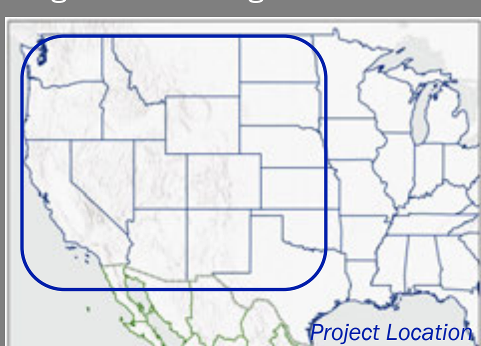
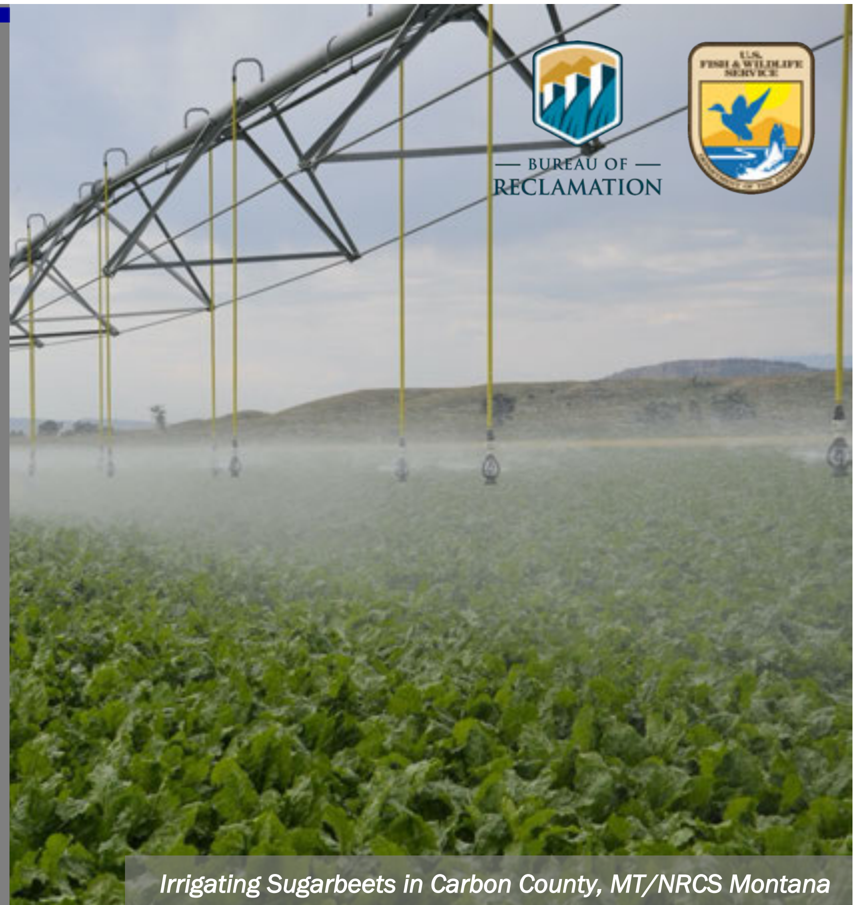
ACTIONABLE SCIENCE

West-Wide Climate Risk Assessments: Irrigation Demand and Reservoir Evaporation Projections

Agricultural water use accounts for 80-90% of U.S. water supply, and demand is rising as the human population grows. Climate change limits water supply for agriculture through reduced precipitation and increasing temperatures, which increases crop evapotranspiration and reservoir evaporation. To better understand future water supplies, the Bureau of Reclamation (Reclamation) conducted a survey of eight major basins and twelve reservoirs in the western U.S. as part of a West-Wide Climate Risk Assessments project. This study used computer modeling to better understand historical and future crop irrigation demands and reservoir evaporation rates to inform the management of water resources during climate change.



