PFAS Contamination in Michigan

Analyzing The Association Between Socioeconomic Risk and PFAS Contamination of Drinking Water

GIS map, analysis, and poster created by Tyler Stotland

Fall 2018, Intro to GIS

BACKGROUND

Per- and polyfluoroalkyl substances (PFAS) make up a large class of compounds used in firefighting foam, non-stick surfaces, paper products, and other items. PFAS have been in use in the United States since the 1940s, and they're now being used globally[1]. Unfortunately, recent research has demonstrated that PFAS chemicals have severe impacts on human health. While PFAS chemicals can reach the human body through a variety of media, the most dangerous one is drinking water. Prolonged exposure to PFAS through drinking water can cause damage to the immune system, thyroid hormone disruption, cancer, and low infant birth weights (in the case of pregnant mothers). Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) are the most extensively produced and studied of the PFAS chemicals, and thus the focus of this research. The U.S. Environmental Protection Agency has established a health advisory of 70 parts per trillion for PFOA and PFOS combined in drinking water[2]. Although some states have adopted this advisory or a stricter standard (such as Vermont, which advises 20 parts per trillion or fewer), there are currently 94 publicly known contamination sites across 22 states in the U.S.[3,4] Many of these contamination sites are in Michigan, as the maps in this analysis show. While the Michigan Department of Environmental Quality has tested over 30 sites for PFAS contamination of groundwater, the locations of all sites are not yet publicly available, so 23 sites have been included in this GIS study. Considering that chemical contamination has historically been associated with environmental injustice (i.e. unfair treatment/involvement of people based on socioeconomic factors in regards to development, implementation, and enforcement of environmental laws and policies), the study examines the extent to which PFAS contamination in Michigan is an environmental justice problem. Further, this study analyzes the association between socioeconomic risk and PFAS contamination.

ACKNOWLEDGEMENTS & DATA SOURCES

I would like to thank Cris Perez, Emily Klotz, Carolyn Talmadge, and all the data lab assistants at the Tufts Data Lab for their help in this project.

Data Sources: ESRI, Michigan State Government, U.S. Census and American Community Survey Data, and US Geological Survey

Background Section Sources:

1. Mueller, Robert, and Virginia Yingling. 2018. "Environmental Fate and Transport for Per- and Polyfluoroalkyl Substances." Interstate Technology Regulatory Council. https://pfas-1.itrcweb.org/wp-content/uploads/2018/03/pfas_fact_sheet_fate_and_transport_3_16_18.pdf.
2. US EPA, OW. 2016. "Drinking Water Health Advisories for PFOA and PFOS." Overviews and Factsheets. US EPA. May 5, 2016. https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos.
3. Vermont Department of Environmental Conservation. 2018. "ANR Adopting Emergency PFAS Rules." July 16, 2018. https://dec.vermont.gov/news/PFAS-emergency-rule.
4. Walker, Bill. 2018. "Update: Mapping the Expanding PFAS Crisis." Environmental Working Group. April 18, 2018. https://www.ewg.org/research/update-mapping-expanding-pfas-crisis.

METHODS & ANALYSIS

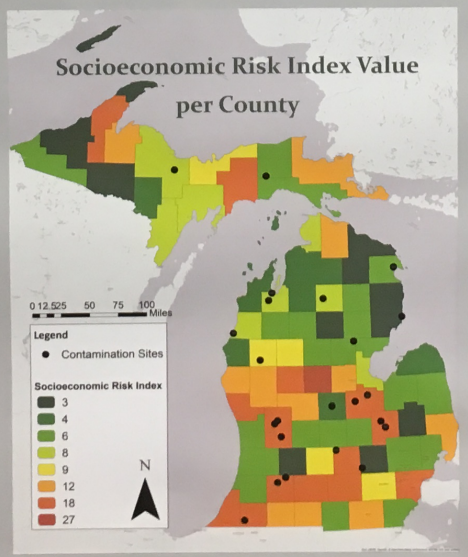
Two main steps went into creating these GIS maps. First, the locations of and information about each of the contamination sites was collected from the Michigan state government's website, then geocoded into ArcGIS using coordinate information. Second, a socioeconomic risk index was created using 3 factors: age, socioeconomic index, and race. Data on percentage of individuals 18 or younger, percentage of low-income households, and percentage of people of color for each county was used to quantify each of these factors per county. For the purpose of this study, a low-income household income is defined as $39,999 or less annually. Each factor was broken down into three categories based on risk, with high percentages of a given factor being designated as high risk (3), medium percentages as medium risk (2), and low percentages as low risk (1) for PFAS contamination and consequential negative health outcomes. As mentioned in the background, chemical contamination has historically disproportionately burdened marginalized communities, such as low-income families or people of color. Age was included in this analysis since children are more susceptible to chemical contamination than adults as they typically have smaller bodies and are still growing. Based on the data, each county was designated a 1-3 risk classification for each of the 3 factors. The three risk classifications were then multiplied to determine the socioeconomic risk index value for each county.

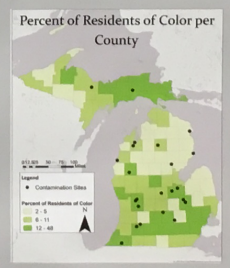
FINDINGS & FUTURE RESEARCH

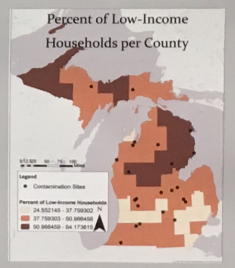
The GIS maps and analysis indicate that about half of contamination sites are in counties classified as 18 on the socioeconomic risk index. Considering that only one county was classified higher than 18 (at 27) on the risk index, this finding is deeply concerning. While one of these contamination cases was due to a tanker spill- coincidence- most of the other sites are from current or historic landfills and factories. While this data is not detailed and extensive enough to declare this situation as an environmental justice problem, it certainly seems suspicious. There is clearly an association between PFAS contamination and socioeconomically at-risk counties (9 or above on the index); at-risk counties bear the vast majority of the PFAS burden in Michigan. It is essential that companies prioritize environmental justice and corporate responsibility going forward. In addition, the U.S. must transition from the current throw-away, plastic-reliant culture to a more sustainable culture in order to minimize the need for toxic chemicals like PFAS. In the meantime, research must develop and test safe alternatives to PFAS chemicals.

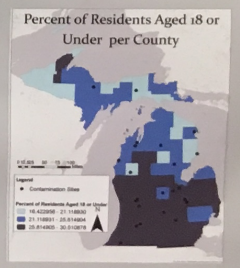
Tufts UNIVERSITY

GRAPHS AND GIS MAPS

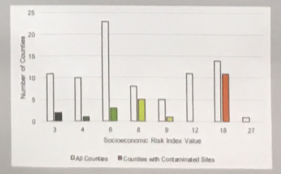




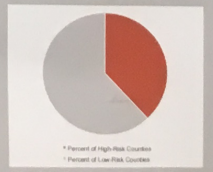


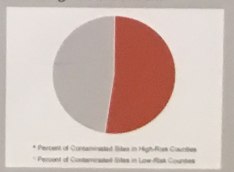


Counties per Socioeconomic Risk Index Value



Percent of High-Risk* Counties Overall vs. Percent of Contaminated Sites in High-Risk Counties





*Where "high-risk" includes risk index values of 9-27