



Givehchi R, Maestre JP, Bi C, Wylie G, Xu Y, Kinney K, Siegel JA. 2019. Quantitative Filter Forensics with Residential HVAC Filters to Assess Indoor Concentrations. *Indoor Air*, **29(3)**, 390–402. DOI: <https://doi.org/10.1111/ina.12536>.

Abstract

Analysis of the dust from heating, ventilation, and air conditioning (HVAC) filters is a promising long-term sampling method to characterize airborne particle-bound contaminants. This filter forensics (FF) approach provides valuable insights about differences between buildings, but does not allow for an estimation of indoor concentrations. In this investigation, FF is extended to quantitative filter forensics (QFF) by using measurements of the volume of air that passes through the filter and the filter efficiency, to assess the integrated average airborne concentrations of total fungal and bacterial DNA, 36 fungal species, endotoxins, phthalates, and organophosphate esters (OPEs) based on dust extracted from HVAC filters. Filters were collected from 59 homes located in central Texas, USA after one month of deployment in each summer and winter. Results showed considerable differences in the concentrations of airborne particle-bound contaminants in studied homes. The airborne concentrations for most of the analytes are comparable with those reported in the literature. In this sample of homes, the HVAC characterization measurements varied much less between homes than the variation in the filter dust concentration of each analyte, suggesting that even in the absence of HVAC data, FF can provide insight about concentration differences for homes with similar HVAC systems.

Practical Implications

Dust that collects on HVAC filters can be analyzed for a variety of particle bound contaminants. When combined with HVAC characterization data (system runtime, air flow rate, filter efficiency), filter dust contaminant concentrations can be converted to integrated airborne concentrations over the life of the filter. In this paper, we use this quantitative filter forensics (QFF) technique to explore the concentrations of bacteria, fungi, endotoxins, organophosphate esters, and phthalates in 59 central Texas homes. QFF reveals differences between homes for these contaminants and suggests the potential of this approach for indoor exposure analysis.

Support provided by:

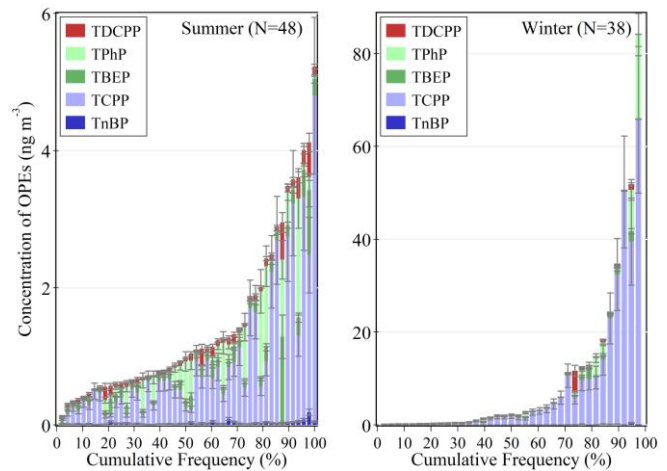


Figure 2. Cumulative distribution functions for concentrations of five organophosphate esters during summer and winter (note difference in y-axis scale.) Quantitative filter forensics reveals differences between homes and seasons for studied compounds.

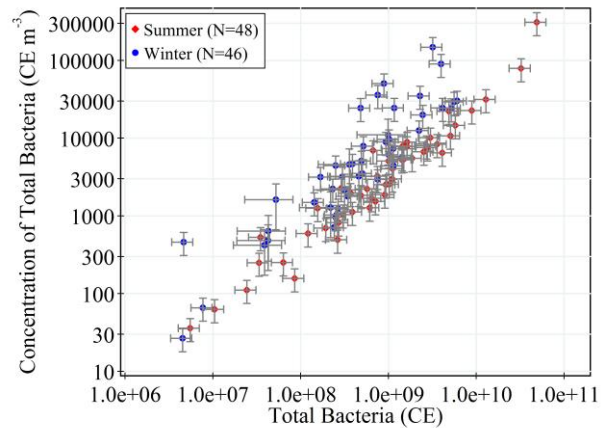


Figure 3. Relationship between quantitative filter forensics (Y-axis) and filter forensics (X-axis) for bacteria. Results for most compounds show that measuring concentrations from filter dust even without considering HVAC metadata generally reveals useful information about airborne concentrations in the home.

