PM 2.5 Relative to Burn Limits and Wood stoves in Missoula County

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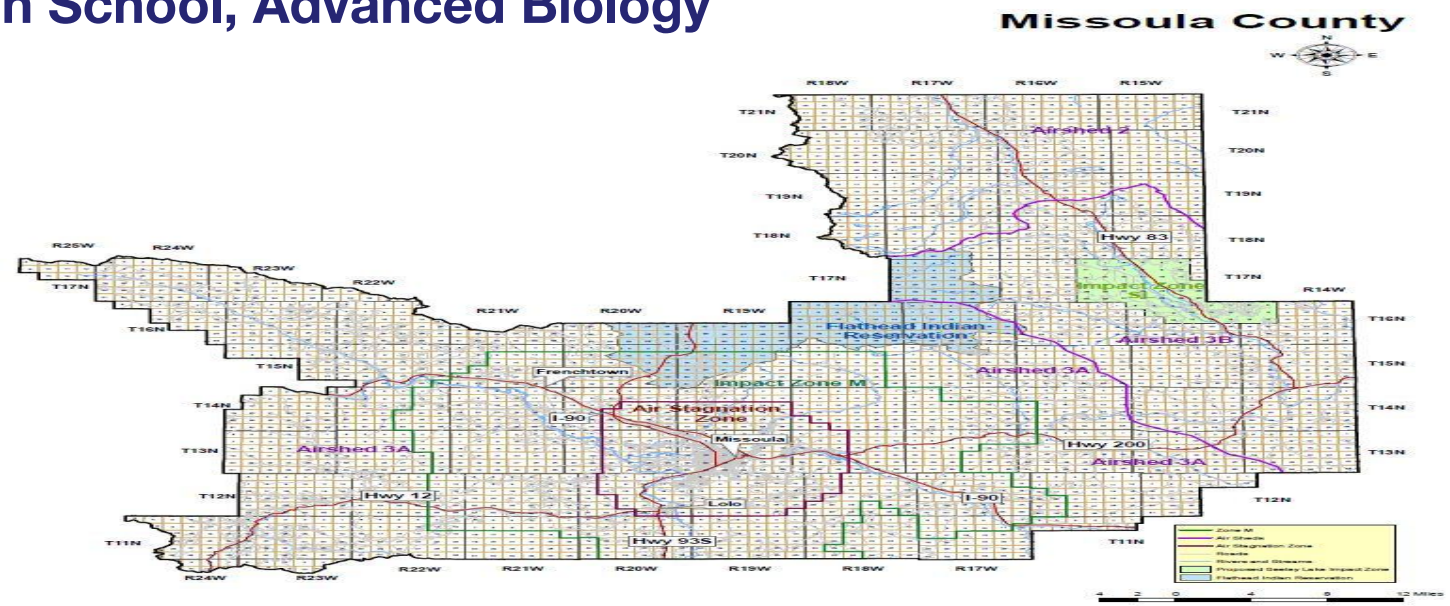

How do burn limits and the use of wood stoves affect PM 2.5 levels in and around Missoula county compared to other counties?

- PM 2.5 stands for Particulate Matter and is a mixture of solid particles and liquid droplets in the air that are 2.5 μm or smaller.[2]
- The small particles can get into your lungs or bloodstream and cause serious health problems.[2]
- Indoor PM 2.5 levels under 12 $\mu g/m^3$ are considered good, while 35 $\mu g/m^3$ is the safe limit for outdoor air. Anything above those levels, for a considerable amount of time, is considered possibly unhealthy for sensitive groups.[2]
- Wood smoke creates multiple pollutants that are bad for your health, including PM 2.5.[3]
- Average outdoor PM 2.5 levels in Montana are 5 $\mu g/m^3$ and Missoula County has average levels of 9.6 $\mu g/m^3$. [4]
- Wood smoke from wood stoves tends to stay in the air longer and work its way into nearby homes.[4]
- Outside city limits, recreational fires cannot be more than 2m in diameter unless they are completely prohibited due to fire danger. [6]
- Within city limits all outdoor fires are prohibited. [6]

More Background Information

- A study done in 2006-2007 found that wood stoves were the cause of 55% of PM 2.5 in Missoula County during the winter months shown in Figure 1. [5]
- Figure 1 also shows that Industry and Ammonium nitrate are the next two highest contributors to PM 2.5 in Missoula County, both being just under 20%.
- Ammonium nitrate is a chemical compound that looks like a white crystalline salt used mostly as a high-nitrogen fertilizer.

