

Since I was young, I have always been interested in hurricanes. I became increasingly interested after witnessing hurricanes taking place, specifically Hurricane Irene and Hurricane Sandy in New York, when I was in elementary school. Instead of being scared of these natural disasters, I wanted to learn more about them. I followed the news of every major hurricane that impacted the United States, eager to know the most that I could about each hurricane. When I was presented with the opportunity to conduct my own research through my school's Advanced Science Research class, I immediately knew that I would be researching something related to hurricanes. As I prepared for this class by completing the summer project, which was to read ten research articles of our choice on any topic, I noticed a trend in the articles concerning hurricanes. Most of them were about the effect of climate change on hurricanes, specifically how climate change was making hurricanes stronger and more dangerous. After reading these articles, I settled on the idea of researching the impact of climate change on hurricanes. My teacher then suggested that I look into climate modeling, as this was a realistic way to research hurricanes.

After securing mentors to help me with my project, we decided to use the Columbia Hazard (CHAZ) Model to simulate hurricanes under conditions representative of projected future temperatures. In order to do so, I worked with a dataset from the National Hurricane Center. Then the results needed to be printed on graphs and maps so that the data could be analyzed. Printing the data required the use of the computer programming language, Python. I did not know Python though, and had little experience with coding. This was the most difficult part of my project, as I was not familiar with how to write code or correct errors, and doing so took a lot of time. It was a relief when I finally got the code right, as it was necessary for the analysis of the data and the completion of my project. Using Python, I was able to create maps and print

hurricane tracks on them, and create graphs with data points and lines of best fit, so I could identify trends in the data.

This project highlighted the connections between science and math as well as the connections between different branches of science. Before learning about climate modeling and conducting the research project, I would not have believed earth and environmental science to be so closely connected to computer science, yet it was necessary to utilize both in order to see results. Computer science is connected to almost every branch of science now, and it can be used to model and simulate situations necessary for research in other branches. Computer science also made the project more accessible and easier to conduct, as I was able to do research on my own device at home and at school.

Most science research projects utilize mathematics in some way, as the two subjects are extremely interconnected. Conducting a project that involves both science and mathematics is a great opportunity to expand both scientific and mathematical knowledge, as well as gain an understanding of how mathematics supplement scientific inquiry. Students who take on these types of projects should enjoy both science and math, and should be willing to go through a lot of trial and error to achieve their end result. In my case, it took many attempts to get the code for my project to work, which was frustrating, so students should be willing to spend a lot of time on their projects. In the end, the results will make the time spent worthwhile.

For my project, Simulating the Impacts of Climate Change on Hurricanes Using the CHAZ Model, I used a climate model to simulate hurricanes in a future climate. This climate takes into account the rate that the climate is currently warming so that the effects of a warmer climate on hurricanes can be shown. A dataset containing several variables, such as intensity (wind speed), forward speed, and hurricane frequency, was used. Each variable was analyzed

separately, and a graph of each data point was plotted on a graph for that specific variable. The graphs were linear regressions, and a line of best fit showed the overall trend in the data. Then maps of the hurricane tracks were printed, as well as maps of tracks that included each specific variable. The maps showed the value of each data point using different colors. From the linear regressions and maps, major trends in the hurricanes were identified, and it was determined that climate change had a considerable impact on the hurricane variables studied.

The research project determined that hurricane frequency, forward speed, and angular speed was increasing due to climate change, but the data also showed that intensity was decreasing. That result was most likely due to the limited availability of data or due to natural variability, as I only studied hurricanes that impacted the Northeastern coast of the United States. Because that area receives a fewer number of hurricanes than other regions, the data was limited, and the results may differ from results of similar studies of other regions.