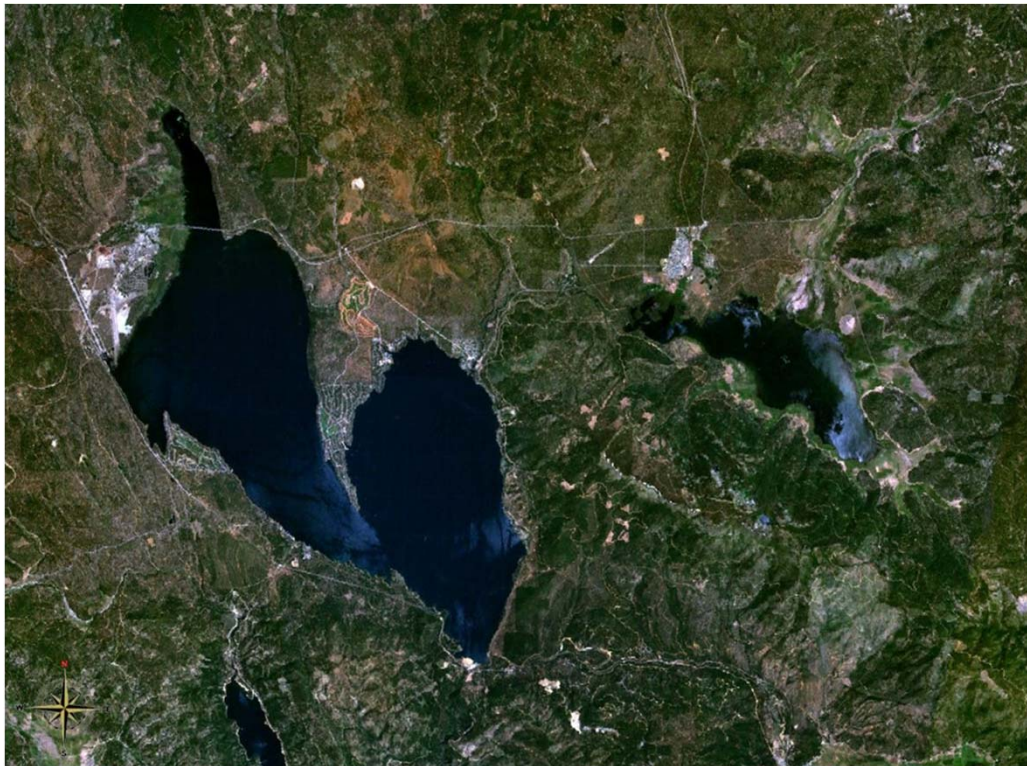


## DOCKETED

<b>Docket Number:</b>	17-IEPR-09
<b>Project Title:</b>	Climate Adaptation and Resiliency
<b>TN #:</b>	220885
<b>Document Title:</b>	In-situ Measurements and Telemetry of the Snowpack to Improve Hydropower Operations in a Changing Climate
<b>Description:</b>	8.29.2017: Presentation by Francesco Avanzi of University of California, Berkeley and Merced
<b>Filer:</b>	Raquel Kravitz
<b>Organization:</b>	California Energy Commission
<b>Submitter Role:</b>	Commission Staff
<b>Submission Date:</b>	8/25/2017 10:23:20 AM
<b>Docketed Date:</b>	8/25/2017

# In-situ Measurements and Telemetry of the Snowpack to Improve Hydropower Operations in a Changing Climate



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2017 IEPR Joint Agency Workshop on Climate  
Adaptation and Resilience for the Energy System  
Sacramento, CA; August 29th, 2017

