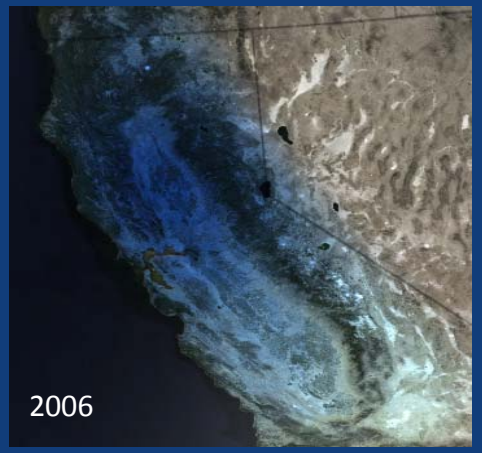
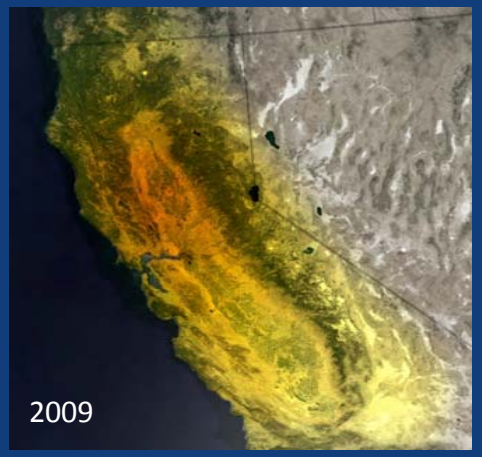
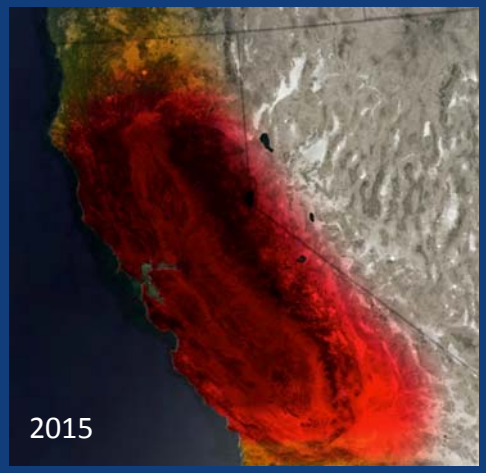
Jay Famiglietti
Shan Malhotra

