



The Richter Scale of Reduction: decoupling management and climatic related drivers of water conservation behavior

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As global populations grow, cities in drought prone regions of the world such as South East Australia are faced with escalating water scarcity and water security challenges. The management approaches geared towards addressing these challenges are diverse, and background climatic variability further complicates the story. Here we use Melbourne, a city of 4.3 million people in South East Australia that recently faced and overcame a > 10 year “Millennium” drought, as a test case for evaluating the relative importance of various management-related and climatic factors in driving reductions in municipal water consumption (>50% in 12 years). Our analysis suggests that Melbourne’s declining municipal consumption cannot be explained by potable substitution alone, as reductions in municipal consumption were not matched by increased use of alternative sources (e.g., urban rain or recycled water). Savings from non revenue water (NRW) reduction (through leak reduction and improved metering) also fell short of the total savings achieved during the drought. In the final analysis, conservation behavior emerged as the dominant driver of municipal water savings, forming a so-called “Richter Scale of Reduction” with conservation saving ~10 fold more water than NRW reduction, which in turn saved ~10 fold more water than alternative water sources. We also used wavelet analysis to illustrate that conservation behavior responds to climate variability at a variety of frequencies (annual-decadal and longer) which correspond to perturbations that impact water system vulnerability and sustainability. Interestingly the shared power of climatic and conservation responses declined as the drought progressed, perhaps reflecting the adoption of more consistent conservation behavior as the drought became increasingly severe.