

Do strong El Niño/La Niña signals translate to higher accuracy and value of seasonal forecasts?

Yes! With a diverse topography, El Niño/La Niña has localized impacts on water availability in the PNW. We expect strong El Niño/La Niña signals on the windward slopes of the Olympics, Cascades and Bitterroots-Rockies, as well as the Snake Headwater region. These are the regions where seasonal forecasts have high accuracy in correctly forecasting droughts, and therefore have the highest value.

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This research highlight is based on work in progress.

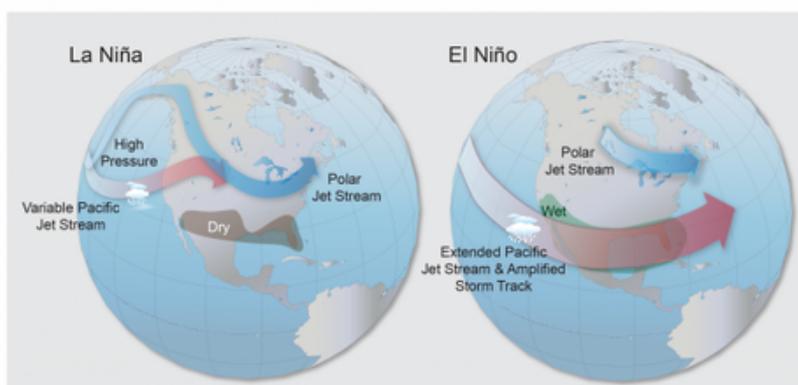


For several decades, ENSO phases (whether it's El Niño or La Niña) have been linked to unusual weather patterns, such as warmer or cooler temperatures or wetter or drier conditions, compared to

normal. In areas where ENSO effects are strong (e.g., southeastern U.S.), ENSO phase forecasts have been used to help make farming decisions, such as land allocation, crop selection,

rotation, sowing/planting date, and fertilizer management decisions. It would be informative to know how much these unusual weather patterns linked to the ENSO phases vary across the U.S. Pacific Northwest (PNW) and find specific regions where this variation is most noticeable.

“El Niño and La Niña are the warm and cool phases of a recurring climate pattern across the tropical Pacific—the El Niño-Southern Oscillation, or ‘ENSO’ for short” (climate.gov/enso). Image: USGCRP



Growers in these regions can potentially use the ENSO phase information for agricultural decision support. Additionally, a strong ENSO signal has been associated with higher accuracy for seasonal forecasts, or weather forecasts made several months out in the future. Therefore, it is expected that seasonal forecasts will have higher economic value in

regions with strong ENSO signals. Our research puts this assertion to the test.

In the PNW, El Niño winters are generally warmer and drier, whereas La Niña winters are cooler and wetter. However, the high mountains of the PNW disrupt prevailing winter air movements brought on by El Niño or La Niña, resulting in varying ENSO signals across the region. In Washington State, ENSO generally has a relatively small impact on water availability (streamflow) in agricultural areas of Yakima Basin and the Columbia Basin Project during the growing season. On the contrary, windward slopes of the Olympics, Cascades and Bitterroots-Rockies, as well as the

Snake Headwater region, are likely to experience strong ENSO impacts on water availability (Figure 1a).

