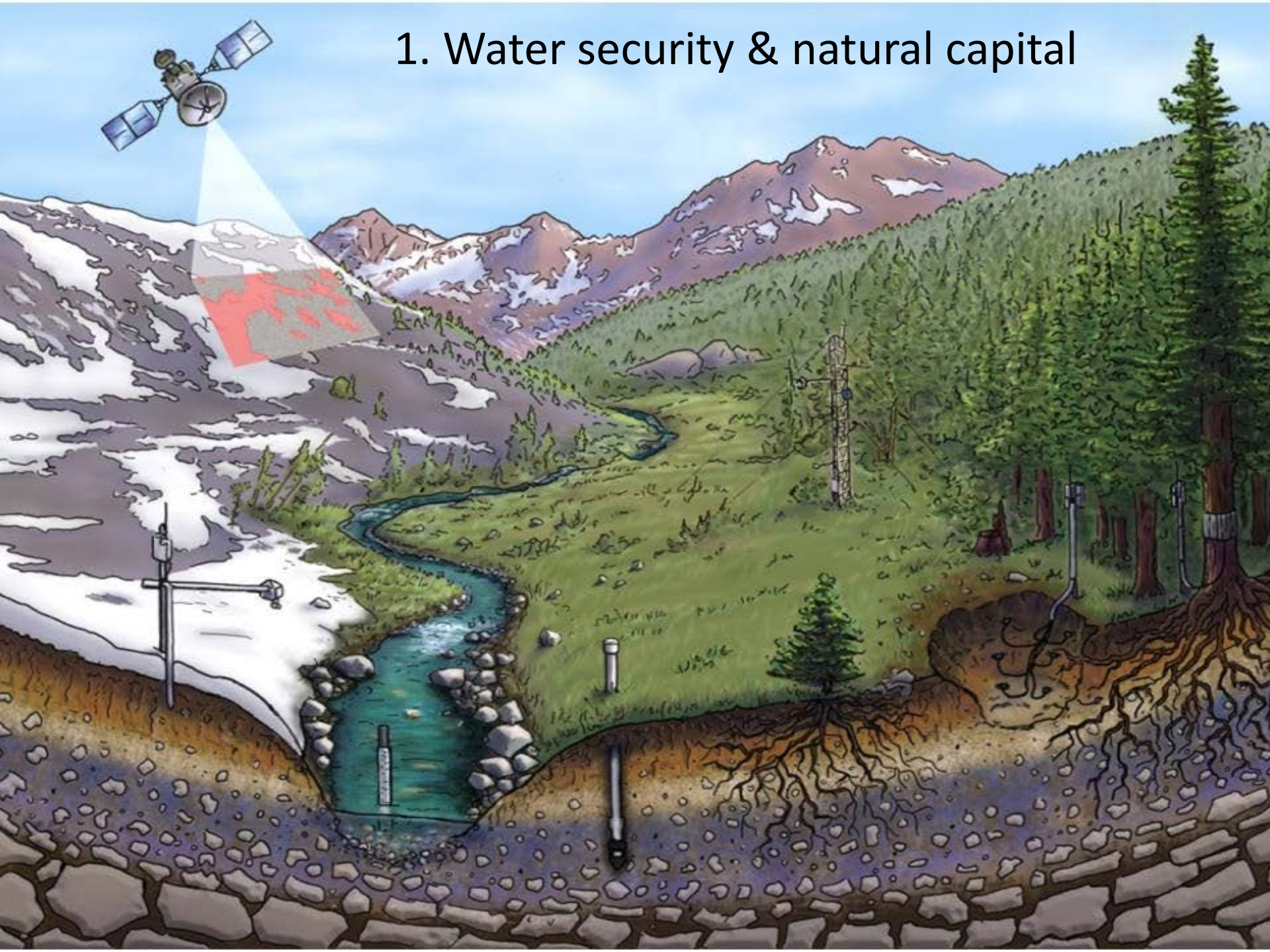
Enhancing California's water security through better water information

Roger Bales
Sierra Nevada Research Institute, UC Merced

1. Water security & natural capital
2. Water information opportunities
3. American River Hydrologic Observatory

1. Water security & natural capital



Making a water-secure world – the three I's

INFRASTRUCTURE
to store, transport
& treat water

HARD

Stronger & more-
adaptable
INSTITUTIONS

SOFT

Water security lies at the heart of adaptation to climate change.

Better & more-
accessible
INFORMATION

<u>Water security</u>: the reliable availability of an acceptable quantity & quality of water for health, livelihoods & production, coupled w/ an acceptable level of water-related risks

