

# Groundwater Availability: An Issue of Scale and Science-Based Water Management

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*Kevin Dennehy is the principal expert and overall program leader for the U.S. Geological Survey's Groundwater Resources Program in Reston, Virginia. He has more than 30 years of experience in the analysis of the quantity and quality of water resources and is the author and co-author of numerous publications on topics like water availability and sustainability, surface water and groundwater interactions, unsaturated zone processes, surface water and groundwater simulation, surface water and groundwater quality sampling and analysis, and aquifer test analysis. Currently his focus is on assessing the nation's groundwater availability by conducting multidisciplinary regional scale studies of principal aquifers. Kevin received undergraduate and graduate degrees from the University of New Hampshire and the University of South Carolina, respectively.*

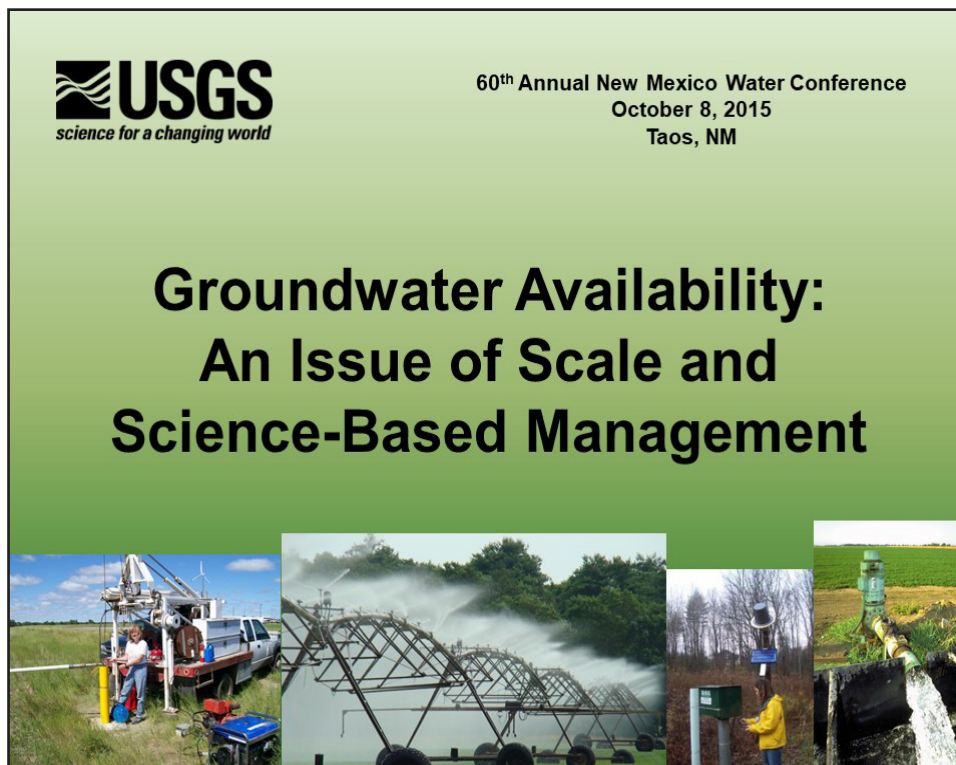


Figure 1. Presentation introduction.

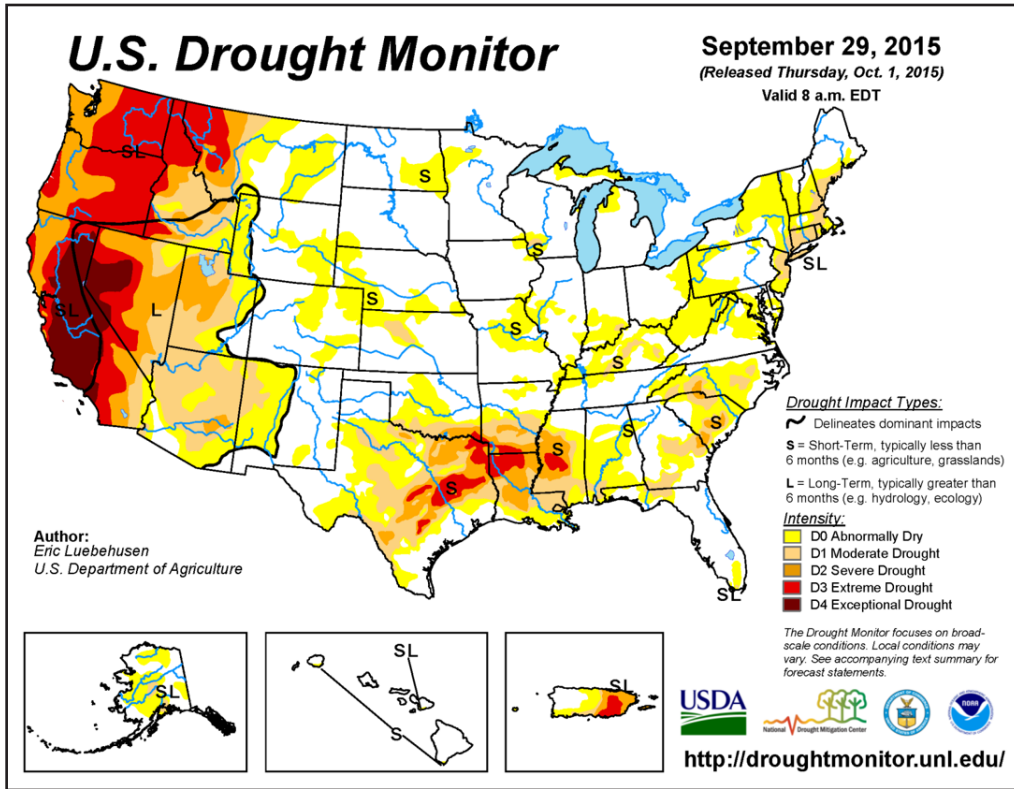


Figure 2. Sustainability of water resources is under continued threat.

