1 Objective

The purpose of this document is to identify key predictors for our variable of interest through visual scatter plot analysis. This method helps in understanding the linear or non-linear relationships and potential clustering patterns between the variable of interest and each predictor.

2 Methodology

For each potential predictor, a scatter plot was generated against our variable of interest. These plots serve as a preliminary step in our variable selection process, allowing for an intuitive assessment of the relationship dynamics. The analysis focuses on detecting trends, patterns, and anomalies that could suggest meaningful correlations or identify outliers that may influence model performance. This document contains 19 scatter plot with a details comment for each one of them.

3 Visual Explorations

3.1 Precipitation index scatterplots

The ENSO Precipitation Index typically refers to measures that specifically track changes in precipitation patterns related to ENSO phases (El Niño or La Niña). This index helps in predicting and analyzing the impacts of ENSO on global precipitation, crucial for agricultural planning, water resource management, and disaster preparedness. These indices are critical tools for meteorologists, climate scientists, and researchers, providing essential data for predicting weather patterns and making informed decisions about climate-related risks. They are used in various applications, from long-term climate modeling to short-term weather forecasting.

1. EI is the El Nino precipitation index
2. LI is La Nina preicipitation index
3. ESPI is a normalized combination of the two.

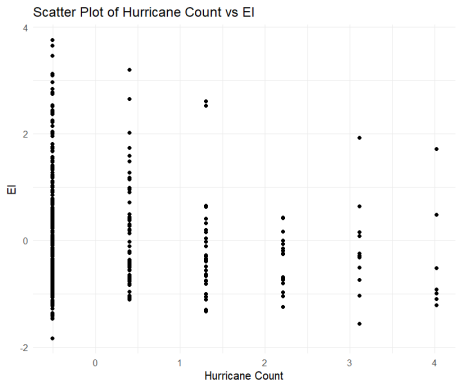

Figure 1: Plot of the standarized version of the hurricane counts vs the standardized EI index.

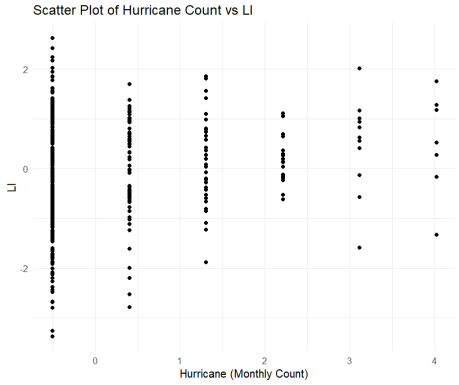

Figure 2: Plot of the standarized version of the hurricane counts vs the standardized EI index.

Comment precipitation indexes

The 3 plots present similar behaviour (as expected), with slighted positive the trend between the of LI and ESPI index when plotted against the standardized counts of hurricanes , and a light negative trend with the EI index. In terms of variablity, lower values for all three indexes seem to have a much higher variability. Meaning that when there are few hurricanes these indexes are little significant, no evident outliers are found. Note that the ESPI index has a negative linear correlation with hurricanes counts -0.48 which is the highest among every predictor.

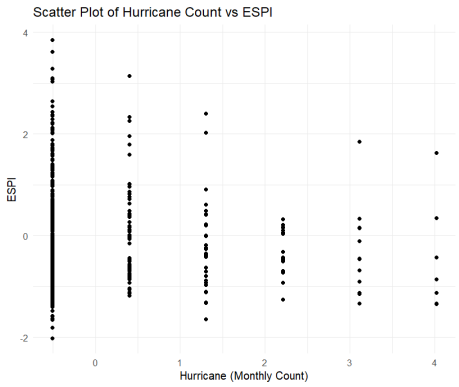

Figure 3: Plot of the standarized version of the hurricane counts vs the standardized ESPI index.

3.2 Heat content indexes

These heat content indices are typically used by meteorologists and oceanographers to monitor and forecast the thermal state of the Pacific Ocean, which plays a critical role in global climate dynamics. By analyzing changes in these indices, scientists can predict ENSO events more accurately and assess their likely impact on weather patterns worldwide

1. **X130E.80W** This index measures the heat content from 130 degrees East to 80 degrees West. This expansive longitudinal range covers a significant part of the Western and Central Pacific Ocean, which are critical areas for the development of El Niño events.

2. **X160E.80W** This index spans from 160 degrees East to 80 degrees West, focusing slightly more on the Central Pacific. It captures ocean heat content that is crucial for the modulation of ENSO cycles.

3. **X180W.100W** This index measures the heat content between 180 degrees West and 100 degrees West, covering an area predominantly in the Eastern Pacific Ocean. This region is particularly important for studying the effects of La Niña events, which are characterized by cooler sea surface temperatures in the Eastern Pacific.

Comment heat content indexes

The 3 plots (figure 4, 5, 6) exhibit remarkably similar behaviors, characterized by high variability at lower hurricane counts and reduced variability at higher counts. None of the plots display any discernible trends. Consequently, it is improbable that these variables will provide useful information for hurricane forecasting.

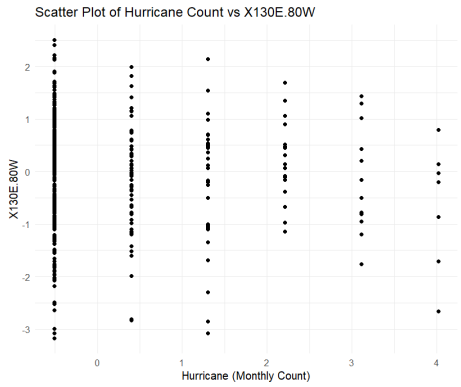

Figure 4: Plot of the standarized version of the hurricane counts vs X130E80W index.

