CWEMF
California Water & Environmental Modeling Forum

Woodard & Curran

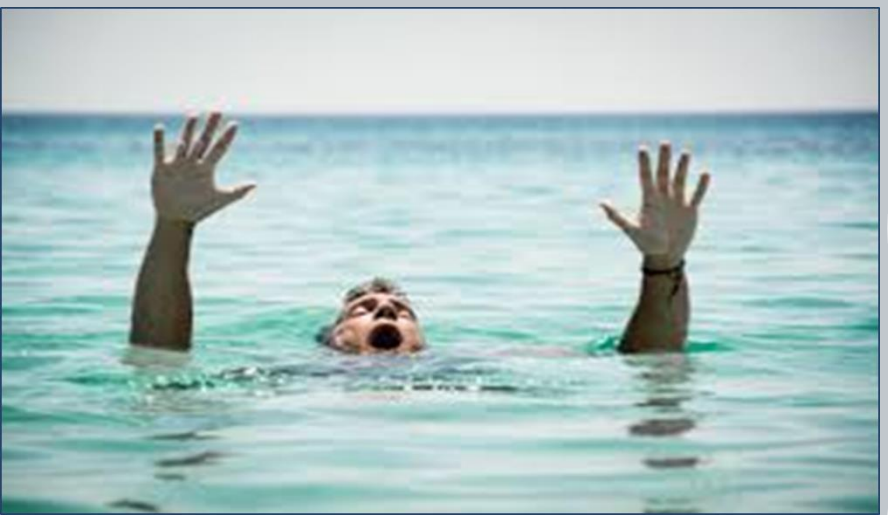
Beyond the Numbers:

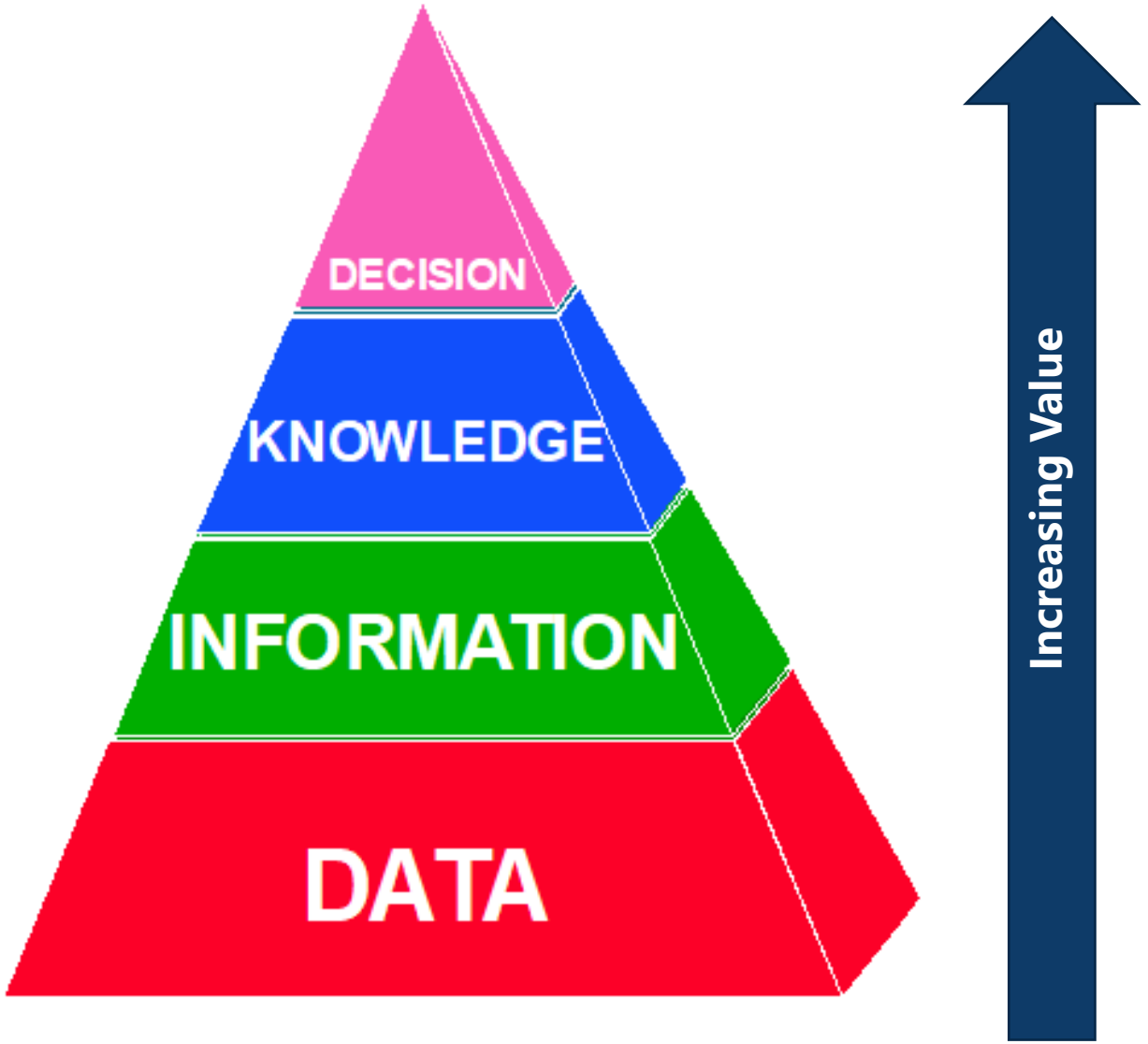
The Future of Sustainable Groundwater Management Through Data-Driven Implementation

Presented by Saquib Najmus, Ph.D., P.E., PMP

Collaborators: Josh Uecker, M.S. and Frank Qian, M.S., P.E.

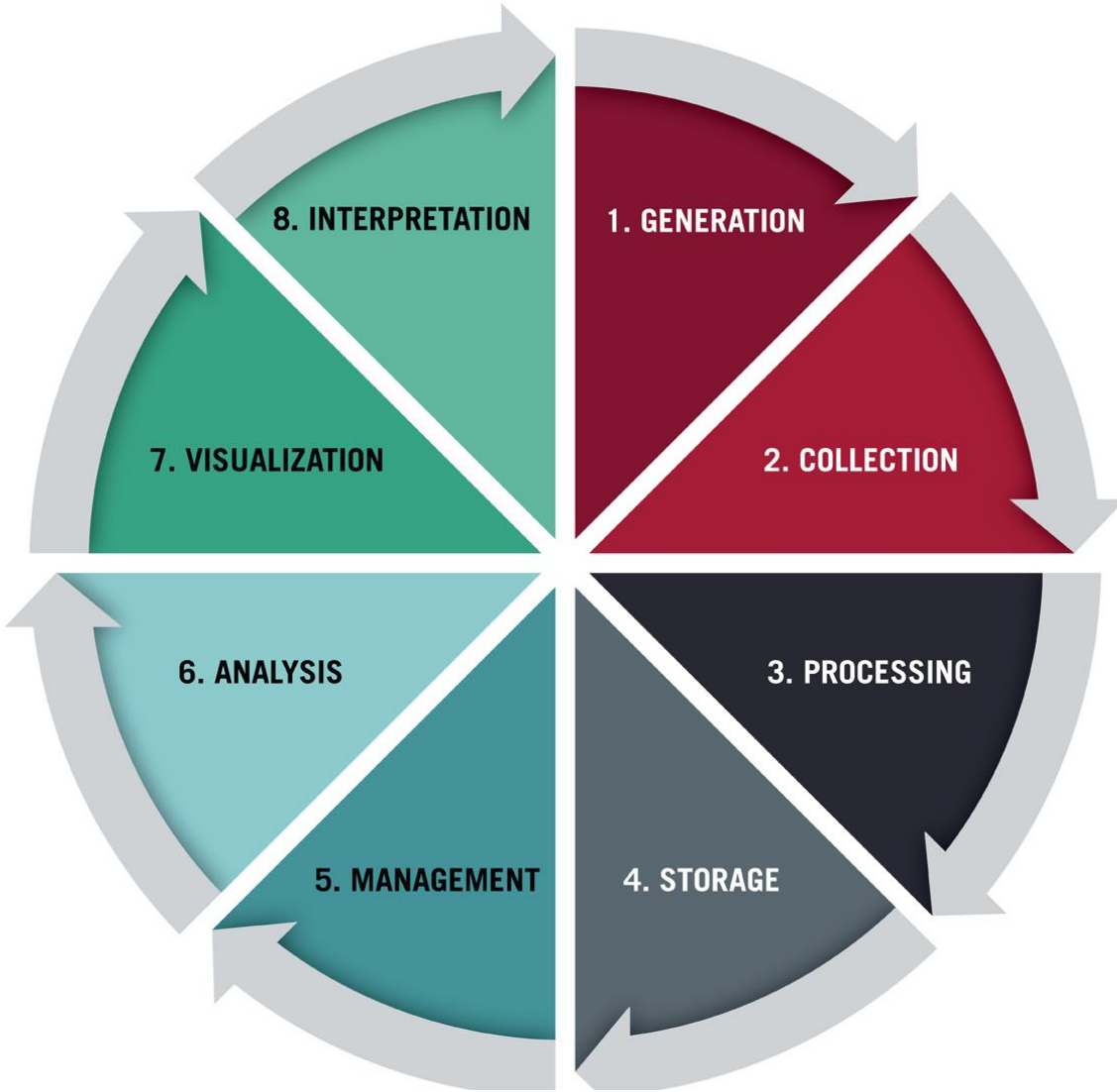
We are drowning in data, but starved for knowledge





Beyond the Numbers:

