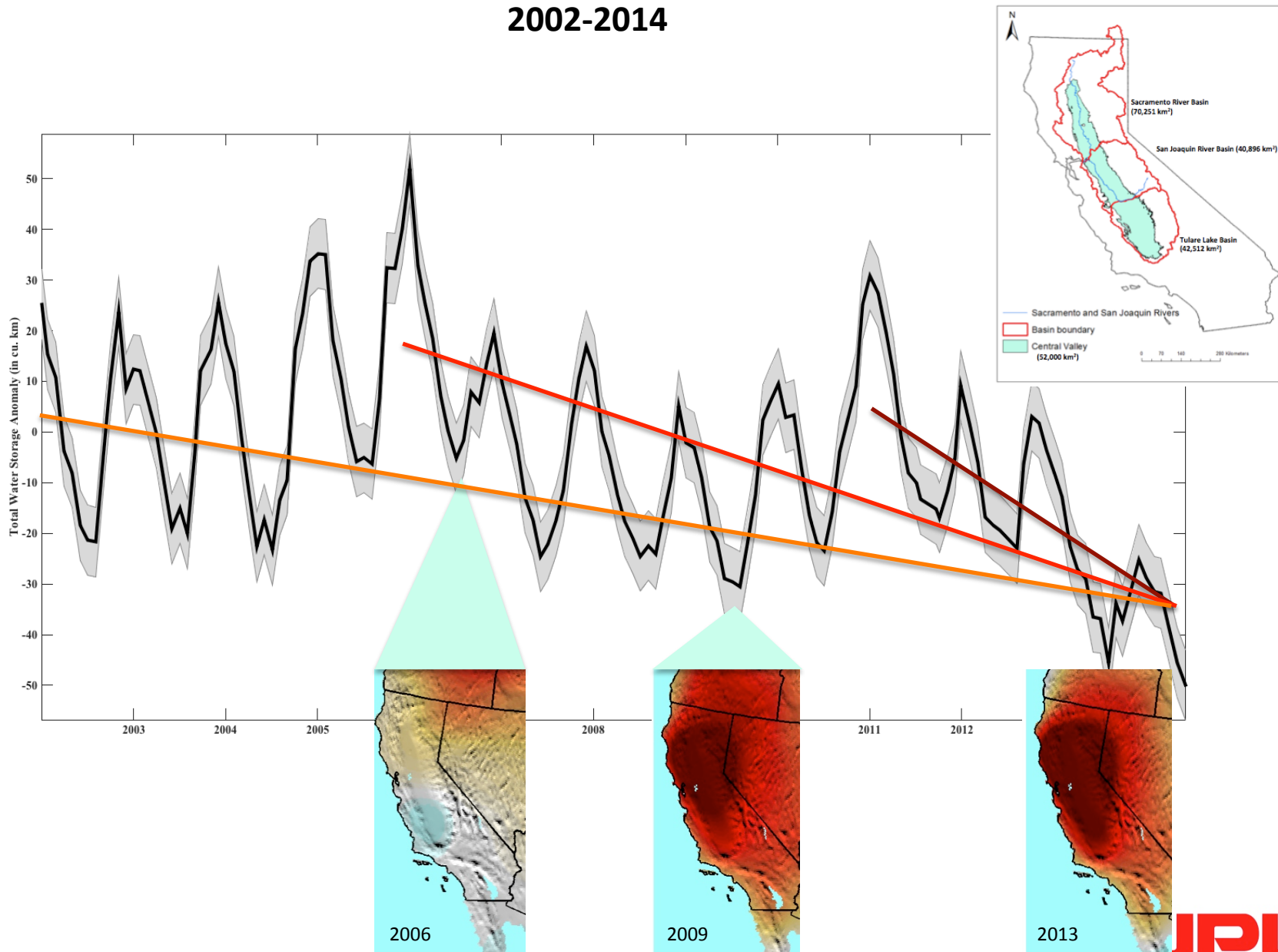


Soooo, THIS is the correct way to weigh yourself.



Apparently I've been doing it wrong all of these years!.