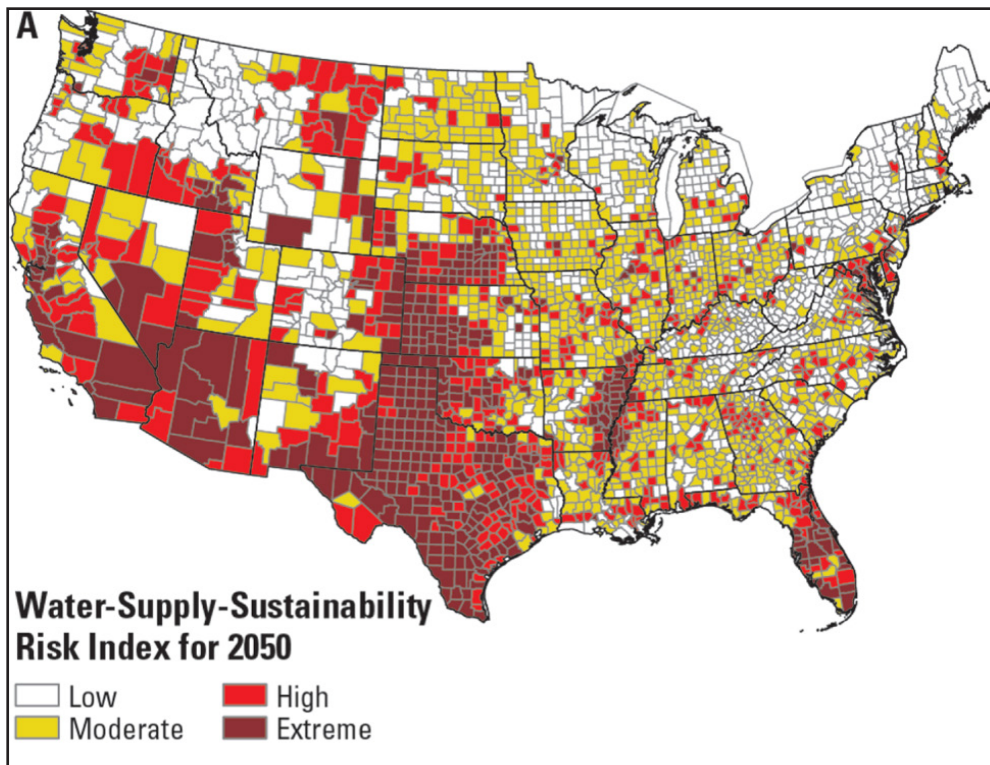


Figure 3. Linking water demand to current and future stresses.

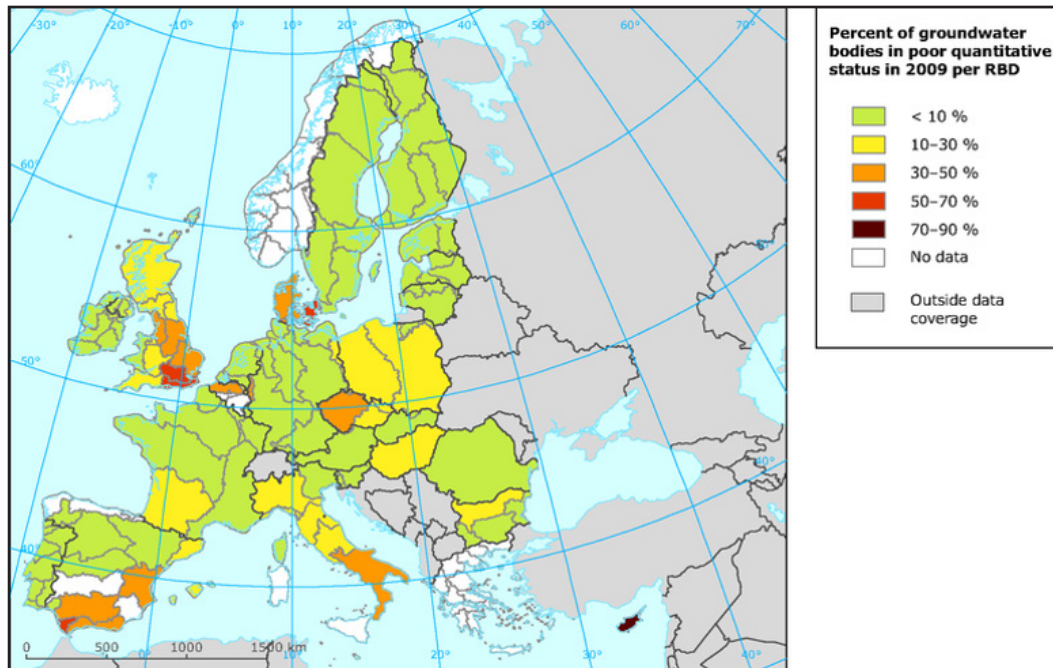


Figure 4. Percentage of groundwater bodies in poor quantitative status across the European Union.