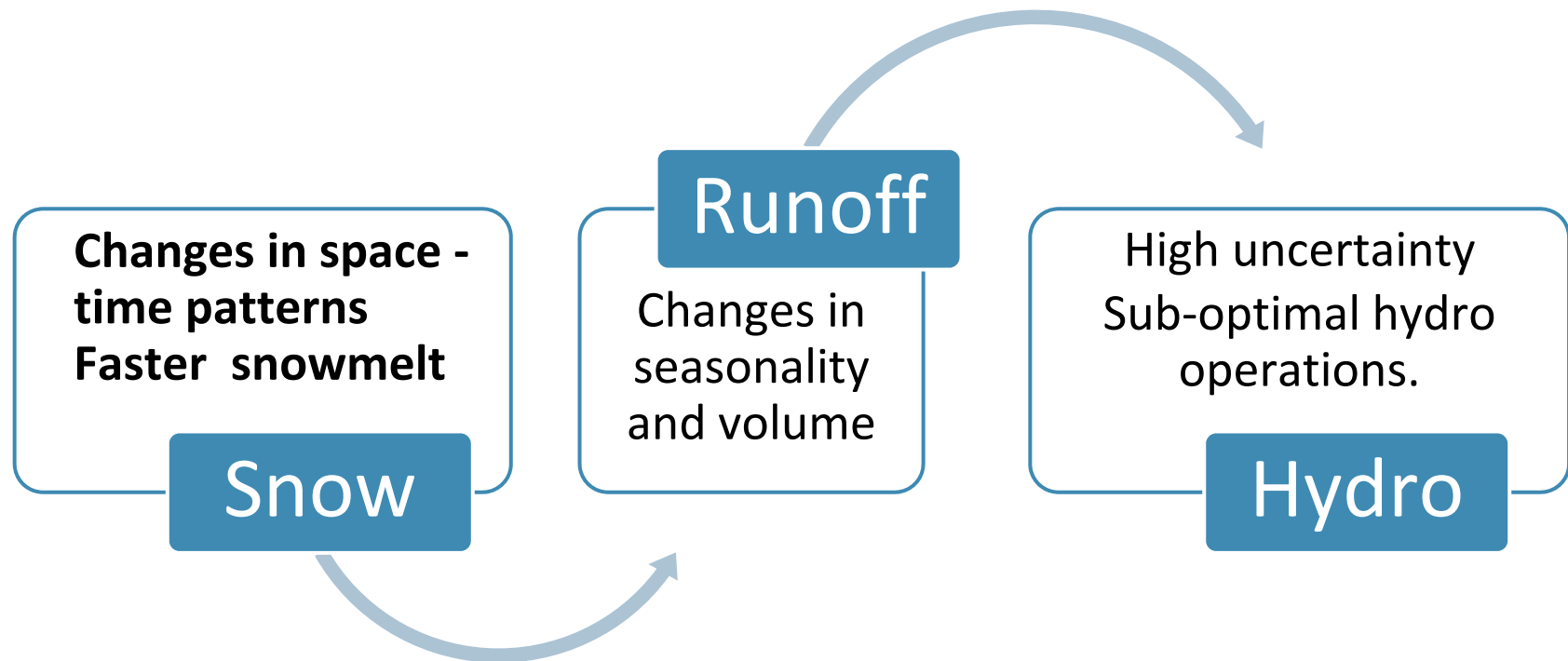


UCMERCED



# Project objective

Offset growing **uncertainty in hydropower forecasts** owing to a **changing climate** and growing **demands for better forecasts** to enhance value of hydropower operations.

