



Land Subsidence along the Delta-Mendota Canal in the Northern Part of the San Joaquin Valley, California

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February 27, 2014

<http://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html>

Summary

- ▶ 1,200 mi² area subsided ½-11 inches/year during 2008-10; surveys indicate these rates have continued through 2013
- ▶ Adversely affecting water conveyances and other infrastructure
 - ▶ Delta-Mendota Canal, California Aqueduct, Eastside Bypass, San Joaquin River, local canals
- ▶ Subsidence is largely permanent
- ▶ Subsidence occurred when groundwater levels declined to historically low levels as a result of pumping
- ▶ Area of maximum active subsidence has shifted about 25 mi northeast from historical (1926-70) maximum
- ▶ Long-term monitoring of water levels and subsidence is needed to detect and track groundwater conditions for decision support

Subsidence Damages Natural Resources and Infrastructure



2 year old well (drilled 2010). Land surface shows 2 feet of subsidence (well location shown on map). Photo courtesy Sarge Green, California Water Institute.

► Flood Protection and Infrastructure

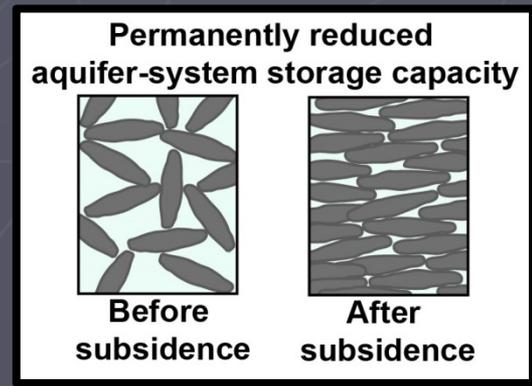
- Damage to water conveyance systems and other infrastructure

- Reduced conveyance capacity and freeboard, panel damage; water surface and liner misalignment; erosion/deposition in unlined channels
- Roads, rails, bridges, pipelines, wells, etc.



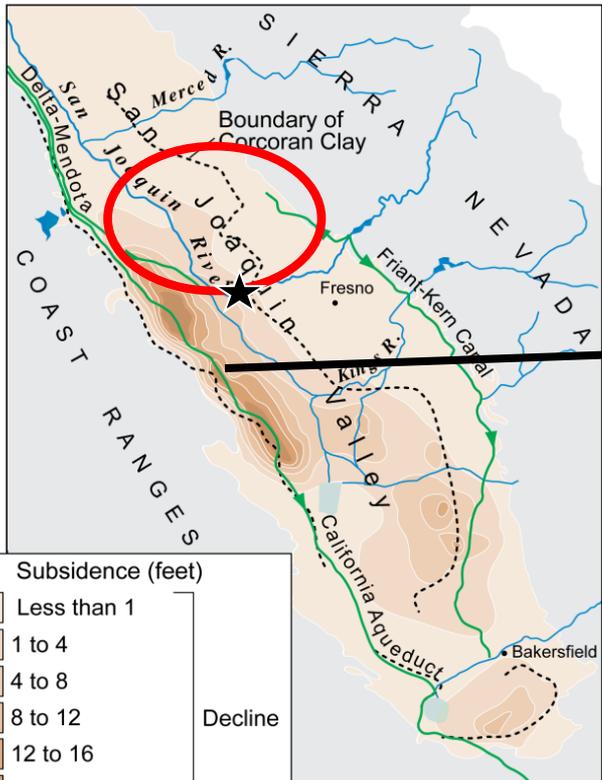
► Natural resources

- Reduces aquifer-system storage capacity
- Impacts to wetland, riparian, and aquatic ecosystems
- Restricted land uses

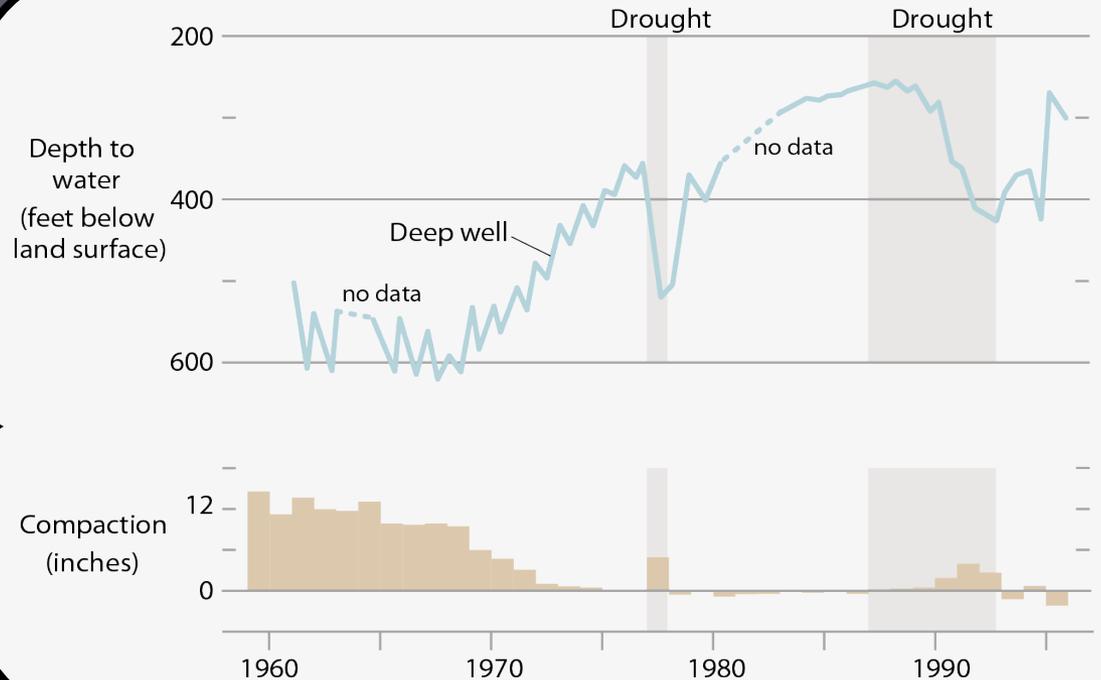


Subsidence History

Extensive withdrawal of groundwater caused widespread subsidence (1920s-1970)



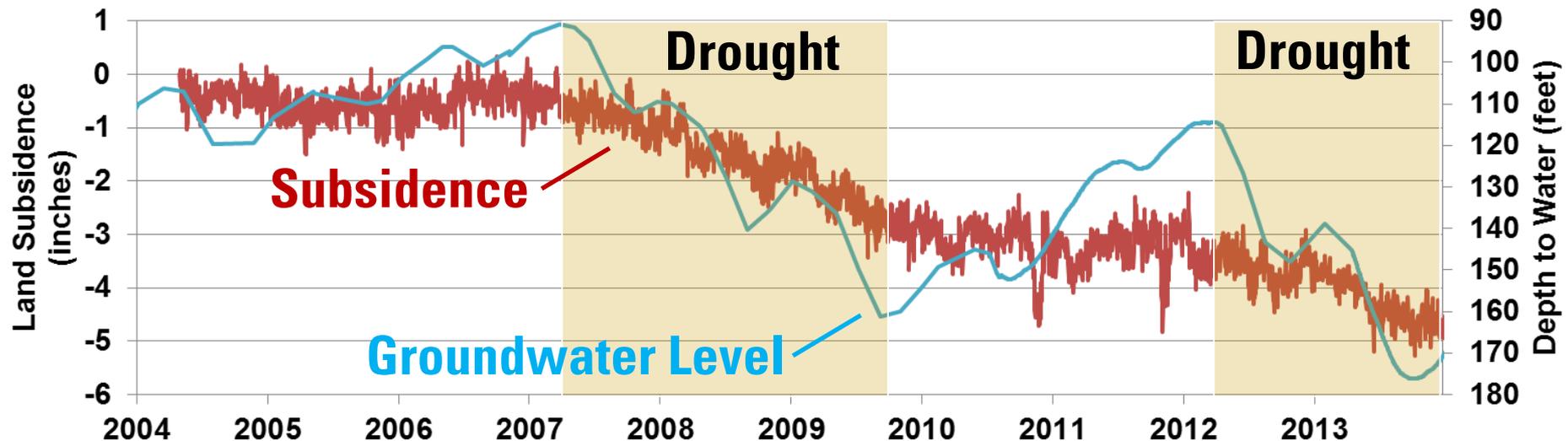
(Modified from Poland and others, 1975)
Land subsidence 1926-70



