

CLIMATE CHANGE RESPONSE

AIRBORNE SNOW SURVEYS

ISSUE: Funding is needed for the full suite of snow survey tools that meet 21st century water management and climate change challenges

OVERVIEW: The Kings River watershed in the Southern Sierra Nevada is where, on average, 1.7 million acre-feet of water supply for portions of Fresno, Kings, and Tulare counties is found stored as snow. The supply is extremely variable. In wet years it can exceed 4 million acre-feet, causing potential flood risk downstream, and can swing below 400,000 acre-feet in the driest years, straining groundwater supply used to meet demand. Water management begins with understanding and forecasting snowpack.

Forecasting water supply with the full suite of complementary snow measurement tools contributes to the daily understanding and analysis of snowpack that allows water managers to mitigate flood risk, plan for swings in supply, and increase the likelihood of putting surplus water to use.

CLIMATE CHANGE, DROUGHT, WILDFIRE IMPACT & RESPONSE

Water supply availability and timing is impacted by climate change. More intense drought periods and inversely intense precipitation events, "atmospheric rivers", are increasing water management complexity. Steve Haugen, Kings River Watermaster, expresses variability coupled with warmer temperatures creates timing hurdles for water managers. Adjusting to this new normal means adjusting to change in natural water storage capacity found in snowpack as snowmelt patterns change and some precipitation falls as rain rather than snow. Under these conditions, reservoirs can fill more quickly triggering flood releases to make room for fast-approaching runoff that otherwise would have been stored in snowpack. Change in forest conditions resulting from wildfire can also impact runoff patterns, leading to an even greater need to understand snowpack before it begins to melt.

AIRBORNE REMOTE SENSING FOR SNOWPACK (ARSS)



Airborne snow depth measurement flights are the most accurate snow measurement tool

available. These flights, commonly referred to as Airborne Snow Observatory (ASO), can cover the entire Kings River watershed with approx 400 million measurements taken over a 12-hour period, completely and accurately assessing snow depth across the entire snowpack area. The program is scalable across Western US watersheds.

ARSS KEY BENEFITS

- Prevent overly conservative flood releases that reduce water supply storage
- Reduce risks associated with flood releases, like crop or property damage, thanks to foresight and planning
- Anticipate and capture flood water for groundwater recharge, offsetting groundwater use and replenishing supplies, a priority under CA's SGMA regulation
- Continue to balance environmental flows while aligning water supply expectations with urban and agricultural users
- Provide insight into potential drought conditions
- Help cities plan their water management strategy, offsetting groundwater pumping to meet the needs of homes, businesses, and industry

CLIMATE CHANGE RESPONSE RESPONDING TO THE CHALLENGE

Using available snow survey tools to forecast supply helps water managers make decisions including when and how much water to release for urban, environmental, and agricultural uses.

PROGRAM NEEDS & WESTERN US SCALE

KINGS RIVER: \$2,000,000 annually

HIGH SIERRA, CA*: \$10,000,000 annually

ALL CA DWR SNOWPACK FORECAST BASINS: \$25,000,000 annually

Funding for 10 flights per water year would provide optimal high-resolution snowpack information throughout the snow accumulation and melt periods. *In California, the program is immediately scalable across existing "High Sierra" programs in the Kaweah, Kings, San Joaquin, Merced, and Toulumne watersheds and could be scaled quickly in the Feather and Yuba watersheds.

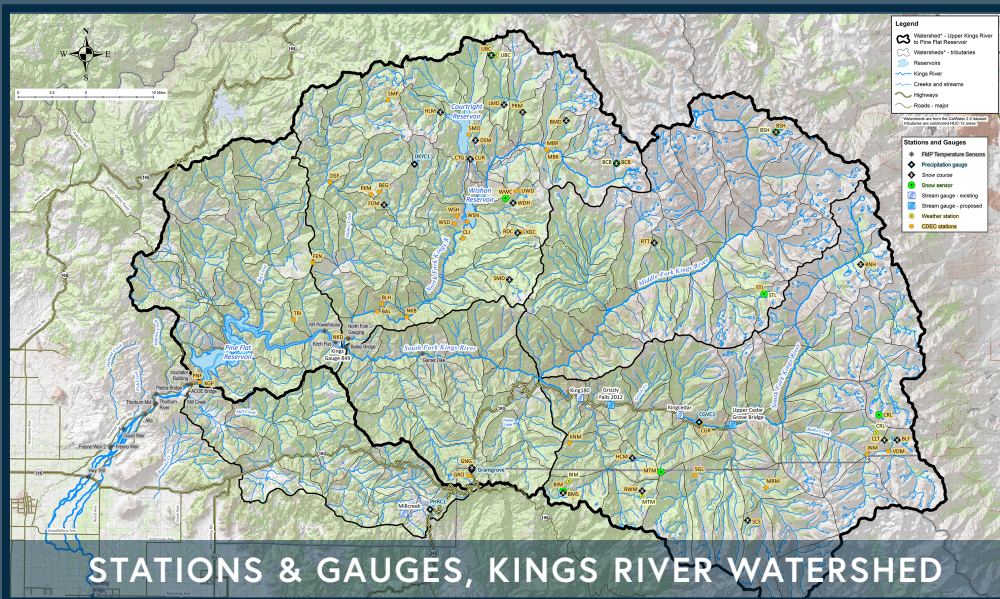
The program is scalable across western US watersheds should funding be made available.

COMPLEMENTARY SNOW SURVEY TOOLS



The Kings River Water Association, along with other agencies and companies, conducts ground sampling at California Cooperative Snow Survey sites throughout the 1,500 square mile watershed, providing snow depth and water content

measurements. This when used in concert with highly accurate ARSS flights, modeling, and automated snow sensors, contributes to daily understanding and analysis of the snowpack.



"It's as important in a drought as it is in a flood year."

- **Steve Haugen, Kings River Watermaster**, on the importance of ASO as a snow forecasting tool to reduce uncertainty and better manage water supply

