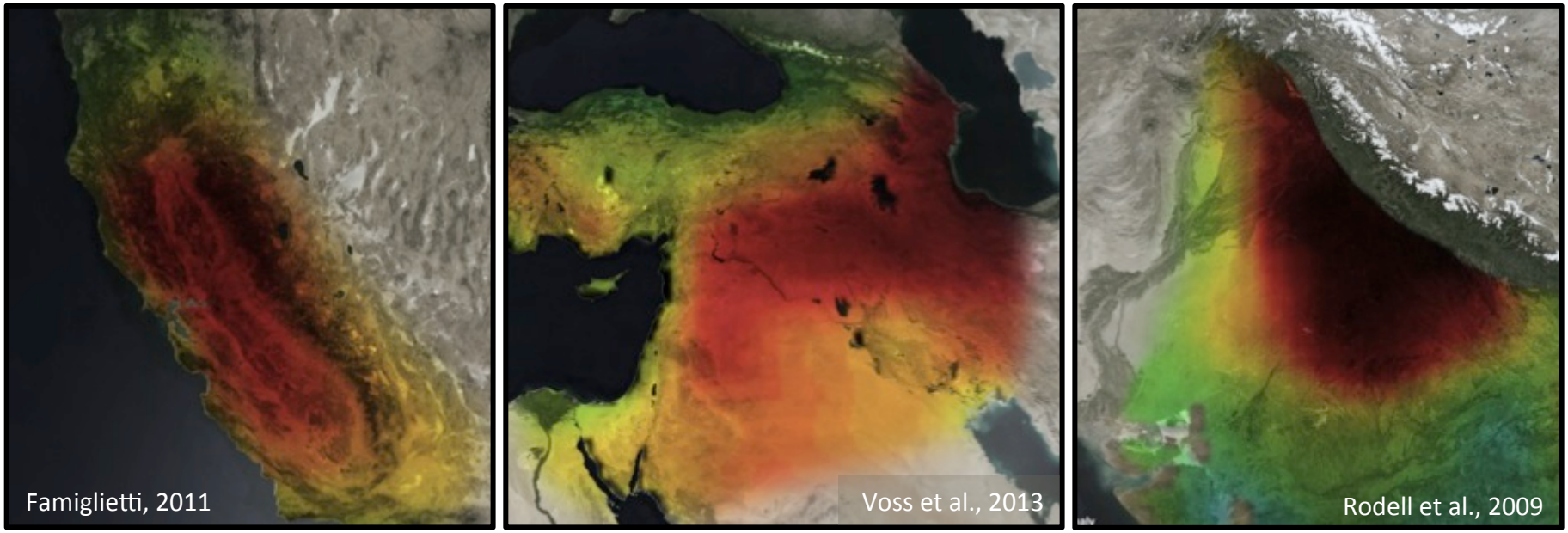
On the Need to Include Better Water Management Parameterization in Land Surface Models

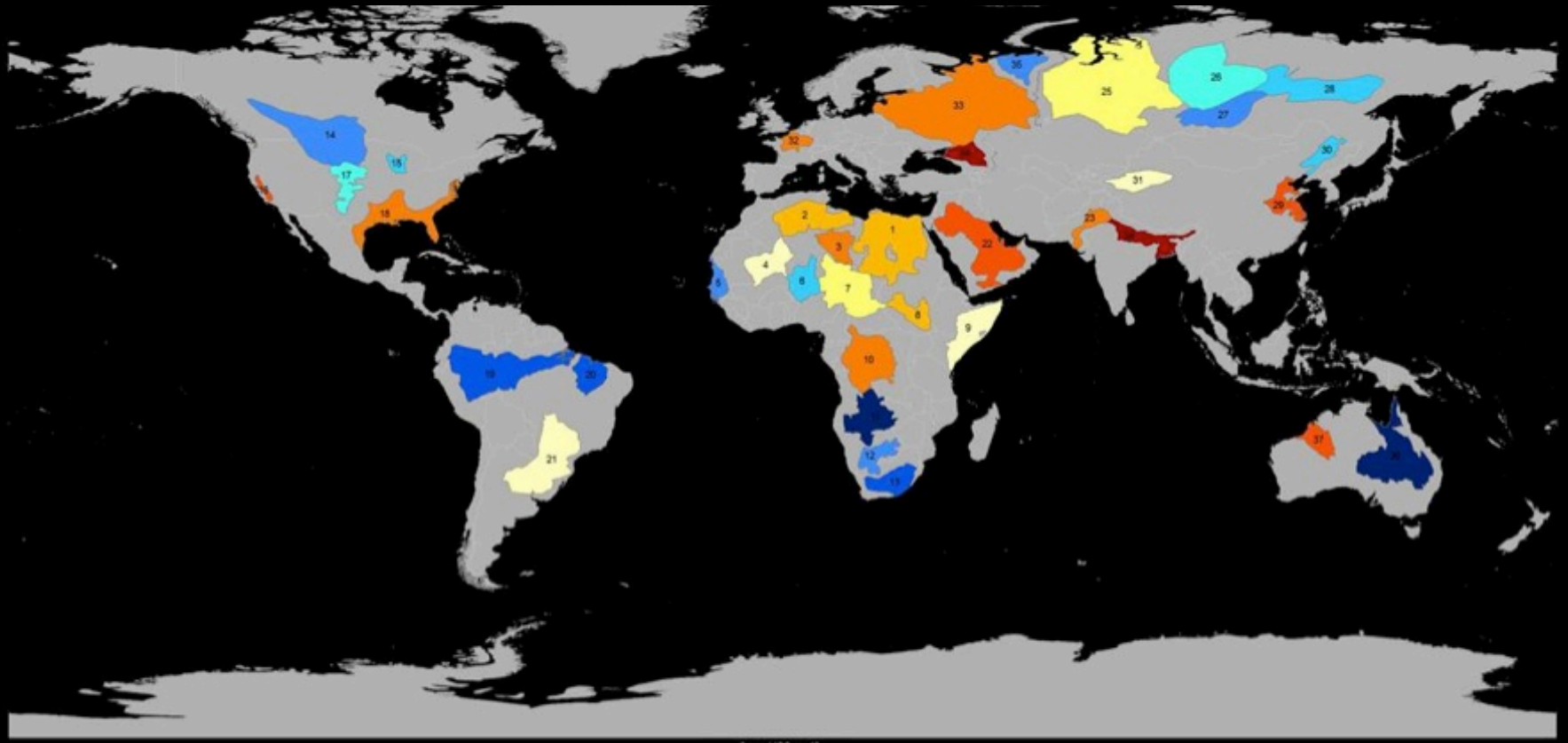
Cumulative freshwater losses in California (left), the Middle East (center) and NW India (right) from GRACE, 2002-2014