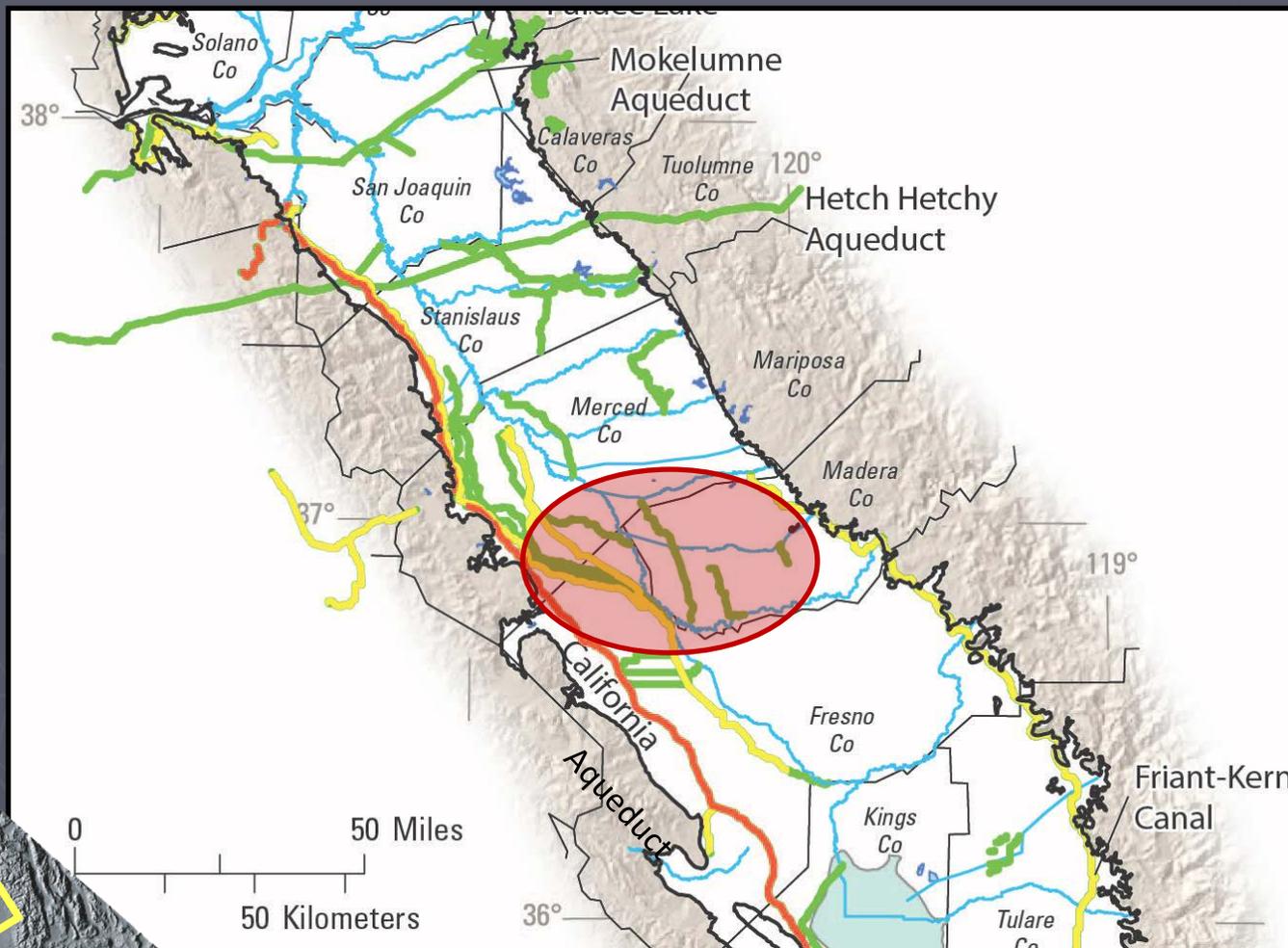
Surface-water deliveries caused widespread recovery and slowing or cessation of subsidence, except when deliveries were curtailed and groundwater pumping increased to meet demand

Recent Subsidence

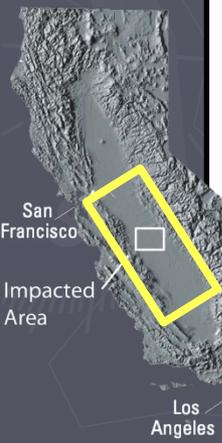
- ▶ Renewed subsidence concern during 2007-09 drought, and now, the current drought
 - Reduced surface water importation
 - More reliance on the groundwater resources
 - As it turns out...this is not just a problem during droughts for some areas without surface-water access



