Spatial Extrapolation Mapping Based on Aggregated Data: Countywide Extrapolation of Phoenix Water Use Data

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Abstract

Understanding water use in the context of urban growth and climate variability requires accurate representation of regional water use. It is challenging, however, because water use data are often unavailable, and when available they are geographically aggregated to protect the identity of individuals. This poster aims to map local-scale estimates of water use in Maricopa County, Arizona, based on data aggregated to census tracts and measured only in the City of Phoenix. To complete our research goals we describe two types of data uncertainty sources (i.e., extrapolation and downscaling processes) and then generate data that account for the uncertainty sources (i.e., soft data). Our results ascertain that the Bayesian Maximum Entropy (BME) mapping method of modern geostatistics is a theoretically sound approach for assimilating the soft data into mapping processes. Our results lead to increased mapping accuracy over classical geostatistics, which does not account for the soft data. The confirmed BME maps, therefore, provide useful knowledge on local water use variability in the whole county that is further applied to the understanding of causal factors of urban water demand.

Objectives

To represent water usage with a targeted local-scale (areas < 7km²).
 To represent countywide water usage.

Available Data

Measured Water Duty (MWD, liters/km²) values with observation areas less than 7km²; uncertainty-free hard data (local-scale data) that need no downscaling processes.
MWD values with observations areas greater than 7km²; uncertain hardened data (larger-scale data) that need downscaling processes.
The hardened data do not include data uncertainty (*U*) related to downscaling.
A mathematical downscaling framework can derive *U*.
Relationship between the hardened data and soft data (local-scale water duty given

Relationship between the hardened data and soft data (local-scale water duty give larger-scale water duty):
 Probabilistic soft data
 Indicating local-scale data
 U
 If U is neglected
 Large-scale hardened data; deterministic values
 If U is accounted for





Conclusions

- This work provided a general solution to situations in which data extrapolation is required.
- This work obtained the downscaled estimates of the water use based on data aggregated to census tract boundaries.
- This works expands the estimation from the City of Phoenix to Maricopa County.
- The resulting estimation maps are the empirical basis for decision support tools and scenario development of the region's future that consider climate change, water policy, and urban growth.

Acknowledgment

This material is based upon work supported by the National Science Foundation under Grant No. SES-0345945 Decision Center for a Desert City (DCDC). Any opinions, findings and conclusions or recommendation expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation (NSF).

