AWRA 2011 ANNUAL WATER RESOURCES CONFERENCE
Albuquerque, New Mexico
November 7-10, 2011

EMPLOYING A WATERSHED MODEL IN THE UPPER RIO GRANDE TO DETERMINE IMPACTS OF CLIMATE-INDUCED VEGETATION CHANGE

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ABSTRACT: An extended, severe drought in the southwestern U.S. from 2000 to 2003 was accompanied by increased temperatures and bark beetle infestations, inducing the large-scale mortality of woody overstory (Pinus edulis). The consequential redistribution of water, radiation, and nutrient availability modified the ecosystem phenology, species composition, and forced the ecosystem to transition into a new state. We hypothesize that the hydrological processes in the ecosystem were also altered due to the mortality. Thus, our objective is to investigate changes in the soil-vegetation-atmosphere continuum at the watershed scale. The Rio Ojo Caliente Basin is a subbasin of the Upper Rio Grande, located mostly in New Mexico, and is approximately 1,000 km^2. To investigate hydrological changes due to the mortality, we employ a physically-based, distributed hydrologic model, tRIBS (TIN-based Real-Time Integrated Basin Simulator) for the Rio Ojo Caliente Basin. STATSGO 1-km soils data, 10-meter National Elevation Dataset DEMs, Carson National Forest vegetation species data, and MM5-downscaled NCEP/NCAR Reanalysis-I meteorologic data are used as model inputs. A combination of MODIS and AVHRR remote-sensing data, values from the literature, and field data from a long-term, piñon-juniper (PJ) observation site in Los Alamos, New Mexico, are used to represent the mortality event and generate spatio-temporally dynamic vegetation parameters. We use the phenological mean computed over the pre-mortality period on a monthly to bimonthly basis, depending on the vegetation parameter, to reconstruct a "no mortality" scenario and compare this to the "mortality" scenario. Basin-averaged and elevational transect output are examined, including: moisture content throughout the soil column, groundwater flux and recharge, evapotranspiration, and surface heat fluxes. The aim of this research is to explore the consequences of a severe drought married with elevated temperatures on vegetation and water resources. As the intensity and frequency of droughts are expected to increase in the southwestern U.S. with rising temperatures, this research contributes to our knowledge of ecosystem and hydrologic response to the changing climate.

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