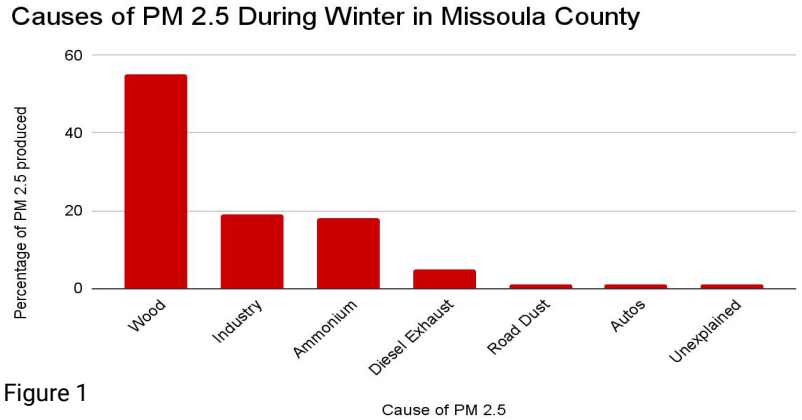

Figure 1

Hypothesis: The use of wood stoves in the winter will cause higher PM 2.5 levels compared to summer when there are more burn limits and less wood stove use. Other counties will also have less PM 2.5 because of less wood stoves being used during winter months.

Method

- The first thing I did in my research was find the average PM 2.5 levels in Montana and compare them to average PM 2.5 levels in Missoula County. [4]
- Then I found the burn limits in Missoula County [6] and the history of wood stoves being used in Missoula county. [5]
- I used the EPA outdoor air quality data website to compare the data of Missoula County air quality to the data of other major counties in Montana (Lewis and Clark County, Flathead County and Yellowstone County).[7]
- Lastly I found other contributors to PM 2.5 in Missoula County to know my uncontrolled variables. [5]