## Information Not Available in Consistent Spatial and Temporal Scales

**EXPLANATION**

- State Boundaries
- Ice-contact
- Lacustrine coarse
- Other sand
- Outwash
- Valley-fill

**Quaternary Atlas (surficial map)**

USGS and others, 2013

**+**

15 million water-well records compiled into a single database

Developing 3D framework of glacial aquifer system

**EXPLANATION**

- Total sand and gravel deposit thickness
- Areas of insufficient data
- Areas of incomplete analysis
- Glacial Extent Boundary

**Sand and Gravel Thickness**

Figure 5. Information not available in consistent spatial and temporal scales.

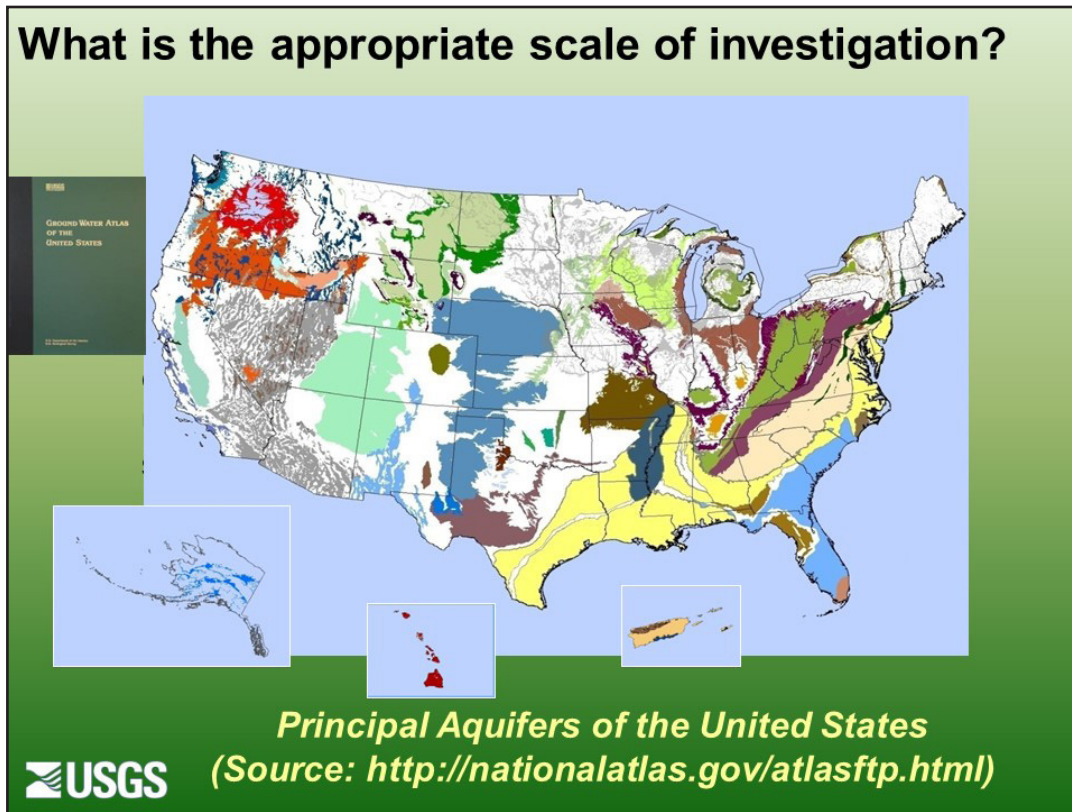


Figure 6. What is the appropriate scale of investigation?