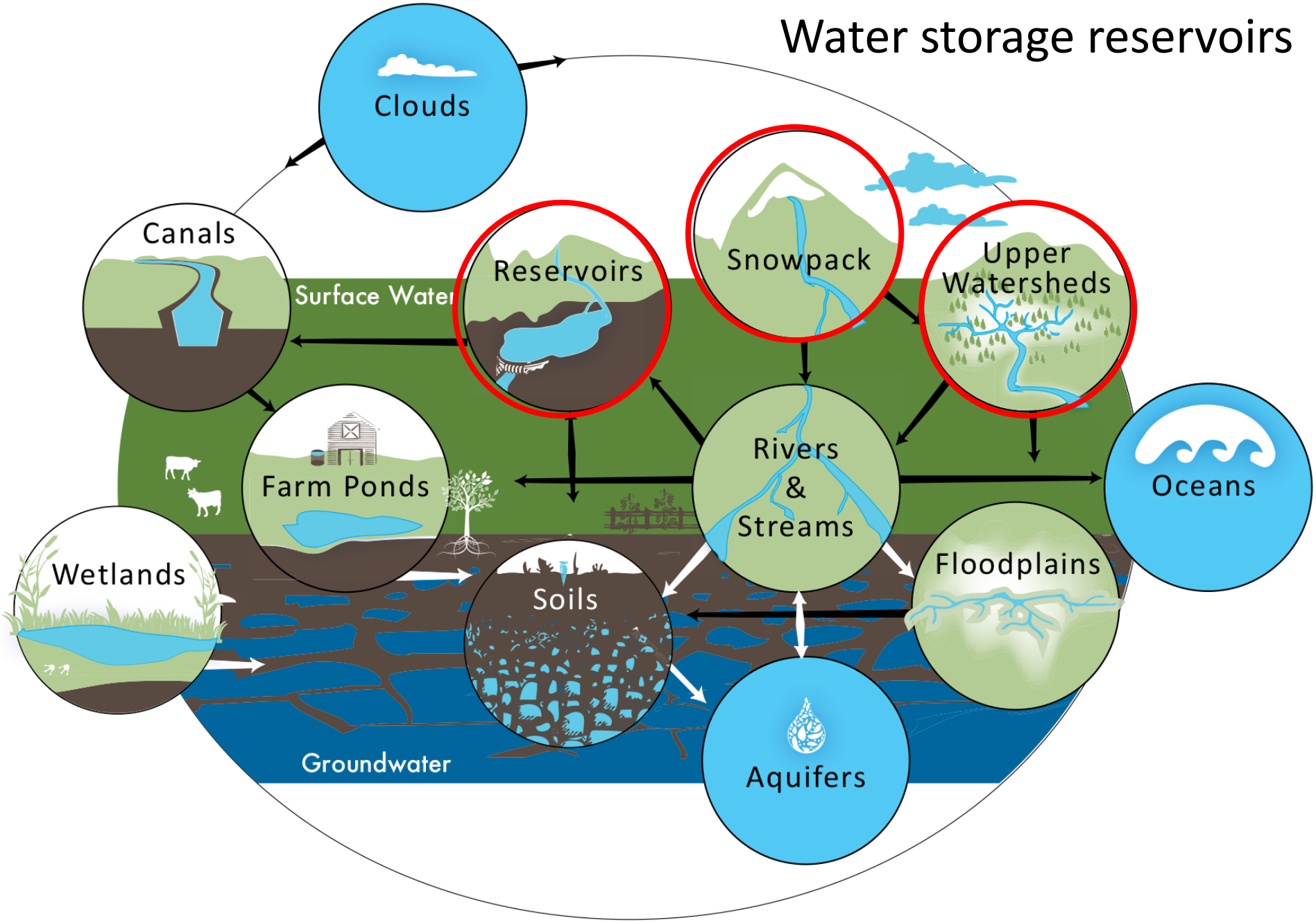
Infrastructure

Actions for reliability, restoration and resilience

The bottom line is that we need to expand our state's storage capacity, whether surface or groundwater, whether big or small. Today, we need more storage to deal with the effects of drought and climate change on water supplies for both human and ecosystem needs. Climate change will bring more frequent drought conditions and could reduce by half our largest natural storage system—the Sierra snowpack—as more precipitation falls as rain rather than snow, and as snow melts earlier and more rapidly.

California Water Action Plan, 2014

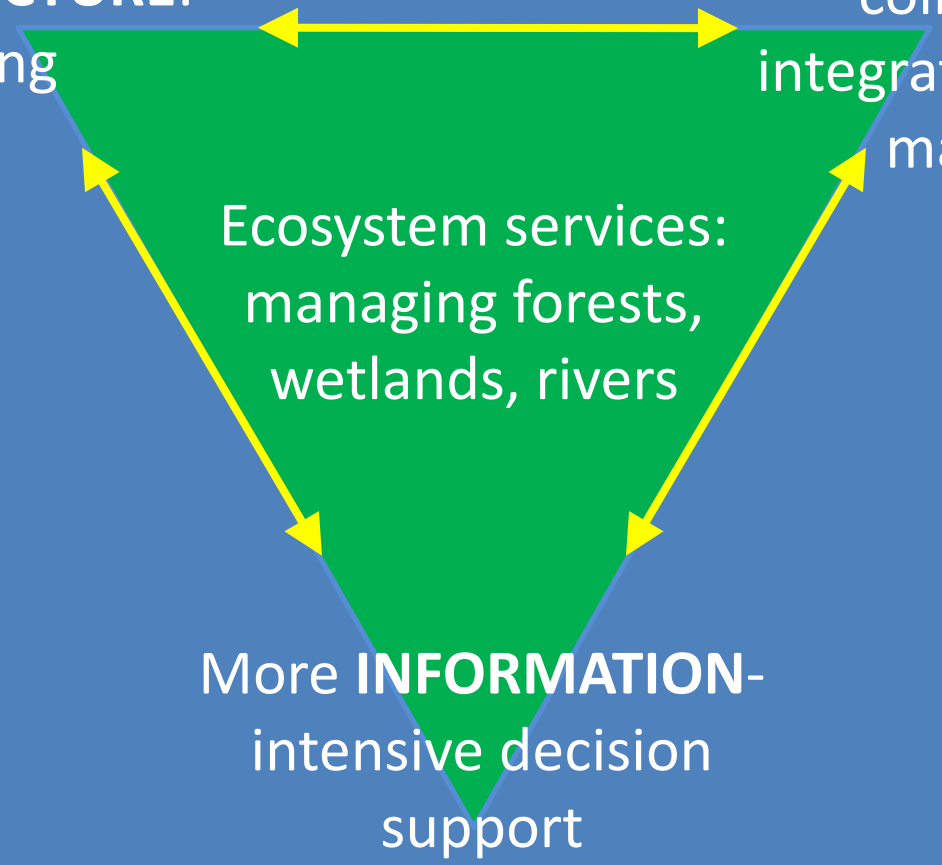
Water storage reservoirs



Water security: from storage to retention

Comprehensive, timely, accurate, accessible, and transparent data and resulting information about our water resources is an essential foundation for effectively managing water storage in California.

Making a water-secure California



Water management translates into managing ecosystem services. Adapting to climate change also means managing ecosystem services.

