UNTAPPED RESERVOIRS: A STORAGE-BASED APPROACH FOR ASSESSING URBAN WATER AVAILABILITY & VULNERABILITY ACROSS THE UNITED STATES

J.C. Padowski and J.W. Jawitz

Storage mitigates the natural variability of supply, and therefore plays a crucial role in the sustainable management of water in urban areas. Typical assessments of water availability (WA) and vulnerability (WV) are made using estimates of "renewable" mean annual runoff (P-ET), which assume stationarity. This method is problematic in that it inherently neglects the storage term despite it being a fundamental variable that is critical to the functionality of many urban areas and is particularly vulnerable to changing hydrologic conditions. This work presents a national assessment of urban WA and WV that also accounts for the role of storage.

All urban areas throughout the coterminous U.S. with populations greater than 100,000 (n=255) were included in this study. The implications of future change in storage were evaluated for a range of increasingly variable conditions, and urban areas were ranked (low, medium, and high) based on the probability of failure to meet annual demand. In addition, for a subset of sample sites from each category, a text analysis based on WV-related terms in recent news sources was conducted as an independent qualitative proxy for the level of vulnerability.

Compared with WA calculated using only mean annual runoff, addition of a storage term reduced the number of urban areas considered "vulnerable" from 80% to 40%. Increases in WA due to storage also mitigated WV. This relationship remained consistent when WV was evaluated under varying degrees of drought severity. The number of urban areas with sources that failed to meet demands at an exceedance frequency of 5, 10 and 25% was 24, 16, and 7 out of 255, respectively. The text analysis supported these results; the average frequency of occurrence for each category was 0.8±0.8 (low), 10.8±2.4 (med), and 33.8±9.7 (high). Together, these findings demonstrate that a storage-based approach can be successfully applied to identify and measure urban WA and WV.