Federal, State, and Local Water Infrastructure in the Impacted Area

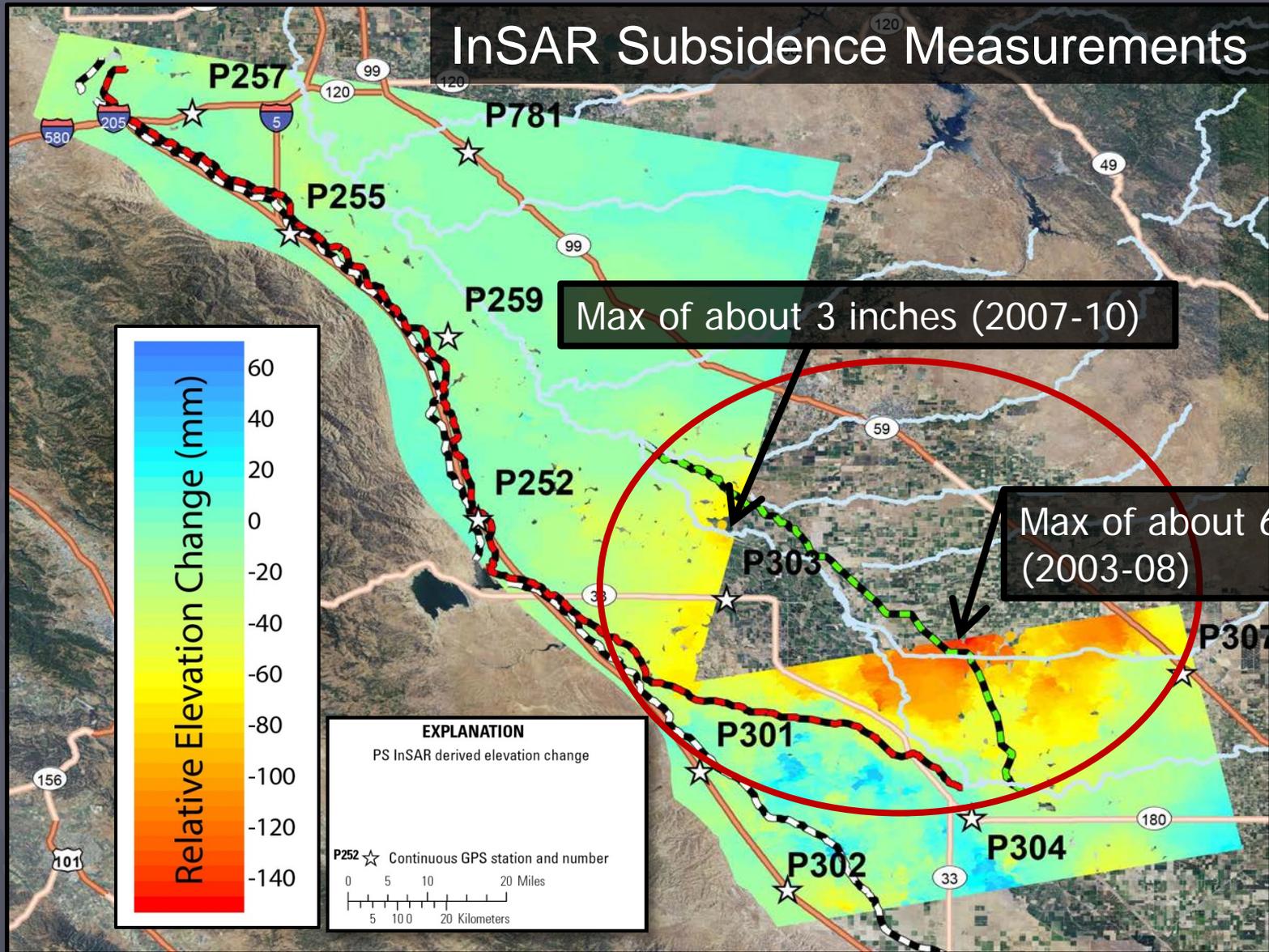


EXPLANATION	
	Historic lakes
	Reservoir
	State Water Project
	Federal Water Project
	Local Canal/Aqueduct Projects
	Selected streams and rivers
	County boundary
	Davis Precipitation station and identifier

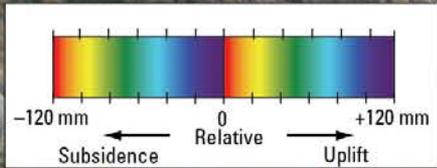
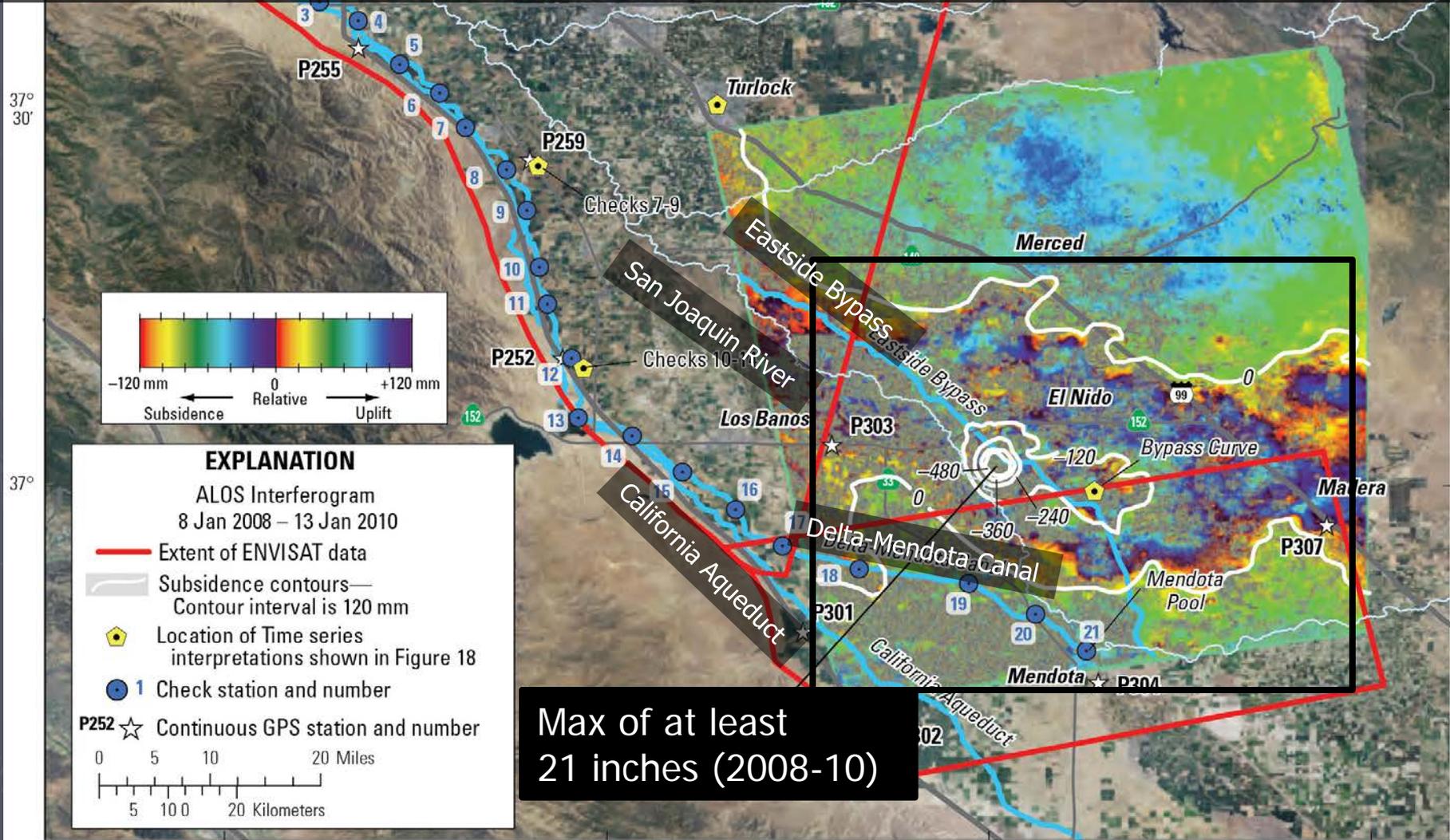


Modified from Faunt, 2009

Detected Edges of Subsiding Area



InSAR Subsidence Measurements: Maximum Subsidence Area near El Nido, between Eastside Bypass and San Joaquin River



