# Hurricane Severity Analysis

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# Goal

Our project was to identify long-term trends and patterns in hurricane severity. By examining the data, we can determine if there are any significant changes in storm intensity over the years.

We asked:

1) What is the overall trend in the number of hurricanes over time?

2) Is there a correlation between the number of hurricanes vs high desert temperatures combined with lower ocean temperatures?

3) Do higher desert temperatures produce more named storms, hurricanes, and major hurricanes?

4) How does wind and evapotranspiration contribute to storm creation and what correlations will we see?

# Technology

- Python
- Pandas
- Matplotlib
- Numbpy
- API Keys

*This analysis considers weather data points for each year in the peak season month of September.

# Data Sources

OpenWeather API - One Call API 3.0

Used to collect 72 years of data including desert temperatures, ocean temperatures, wind speed and direction, and evapotranspiration

https://api.openweathermap.org/data/3.0/onecall?lat={lat}&lon={lon}&exclude={part}&appid={API key}

Kaggle Data Set (**Hurricanes Recorded by Year by** BRYAN SOUZA)

Used to gather over 100 years of data including the year, named storms, total hurricanes, and major hurricanes. Original Data is from The Deadliest, Costliest, and Most Intense United States Hurricanes 1900-2000

# Cleaning & Merging

We cleaned and combined 3 data sets into one by year, giving us a solid dataframe of number of storms, with the corresponding ocean and desert weather data for our analysis and visualizations. Our usable data covers 1945 through 2017.

| | Year | Named Storms | Hurricanes | MajorHurricanes | Avg Ocean Max Temp | Avg Ocean Min Temp | Ocean Wind Speed | Ocean Wind Direction | Ocean Evapotrasnpiration | Avg Desert Max Temp | Avg Desert Min Temp |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1945 | 11 | 5 | 2 | 65.646667 | 53.420000 | 11.696667 | 194.900000 | 2.839000 | 89.376667 | 65.470000 |
| **1** | 1946 | 6 | 3 | 1 | 61.250000 | 50.146667 | 11.866667 | 225.200000 | 2.511333 | 87.130000 | 64.520000 |
| **2** | 1947 | 9 | 5 | 2 | 62.130000 | 50.490000 | 11.840000 | 185.333333 | 2.670000 | 88.626667 | 67.623333 |
| **3** | 1948 | 9 | 6 | 4 | 60.400000 | 48.750000 | 12.526667 | 233.300000 | 2.655000 | 89.186667 | 68.453333 |
| **4** | 1949 | 13 | 7 | 3 | 63.376667 | 51.976667 | 12.990000 | 220.700000 | 2.766333 | 87.946667 | 64.596667 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **68** | 2013 | 14 | 2 | 0 | 58.763333 | 54.073333 | 12.596667 | 255.566667 | 2.723000 | 91.760000 | 68.343333 |
| **69** | 2014 | 8 | 6 | 2 | 61.203333 | 55.613333 | 11.620000 | 216.966667 | 2.730333 | 92.663333 | 69.330000 |
| **70** | 2015 | 11 | 4 | 2 | 61.023333 | 55.083333 | 12.553333 | 207.900000 | 2.584667 | 92.596667 | 70.083333 |
| **71** | 2016 | 15 | 7 | 4 | 60.666667 | 55.720000 | 10.856667 | 193.333333 | 2.775000 | 92.130000 | 69.736667 |
| **72** | 2017 | 17 | 10 | 6 | 62.973333 | 55.256667 | 21.440000 | 199.666667 | 3.090333 | 91.890000 | 69.940000 |

73 rows × 14 columns

# How Hurricanes Form

Thunderstorms, warm ocean water and light winds are the conditions needed for a hurricane to form.