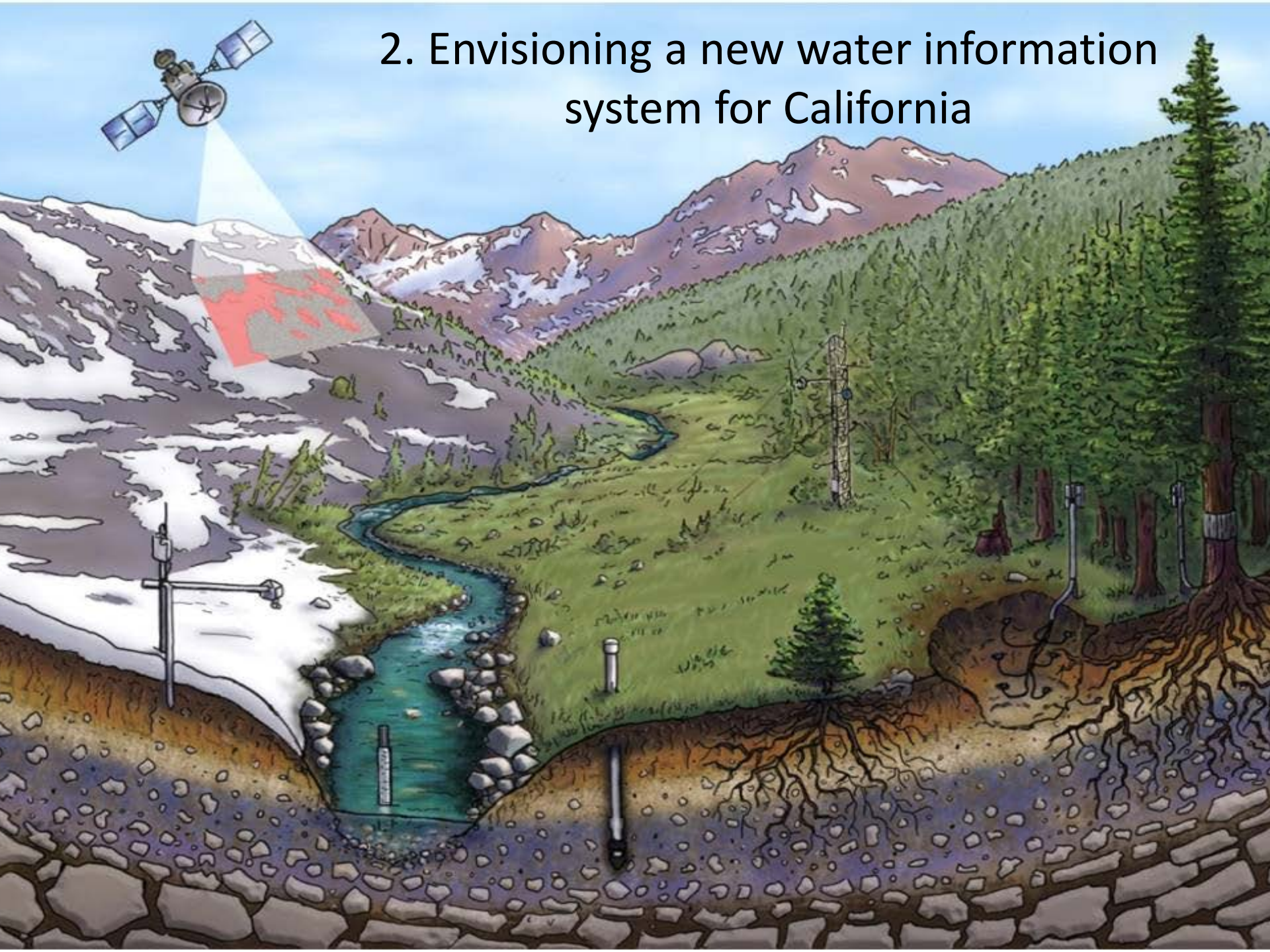
ACWA Policy Principles on Improved Management of California's Headwaters

"… managing California's headwaters is integral to optimizing … water supplies … Increasing water yield and quality; reducing the risk and impacts of catastrophic wildfire; and enhancing natural features and functions; are all benefits to be derived, locally and statewide, from improved headwaters stewardship. Enhancing the resiliency and adaptability of headwaters is overdue.

California can no longer afford to relegate management of its headwaters to the margin."

Association of California Water Agencies
Since 1910
ACWA
Leadership • Advocacy • Information • Service

2. Envisioning a new water information system for California



Why water information

Accurate, transparent, timely water accounting can transform operation of infrastructure and institutional response to change

- Salient, credible, and legitimate information at the proper spatial and temporal resolution is increasingly a critical bottleneck for sound decision making
- Understanding of the way water flows through the natural environment, and how it is extracted, conveyed, and stored in a combination of built and natural infrastructure, is fraught with uncertainties.
- Water management institutions in California have not evolved to pace with yesterday's scientific and engineering developments, let alone the capacity to adapt to 21st century stressors

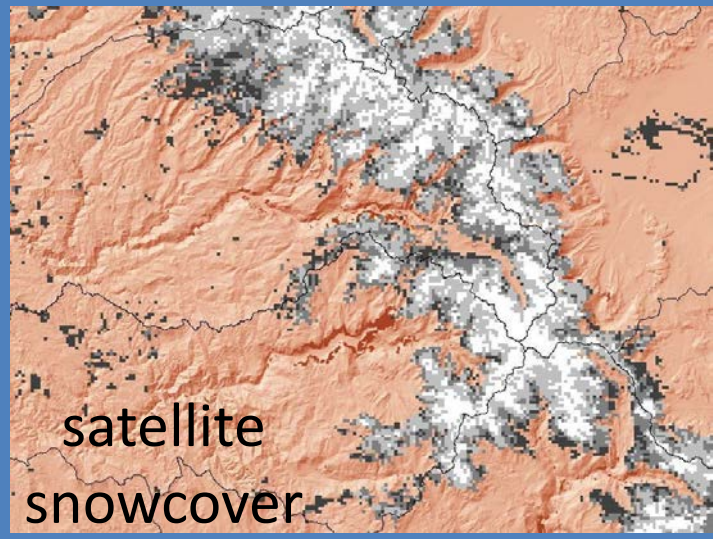
Example – seasonal forecasts – uncertainty can be high

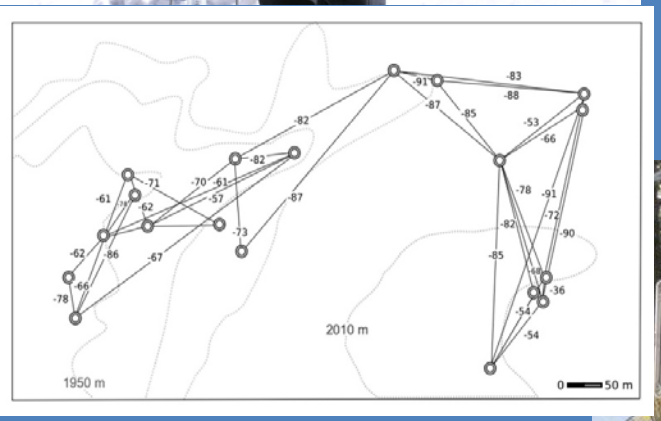
- Mainly monthly, manual measurements
- Few automated, but non-representative measurements
- Statistical forecasts, vs. hydrologic models

