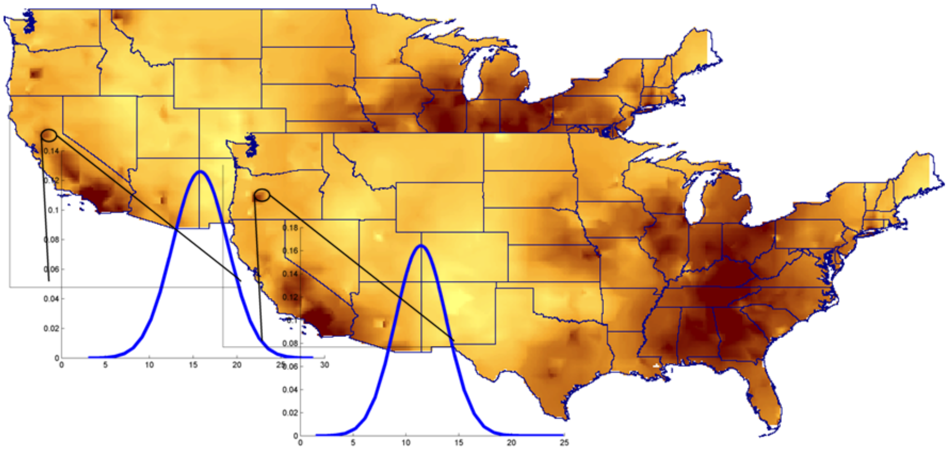

Two Sources Are Better Than One: Estimating PM2.5 from Observation and Model Outputs

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Abstract

PM2.5 is particulate matter that is 2.5 microns in diameter or smaller. Despite its small size, this little pollutant is associated with a large host of health problems ranging from asthma, to respiratory infections and cardiovascular diseases. Many epidemiological studies rely on accurate exposure estimates in order to tie these exposure levels of PM2.5 to a range of health outcomes. However, it is not practical to have study participants walking around with PM2.5 monitors attached to them at all times. Trickier still, the study design may be such that exposure has to be assigned retrospectively. Therefore there exists a great need to accurately estimate ambient concentrations of PM2.5 in order to assess exposure levels. The field of geostatistics fulfills this need. Geostatistics is able to take in data sets of the pollutant of interest (e.g. PM2.5) and through interpolation methods, estimate concentration levels where they are needed. Vast arrays of datasets calculate PM2.5 concentration with varying levels of accuracy including observational data, chemical transport models (e.g. CMAQ), satellite data, land use regression, etc. With all the available datasets out there, which one should be chosen? Many studies have used geostatistics on only one dataset. However, why not choose more than one? This study investigates the combination of data sources and how multiple data sources increase accuracy and in turn can improve estimation. Namely, the modern geostatistical framework of Bayesian Maximum Entropy (BME) will be used to combine observational PM2.5 data along with PM2.5 estimated from chemical transport models (CTMs). By combining datasets, estimated concentrations have the best of both worlds: the accuracy of observational data with the coverage of modeled data. CTMs are known to be biased. We investigate how bias changes geographically, how to incorporate that bias into BME, and how to quantify that uncertainty to produce estimates that have increased accuracy over more traditionally used methods. Accuracy will then be qualitatively assessed visually with maps and quantitatively assessed with cross-validation statistics.