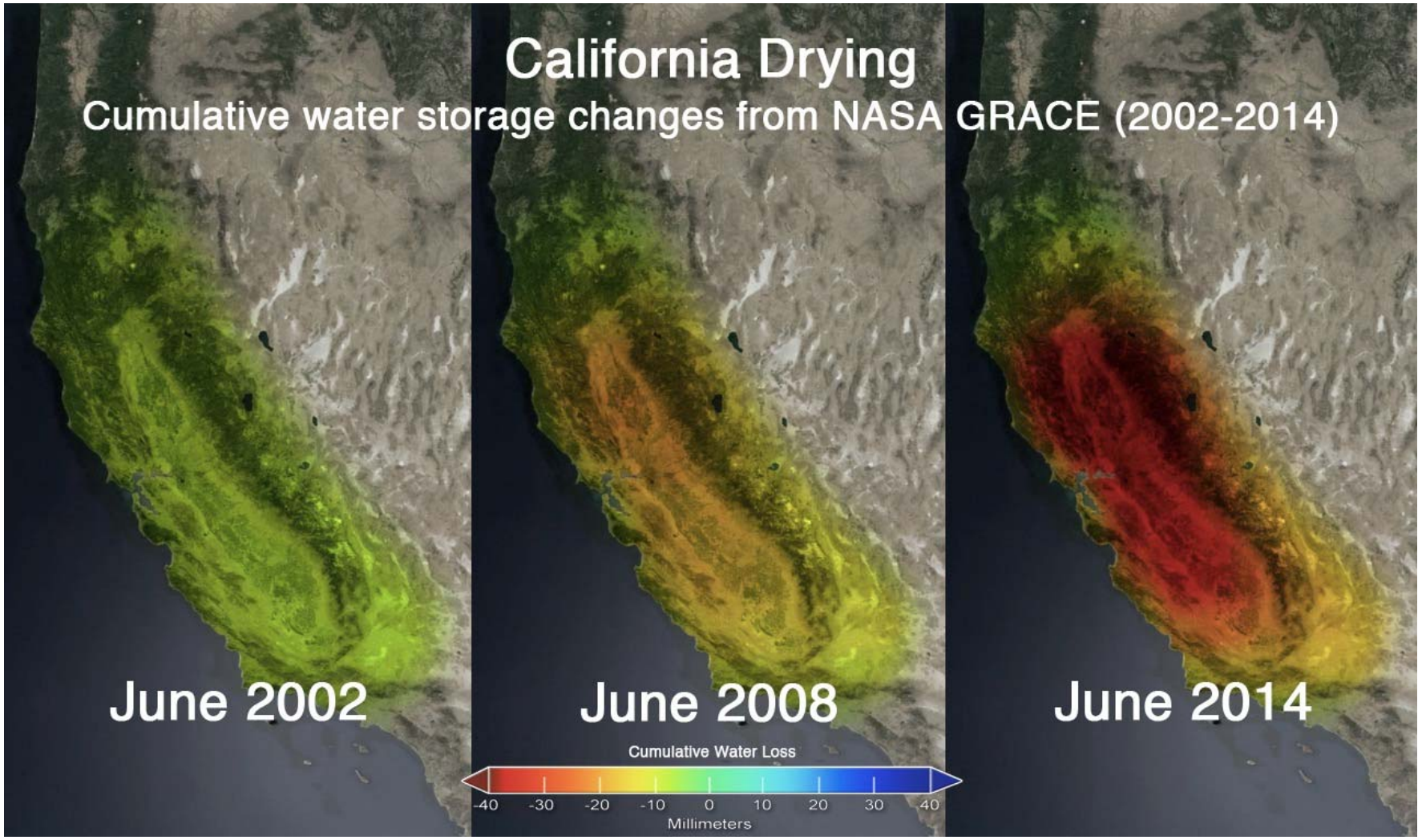
Big Data Analytics in Hydrology



