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Quantile Regression Estimation of Streamflow Trends in the Pacific Northwest United States

Charles Luce (1) and Zachary Holden (2)

(1) US Forest Service Research, Boise, United States (cluce@fs.fed.us), (2) US Forest Service, Region 1, Missoula, MT, United States (zaholden@fs.fed.us)

The effects of climate change on the water cycle have important implications for water management as well as aquatic and terrestrial ecology. Most recent studies of annual streamflow in the Pacific Northwest have looked at the mean or median streamflow, where they have found little or no change during recent decades, or streamflow timing, which is occurring substantially earlier in snowmelt dominated systems. Because of the non-stationary distributions, estimates of trends in the mean from least-squares regression is not robust. We analyzed annual runoff data from 43 stations in the Pacific Northwest covering the years 1948 to 2006 using quantile regression of annual flow data. While about half of the stations had significant (=0.10) declines in median or mean stream flow, a large majority (72%) of the stations had significant declines in stream flow in the 25th percentile annual flow. In other words, dry years have been getting substantially drier. Because many aspects of managed and natural systems operate without impairment within some range of the mean, trends in less central parts of the distribution may actually be more important than trends in the mean. The decreasing trends in the lowest quartile, in particular, represent increasing challenges for land and water managers who must cope with water scarcity and its ecological consequences on more frequent and acute basis.