

Hurricane Tracking and Trending

A Data Analytics Project

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Agenda

Introduction to Hurricanes
NOAA Data
Time Series Analysis
Correlation Analysis
Hurricane Tracking Maps
Thematic Mapping Analysis
Concluding Summary
Questions





Hurricanes, Typhoons, Cyclones

What are we talking about?

What is it?

Low pressure system with sustained wind speeds of at least 74 mph
Characterized by a well-defined circulation pattern with a closed center (eye). The eye is surrounded by a ring of intense thunderstorms called the eyewall, where the strongest winds and heaviest rainfall are typically found.

Formation Factors

- warm ocean waters ($+27^{\circ}\text{C}$)
- moisture
- low vertical wind shear
- Coriolis effect
- pre-existing storms

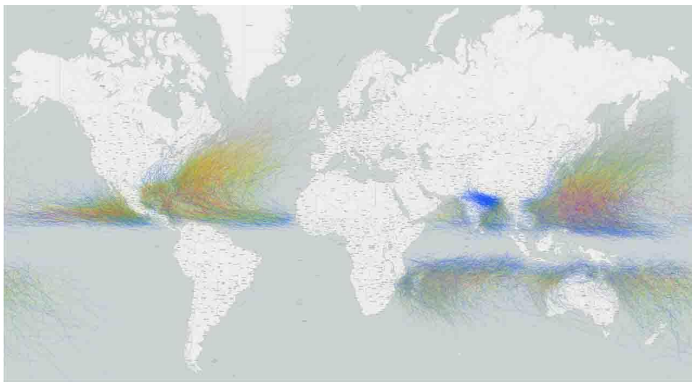




NOAA

National Oceanic and Atmospheric Administration

NOAA World Hurricane Map





Time Series Analysis

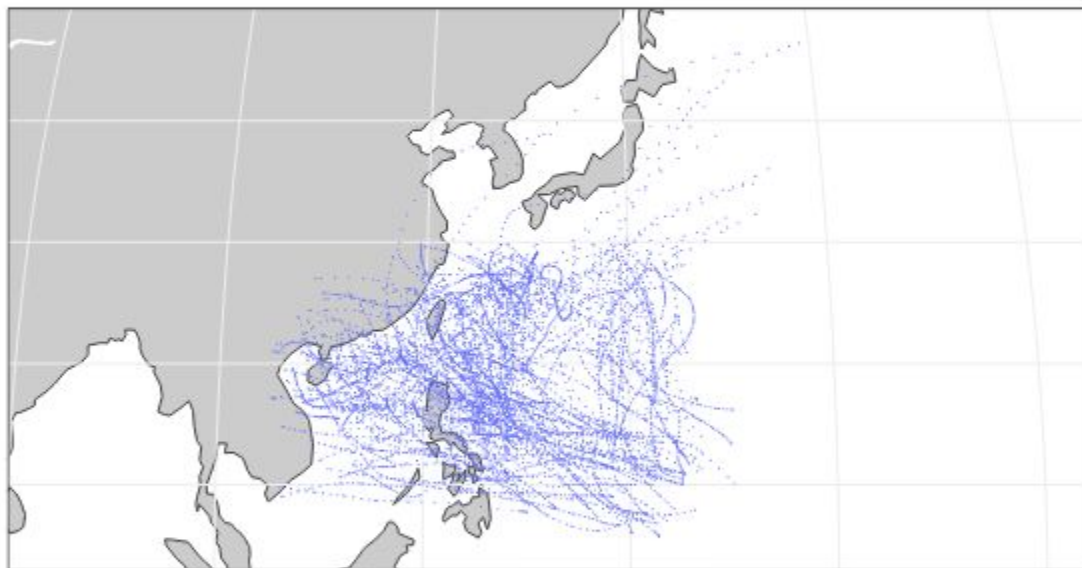
Question: Are hurricanes increasing in frequency and intensity over time?