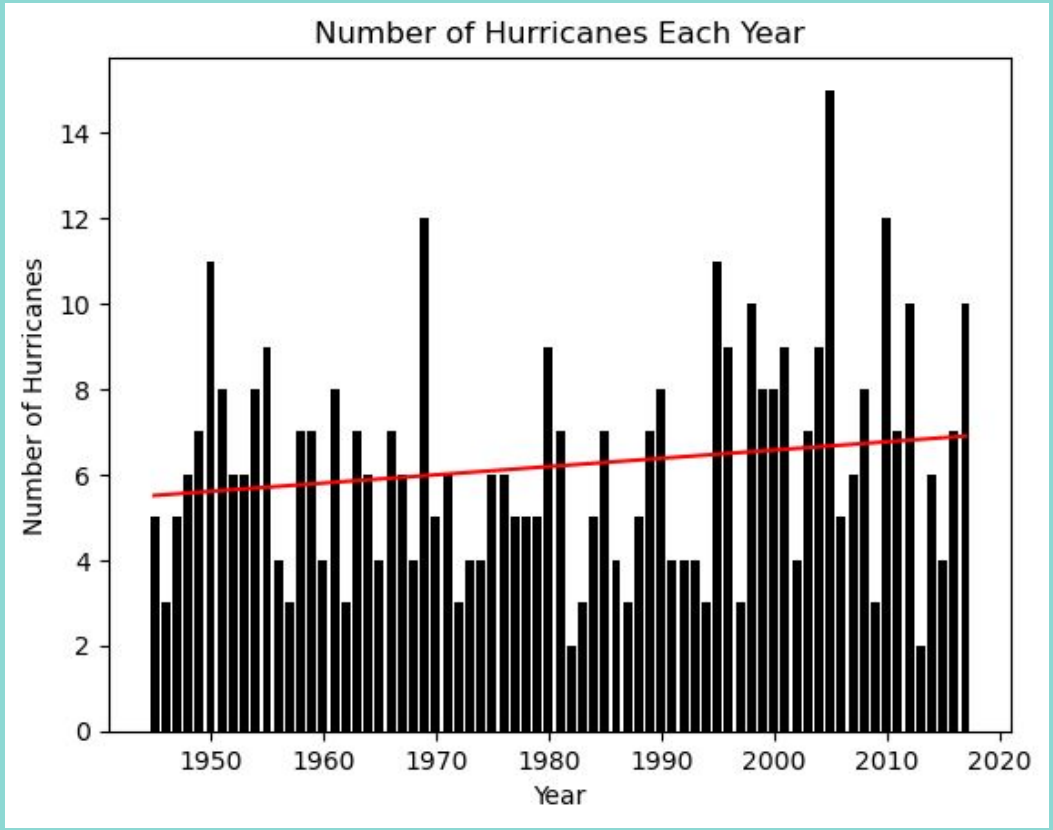
Once formed, a hurricane consists of huge rotating rain bands with a center of clear skies called the eye which is surrounded by the fast winds of the eyewall.

## What is the overall trend in the number of hurricanes over time?

| | Year | Named Storms | Hurricanes | MajorHurricanes |
|---|---|---|---|---|
| **count** | 73 | 73 | 73 | 73 |
| **mean** | 1981 | 11 | 6 | 3 |
| **std** | 21 | 4 | 3 | 2 |
| **min** | 1945 | 4 | 2 | 0 |
| **25%** | 1963 | 8 | 4 | 1 |
| **50%** | 1981 | 11 | 6 | 2 |
| **75%** | 1999 | 13 | 8 | 4 |
| **max** | 2017 | 28 | 15 | 8 |

| Category | Wind Speed (mph) | Damage at Landfall | Storm Surge (feet) |
|---|---|---|---|
| 1 | 74-95 | Minimal | 4-5 |
| 2 | 96-110 | Moderate | 6-8 |
| 3 | 111-130 | Extensive | 9-12 |
| 4 | 131-155 | Extreme | 13-18 |
| 5 | > 155 | Catastrophic | 19+ |