Jay Famiglietti
Jet Propulsion Laboratory, California Institute of Technology
presented by
Hyungjun Kim
University of Tokyo

Trends in Groundwater Storage from NASA GRACE Mission (2003-2013)

Richey at al., 2015, Water Resources Research

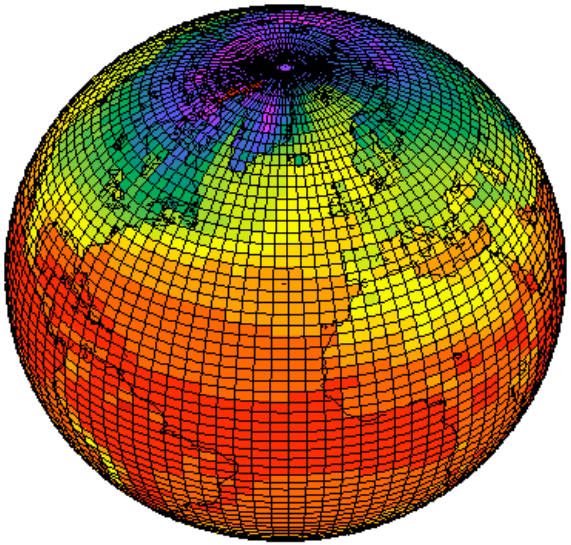


Richey, A.S., B.F. Thomas, M. Lo, J.T. Reager, J.S. Famiglietti, K. Voss, S. Swenson, M. Rodell (2015), Quantifying Renewable Groundwater Stress with GRACE, Water Resour. Res., doi: 10.1002/2015WR017349

Water Redistribution Aqueducts in California

The Challenge

- Given the strong fir … nt on the global water landscape, we must … sses like groundwater pumping, irrigation … ter tranfers, etc. into our land surface model…



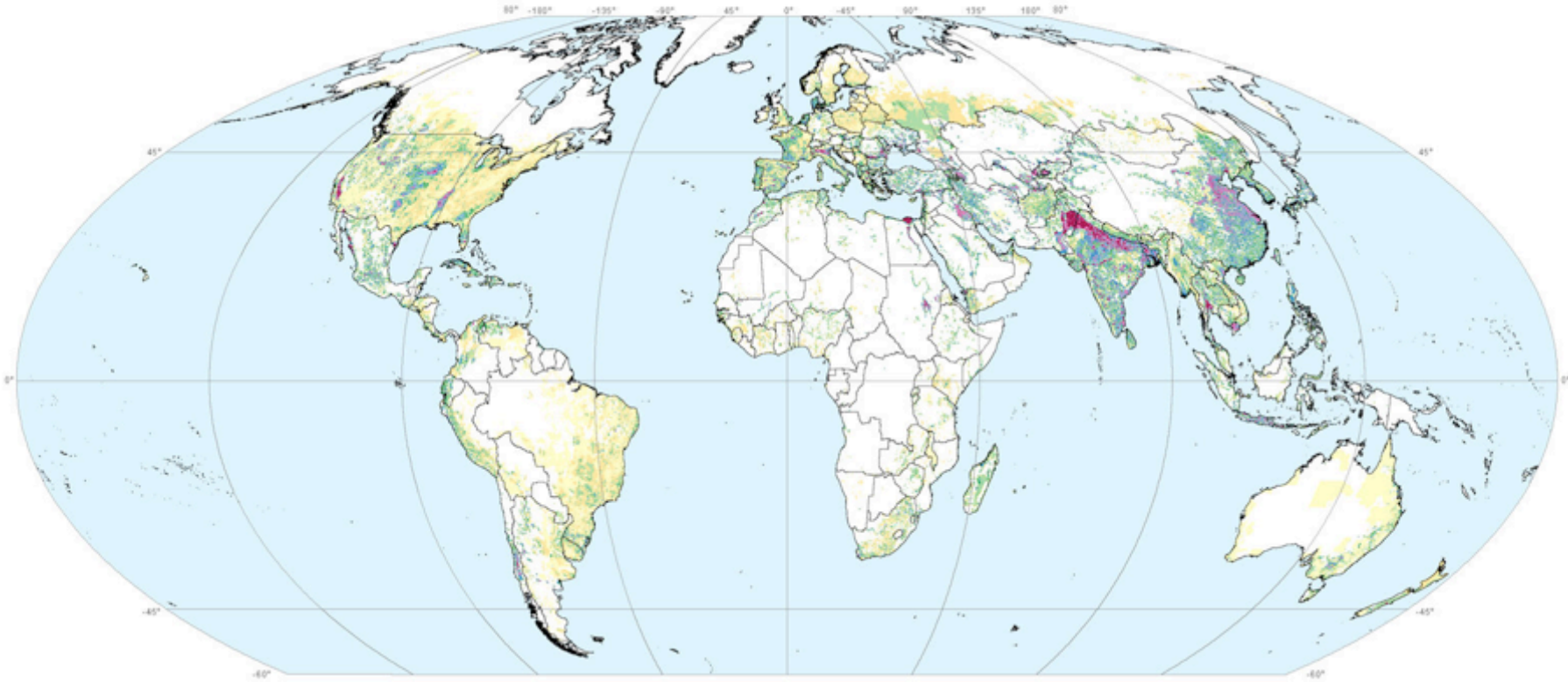
- How, for example, … mpacts on groundwater resources, if we can… haracteristics of the soil and groundwater re…