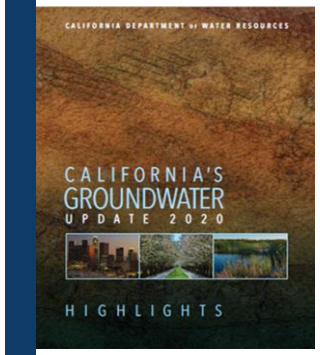
Making the Invisible, Visible



DATA LIFE CYCLE

CWEMF
California Water & Environmental Modeling Forum

Woodard & Curran

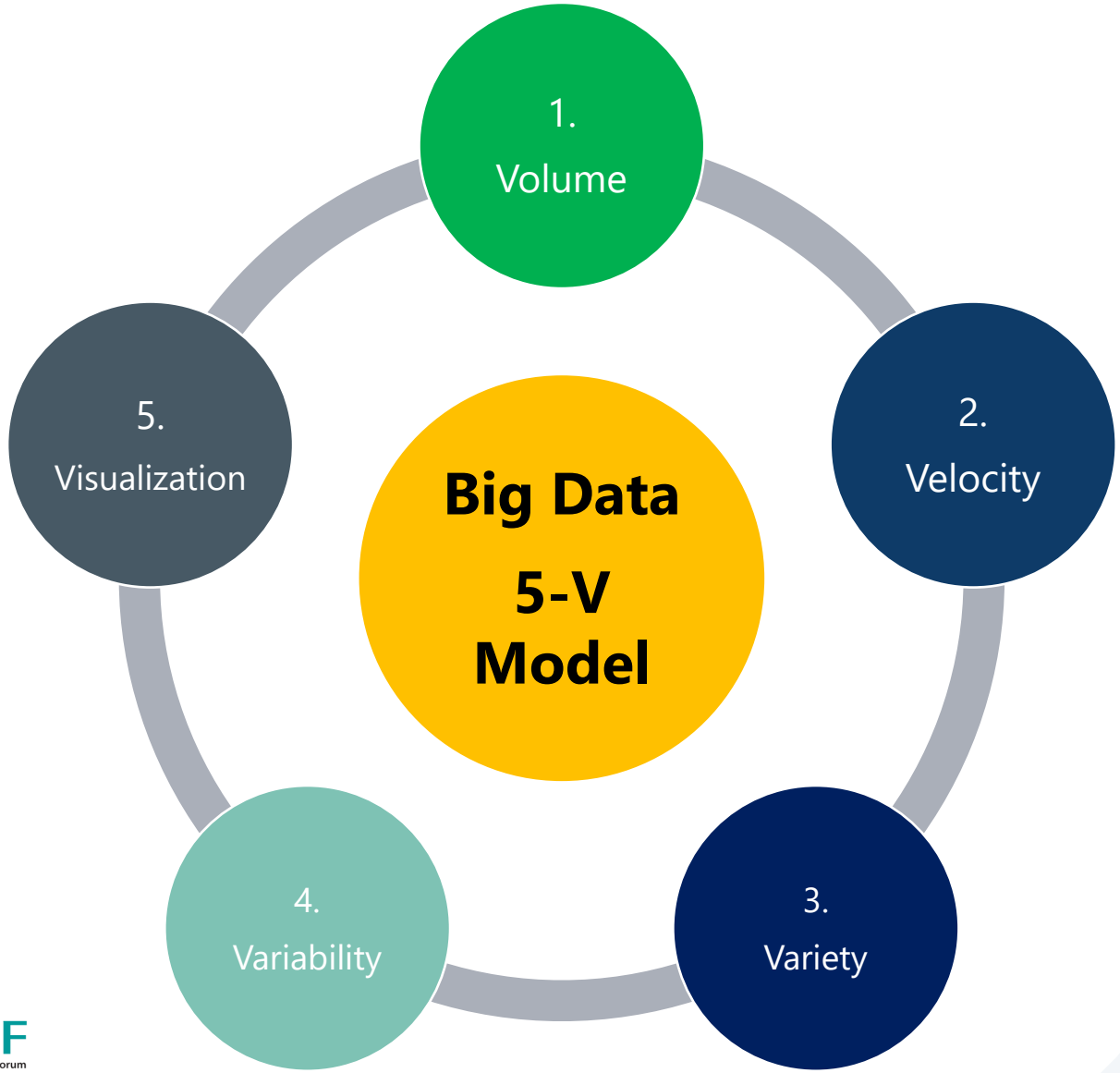


Advancing Data Driven Decisions is a Key Recommendation of CalGW 2020 (Bulletin 118)

Advance Data Driven Decisions

1. Strengthen and support long-term groundwater data collection programs at State, local, and regional levels …
2. Enhance SGMA reporting systems and align them with the Open and Transparent Water Data Act (AB 1755) …
3. Develop and enhance analysis methods, standards, and modeling tools …
4. Build upon B-118 legacy by collaborating with local agencies on the application of new technology and tools …

Groundwater Data has entered "Big Data" Era



GAMA Database:
290,000 wells
87 million analytical results

Water Data Library:
35,000 wells

CWEMF
California Water & Environmental Modeling Forum

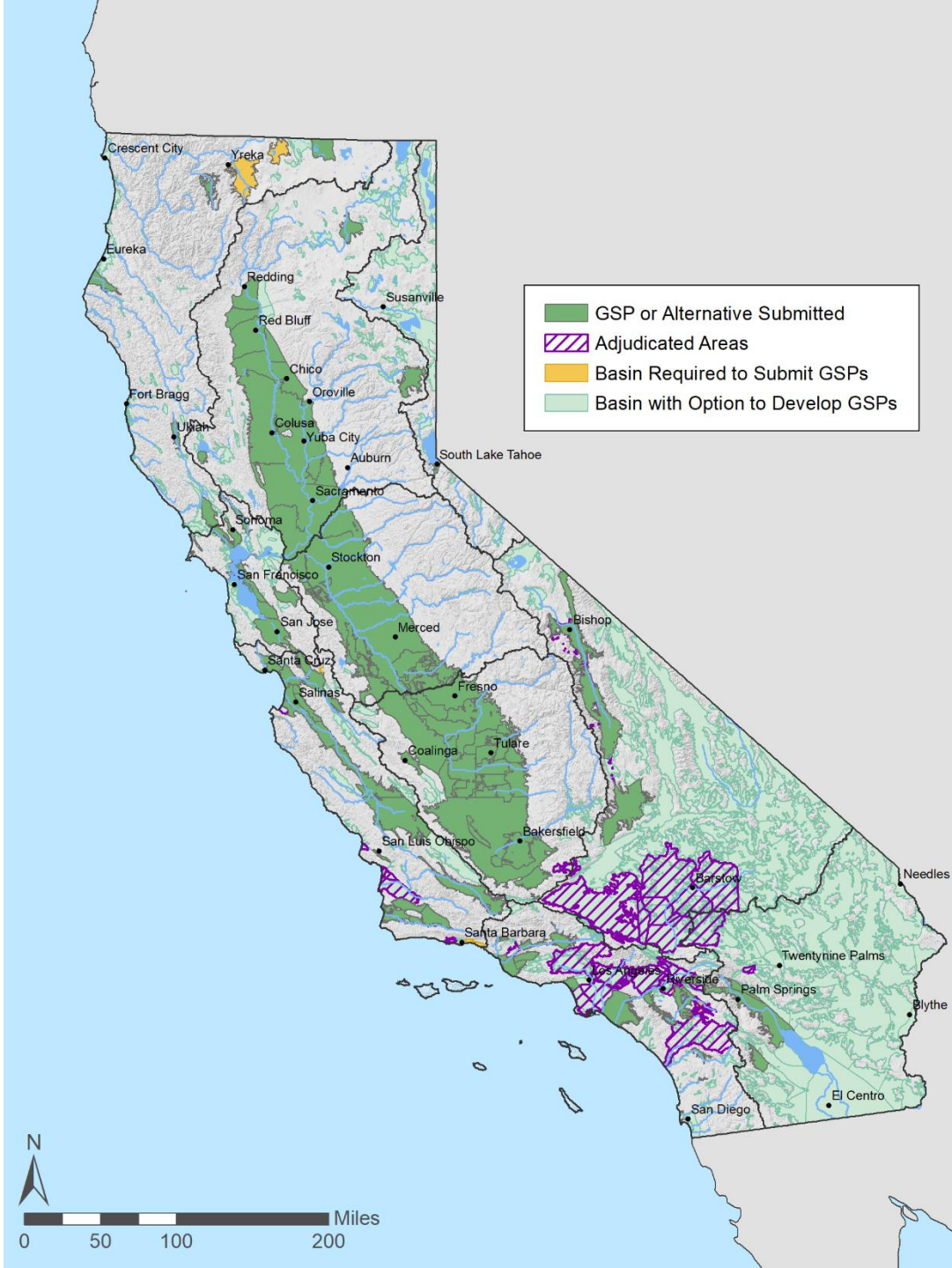
Woodard & Curran

Pre-SGMA: State of Groundwater Data

- Isolated/Siloed
- Infrequent reporting
- Inconsistency in reporting
- Various methods and standards

Local Agencies Driving Data Growth

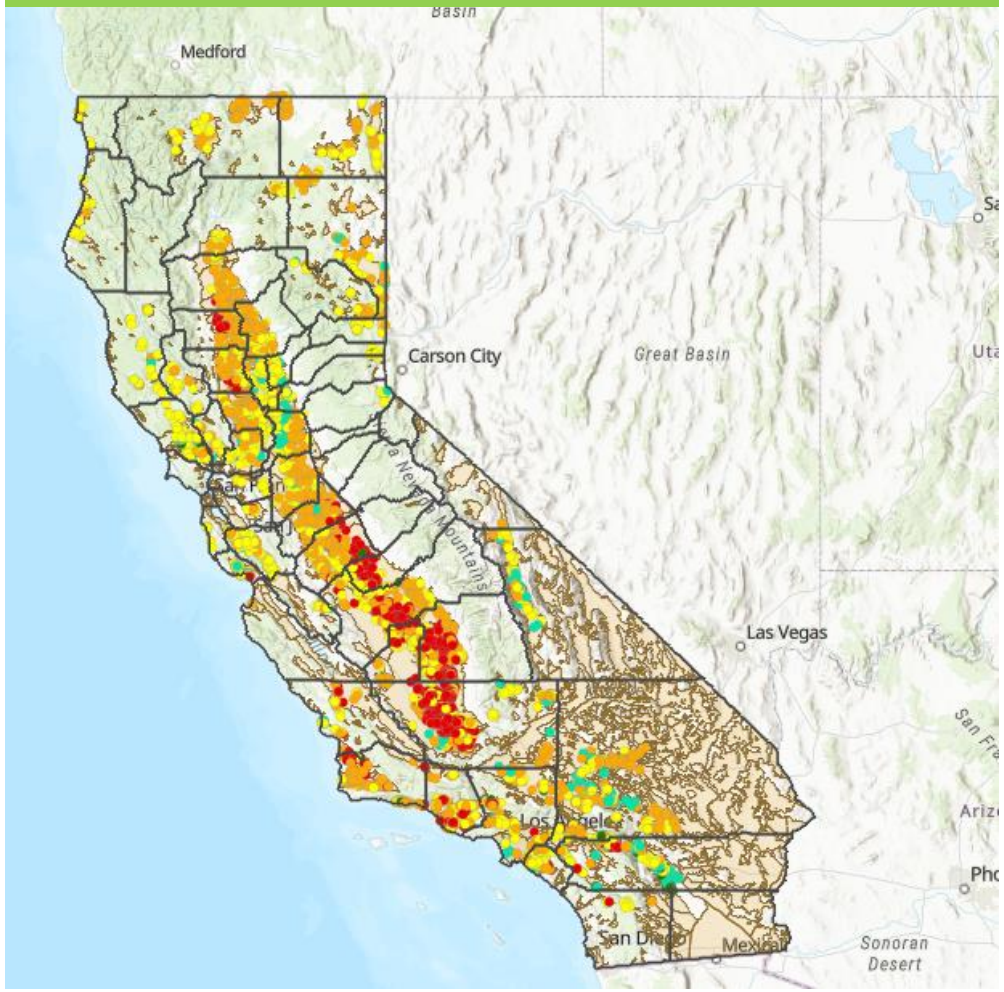
- Data from GSAs will cover significant portions of the state
- 98% of groundwater use covered by a GSP or adjudication