Location: West Pacific Basin

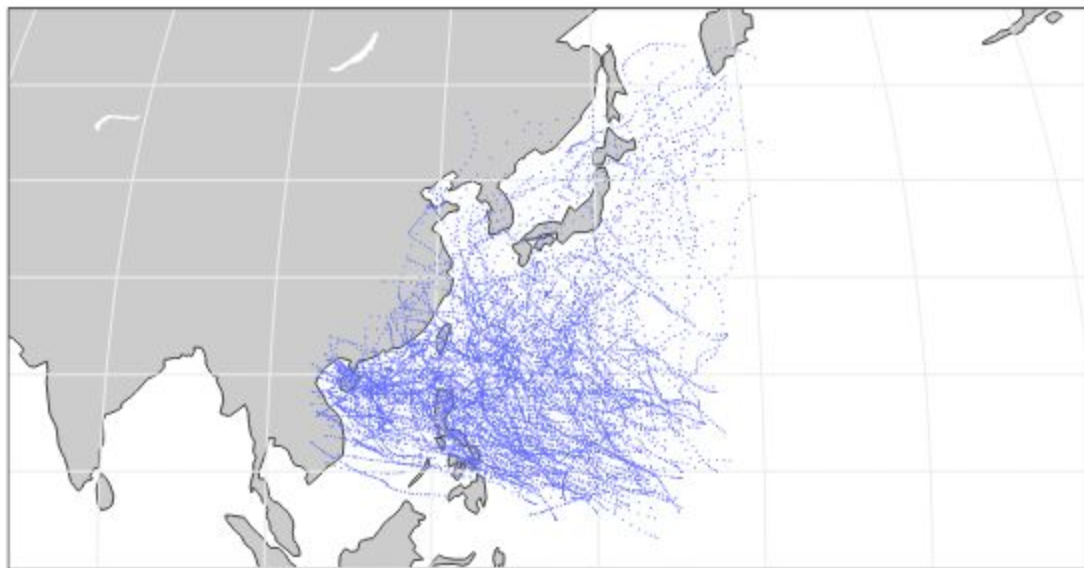
Time Frame: 1922 - 2021

10 Maps representing subsequent decades

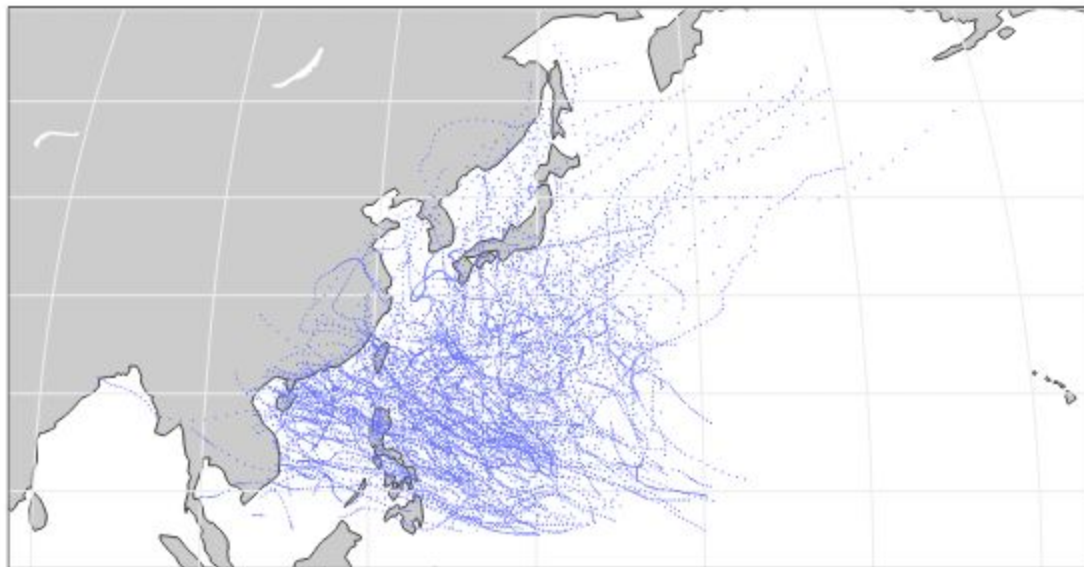
Hurricane Paths (1922-1931)



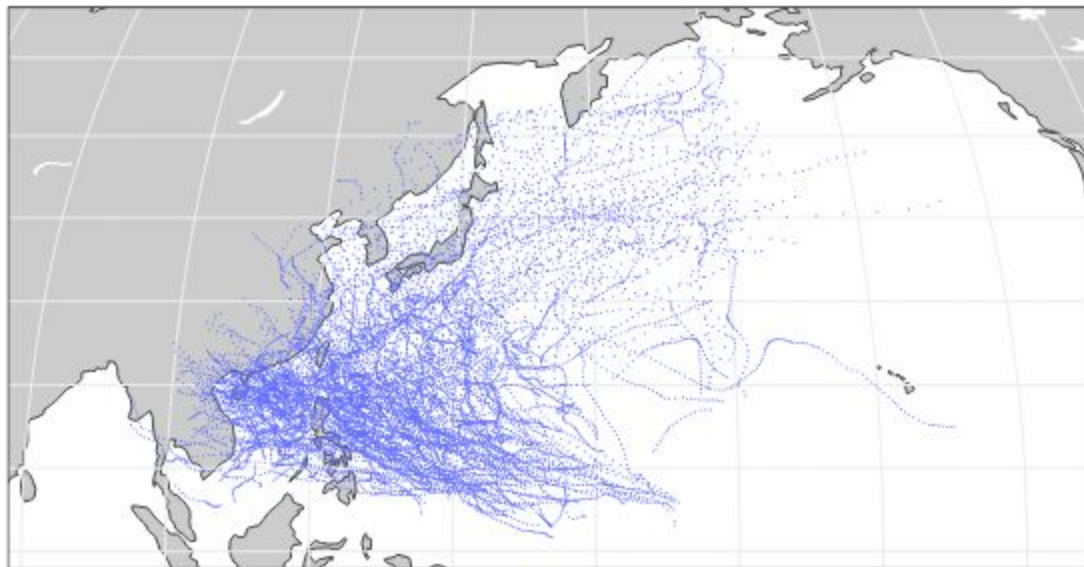
Hurricane Paths (1932-1941)



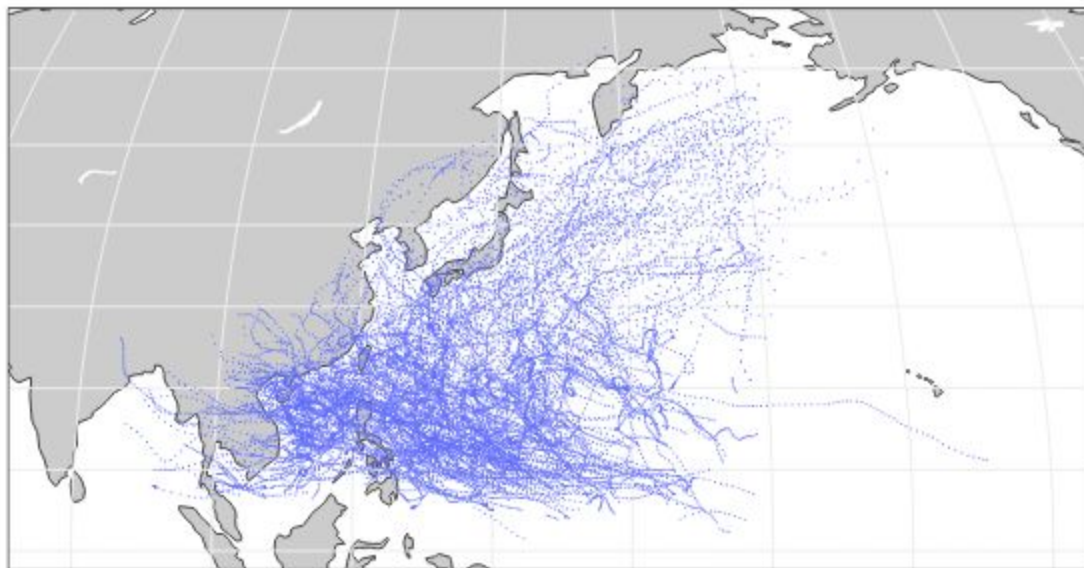
Hurricane Paths (1942-1951)



