Mecklenburg County Air Quality GLOBE Project

Abstract: The purpose of the project was to collect air quality data from weather stations at JM Alexander Middle School of Huntersville, North Carolina and Moorehead STEM Academy of Charlotte, North Carolina. The research question was "Is there a relationship between air quality, population growth, and respiratory health?" Students were to collect daily temperature, relative humidity, cloud cover, wind direction and ground ozone data at or around solar noon. We followed GLOBE Ozone and Atmosphere Protocols. Our results are inconclusive due to inconsistant data collection.

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Students:
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Research Question

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After teaching middle school for several years, the teachers had seen an increase of asthma and allergy sufferers in their classes at both of their schools. Also, there has been increase in population growth into the suburbs of Charlotte, North Carolina. Mrs. Zingher observed that the area around JM Alexander Middle School was changing. The suburban school is five miles from Charlotte. In the last ten years, five neighborhoods had been built by the school, a dozen or more businesses have been built as well as a Walmart Supercenter and several car dealerships. The rural highway that ran by the school was widened and access to Interstates 485 and 77was added. Moorehead STEM , where Mr. Pilarsky teaches, is less than 1 mile from downtown Charlotte and has become a densely populated urban area. After learning about the dangers of ground ozone to health at the GLOBE L2R workshop, the teachers wondered if the population growth and the increase of respiratory illnesses were related. Since there was an ozone garden already established at Moorehead, the teachers wondered if it was ozone that was causing the health problems in their students.

Materials and Method

Atmosphere Materials: GLOBE Cloud chart
Digital Hydrometer
Digital max/min Thermometer
Metric rain gauge
pH paper
instrument shelter

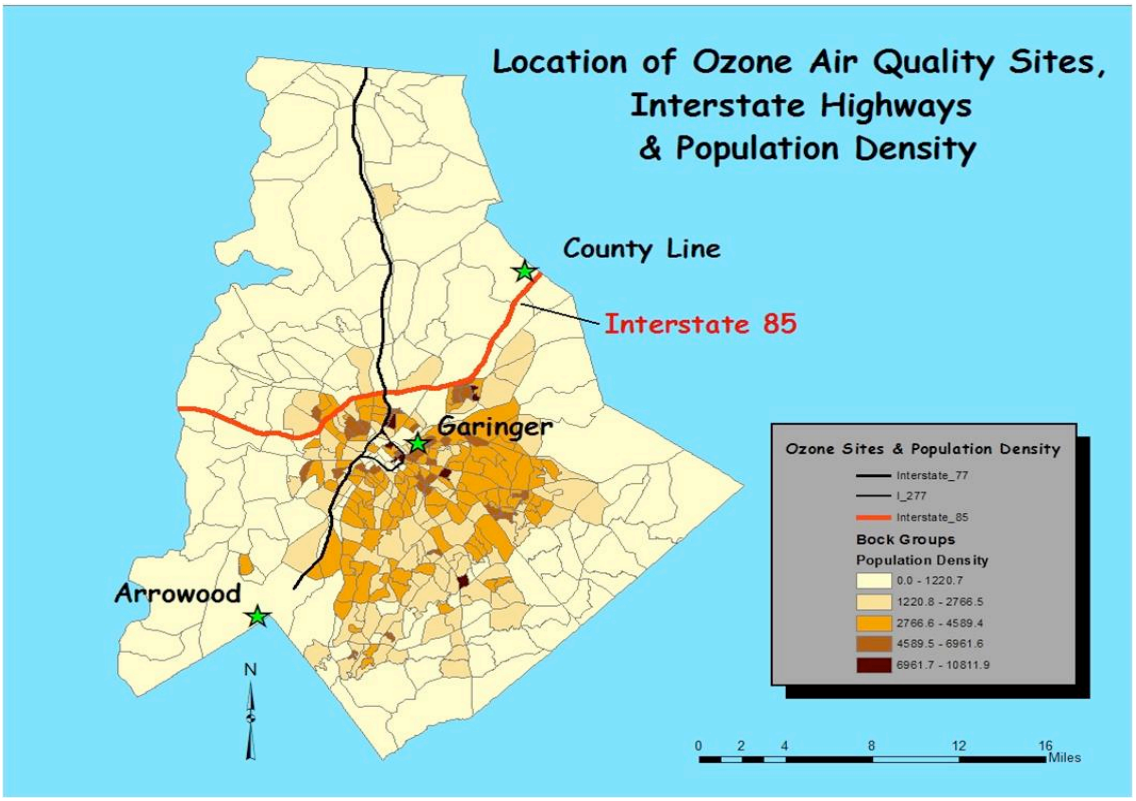
Surface Ozone Materials: Testing solution (corn starch, Potassium Iodide, distilled water)
Coffee filters cut into 1 inch strips
Hot plate
Paintbrush
Ziplock bags
Glass plate
Schoenbein Color Scale
Compass
Wind direction Devise(make your own)

