American Water Resources Association
Washington Section
www.waawra.org
SEPTEMBER-OCTOBER

President's Notes

By Tyler Jantzen, P.E., CH2M Hill, AWRA-WA President

It is with great pleasure that I am able to inform you that the Washington Section of the American Water Resources Association has been selected as the AWRA Outstanding State Section for 2015! The award will be presented at the AWRA Annual Conference held this November in Denver.

As AWRA President John Tracy noted in the notification letter, AWRA-WA competed for this award from a pool of excellent nominations across the country. There are many reasons why I believe AWRA-WA was selected, including our:

- Strong student and community outreach
- Regular and well attended educational and networking events
- Expansion of programs outside of Puget Sound and across the state
- Partnership with non-profit and educational organizations
- Our regular and highly professional newsletter[1]

I am extremely grateful for your support and critical role in AWRA-WA's success. It is the support of our sponsors, partner organizations, volunteer board and engaged membership that makes our program possible. I am especially grateful for the hard work of recent AWRA-WA presidents: Megan Kogut (2014), Dustin Atchison (2013), Scott Kindred (2012) and Beth Peterson (2011). The list really goes beyond what I list – 2011 is an arbitrary cutoff. See the full list dating back to Gary Minton (1979) in a recent conference program. These past presidents, and their respective boards of directors, each strengthened the organization and our mission to advance water resources management in Washington. With your help, I look forward to continuing to grow and strengthen AWRA-WA.

On a completely different topic and without any appropriate segue, I wanted to express my concern about the impacts of the continued drought and especially of the recent record-setting wildfire season on our state's water resources. I know many of you are actively working to protect and restore our water resources in these extreme conditions, and for that I thank you. I am continuously amazed by nature's resilience, and am confident she can recover at a surprising rate. Nonetheless, we as water resource managers definitely have our work cut out for us.

In light of the fires, I want to highlight one of many resources out there for water resource managers such as Ecology's toolset for performing hydrology calculations for recently-burned watersheds. If you know of other similar tools or information related to impacts of the fires on water resources, please send them my way and I can distribute to our membership.

The past few weeks of extreme low water levels and record wildfire damage underscore for me the timeliness and importance of our annual conference topic – Water Management Strategies in the Face of Climate Change. The information, discussion and case studies presented here should be immediately applicable to you on ways to respond now and in the future. A friendly reminder that rates increase at the end of September, so make sure to register soon! I look forward to seeing many of you there.

-Tyler

(tyler.jantzen@ch2m.com)

1. And many thanks to our tireless and reliable editor, Eric Buer for making it so!

In this Issue:

Registration For the AWRA-WA State Conference is Open!
October 22, 2015

This Year's Topic:

Water Resources and Climate Change
Adapting to a Changing World

What to Expect When You're Expecting El Niño: Winter 2015 Outlook

By Karin Bumbaco and Nick Bond, Office of the Washington State Climatologist

¿Cuál es El Niño?

Most readers have likely heard that the chances of the current El Niño lasting through the winter of 2015-16 are high, with the Climate Prediction Center reporting that there is over a 90% chance of the conditions continuing. Recent drought in Washington, Oregon, and California has added extra interest in the unfolding climate event, with hopes that it could bring drought-busting rain and snow to parts of the west.

The 2014-15 winter in WA State was not lacking precipitation, but record warm winter temperatures caused the precipitation to fall as rain rather than snow at higher elevations, resulting in a meager snowpack. A warm and dry spring and summer turned the situation into a bona fide drought; more information on the 2014-15 winter conditions and the WA drought can be found at the Office of the Washington State Climatologist webpage.

