Research Project 4

Atmospheric Sources of PCB Congeners

The overall goal of Project 4 is to identify and characterize sources and quantify emissions of airborne PCB congeners and their major breakdown products. The Project is intensely integrated throughout the ISRP: It is a major route of discovery for the center and provides a path for significant and measurable reduction of human risk through exposure to PCBs and their major breakdown products. The Aims of Project 4 are organized around field studies in urban and rural environments.

Aim 1 is to determine sources of airborne Aroclor and non-Aroclor congeners in urban air. In 2018 researchers published a collaboration with Environment and Climate Change Canada to examine the applicability of our method for determining the sampling rates and effective volumes of passive samplers for collecting airborne PCBs. Our method can be used to predict the effective sampling volumes of a PUF-PAS sampler deployed anywhere in the world (Herkert et al, 2018a). In addition to the journal publication, and in collaboration with the Research Translation Core, we developed and published an interactive website through which a user can input the location and deployment period and the website will provide a calculated sampling volume. In 2018 researchers also finished their study of air/water exchange of PCBs in Lake Michigan and confirmed that Chicago remains an important atmospheric source of PCBs to Lake Michigan (Boesen et al. in preparation).

Aim 2 is to characterize the release of airborne PCBs in the Indiana Harbor and Ship Canal (IHSC) in East Chicago, Indiana. Researchers published a new study of emissions from the IHSC (Martinez et al., 2019). Using a novel system of passive samplers installed in the canal, with the assistance of the
U.S. Geological Survey, they demonstrated that this passive sampling approach represents a simple and cost-effective method to assess the air-water exchange of PCBs, increase analytical sensitivity, and reduce uncertainties related to unexpected episodic events. Earlier findings that the IHSC experiences constant release of gas-phase PCBs were confirmed. They also released the data produced by study of PCB fluxes in the IHSC to a public data repository, Pangaea (Martinez et al., 2018). This was the first time the ISRP has released chemical data to a public repository.

Aim 3 is identification of sources of PCB congeners in indoor air. In 2018 researchers reported two major studies of PCBs in indoor air, both led by Ph.D. student Nicholas Herkert (Herkert et al, 2018b;

![Diagram of PCB congeners](image)

Herkert et al, 2018c). They reported their study of the dynamics of airflow within a room and how the airflow affects the measurement of airborne PCBs using PUF-PAS. Variability of wind speeds throughout the room significantly (P < 0.001) affected uptake rates. In 2018, they also published their study of residential homes in Iowa City (Herkert et al, 2018c). Using the PUF-PAS methods from the first study, they measured both Aroclor and non-Aroclor sources of airborne polychlorinated biphenyls (PCBs) in 16 residential homes and found PCB-47, PCB-51, and PCB-68 to account for up to 50% of measured indoor ZPCBs (2700 pg. m–3). Another non-Aroclor congener, PCB-11, a byproduct of pigment manufacturing, was found inside and outside of every household and was frequently the predominate congener. They hypothesize these congeners are inadvertent byproducts of polymer sealant manufacturing and produced from the decomposition of 2,4-dichlorobenzoyl peroxide used as an initiator in free-radical polymerization of polyester resins.

Aim 4 is the determination of properties of PCB breakdown products. This aim was completed in 2017 when they used previously reported methods to determine the behavior of OH-PCBs in air samples in order to interpret their findings of OH-PCB congeners in schools (Marek et al, 2017).

Recent Publications:


- **Project Leader:** Keri C. Hornbuckle, PhD [4] is a Professor and Chair of the Department of Civil & Environmental Engineering at the University of Iowa. Dr. Hornbuckle’s research concerns the fate and transport of pollutants in the environment. She is particularly interested in persistent organic pollutants including PCBs and other legacy industrial pollutants, perfluorinated compounds related to the production of surface protectants, fragrances and other persistent chemicals in household products, and pollutants related to large-scale agriculture.

- **Dr. Andres Martinez,** Research Scientist and Adjunct Professor in the College of Engineering, has nearly 10 years of scientific research experience, during which he has developed expertise in the areas of field sampling, development of analytical method and analysis of hydrophobic organic compounds in complex environmental matrices, environmental modeling, and data analysis. Distribution, transport, and fate of polychlorinated biphenyls (PCBs) in air, water and sediment/soil have been his main areas of interest.

- **Dr. Scott Spak,** Assistant Professor in Urban and Regional Planning and Civil and Environmental Engineering, has more than 10 years of experience studying air pollution and climate in the Great Lakes region, including criteria air pollutants, air toxics, exposure and health impacts assessment using chemical transport and emissions modeling and chemical data assimilation of in situ and satellite observations.

- **Dr. Kai Wang** is a Professor of Biostatistics in the College of Public Health at the University of Iowa.
[3] https://pubs.acs.org/doi/10.1021/acs.est.8b00966