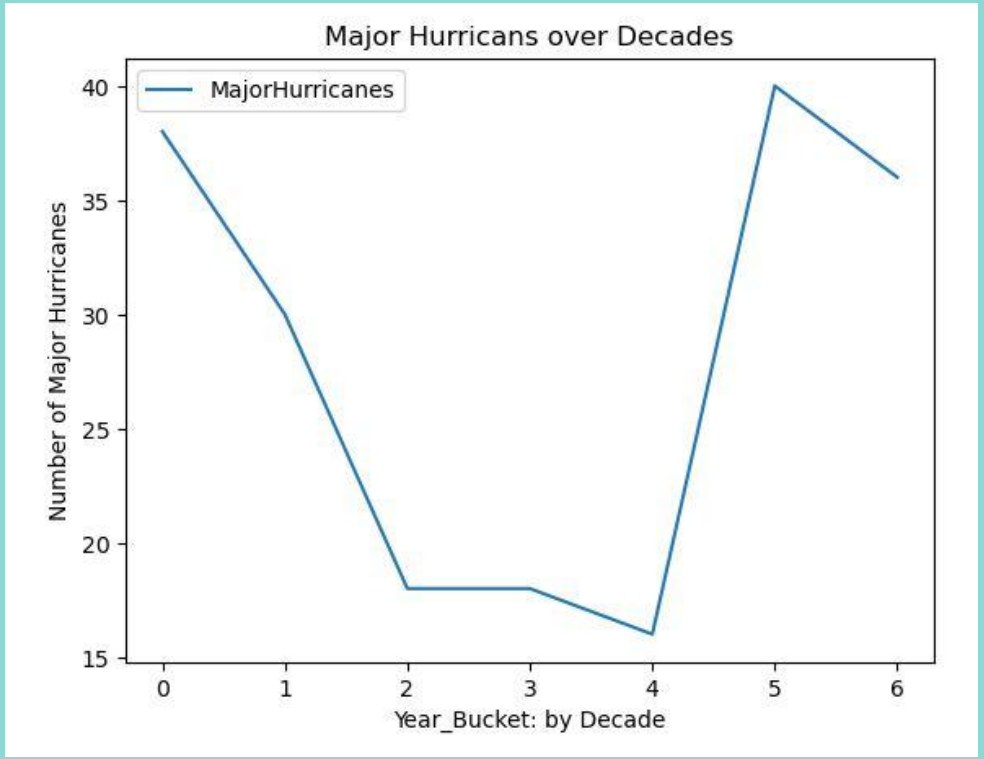
## What is the overall trend in the number of hurricanes over time?



# Major Hurricanes:

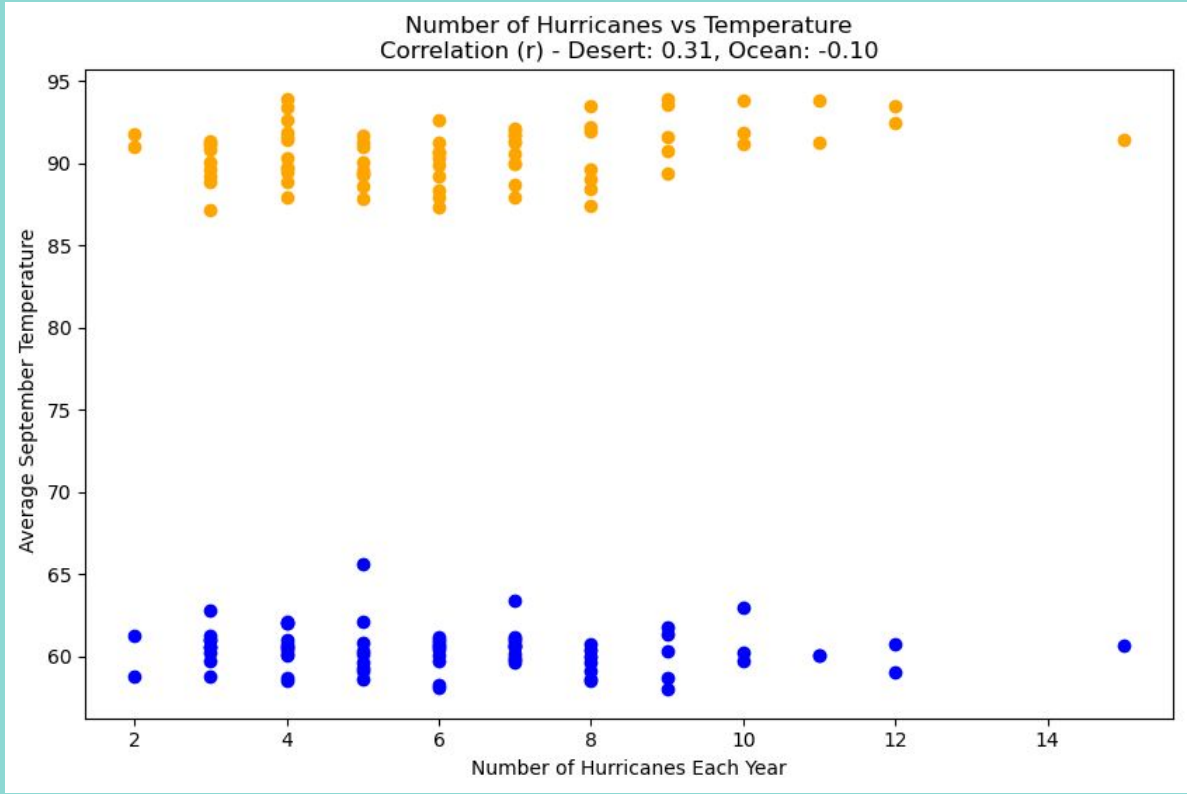
*“Hurricanes reaching Category 3 and higher are considered major hurricanes … Category 1 and 2 storms are still dangerous…”*

