Source apportionment of PM2.5 concentrations with Bayesian hierarchical models

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Abstract

Fine particulate matter (PM2.5) can cause adverse health effects in human populations. They are emitted to the environment from a variety of sources, such as road dust, biomass burning, industrial activities, and vehicle exhaust. The PM2.5 originating from some sources may be more harmful than that from other sources. Accurate estimation of quantitative source contributions to environments is therefore crucial to developing effective control strategies for controlling PM2.5 mass concentrations and protecting human health. Although multivariate models such as the popular positive matrix factorization method which simultaneously retrieves source contributions and profiles from measurements with non-negativity constraint, had been widely applied in many real data analysis, the results were often unsatisfactory. We proposed to construct a multivariate model under Bayesian framework so that expert knowledge regarding the emission can help estimate source profiles, and external data such as weather could improve estimation of the source concentrations. We used simulated data to evaluate the performance of the proposed method. We also used long-term PM2.5 measurements collected in locations with different sources to demonstrate the feasibility of the proposed method. This is joint work with Dr. Jia-Hong Tang.