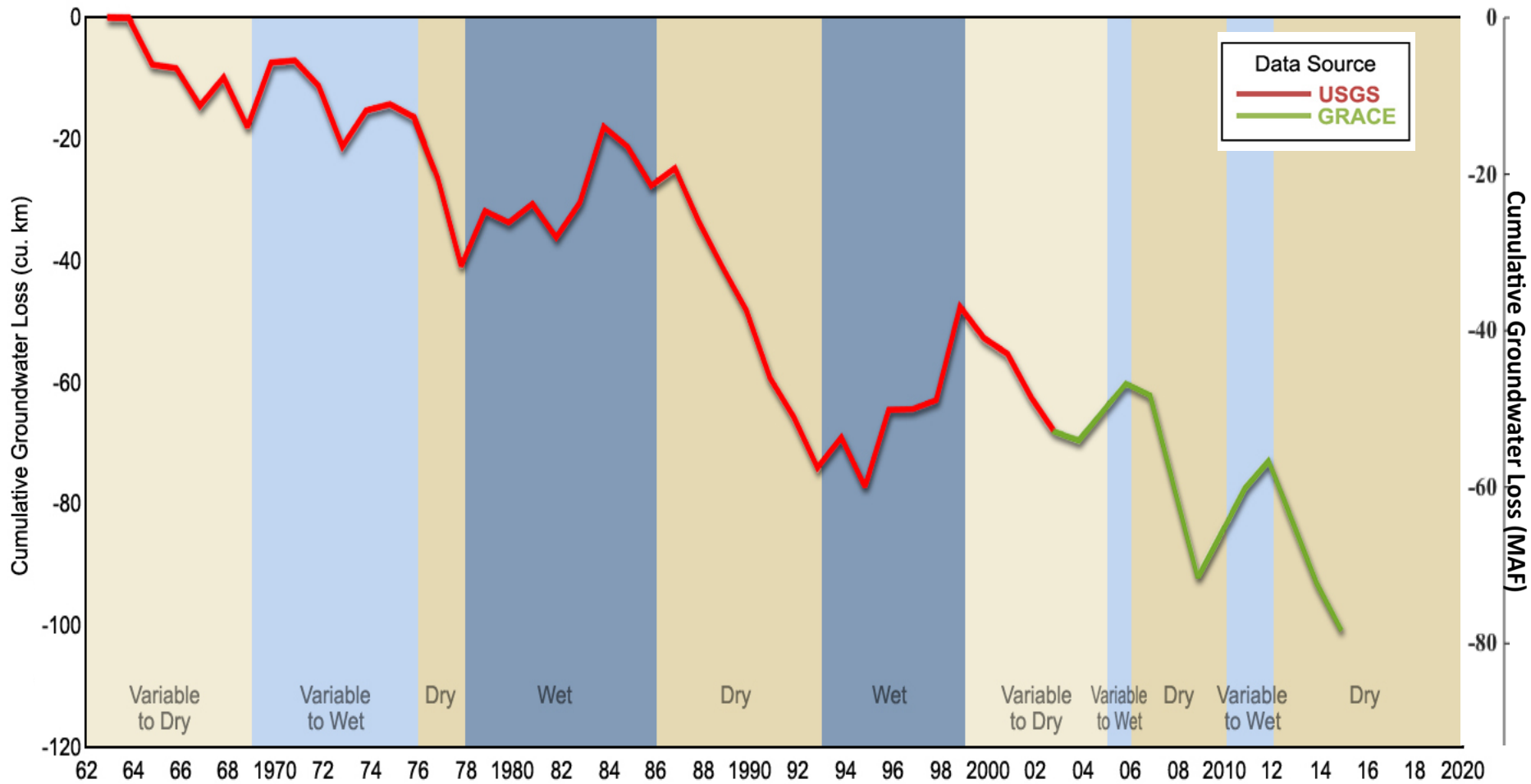
Change in total water storage in the Sacramento-San Joaquin River basins from GRACE 2002-2014



Time series and images computed from NASA JPL Mascons solutions by Felix Landerer



Cumulative groundwater depletion in California's Central Valley from USGS and GRACE