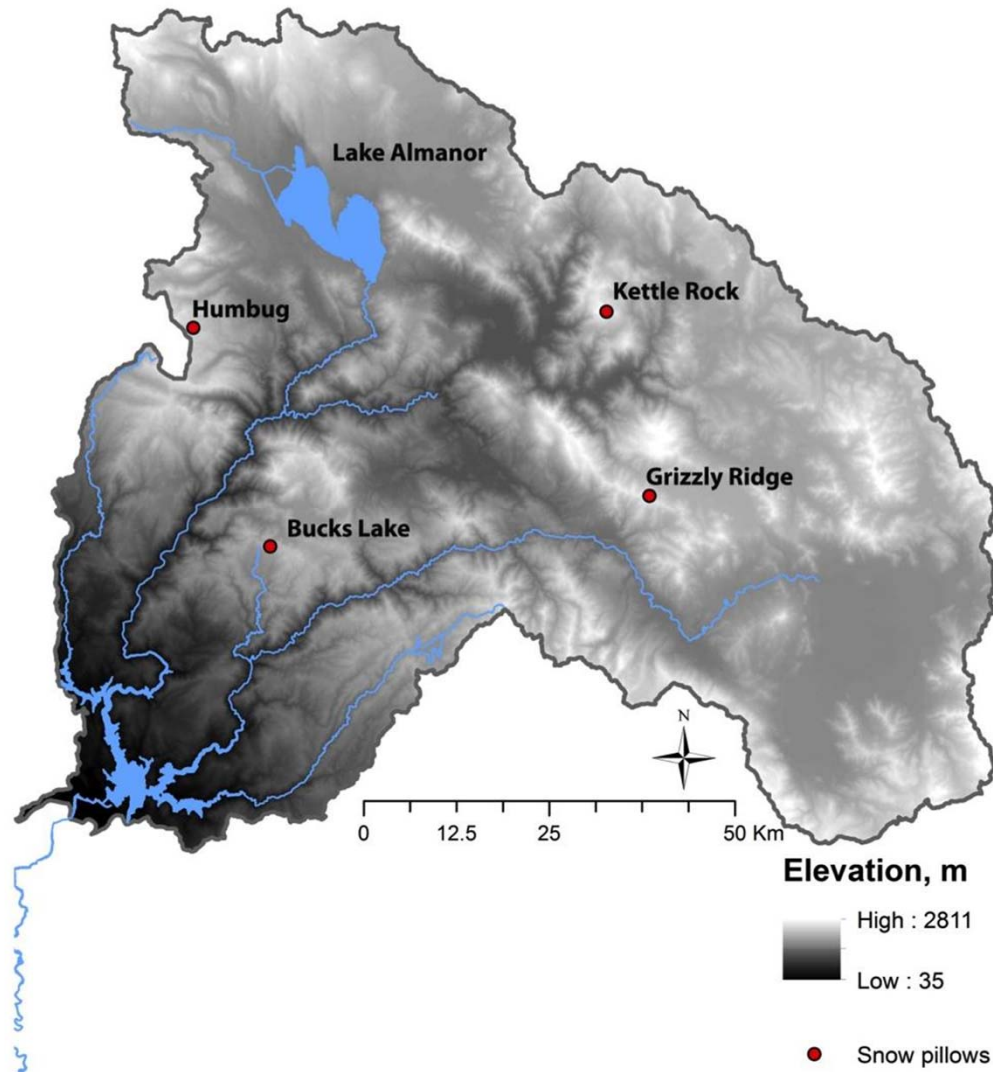


# North Fork Feather River

Support **PG&E's**  
**Hydropower Planning and**  
**Operations**

Key priorities:

1. Uncertainty and temporal resolution of forecasts.
2. Spatial resolution of snowpack storage and snowmelt.



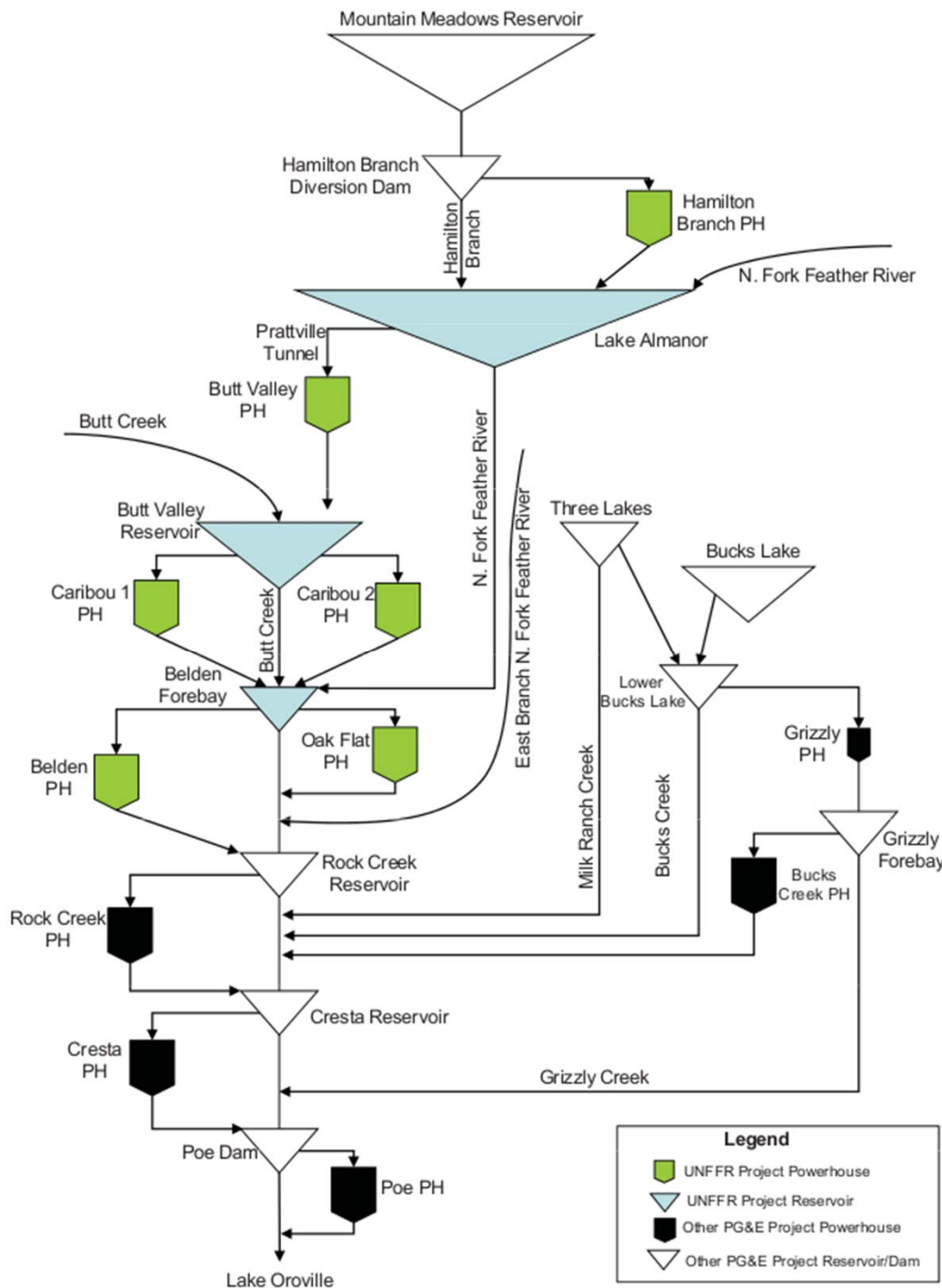
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