L'inférence causale en présence de dépendance et de structure de réseau
« Atelier sur l'ajustement causal en présence de la dépendance spatiale »
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A spatial causal analysis of wildfire-contributed PM2.5 using numerical model output

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Wildfire smoke contains hazardous levels of fine particulate matter (PM2.5), a pollutant studies have shown adversely effects the respiratory and cardiovascular health of exposed individuals. Accurate estimates of PM2.5 concentrations attributable to wildfires are key to understanding the extent to which wildfires contribute to poor air quality and to adverse health outcomes. We propose a method for separating estimates of wildfire-contributed PM2.5 from ambient PM2.5 concentrations using a novel causal inference framework and bias-adjusted computer simulations of PM2.5 under counterfactual scenarios. The numerical PM2.5 data for this analysis is from the Community Multi-Scale Air Quality (CMAQ) Modeling System, run with and without fire emissions across the contiguous U.S. for the 2008-2012 fire seasons. To account for biases, the CMAQ output is calibrated with observed data from the U.S. Environmental Protection Agency's Federal Reference Method (FRM) PM2.5 monitoring sites for the same spatial domain and time period. We use a spatial Bayesian model to estimate the effect of wildfires on PM2.5 and state assumptions under which the estimate has a valid causal interpretation. The analysis is run separately for nine regions that partition the contiguous U.S. based on similar climates. We find that the fire effect on PM2.5 is highest in areas of the U.S. where wildfires are most prevalent, including the West, Northwest and parts of the Southeast. Our results provide insight into using causal inference with numerical and spatial data, as well as a method that can be extended to investigate the causal effects of wildfire smoke on public health outcomes.

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