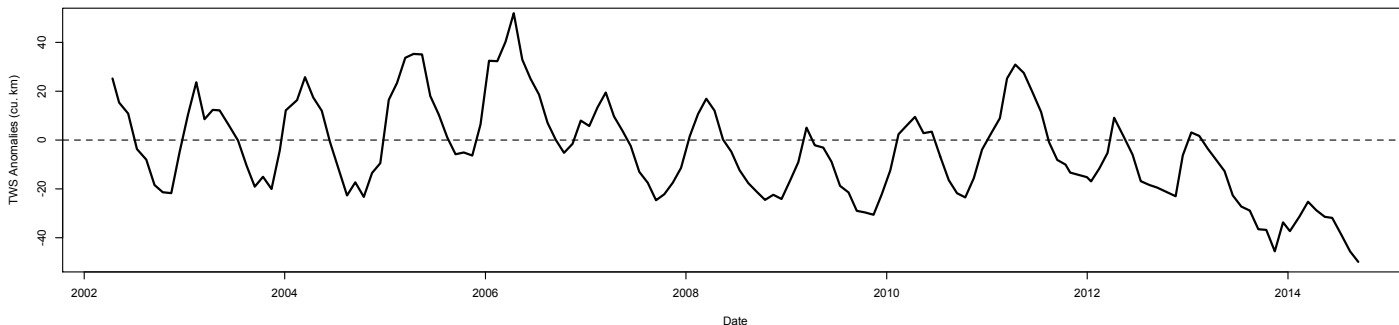


California's system of aqueducts for surface water redistribution

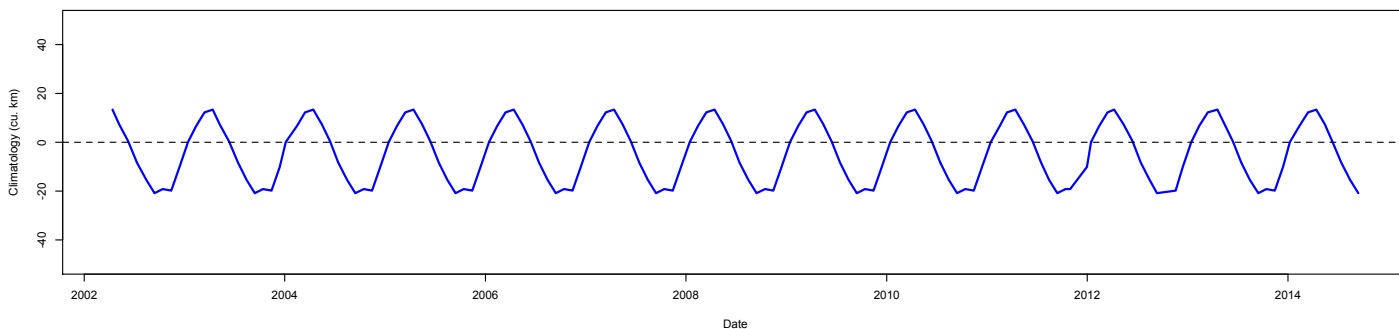


Characterizing California drought with GRACE and Total Water Storage Deficit

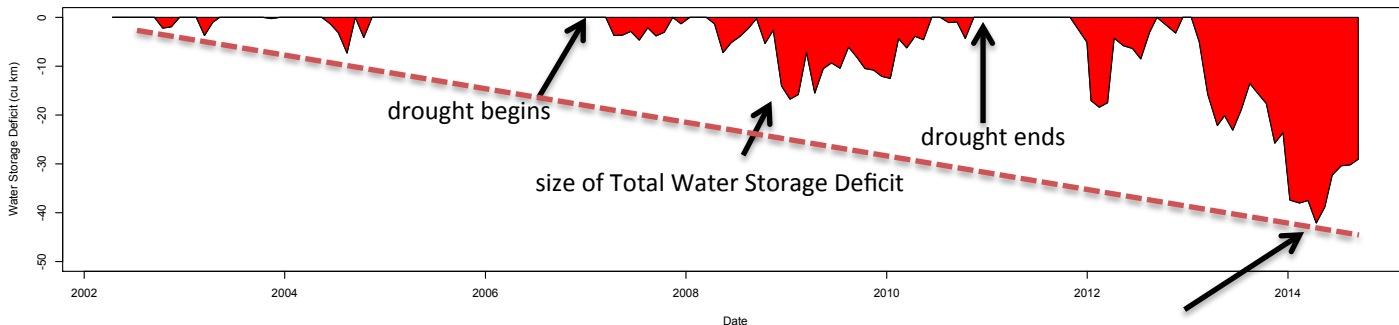
Actual monthly water storage variations



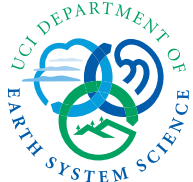
'Normal' range of monthly water storage variations



