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Statistical and Biophysical Models for Predicting Total and Outdoor Water Use in Los Angeles

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Modeling water demand is a complex exercise in the choice of the functional form, techniques and variables to integrate in the model. The goal of the current research is to identify the determinants that control total and outdoor residential water use in semi-arid cities and to utilize that information in the development of statistical and biophysical models that can forecast spatial and temporal urban water use. The City of Los Angeles is unique in its highly diverse socio-demographic, economic and cultural characteristics across neighborhoods, which introduces significant challenges in modeling water use. Increasing climate variability also contributes to uncertainties in water use predictions in urban areas. Monthly individual water use records were acquired from the Los Angeles Department of Water and Power (LADWP) for the 2000 to 2010 period. Study predictors of residential water use include socio-demographic, economic, climate and landscaping variables at the zip code level collected from US Census database. Climate variables are estimated from ground-based observations and calculated at the centroid of each zip code by inverse-distance weighting method. Remotely-sensed products of vegetation biomass and landscape land cover are also utilized. Two linear regression models were developed based on the panel data and variables described: a pooled-OLS regression model and a linear mixed effects model. Both models show income per capita and the percentage of landscape areas in each zip code as being statistically significant predictors. The pooled-OLS model tends to over-estimate higher water use zip codes and both models provide similar RMSE values.Outdoor water use was estimated at the census tract level as the residual between total water use and indoor use. This residual is being compared with the output from a biophysical model including tree and grass cover areas, climate variables and estimates of evapotranspiration at very high spatial resolution. A genetic algorithm based model (Shuffled Complex Evolution-UA; SCE-UA) is also being developed to provide estimates of the predictions and parameters uncertainties and to compare against the linear regression models. Ultimately, models will be selected to undertake predictions for a range of climate change and landscape scenarios. Finally, project results will contribute to a better understanding of water demand to help predict future water use and implement targeted landscaping conservation programs to maintain sustainable water needs for a growing population under uncertain climate variability.