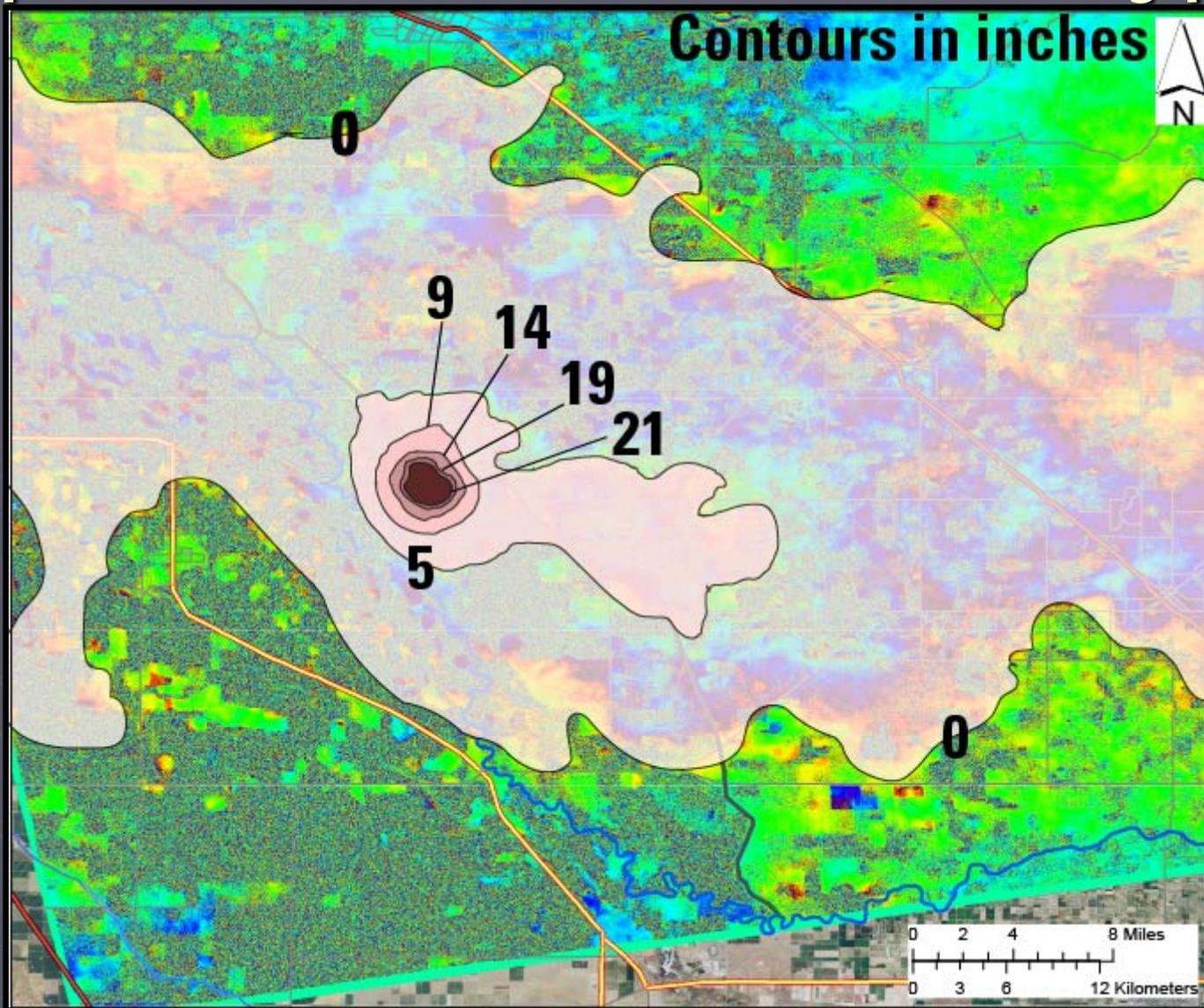
EXPLANATION

- ALOS Interferogram
8 Jan 2008 – 13 Jan 2010
- Extent of ENVISAT data
- Subsidence contours—
Contour interval is 120 mm
- Location of Time series interpretations shown in Figure 18
- 1 Check station and number
- P252 ☆ Continuous GPS station and number

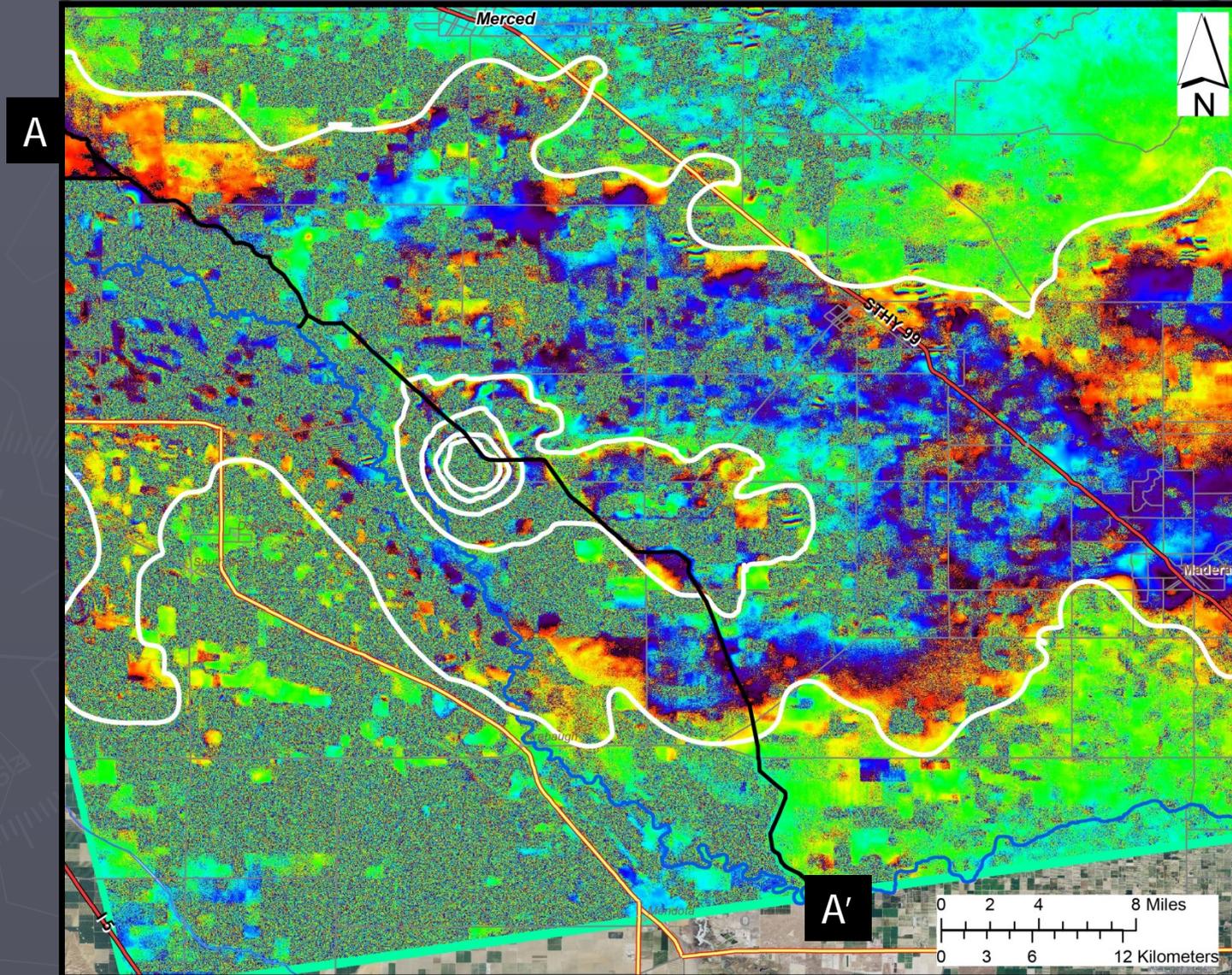
0 5 10 20 Miles
0 5 10 20 Kilometers

Max of at least
21 inches (2008-10)

