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Title: Dissecting the causes and effects of a climate-induced regional-scale tree mortality event.

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Abstract:
Droughts in the southwestern U.S. are projected to increase in frequency and intensity as global warming progresses (IPCC 2007). The recent protracted drought in the Southwest (1999-2003), in conjunction with warmer temperatures and bark beetle infestations, contributed to the subcontinental-scale mortality of overstory trees (primarily *Pinus edulis* and *Pinus ponderosa*). This rapid, widespread mortality will alter ecosystem structure and function for decades. Our goals are twofold: 1) to determine the driving forces behind the mortality by assessing the respective roles of abiotic climatic factors versus biotic host/pathogen population dynamics; and 2) to investigate possible changes in hydrological processes due to the mortality, in terms of precipitation and streamflow. Results of spatio-temporal pattern analysis demonstrate that mortality was primarily related to sustained low precipitation combined with increased temperatures and, secondarily, to stand properties associated with bark beetle infestation. In conjunction with drought, the high temperatures were key to the epidemic proportion of the mortality. To explore changes in the hydrological processes, we compare the temporal variability in the Rio Ojo Caliente streamflow (a subbasin of the Rio Grande where a significant portion of the overstory was impacted) to a remotely-sensed vegetation index (1-km AVHRR NDVI for 1989-2006), including the mean, anomalies from the mean, and seasonally-based duration curves. Significant correlations (correlation coefficient ρ = -0.61) exist between the streamflow and NDVI at approximately a three-month lag (NDVI lagging streamflow) during 1989-2006. In analyzing the three phases of the drought, the correlation is slightly stronger during the pre-drought (ρ = -0.64) and drought (ρ = -0.65) periods, yet markedly stronger during the post-drought period (ρ = -0.74), all with a three-month lag. This suggests that the coupling between vegetation water use and streamflow is tighter after the drought, which may be attributable to the reduction in the less-responsive overstory (tree mortality) and increase in the more-responsive understory (grasses and shrubs exploiting newly available resources). The aim of our research is to examine the causes and effects of a climate-induced regional-scale tree mortality event in order to improve our knowledge of ecosystem and hydrologic response to the changing climate.