*-NationalWeatherService.gov*




| | Year Bucket | MajorHurricanes |
|---|---|---|
| 0 | 1945-1954 | 38 |
| 1 | 1955-1964 | 30 |
| 2 | 1965-1974 | 18 |
| 3 | 1975-1984 | 18 |
| 4 | 1985-1994 | 16 |
| 5 | 1995-2004 | 40 |
| 6 | 2005-2017 | 36 |

# Number of hurricanes vs High Desert temperatures combined with Lower Ocean temperatures?

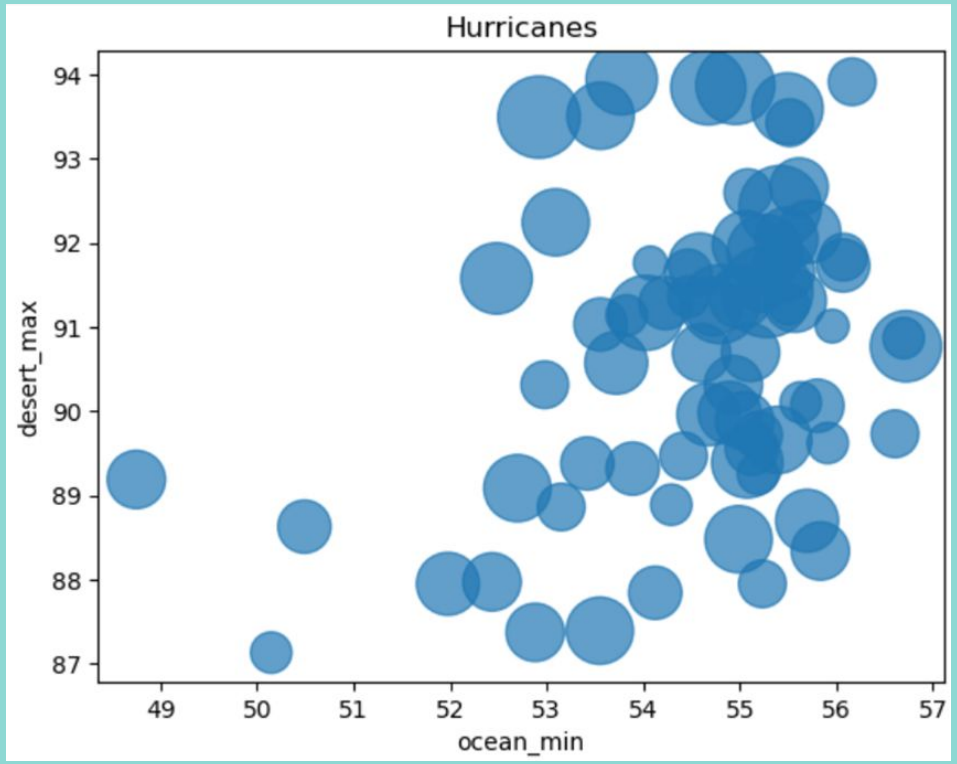


# Is there a correlation between the number of hurricanes vs high desert temperatures combined with lower ocean temperatures?