El Niño and Washington Winters

The El Niño-Southern Oscillation (ENSO) is a mode of natural variability in the tropical Pacific Ocean that can impact winter weather patterns across the globe. El Niño - the warm phase of ENSO – occurs when temperatures in the eastern equatorial Pacific are warmer than normal across the basin, with corresponding anomalies in the winds and deep convection that generally impacts weather patterns across much of the globe. Figure 1 shows a series of ENSO model forecasts as of mid-August, with each line representing a different dynamical or statistical model forecast. All models show warmer than normal sea surface temperature (SST) anomalies for the upcoming winter, meaning an El Niño, with the consensus close to a 2°C anomaly. So what does that mean for the winter weather in WA State?

Pacific Northwest winters tend to be warmer than normal during El Niño events, especially after January 1. The CFSv2 seasonal forecast model is a fully coupled ocean-atmosphere model that also takes into account the persisting El Niño. The forecast initialized on 14-23 August (Figure 2a) shows warmer than normal temperatures for all of WA State for December through February (DJF). This forecast is consistent with previous forecast initializations, which is no surprise.

In addition to the tendency for temperatures to be elevated during an El Niño event, the Pacific Northwest is also experiencing the impact of "the blob". The blob is a nickname for an area of warmer than normal sea surface temperatures that has persisted off the WA coast since early 2014 that has been linked to warmer than normal air temperatures over land in the state, especially west of the Cascade Mountains.

During El Niño winters, there tends to be less total precipitation and snow by April 1 in WA State. Figure 3 shows the total October-March precipitation averaged over the state compared to the ENSO3.4 SST index. Negative ENSO3.4 index values indicate La Niña conditions. Positive ENSO3.4 index values indicate El Niño conditions. When El Niño conditions are developing or are fully developed, the statewide mean precipitation is approximately 2 inches less than during ENSO3.4-neutral years.

However, it is important to note that there is substantial variation from one El Niño year to another. While the El Niño winter precipitation mean is about 2 inches less than the average for all 82 years, there are certainly plenty of El Niño winters that have more precipitation statewide than some La Niña winters. With that said, the CFSv2 seasonal forecast model is calling for below normal precipitation for a majority of the state during DJF (Figure 2b).

What Lies Ahead

While WA winters tend to be warmer and drier during an El Niño, on average, this is certainly not a guarantee. An appropriate analogy is at the poker table: El Niño stacks the deck, but does not guarantee a particular deal of cards. The last strong El Niño in 1997-98, for example, had warmer than normal temperatures, but near-normal winter precipitation averaged statewide and near-normal snowpack in the mountains.

The forecasted El Niño also does not mean we can't get cold spells even though the average winter conditions are warmer than normal. The recent moderate El Niño of 2009-10 represents a good example. In early December 2009, an arctic air outbreak occurred causing temperatures in the single digits around the state. Those cold air outbreaks are less likely in an El Niño winter but that does not mean they cannot hap-