- We have a long way… here…

- To here

The digital global map of irrigation areas

February, 2007



Area under irrigation in percentage of land area

0	10 - 20
<0.1	20 - 35
0.1 - 1	35 - 50
1 - 5	50 - 75
5 - 10	75 - 100

The map depicts the area equipped for irrigation in percentage of cell area.
For the majority of countries the base year of statistics is in the period 1997 - 2002.

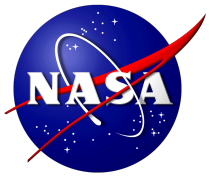
Projection: Mollweide

http://www.fao.org/ag/agl/aglw/aquastat/irrigationmap/index.stm

Stefan Siebert, Petra Döll, Sebastian Feick (Institute of Physical Geography, University of Frankfurt/M., Germany) and
Jippe Hoogeveen, Karen Frenken (Land and Water Development Division, Food and Agriculture Organization of the United Nations, Rome, Italy)

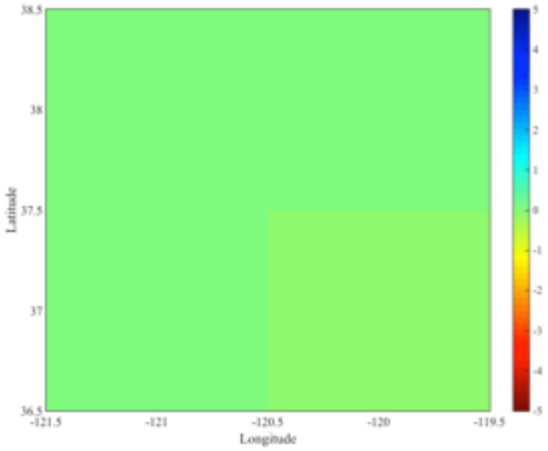
UNIVERSITÄT FRANKFURT AM MAIN

Some of the things that we are working on at JPL

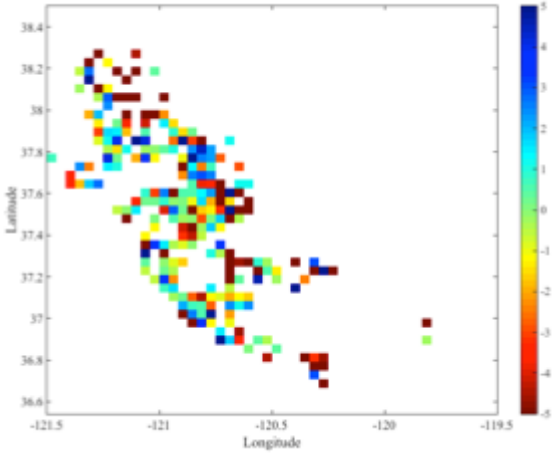


Downscaling GRACE to water management scales California's Central Valley

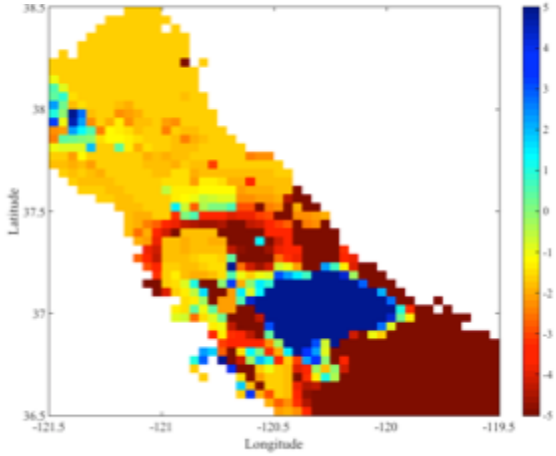
Storage changes from NASA's GRACE (2010)



Local groundwater well data (2010)



High resolution map of groundwater change (2010)



Miro and Famiglietti (2016), submitted

Output at 10-fold higher resolution

Spatial resolution of GRACE:

- 1 degree by 1 degree - 200,000 km^2

Spatial resolution of output maps:

- 4km by 4km - 16 km^2

Acceptable NSE values

- Calibration – 0.1911 to 0.8200
- Validation - 0.3546 to 0.8302
- 0 – 1 is acceptable, 1 is ideal

JPLWATER

The Western States Water Mission

- A focused, accelerated effort in a flight project framework (i.e. treating it with the intensity of a NASA satellite mission)

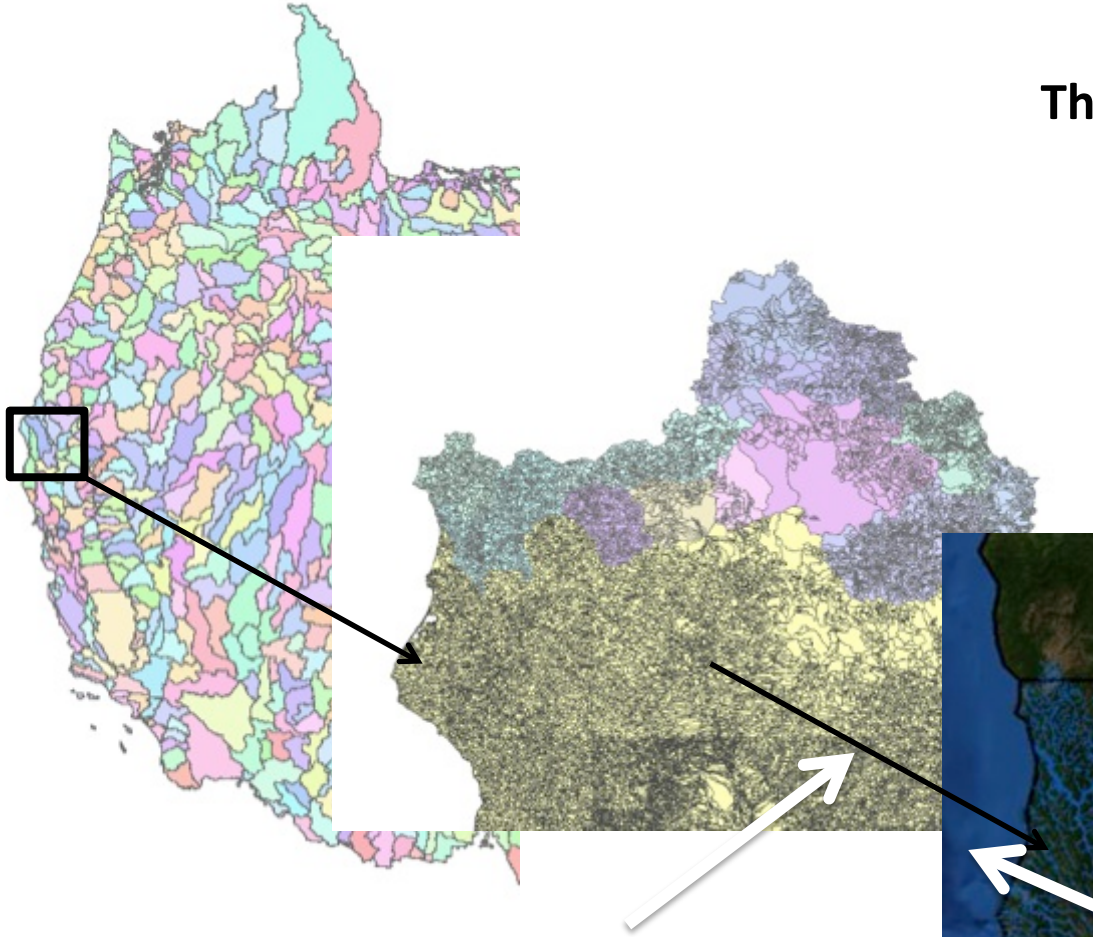
- Integrate key satellite, aircraft and ground-based measurements (GRACE, GRACE-FO, SMAP, snow cover, SWOT-ready) into a high-resolution model (3 km^2 or less) of California and western U. S. hydrology

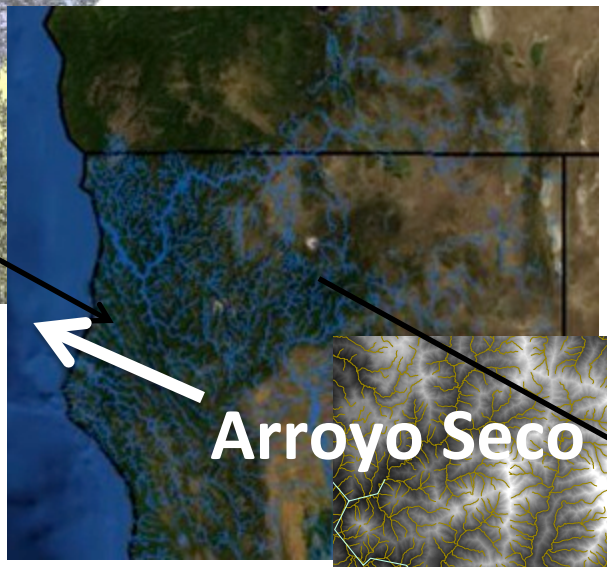
- Represent the major features of the natural (snow, surface water, soil moisture, groundwater, streamflow, evapotranspiration) and managed (conveyances, reservoirs, groundwater pumping, irrigation) water cycle in catchment-based framework with explicit river networks