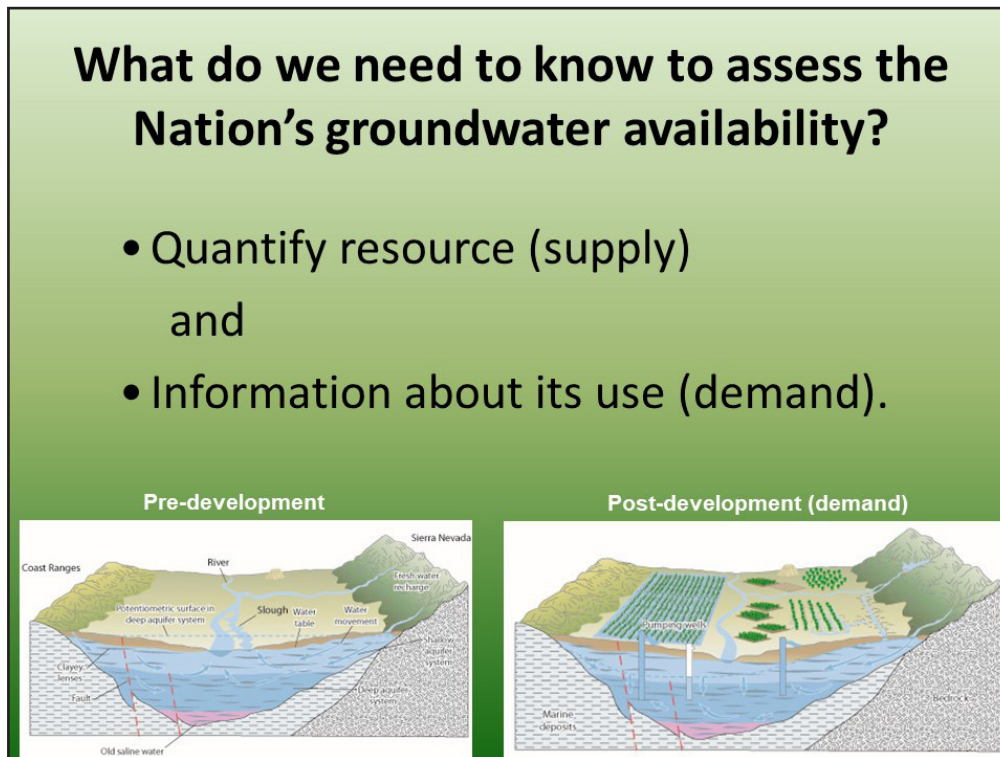


Figure 7. Assessing the nation's groundwater availability.

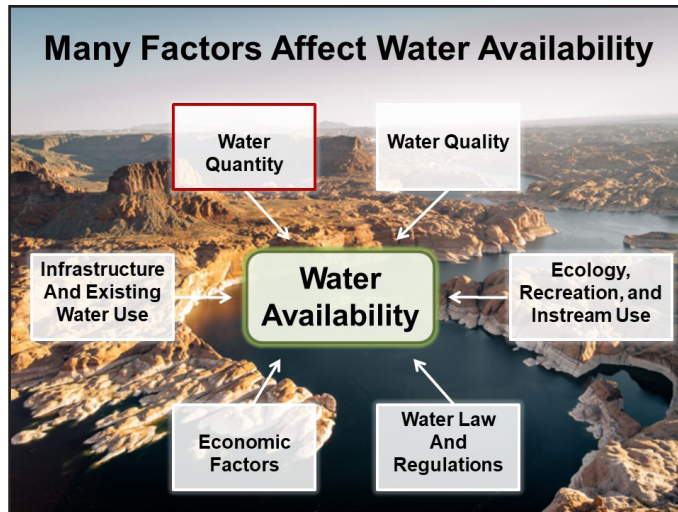


Figure 8. Factors that affect water availability.

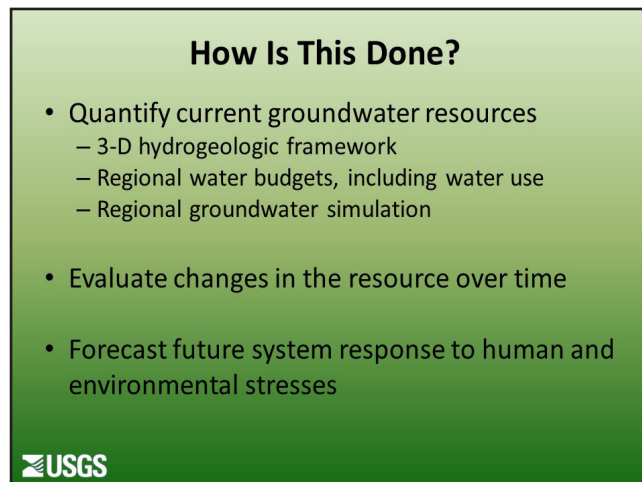


Figure 9. How to assess groundwater.

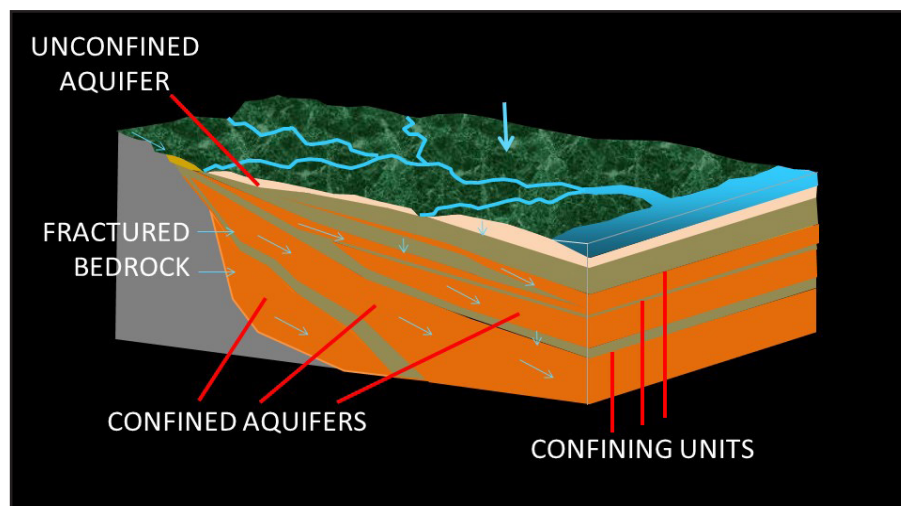


Figure 10. 3-D hydrogeologic framework.