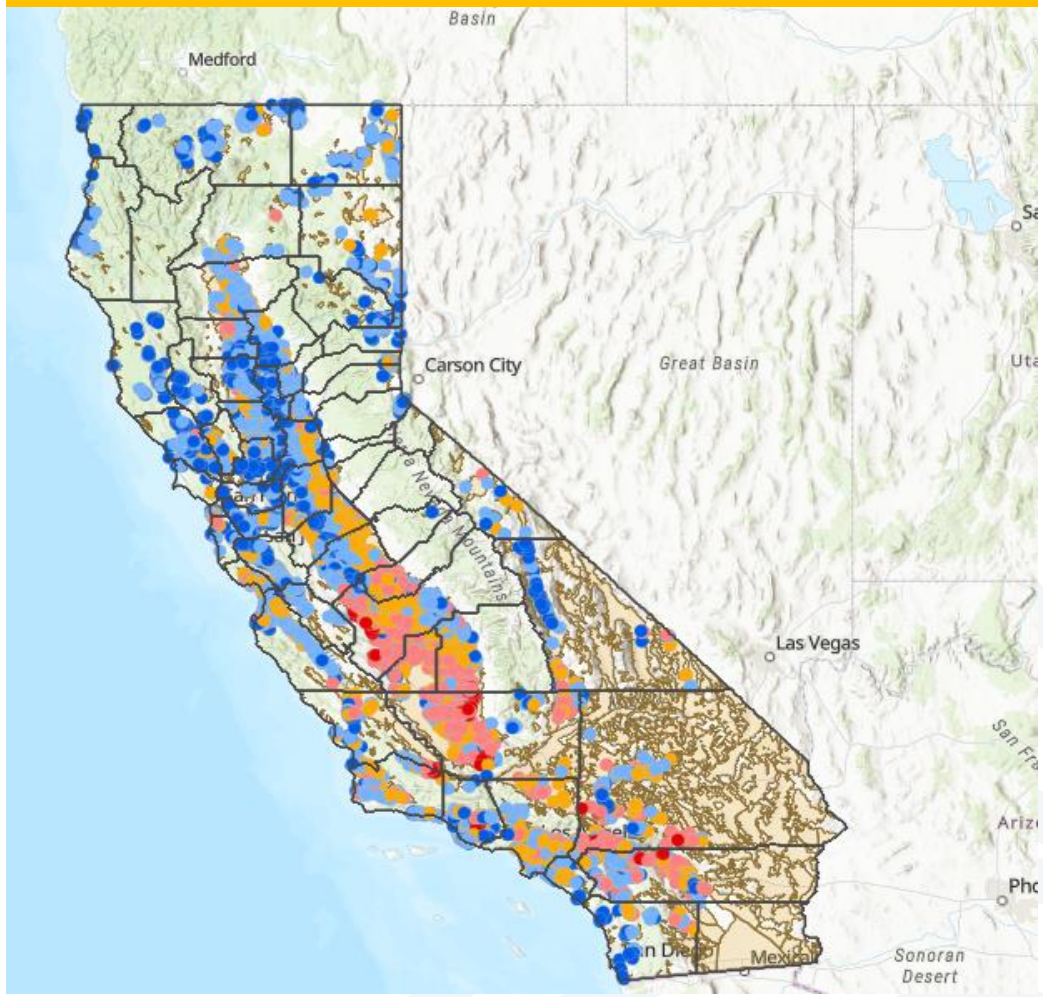
CWEMF
California Water & Environmental Modeling Forum

Volume and Velocity have Increased

4,800 Wells with GW Level Data for past 20 years



8,400 Wells with GW Level data in past 18 months



Variety has Also Increased

Figure 5-1 Groundwater Level Monitoring Wells by Monitoring Program (2015–2018)

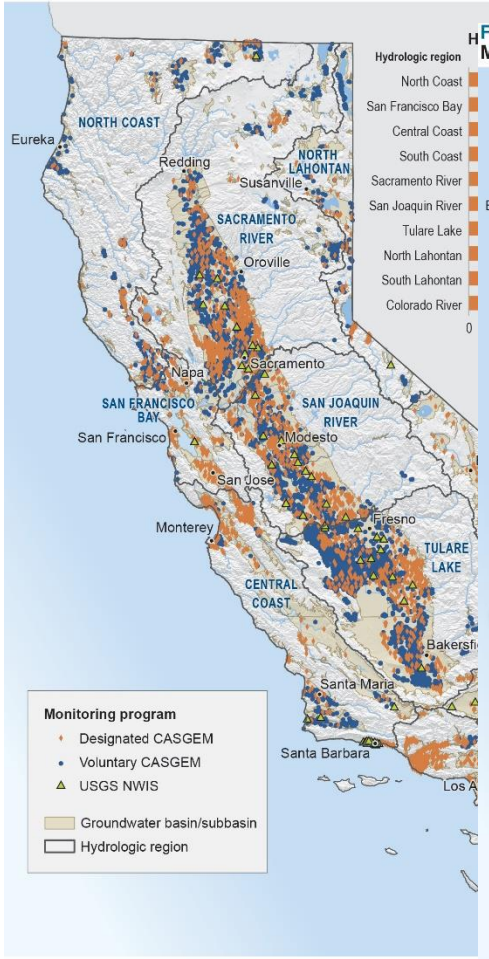


Figure 5-6 Groundwater Quality Monitoring Stations in the Groundwater Ambient Monitoring Assessment (GAMA) Database (as of July 2020)

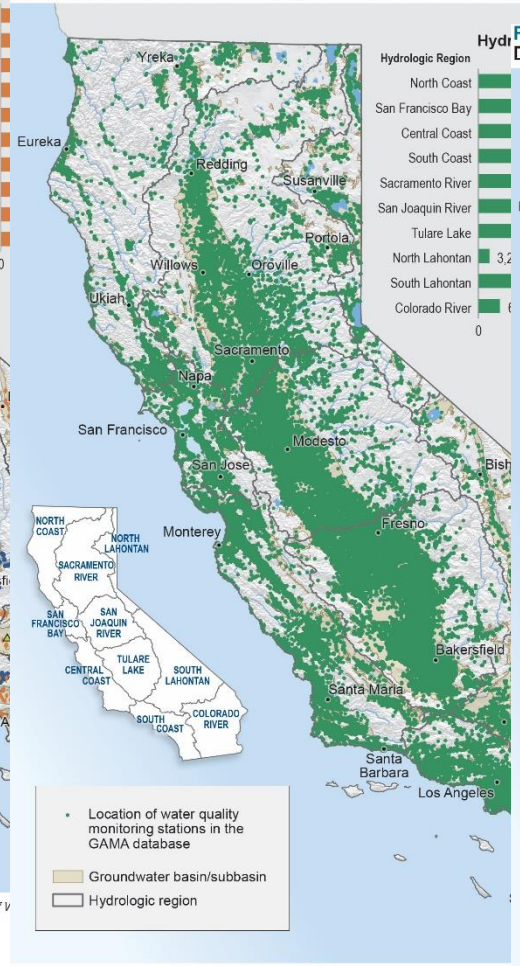


Figure 5-7 Distribution of Continuous GPS Stations, Borehole Extensometers, InSAR Data Coverage, and Regional Subsidence Networks

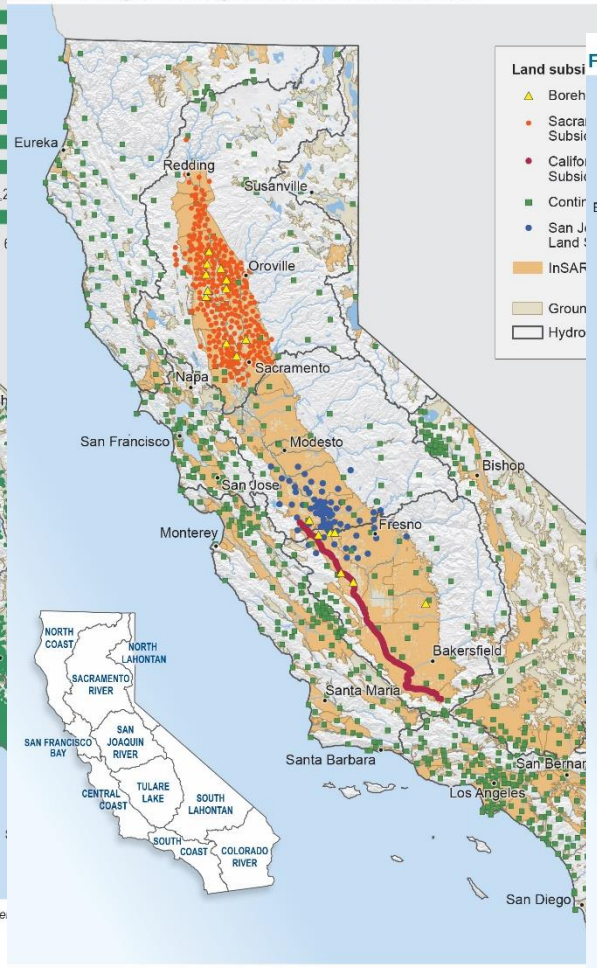
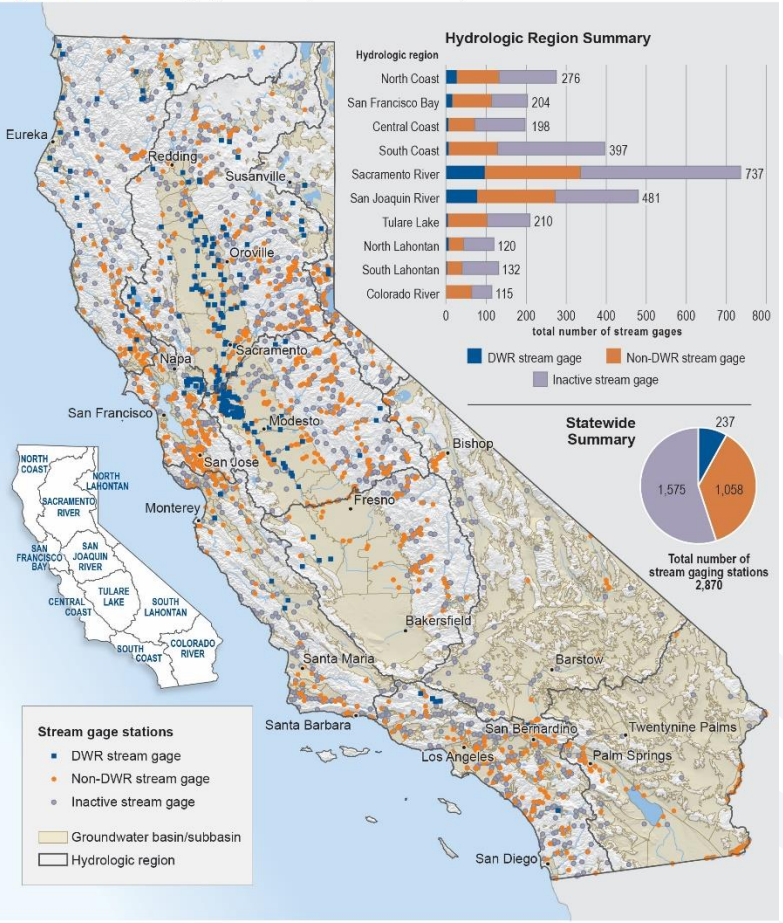


Figure 5-8 Stream Gaging Stations (as of March 2020)

