

# Statistical analysis of small-area data based on independence, spatial, non-hierarchical, and hierarchical models

L. Kang

D. Liu

N. Cressie

*The Ohio State University*

## **Abstract**

Data associated with spatially contiguous small areas may be modeled via regression on covariates, with error terms that are either independent or are spatially dependent according to which areas are neighbors of each other. But the data may have extra components of variability due to measurement error, which a careful statistical analysis should filter out. The combination of these possibilities leads to four models, three of which are special cases of the fourth: the spatial hierarchical model. In this paper, we develop a number of new results for the analysis of small-area data: estimation of the measurement-error variance; diagnostics to determine which model fits and predicts better; and a sensitivity analysis to compare an empirical-Bayesian analysis to a Bayesian analysis. A small-area dataset of doctors' prescription amounts per consultation is fitted to all four types of models and used to illustrate our spatial methodology.