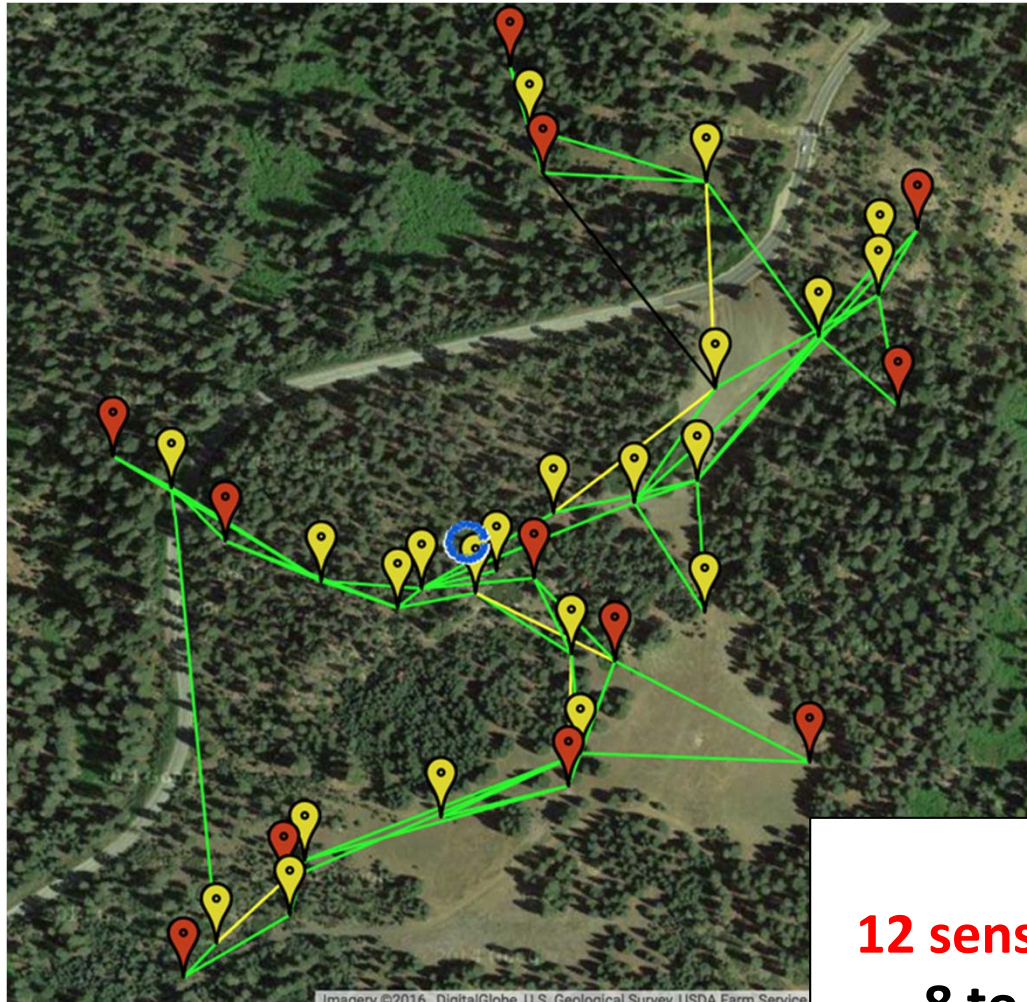
- 1. Uncertainty and temporal resolution of forecasts.**
- 2. Spatial resolution of snowpack storage and snowmelt.**



