Fusing point and areal level space-time data with application to wet deposition

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Abstract

Motivated by the problem of predicting annual wet chemical deposition in the eastern United States, this paper develops a framework for joint modeling of point and grid referenced spatio-temporal data in this context. The proposed hierarchical model is able to provide accurate spatial interpolation and temporal aggregation by combining information from observed point referenced monitoring data and gridded output from a numerical simulation model known as the Community Multi-scale Air Quality (CMAQ) model. The technique avoids the change of support problem which arises in other hierarchical models for data fusion settings to combine point and grid referenced data. The hierarchical space-time model is fitted to weekly wet sulfate and nitrate deposition data over the eastern United States. The model is validated with set-aside data from a number of monitoring sites. Predictive Bayesian methods are developed and illustrated for inference on aggregated summaries such as quarterly and annual deposition maps.

Key Words: Change of support problem; hierarchical model; Markov chain Monte Carlo; measurement error model; spatial interpolation; stochastic integrals.

This is joint work with Alan Gelfand and David Holland.