CS418 Group 15:

Shahryar Ahmed (NetID: sahme34, GitHub: shahryarahmed3)
Shoaib Ahmed (NetID: fahme8, GitHub: FnuShoaibAhmed)
Noura Almasri (NetID: nalma7, GitHub: nalmasri17)
Lorena Castillejo (NetID: lcasti39, GitHub: LorenaCastillejo)
Sakinah Chadrawala (NetID: schadr2, GitHub: sakkk90)

GitHub Repository: https://github.com/shahryarahmed3/Climate-Change-vs-Extreme-Weather

Google Colab Link:
https://colab.research.google.com/drive/1rYo2a7McVa0maMLB27PdSZAEJ7GQiPZP

Introduction

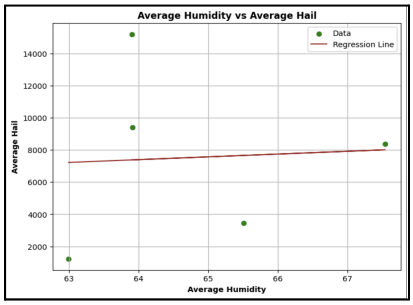
Our big idea is to examine the relationship between climate change and extreme weather. Many variables contribute to this complex relationship, however, we chose to focus on a few specific variables. For climate change, we analyzed temperature, humidity, CO2, and precipitation. On the other hand, for extreme weather, we considered tornadoes, wind, and hail. To narrow this broad topic, we would like to consider our hypothesis to be: Changes in climate patterns affect extreme weather. It is worth looking at this relationship as the weather is slowly warming up annually in some places in the world as it is becoming much colder in other parts.

Data

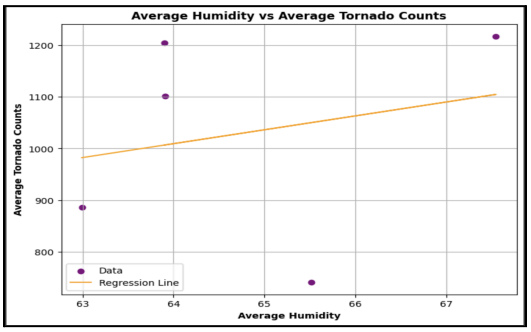
While looking for data, our main region of focus was the United States with records for the past five decades. It was hard to obtain climate change variable data for more years due to it being costly. Hence, we had to work with data from two years from each decade, specifically 1975-1976, 1985-1986, 1995-1996, 2005-2006, and 2015-2016.

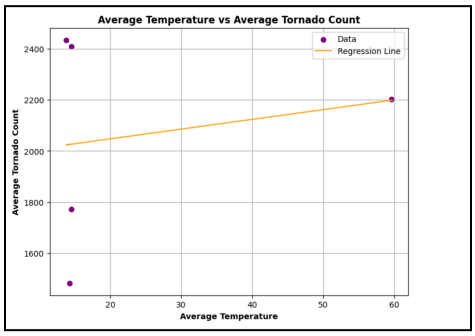
Findings

Sakinah - After collecting the data, we ran the statistical analysis/machine learning on each climate variable against extreme weather variables. We ran a Pearsonr analysis for temperature and humidity against all extreme weather variables because Pearsonr looks

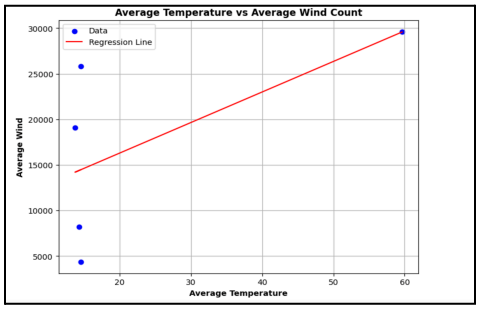


at the correlation between two sets of data. The correlation between humidity and hail analysis was 0.06, and the correlation between humidity and wind was 0.04; thus, hail and wind have little to no correlation with humidity as the PCC is very close to zero. However, the correlation for humidity versus tornado regression line is going upwards showing a positive relationship, however, it is a weak positive since the correlation was 0.23. Hence, we can conclude that a change in humidity might slightly affect tornadoes but not wind or hail.

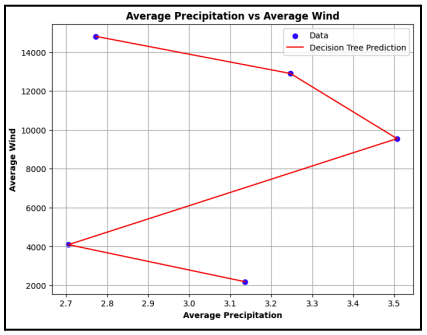




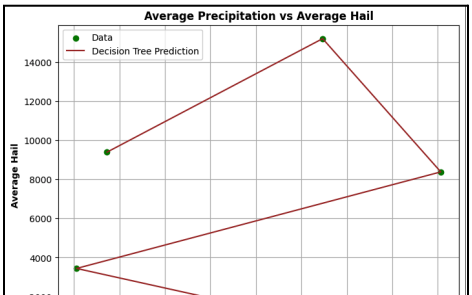
Noura - Comparing the correlation between temperature and tornado, we found a correlation of 0.19, which indicates a weak positive correlation. This means that as temperature increases, tornado occurrences tend to increase slightly.