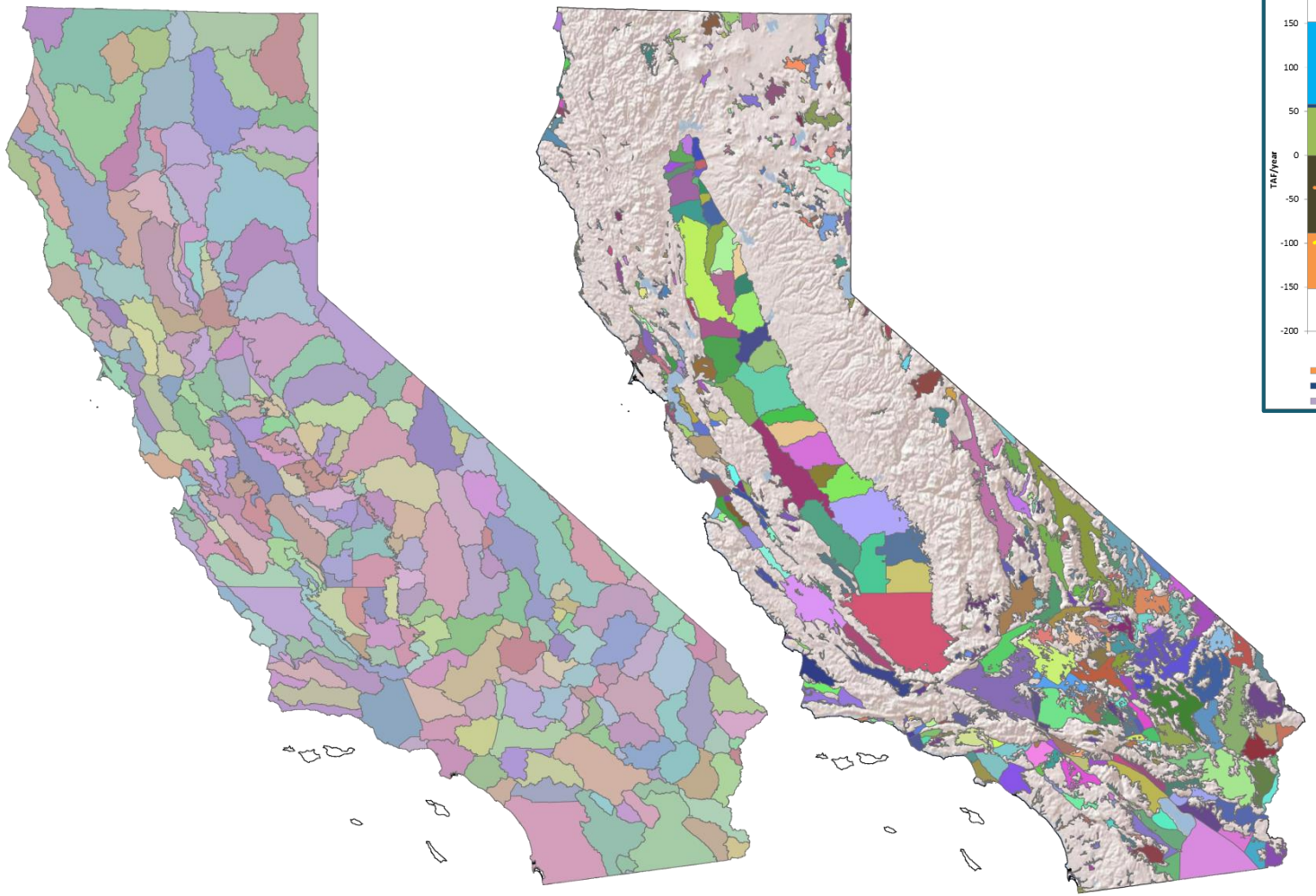


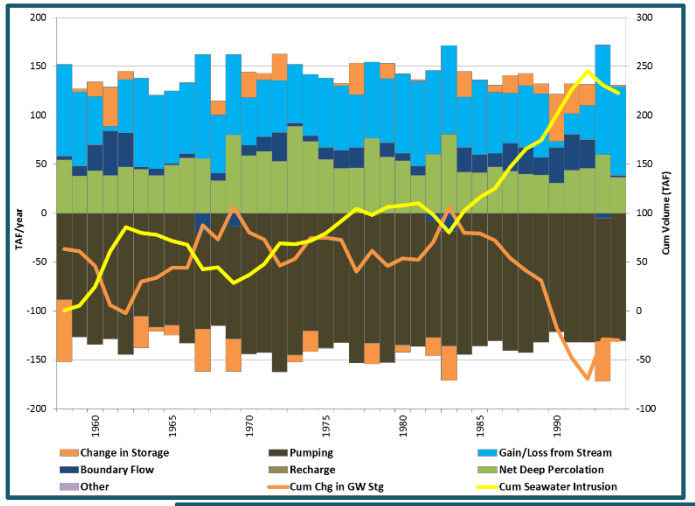
CWEMF
California Water & Environmental Modeling Forum

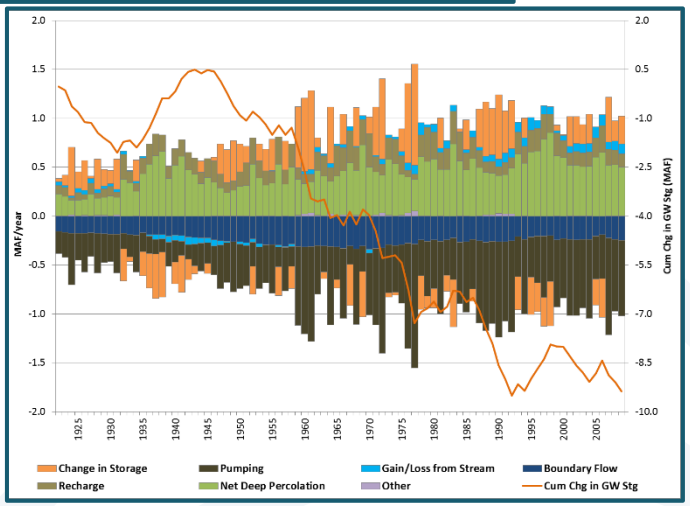
Variability has Multiplied: Spatial and Temporal

479 DAUs

515 Groundwater Basins







CWEMF
California Water & Environmental Modeling Forum

Woodard & Curran

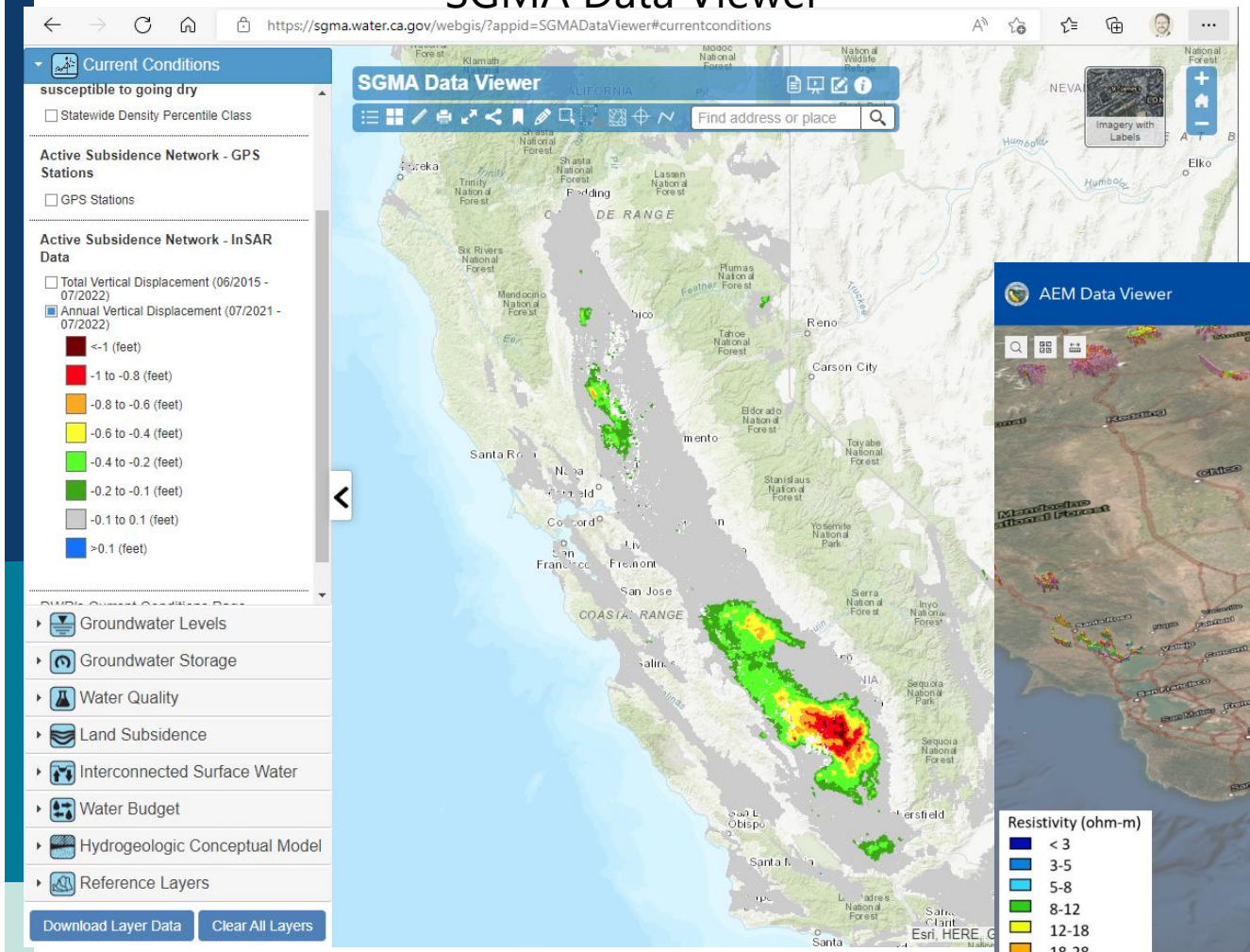
Model Enhancement Adding to Spatial Variability