Continued on Page 3: ENSO

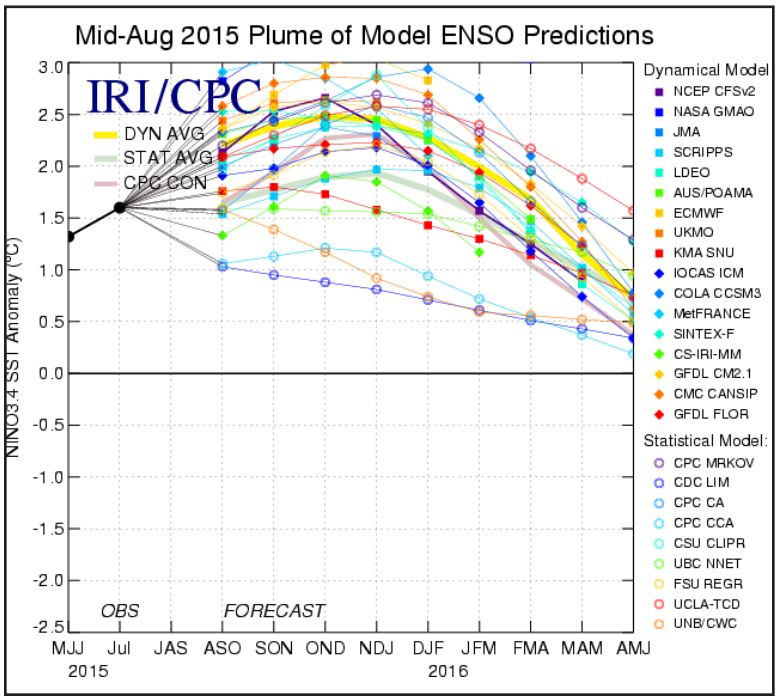

Figure 1. ENSO sea surface temperature anomoly model forecasts initialized in August 2015. The blob is not shown.

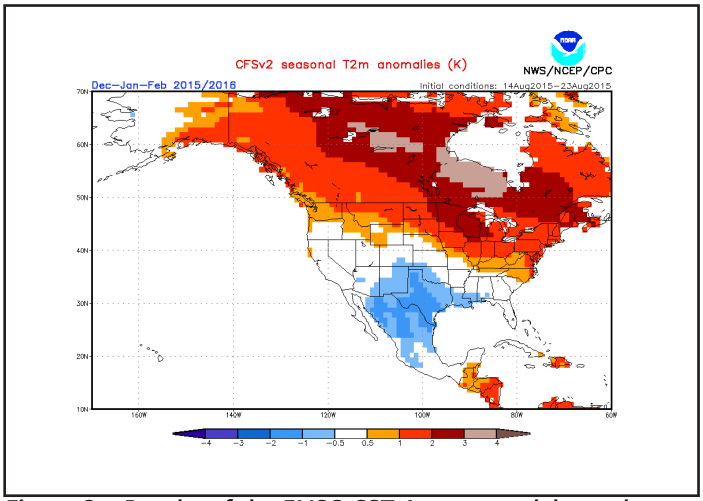

Figure 2a. Results of the ENSO SST August model run show moderately warmer than normal temperatures for all of Washington State.

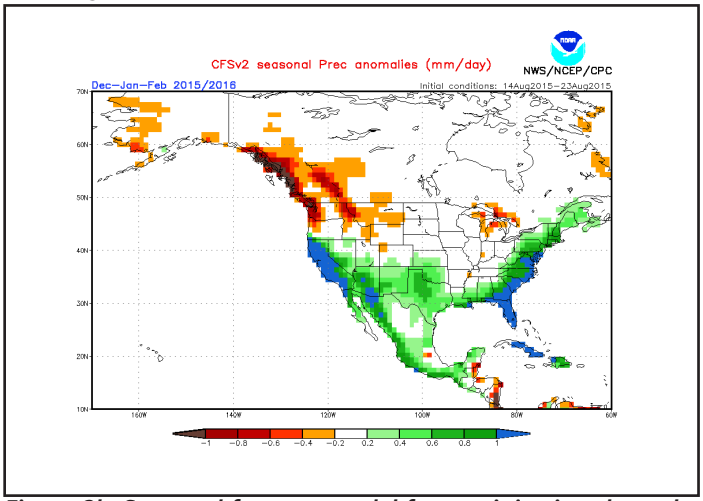

Figure 2b. Seasonal forecast model for precipitation throughout the U.S. shows lower-than-normal totals for Washington, Oregon, and Idaho, but higher-than-normal totals for California and Arizona

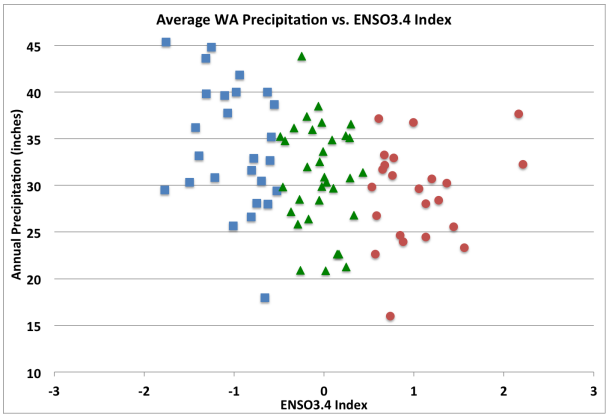

Figure 3. The average statewide October through March precipitation compared to the average ENSO3.4 index for the same period for 1933-2015. The green values represent neutral years, the blue La Niña years, and the red values El Niño years.

