filling the gaps

Climate and Weather Information for Small- and Medium-size Water Utilities

WESTERN WATER ASSESSMENT
A NOAA RISA TEAM

THE Water Research FOUNDATION

Snowpack, Drought, and Water Supply in a Warming Mountain West

Science and Trends

Climate change in the Mountain West manifests with increased temperatures, changing seasonality of precipitation, increased potential evapotranspiration (PET), more precipitation falling as rain instead of snow, and an increase in regional extent and severity of drought. The region faces temperature increases of 5° to 10°F by 2100, depending on the emissions scenario, with the strongest warming in summer and fall. Warming increases atmospheric 'thirst'[1], and PET could rise 8% to 13% in the next 40 to 70 years, impacting streamflow and municipal and agricultural water demand. Under a moderate emissions scenario, these factors contribute to a small increase in the number of moderate or worse drought years, but under a high emissions scenario by 2100, the entire region would be affected by drought, with much of the region seeing half of all summers in drought[2].

1 Gonzalez, P., et al. 2018: Southwest. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume I Reidmiller, D.R., et. Al. U.S. Global Change Research Program, Washington, DC, USA, pp. 1101–1184. doi: 10.7930/NCA4.2018.CH25

2 Ahmadalipour, A. et al. 2017. A comparative assessment of projected meteorological and hydrological droughts: Elucidating the role of temperature. Journal of Hydrology, Volume 553, October 2017, Pages 785-797

Purpose of the Workshop Series

This workshop series was designed by NOAA and the Water Research Foundation to improve delivery of information resources for small- and medium- size water utilities useful for building their resilience to a changing climate. Each workshop was organized by NOAA's regional partners and addressed issues identified by and for each region. The workshops offered a forum for exchanging ideas to:

- Identify gaps and improve NOAA climate and weather-related tools and information resources;
- Provide timely and relevant weather and climate information and raise regional-scale awareness of NOAA tools and resources;
- Build regional connections that support small-scale utility decision making;
- Develop improved communication materials and enhance NOAA's tools for local decision making.

The Western Water Assessment Regional Workshop

Working in collaboration with partners at the Aspen Global Change Institute, Denver Water, the Water Utility Climate Alliance, and the Water Research Foundation, Western Water Assessment invited regional water managers to shape the workshop content and structure by participating in a pre-workshop survey. The resulting workshop focused on the impacts of drought and snowpack on water supplies at both short and long timescales. It included a mix of science presentations, tools demonstrations, a panel discussion, and opportunities to talk with peers.

Summary

Participants pointed to their need for improved seasonal data specifically for mid-and high-elevation snowpack and Snow Water Equivalent data; information to understand implications of antecedent soil moisture conditions; and methods to evaluate risk due to increasing temperatures. Methods to communicate risk to community residents and decision makers would also help water managers get buy-in for adaptation plans to manage water supplies in a changing climate.

Participants appeared to be largely familiar with the tools demonstrated. Many rely on the snow observing network (SNOTEL) and the Colorado Basin River Forecast Center resources, and half were familiar with the NOAA Water Dashboard and the Intermountain West Climate Dashboard.

Workshop Date :: August 2020

Case Studies

A panel discussion provided perspectives based on the experience of various water management practitioners.

Dena Egenhoff - City of Cheyenne, WY Board of Public Utilities. By linking higher future temperatures, reduced snowpack, and the relationship of drier soils to runoff, engineering staff were able to convey future risks to their Board and their community.

Jarrod Biggs - City of Durango, CO; Assistant Utilities Director. The VCAPS process (Vulnerability, Consequences, and Adaptation Scenarios) opened the eyes of the community and City Council to their water supply vulnerability under climate change.

Jon Parry, Weber Basin Water Conservancy District; Assistant General Manager, Weber Basin, Utah. A junior water rights holder providing wholesale water supply and flood control for five counties conducted a climate variability study to inform their drought contingency planning.

Meagan Smith - City of Fort Collins, Engineer, Water Resource Division, Ft. Collins, CO Utility. A wildfire that made their water source unusable spurred this community to conduct a climate vulnerability assessment, leading to both a drought management plan and plans to increase the size of their reservoir.

Beartooth Lake SNOTEL site, Wyoming
Credit: NRCS

Boulder Reservoir, Colorado
Credit: City of Boulder

McPhee Reservoir in SW CO at low levels
Credit: Seth Arens

Release of water from Glen Canyon Dam
Credit: National Park Service

Lessons Learned

Soil moisture deficits are increasingly affecting runoff.

