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- Adaptive management
- California water & Sierra Nevada hydrology
- SNRI & UC Merced
3 objectives:

Measure changes in water quality & water budget in representative areas subjected to Framework/SPLATS treatment

Estimate the impact of forest treatments on water quality, water budget & aquatic habitat at three levels: watershed, forest, bioregion

Provide basis for continuing operational assessment of how Framework treatments will impact streams, water cycle & forest health
Tasks: Water Quality & Quantity

Field measurement program
before/after treatment
controls in parallel w/ treatment
stream temperature, turbidity, dissolved oxygen, electrical conductivity
stream stage/discharge, soil moisture
meteorology, erosion, soil temperature, snowpack, precipitation

Modeling & spatial scaling
integrate observations using hydrologic model
estimate model parameters from satellite & ground data
extend impacts across hydrologic & watershed conditions
couple watershed, erosion, stream responses
Hydrology focuses on 3 smaller catchments:
- treatment
- control
- higher elevation, future treatment

Same strategy in Sierra NF
California’s water resources challenges: increasing pressure on mountain resources

1. Changing urban & agricultural water demand
2. Sea level rise
3. Reduction of average annual snowpack
4. Changes in precipitation: timing, intensity, location, amount, variability
5. Long-term changes in watershed vegetation & increased incidence of wildfires
6. Increased water temperatures

New knowledge is needed to meet these challenges
### California’s changing water use

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<th>1990</th>
<th>2020</th>
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Demand for water in California & across the West will continue to rise.

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DWR, 2005
Likely loss of 3-5 million acre feet of snowpack storage in coming decades

Data from DWR
California precipitation: becoming more variable

Coefficient of variation for annual average precipitation in California from 1890 to 2001 with trend line

Source: DWR
Snowmelt runoff: occurring earlier in the year

Annual April through July unimpaired runoff for four Sacramento Valley rivers compared to total unimpaired annual runoff

Source: DWR
UC Merced research: mountain hydrology

- Satellite snowcover
- Sierra Nevada Hydrologic Observatory
- Research, integration & applications partnerships
Snow covered area (SCA) from MODIS satellite

May 10, 2004
UC Merced snowpack estimates in CA-DWR monthly climate report

Merced river basin

Snowcover increases with elevation

www.climate.water.ca.gov/climate_data/
Using daily satellite data, we estimate that one-third of snowmelt comes from elevations above 10,000 feet (3,000 m).
Predicting the fate of rainfall & snowmelt: historical methods & measurements are no longer adequate

new measurements
↓
new understanding
↓
accurate predictions

precipitation

evapotranspiration

infiltration

snowmelt

sublimation

runoff

ground & surface water exchange
Sierra Nevada Hydrologic Observatory

A new generation of measurements & infrastructure
Serving both research & applications
UC Merced research partnership sites (⭐)
Collaborative efforts with other UC’s, state, federal agencies, water districts
Wolverton, Sequoia NP
Wolverton, Sequoia NP

Vertical soil profiles of moisture & temperature, co-located with snow & radiation measurements

Wells & piezometers in meadows & riparian areas

Met stations across the basin
Kings River Experimental Watersheds, Sierra NF

USFS research site, critical zone observatory & candidate for broader ecological research across rain-snow transition

Flux tower under construction
Observatory as transect: Tioga Road corridor, Yosemite National Park

Strategy: rather than spreading instruments across a whole basin, this transect statistically samples the variability in the Tuolumne & Merced basins, taking advantage of the Tioga Pass Road as infrastructure.

Instrument sites leverage operational & research investments.
Gin Flat site, Tioga Pass road, Yosemite NP

Wireless pod for recording snow depth

Capturing variability across the landscape

Add new measurements at operational sites
SNRI involves 18 faculty across 3 schools, 10 research scientists, 10 graduate students, field facilities, analytical laboratory

Water, climate, air quality & environmental health in SNRI

Hydrology & climate: current research & educational strength of SNRI & UCM
- 3 senior & 3 junior faculty
- research scientists, postdocs, grads & undergrads
- complimentary biogeochemistry, soils & water quality research

Partnerships with other UC’s, federal research & resource management scientists, state agencies, water districts