AWRA-WA State Conference

Location: Seattle Mountaineers Event Center, 7700 Sand Point Way NE, Seattle

Date: 22 October 2015 8:00 AM PDT

Event Information

This year's conference will focus on the latest understanding of impacts of climate change to water resources in Washington State and potential strategies for adapting to these changes. The warm winter of 2015, perhaps a typical year in future decades, provides an interesting backdrop for discussing climate change impacts.

Although the rate and magnitude of climate change is uncertain, there is clear scientific evidence that global temperatures will warm considerable over the next century, resulting in significant changes to temperature and precipitation patterns across the globe. Most models predict that Washington State will experience significant reductions in snowpack, dramatically changing the runoff patterns for streams and rivers that drain mountainous basins with snow-dominated hydrographs. In general, runoff is expected in increase in winter months and decrease in summer months.

The impacts associated with these changes in runoff patterns are substantial and widespread, and the conference will address impacts associated with fisheries, power generation, domestic and industrial water supply, irrigated agriculture, recreation (e.g., skiing, boating, and fishing), and flood control. Most importantly, the conference will focus on discussing various strategies to address these impacts. As always, we will include speakers with diverse backgrounds and alternative viewpoints and hope to stimulate discussions regarding potential solutions.

An evening reception will follow the conference with an opportunity to meet and mingle among water resource professionals, and the opportunity to enjoy a variety of hors d'oeuvres and select beverages.

Please contact one of the conference co-chairs with questions: Scott Kindred (scottk@kindredhydro.com) or Steve Nelson (snelson@rh2.com).

Register on the AWRA-WA Website Today!

Continued from 2: ENSO pen. To summarize, the upcoming winter is expected to be warmer and drier as a whole, but there will be variability in the day-to-day weather just like every other winter. The CFS model, the Climate Prediction Center outlook, past El Niño events, and the persistence of "the blob" all support a warmer and drier than normal winter, with higher confidence in the temperature forecast compared to the precipitation forecast.

This prediction is certainly concerning in light of the current statewide drought emergency, but we can take comfort in the fact that there is a high amount of variability in past El Niño events. A few good storms out of the Gulf of Alaska, especially late in the winter, would go a long way to ensure that we don't see a repeat of the 2014-15 season.

Water Resources Planning under Climate Change: Modeling Approaches and Challenges in California

By Thomas FitzHugh, Supervisory Water Resources Scientist, MWH Global

Introduction

California is facing a long-term water crisis centered on water supplies and environmental conditions in the Central Valley, which is being exacerbated by drought and the impacts of climate change. Water supply yields for the State Water Project (SWP) and the Central Valley Project (CVP) have dropped over the last few decades due to increasing environmental regulations, while health of the Delta ecosystem and endangered species have continued to decline. The current drought in California is not only making conditions worse for both ecosystems and those dependent on scarce water supplies, but also heightening other issues such as excessive groundwater pumping.

Climate change is playing an important role in this crisis. A recent study by Columbia University showed that while long-term climate patterns are still dominated by year-to-year variability, global climate change has increased the likelihood of extreme droughts in California. Solutions to this crisis are being investigated in terms of new reservoir and conveyance facilities that will improve drought supplies and water supply reliability. Planning studies for these proposed projects involve complex modeling of water supply conditions and environmental impacts, which has spurred the need for improved data and analytical capabilities with regard to climate change.