CWEMF
California Water & Environmental Modeling Forum

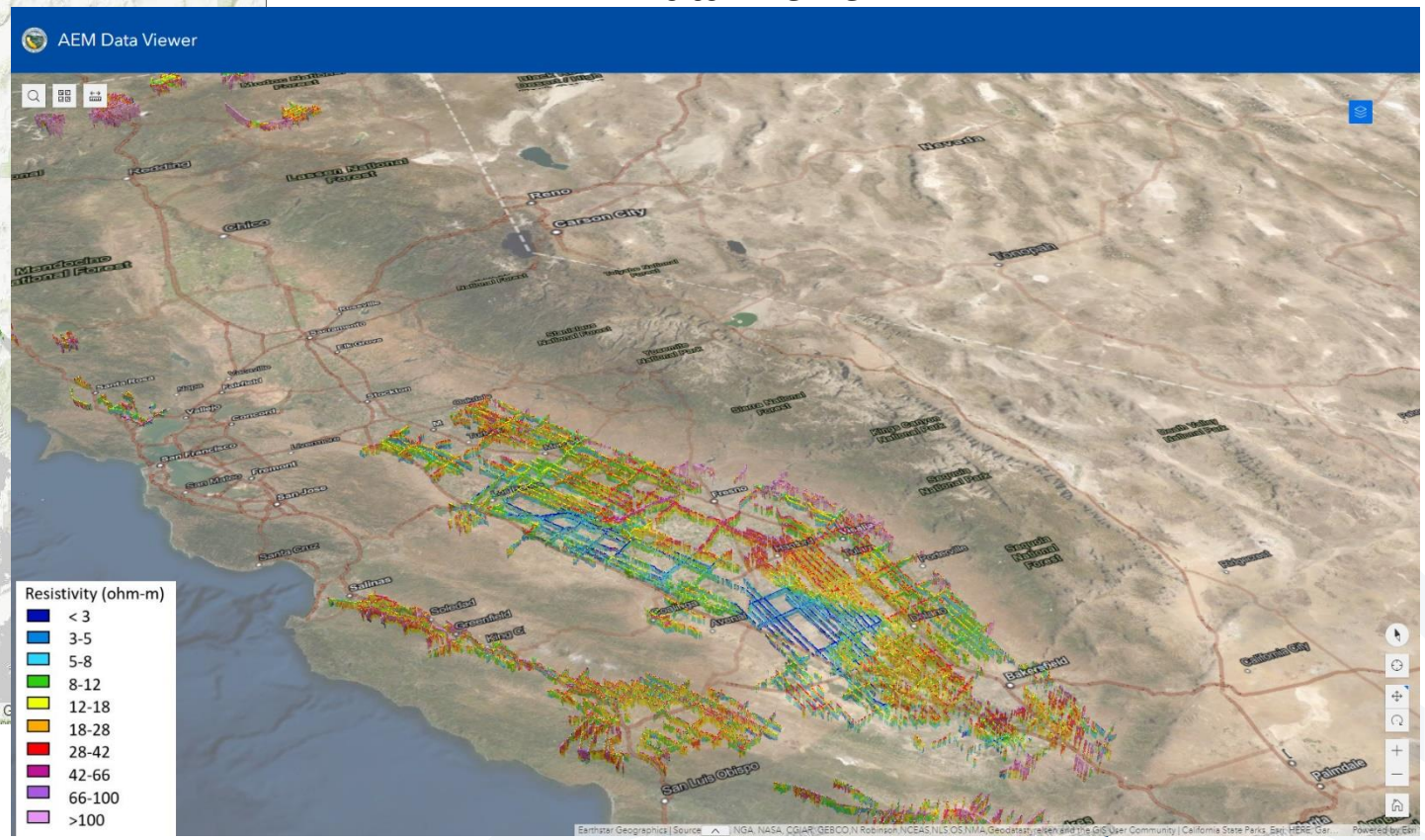
Woodard & Curran

Visualization has Enabled Complex Analysis

SGMA Data Viewer

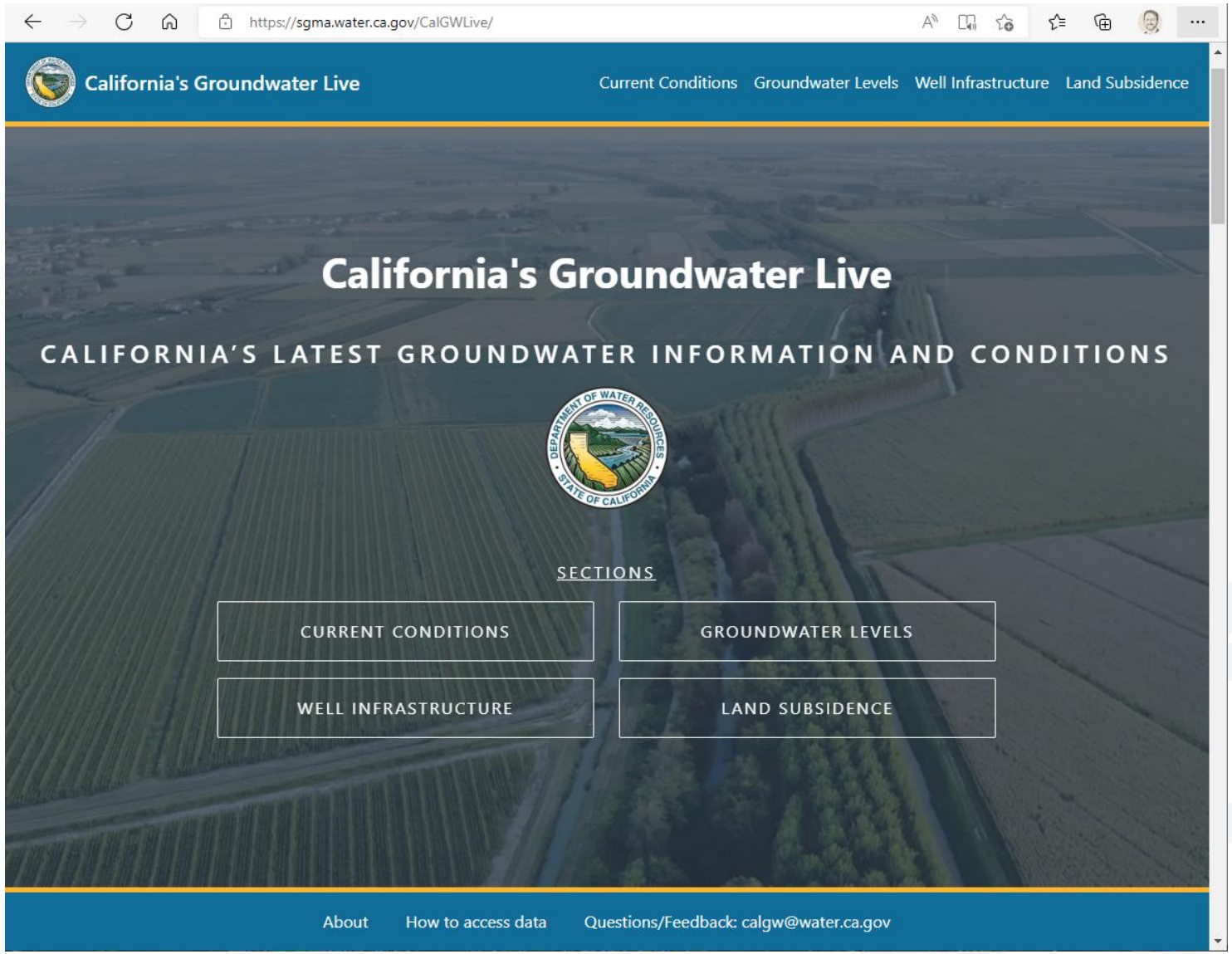


AEM Data Viewer

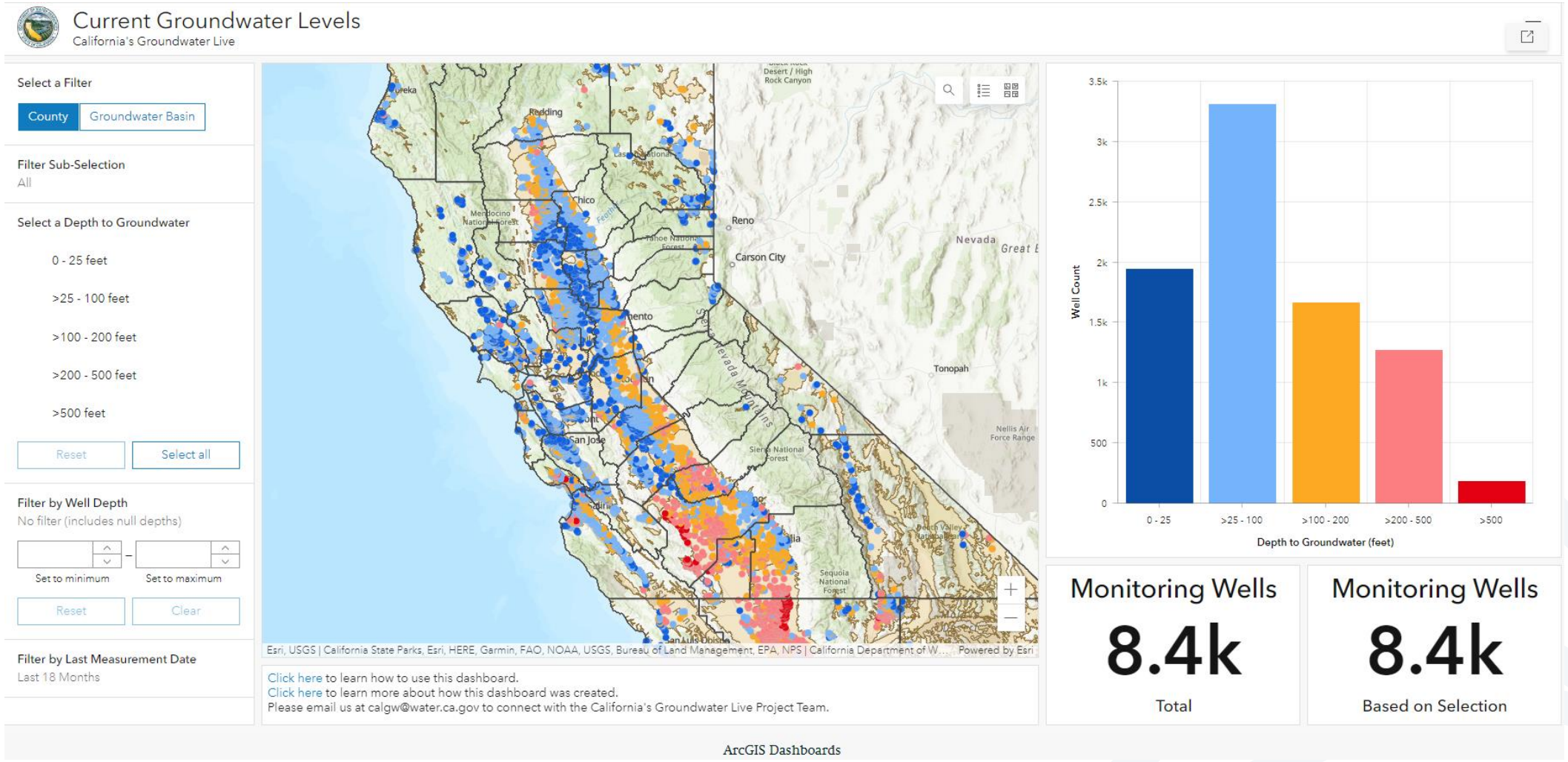


CWEMF
California Water & Environmental Modeling Forum

New Tools: Real-time Data Visualization



New Tools: Real-time Data Visualization

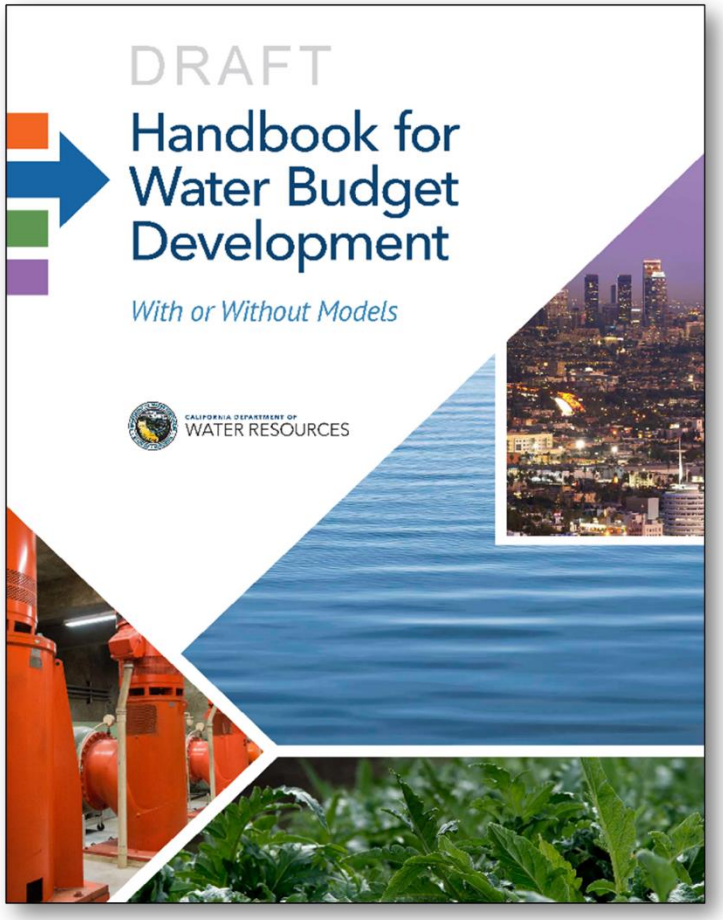


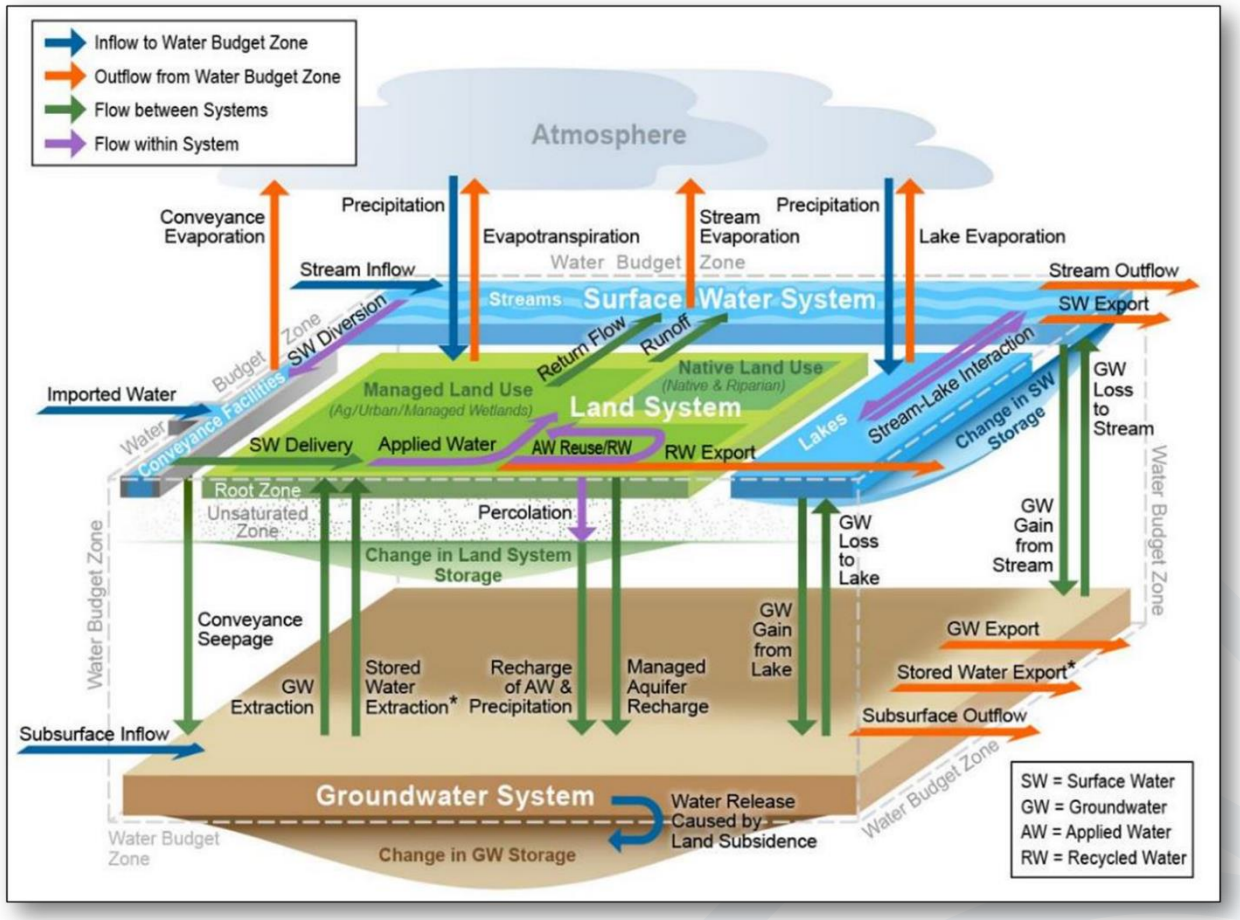
CWEMF
California Water & Environmental Modeling Forum