Dot size represents quantity of hurricanes

Desert highs appear to produce more storms than ocean highs or lows

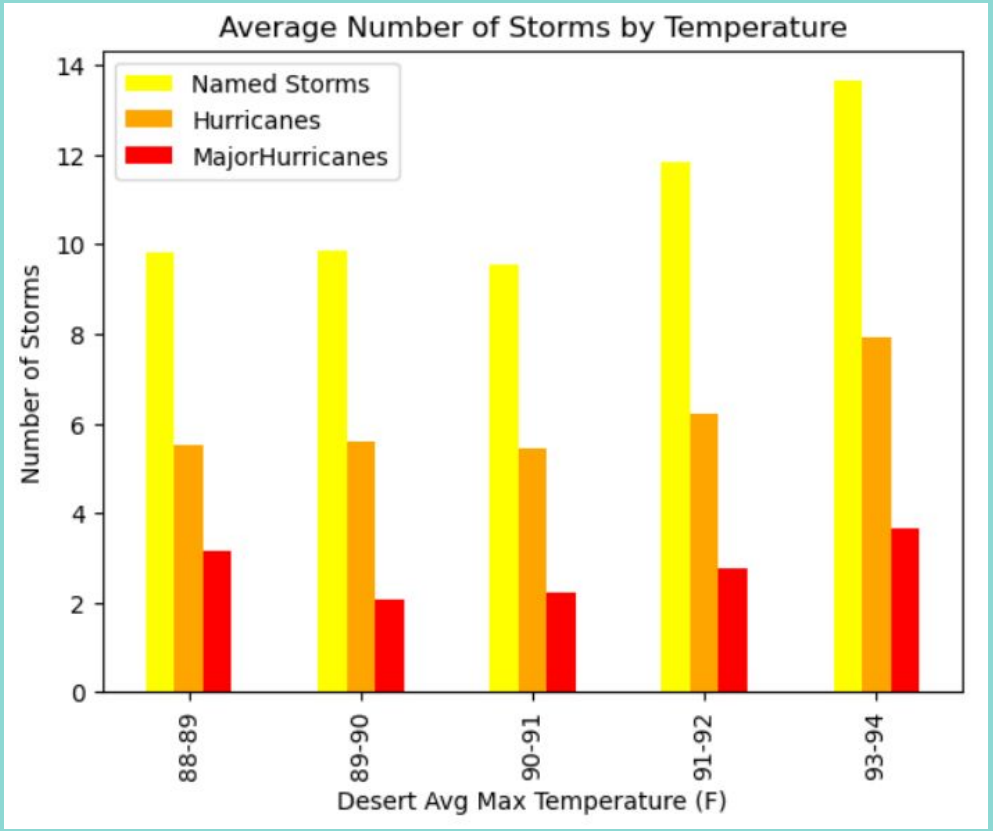
Let's investigate further...



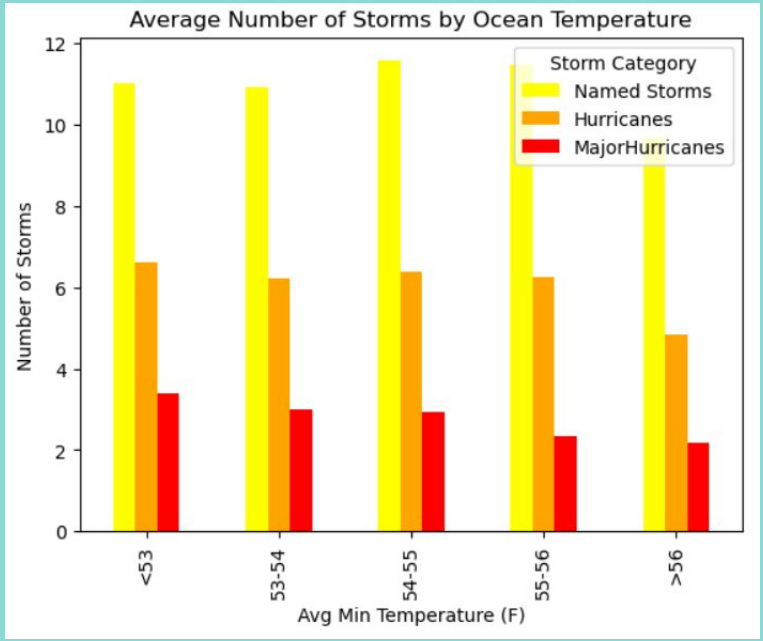
# Do higher desert temperatures produce more named storms, hurricanes, and major hurricanes?