Data Collection Method:

The instrument shelter, GLOBE cloud chart, digital hydrometer and thermometer, and rain gauge were provided by The GLOBE Program. Using GLOBE protocols, the JMA study site was selected and the instrument shelter was installed. Also using GLOBE protocols, the Ozone measurement station was installed and the Wind direction instrument was constructed. This was also completed at Moorehead STEM Academy.

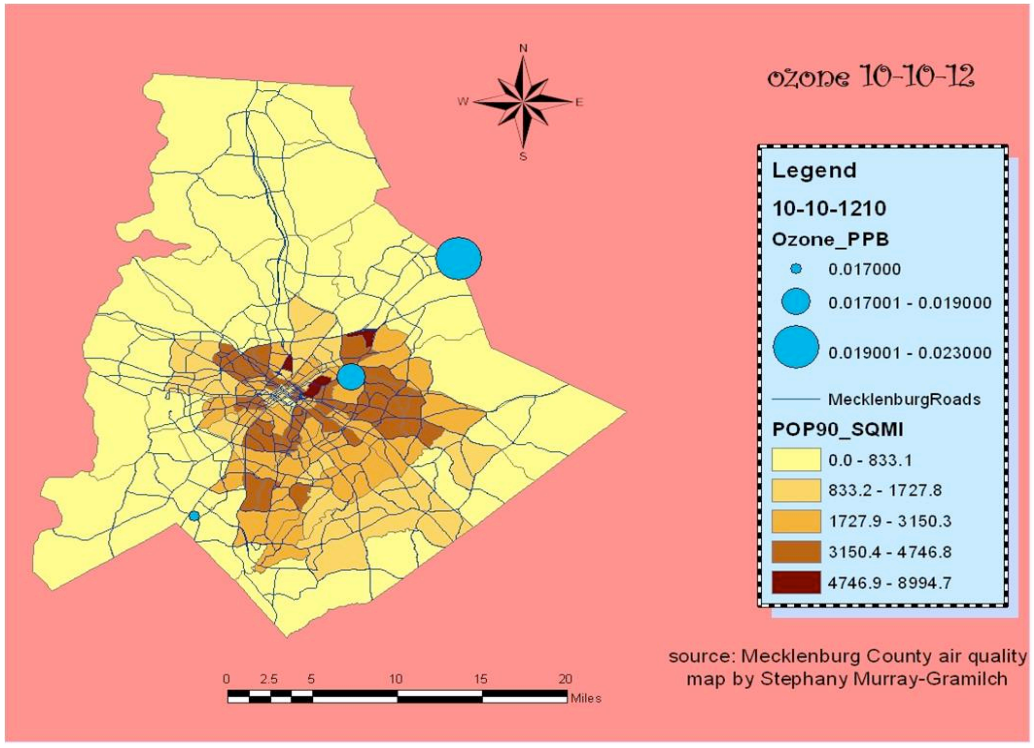
JMA: According to the school's rules for clubs, a group of 14 sixth graders became "The GLOBE Club". The club's first meeting explained the purpose and research questions and detailed the data collection procedure and the use of the ArcGIS program to analyze and display the data. The club was divided into two groups: one to collect the data daily and the other to gather historical ozone data. The daily collectors met at the weather station almost every day at approximately solar noon and recorded max/min temperature, relative humidity, cloud cover, wind direction, and ground ozone data using Schoenbein strips. The following GLOBE Protocols were used to collect data: Clouds Protocol, Relative Humidity Protocol, Precipitation Protocol, Max/Min/Current Air Temperature Protocol, and Surface Ozone Protocol. This data was recorded into GLOBE 7 day data sheets. The group that gathered historical data worked with Laurie Garo from the Department of Geographic and Earth Sciences of the University of North Carolina at Charlotte. She showed them where to find the ozone data sites already established by Mecklenburg County(where both schools are located) and taught them how to layer the information using ArcGIS software. They each built maps of the county using the data from the Mecklenburg County collections sites. Also this group collected asthma data from a Mecklenburg County source and using the ArcGIS software, layered this over the ozone data.