Several participants noted their surprise when 2020 spring runoff was less than expected based on spring snowpack information. Sensitivity analysis highlights the importance of spring storms from April to June, and precipitation and snow melt have been considered the largest factors in stream flow models. As it turns out, dry soil conditions are increasingly a dominant factor, and local water managers are starting to understand these connections. A simplified water budget analysis illustrates that streamflow may decrease by as much as 25% with a 10% increase in evapotranspiration. This is a likely scenario as late 21st century temperatures are predicted to rise by as much as 5°-10°F. This is especially a concern for junior water rights holders who are affected by water use of senior rights holders, and must forecast residual water availability.

Communities are wary of spring rains in areas scarred by wildfires.

Water managers are observing, in areas scarred by wildfires, spring rain increases sediment and debris, which fouls water supplies, clogs rivers and treatment facilities, and raises the risk of flooding. While wildfire was not the focus of this workshop, some participants discussed the increasing risk of wildfire that is motivating their climate adaptation assessments. For example, the 2002 Missionary Ridge fire ran through Durango's entire water supply, and the constant reminder of increasing fire risk contributes to their drive to develop additional water sources. Wildfire concerns have also motivated planners in Ft. Collins to update their water conservation plan, and residents for the first time have voluntarily adopted conservation practices.

Water agencies in the Mountain West are starting to consider climate change, but putting adaptation actions into practice can be enhanced by employing some key organizational practices, according to studies by the Water Utility Climate Alliance.

- Incorporate participation across the organization.
- Incorporate climate in meetings and conversations to build the knowledge base.
- Foster sustained relationships with the climate science community.
- Leverage the power of well-placed climate change screening questions, e.g., when prioritizing capital expenditures.
- Take on climate change as another component of risk management.
- Make the business case for climate adaptation.

SCAN ME

› NOAA Workshop Series Website

› WWA Workshop Website

Tools Demonstrated:

› Intermountain West Climate Dashboard (Western Water Assessment)

› Colorado Drought Update (Colorado Climate Center)

› Snowpack Monitoring in the Rocky Mountain West: A User Guide

› Colorado Basin River Forecast Center

› Climate Resilience Toolkit

› Water Resources Dashboard

› Climate Explorer

Dispelling the Myth: "If you build it, they will come." Fact: Scientists can't just build new tools - useability and acceptance are essential. To date, WWA has held six VCAPS workshops, and WUCA has conducted various case studies, to understand what factors improve the useability of climate information as well as how organizations get buy-in to put information in practice, suggesting the following factors:

- Geographic Scale: The right scale for the user.
- Skill of info: A track record of consistently and accurately projecting climate conditions.
- Understandability: Information is tailored to users' technical capacity.
- Coproduction: Actively engage users in development of new information products.
- Organizational Factors: Information is provided by trusted sources, a community of practice tests new methods, and the organization has resources to allow staff training.

Information Needs

Snow Water Equivalent: SNOTEL and ASO

- ❍ Increased number of SNOTEL sites, especially in the highest elevation basins.
- ❍ Spatialized snowpack data and products from the Airborne Snow Observatory (ASO) and LIDAR for more accurate information on snow cover and SWE information at higher elevations and unmonitored locations.
- ❍ Products to show the relationship between elevation and snowpack; integration of ASO data into CBRFC forecasting processes.

Soil Moisture and Runoff Efficiency

- ❍ Remotely sensed soil moisture data.
- ❍ Track runoff efficiency trends, monitor soil moisture, and synthesize information to understand feedback loops.
- ❍ Track vegetation to get a handle on increase or decrease in ET.
- ❍ Better understanding of precipitation variability and how it connects to runoff.

Capacity Building and Communication

- ❍ Modified hydrologic and operational models to incorporate climate change information
- ❍ Improved data products to facilitate customization for communicating with decision makers.
- ❍ Technical assistance and guidance on using climate change information, and communicating to decision makers, including the idea of multiple climate futures.

Next Steps

The workshop reinforced the understanding of the need for scientific information and tools to increase water utility resilience in a changing climate for both large and small communities and utilities in the Mountain West. One such need is better snowpack information - as a result, WWA now plans to finalize its draft snowpack user guide.

Participants highly valued the opportunity to learn from scientists and peers, and are interested in opportunities to advance local planning for climate resilience. Discussion and survey responses are helping WWA identify topics for future workshops and webinars. The advent of CoVid-19 has shifted workshops from large in-person events to virtual events. The virtual format allows WWA to reach participants in more utilities and communities and WWA plans to expand its virtual offerings in future years throughout the Mountain West.

Organized by

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