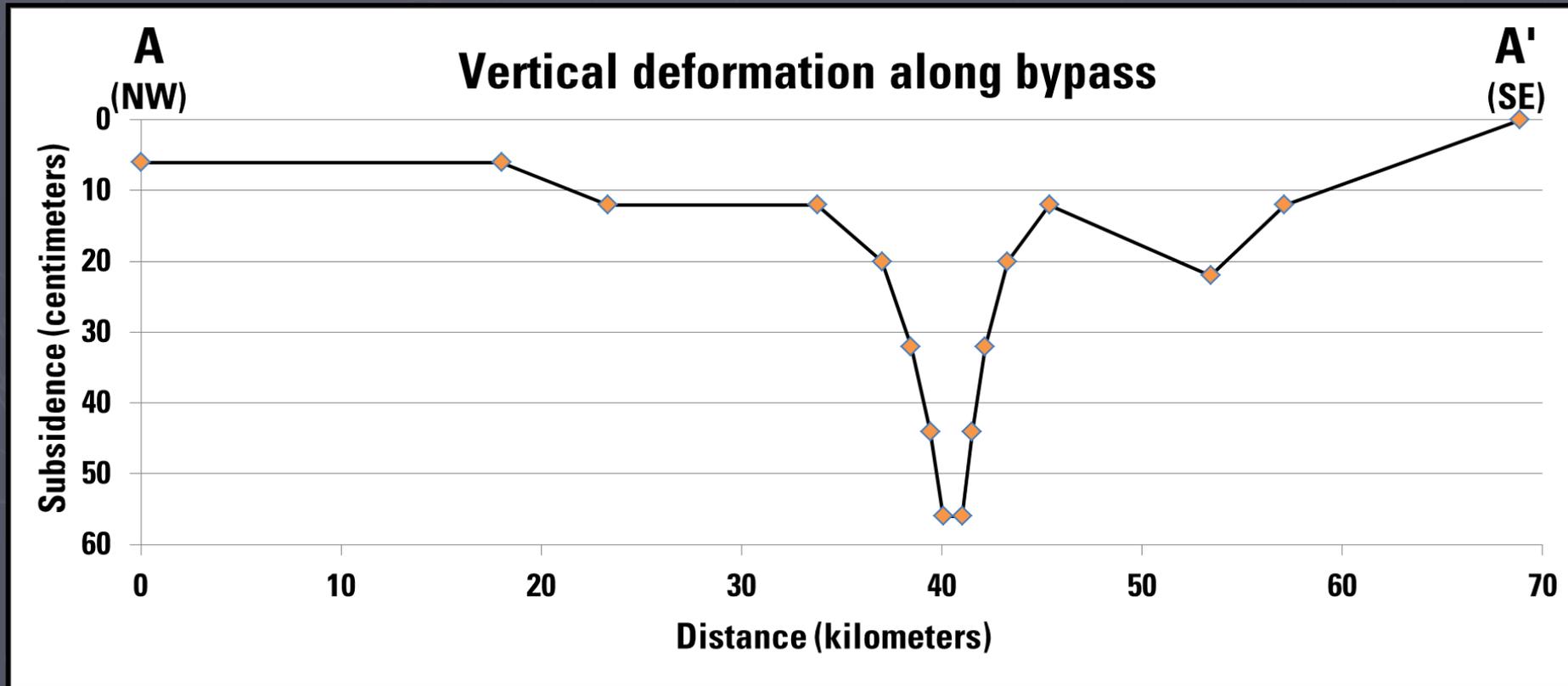
Highest Impact: Adjacent to San Joaquin River and Eastside Bypass



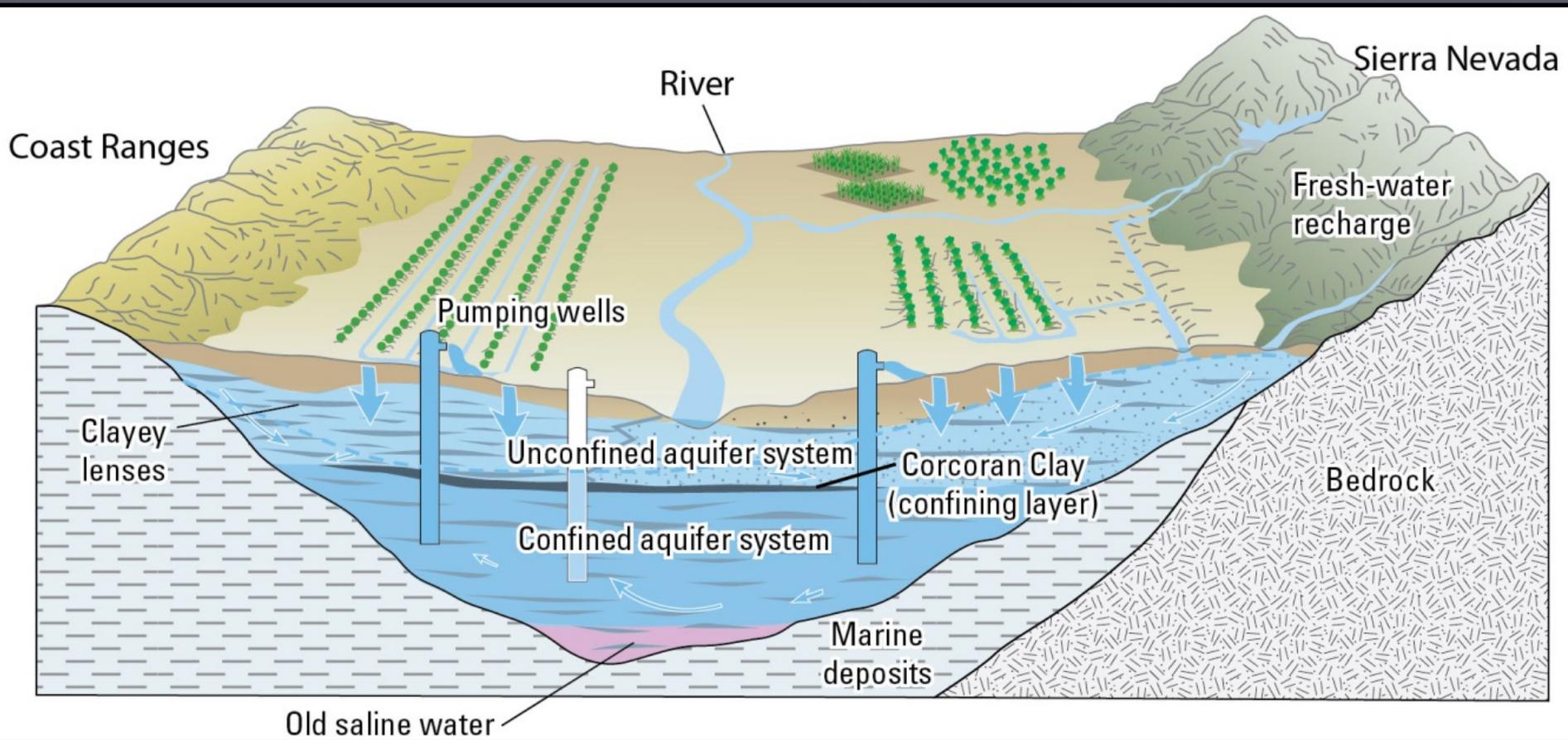
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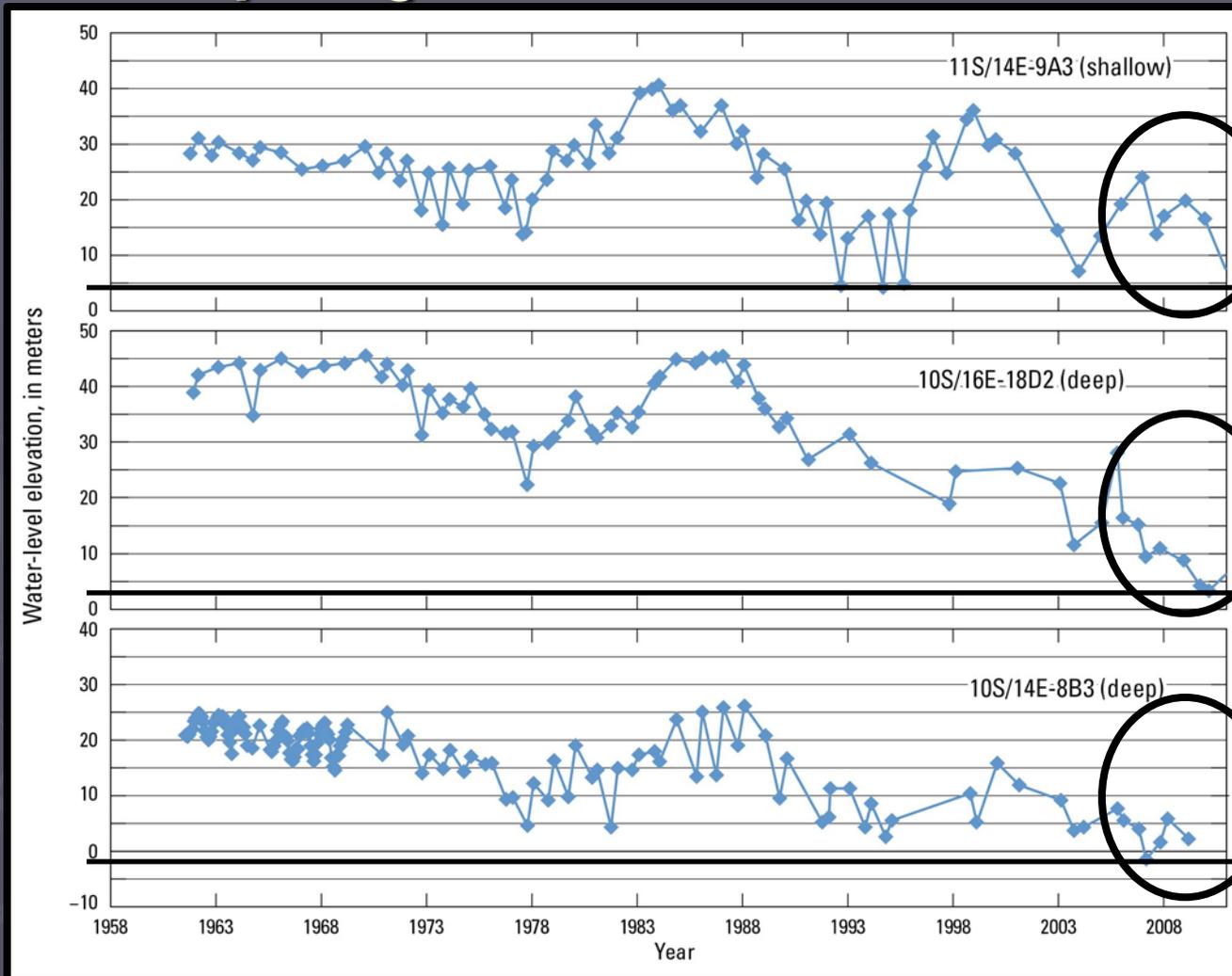
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Water levels in the Shallow and Deep Systems Declined 2007-10