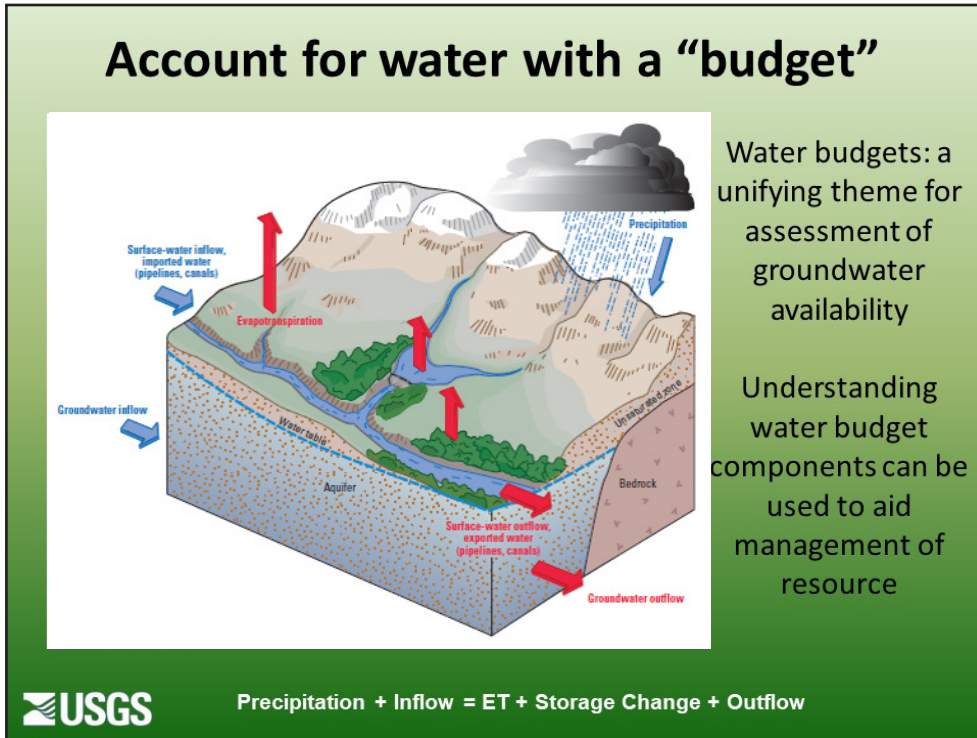


Figure 11. Account for water with a “budget.”

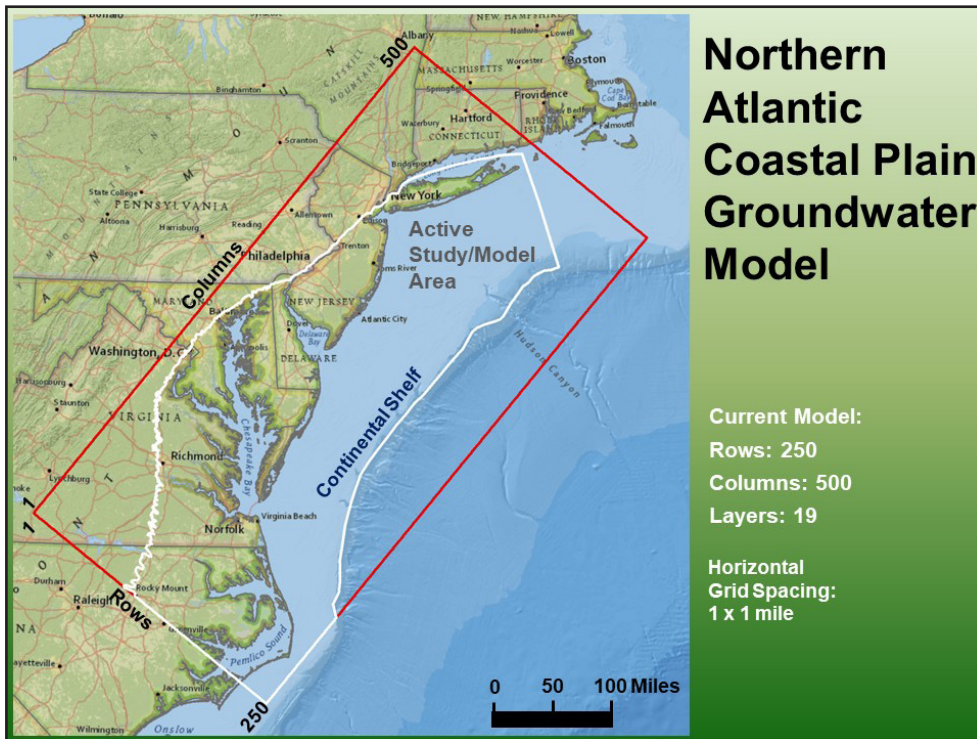


Figure 12. Northern Atlantic Coastal Plain Groundwater Model.

