



An Analysis of Select Weather Parameters and Aircraft Noise Levels in Dearborn Heights, Michigan

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Abstract

Noise pollution from an aircraft is an often-overlooked component of quality of life in urban and suburban areas. Understanding this is crucial when trying to minimize health effects. These health effects include high blood pressure, anxiety, inner ear degradation, and psychological stress (EPA 2023). Crestwood High School hosts many outdoor activities, such as cross country, track, soccer, baseball, football, etc. Crestwood High School is affected by noise pollution because it is an area airplanes visit many times daily en route to the airport for flights coming in. This research was conducted during the fall and winter seasons of 2023/24. Researchers used a Sound Level meter and various devices to measure aircraft noise in decibels over four months. Data on air temperature, noise pollution, dew point, relative humidity, and the cloud cover, was collected using GLOBE protocols. The environmental factors listed above were collected with the Vernier Go Direct Weather device and the Weather Bug app and the researchers took cloud observations and uploaded their data through the GLOBE Cloud Observer app. While further research on this topic is warranted, adjusting outdoor activities to coexist with periods minimal noise could reduce health risks associated with aircraft noise. One objective of this research is to find out when aircraft-caused noise pollution is at its peak so that its adverse effects on students participating in outdoor activities may be avoided or minimized.

Discussion

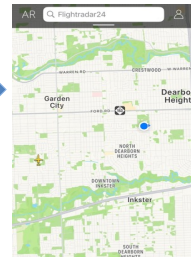
The null hypothesis that cloud coverage does not affect noise pollution was accepted. The researchers found that when cloud coverage varied, there was no significant difference in aircraft noise levels measured in decibels. This was because not all aircraft were flying directly overhead the Sound Level meter, and most aircraft were flying into the Metro Detroit Airport and over the researchers' school from the northeast direction. Due to the aircraft flying slightly further than ideal when trying to observe the effect of cloud cover on aircraft noise, the researchers couldn't pick up on a relationship between cloud cover and aircraft noise in decibels.

The null hypothesis that air temperature and humidity have no correlation with noise pollution was rejected because the researchers found that air temperature and humidity are inversely related to aircraft noise. Air temperature and humidity influence airplane noise due to their impact on atmospheric absorption. Gases in the atmosphere, such as water vapor, carbon dioxide, and ozone, absorb frequencies. The degree of atmospheric absorption differs across different regions of the electromagnetic spectrum and is the presence of absorbing gases and particles in the atmosphere (NASA 1999). The degree of absorption also varies depending on humidity and temperature. When both humidity and temperature are high, the degree of atmospheric absorption is high, and the frequencies are lower. Dew point and relative humidity are directly related, meaning the dew point also affects the degree of atmospheric absorption. A result is the absorption of more of the sound waves and lowering the noise, in decibels, airplanes were producing (Oakland International Airport 2006). The relationship between air temperature, humidity, dewpoint, and atmospheric absorption underscores the significance of managing airplane noise with higher air temperature and humidity levels contributing to reduced aircraft noise levels, highlighting the importance of looking at weather variables when trying to manage aircraft noise efforts.

Methods and Materials



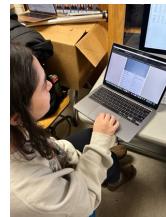
Satellite image of data collection site, Crestwood High School



Researchers used Flighttracker24 app for aircraft information



Using Vernier Sound Level Meter and Vernier Go Direct Device



Student researching sending data to GLOBE

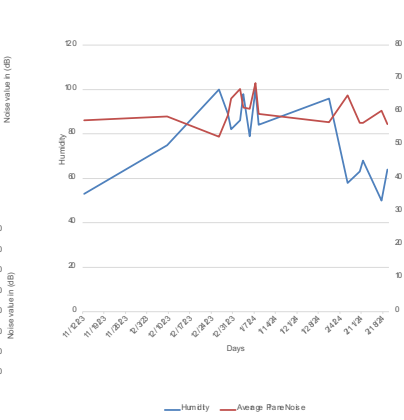
Time	Altitude	Speed	Direction	Distance	Altitude	Speed	Direction	Distance
11:00 AM	3,000 ft	170 mph	030°	1.7 mi	412 feet	174 mph	030°	1.7 mi
11:05 AM	2,500 ft	160 mph	030°	1.5 mi	402 feet	164 mph	030°	1.5 mi
11:10 AM	2,000 ft	150 mph	030°	1.3 mi	392 feet	158 mph	030°	1.3 mi
11:15 AM	1,500 ft	140 mph	030°	1.1 mi	382 feet	148 mph	030°	1.1 mi
11:20 AM	1,000 ft	130 mph	030°	0.9 mi	372 feet	138 mph	030°	0.9 mi
11:25 AM	500 ft	120 mph	030°	0.7 mi	362 feet	128 mph	030°	0.7 mi
11:30 AM	0 ft	110 mph	030°	0.5 mi	352 feet	118 mph	030°	0.5 mi
11:35 AM	0 ft	100 mph	030°	0.3 mi	342 feet	108 mph	030°	0.3 mi
11:40 AM	0 ft	90 mph	030°	0.1 mi	332 feet	98 mph	030°	0.1 mi
11:45 AM	0 ft	80 mph	030°	0.1 mi	322 feet	88 mph	030°	0.1 mi
11:50 AM	0 ft	70 mph	030°	0.1 mi	312 feet	78 mph	030°	0.1 mi
11:55 AM	0 ft	60 mph	030°	0.1 mi	302 feet	68 mph	030°	0.1 mi
12:00 PM	0 ft	50 mph	030°	0.1 mi	292 feet	58 mph	030°	0.1 mi

Data gets compiled onto a spreadsheet



Researchers inputting data into the GLOBE observer app

Results



Conclusion

The researchers then use the Vernier Go Direct Weather device to test for the surface wind speed. Using the Vernier Sound Level Meter, there was a notable difference between air temperature and humidity compared to sound produced by aircraft in decibels. The results indicated an inverse relationship between air temperature and humidity when compared with noise produced by aircraft. Hence, as noise levels produced by aircraft increase, air temperature decreases, implying that colder weather has a more significant impact making noise levels louder. However, there was also noted that barometric pressure and surface wind speed did not appear to influence the overall noise produced by aircraft. Some other factors researchers did not consider in this project included the type of engines within the aircraft, the altitude of the aircraft, and the type of airplane. Considering all these factors, it is possible that prolonged exposure to aircraft noise can be potentially unsafe depending on how long and how frequently one is exposed to the noise. Students attending the school near the study site should consider adjusting after-school activities to coincide with times when aircraft noise is minimal which could reduce possible health risks to students. Further research should be conducted to more fully understand the impact of aircraft noise on student health. This research could be improved by expanding our study period and taking data multiple times throughout the day rather than just one specific time.

Acknowledgements

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Citations

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