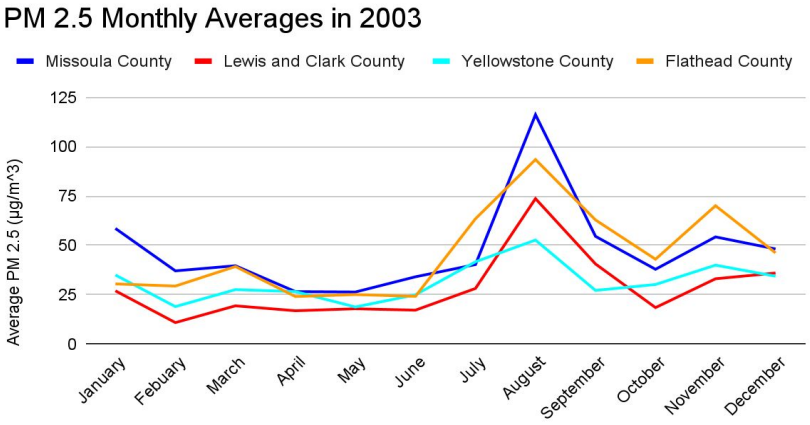

Figure 2

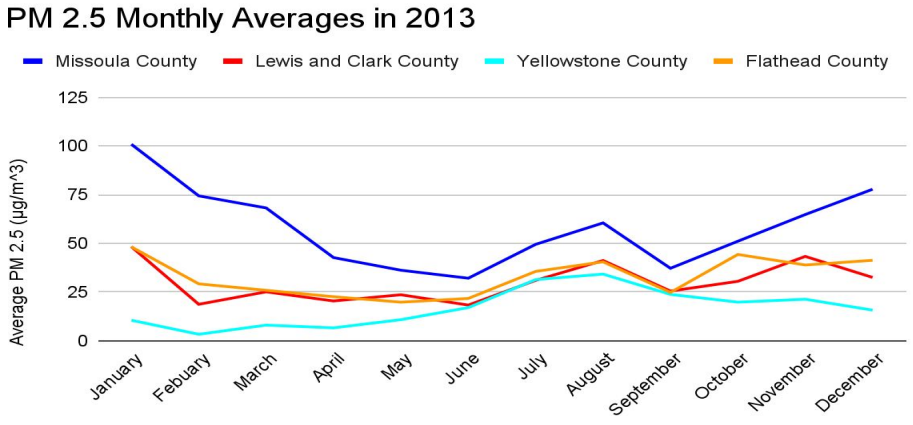

Figure 3

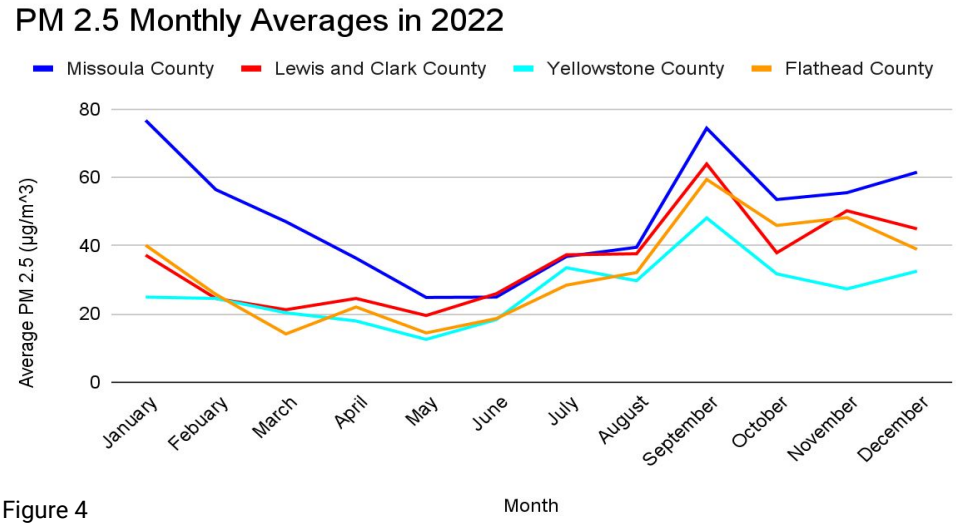

Figure 4

Data Analysis

- In Figures 2-4 it shows how PM 2.5 levels compare to other nearby counties in different years.
- Each graph shows the average of each month based on the highest PM 2.5 reading of each day.
- The graphs show how much higher Missoula County averages are compared to other places in Montana.
- In the 36 months worth of information gathered, Missoula County had the highest averages outside of a few occasions.
- They also show how PM 2.5 in Missoula County is higher during winter months compared to summer months. This result is best shown in Figure 3 where January is close to an average of 100 $\mu g/m^3$ compared to June and July with averages around 30-50 $\mu g/m^3$, then jumping back to around 75 $\mu g/m^3$ in December.

Conclusions and Sources of Error

CONCLUSIONS:

The PM 2.5 levels in Missoula County were higher almost year round compared to PM 2.5 levels in other areas. Almost every year the PM 2.5 levels in Missoula County during the winter were significantly higher than the levels during summer with the exception of fire season around August and September. This result supported my hypothesis but I was still surprised by how much worse it truly was in the winter compared to summer. My results show that there should be a concern around the air quality in Missoula County because it consistently sits around and above the unhealthy level of PM 2.5 recommended by the EPA.

SOURCES OF ERROR:

The severity of each fire season is something I'm unable to account for and my research is also unable to account for PM 2.5 caused by other producers like industry and ammonium nitrate. My test was focused on the use of wood stoves and how it correlates with higher PM 2.5 levels in Missoula County. The data I collected could also have been affected by the weather conditions of each day. If I could continue my research I would like to gather more information on more years than just the three I researched. I would also like to find information on the weather of each day and other outside factors like fires that could also have affected the results gathered.

NEXT STEPS:

If I could continue my research I would like to gather more information on more years than just the three I researched. I would also like to find information on the weather of each day and other outside factors like fires that could also have affected the results gathered.

References

[1] The Impact of Wood Burning Fireplaces and Woodstoves on Indoor Air Quality
https://www.trusens.com/news/blog/indoor-fireplace-pollution-solution/

[2] Particulate Matter (PM) Basics
https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#effects

[3] Wood stoves in Missoula County
https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/woodstoves-home-page

[4] Montana Air Quality Index (AQI)
https://www.aqi.in/us/dashboard/united-states/montana#:~:text=I%20be%20worried%3F-,The%20current%20concentration%20of%20PM2.,5%20(%C2%B5g%2Fm%C2%B3).

[5] Missoula County Air Quality History
https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/history
https://www.epa.gov/outdoor-air-quality-data/monitor-values-report

[6] Missoula County Outdoor Burning
https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/outdoor-burning#:~:text=Recreational%20fires%20are%20allowed%20outside,burn%20untreated%20wood%20and%20vegetation.

[7] Outdoor Air Quality Data
https://www.epa.gov/outdoor-air-quality-data/air-data-tile-plot