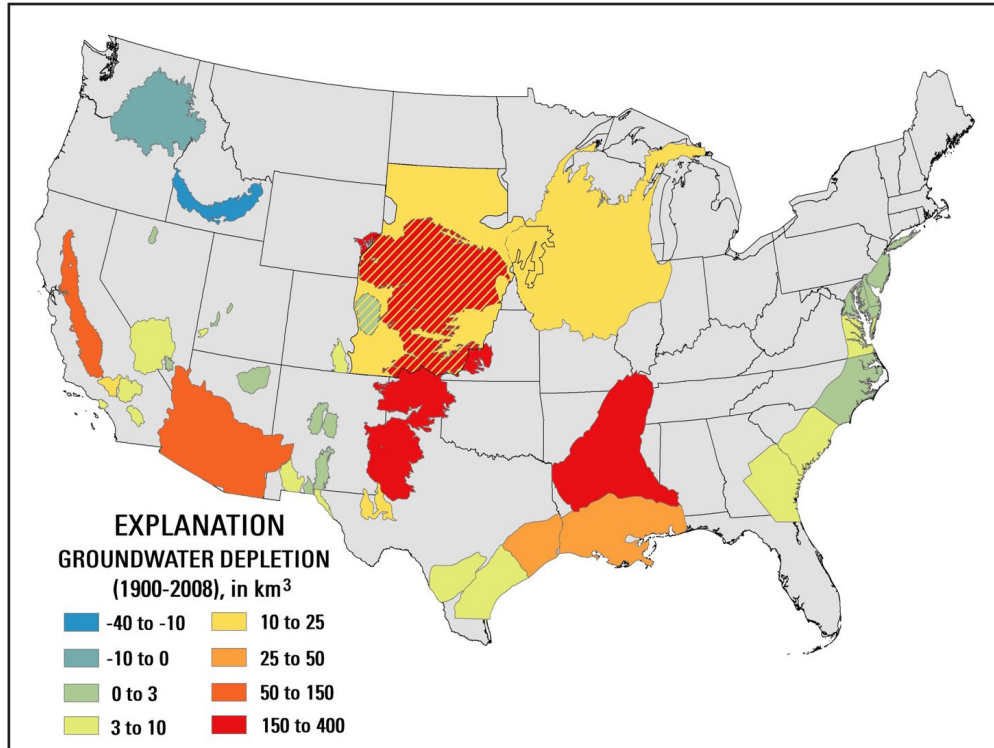


Figure 13. Cumulative volumetric groundwater depletion (1900-2008).

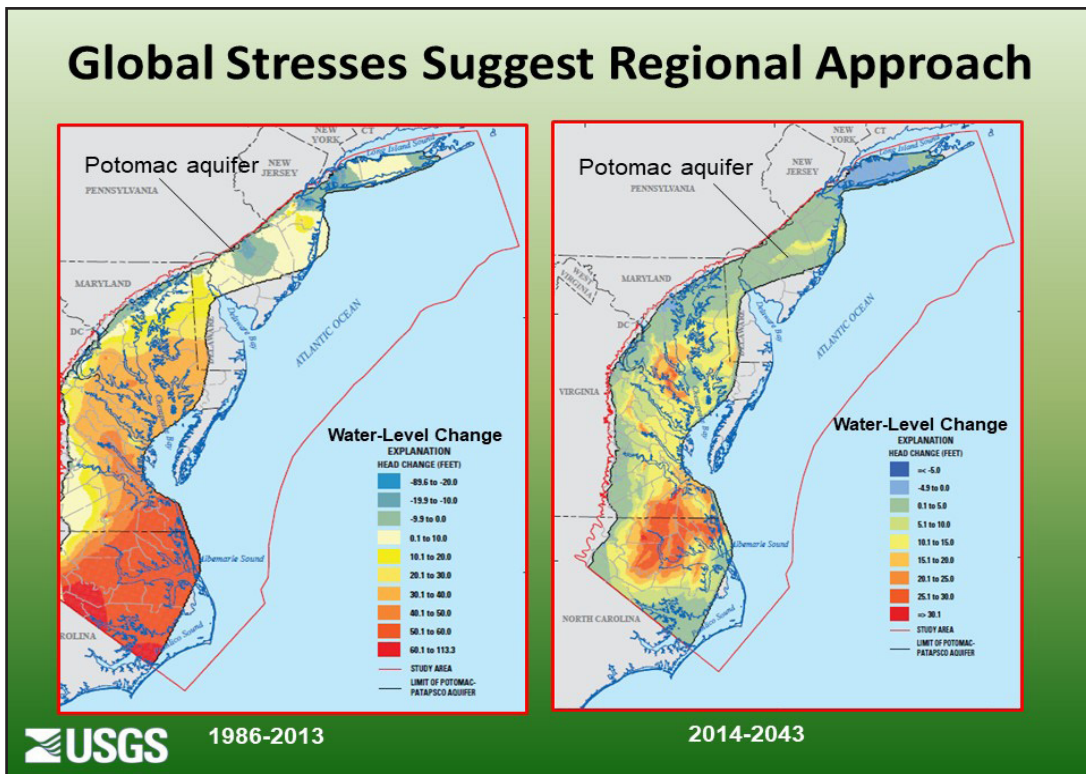


Figure 14. Global stresses suggest regional approach.