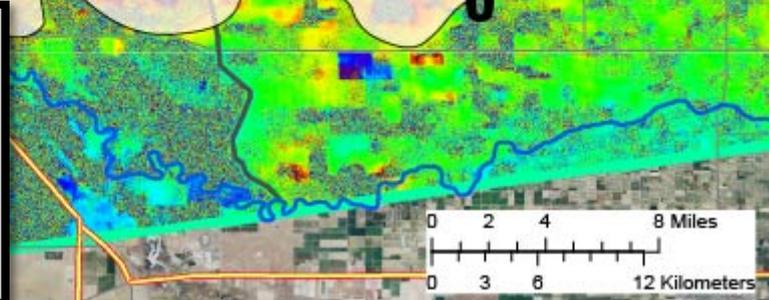
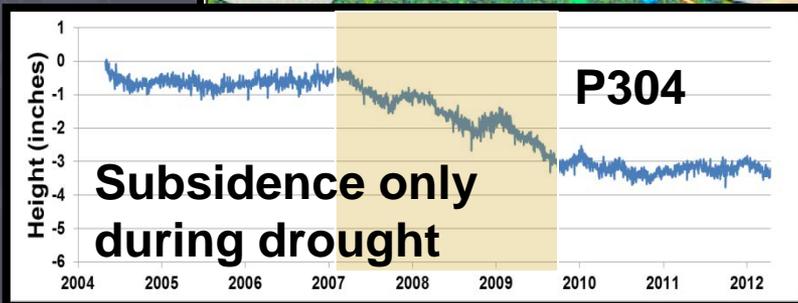
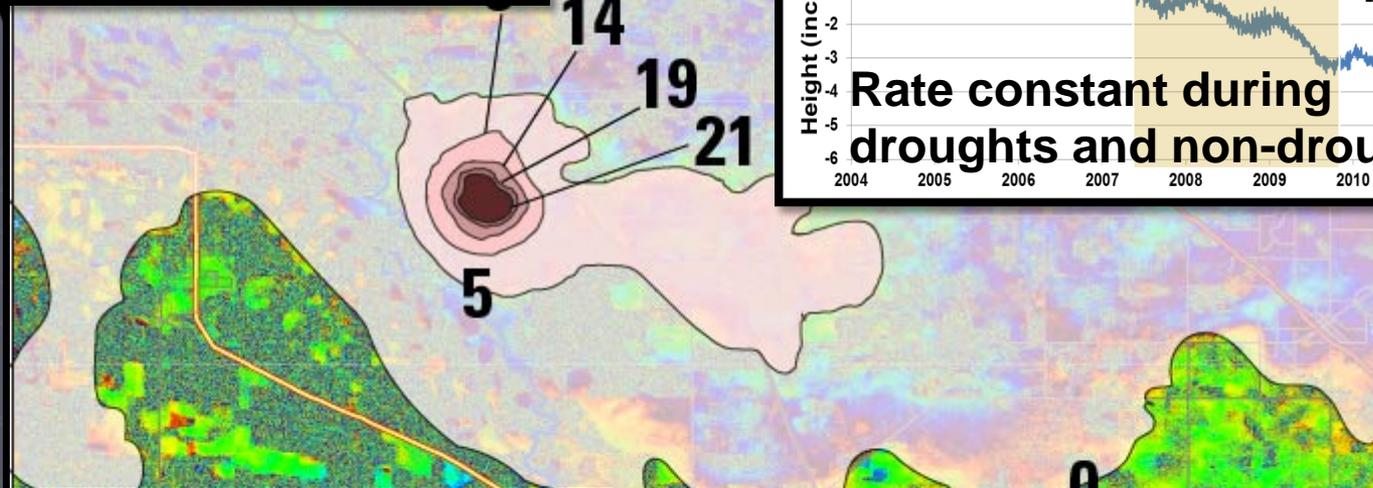
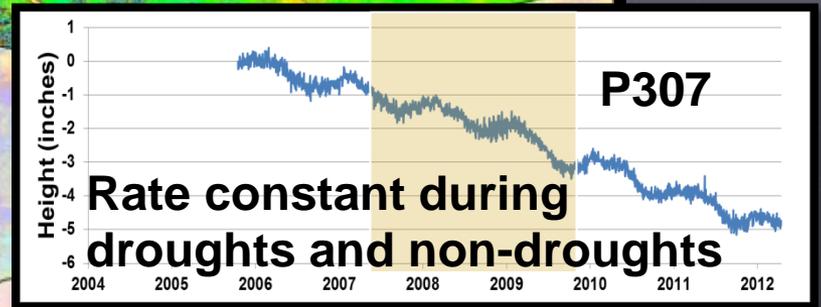
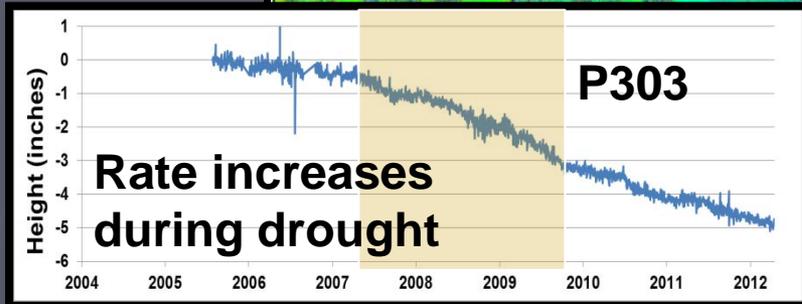
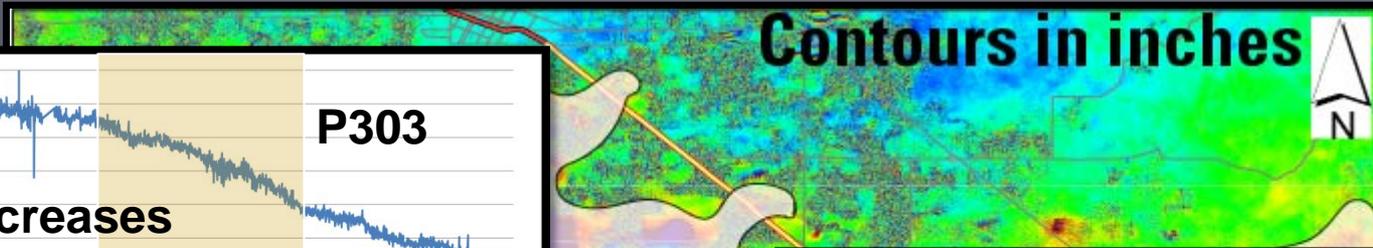