Now, when comparing temperature with wind, we see a correlation of 0.62, which suggests a moderate positive correlation. This indicates that as temperature increases, wind count tends to increase more strongly than that of the tornado data. Similarly, a correlation of 0.19 is shown between temperature and hail averages, which indicates a weak positive correlation, implying that as temperature increases, hail counts slightly increase as well.



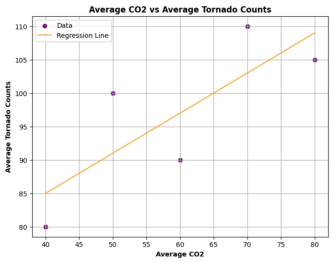
Lorena - Shifting our focus to precipitation, we created an ML/statistical analysis to compare and contrast its relationship with



the extreme weather variables we chose. We have created decision trees for each variable by using the decision tree regressor from sklearn in python.To accomplish this, I created regression models for each variable, reshaped the data into a 2D array, and trained the model.

If we take a look at precipitation vs wind, we can see that there are 9 nodes in the tree with a depth of 4. This tells us that there is a moderate positive correlation between the two variables. This is similar to the decision tree of precipitation vs hail, with a total of 9 nodes and a maximum depth of 3. This tells us that while precipitation stayed more or less consistent throughout the years, wind and hail increased. An inference we can make is that low amounts of precipitation during these years have caused higher amounts of wind and hail. This can be further explored with more years to delve deeper into its relationship with these variables.

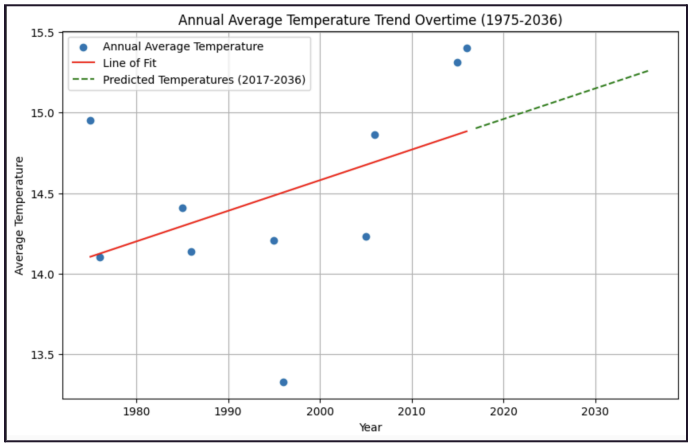
Shoaib - In my analysis, I looked at how CO2 emissions are connected to weather events like tornadoes, wind, and hail. By plotting the CO2 levels against these events and drawing a trend line through the data, I found that all three relationships showed a positive trend. This means that as CO2 levels go up, the number of these weather events tends to increase as well.



The Pearson Correlation Coefficient (PCC) for these relationships was close to one, indicating a strong positive link. In simple terms, this suggests that any increase or decrease in CO2 emissions could significantly affect how often these weather events occur. This insight highlights the potential impact of environmental changes on our weather.

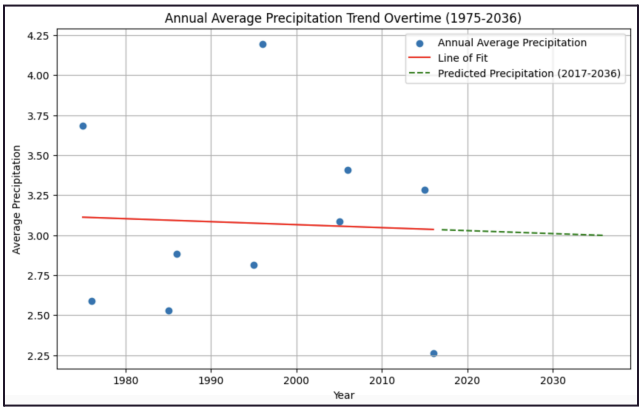
Results

Shahryar - We have discussed the relationship between the various climate and weather variables. To



the right, there is a forecast machine learning analysis. Linear regression SVR model is used to predict the temperature trends of the next decade. This model was trained with a baseline comparison value of 0.29. The features of this graph are time, and the target value is temperature in Celsius. Looking at the graph we observe the temperatures might rise to half a degree in the next ten years. This is significant to gain insights into how the weather variables might trend in the near future in relation to temperature rise.

Now let's look at another forecast analysis, where the feature is once again time and the target variable is precipitation. This model is also a linear regression SVR with a baseline comparison value of 0.29. Observing the trends on this graph we can see precipitation has been very consistent historically and may even be at a slight decline.



Conclusion

Overall, the climate variables had either a slight or moderate positive relationship, which indicates that our climate variables had a positive effect on our weather variables. As shown in the ML analysis we could see that in the context of climate temperature, they are on the rise in the future. Although precipitation is shown to have a slight decline in the future, we can see from the decision tree that it is greatly affecting the weather variables, which concludes our hypothesis is true.