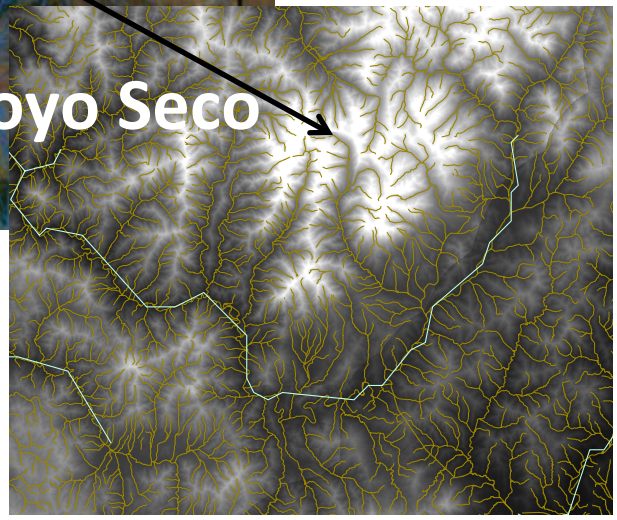
- Provide NASA's best-available estimates of freshwater availability from local-to-regional scales, including: snowcover, snow depth, snow water equivalent; surface water storage and streamflow; soil moisture content; and groundwater levels and storage changes

- Link to models of agriculture, food production, energy production, climate, ecology, etc; and very high resolution models for localized flooding

