

# Spatially and temporally detailed indoor and outdoor woodsmoke detection

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Particulate matter (PM) has been linked to adverse effects on respiratory and cardiovascular health (e.g. Pope *et al.* 2009). In urban settings, human exposure to PM is often connected to sources emitting black carbon (Naeher *et al.* 2007), both outdoors and indoors (Smith *et al.* 2010). The current regulatory measurement network is not able to cover large spatial and temporal variability in source impacts, nor indoor exposures.

This study involves extended measurements in Rochester, NY (ca 210,000 inhabitants) using 52 low cost PM monitors, Speck (Airviz Inc., Carnegie Mellon University, Pittsburgh, PA, USA), located at 26 sampling sites with wood burning appliances or in areas with noticeable wood smoke (Fig. 1). The study participants, mostly employees of the University of Rochester, also completed a survey on house type and age, heating fuel and frequency, and other activities influencing indoor air quality data.

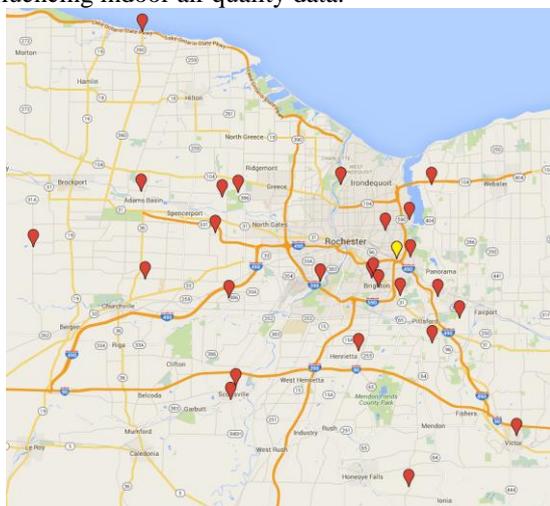


Figure 1. Measurement location across Monroe County. The DEC site position is highlighted by yellow marker. Map downloaded from <https://www.google.com/maps>.

At each location, one indoor and one outdoor monitor in a weatherproof housing were installed, and are concurrently measuring 1-minute particle number concentrations, estimated particle mass concentrations of indoor and outdoor PM between 0.5 and 3  $\mu\text{m}$ , and temperature. Additionally, a CO monitor has been placed inside each household to help distinguish between combustion and non-combustion sources of indoor PM.

Two additional outdoor Speck instruments were placed at the New York Department of Environmental Conservation (DEC) site in Rochester with continuous PM measurement (Thermo Scientific TEOM, model 1405-DF [FEM]), and a 2-wavelength Aethalometer Model AE-22.

At three locations (one is the DEC site), three pairs of recently developed TSI AirAssure PM<sub>2.5</sub> air quality monitors that are not yet available for sale in the U.S. and Europe, have been located for a first real data comparison.

All instrumentation was installed during November and December 2015 to record the entire 2015/2016 heating season. Some additional 48-hours measurements were made at the homes in January, in the middle of the heating season, using PM<sub>2.5</sub> filter samples, an aethalometer and an optical particle spectrometer.

Preliminary results show differences in indoor and outdoor PM concentrations at the homes, during periods when wood smoke is expected to be present (e.g., during high PM concentration events during the holidays). Comparing the Speck monitors with the FEM at the DEC site, the regional outdoor pollution events have been observed by the Speck monitors outside the homes with reasonable precision. The limit of detection of the Speck monitors was determined to be  $\sim 9 \mu\text{g}/\text{m}^3$  by comparing several days of data from collocated monitors using the method described in Wallace *et al.* (2011). Several additional results will be available after the heating season:

- the indoor/outdoor ratio will be calculated and compared to house type, ventilation etc.,
- the spatial variability of outdoor PM concentrations in the county will be described,
- the proportion of wood smoke in the outdoor and indoor PM concentrations will be estimated, and
- the AirAssure, Speck, and FEM/Grimm instruments will be compared.

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