This article will summarize the evolution of analytical approaches for evaluating climate change in water resources planning studies in the Central Valley of California, focusing on major studies conducted over the last 10 years. All studies described here were led by the California Department of Water Resources (DWR) or the U.S. Bureau of Reclamation (Reclamation), which operate the SWP and CVP, respectively. Initial studies conducted from 2006-2010 will be summarized first, following by more detailed description of studies between 2011 and 2015, which included more sophisticated climate change approaches and analysis of proposed projects that could be important to water supply sustainability in California in the future. Some themes that will be covered here are criteria for selecting emissions scenarios for use in planning analyses, notable trends in results for water supply operations in baseline and alternative scenarios, and future challenges.

2006-2010 Studies

Studies during this period included reports in 2006 and 2009 from DWR on incorporating climate change into water resources planning studies in the Central Valley, and a 2008 Biological Assessment of the operations of the CVP by the US Bureau of Reclamation. The latter report did not address climate change throughout, but has a sensitivity analysis of how results from the report would be affected by different climate futures. The DWR reports used 4 and 12 emissions scenarios respectively, with a primary selection criteria being how well the model results fit to historical climate records. The 2008 Reclamation report instead used a quadrant approach wherein 4 emissions scenarios were selected that accounted for most of the variability in the predicted range of temperature and precipitation changes of a much larger set of scenarios. The 4 scenarios represented less warming/drier conditions (Q1), more warming/drier conditions (Q2), less warming/wetter conditions (Q3), and less warming/wetter conditions (Q4).

The advantage of the quadrant approach is that it captures the full range of uncertainty in a set of projections, which is desirable since evidence suggests that historical model performance is not a good predictor of future climate change performance. Later studies discussed below expanded on this approach. Comparison of these three studies indicates how emission scenario selection can affect results. The scenarios selected for the DWR studies were biased toward drier conditions, which led to results where most (or all) of the future scenarios showed worse water supply and reservoir storage conditions than were observed in the historical climate record.

The Reclamation study showed a broader range of effects, with some scenarios leading to some higher delivery and storage volumes, and some lower. One notable result was that CVP project deliveries were affected differently by climate change north of the Delta vs south of the Delta, with northern deliveries varying less under a range of climate change scenarios due to the presence of more senior water rights which were last in line to feel the impacts to the season's available supply. Only under very dry conditions were those deliveries significantly affected.

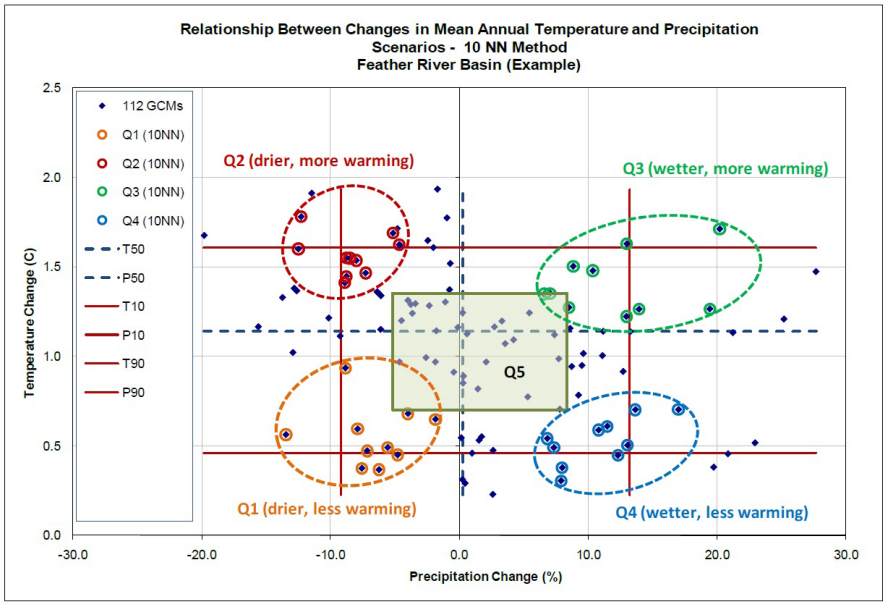

Figure 1. Example of Downscaled Climate Projections and Sub-Ensembles Used for Deriving Climate Scenarios (Q1-Q5), Feather River Basin at 2025 (from BDCP EIS).