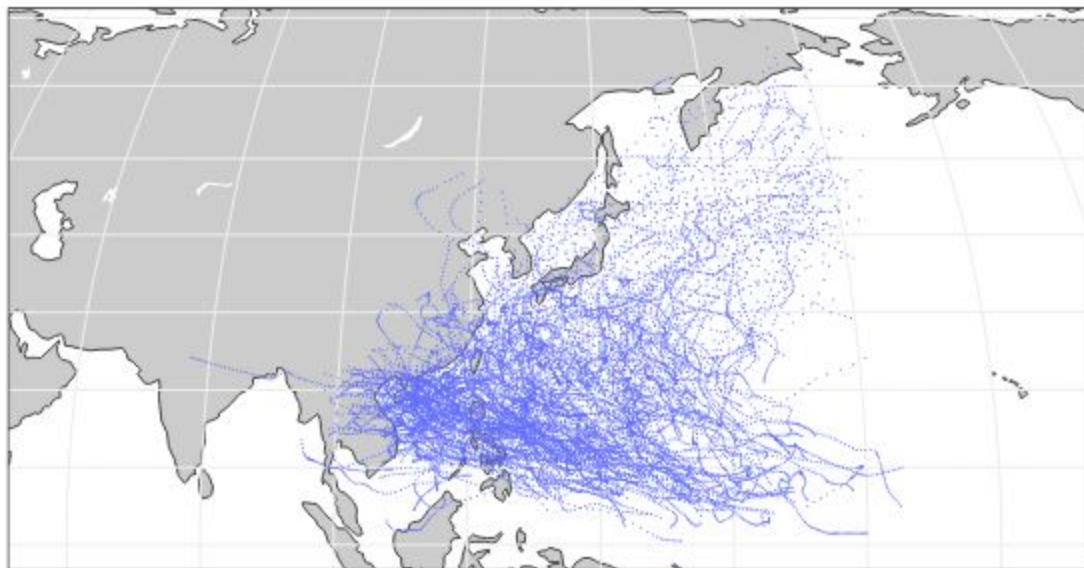
Hurricane Paths (1952-1961)



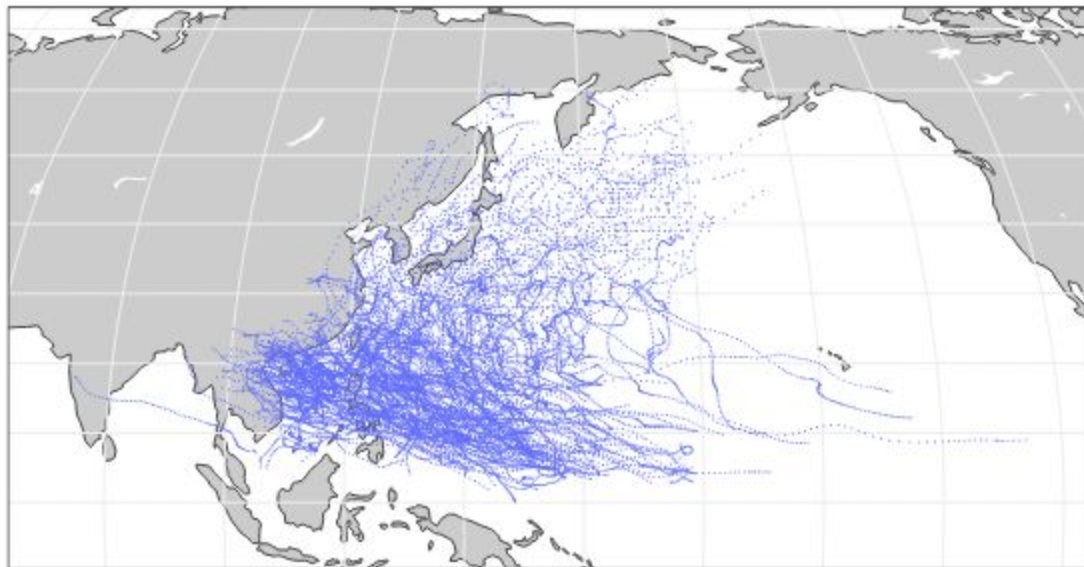
Hurricane Paths (1962-1971)



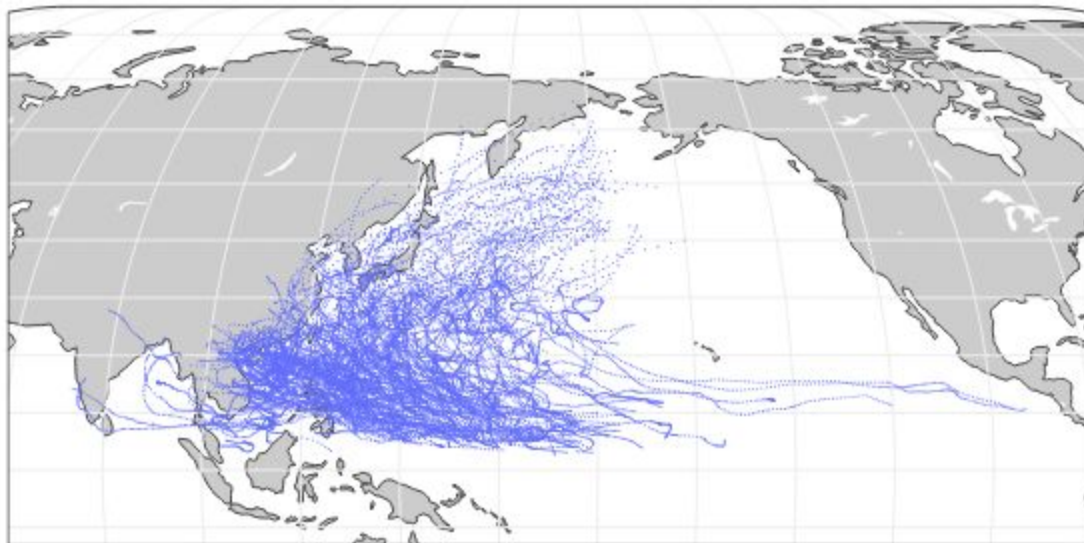
Hurricane Paths (1972-1981)