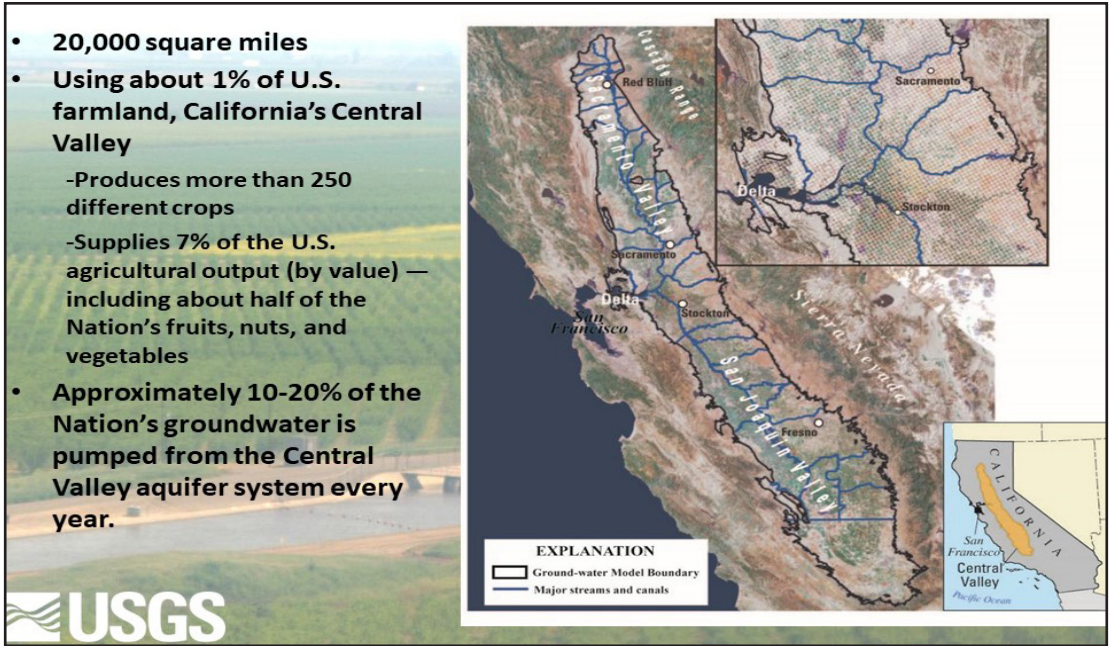


Figure 15. California's Central Valley.

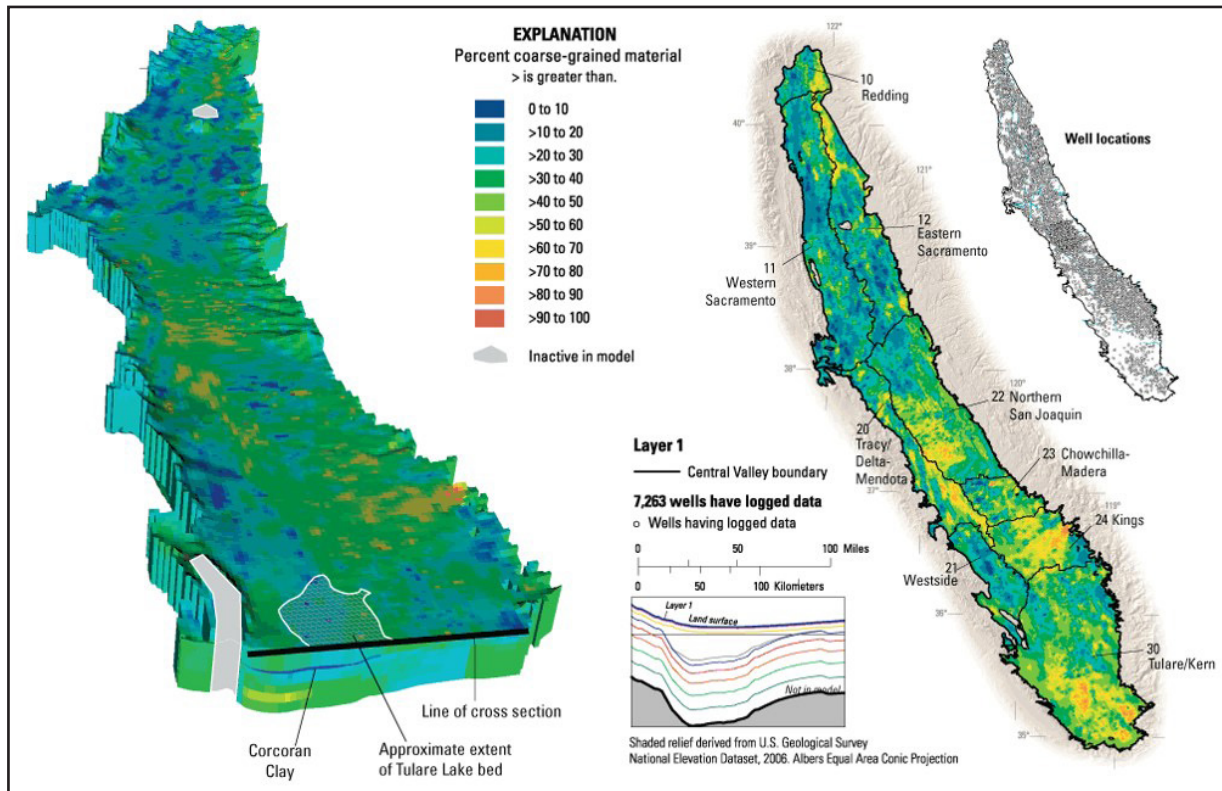


Figure 16. Texture analysis used in defining 3-D hydrogeologic framework.