*Source: Upper North Fork Feather River Hydroelectric Project*





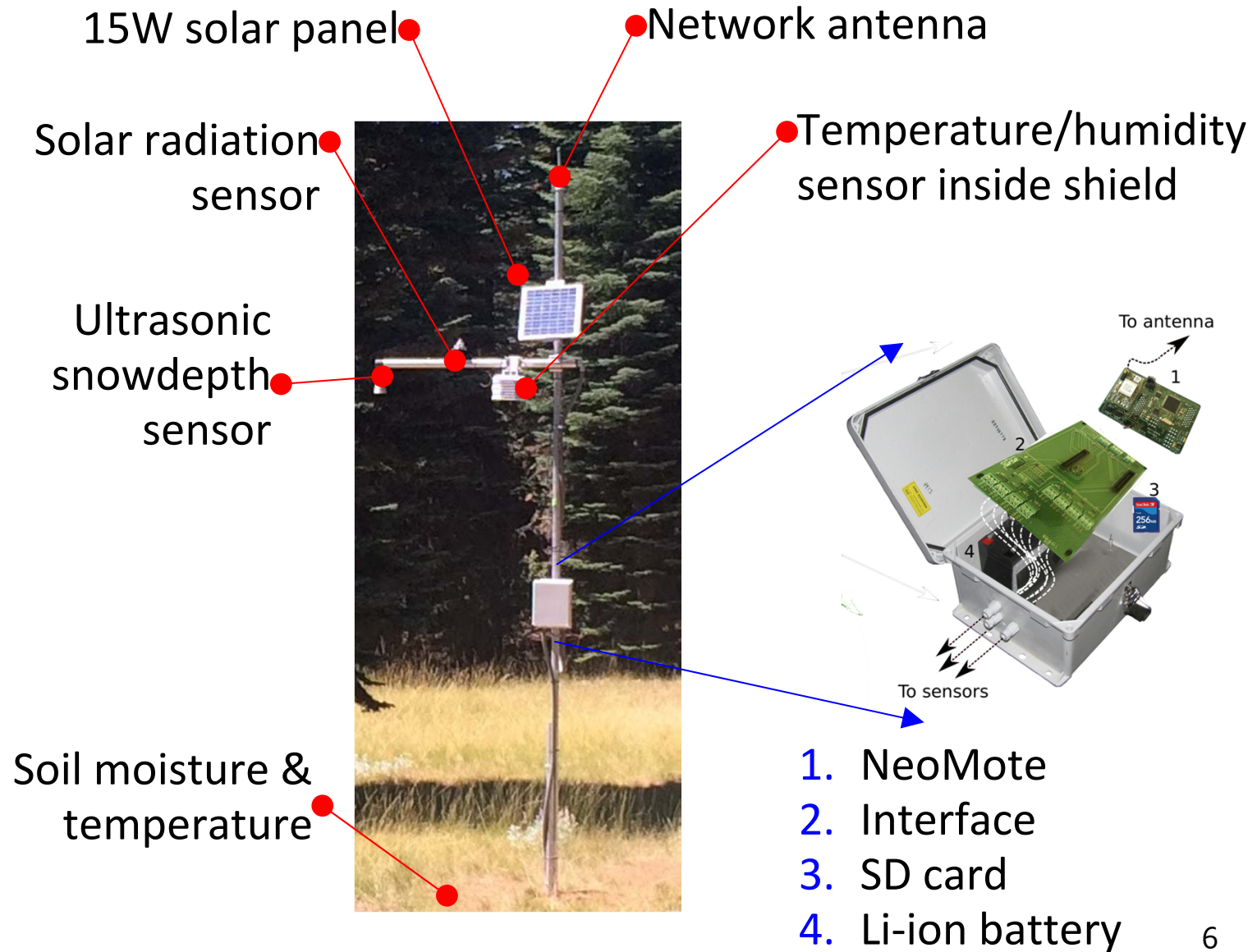
# Real-time wireless sensor networks



-  Sensor node
-  Repeater node

**Four key locations**  
**12 sensor nodes** for each location  
**8 to 12 Ha** spatial resolution  
(20 to 30 ac).