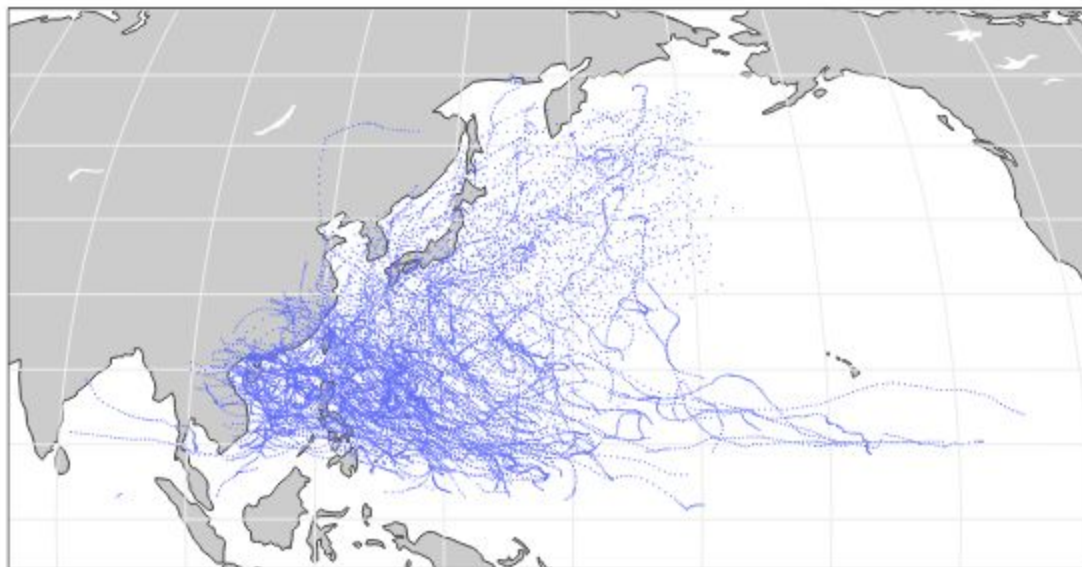
Hurricane Paths (1982-1991)



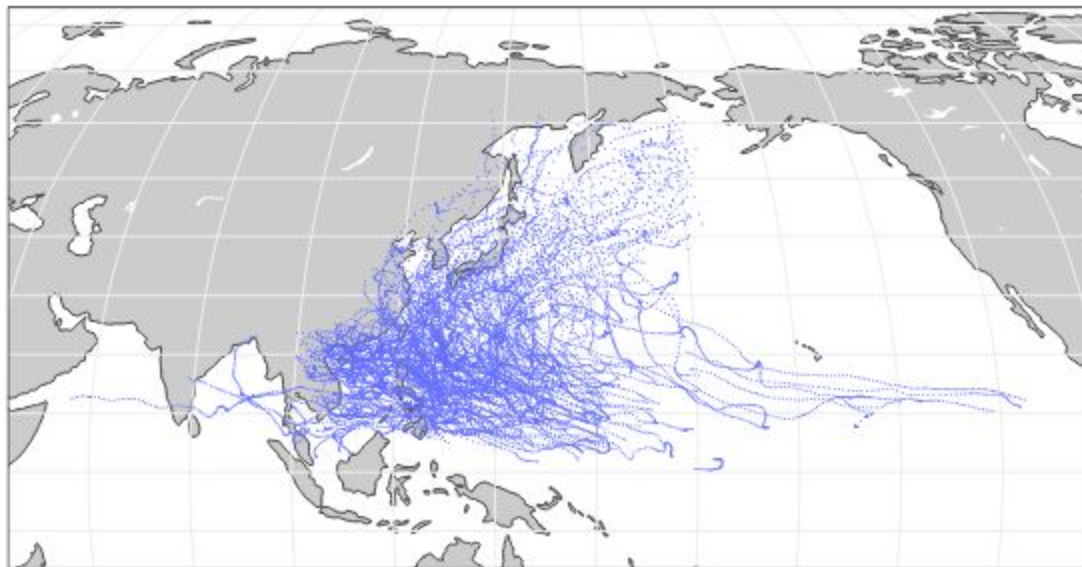
Hurricane Paths (1992-2001)



Hurricane Paths (2002-2011)



Hurricane Paths (2012-2021)





Time Series Analysis

Question: Are hurricanes increasing in frequency and intensity over time?