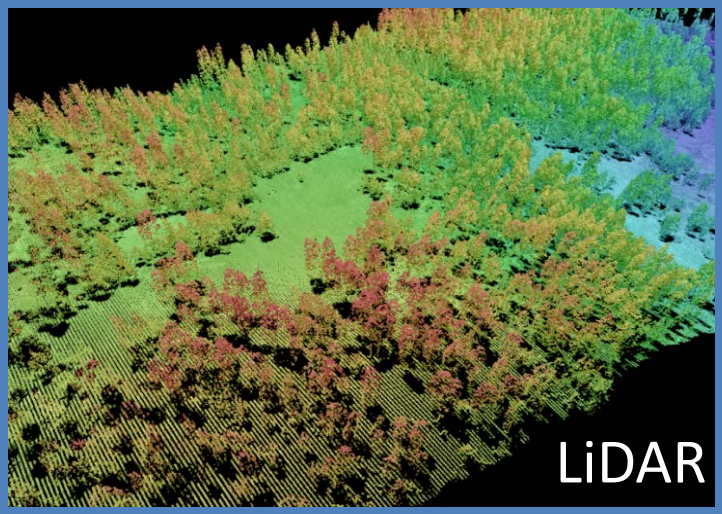
<u>New, mature technology available now</u>: blending data from satellites, aircraft, low-cost wireless sensor networks, advanced modeling tools

Measurement technology – verification & forecasts

<u>Available now</u>: blending data from satellites, aircraft, wireless sensor networks, advanced modeling tools