2011-2015 Studies

Continued on Page 6: California

Water Resources News Roundup

By Eric Buer, Farallon Consulting, AWRA-WA Board Member, Editor

Welcome back loyal readers! WRNR has returned along with a new school year, football, and some very welcome rain! As the summer has progressed Pacific Northwest residents have watched their lawns dry out, rivers dwindle, and the air quality degrade while wildfires have raged across public forests and the front country. As of this writing 29 wildfires are still burning in Washington State alone (get the latest information from InciWeb).

After a warm and dry winter and some of the best spring bike commuting in recent memory, this summer seems to have brought climate change and its impacts on water resources to the forefront of many conversations. There certainly seems to be no "shortage" of news stories to discuss.

Droughts have been declared in the Columbia Plateau of Washington and the Willamette Valley of Oregon, as well as the Cascades Mountain Range. According to the vegetation drought response index published by the National Drought Mitigation Center 30-percent of Washington is experiencing moderate to extreme drought. Reservoir storage is down across the western US, particularly along the west coast and in the basin and range province. Many water projects are currently using less than 50-percent of their available storage, raising painful questions about their future utility if present rainfall and snowpack trends continue.

Water shortages have been declared by many public utilities including Seattle, Everett, and Tacoma, where customers have been asked to voluntarily reduce water usage by 10-percent in order to stretch available supplies further into the fall. Further south water scarcity has apparently resulted in more drastic measures that included drought shaming neighbors who water their lawns on Twitter (#droughtshaming), and reporting them to the government. In August to further conserve water at the Los Angeles Reservoir, the Los Angeles Department of Water and Power bounced around and then adopted a $34.5 million dollar measure to cover the water surface with millions of floating plastic balls to reduce evaporation losses.

Low discharge rates and very warm waters in rivers and streams up and down the west coast have resulted in significant mortality for cold water fish such as salmon, steelhead, and smelt. Meanwhile off the coast warm water species including sardines and albacore tuna are expected to do better than average as a result of the formation of what our friends at the Office of the Washington State Climatologist have referred to as "the blob." (If you're interested there's a blob of text about the blob on page 2 and more blobs on some blogs online).

It is particularly timely that this year's AWRA-WA State Conference will address water management strategies in the face of climate change. Each year it seems PNW residents and professionals witness more numerous and significant impacts to the region as a result of the shifting climate. This conference will address a broad range of professional water resources topics including climate change impacts to supply and demand, economic costs, and ecologic effects. We hope to see you there.

Thanks to Our Basin Sponsors!

2015 AWRA-WA BOARD MEMBERS

Continued from 4: California Subsequent studies used improved climate change datasets and began to incorporate climate change analysis into evaluation of project alternatives. The EIS for the Bay-Delta Conservation Plan (BDCP), an ambitious project which proposes to combine a new water conveyance facility with habitat restoration in the Delta to meet the dual goals of water supply reliability and ecosystem health, invested significantly in improving climate change datasets. BDCP used the multi-model ensemble-informed approach, where subsets of a larger set of models were used in combination to characterize climate (Q1-Q4) change under the same four temperature and precipitation conditions used in the quadrant approach described above. In addition a fifth ensemble (Q5) was used to represent median conditions. Figure 1 shows the an example of sub-ensembles used to characterize those 5 conditions in the Feather River Basin. Recent studies have shown that ensemble-based scenarios are advantageous over single climate model scenarios for characterizing climate change. These emissions scenarios were used not only in the BDCP EIS but in other studies as well.