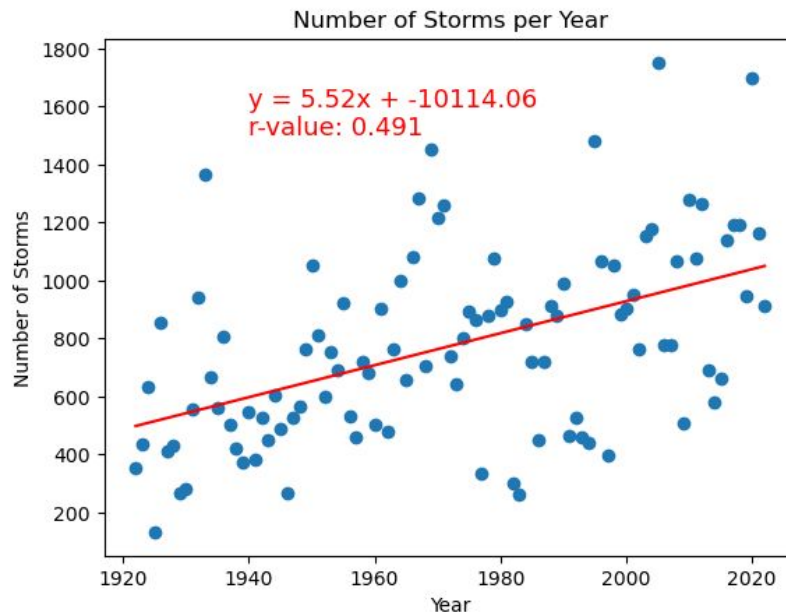
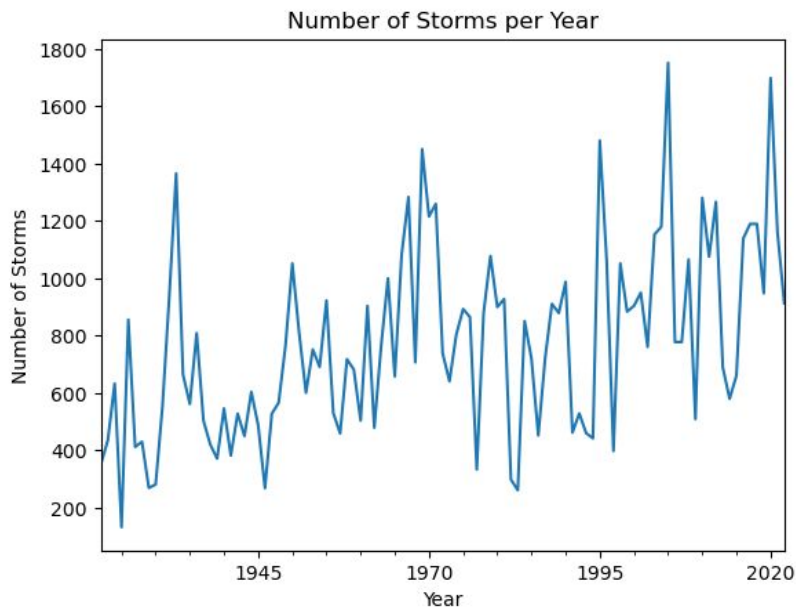
Conclusion:

Based on the increased dot density and the growing area of hurricane coverage, we can conclude that hurricanes are generally increasing in frequency between 1922 and 2021 in the West Pacific Basin.



Time Series Graphs (North Atlantic Basin)

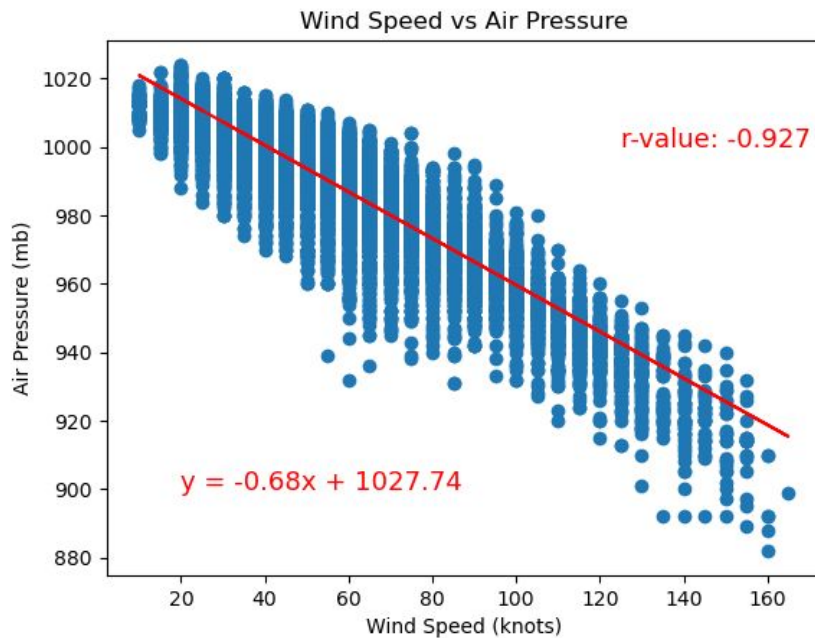
Question: Are hurricanes increasing in frequency and intensity over time?