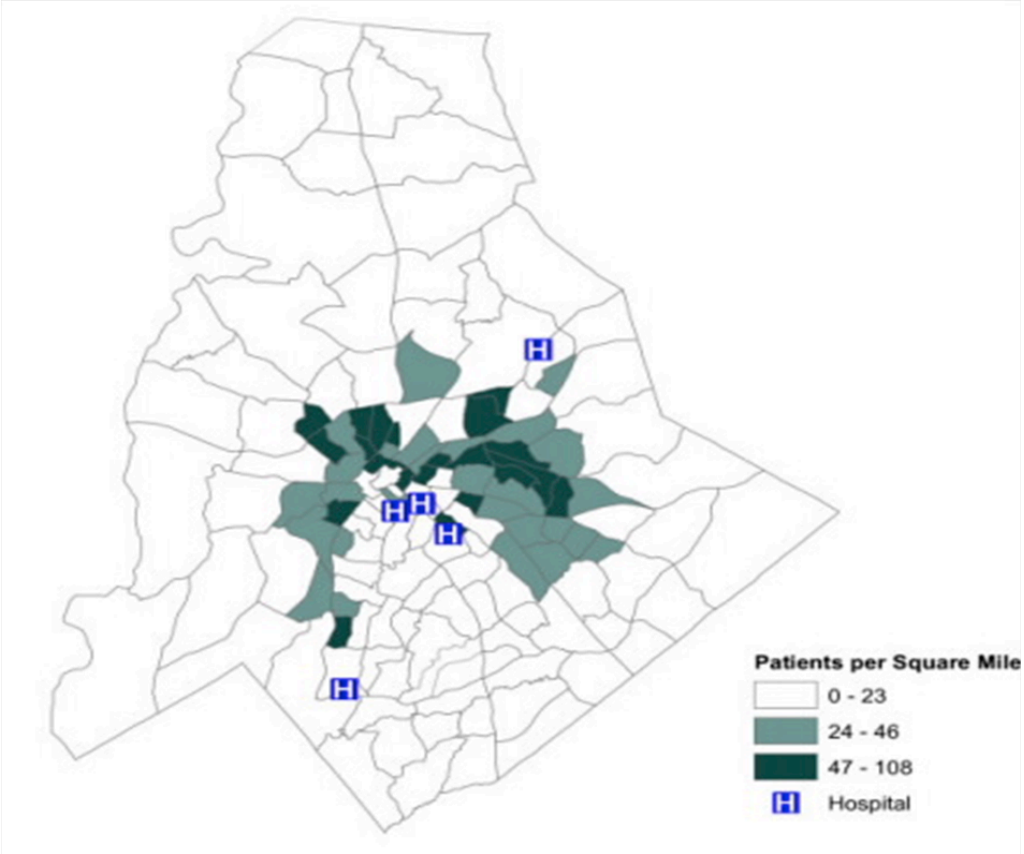
Data Summary



	A	B	C	D	E	F	G	H	I	J
1	ID	Date	Location	XLON	YLAT	OzonePPB	TempDegC	Humidity	Cloud Cover	WindSpeed
2	1	10/10/2012	Arrowwood	-80.9197222	35.1130556	0.017	30.89	88	60	3.1
3	2	10/10/2012	Garinger	-80.7855556	35.2402778	0.019	30.89	88	60	3.1
4	3	10/10/2012	County Line	-80.6936111	35.3486111	0.023	30.89	88	60	3.1