Two studies conducted by Reclamation provided a second dataset that has also been used in subsequent analyses. These were the Central Valley Project Integrated Resource Plan (CVPIRP) and its precursor study, the Westwide Climate Risk Assessment (WWCRA) for the Sacramento and San Joaquin Basins. Both studies used 5 ensemble informed climate change projections developed in a similar manner as BDCP, augmented by additional scenarios to capture a wider range of variability beyond the ensembles. The WWCRA also used 12 individual global climate model scenarios, and the CVPIRP combined the 5 ensemble-informed scenarios (and a baseline) with 3 socioeconomic trends (Current Trends, Slow Growth, and Expansive Growth). So in total each study had 18 scenarios.

Multiple studies were conducted during this time period to assess the ability of proposed projects and policies to improve water supply reliability, all of which incorporated climate change to some extent. The CVPIRP was most extensive as it analyzed a series of water management actions and how they improved supply and other water resources metrics under the climate change scenarios described above. However, the water resources modeling techniques used in CVPIRP were at a less detailed screening level, as opposed to more detailed modeling conducted for EISs and Federal Feasibility Studies. Studies that fit these two latter categories are the BDCP EIS and three studies of additional reservoir storage; for construction of an offstream storage facility in the Sacramento River Basin (NODOS); enlargement of Shasta Reservoir on the Sacramento River; and construction of a new reservoir (Temperance Flat) just upstream of Millerton Lake on the San Joaquin River. As will be discussed later, while climate change data was incorporated into all four of the studies, none of them used the full range of climate scenarios in the final analysis of alternatives.

While different methodologies and purposes make it difficult to draw firm conclusions from comparing the results of different studies, selected results show the type of useful information that can be gleaned from studying alternatives under a range of climate change scenarios. In the NODOS study, the storage benefits of the alternative with the smallest raise improved relative to benefits of other alternatives as climate change progressed through the 21st century. The alternative analyzed under climate change in the Shasta Enlargement EIS shows a different pattern of benefits under a drier climate change scenario, with fewer storage benefits and more delivery benefits when compared to wetter conditions. In contrast, the Temperance Flat EIS showed low delivery benefits under drier conditions. Finally, in the CVPIRP study aggressive water conservation was shown to have the greatest potential benefit compared to other proposed actions across a range of climate change conditions.

Future Challenges

While climate change analysis for water resources planning in California has advanced significantly in the last 10 years, there are many challenges ahead. One major challenge in water supply operation modeling is that climate change is incorporated into model hydrologic inputs with minimal changes in operational rules. This inevitably produces unrealistic reservoir operations, for example in most of these studies reservoirs hit their minimum pool levels far more frequently in the climate change scenarios than in baseline analyses. This is an unrealistic operation, because in the real world operational criteria would be adjusted to minimize these situations, and it has engendered misinterpretation of model results in public discussions of some of these projects. There is no easy solution to this however, since the problem is that operational criteria for reservoir operations are tightly linked with legal and institutional arrangements such as environmental regulations, water rights, and contracts, changes to which would be very controversial.

Sea level rise assumptions were not mentioned above, but all of the studies discussed here except the 2006 DWR study assumed that sea level will continue to rise through the 21st century. Because large volumes of water are taken directly from the Sacramento-San Joaquin Delta for agricultural and domestic purposes, and because there are environmental standards for maintaining salinity below certain levels in the interior of the Delta, sea level rise is perhaps the most significant climate change impact on water supply and environmental quality in California. Reservoir releases to mitigate against these salinity and delta water quality degradation problems are a large part of the reason for the unrealistic reservoir operations described in the previous section. Hence, dealing with sea level rise is a critical challenge for the future.