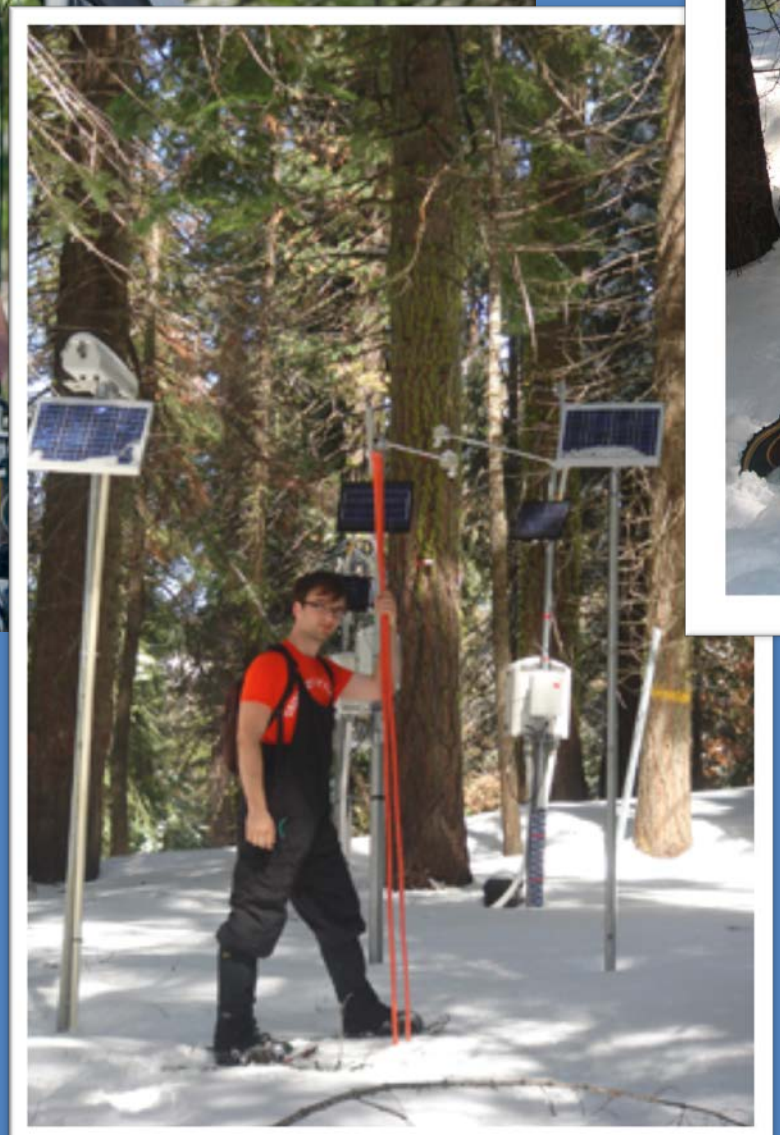


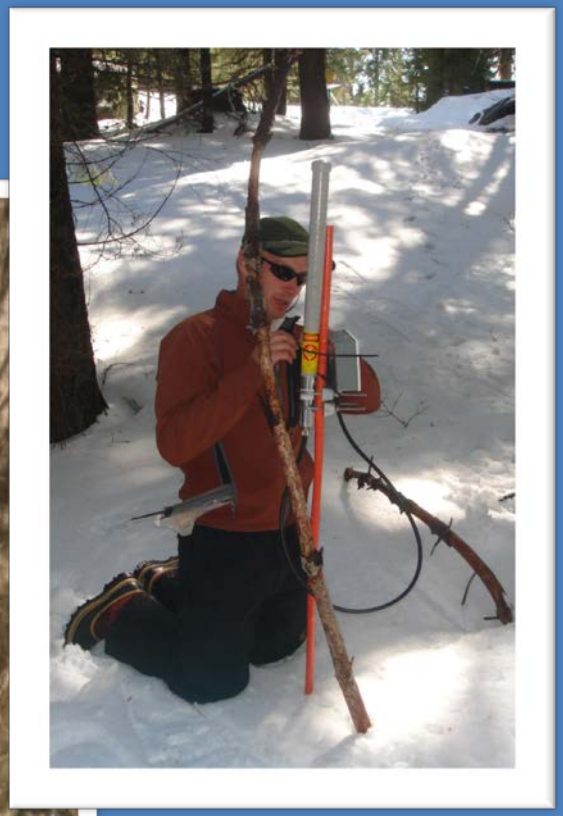


Together these add up to Big Data challenges

Wireless embedded sensor network nodes

Sensor node



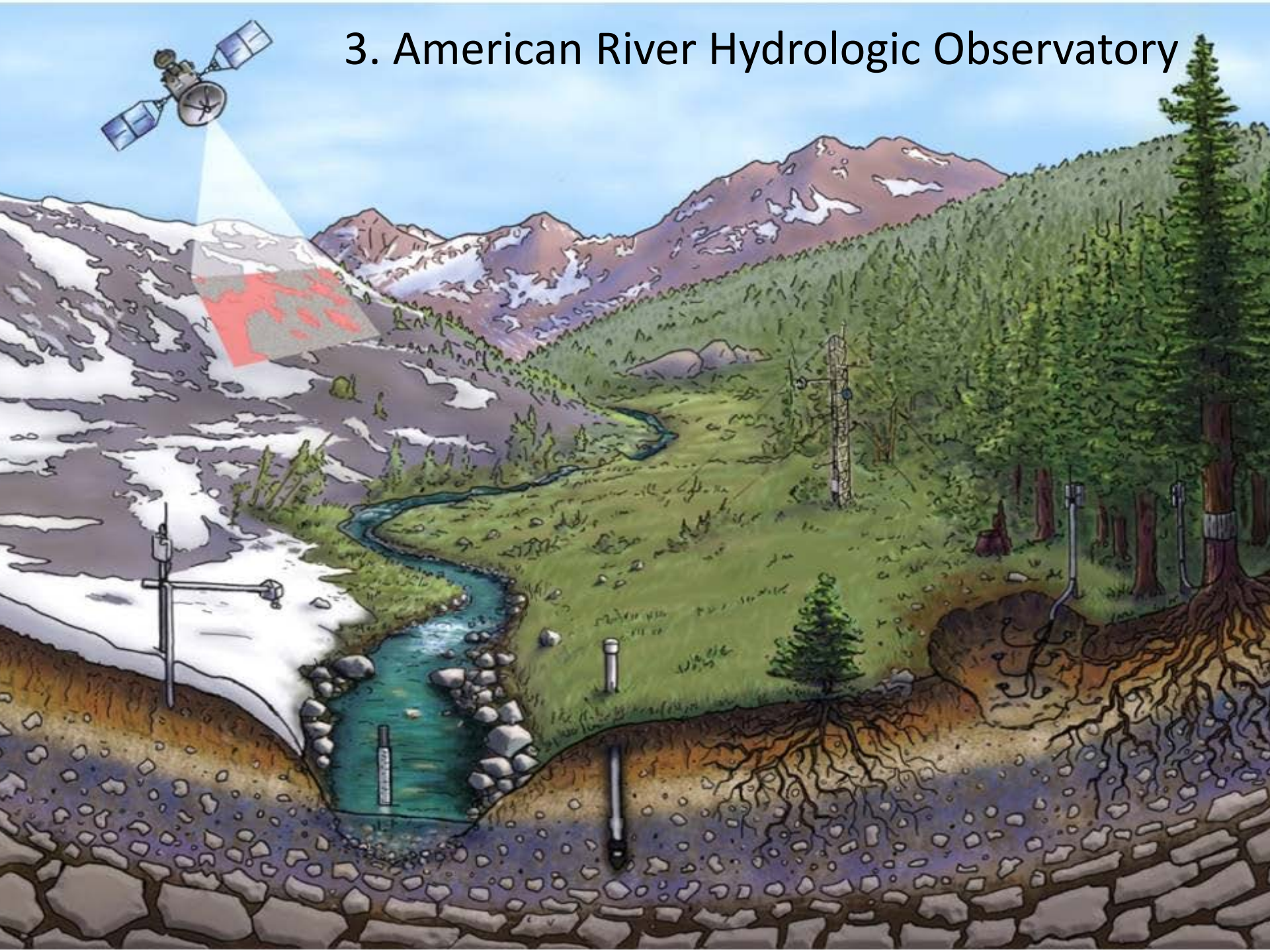


Hopper node

Wireless motes
Snow

Soil moisture

3. American River Hydrologic Observatory



American R. basin hydrologic observatory (in progress)

Platform for research & core element of new water information system

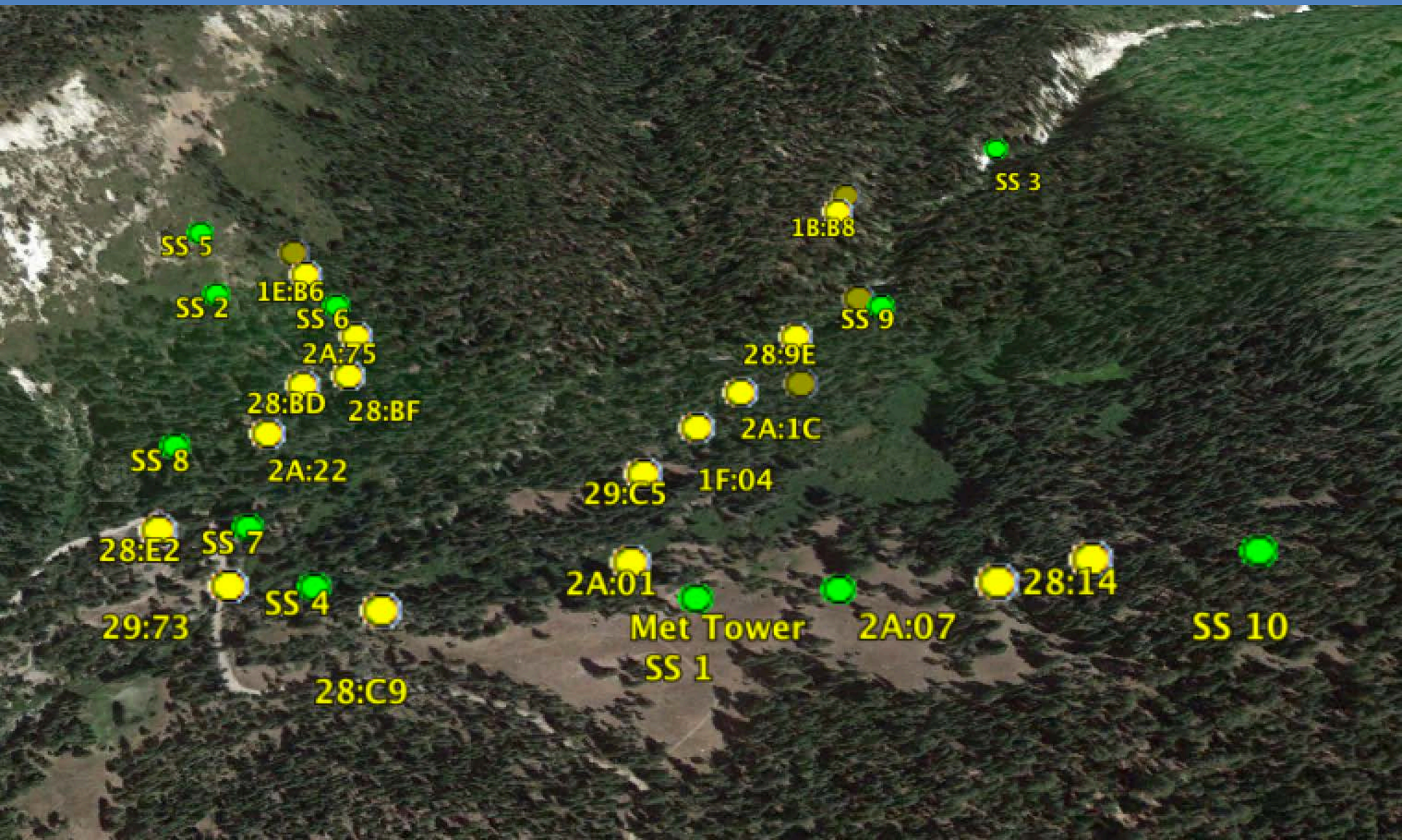
Strategically place low-cost sensors to get spatial estimates of snowcover, soil moisture & other water-balance components