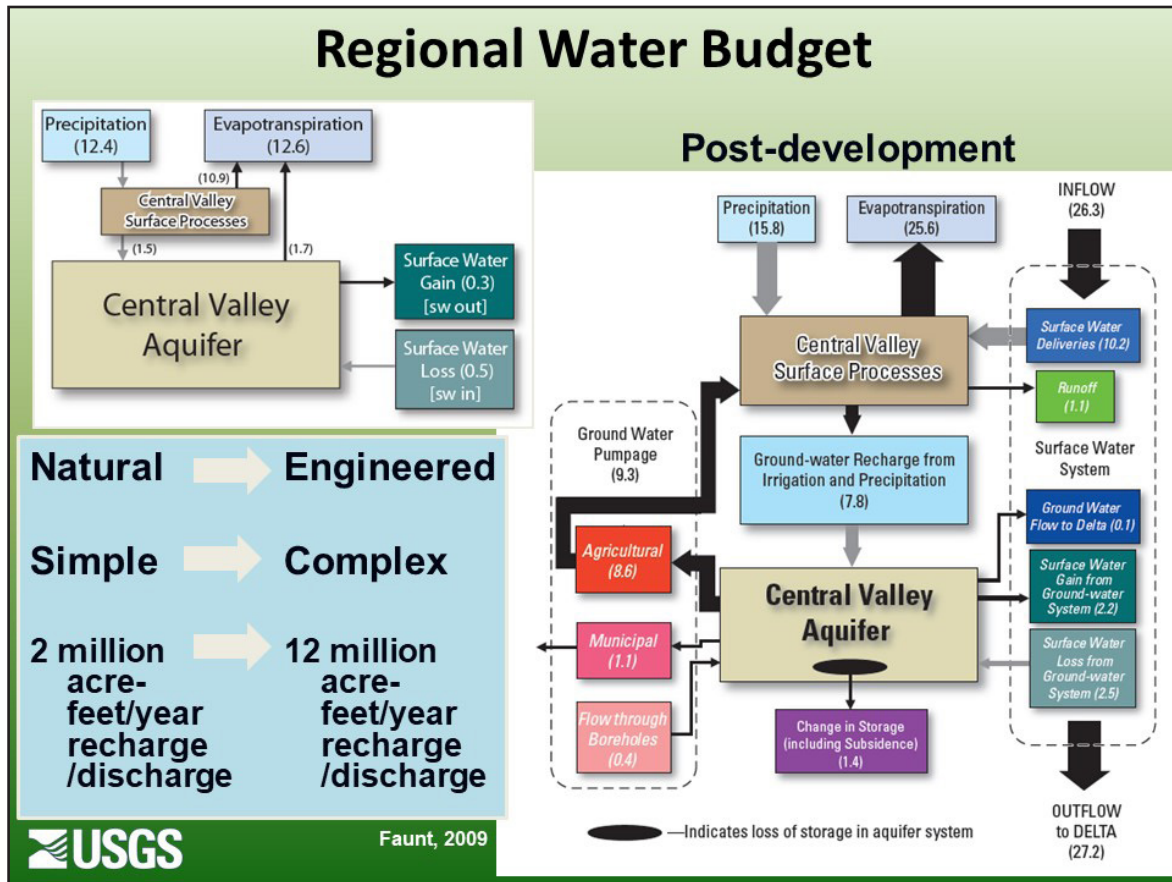


Figure 17. Regional water budget.

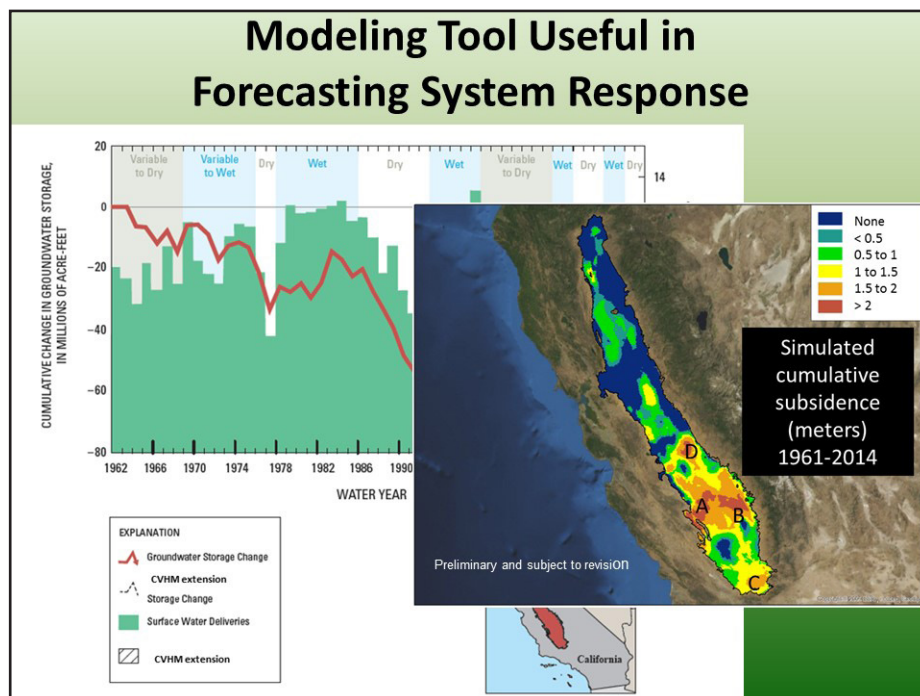


Figure 18. Modeling tool useful in forecasting system response.

## Summary

- Analyzing entire groundwater system has practical advantages
- Local water managers are focusing on different scales than required to address aquifer sustainability
- Regional analysis can address aquifer sustainability using a holistic approach
- Regional studies advance state-of-knowledge of large groundwater systems





Figure 19. Summary.

## Summary (Cont.)

- Models helpful in hypothesis testing which aid in management of resource
- Management of these resources by local government should be done with awareness of the regional system





Figure 20. Summary (Cont.).