Finally, with the exception of the CVPIRP, none of the recent studies incorporated the full range of climate change scenarios into alternatives analysis. Typically either a single climate change scenario was used for alternatives analysis or multiple climate change scenarios were used in a sensitivity analysis at the end of the study. While analyzing a greater number of scenarios is a challenge in studies such as these that are already extremely complex, momentum continues to build in this direction. The Federal government is currently in the process of implementing new planning standards that will require more extensive analysis of climate change in planning studies. The correspondingly more rigorous analysis of project performance under different climate futures will provide essential information for water resources planners in California as they deal with grapple with these changes into the next century.

2015 Program and Speakers

Intro and Keynote Speaker
Dr. Joe Casola, University of Washington, Deputy Director, Climate Impacts Group

Predicted Climate Change and Hydrologic Impacts in Washington State
- Dr. Julie Vano, Oregon Climate Change Research Institute
- Matt Bachmann, United States Geological Survey Glacier Studies

Supply and Demand Forecasts
- Tom Tebb, Department of Ecology, Director, Office of Columbia River
- Dr. Jennifer Adams, Washington State University

Economic Impacts
- Terese Richmond, Partner, Van Ness Feldman LLP
- Dr. Gretchen Greene, Senior Manager, Ramboll Environ

Lunch Speaker:
Martha Kongsgaard, Chair of Marine Resource Advisory Council and Leadership Council, Puget Sound Partnership

Flooding and Water Supply
- Dr. Erkan Istanbulluoglu, University of Washington, Associate Professor, Watershed Dynamics Research Group
- Glen Connelly, Chehalis Tribe, Environmental Programs Manager
- Kevin Shafer, Army Corp of Engineers, Hydraulics Engineer

Streams and Fish
- Dr. Tim Beechie, NOAA, Northwest Fisheries Science Center, Supervisory Research Fish Biologist
- Aja DeCoteau, Columbia River Inter-Tribal Fish Commission, Watershed Department Manager
- Scott Nicolai, Yakama Nation Fisheries, Habitat Biologist

Call to Action - What Should We be Doing Now to Build Resiliency?
- Jeff Marti, Department of Ecology, Drought Coordination
- Paul Fleming Seattle Public Utilities, Manager, Climate Resiliency Group
- Dr. Bob Freitag, University of Washington, Director, Institute for Hazards Mitigation Planning and Research
- Lisa Pelly, Trout Unlimited's Washington Water Project, Director

Reception to Follow

Don't Be Left Out At the Water Cooler Monday Morning, Register Now

Thanks to Our Media Sponsor

The Water Report
Water Rights, Water Quality & Water Solutions in the West

American Water Resources Association Washington Section
P.O Box 2102
Seattle, WA 98111-2102
(Change Service requested)

PRSRT STD
U.S. POSTAGE
PAID
SEATTLE, WA
PERMIT #1445

Special thanks to Farallon Consulting for publishing support on this newsletter.

2015 MEMBERSHIP / CHANGE OF ADDRESS FORM

(PLEASE CIRCLE AS APPROPRIATE)

Annual membership for the AWRA Washington Section costs $35.

Name _____Position _____ Affiliation _____

Street Address _____City _____State _____Zip_____

Phone (_____)_____Fax (____)_____E-mail _____@_____

□ Please indicate if you prefer to receive your newsletter electronically.

□ Check if you would like to be actively involved on a committee. You will be contacted by a board member.

2014 Membership Dues: $35.00.

Preferred Method: Pay via Paypal on our website: http://waawra.org/.

For Checks: please make payable to AWRA Washington Section.

Mail to: American Water Resources Assoc. WA. Section
P.O. Box 2102
Seattle, WA 98111-2102

The American Water Resources Association is a scientific and educational non-profit organization established to encourage and foster interdisciplinary communication among persons of diverse backgrounds working on any aspect of water resources disciplines. Individuals interested in water resources are encouraged to participate in the activities of the Washington Section. Opinions and views expressed in articles of this newsletter are those of the author, not AWRA-WA.