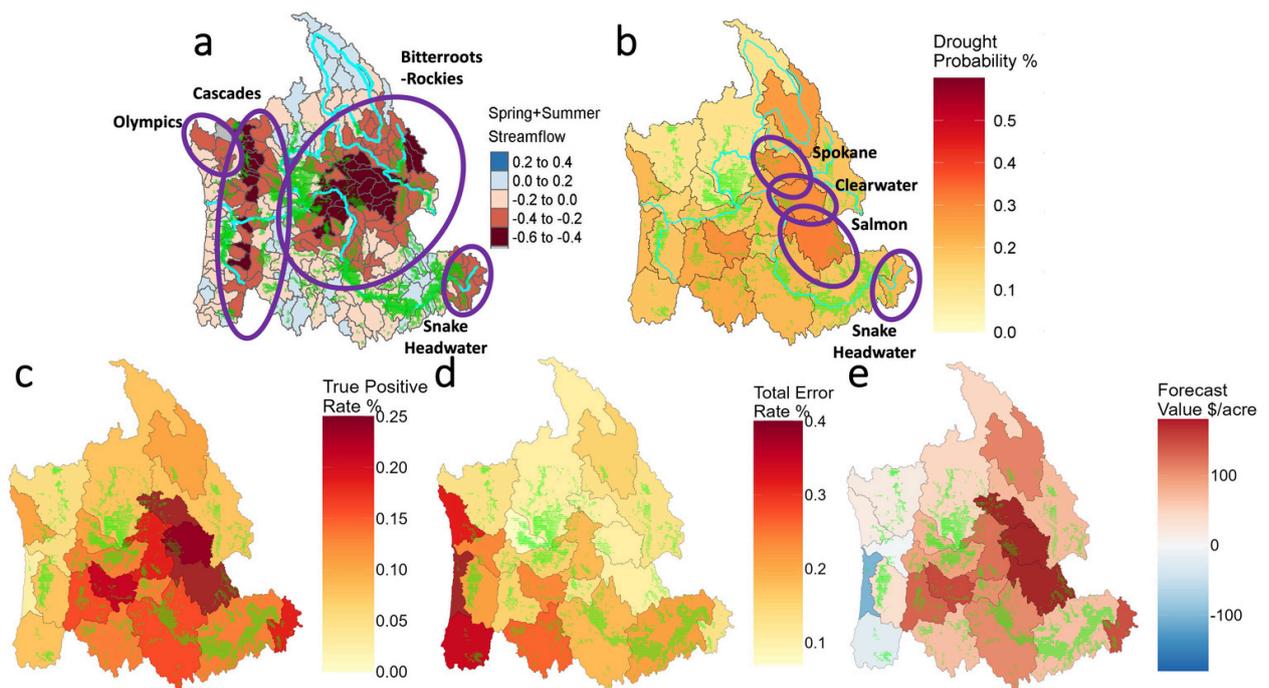
Moreover, these regions that experience strong ENSO signals overlap with areas where drought is relatively frequent, such as the Spokane, Clearwater, and Salmon sub-basins (Figure 1b). The strong ENSO signals translate to a higher seasonal forecast skill in correctly identifying drought years (i.e., a higher true positive rate) (Figure 1c), which means that these regions also have a higher forecast value (Figure 1e).

In our previous work (refer to Can a seasonal drought forecast be wrong and still worth using for making water leasing decisions?),

we used the case of a farmer with junior water rights making water leasing decisions to assess the value of seasonal drought forecasts for the Pacific Northwest. We demonstrated that a forecast will have more value if droughts happen more often, and when the forecast is skilled enough to not miss too many droughts. Both conditions are met in the region of Spokane, Clearwater, and Salmon sub-basins (Figure 1e). Snake Headwater has both high true positives and true negatives – seasonal forecasts correctly predict both droughts and non-droughts, and so forecast value is also high, due to relatively low overall error (Figure 1d).

Hence, Spokane, Clearwater, and

Figure 1. (a) ENSO signal as depicted with El Niño/La Niña impact on the spring to summer streamflow, and (b) historical drought frequencies over 1980–2010; (c) true positive rate (chances of a random year correctly predicting drought based on historical data over 1980–2010); (d) total error rate (chances of a random year falsely predicting drought/non-drought based on historical data over 1980–2010); (e) forecast value based on assumptions on water leasing price of \$450/acre and agricultural profit of \$1500/acre.



Salmon sub-basins in Idaho are likely good candidates for ENSO-based agricultural decision making. Farmers should have more confidence in seasonal forecasts in such regions with strong ENSO signals. Water in the Columbia River basin mainly comes from snowmelt from upstream, and therefore the high forecast accuracy at Snake Headwater can be helpful for decision making in the adjacent Upper Snake agricultural areas.

This research can help farmers predict water availability during the growing season when the prior winter was El Niño or La Niña, and pinpoints areas that can expect

strong ENSO impacts. In addition, in areas where there are strong El Niño/La Niña signals, seasonal forecasts are likely to be more useful.



Near the Snake River east of Starbuck, WA.

Chen “Jacky” Xu, Ph.D., is a researcher and data scientist in climate (water), agriculture, and economics at Washington State University. Dr. Xu is interested in applying a broad range of hydrological, geospatial, and statistical tools that empower data-driven decision-making, and bridging the gap between climate data engineers and decision-makers to address the challenges posed by climate change on the human-environment nexus. This work is part of Dr. Xu’s Ph.D. dissertation (2024).

Jennifer C. Adam, Ph.D., is a Berry Distinguished Professor at the Department of Civil and Environmental Engineering at Washington State University. Dr. Adam is interested in the connections between climate, hydrology, land use, and ecological (natural and agricultural) processes. This includes understanding how climate variations and direct human influences interact to alter land surface hydrologic processes at watershed, regional, and global scales.

Michael P. Brady, Ph.D., is an Associate Professor and Extension Economist (specialty crops) at the School of Economic Sciences at Washington State University. Dr. Brady is interested in modeling coupled human and environmental systems related to water use and irrigated agriculture in an interdisciplinary framework. This includes farmland ownership, agricultural land values, and land use change for specialty crop (tree fruits, vineyards, vegetables, horticulture, and nursery crops) production.

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