Differences from 'normal' dry conditions



peak Total Water Storage Deficit is 42 km³ in 2014





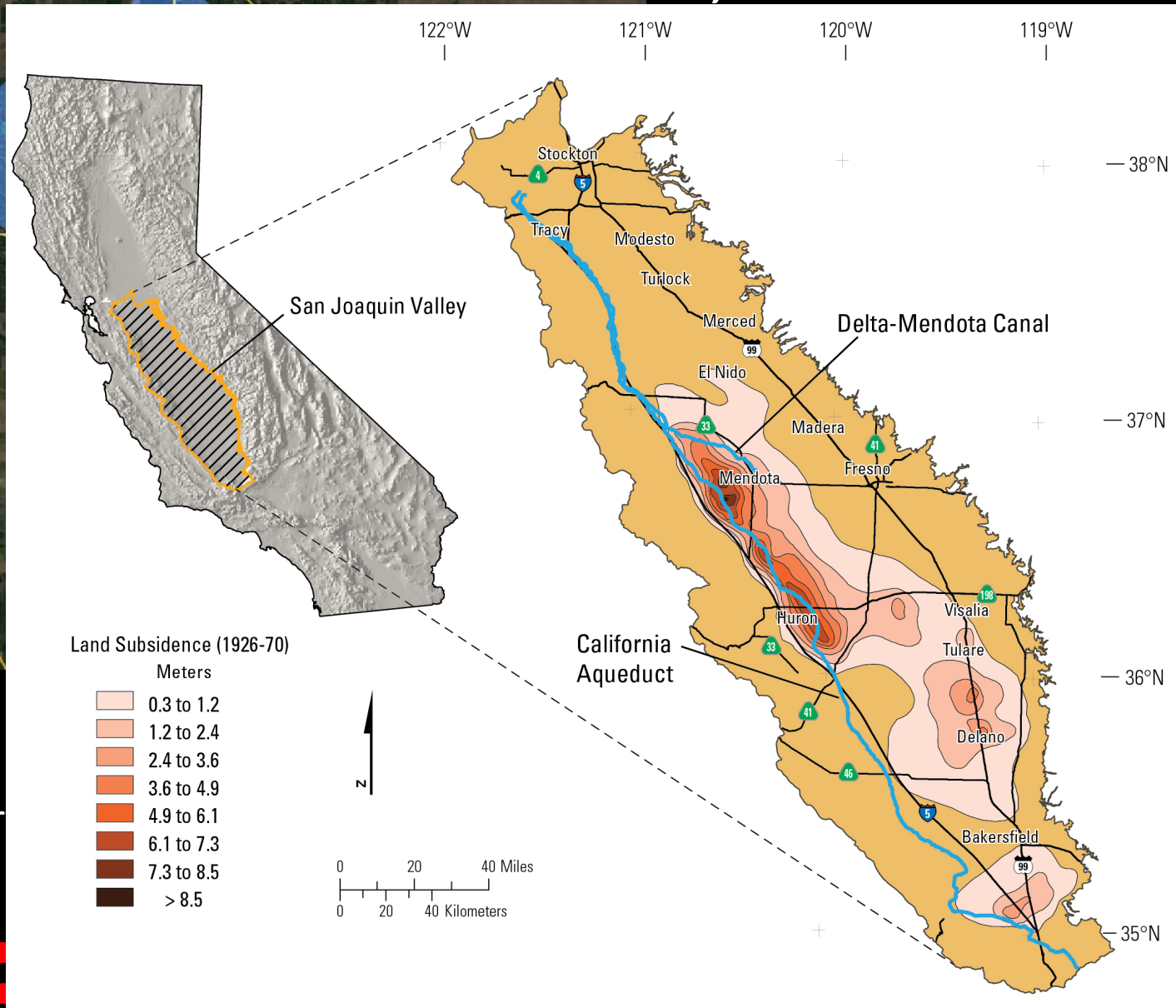
1925

1955

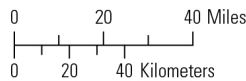
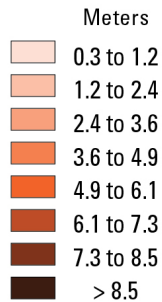
SAN JOAQUIN VALLEY
CALIFORNIA
BM 5681
SUBSIDENCE BM
1925-1977

