BUREAU OF RECLAMATION

Snow Water Supply Forecast Program: 2024 SNOFO Projects

Arizona State University: Fusing Airborne and CubeSat Methods for Snow Estimation and Supply Forecasting into Salt River Project Reservoirs

Reclamation Funding: $974,265 **Total Project Cost: $1,274,265**

This project will develop a long short-term memory (LSTM) model using near-daily CubeSat data, ground observations, and lidar snow maps from the Airborne Snow Observatories, Inc. (ASO), to generate an advanced snow estimation product. Applied for the first time in Arizona, ASO snow maps will be used to enhance a process-based distributed hydrologic model. The project will use the high-resolution hydrologic model to translate weather and snowpack conditions to forecasted inflows to a reservoir system. This collaborative effort between Arizona State University and the Salt River Project will improve snow estimation in forested environments for water supply, flood hazard, and water resilience forecasting. As the largest water supplier for the Phoenix Metropolitan Area, SRP operates six reservoirs in the Salt and Verde River (SVR) basin. This modeling approach will provide SRP with new water supply forecasting capabilities. The LSTM SWE product will be compared to an independent gridded product and then applied to initialize the snow water supply forecasts that generate reservoir inflows for short-, medium-, and long-lead times. Outcomes will be incorporated into the SRP Project Reservoir Operations Plan.

Friant Water Authority: Snow Water Supply Forecasting in the Upper San Joaquin River Watershed

Reclamation Funding: $ 702,169 **Total Project Cost: $ 3,556,798**

The project is expanding the application of established Airborne Snow Observatory Inc. (ASO) technologies in the upper San Joaquin River basin to supplement and refine sensitive water year type management of snow supplies. ASO data will be shared and applied to water supply forecasting tools managed by the California Department of Water Resources (DWR), the California Nevada River Forecast Center (CNRFC), the U.S. Bureau of Reclamation (Reclamation), and other agencies and organizations that support research and the development of forecasting tools for the San Joaquin River basin and the western United States. Federal funding will supplement planned California's Department of Water Resources (DWR) programming through DWR's Division of Flood Management and the California Cooperative Snow Surveys Program. Proposed activities focus on additional ASO flights to target critical management periods

depending on year type, additional in-situ snow courses to aid in data validation, the development of a historical retrospective of iSnobal modeling in the San Joaquin basin, and the development of a tool which will estimate elevation-banded snow-water equivalent (SWE) in bulk and in an elevation banded format from snow pillows.

Oregon State University: Fusing LIDAR and In-Situ Community Measurements to Improve Estimates of Snowpack

Reclamation Funding: $ 946,203 **Total Project Cost: $ 1,198,187**

This project contributes to the improvement of water supply forecasts by acquiring new datasets and by looking for new ways to blend and optimize datasets that will improve both the accuracy and resolution of our understanding of snow. This project will use several datasets to help improve snowpack models. In addition to leveraging existing datasets, new airborne LIDAR data will be acquired in the Oregon Cascades. The project has two main objectives: (1) Fuse LIDAR (high spatial resolution, low temporal resolution) data with point data from SNOTEL and community science programs (low spatial resolution, high temporal resolution) to obtain better model results than using just one data source (2) Scale a relatively small LIDAR over-flight to much larger areas and obtain high-accuracy model results. The project outcomes will maximize the benefits of costly flights to water supply forecasting.

Oregon State University: The utility of aerial LiDAR snow surveys to improve water supply forecasts across the western United States: comparing the relative importance of current snow conditions and future weather

Reclamation Funding: $ 971,862 **Total Project Cost: $ 1,230,504**

It is poorly known how much operational WSFs may benefit from additional snowpack monitoring and how much WSF accuracy is constrained by snowpack conditions versus future weather. Addressing this problem would help identify the most effective ways to improve WSFs. This project will address this problem by identifying locations with unique snowpack dynamics not sampled by existing networks and testing the potential for snow water equivalent (SWE) data from these locations to improve WSFs. Project funds will support acquisition of aerial LiDAR snow survey data on multiple dates in the McKenzie River basin (Oregon), which currently lacks LiDAR snow survey data. The team will utilize new and existing aerial LiDAR snow surveys in over 33 basins across the western U.S. to compare snow dynamics from this emerging technology to what is currently monitored at snow pillow sites (e.g., SNOTEL). The project will identify “hot spots” where snow dynamics differ from what is measured at SNOTEL and SWE is substantial. The team will evaluate how including snow data from these hot spots improves WSFs. They will produce forecasts with the state-of-the-art NRCS WSF system (M4), starting with a baseline model and then adding additional SWE time series from hot spot locations. The relative importance of initial snow conditions informed by LiDAR versus future weather will be summarized to identify when and where there is high potential to improve WSFs through enhanced snow monitoring. The project will focus on basins in three study regions (CA, CO, OR), which are hydroclimatically distinct.

Utah Division of Water Resources: Wings Over Weber

Reclamation Funding: $ 975,844 **Total Project Cost: $ 1,951,689**

The Wasatch Front, a metropolitan region in the north-central part of Utah and within the Great Salt Lake Basin is experiencing mounting pressure on limited water sources, including declining levels in critical reservoirs and the Great Salt Lake. The proposed project seeks to address these challenges by implementing Airborne Snow Observatory Inc. (ASO) technology in the Weber River watershed. The project will conduct ASO flights to gather snowpack data via integrated aerial LiDAR and spectrometer surveys combined with real-time simulation and assimilation into the WRF-Hydro model for forecasting. Evaluation of the ASO-informed forecasts will be conducted against conventional methods (forecasts from operational agencies) to assess improvements in water management outcomes and associated costs. The project aims to enhance the skill of snowpack measurements and streamflow predictions, and through collaboration with key stakeholders, empower Weber River water managers to optimize reservoir operations, mitigate drought impacts, and better allocate water resources. The Project will take place in the Weber River watershed in north-central Utah. Its success will be measured by its impact on the area's reservoir management and water delivery.