MODELING IMPACTS OF LAND-USE CHANGE ON SPATIAL DISTRIBUTIONS OF EMISSIONS

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BIOGRAPHY

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INTRODUCTION

Air pollution is one of the most important human impacts resulted from urbanization. It not only causes harm to human health but also has other negative effects such as reducing crop production, disturbing or ruining ecosystem, and damaging material. In addition, some air pollutants also contribute to climate change. Therefore, changes in regional air quality accompanying with urban sprawl has been a major concern to urban planners since the 90s, particularly to those who are interested in smart growth or "new urbanism".

Emission inputs are one of the critical inputs into air quality model. Estimating, allocating and locating emissions across space and time provide answers to the following questions:

- Where will be emission hotspots in the future
- How sensitive is the spatial and temporal distribution of emissions to the driving forces such as land-use change, technology, and planning policies?
- How do emission patterns vary among different pollutants?

The ability to answer such questions is particularly important for areas that are near the border of compliance with the National Ambient Air Quality Standards. Based on the answers, effective approaches may be developed to mitigate or assess and prevent future emissions problems within the region. Unfortunately, the current state-of-the-art for predicting future emissions simply increases emissions from existing locations. Although the approach calculates future total emissions in the region, it does not take into account a common phenomenon accompanying urbanization: the changing amount and location of emission sources as land develops. In addition, because primary pollutant concentrations govern chemical reaction rates and hence subsequent human exposure, models that assume increased future emissions without capturing their spatial distribution over time would tend to overestimate the resulting consequences at some locations and underestimate them at others.

CURRENT DEVELOPMENTS

A “bottom-up” approach based on Geographic Information System (GIS) was proposed and evaluated in this paper for predicting future residential and industrial emissions over St. Louis Metropolitan Area (SLMA) which consists of 10 counties. For residential combustion emissions, the validation methodology started from Census data of SLMA, and adopted emission factors used by 1999 National Emission Inventory (1999 NEI) to spatially allocate emissions of VOCs, NO_x, CO, SO_2, PM-10 and PM-2.5 at Census block group level. On the other hand, the estimation of industrial emissions started from 2000 land-use map. The total residential emission of each pollutant over the study region was compared to the 1999 National Emission Inventory (1999 NEI). The results showed that this approach provides a simple and quick way to spatialize emissions. Next step will involve applying this methodology to simulated land-use maps of SLMA between 2005 and 2050. Various land development scenarios and emission control scenarios will also be assessed to support regional decision-making.