Woodard & Curran

New Handbook: Data Ingestion

Established Common Vocabulary, Water Budget Framework, and Standard Templates



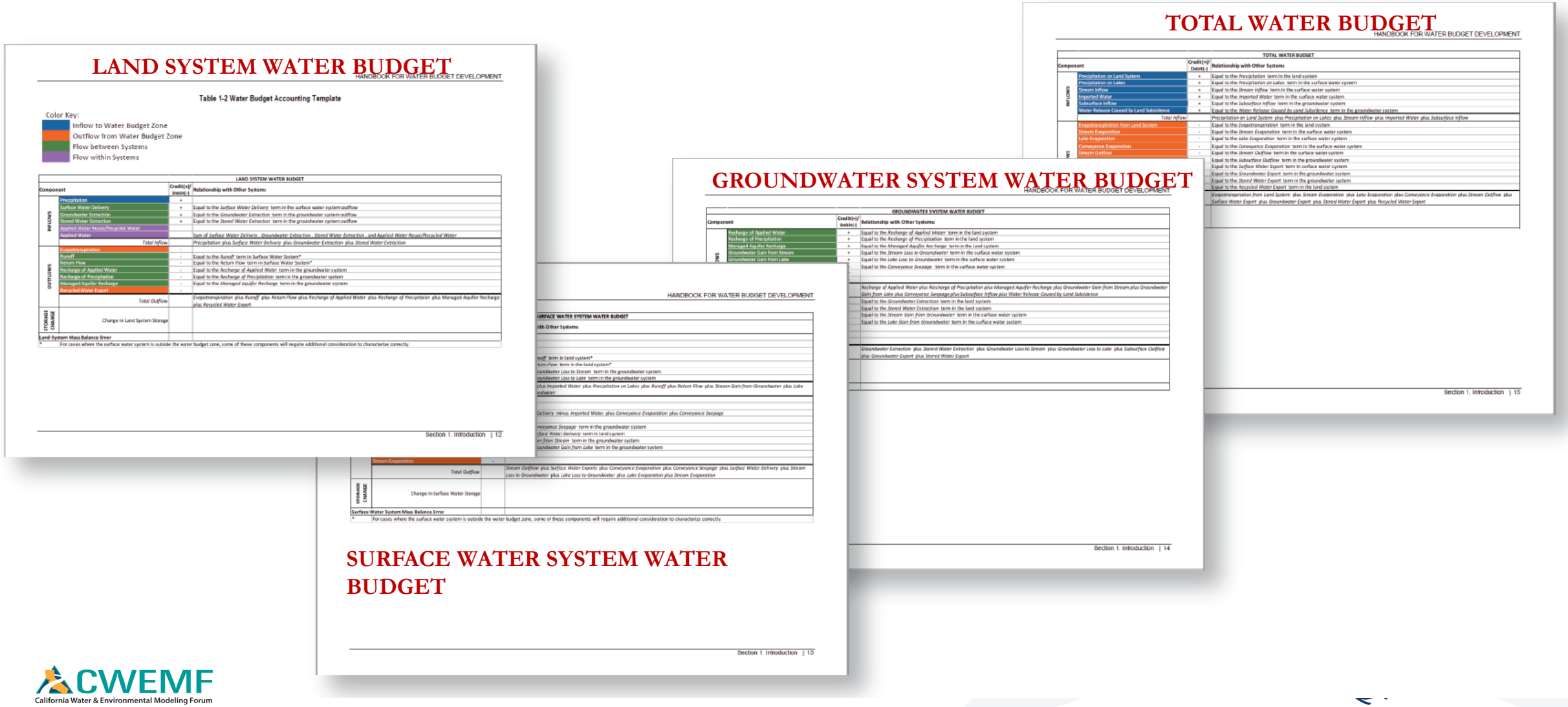


CWEMF
California Water & Environmental Modeling Forum

Woodard & Curran

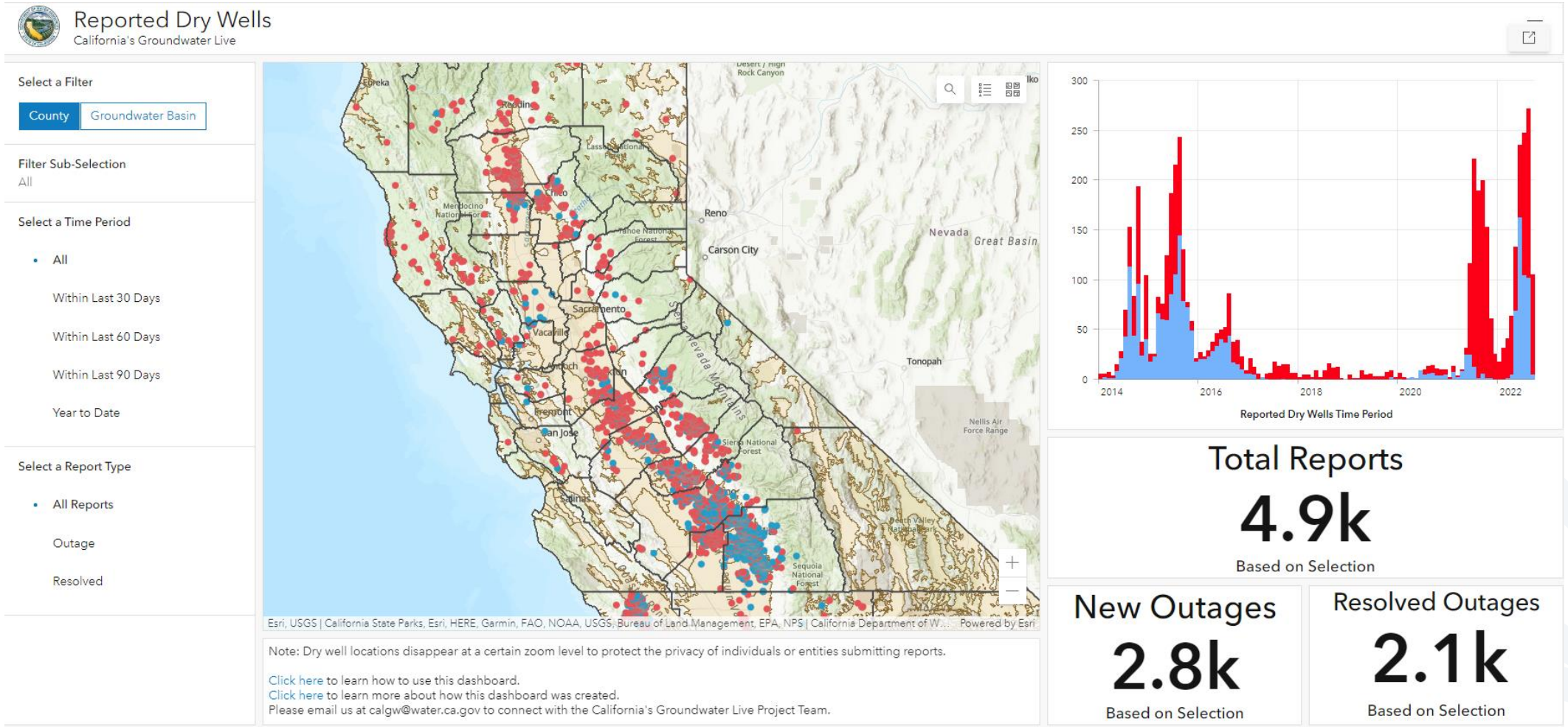
New Handbook: Data Ingestion

Established Common Vocabulary, Water Budget Framework, and Standard Templates



CWEMF
California Water & Environmental Modeling Forum

New Data and Tools:
Drought Response and Preparedness



CWEMF
California Water & Environmental Modeling Forum

Woodard & Curran

New Data and Tools:
Drought Response and Preparedness

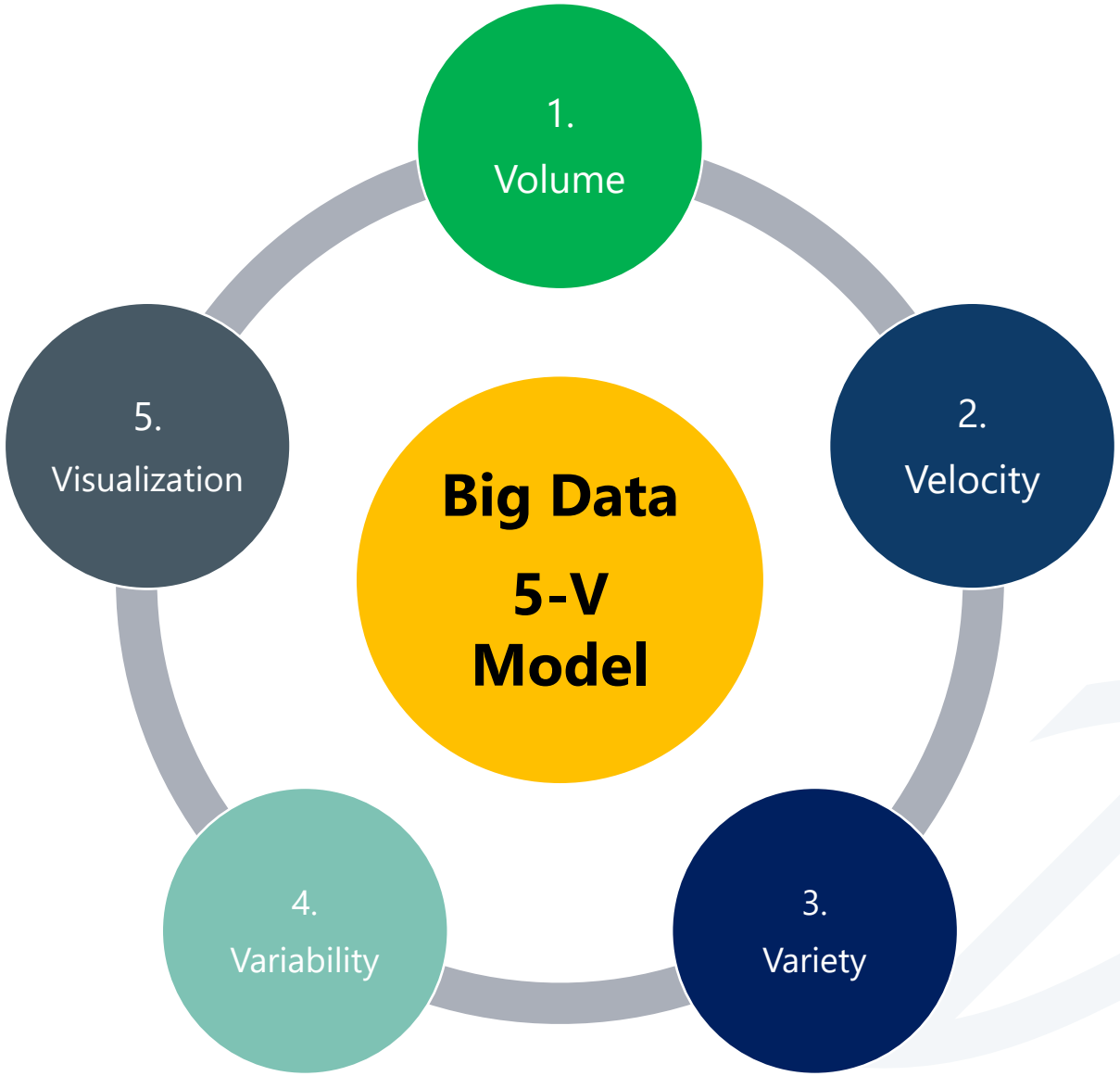
Dry Well Susceptibility Dashboard

CWEMF California Water & Environmental Modeling Forum