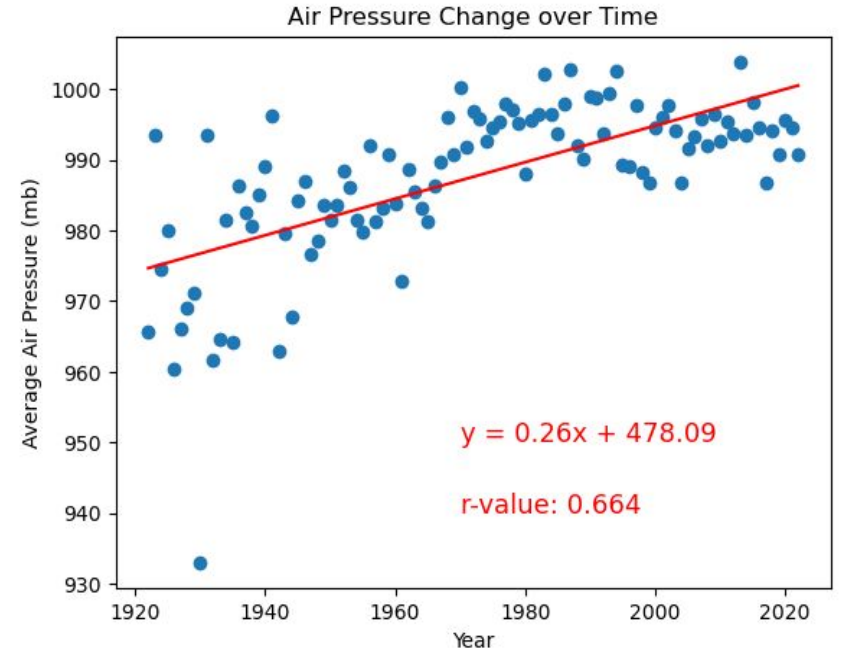
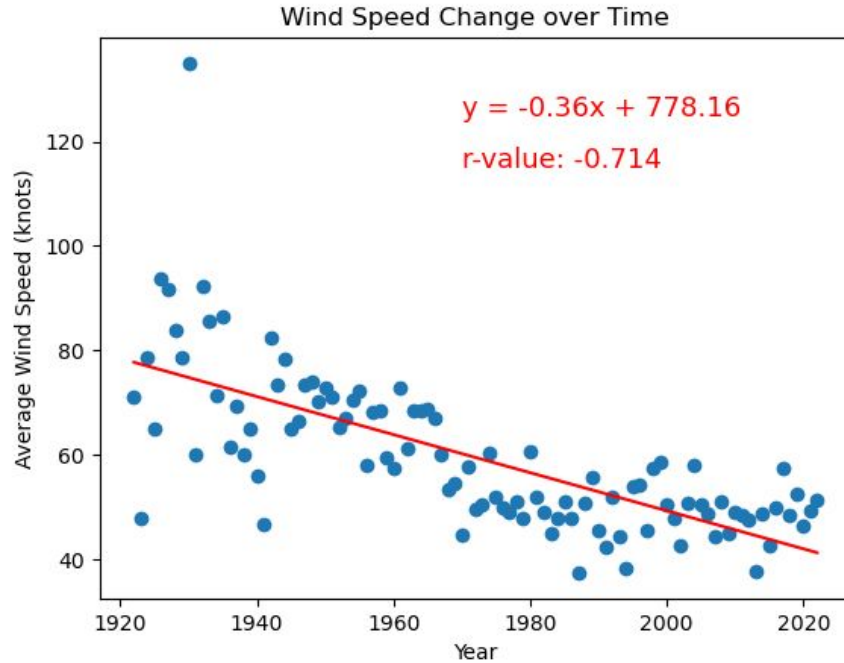


Correlation Analysis

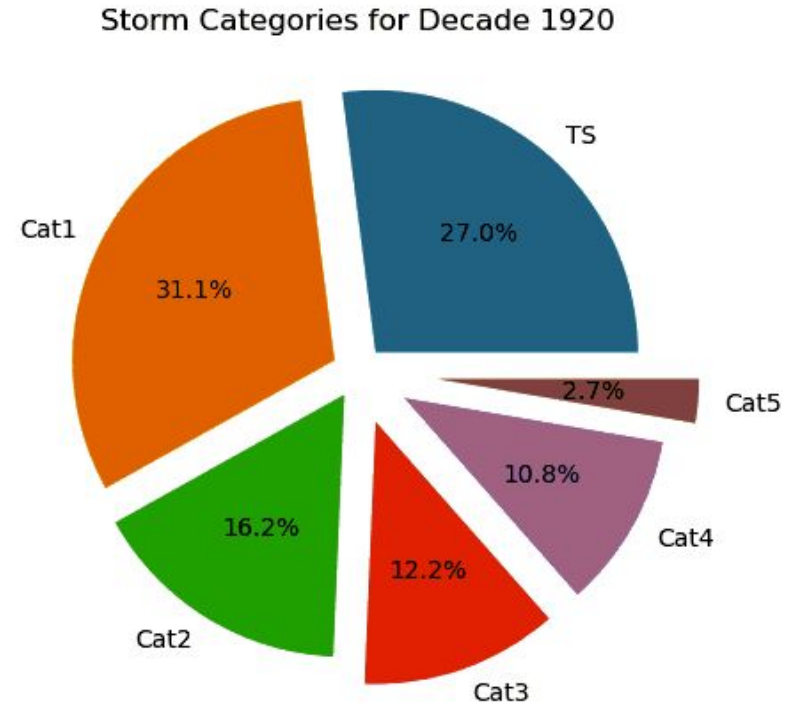
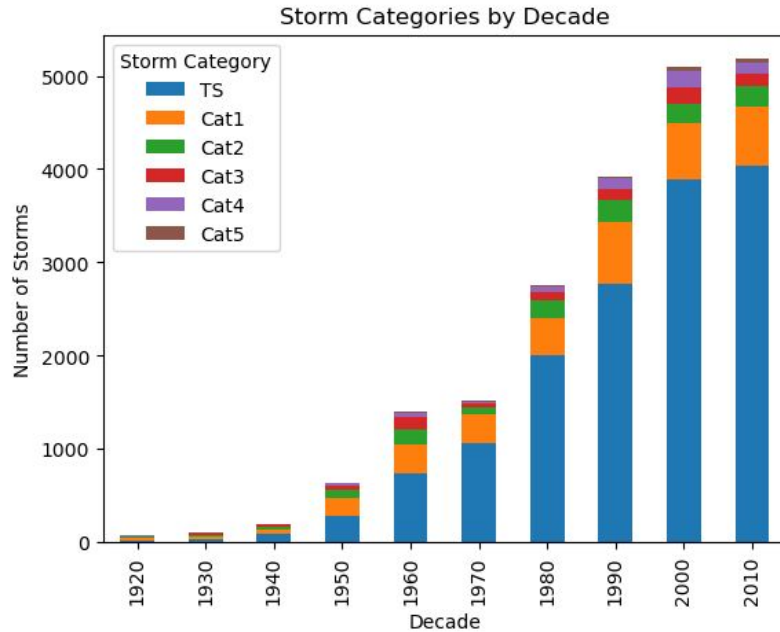
Question: Are there trends in Wind Speed and Air Pressure for storms in the North Atlantic Basin?