1977

Mapping Groundwater Induced Subsidence Rates Near El Nido, CA



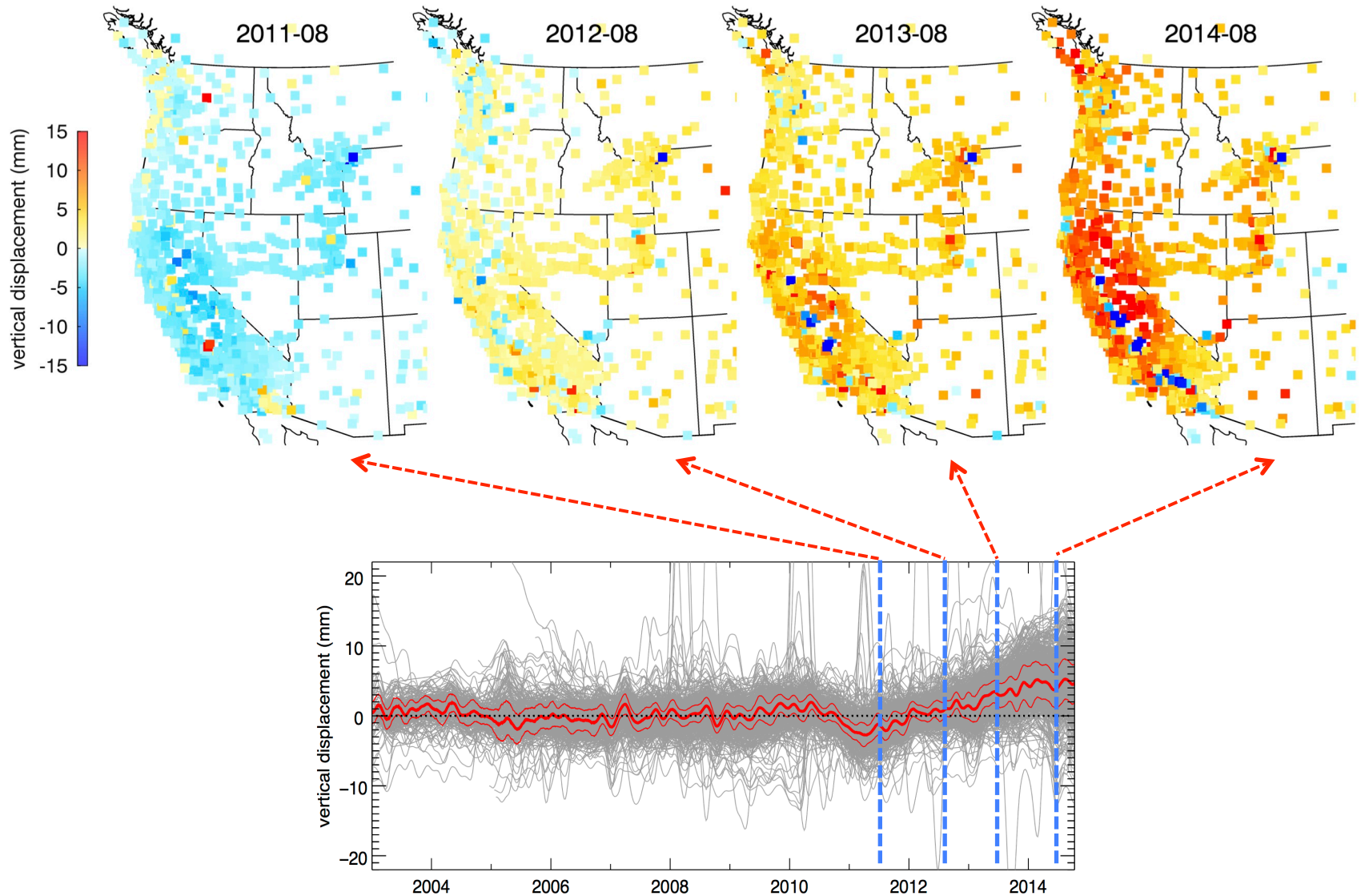
Land Subsidence (1926-70)



