

Passive Sampling to Characterize Spatial and Compositional Variability in Coarse Particulate Matter (PM_{10-2.5})

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Background

Low-cost passive sampling provides an effective means to capture and characterize spatial variability of coarse particulate matter (PM_{10-2.5}) over large geographic areas. Computer controlled scanning electron microscopy (CCSEM) may be performed to obtain information on morphology and composition in addition to mass.

Objective

Characterize spatial variability of PM_{10-2.5} by composition using passive samplers

Methods

- Deployed passive samplers at 26 sites for week-long intervals over three weeks
- Analyzed chemical composition and size of individual particles by CCSEM with energy dispersive X-ray spectroscopy
- Segregated PM_{10-2.5} mass into fourteen chemical classes based on CCSEM results
- Used geostatistical methods to quantify the spatial variability of each chemical class as relative spatial heterogeneity (% SH)
- Plotted normalized concentrations (concentration / mean) to visually compare relative spatial variability between chemical classes



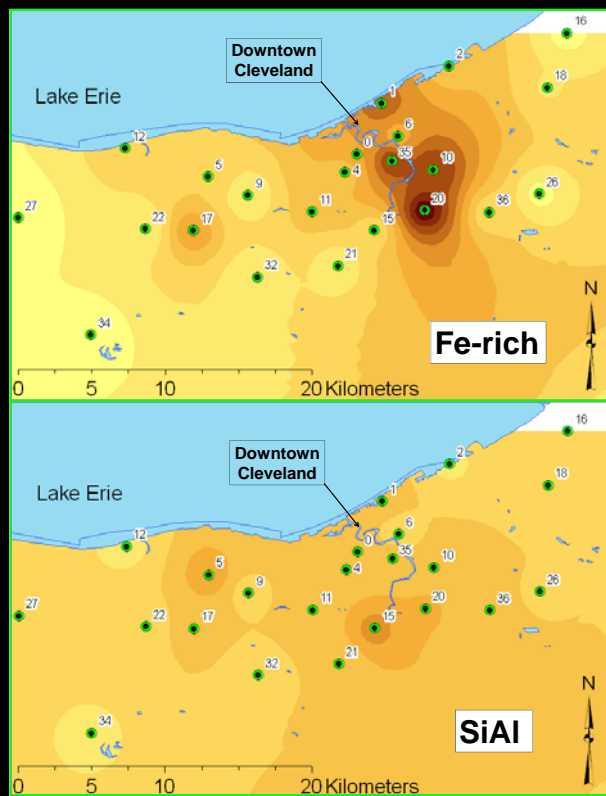
UNC passive sampler



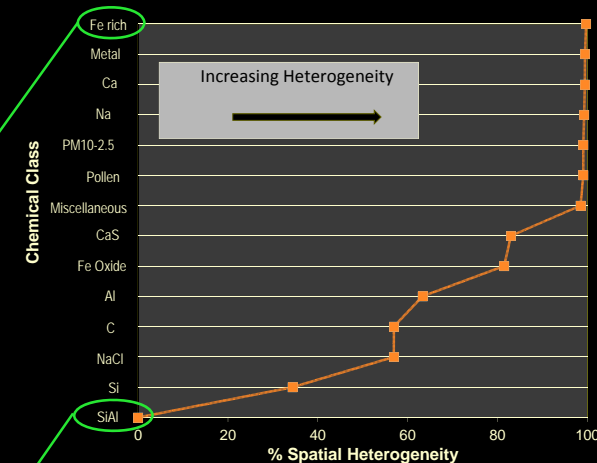
Passive Sampler installed in Ott-Peters shelter.

Results

- Fe-rich most spatially heterogeneous chemical class; suggests local sources
- SiAl least spatially heterogeneous chemical class; suggests ubiquitous sources throughout the study area



Compositional variability example comparing particle class Fe-rich (Top) to particle class SiAl (Bottom) across Cleveland, OH airshed. Results are normalized concentrations (concentration / mean) for each particle class. Numbers on maps represent sampling site locations



Percent spatial heterogeneity for all three weeks by chemical class

Conclusions

- Some chemical classes are substantially more heterogeneous than others
- Passive sampling with analysis by CCSEM / EDS provides a powerful tool to assess spatial variability of particulate pollutants by composition

Future Research

- Compare PM_{10-2.5} measured passively to that measured by federal reference method
- Investigate relationships among adverse health outcomes and coarse particle concentrations by composition