# Sensor node





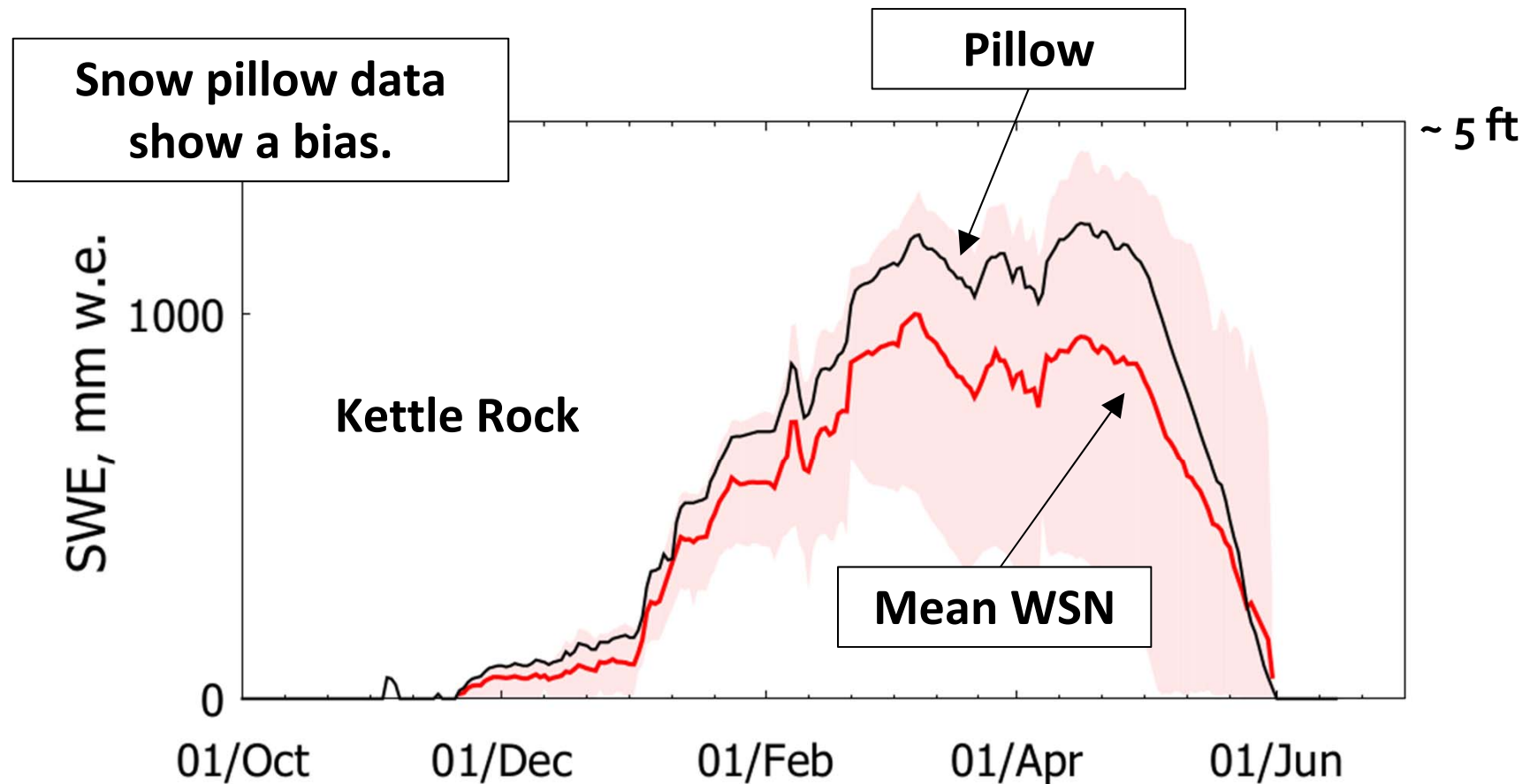


## The 2016/17 snow season

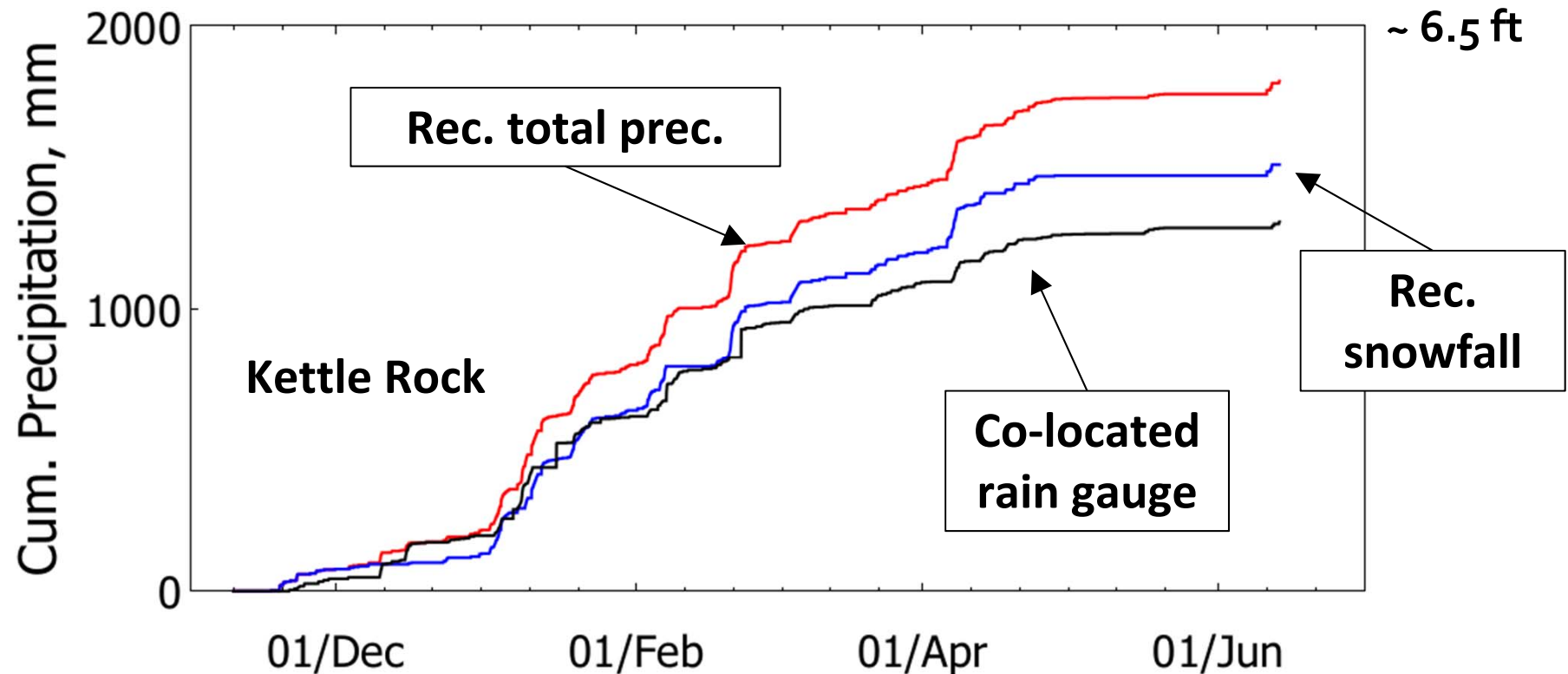




Wireless sensor networks track **representative patterns of water content** based on physiographic variables.

