High Resolution Space-Time Ozone Modeling for Assessing Trends

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Abstract

The assessment of air pollution regulatory programs designed to improve ground level ozone concentrations is a topic of considerable interest to environmental managers. To aid in this assessment, it is useful to model the space-time behavior of ozone for predicting summaries of ozone across spatial domains of interest and for the detection of long-term trends at monitoring sites. These trends, possibly adjusted for the effects of meteorological variables, are needed for determining the effectiveness of pollution control programs in terms of their magnitude and uncertainties across space. We offer a space-time model for daily 8-hour maximum ozone levels.

The model is applied to the analysis of data from the state of Ohio which contains a mix of urban, suburban, and rural ozone monitoring sites. The proposed space-time model is auto-regressive and incorporates the most important meteorological variables observed at a collection of ozone monitoring sites as well as at several weather stations where ozone levels have not been observed. This misalignment is handled through spatial modeling. In so doing we adopt a computationally convenient approach based on the successive daily increments in meteorological variables. The resulting hierarchical model is specified within a Bayesian framework and is fitted using MCMC techniques. Full inference with regard to model unknowns as well as for predictions in time and space, evaluation of annual summaries and assessment of trends are presented.