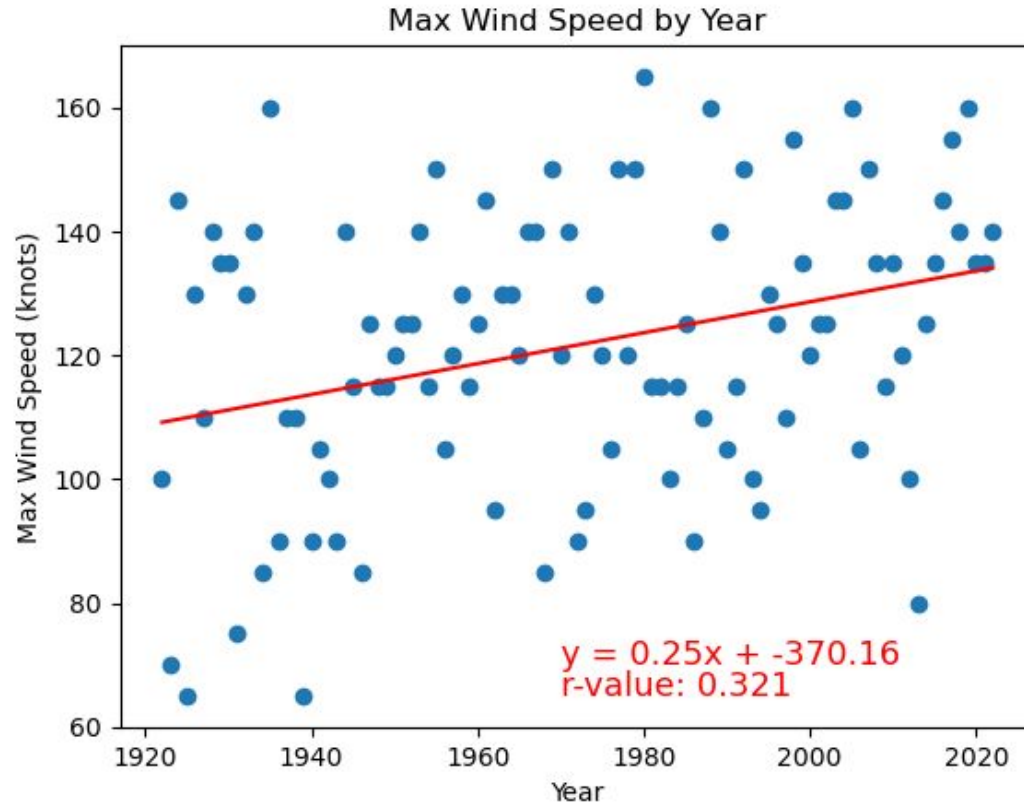
Average Wind Speed and Air Pressure over Time



Categorizing Wind Speed



Max Wind Speed over Time





Correlation Analysis

Question: Are there trends in Wind Speed and Air Pressure for storms in the North Atlantic Basin?

Conclusion:

All together, this snapshot of the North Atlantic basin over the last 100 years points to an increase in the number of storm events, particularly lower-intensity Tropical Storms, over time. It suggests that the average intensity of all storms across a given year is decreasing, but that the most intense storms may be increasing in intensity. More analysis is needed to understand these relationships fully.



