

Title : An Analysis on Storm Frequencies and Intensities Over Time

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The **storms** dataset, available in R, provides historical storm track data from 1975 to 2022, sourced from the **NOAA Atlantic hurricane database(HURDAT)**. With 19,537 observations, this analysis seeks to answer, *how have the long-term trends in storm frequency and intensity changed over time?* It examines variations in wind speed (knots), atmospheric pressure (mb), and storm classification from the 'status' column, which categorizes storms into Tropical, Extratropical, Subtropical, and Hurricane systems. By identifying shifts in storm characteristics, this study aims to uncover climate change patterns and provide insights into storm preparedness strategies.

As seen in[Figure. 1.1],storm occurrences have risen significantly over the decades. While storms fluctuated between 200 and 300 annually in the late 1970s and early 1980s, their frequency increased sharply from the 1990s onward, with several years exceeding 500 storms. Notably, 2005 and 2020 recorded over 800 storms, reflecting the influence of rising global temperatures and ocean warming. [Figure. 1.2]further highlights increasing hurricane intensity, with more storms reaching lower pressures and higher wind speeds. Extratropical storms have also become more frequent, while tropical storms and depressions exhibit greater variability. These trends suggest more severe storms and shifting storm dynamics, likely driven by climate change.

The [Figure 1.2] confirms the inverse relationship between wind speed and atmospheric pressure, reinforcing that lower pressures correspond to stronger storms. While extreme storms(160+ knots) have persisted across multiple decades, maximum wind speeds have remained relatively stable[Table1.1], indicating that the strongest storms are not weakening. However, minimum pressure values have dropped significantly over time(as low as 882 mb in the 2000s), suggesting that some storms are reaching greater intensities. Despite fluctuations, the statistics[Table1.1] does not indicate a continuous increase in storm intensity but rather a shift in storm distribution.

In conclusion, this analysis highlights a significant increase in storm frequency over the past decades, with severe storms continuing to occur frequently. While hurricanes have remained intense and minimum pressure values have dropped, maximum wind speeds have remained stable rather than increasing, indicating that storm intensity is not uniformly rising but evolving in distribution. These findings highlight growing storm unpredictability, underscoring the need for stronger preparedness measures.

Decade	Min. Wind Speed(Knots)	Mean Wind Speed(Knots)	Max. Wind Speed(Knots)	Min. Pressure(mb)	Mean Pressure(mb)	Max. Pressure(mb)
1970	15	50.9	150	924	995	1015
1980	10	51.0	165	888	994	1018
1990	10	51.4	155	905	993	1020
2000	10	49.9	160	882	993	1024
2010	15	49.0	160	908	994	1021
2020	15	48.6	140	917	994	1018

Table 1.1 Summary Statistics of Storm Intensity by Decade (1970-2020)

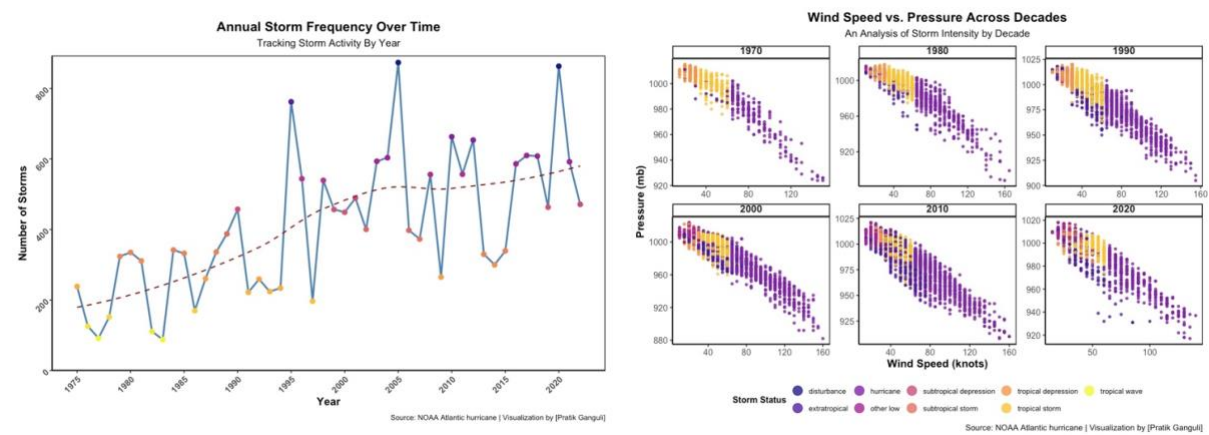


Fig. 1.1 Annual Storm Frequency Over Time (1975-2022)      Fig. 1.2 Wind Speed vs. Pressure Across Decades (1970-2020)