Table I. Fall 2012 Ozone Data





Asthma Patients Needing Emergency Room Care in October 2012

Analysis and Results

At JMA, our data was incomplete due to inconsistent data collection. This is because the school's rules about unsupervised students out of class. Mrs. Zingher couldn't always leave her class to supervise collection so on those days the students were on their own and if they couldn't leave their class to collect the data, it was not collected. When the data was collected, it was never entered into the GLOBE website. This was due to the "GLOBE Club" not meeting enough times to complete this task. Again, Mrs. Zingher had to follow the school's policy of not pulling students out of classes to do club work. The students also struggled with getting a consistent result with the Schoenbein strips. Since the strips should have been read after one hour, the students usually read the results after four or more hours. The only data the students analyzed was the few days in October where it was entered into the ArcGIS software and used to layer on a map of Mecklenburg county. Using the historical ozone data collected from the county's collection sites, the students layered this as well using ArcGIS. The students noticed that there was higher ozone at the County Line collection site and at the Garringer Collection site. There isn't enough respiratory illness data collected by Mecklenburg County to analyze.

Conclusions

At JMA, the data collected at the school's weather station was too little to draw any conclusions. There does appear to be some support for Mecklenburg County having areas of significant ozone levels in the fall. The students concluded that the County Line site had higher ozone due to it's proximity to two interstate highways. Even though the Garringer site is in a more densely populated area, it was higher than other sites, but less than the County line site. No conclusion can be drawn from the historical asthma data since the information wasn't readily available to the students.

Discussion

This first year was a real learning curve for JMA. We have established the study site and gathered a group of interested students. We learned the protocols and the importance of consistent data collection. We learned that collaboration with another school isn't easy. JMA and Morehead never communicated very much and it seemed that the schools had different goals. Using what they learned about the software, the students were one of only four student groups that presented at the regional GIS Expo in Charlotte. This success made the JMA students more dedicated and persistent in their desire to "do real research". However, they felt confined by school policy. Not giving up, they dug in and designed an outdoor classroom for the school anchored on their desire to do more climate research. Mrs. Zingher found two grants and the classroom was completed in 3 weekends with the help of 50 "non-GLOBE" volunteers. There is a large dedicated space for an ozone garden that will include a wide variety of bioindicators. The plants have been ordered and the students are on call to plant them when they arrive. Their dedication to continue the research has impressed Ms. Richardson, JMA's new principal, to the extent that she is open to giving the group permanent passes like the ones given to the yearbook camera team. This opens the door for them to leave classes at solar noon to collect data consistently. They feel

compelled to continue their work with more diligence. The group has decided to adjust their research to include aerosol and particulate data. Also, they would like to procure an ozone meter to confirm/replace the Schoenbein strips and a photometer. The students have decided they need to establish a community partnership with the appropriate resource to gather more respiratory illness data. Leaders have developed among them. Mrs. Zingher has no doubt that these students will accomplish these goals next year.

Next Year Goals

1. More Consistent Data Collection
2. Meet with GLOBE Club members every week.
3. Add Particulate/Aerosols Protocols
4. Collect Ozone Data from Bioindicators
5. Enter Data into the GLOBE website

Acknowledgments

The students at JMA would like to acknowledge the help of Laurie Garo of UNCC for her instruction in ArcGIS. The students would also like to thank Principal Angela Richardson for her support. Also, they would thank Lowe's Home Improvement, inc and JMA's PTSA for the grants that made building of JMA's Outdoor Classroom possible. Lastly, the students would like to acknowledge Alisa Wickliff of UNCC STEM for her constant support in helping the students stay dedicated.