Spatially-explicit characterization of the exposure and health burden of fine particulate matter in the U.S.

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Published in:
Abstract book of Joint Meeting of the International Society of Exposure Science and the International Society of Indoor Air Quality and Climate 27th Annual Meeting

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Joint meeting of the
INTERNATIONAL SOCIETY OF EXPOSURE SCIENCE
and the
INTERNATIONAL SOCIETY OF INDOOR AIR
QUALITY AND CLIMATE

August 18 - 22, 2019

The built, natural, and social environments: impacts on exposures, health and well-being

PROGRAM
MO-PL-D2-40
Source-specific Fine Particulate Using Spatiotemporal Concentration Fields Developed using Chemical Transport Modelling and Data Assimilation: Application to North Carolina for Health Associations with Coronary Heart Disease

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A number of studies have found differing associations of disease outcomes with PM2.5 components (or species), and sources (e.g., biomass burning, diesel vehicle and gasoline vehicle). Here, a unique data fusion method has been utilized to generate spatiotemporal fields of major gaseous pollutants and PM2.5 components (e.g., ozone, NO2, SO2, total PM2.5 mass and speciated PM2.5 including crustal metals) over North Carolina for 2002-2010. In a prior study, the PM2.5 total mass field was used as part of the CATHGEN study of associations between PM2.5 and disease associated with cardiac heart disease patients. Here, we extend the exposure method for further health analyses. The method fuses daily CMAQ model observations with observations to develop accurate spatiotemporal maps of pollutant concentrations. Those results are then used in an advanced chemical mass balance source apportionment model, CMBGC-Iteration, that uses both gas and particulate matter concentrations to quantify source impacts. The method, as applied to North Carolina, quantifies the impacts of nine source categories and estimate source contributions of total PM2.5 mass. The nine source categories include sources of both primary (diesel vehicle, gasoline vehicle, suspended dust, biomass burning, and coal combustion sources) and secondary components (ammonium sulfate, ammonium bisulfate, ammonium nitrate and secondary organic carbon). The results show the dramatic decrease in source impacts, e.g., sulfate, primarily from coal-burning, and from mobile sources. Secondary organic aerosol, e.g., from biogenic emissions, is becoming more dominant over the state. This study highlights an advantage of using a chemical transport model to develop spatiotemporal fields of pollutants, i.e., the ability to assess PM components and their sources.

Keywords: epidemiology, exposure models, health, other/general, metals

MO-PL-D2-41
Spatially-explicit characterization of the exposure and health burden of fine particulate matter in the U.S.

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Air pollution impacts are estimated using spatialized exposures and dose-response functions. We developed spatially-explicit intake fractions (iF – fraction of the emission taken in by population) and characterization factors (CF – health burden per precursor emission unit) for sector-specific emissions of primary PM2.5, NH3, SO2, and NOx in the U.S. We calculated iFs for 43,304 locations in the contiguous U.S. using a reduced-form chemical transport model, the Intervention Model for Air Pollution (InMAP). For each source location, we integrated iFs multiplied by the non-linear integrated exposure-response function and region-specific burden estimates at each receptor location, both obtained from the Global Burden of Disease, to derive cumulative location-specific CF estimates. Using spatial information of annual emissions for 50 states and 60 sectors, we estimated emission-weighted state and sector-specific iFs and CFs. The emission-weighted national average iF was 0.8 parts per million (ppm) for PM2.5, 0.4 ppm for NH3, 0.3 ppm for SO2, and 0.1 ppm for NOx. Location-specific estimates varied up to three orders of magnitude, driven by population. Using an average exposure-response slope between background and “no risk” PM2.5 levels, national CFs were estimated at 209, 99, 75, and 38 μDALYs/kg for PM2.5,
NH3, SO2, and NOx, respectively. State CFs varied substantially with a precursor-dependent range. For PM2.5, CFs varied by a factor 60 from highest (Arizona) to lowest state (North Dakota). For NH3 CFs varied by factor of 40 by state and for NOx and SO2 by a factor of 10. A marginal slope resulted in twice-lower estimates. For PM2.5 and NH3, CFs for the mobile sector were ~5 times higher than those for the agriculture sector. We found little variability between sectors for SO2 and NOx emissions. Results highlight the importance of spatial and sector-specific estimates in characterizing more accurately the health burden of PM2.5.

Keywords: air, environmental health, exposure factors, geospatial analysis/GIS, health, chronic diseases, lifecycle analysis, risk assessment

**MO-PL-E2-SEM: Consumer Products and Building Materials**

**MO-PL-E2-42**

**Inadvertent Polychlorinated Biphenyls (PCBs) in Consumer Products**

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Although production of commercial polychlorinated biphenyls (PCBs) was banned in 1979 under the Toxics Substance Control Act (TSCA), inadvertent generation of PCBs continues during a variety of chemical production processes and can contaminate products as well as waste streams. A well-studied process leading to inadvertent PCB contamination is diarylide yellow pigment production and the resulting creation of PCB-11 within the pigment molecule. Existing research has focused on evaluating PCB concentrations in consumer products, or in the environment and human blood. Data concerning the fate and transport of inadvertent PCBs from consumer products and the exposure pathways to humans is lacking. Our research investigates the concentrations of inadvertently generated PCBs in consumer products typically used by children to better understand migration pathways from these products into the environment and potential routes of exposure for human health risk assessment. As the first step, fourteen consumer products, such as chalk, crayon, paint, glue sticks, foam sheets, and food packages, were purchased from retail stores in the United States between September and October of 2018. Duplicate products were extracted and analyzed for 209 PBC congeners using modified EPA Method 1668C. Sonication and soxhlet extraction methods were compared for several products as well. Our preliminary results show that 4 out of 14 products contained PCB-11 only, in the range of 43 to 168 ng/g and a fifth product had PCB-95, PCB-121, PCB-85, PCB-118, PCB-149, PCB-153, and PCB-138, in the range of 64 to 137 ng/g. More product testing is needed to identify and quantify inadvertent PCBs in consumer products to provide the basis for further study of their migration pathways and potential routes of human exposure.

Keywords: SVOCs, children, consumer and personal care products, exposure factors

**MO-PL-E2-43**

**Development of new analytical and measurement methods for characterizing the emission of semi-volatile organic compounds (SVOCs) from building and consumer materials**

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Phthalates and organophosphate flame retardants (OPFRs), two families of SVOCs, are ubiquitous indoor pollutants that are added to various indoor building and consumer materials to enhance their properties. However, these compounds are of great research interest due to the severe health effects they cause. The gas-phase concentration of SVOCs in equilibrium with the material surface (y0) is a key parameter in determining indoor emission of materials and estimating the risk of human exposure to these compounds. However, their high