Hurricane Tracking Analysis

Question: What are the longest hurricanes by time in a given year

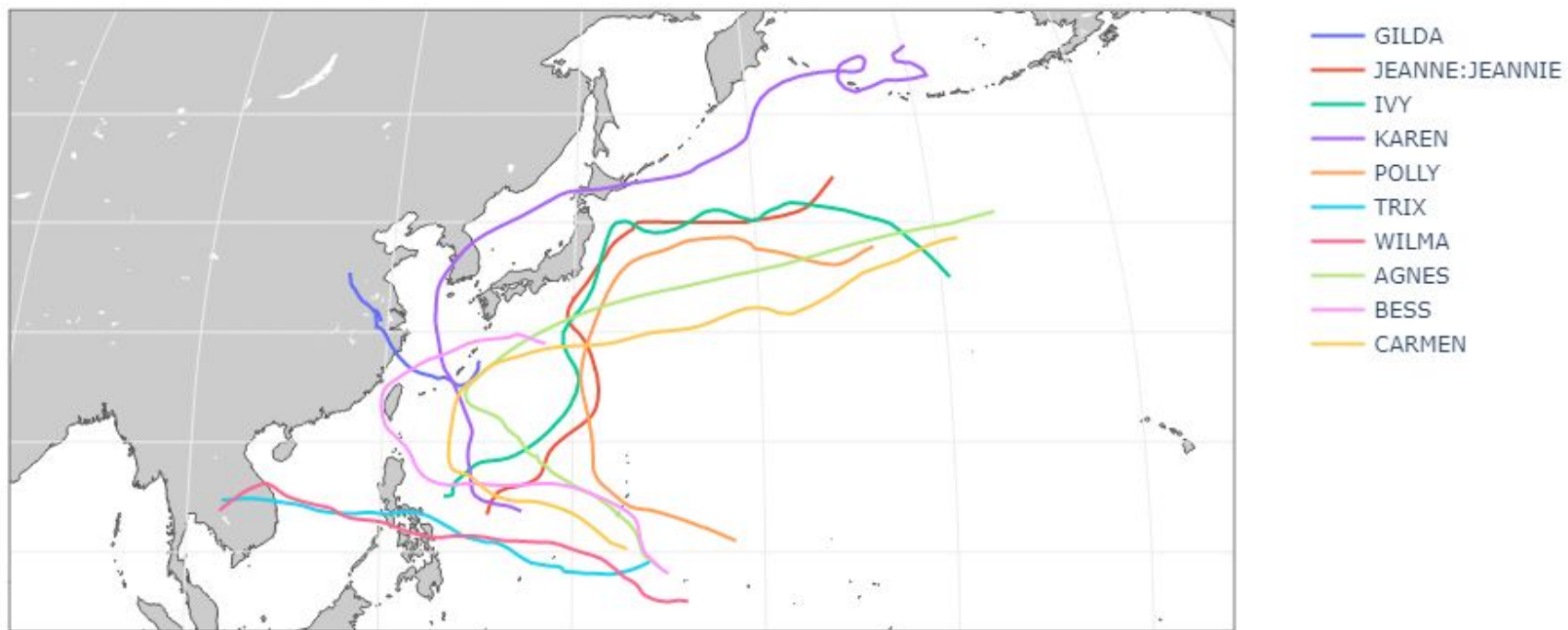
Two linear maps of hurricane paths

Location: West Pacific Basin

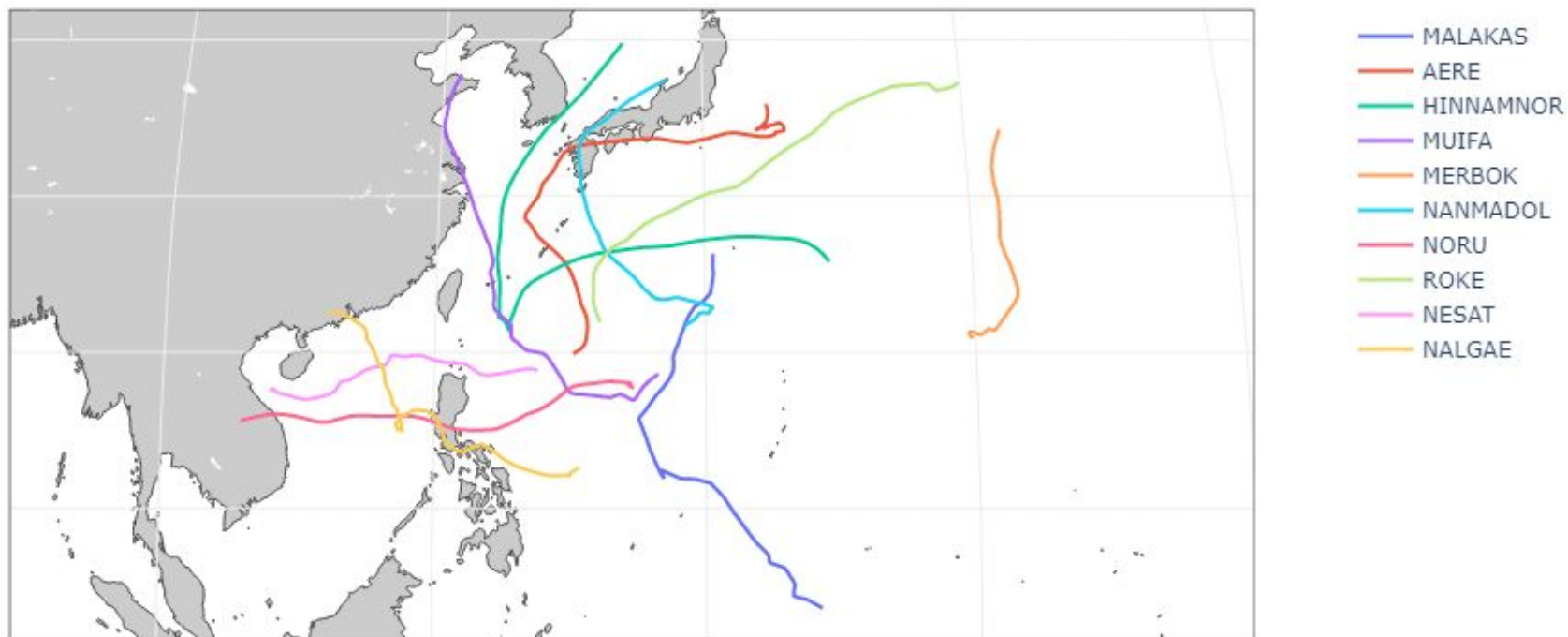
Selected years: 1952 and 2022

Filter: 10 longest hurricanes of the year by time

Top 10 Longest Hurricanes in North Asia Pacific (1952)



Top 10 Longest Hurricanes in North Asia Pacific (2022)





Hurricane Tracking Analysis

Question: What can we learn from tracking hurricanes?

Conclusion:

1. Powerful hurricanes that do not make landfall may not cause significant destruction.
2. Identifying trends: Hurricanes tend to track towards higher latitudes.
3. Path analysis shows the unpredictability of hurricanes.
4. Landfall locations reveal areas most prone to destructive impacts.



Thematic Mapping Analysis

Question: What countries are most susceptible to hurricanes and by how much?

Choropleth Maps of Countries Most Affected by Hurricanes

Country susceptibility is measured by the number hurricane data points within 111.12 km of a country

Location: West Pacific Basin

Selected years: 1952 and 2022

Filter: 10 most susceptible countries

Proximity Counts of Hurricanes in Pan Pacific Countries (1952)



Proximity Counts of Hurricanes in Asian Countries (2022)





Choropleth Maps of Countries Most Affected by Hurricanes

Question: What countries are most susceptible to hurricanes and by how much?

Top 10 countries with the highest proximity counts to hurricanes:

1952

China: 1563
Philippines: 810
Vietnam: 368
Taiwan: 191
Federated States of Micronesia: 164
Japan: 151
Cambodia: 130
Laos: 77
Thailand: 71
South Korea: 49

2022

Philippines: 378
China: 193
Japan: 162
Vietnam: 37
South Korea: 12
Palau: 6
Laos: 4



Concluding Summary

The time series analysis shows that hurricanes are increasing in frequency across multiple basins over the chosen 100 year time frame. More analysis is needed to determine if intensity is increasing or decreasing over time.

The statistical analysis shows an increase in the number of storm events in the North Atlantic Basin, particularly lower-intensity storm, over time. It suggests that average intensity of storms in a year is decreasing, and that the most intense storms may be increasing in intensity.

The hurricane tracking analysis shows that while hurricane paths are unpredictable, they tend to track towards higher latitudes. It also demonstrates that landfall locations indicate areas prone to destructive impact, whereas powerful storms that don't make landfall may not cause significant destruction.

The thematic map analysis shows that China and the Philippines are the two hardest hit countries in the Western Pacific basin in 1952 and 2022 respectively.



Questions?