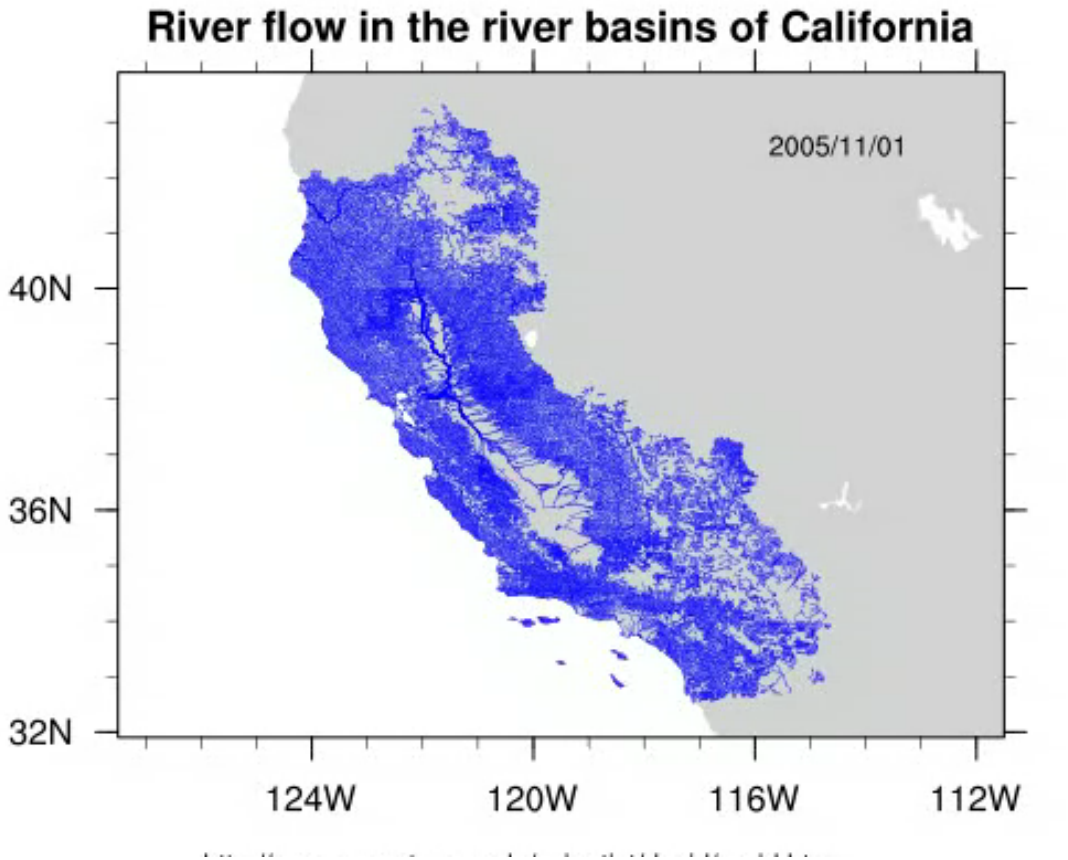
The Western States Water Mission







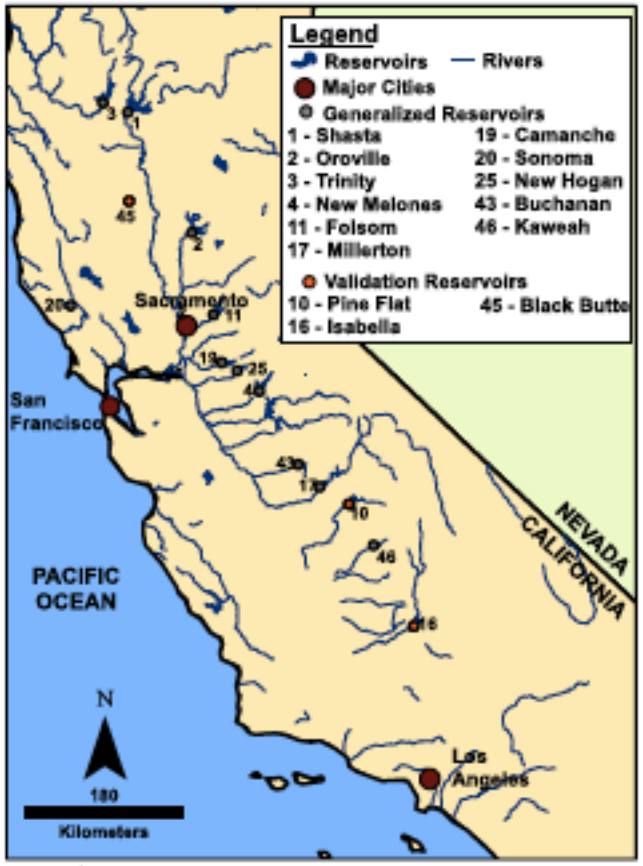
WESTERN STATES WATER MISSION
NASA • JPL

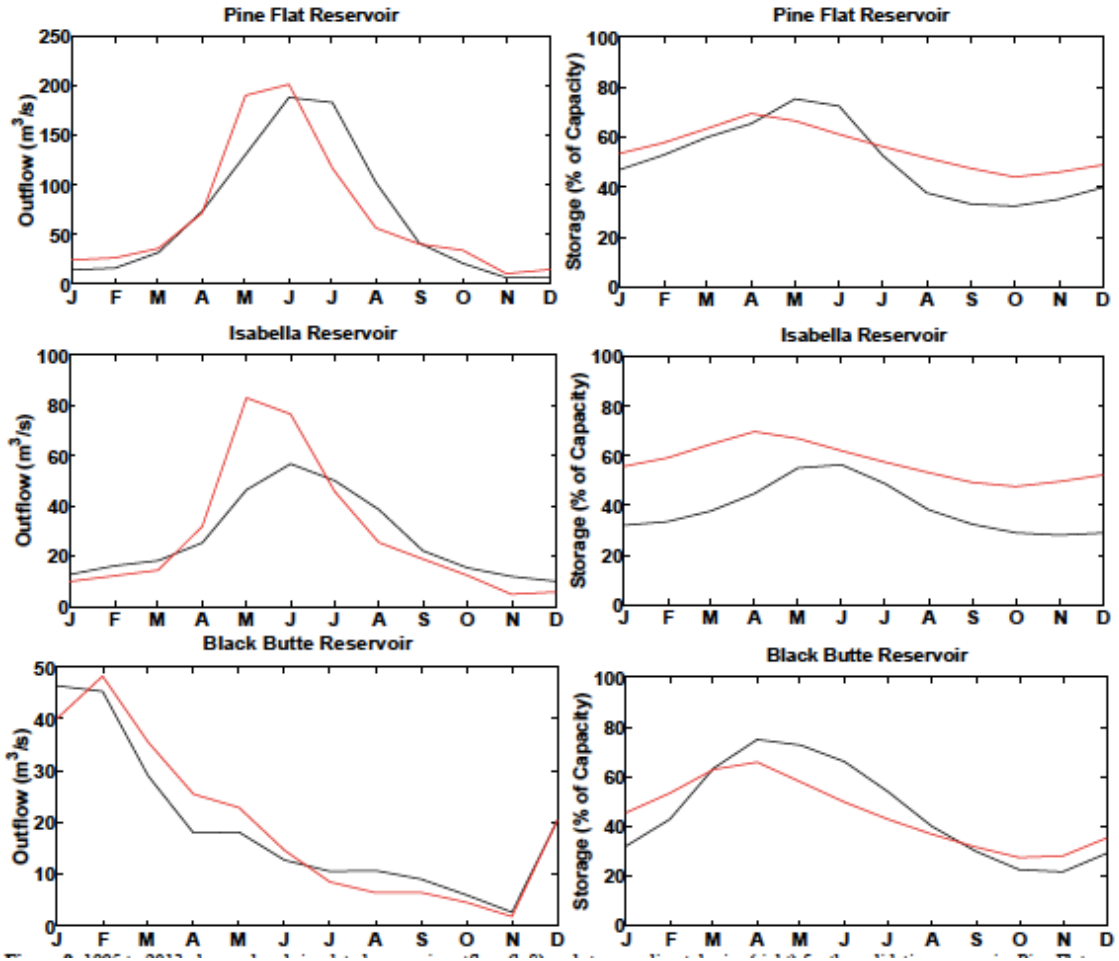


Cedric David, NASA Jet Propulsion Laboratory

David et al., 2015

Including simple reservoirs on the river network
Solander et al. (2015)





NASA Western Water Applications Office (WWAO)

What is the WWAO?

