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Extrapolation mapping of water demand: Case study using historical water use data in Phoenix, Arizona

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Critical to understanding the dynamics of water use in the context of urban growth and climate variability is an accurate representation of water use at points beyond the spatial and temporal scope of recorded data. It is, however, challenging to extrapolate water use for future points in time and for areas not yet developed. This study accounts for spatial and/or temporal variability in water use for the City of Phoenix, uses this information to generate estimates of water use beyond the observed points, and processes estimates and their associated uncertainty into the Bayesian Maximum Entropy (BME) mapping method. The uncertain estimates are generated by stochastic empirical laws between a primary variable, water use and secondary variables. First we develop a spatial extrapolation framework using the relationship between land use and water use to extend the spatial framework. Second we use projected population density and the relationship between density and water use to forecast water use into the future. An evaluation of the results reveals that BME produces more accurate results than classical mapping methods that purely depend on historical data or disregard uncertainty in the generated estimates. These tools to predict urban water demand can be used by urban planners, water managers, and local policy makers.