

Science

BRIEFING

February 13, 2014

PRECIPITATION DECLINES IN PACIFIC NORTHWEST MOUNTAINS

BACKGROUND

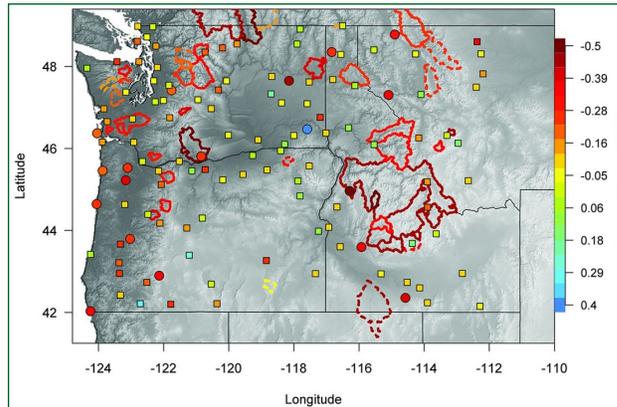
A rapidly warming climate across the Pacific Northwest is altering the volume, timing, and quality of water received from winter snowpack. Historic observations show increased dryness accompanying more widespread wildfire and forest die-off. These trends have generally been attributed to warming temperatures because measurement gauges at lower elevations throughout the region showed no significant decrease in precipitation.

RESEARCH

Research Activity: In a recent article published in the journal *Science*, RMRS Research Hydrologist Charlie Luce and colleagues examined high-elevation climate trends in the Pacific Northwest. Their research shows that streamflow declines are linked to decreases and changes in westerlies, winter winds that bring precipitation to mountains across the region. They hypothesize that natural fluctuations of weather and human-induced climate change are the driving forces behind declines in mountain precipitation.

Management Implications: These findings suggest an alternative mechanism may compound the changes expected from warming alone, altering previous projections of how a warming climate will impact the region's water supply and ecology. Projections under future climate change scenarios indicate decreases in winter winds leading to decreased precipitation, highlighting an additional stressor which will have detrimental impacts on hydrologic resources across the region.

This research presents important implications for resource managers because mountains are a primary source of water supply for the Pacific Northwest region. Less precipitation leads to reduced runoff for communities, industry, and agriculture. Decreased precipitation also exacerbates early snowmelt tied to warming temperatures. This may have important implications for changes in mountain precipitation and future water availability for other areas as well. Identifying, planning, and implementing successful adaptations to a changing climate will require resource managers to learn how to respond quickly and insightfully as many unknown and unforeseen events, such as the effects of decreasing precipitation, associated with climate change unfold.



Location of precipitation (circles or squares) and streamflow (outline of watershed boundary) gages in the Pacific Northwest. Statistically significant trends are denoted with circles for precipitation and solid outlines for streamflow. The lack of historical declines in precipitation is based on estimation of trends, which show mostly non-significant declines (red, orange, and yellow squares) in precipitation over the region from 1948-2006.

KEY FINDINGS

- Prevailing winter winds blowing from the west to the east push water vapor off the North Pacific into the Cascade and Northern Rocky Mountain Ranges. These westerly winds play a key role in carrying precipitation into the mountains.
- Climate change is likely responsible for the steady slowdown of the westerlies observed from 1950-2012. Their average speed during the 1950s was about 9.5 m/s, but has declined to 8.5 m/s today.
- Decreased westerlies are hypothesized to have reduced orographic precipitation, yielding differential trends in precipitation across elevations and contributing to the decline in annual streamflow.
- Additional research is needed to confirm the overall impact of weaker westerlies on the Pacific Northwest's water supply.

MORE INFORMATION

- <http://www.treearch.fs.fed.us/pubs/45750>

For additional information please contact **Charlie Luce**, USFS Research Hydrologist, (208)373-4382 or cluce@fs.fed.us.