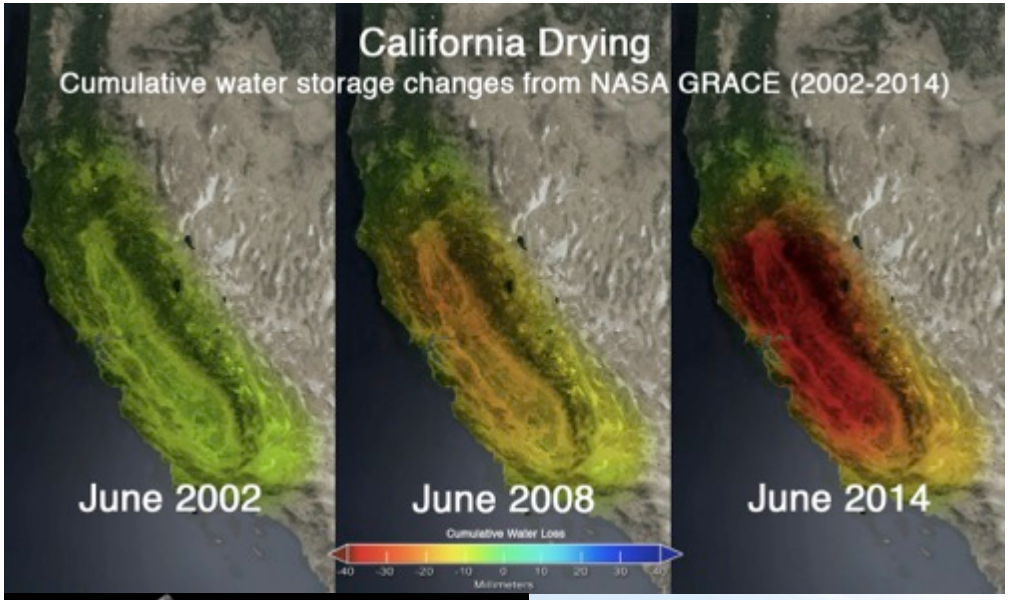
A new NASA initiative to make satellite hydrology data more accessible and informative for western US water management

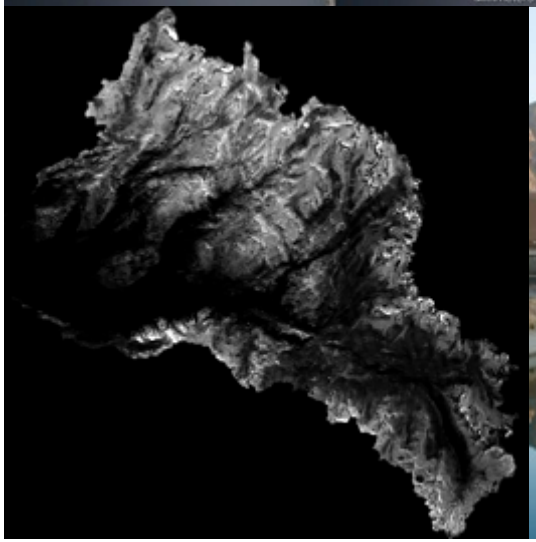
What Does the WWAO Do?

- Connect stakeholders with NASA scientists, NASA technology, tools, and data.
- Serving NASA hydrology data in accesible format at water management scale
- Strategic support of NASA projects that enhance application readiness

Why the NASA-WWAO?

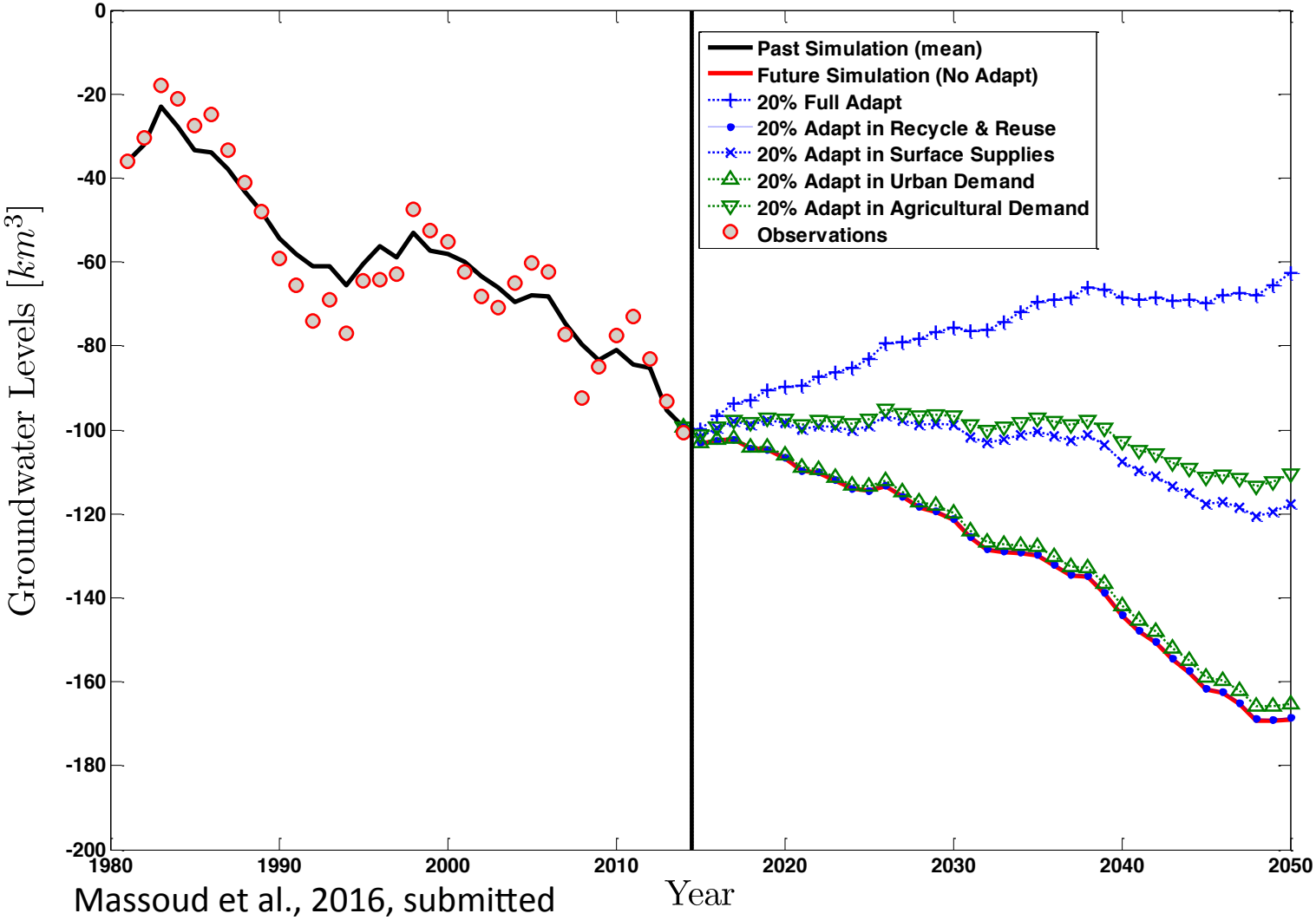
- Apply NASA's wealth of science, remote sensing data and expertise.
- Leverage decades of investment in science and technology.
- Develop and maintain lasting relationships with stakeholders.