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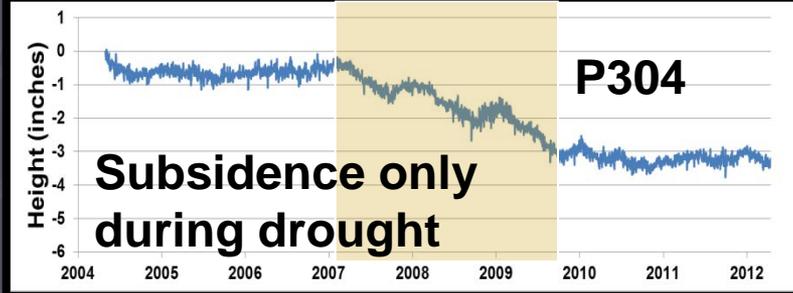
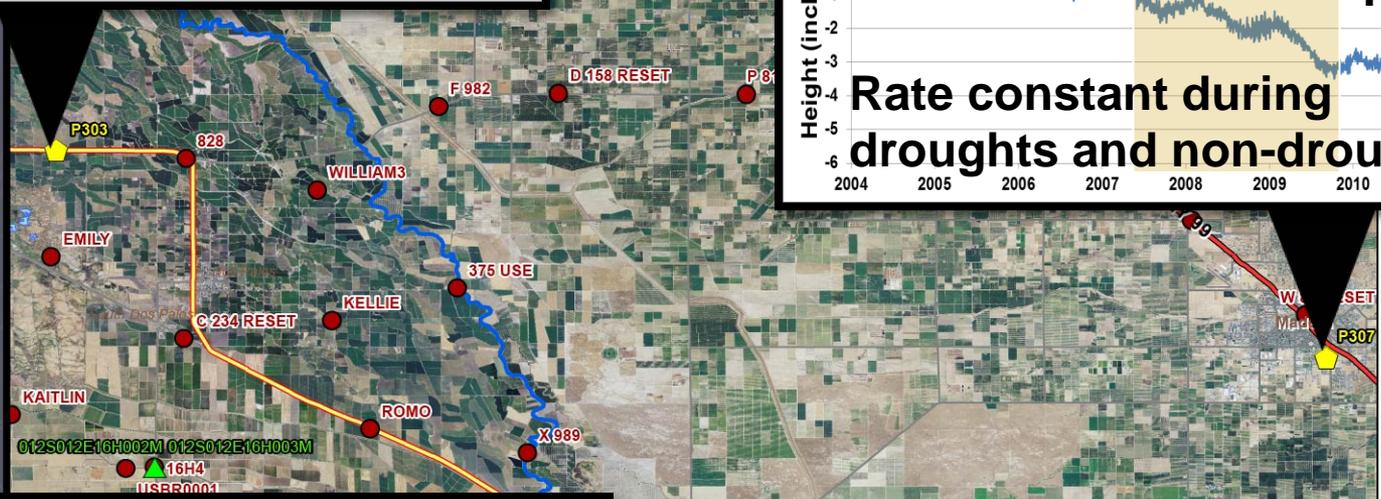
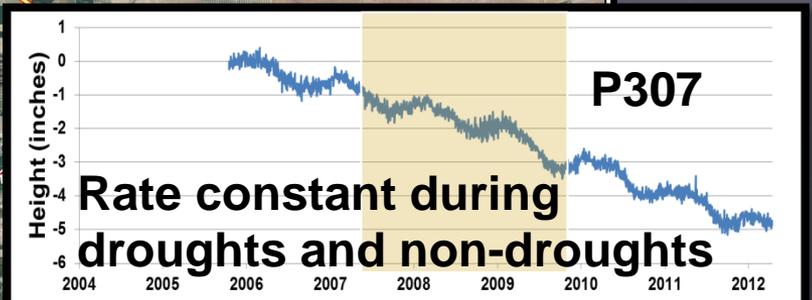
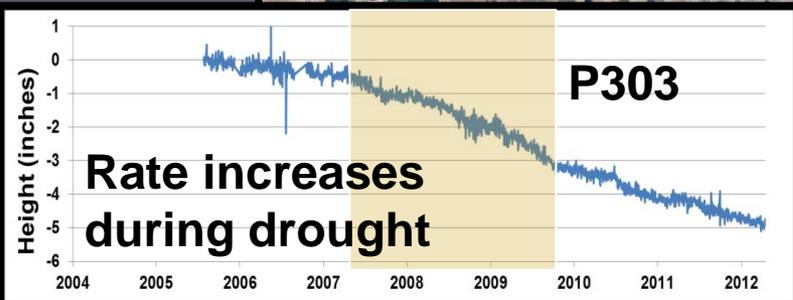
Shallow System Above Historical Low Levels