Project Location



Irrigating Sugarbeets in Carbon County, MT/NRCS Montana

KEY ISSUES ADDRESSED

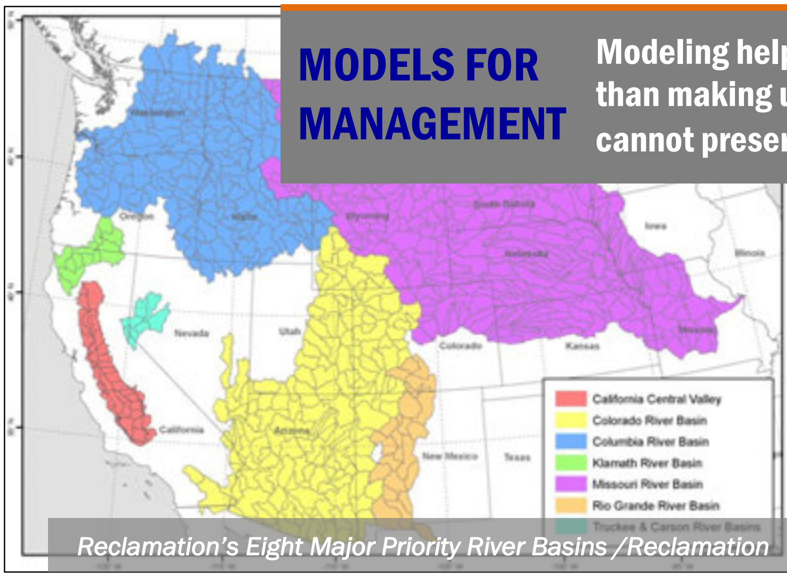
As the human population grows, demand for agricultural products increases. However, predicting water supply for agriculture is difficult because climate change disrupts atmospheric patterns and increases average temperatures. Climate change is causing a rise in evaporation and evapotranspiration rates, causing water to become scarcer. To better understand evapotranspiration and reservoir evaporation rates while considering the challenge of predicting water demands in a changing climate, this study evaluated multiple climate change scenarios across various time scales in the west to determine the most accurate outlooks.

PROJECT GOALS

- Provide scientifically reliable estimations of historical and future crop irrigation water demand and reservoir evaporation rates
- Create informational reference for future studies, assessments, planning efforts and other risk assessment projects
- Establish a foundation for future water management strategies

MODELS FOR MANAGEMENT

Modeling helps inform water management decisions now, rather than making uninformed decisions in the future, when managers cannot preserve lost resources from climate change.



Reclamation's Eight Major Priority River Basins /Reclamation

PROJECT HIGHLIGHTS

Developing Future Climate Scenarios: Researchers developed five climate scenarios based on CMIP3 (World Climate Research Program Coupled Model Intercomparison Project Phase3) climate projections of precipitation and temperature including warm-dry, warm-wet, hot-dry, hot-wet, and a central range of the climate projections (central tendency). Three future time frames were used to assess future demands: 2010-2039; 2040-2069; and 2070-2099.

Evapotranspiration and Irrigation Demands (ET) Model: The ET Demands Model predicts crop evapotranspiration and net irrigation water requirements under future climate scenarios. This model is more reliable than other models because it considers differing growing seasons across climate scenarios and more accurately calculates net irrigation water requirements of specific crops.

Complementary Relationship of Lake Evaporation (CRLE) Model: The CRLE model predicts historical and future evaporation rates from twelve Reclamation reservoirs and lakes. It can be more reliable than the traditional pan evaporation method to measure large water body evaporation because it accounts for heat storage. This model utilizes limited weather data to overcome limitations associated with other more complex models, making it more practical but reliable.

Collaborators

- See online for full list of collaborators

LESSONS LEARNED

All basins are projected to experience increases in temperature. Because heat promotes water vaporization, projections also indicate increases in evapotranspiration and reservoir evaporation. Still, many factors of evaporation and water demand are highly variable and basin dependent, including precipitation.

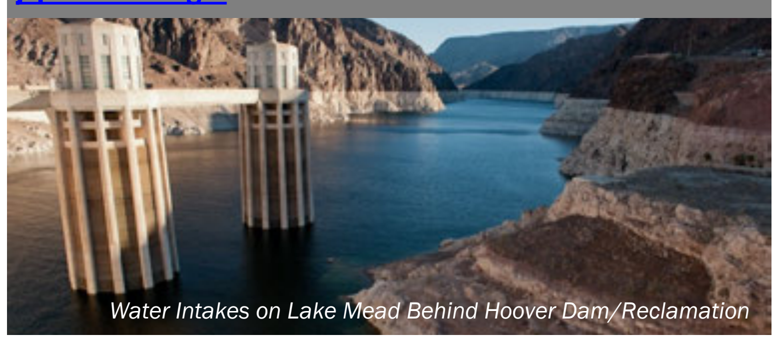
Building the ET Demands Model posed significant challenges. The model had to be modified for application to all basins being assessed, requiring extensive calibration and model modifications. Moreover, the budget and timeline of this project were significantly greater than initially estimated.

The most recent 231 downscaled and bias-corrected CMIP5 climate projections became available during this project, but the condensed CMIP3 projections had to be used because of budget and schedule constraints. Using finer resolution model inputs (e.g., 2-kilometer gridded), compared to the HUC8 spatial scale used in this study, would have produced more comprehensive results. Overall, the model results provided a solid baseline for future projects and water management.

NEXT STEPS

- Conduct another run of the models using the most recent climate projections and more higher-resolution climate scenarios
- Apply information learned from this risk assessment with more advanced instrumentation in the field to improve future risk assessments
- Use risk assessment to inform water and drought management of water bodies across the U.S.

For more information on this project, contact Mark Spears: jspears@usbr.gov


Water Intakes on Lake Mead Behind Hoover Dam/Reclamation

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