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Local source impacts on primary and secondary aerosols in the Midwestern United States

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1 Local source impacts on primary and secondary aerosols in the Midwestern United States2 Thilina Jayarathne[‡], Chathurika M. Rathnayake[‡], Elizabeth A. Stone*

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8 Atmospheric particulate matter (PM) exhibits heterogeneity in composition across urban areas, leading
9 to poor representation of outdoor air pollutants in human exposure assessments. To examine
10 heterogeneity in PM composition and sources across an urban area, fine particulate matter samples
11 (PM_{2.5}) were chemically profiled in Iowa City, IA from 25 August to 10 November 2011 at two monitoring
12 stations. The urban site is the federal reference monitoring (FRM) station in the city center and the peri-
13 urban site is located 8.0 km to the west on the city edge. Measurements of PM_{2.5} carbonaceous aerosol,
14 inorganic ions, molecular markers for primary sources, and secondary organic aerosol (SOA) tracers
15 were used to assess statistical differences in composition and sources across the two sites. PM_{2.5} mass
16 ranged from 3 – 26 $\mu\text{g m}^{-3}$ during this period, averaging $11.2 \pm 4.9 \mu\text{g m}^{-3}$ (n=71). Major components of
17 PM_{2.5} at the urban site included organic carbon (OC; 22%), ammonium (14%), sulfate (13%), nitrate (7%),
18 calcium (2.9%), and elemental carbon (EC; 2.2%). Periods of elevated PM were driven by increases in
19 ammonium, sulfate, and SOA tracers that coincided with hot and dry conditions and southerly winds.
20 Chemical mass balance (CMB) modeling was used to apportion OC to primary sources; biomass burning,
21 vegetative detritus, diesel engines, and gasoline engines accounted for 28% of OC at the urban site and
22 24% of OC at the peri-urban site. Secondary organic carbon from isoprene and monoterpene SOA
23 accounted for an additional 13% and 6% of OC at the urban and peri-urban sites, respectively.
24 Differences in biogenic SOA across the two sites were associated with enhanced combustion activities in
25 the urban area and higher aerosol acidity at the urban site. Major PM constituents (e.g., OC, ammonium,
26 sulfate) were generally well-represented by a single monitoring station, indicating a regional source
27 influence. Meanwhile, nitrate, biomass burning, food cooking, suspended dust, and biogenic SOA were

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