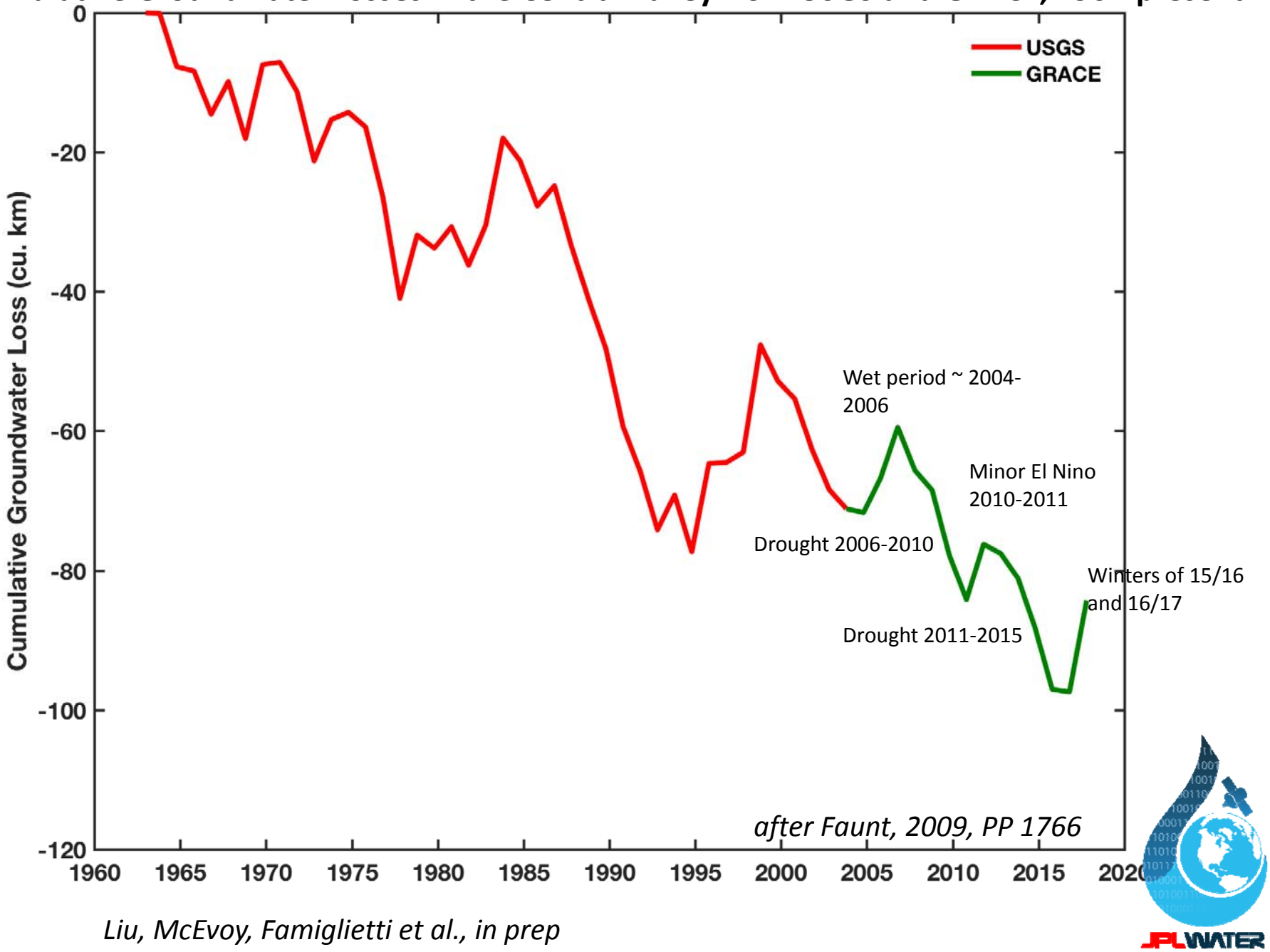




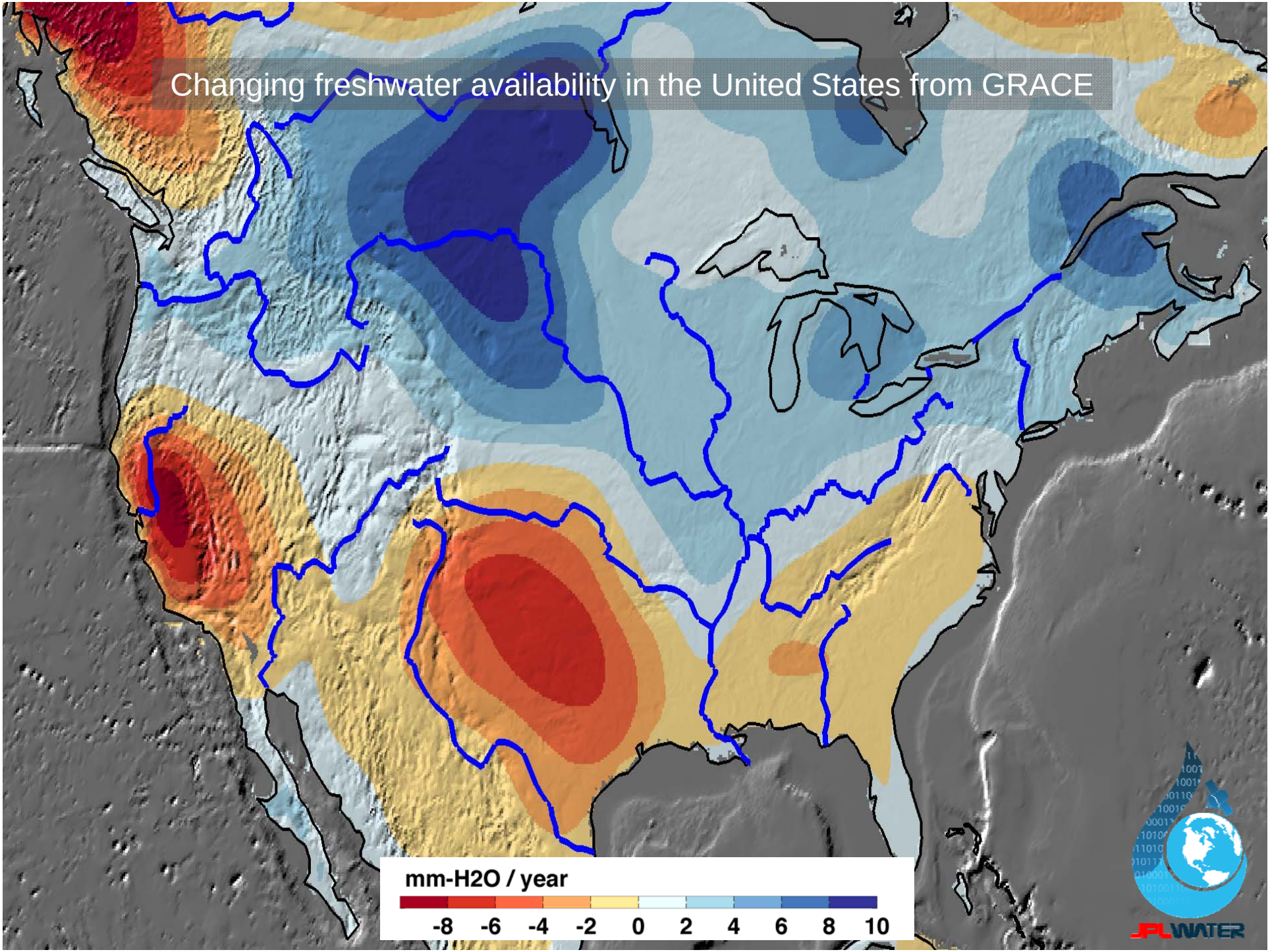
Ad Hoc Big Data Task Force of the NACSC
Jet Propulsion Laboratory, von Kármán Auditorium
November 1, 2017