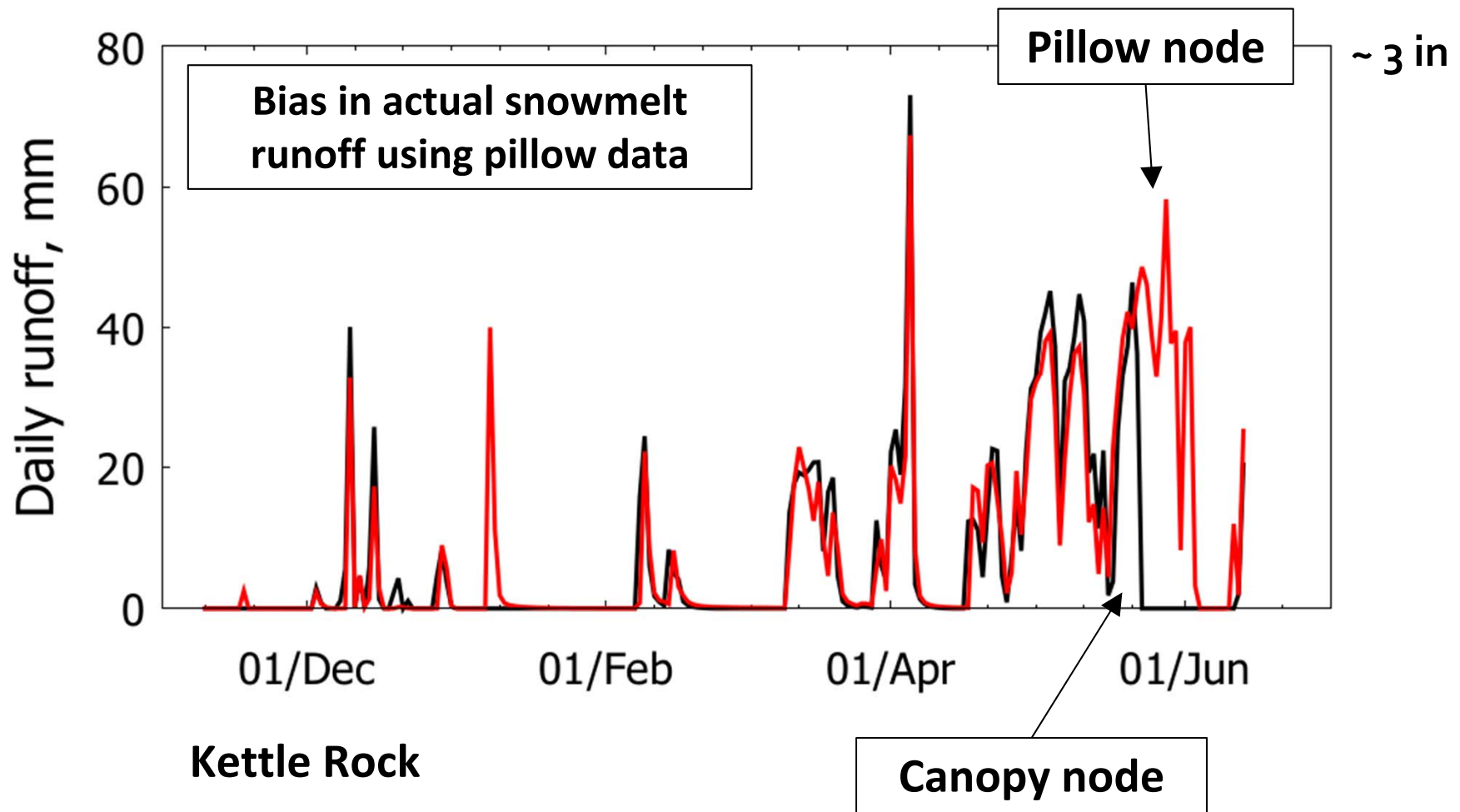


Wireless sensor networks can estimate **undercatch** of rain gauges and **partitioning** between rain and snow.



Snow depth and rain gauge data can be blended to better estimate actual precipitation.

Combined with mass-balance models, the networks reconstruct **snowmelt runoff inputs** to the hydrologic system.



# Summary

We are developing core elements of a **next generation hydrographic data network**.

The network can **support hydropower decision makers in real time** with more information about the snowpack state.

The project is successful if the products **enhance hydropower value to utilities and ratepayers** through lower uncertainty