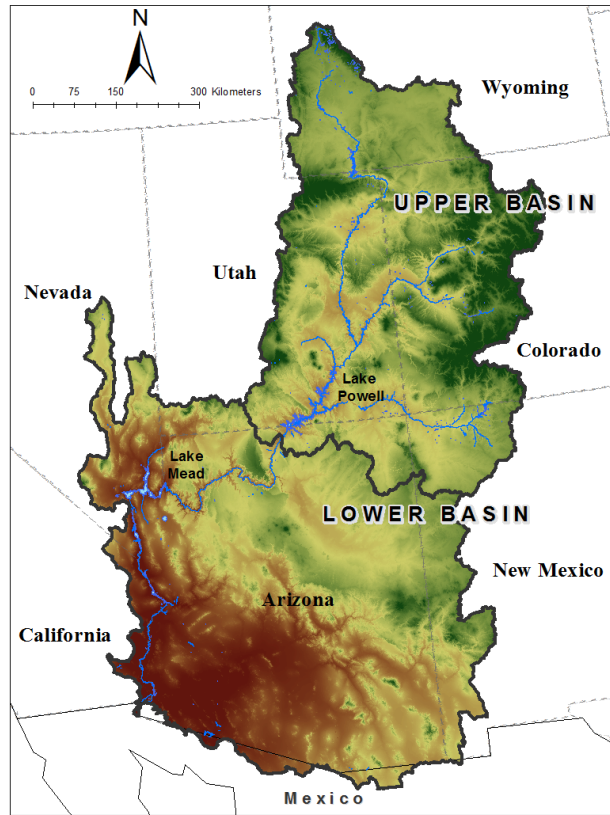
Slide cour



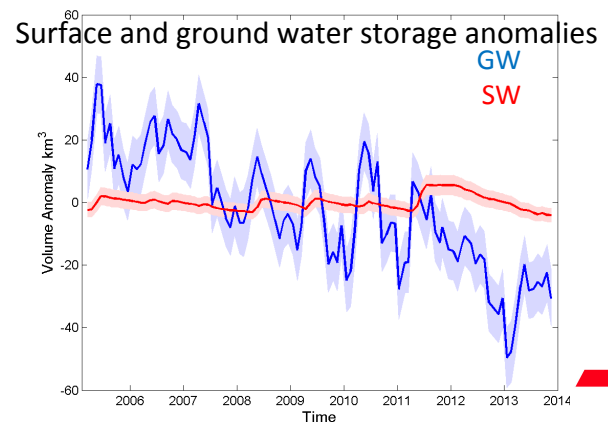
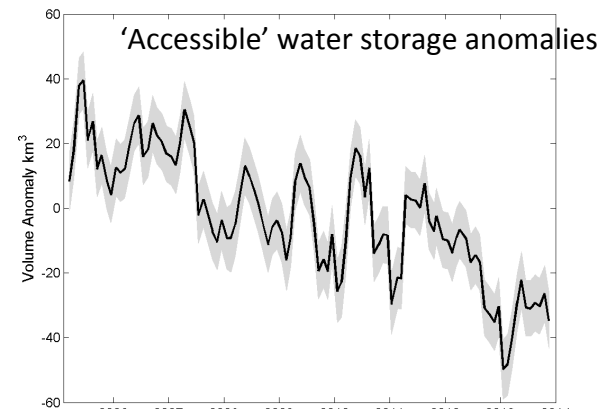
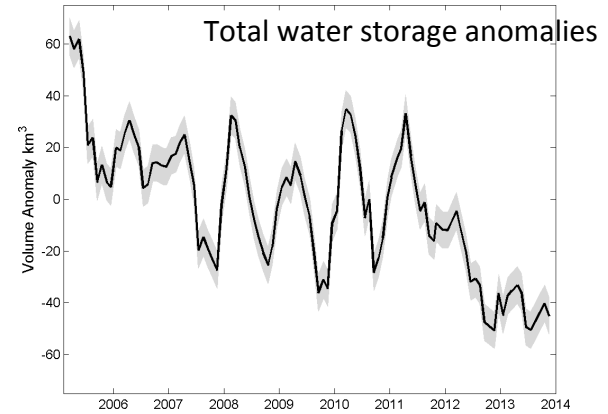
GPS network shows progressive uplift of western U. S. due to water mass loss in drought



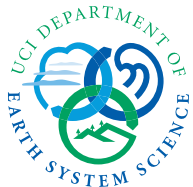
Groundwater depletion during drought threatens the water security of the Colorado River Basin (2005-2014)



Castle et al., 2014



What are we going to do about it?