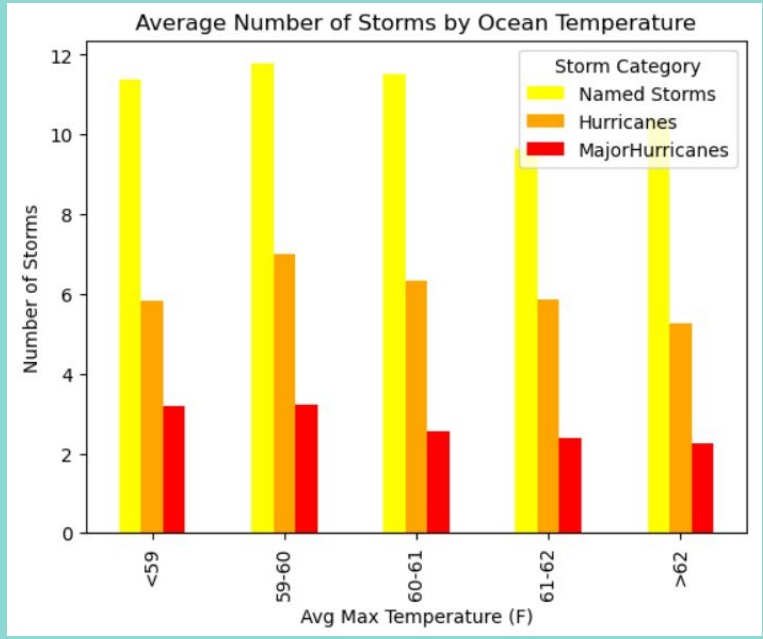
We observe a slight positive correlation in the average number of storms for years that fall into higher ranges of max temperatures.

What about ocean temperatures?



Ocean temperatures (min or max) show less of a correlation with number of storms. We do observe a slight trend with more hurricanes where we see lower ocean temperatures.

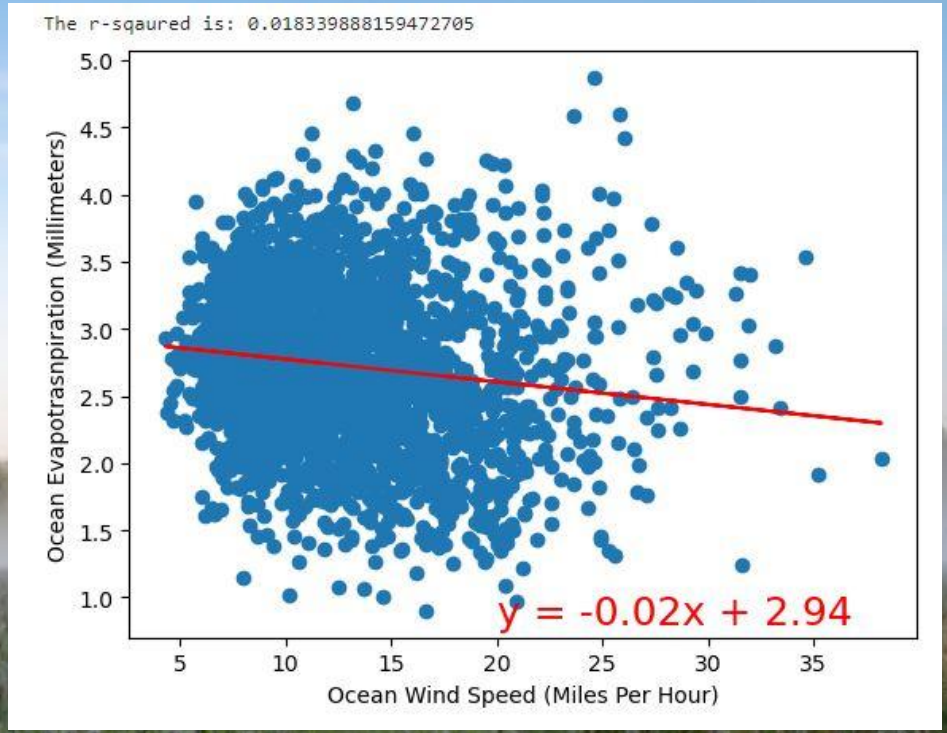


# Evapotranspiration vs Wind Speed

*"Evapotranspiration is the sum of all processes by which water moves from the land surface to the atmosphere via evaporation and transpiration."*
-USGS.com (US Geological Survey)

