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Socioeconomic Drought in a Changing Climate: Modeling and Management

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Drought is typically defined based on meteorological, hydrological and land surface conditions. However, in many parts of the world, anthropogenic changes and water management practices have significantly altered local water availability. Socioeconomic drought refers to conditions whereby the available water supply cannot satisfy the human and environmental water needs. Surface water reservoirs provide resilience against local climate variability (e.g., droughts), and play a major role in regional water management. This presentation focuses on a framework for describing socioeconomic drought based on both water supply and demand information. We present a multivariate approach as a measure of socioeconomic drought, termed Multivariate Standardized Reliability and Resilience Index (MSRRI; Mehran et al., 2015). This model links the information on inflow and surface reservoir storage to water demand. MSRRI integrates a "top-down" and a "bottom-up" approach for describing socioeconomic drought. The "top-down" component describes processes that cannot be simply controlled or altered by local decision-makers and managers (e.g., precipitation, climate variability, climate change), whereas the "bottom-up" component focuses on the local resilience, and societal capacity to respond to droughts. The two components (termed, Inflow-Demand Reliability (IDR) indicator and Water Storage Resilience (WSR) indicator) are integrated using a nonparametric multivariate approach. We use this framework to assess the socioeconomic drought during the Australian Millennium Drought (1998-2010) and the 2011-2014 California Droughts. MSRRI provides additional information on socioeconomic drought onset, development and termination based on local resilience and human demand that cannot be obtained from the commonly used drought indicators. We show that MSRRI can be used for water management scenario analysis (e.g., local water availability based on different human water demands scenarios). Finally, we provide examples of using the proposed modeling framework for analyzing water availability in a changing climate considering local conditions.

Reference:

Mehran A., Mazdiyasni O., AghaKouchak A., 2015, A Hybrid Framework for Assessing Socioeconomic Drought: Linking Climate Variability, Local Resilience, and Demand, Journal of Geophysical Research, 120 (15), 7520-7533, doi: 10.1002/2015JD023147