A Space-Time Analysis of Multi-Year Air Quality Data in Fort Worth and Houston in order to Quantify Cancer Risk

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INTRODUCTION

The goal of this project was to use collected data on BTEX (benzene, toluene, ethylbenzene, xylene) concentrations in Fort Worth and Houston to be able to determine cancer risk levels. Two years' worth of Automated Gas Chromatography data were collected and analyzed in order to create this poster. This topic is important because it allows the people who spend time in these areas to be more informed about their health and the effects that air pollution can have on them. Inhalation is the main route of exposure to these chemicals which largely come from vehicle emissions, industrial activity, and cigarette smoke.

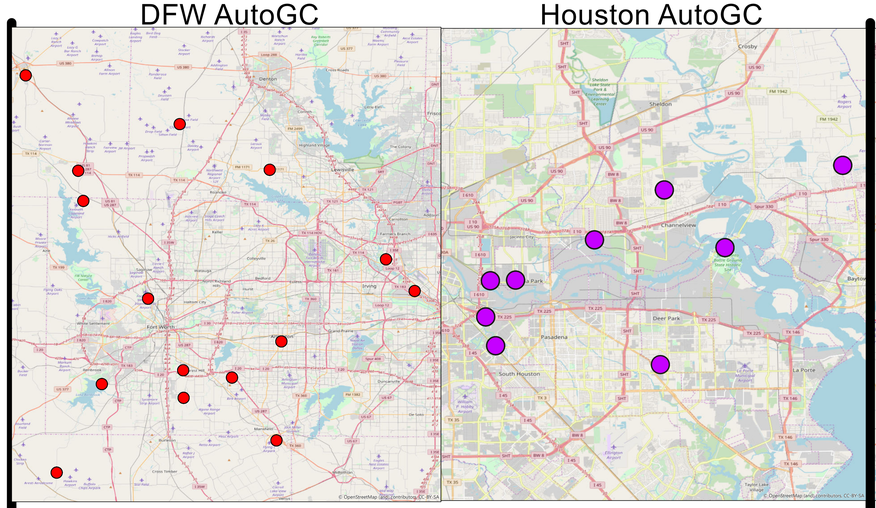
STUDY COMPOUNDS

Benzene: A highly flammable and volatile liquid aromatic hydrocarbon found in crude oils. A product of burning gasoline; benzene is a known carcinogen linked to increased risk of lymphatic cancer and leukemia.
Toluene: Used widely as an additive to gasoline and as a solvent. Toluene impacts the central nervous system and can also cause irritation of the respiratory system. The EPA has concluded that there isn't enough information to assess the carcinogenic potential of Toluene.
Ethylbenzene: A colorless hydrocarbon, it is used as an additive in gasoline to reduce engine knock. Ethylbenzene's carcinogenic effects on humans are not known, but studies have shown that inhalation has resulted in increased kidney, lung, and liver tumors in rats and mice.
Xylene: Another additive of gasoline, xylene exists as a family of isomers. EPA group D meaning they are not classifiable as to their carcinogenicity to humans.

Source: All information about the study compounds was sourced from https://pubchem.ncbi.nlm.nih.gov/

MONTHLY TRENDS

DFW AutoGC | Houston AutoGC



Concentrations of BTEX compounds at a subset of sites in DFW. Scale for graphs may be different to emphasize the data.

Concentration of BTEX compounds at a subset of sites in Houston. Scale for graphs may be different to emphasize the data.

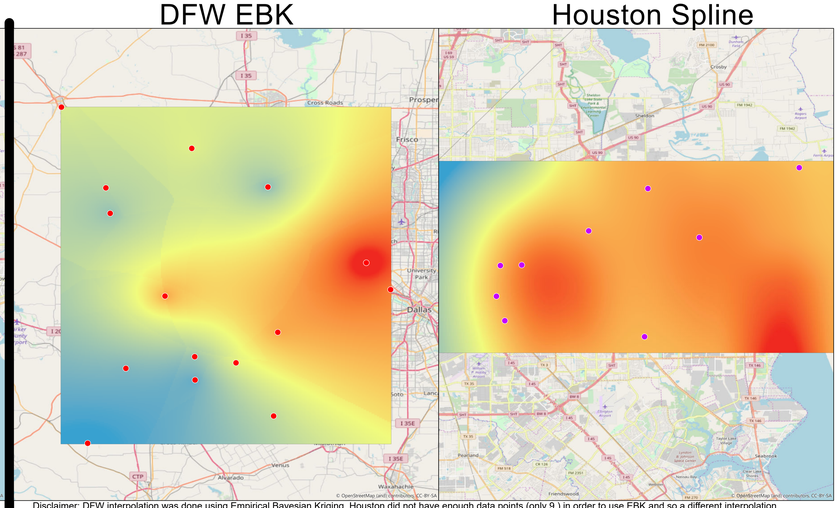
ANALYSIS

The two-year Automated Gas Chromatography data was analyzed in order to determine if monthly trends were present. The vast majority of the data experienced peaks from September to November of each year. Interestingly enough, these peaks occurred in both the DFW metroplex and in Houston around the same time. The total concentrations in Houston were generally higher than the concentrations in the DFW metroplex. Urban areas also experienced higher concentrations than more rural areas. These two trends can likely be attributed to the population density; both of the different study areas, and of rural areas and urban areas.

Source: All AutoGC data was sourced from the Texas Commision on Environmental Quality at https://www.tceq.texas.gov/

INTERPOLATED DATA AND CANCER RISK

DFW EBK | Houston Spline



Disclaimer: DFW interpolation was done using Empirical Bayesian Kriging. Houston did not have enough data points (only 9) in order to use EBK and so a different interpolation

CONCLUSION

According to the data, the average person living in Fort Worth or Dallas will be exposed to .000015g/kg bodyweight/day and .000016g/kg bodyweight/day of benzene respectively. In Houston, the average person will be exposed to .000095g/kg bodyweight/day of benzene. Houston has an average exposure about 6 times greater than the DFW metroplex. In conjunction with the NCI's Cancer Atlas, I tried to find a correlation between this higher concentration and increased cancer rates. The incidence rate of leukemia in Houston was not significantly different from that in the DFW metroplex. This could be due to a number of factors such as differences in the demographics of the study areas.

LIMITATIONS

AutoGC collection sites are very spread out in the DFW metroplex and don't extend to the eastern side of Dallas. In Houston, only 9 collection sites exist and they are all on the southeastern side of the city so I don't have any data for the rest of Houston which impacted the interpolation method and subsequent data.