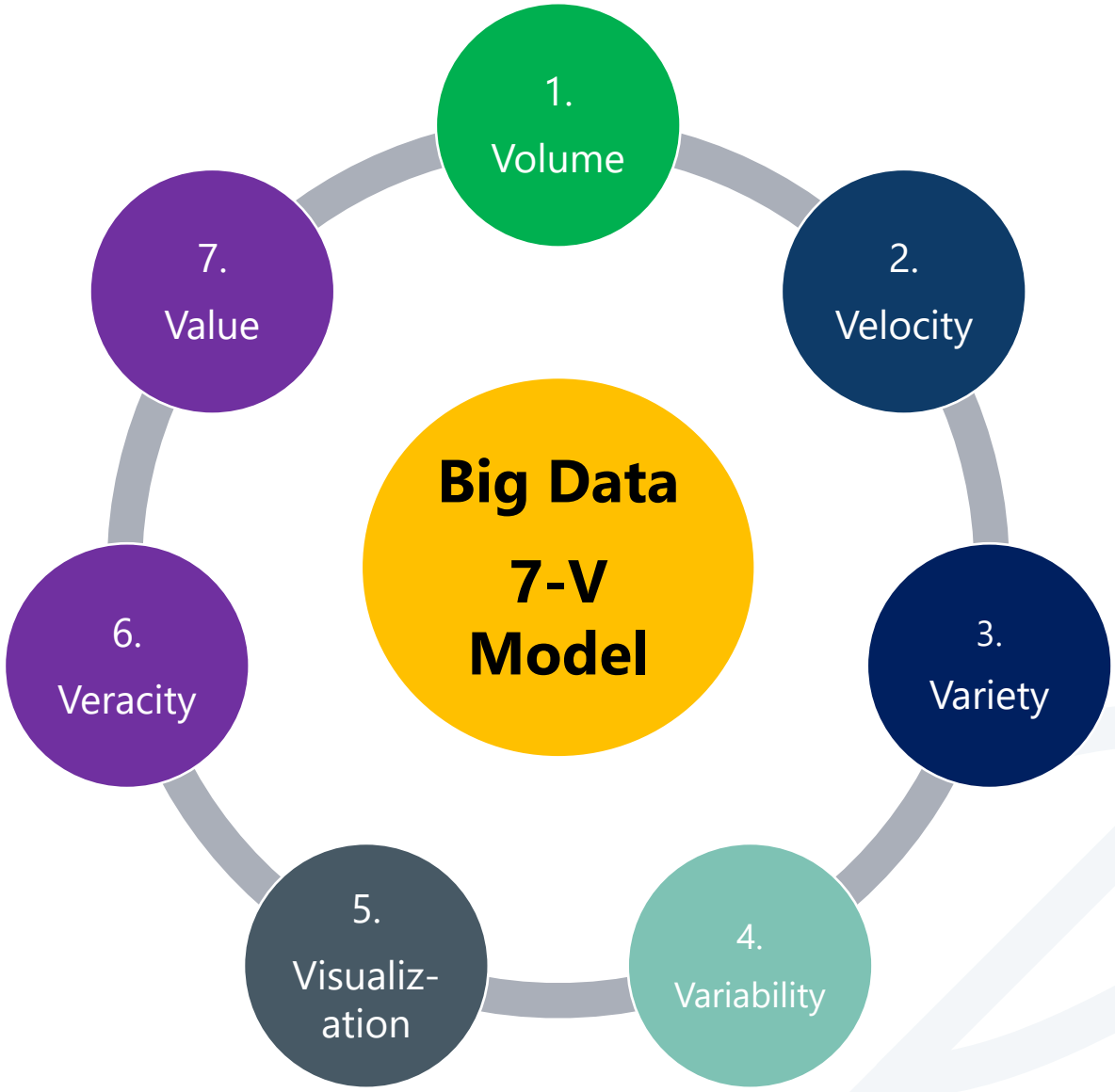
Woodard & Curran

Using Data to Solve Problems

Big Data Journey from 5-V Model to 7-V Model



Big Data Journey from 5-V Model to 7-V Model



Hype or Hope?!

Forbes Feb 8, 2019, 06:00am EST

CRYPTO & BLOCKCHAIN

IBM Pilots Blockchain and IoT Sensor Solution To Track Sustainable Groundwater Usage In California

Colorado senator wants to study blockchain for water rights management

March 7, 2019 - 10:41 am

Front. Environ. Sci., 15 June 2022
Sec. Water and Wastewater Management
https://doi.org/10.3389/fenvs.2022.909606

A Framework of Blockchain Technology in Intelligent Water Management

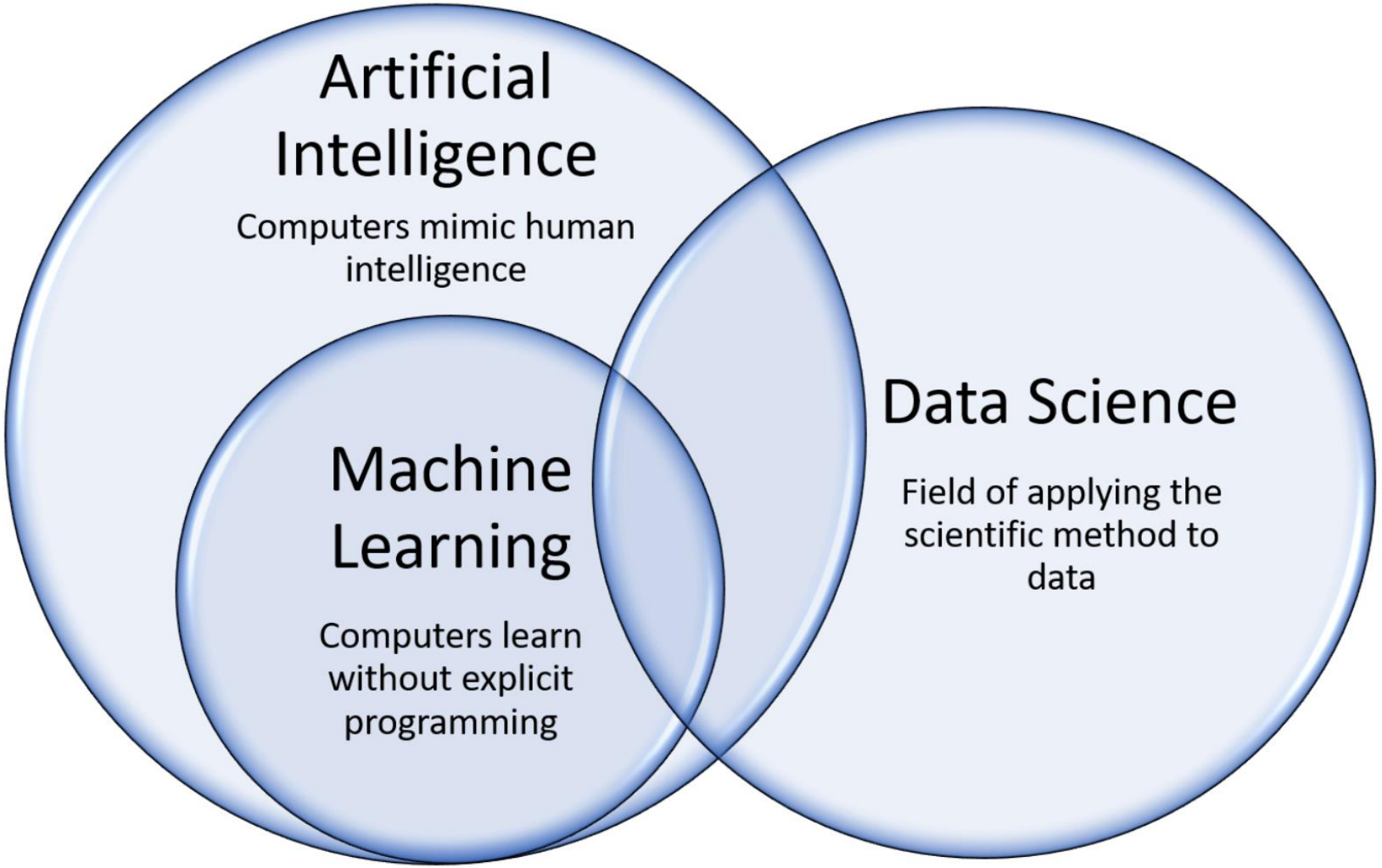
Special issue: Recent advances in drought and water scarcity monitoring,...