Integrated models enable new science and applications

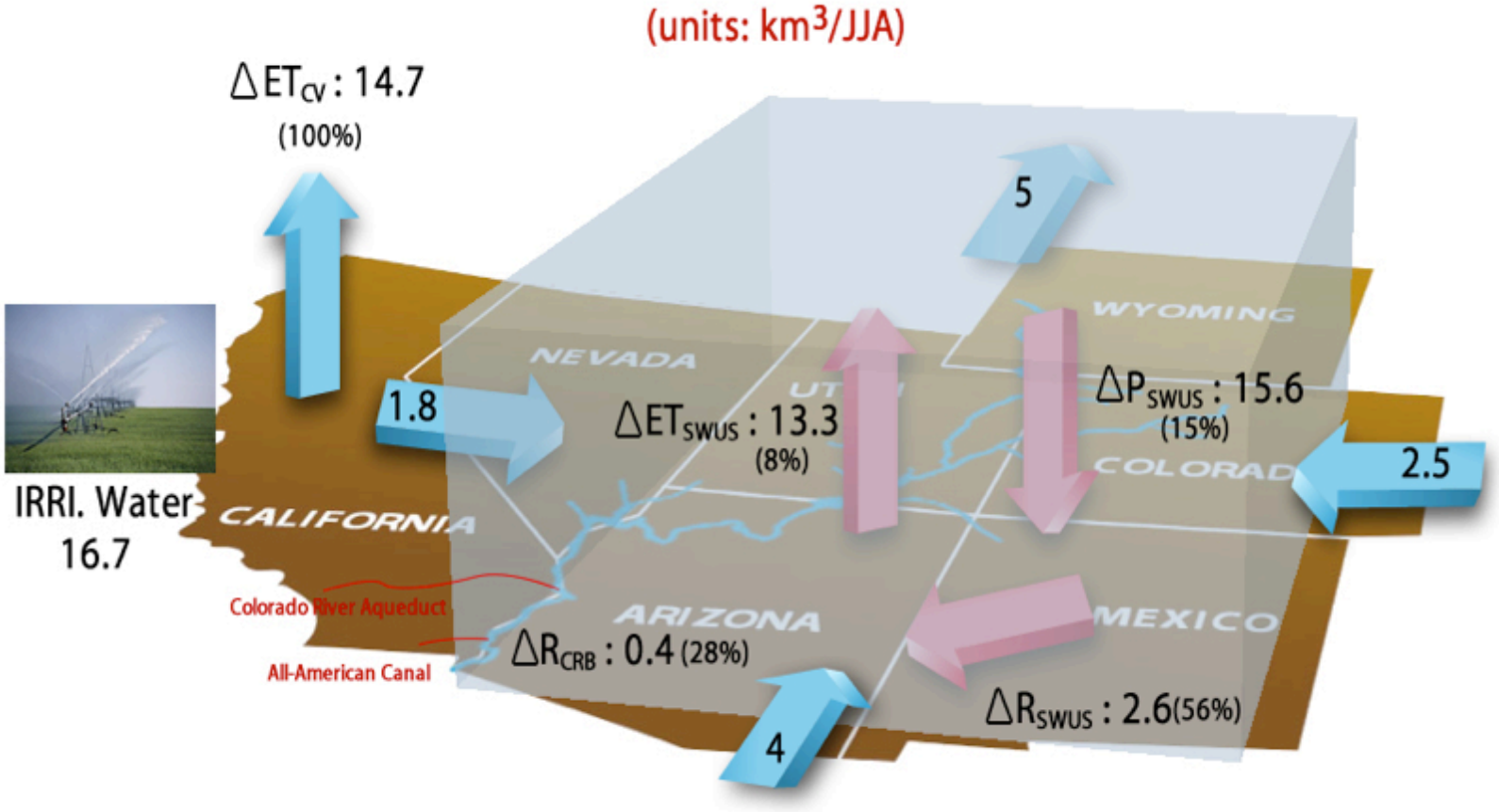
Helping California water managers define 'sustainable' groundwater use



Massoud et al., 2016, submitted

Integrated models enable new science and applications:

Irrigation in California's Central Valley Strengthens the Southwestern U. S. Water Cycle



Lo and Famiglietti, 2013