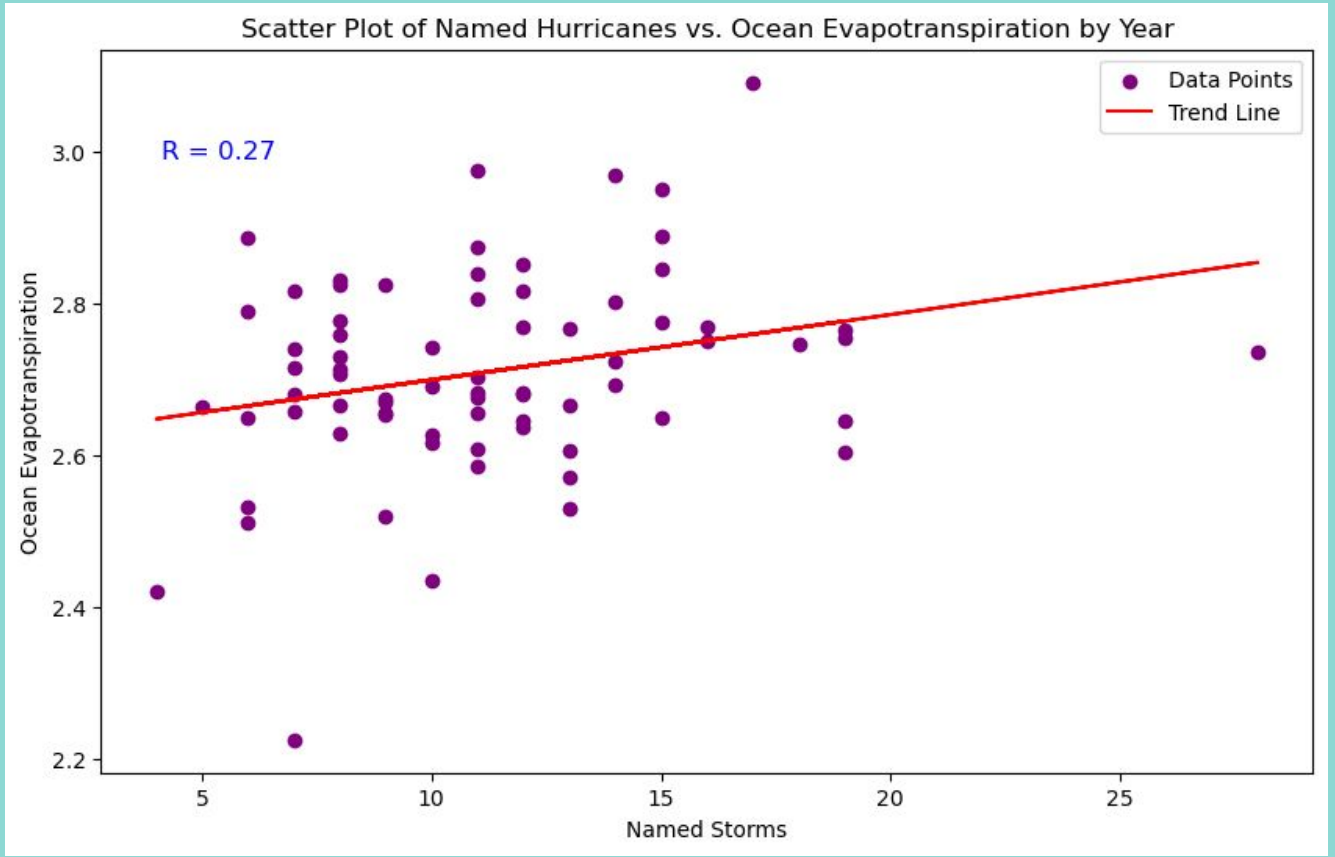
*According to Britannica, this process also includes water from soil and plant leaves as well.*




*all data points for Sept in each year

# Named Storms vs. Evapotranspiration

There was little correlation between the number of named storms and the ocean evapotranspiration rate each September.



# Analysis & Conclusions

- The number of storms and hurricanes have shown an increasing trend over the last 72 years.
- Higher desert temperatures in September increase the likelihood of observed storms, hurricanes, and major hurricanes for that year. The data showed a positive correlation of 0.31 for desert temperatures and negative correlation of -0.10 ocean temperatures.
- The ocean evapotranspiration rate for each September had little correlation with an r-value of 0.27 for the observed storms.