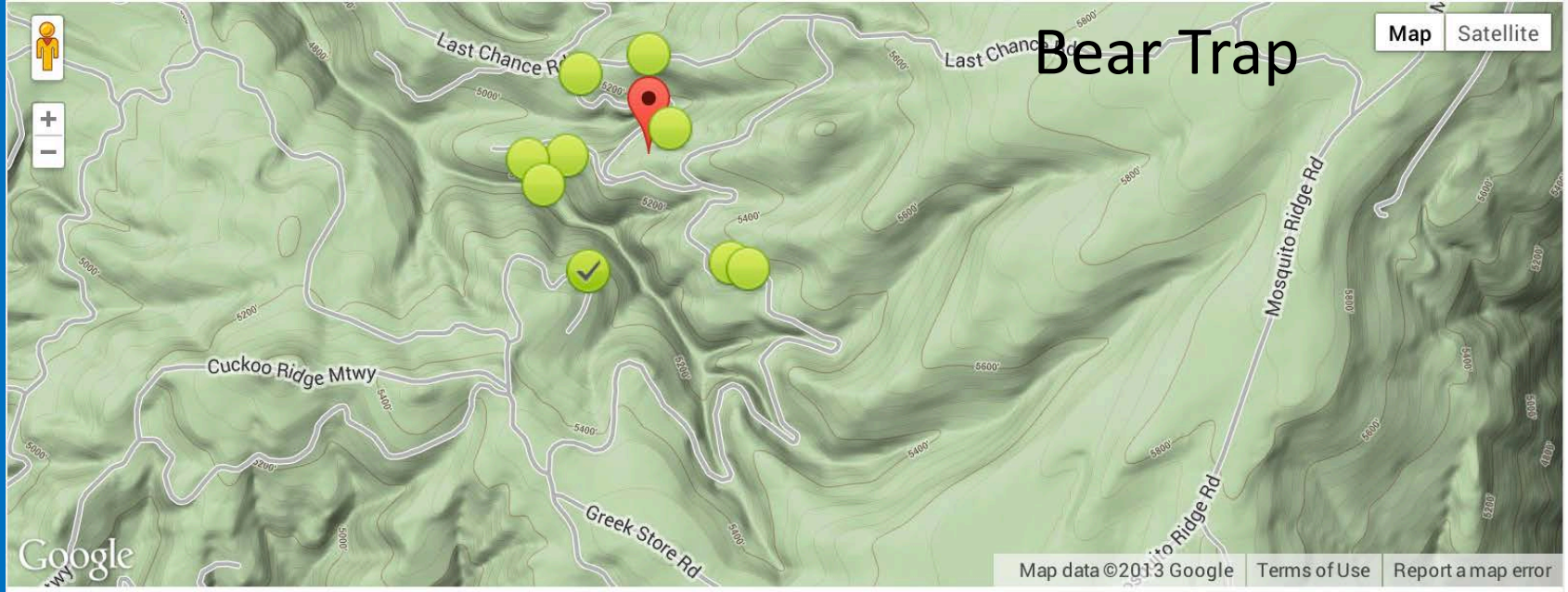
Integrate these sensors with remotely sensed data, forecasting tools & decision support

Goals of American River basin observatory & water-information system

1. Demonstrate basin-scale, real-time intelligent water information system
2. Reduce uncertainty in water-supply forecasts
3. Potentially enable more-flexible operation of Folsom Dam
4. Enhance hydropower operations
5. Document & forecast impacts of forest management on water
6. Provide information of unprecedented accuracy & scope for current forecasting & decision-support systems
7. Enable more information-intensive forecasting & decision-support tools
8. Provide first core element of broader information system for California