California Drying
Cumulative water storage changes from NASA GRACE (2002-2014)
June 2002
June 2008
June 2014
Cumulative Water Loss
-40 -30 -20 -10 0 10 20 30 40
Millimeters

Cumulative Groundwater Losses in the Central Valley from USGS and GRACE, 1962-present

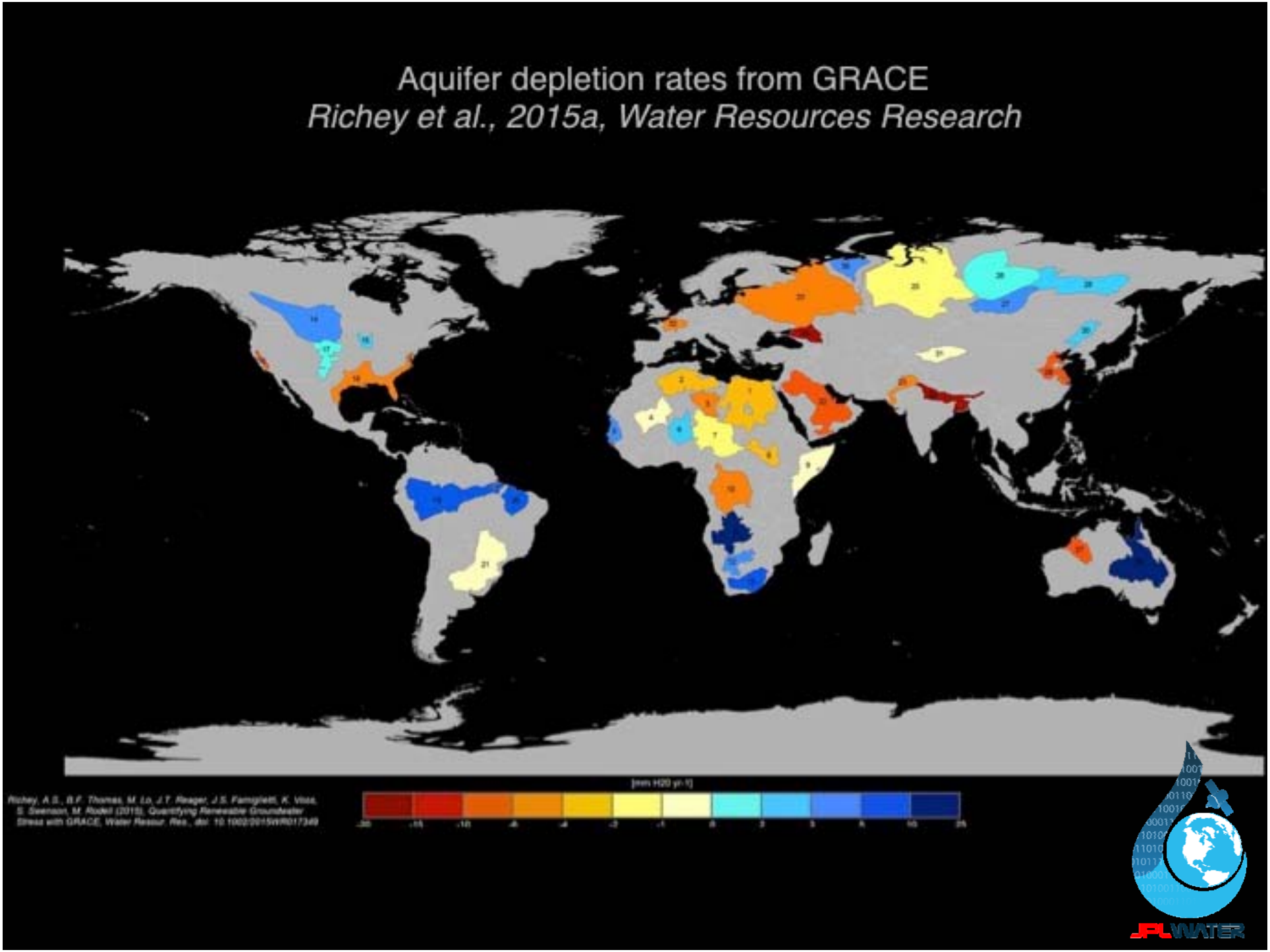


Liu, McEvoy, Famiglietti et al., in prep


Changing freshwater availability in the United States from GRACE
mm-H2O / year
-8 -6 -4 -2 0 2 4 6 8 10
JPLWATER

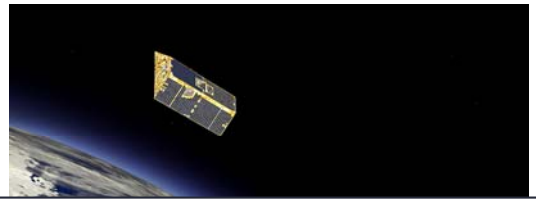
Aquifer depletion rates from GRACE

Richey et al., 2015a, Water Resources Research



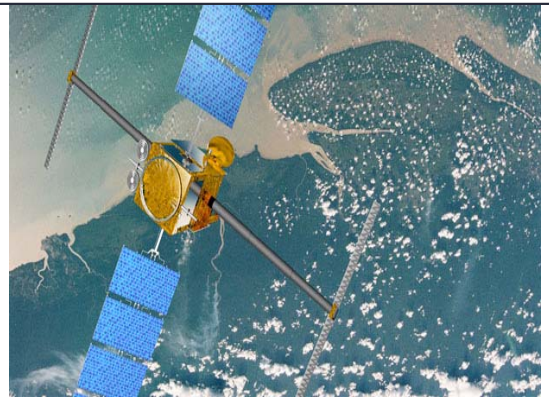
Some Current and Future NASA JPL Water Missions

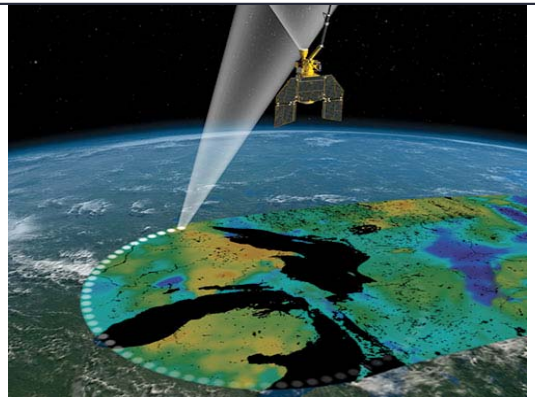
GRACE-FO (2017)



ASO (2013)

Arguably, it's time to integrate these data together to get a more holistic picture of the science and the management implications