Deep System Exceeded Historical Low Levels

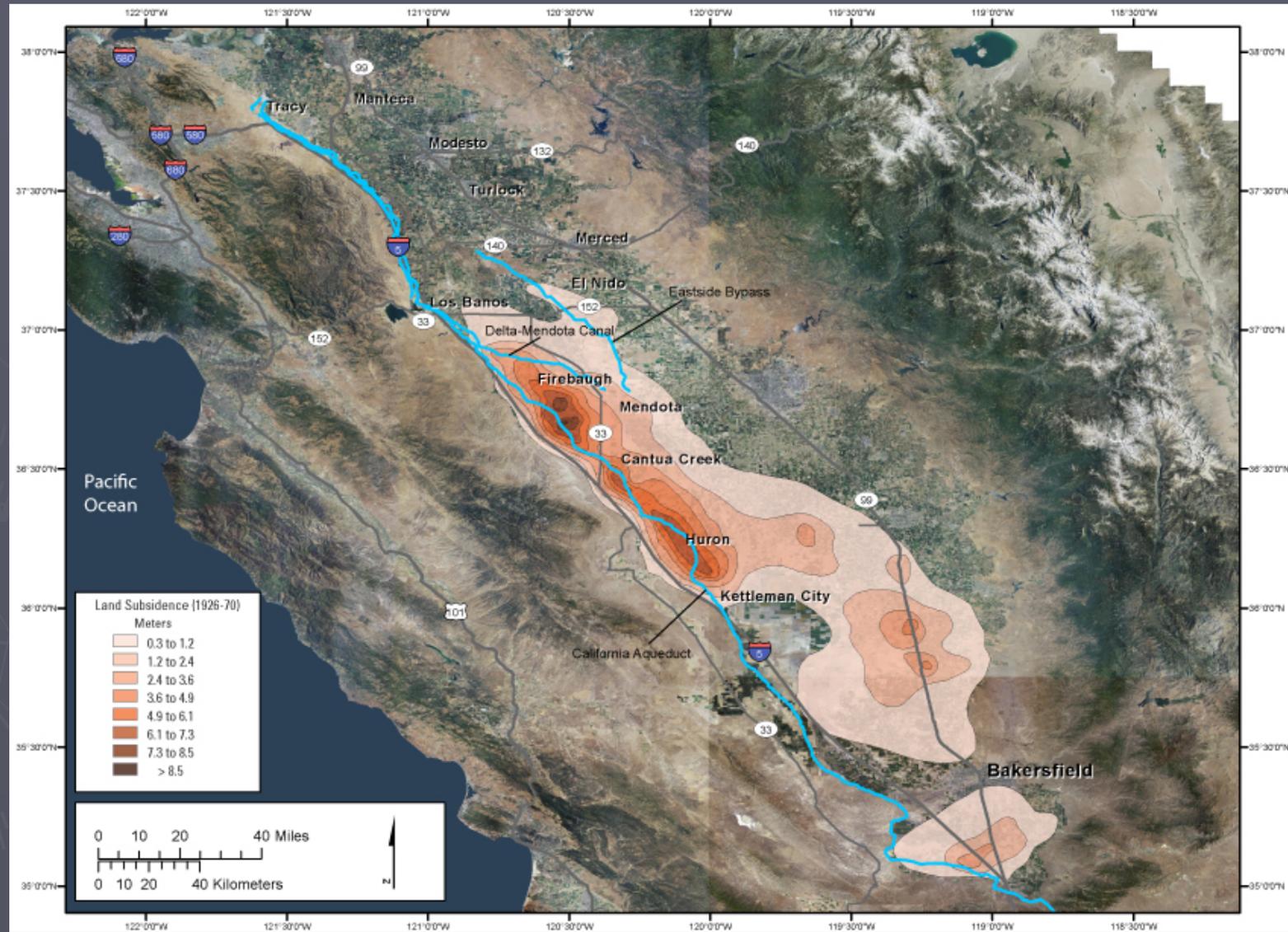
GPS Subsidence Measurements



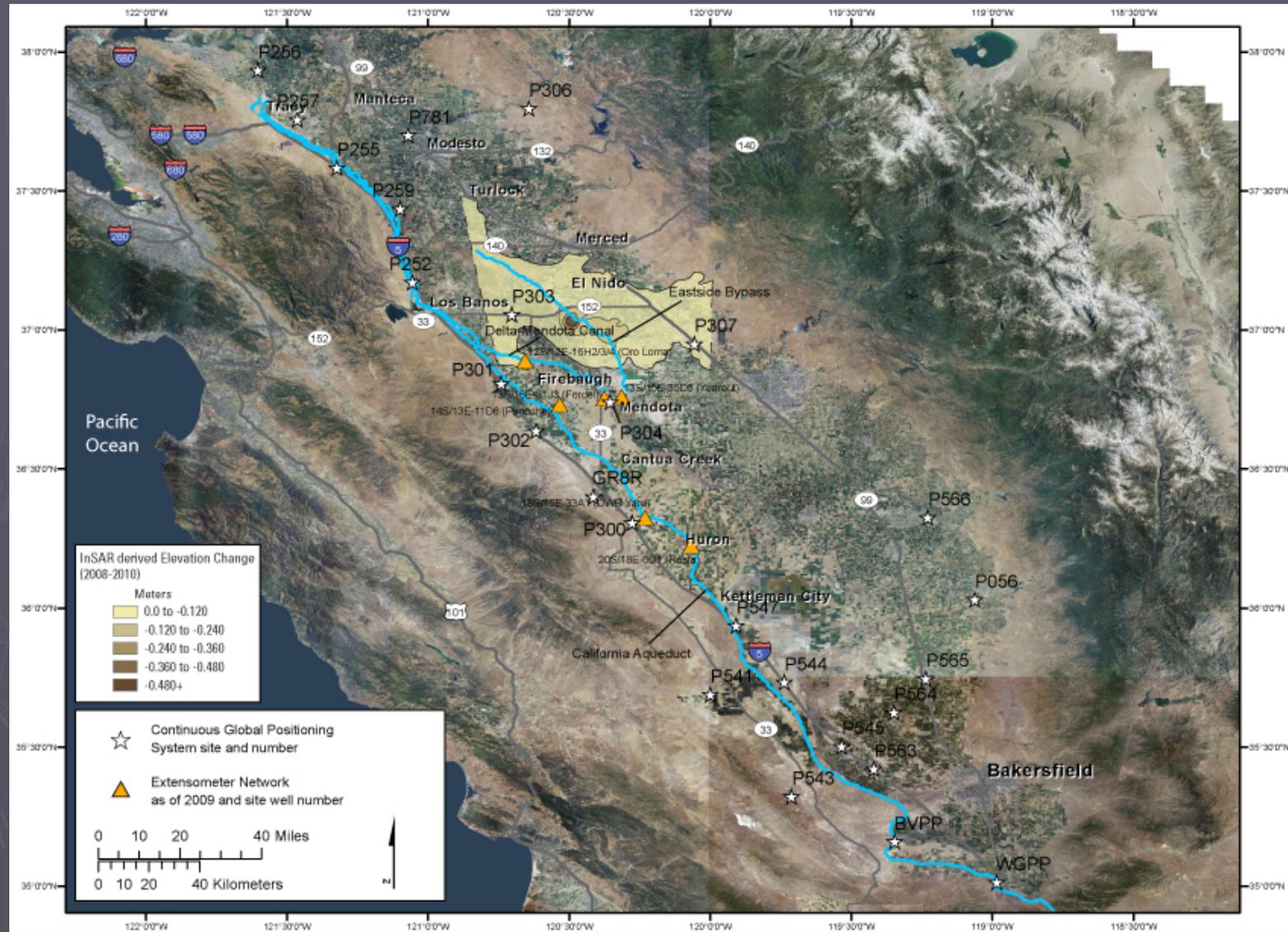
GPS Subsidence Measurements



Historical Subsidence



Recent Subsidence



What Can Be Done About It?

- ▶ Focus on maintaining groundwater levels above historical low levels
 - Reduction of groundwater withdrawal
 - ▶ Decreasing groundwater demand
 - ▶ Limiting/redistributing groundwater use
 - ▶ Increasing supplemental water supply
 - Enhanced groundwater recharge
 - ▶ Artificial recharge: direct well injection or surface infiltration
 - ▶ Natural recharge: source protection
- ▶ Long-term monitoring of water levels and subsidence is needed to detect and track groundwater conditions for decision support

Thanks!

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