Bear Trap: 10 sensor nodes, 1 met station & 20 repeater nodes




Bear Trap
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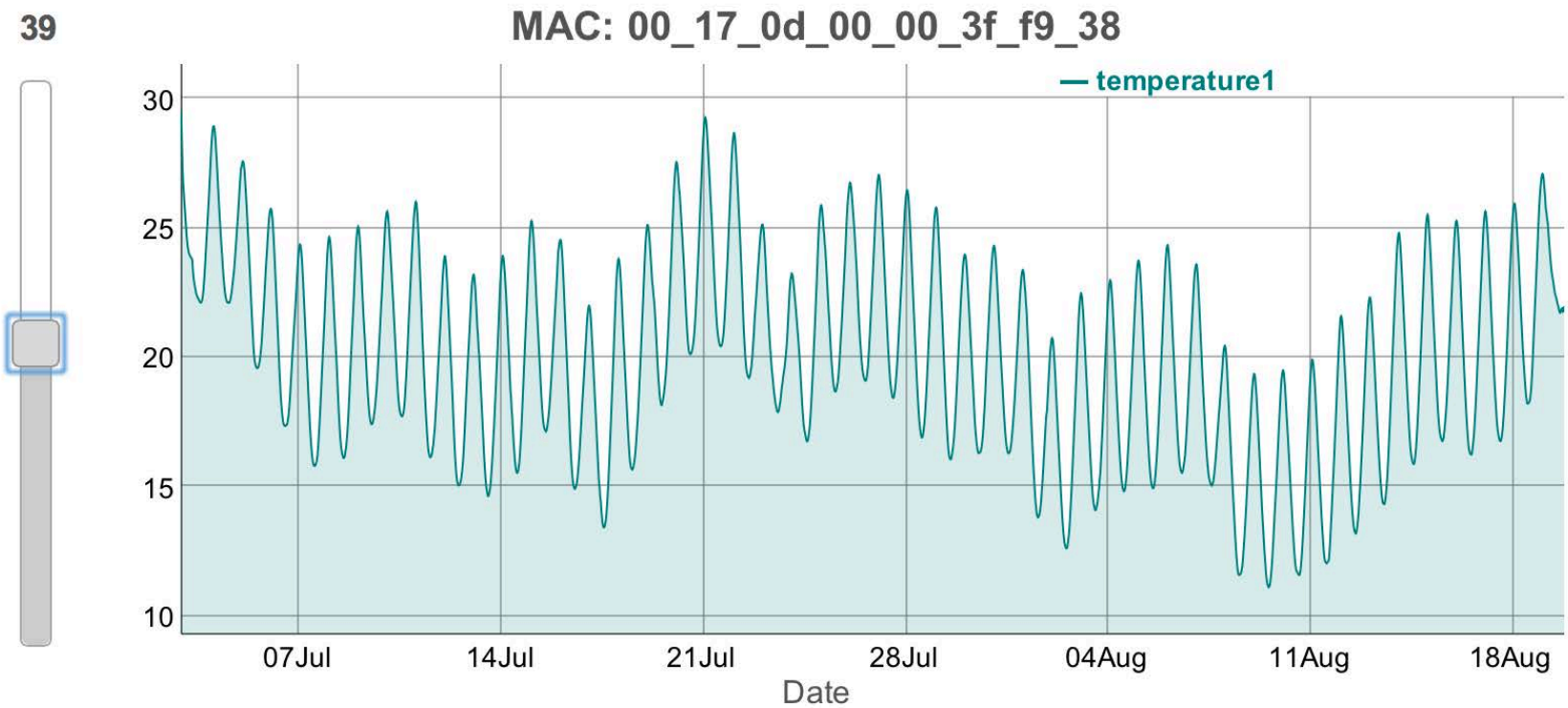
Report a map error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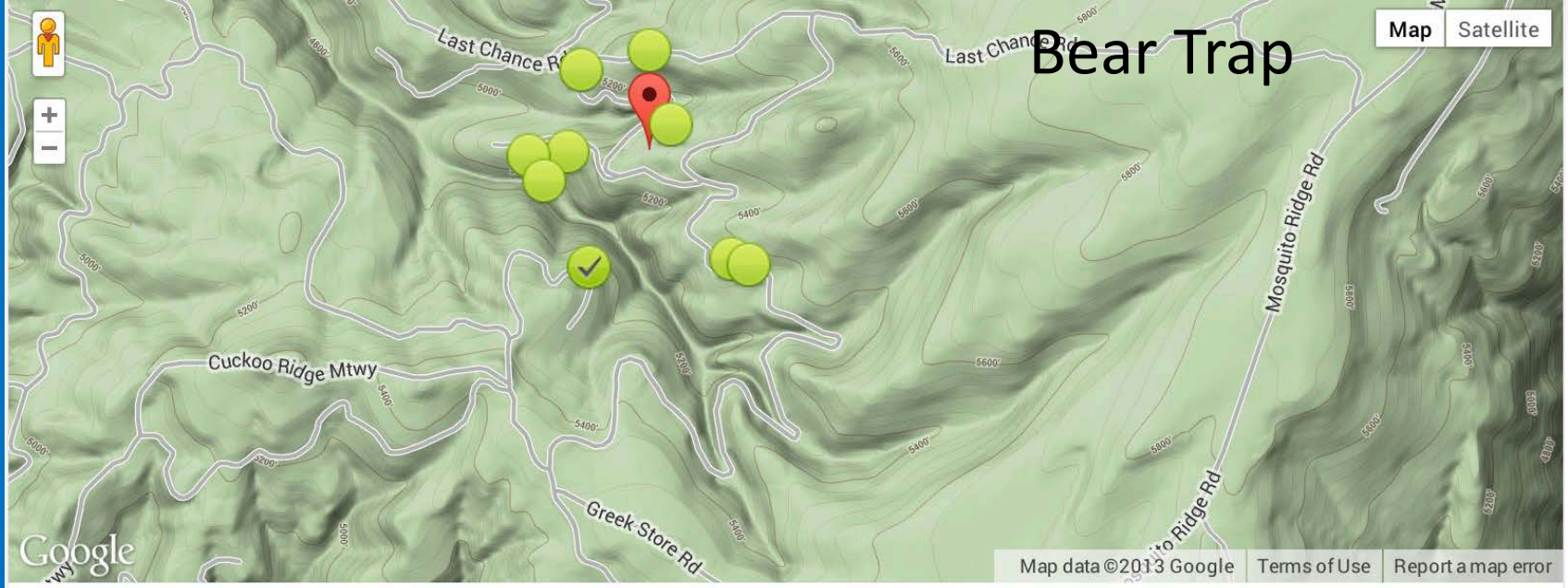
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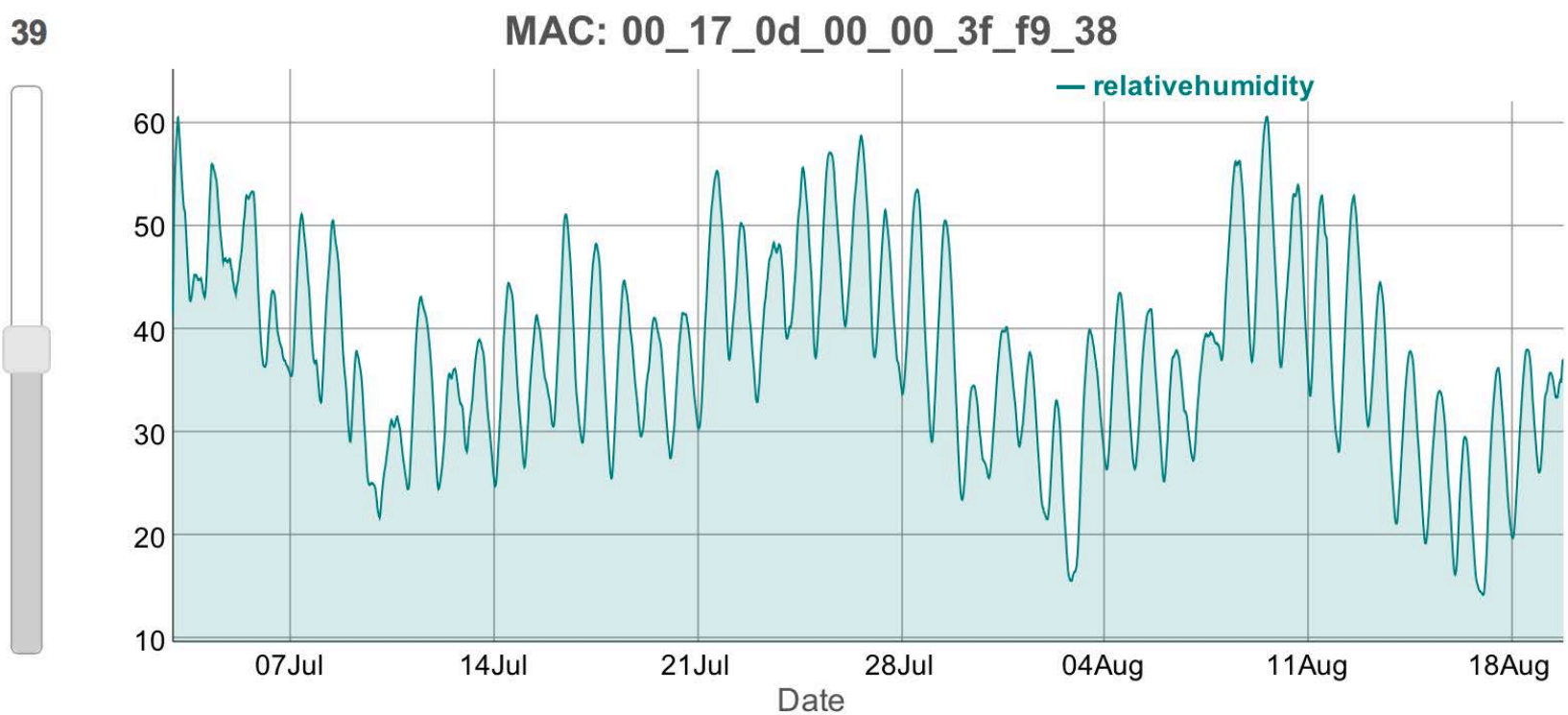
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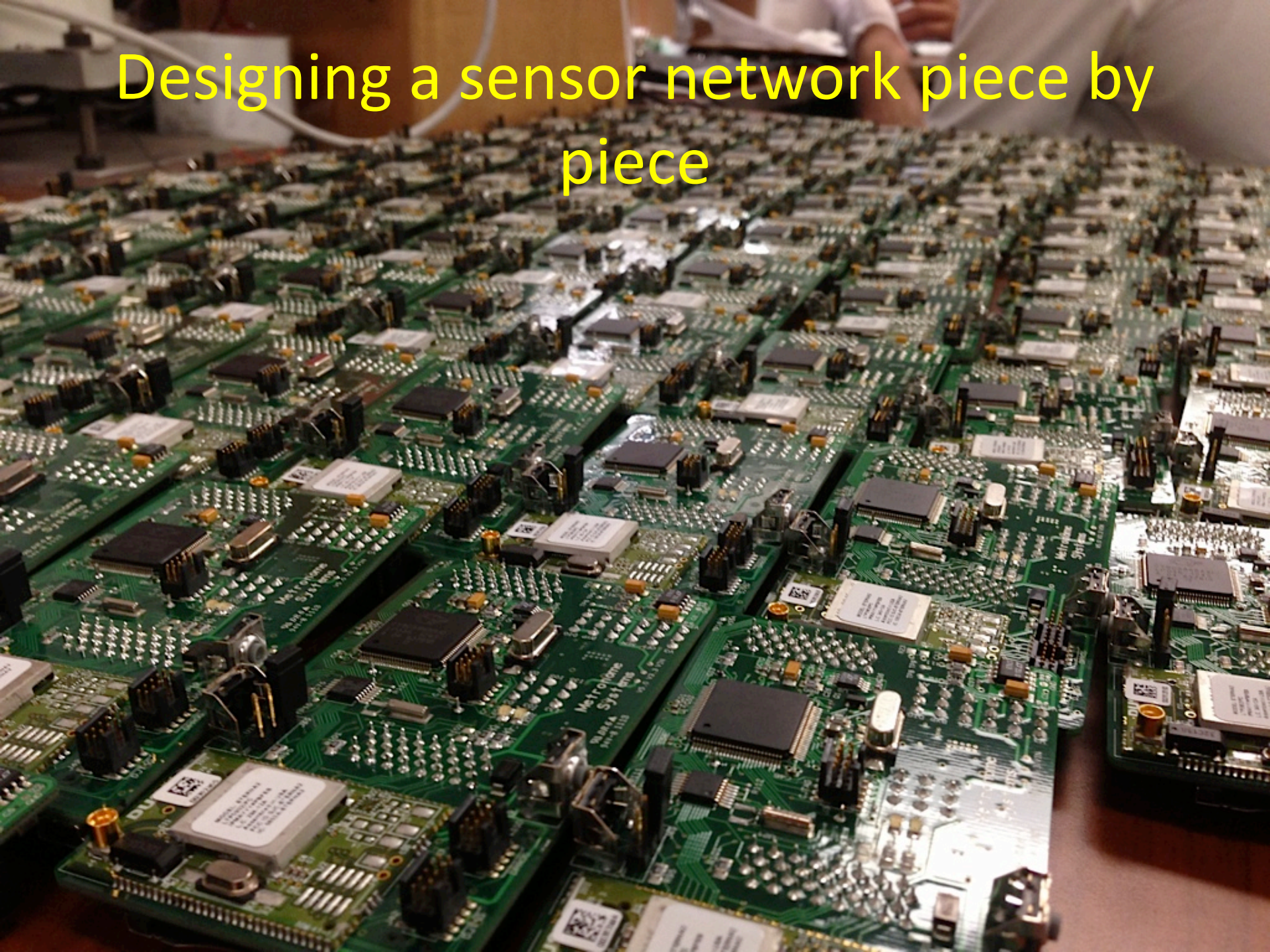
Node construction at Alpha site

Designing a sensor network piece by piece



Some concluding points

1. Sustained forest management that provides measurable benefits for water supply will require investment , verification & maintenance
   - Next step: do scalable demonstration project in Sierra Nevada
2. Better information is a critical foundation for water security, especially in a warming & more-variable climate
   - Next step: incorporate research products into scalable water information system
3. American R basin is both research platform & core element of new water-information system
   - Next step: continue development of technology & knowledge to meet emerging challenges

Some concluding points (cont.)

- With better-informed management, California's existing water supply could go further to meeting the needs of the state's urban & agricultural uses
- The same need for better water information applies to groundwater supplies, to agricultural water use, urban water use – the full natural and engineered water cycle

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