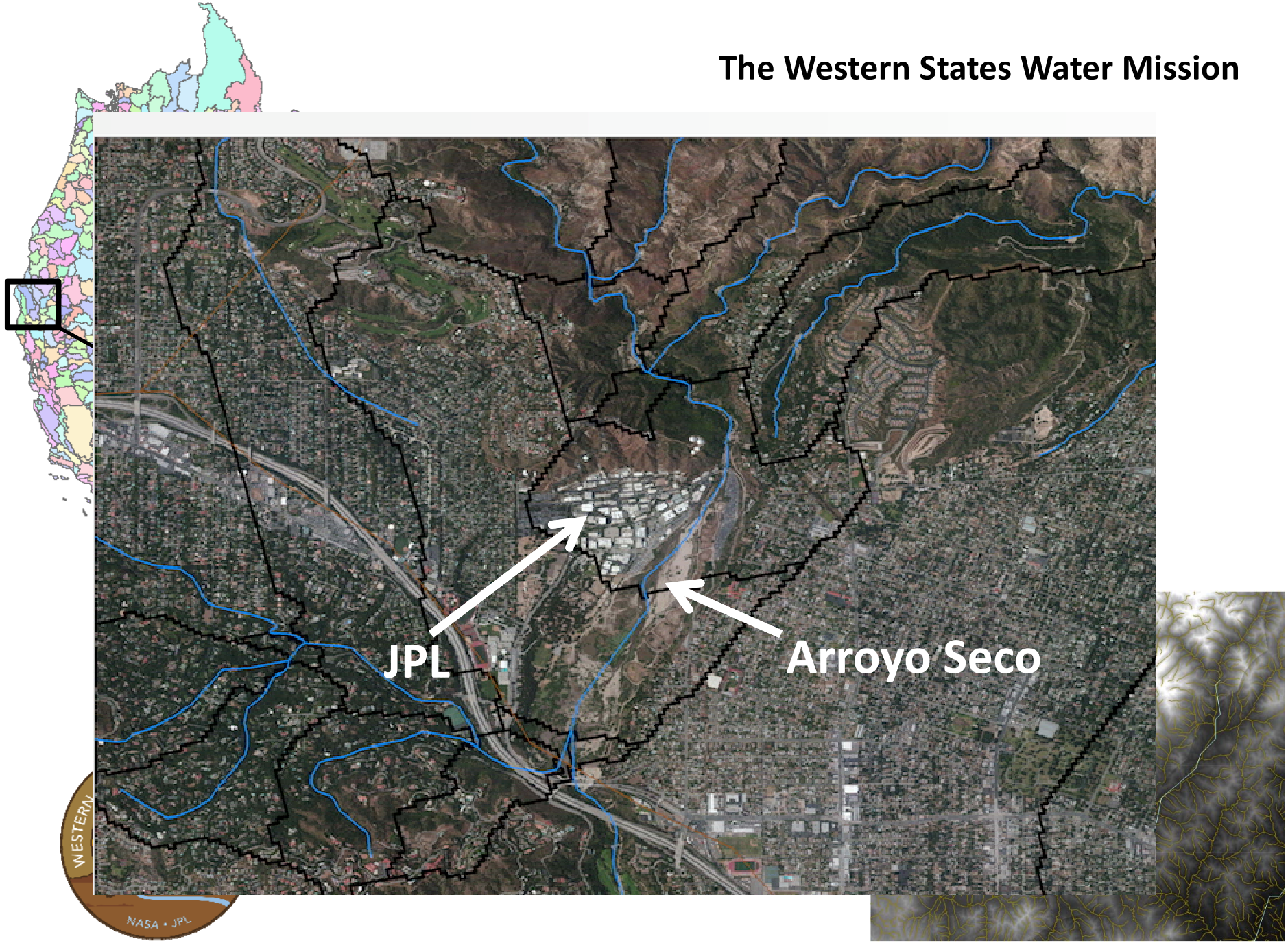


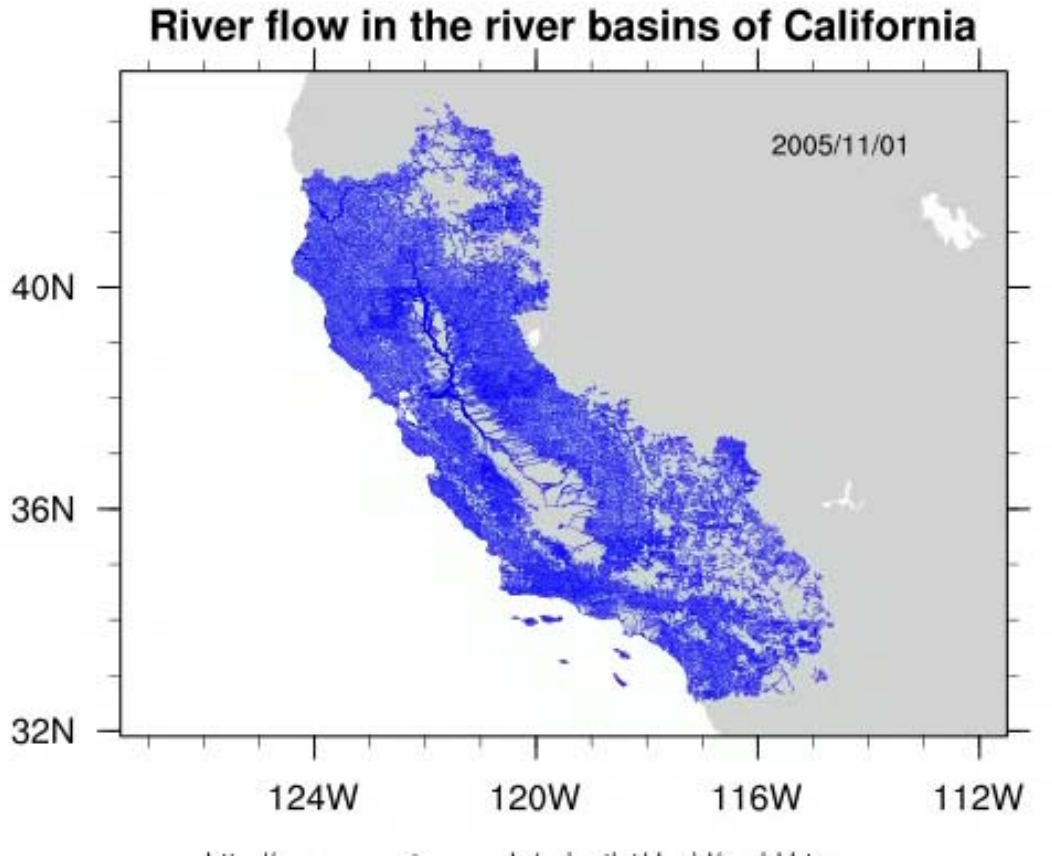
Plus NISAR, ECOSTRESS, etc

The Western States Water Mission

- Integrates key satellite, aircraft and ground-based measurements into a high-resolution model (3 km^2 or less) of California and western U. S. hydrology
- Utilizes a focused, accelerated effort in a flight project framework
- Represents the major features of the natural (snow, surface water, soil moisture, groundwater, streamflow, evapotranspiration) and managed (conveyances, reservoirs, groundwater pumping, irrigation) water cycle in catchment-based framework with explicit river networks
- Provides NASA's best-available estimates of freshwater availability from local-to-regional scales, including: snowcover, snow depth, snow water equivalent; surface water storage and streamflow; soil moisture content; and groundwater levels and storage changes
- Link to models of agriculture, food production, energy production, climate, ecology, etc; and very high resolution models for localized flooding

The Western States Water Mission





Cedric David, NASA Jet Propulsion Laboratory

David et al., 2015

Now, imagine doing this for North America, or, globally

- Imagine creating a modeling and data analytics platform that allows us to:
  - Select hydrologic regions of interest
  - Select and automatically prepare input datasets, including retrieving the latest data and observations from the web
  - Run simulations
  - Visualize and analyze output
  - Make selected outputs widely available to the community

- The ultimate goals from a data science perspective are to:
  - Create the capability to observe and simulate the quantity and quality of water, at progressively higher resolutions, everywhere
  - Make these data available for research
  - Give access to selected outputs in usable formats in near real time