ADIÓS, LARRY AGRAN, CURT PRINGLE AND MIGUEL PULIDO! | HAPPY 10TH BIRTHDAY, 'ASK-A-MEXICAN!' | HELLO, BOOB DEODORANT!
NOVEMBER 14-20, 2014 | VOLUME 20 | NUMBER 12

OUT OF FOCUS AND BADLY LIT SINCE 1995 | OCWEEKLY.COM

OCWEEKLY

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WE'RE F*CKED

THINK RAIN WILL SAVE US FROM
OUR DROUGHT? ONE UC IRVINE
SCIENTIST SAYS THINK AGAIN

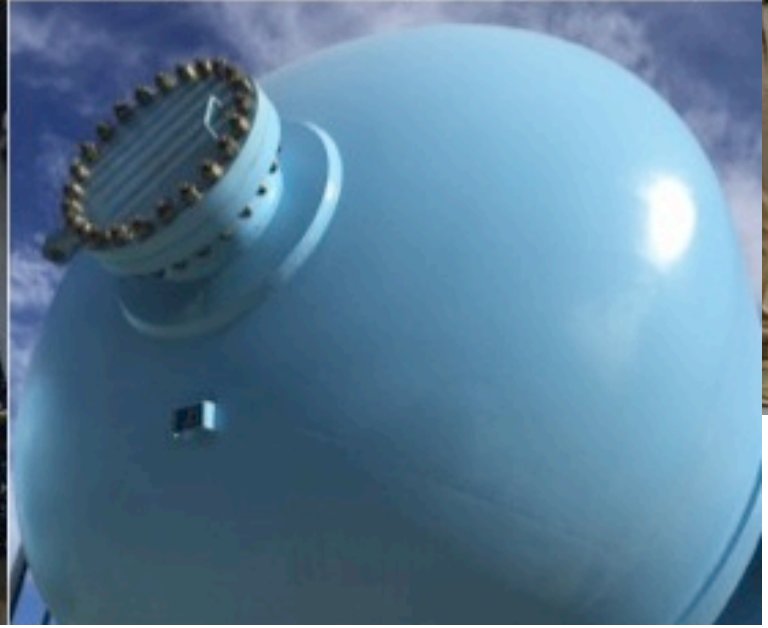
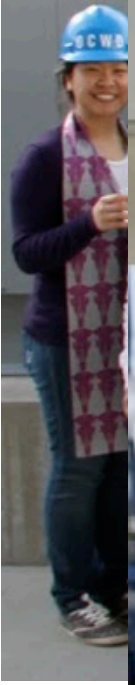
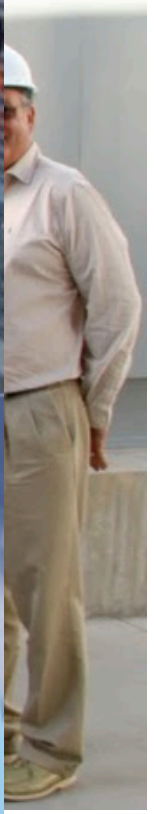
by Matt Coker

Los Angeles Times

**Op-Ed California has about
one year of water left. Will
you ration now?**

by Jay Famiglietti, March 12, 2015

- 1) Mandatory rationing
- 2) Emergency groundwater plan
- 3) Long-term planning
- 4) Public ownership



Food for Thought



Food for Thought

- We use more water than we have available to us on a renewable basis in CA: California is running out of water
- Most of that gap is supplied by groundwater
- Most of that is used to support agriculture
- Groundwater remains unprotected and is rapidly disappearing
- Given these, how do we define 'sustainability' when we are knowingly and rapidly depleting our strategic reserve
- Yet we need to grow food for a growing population in the face of changing climate



**YOUR WATER METER READING
IS HIGHER THAN USUAL**

**It is suggested that you inspect and
repair, if necessary, all water
connections – giving special
attention to toilets.**

**Small leaks can cause a substantial
increase in your water bill.**

Thank you!

For more information | @JayFamiglietti | <http://jayfamiglietti.com>