Research article | 03 Dec 2021

Applying machine learning for drought prediction in a perfect model framework using data from a large ensemble of climate simulations

Elizaveta Felsche and Ralf Ludwig
Show author details

New Tools for Handling Big Data:
AI, Machine Learning, and Data Science



Applications of Big Data Tools in Groundwater

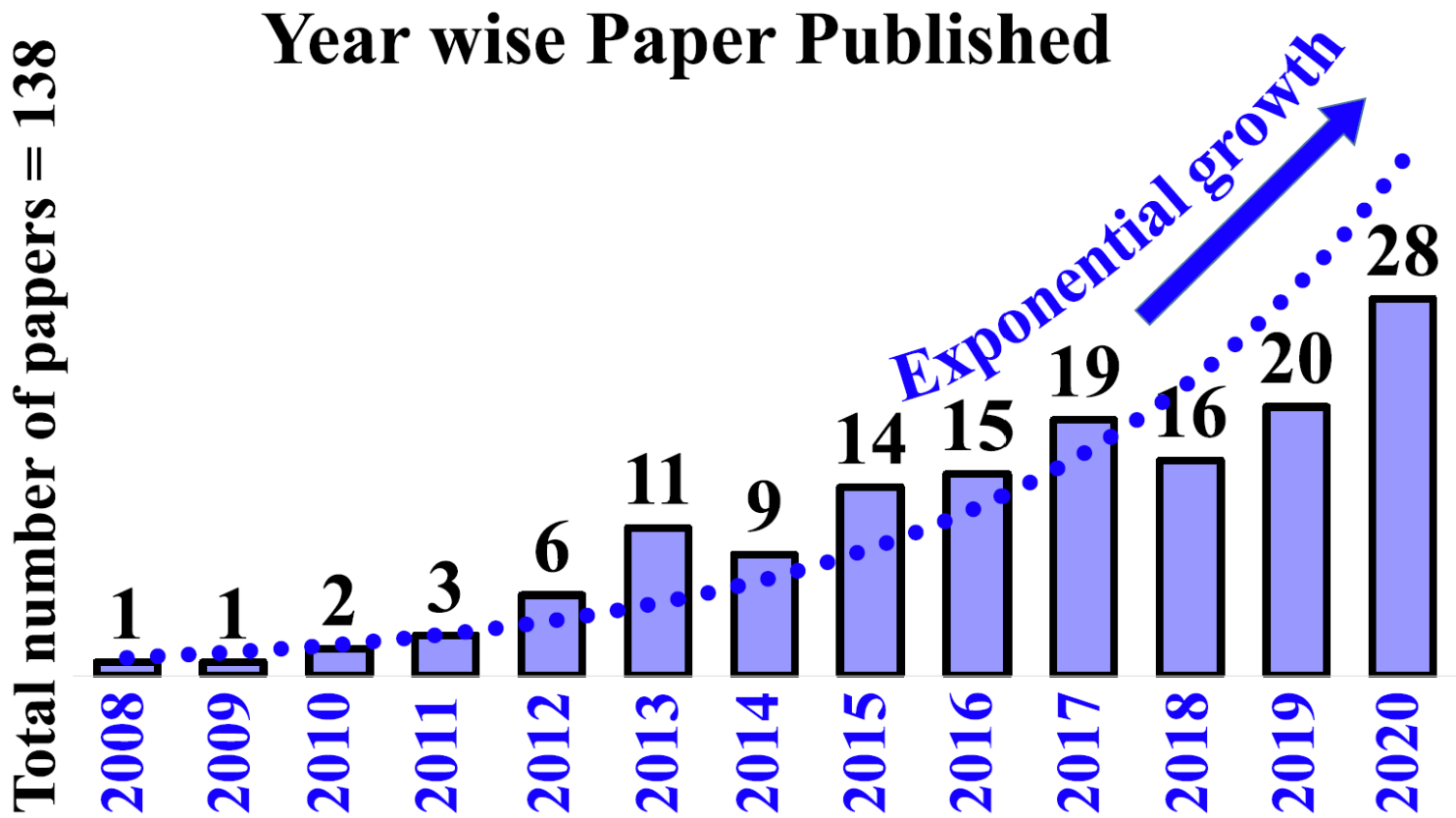


Fig. 2. Arithmetical conceptualization of growth observed in GWL research using AI based model during 2008–2020.

Science News *from research organizations*

Big data offers promise of better groundwater management in California

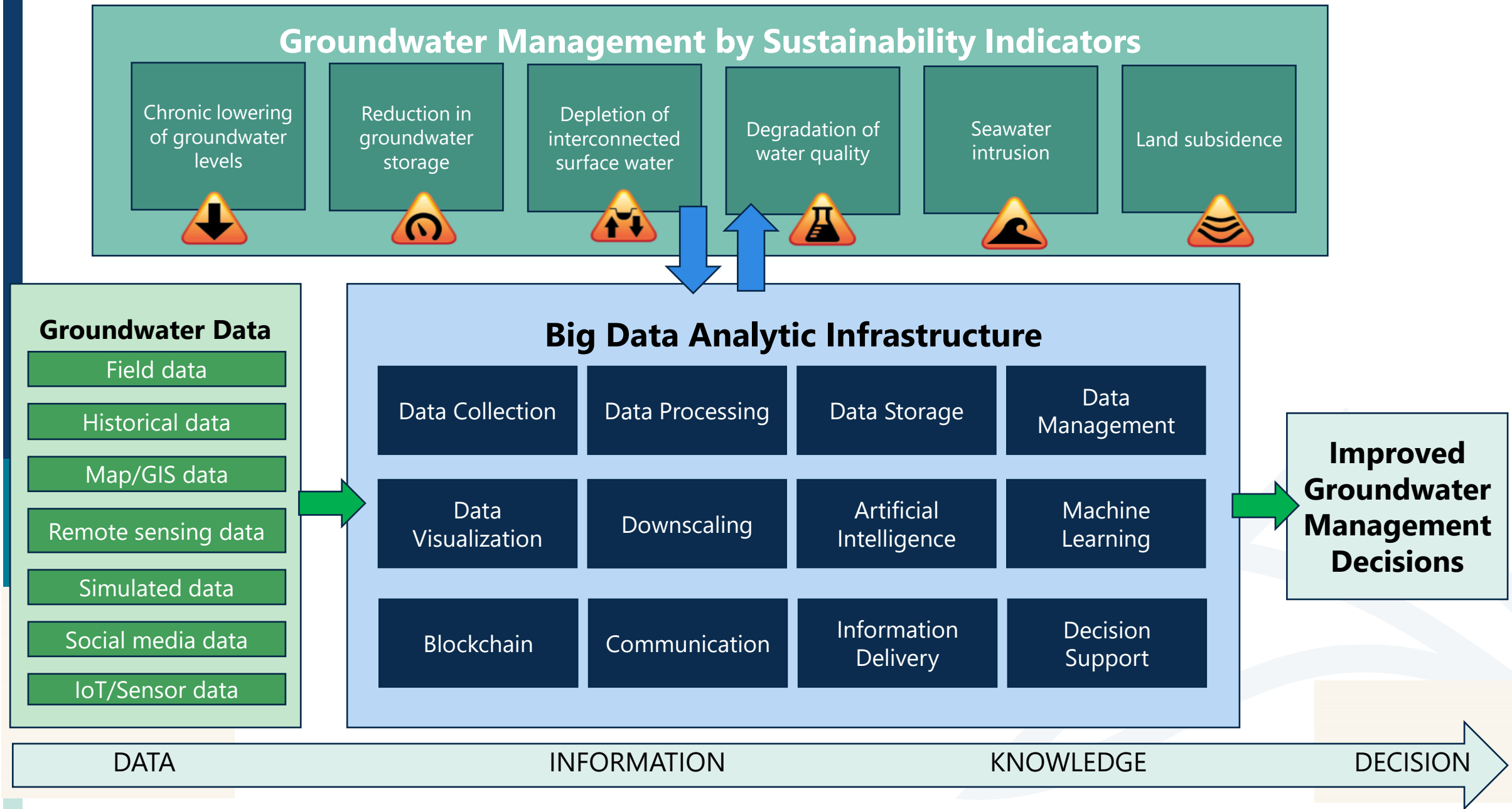
Analysis of 200,000 groundwater samples reveals major mismatch in California groundwater data

Date: December 9, 2020

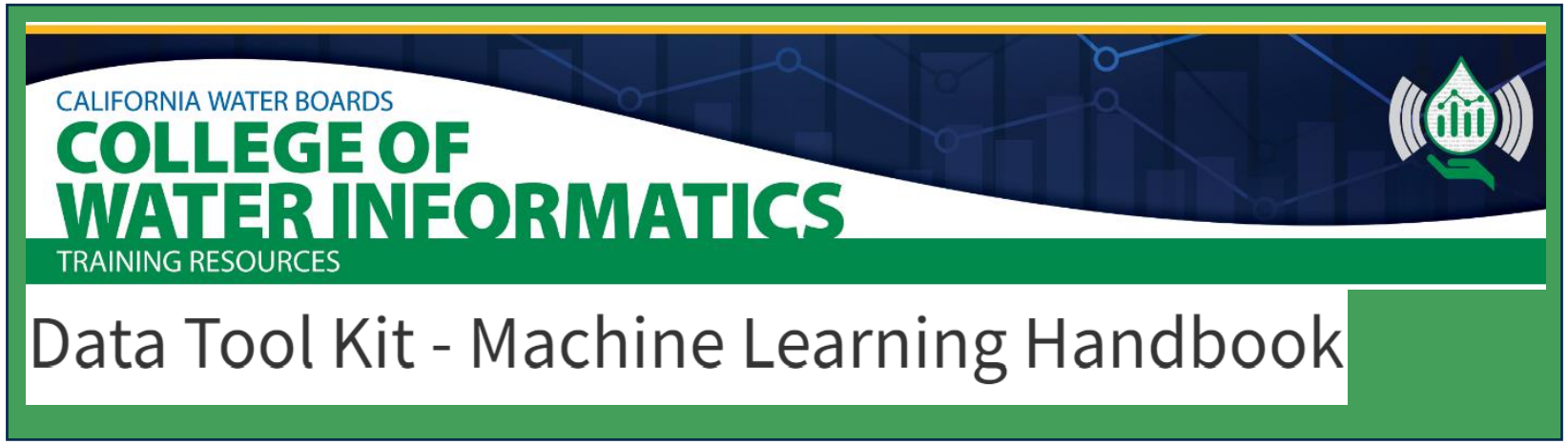
Source: McGill University

Summary: A research team has analyzed big data of more than 200,000 groundwater samples taken from across the state and found that there are problems with the guidelines used for groundwater management. Known as the 'Base of Fresh Water', the guidelines are close to fifty years old and don't reflect current uses, knowledge, concerns or technologies related to managing groundwater in this coastal state with a multi-billion-dollar agricultural industry.

A Theoretical Framework for Big Data in Groundwater

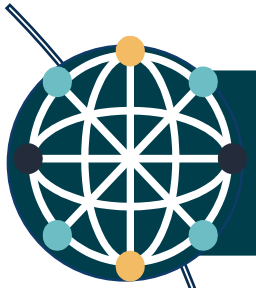


Capacity Building: Skills are Necessary



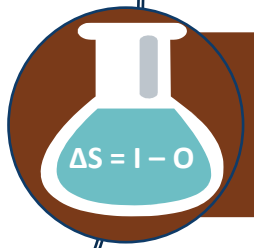
The Value Proposition

A Vision for the Future: From Extraction to Stewardship



California's water data is integrated and accessible to all to support decision making for long-term resiliency and sustainability

California's suite of water models and tools use data from the same source and provide the output to the same source for use by state, local, and federal agencies, and stakeholders



Water budgets are developed and used for long-term planning, drought resiliency, and water marketing using common vocabulary and integrated sources of data and suite of models

Decision making is supported by a reliable and robust data/information base that is up-to-date

Woodard & Curran

Thank You!

Saquib Najmus
Senior Technical Leader
snajmus@woodardcurran.com
916-806-8360

woodardcurran.com