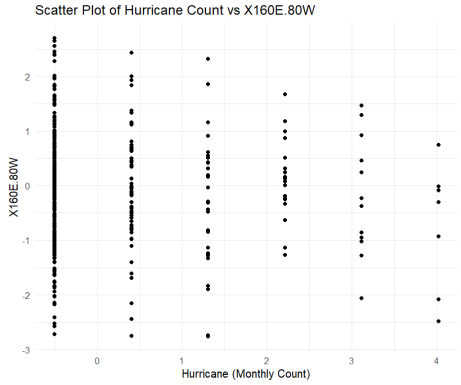

Figure 5: Plot of the standardized version of the hurricane counts vs X160E.80W

3.3 Other climate indexes

1. TNI (Trans-Niño Index) Description: The Trans-Niño Index (TNI) is a climate index used to measure the temperature gradient between the central and eastern tropical Pacific Ocean. It is calculated based on sea surface temperature anomalies in these regions and is used to assess the intensity and phase of ENSO (El Niño Southern Oscillation) events, distinguishing between El Niño, La Niña, and neutral conditions.

2. SOI (Southern Oscillation Index) The Southern Oscillation Index (SOI) is one of the key indicators for monitoring the El Niño and La Niña phenomena. It measures the difference in air pressure between Tahiti and Darwin, Australia. Positive values of SOI generally indicate La Niña conditions (higher pressure over the western Pacific), while negative values suggest El Niño conditions (lower pressure over the western Pacific).

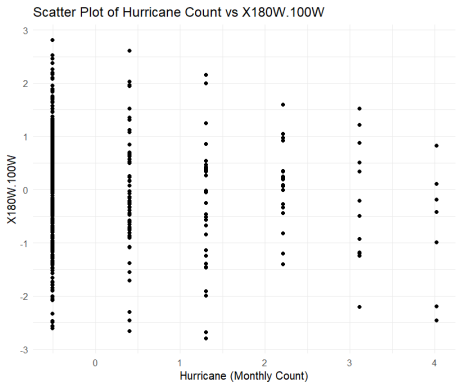

Figure 6: Plot of the standardized version of the hurricane counts vs the standardized X180W.100W index.

3. PNA (Pacific North American Pattern) The Pacific North American Pattern (PNA) is a climatological feature that describes the atmospheric circulation variability over the Pacific Ocean and North America. The PNA index is characterized by a quadrupole pattern of pressure anomalies located in the vicinity of Hawaii, the Aleutian Islands, the southeastern U.S., and over the intermountain region of North America. This pattern influences the weather across North America, including temperature and precipitation patterns.

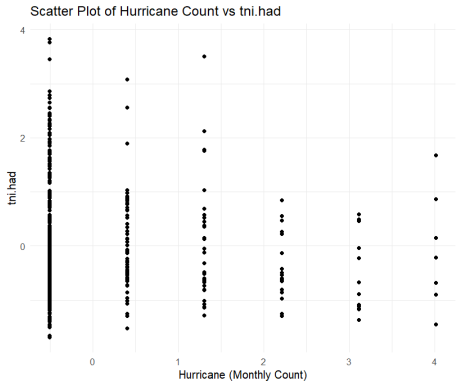

Figure 7: Plot of the standarized version of the hurricane counts vs tni.had.

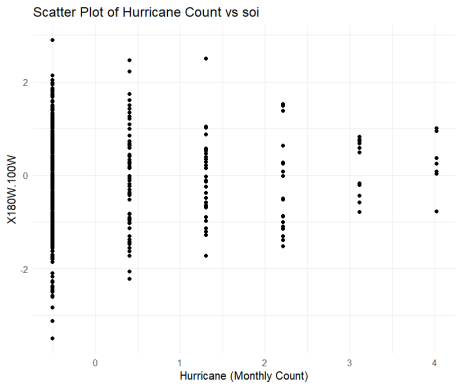

Figure 8: Plot of the standardized version of the hurricane counts vs Soi

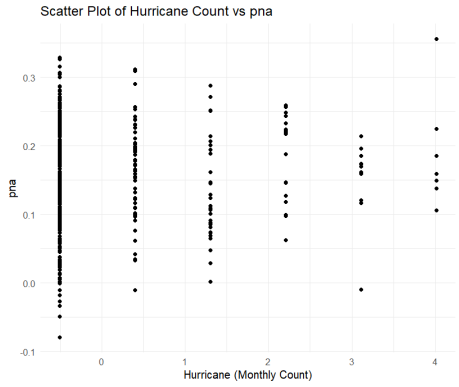

Figure 9: Plot of the standardized version of the hurricane counts vs the standardized pna.had index.

Comment on SOI

The 3 plots (figure 7, 8, 9) are characterized high variability at lower hurricane counts and reduced variability at higher counts. tni.had is the only index that showed a trend, with a light negative direction.

3.4 Wind Data

- **time_series2.z500_avg**: Represents the average geopotential height at 500 millibars. This is a crucial metric for analyzing mid-tropospheric weather patterns.
- **time_series2.z500_std**: The standard deviation of the geopotential height at 500 millibars, indicating variability around the mean.

- **time_series2.zzwnd200_ori**: Original readings of a specific wind-related variable at 200 millibars, typically used to study high-altitude winds and jet streams.
- **time_series2.zwdn_200_an**: Analyzed or annualized wind data at 200 millibars, useful for long-term climatic studies and understanding upper atmospheric dynamics.
- **time_series2.zwdn_500_an**: Similar to the above but for 500 millibars, providing insights into mid-tropospheric wind behaviors.
- **time_series2.zwnd200_st**: A statistical measure of wind data at 200 millibars.

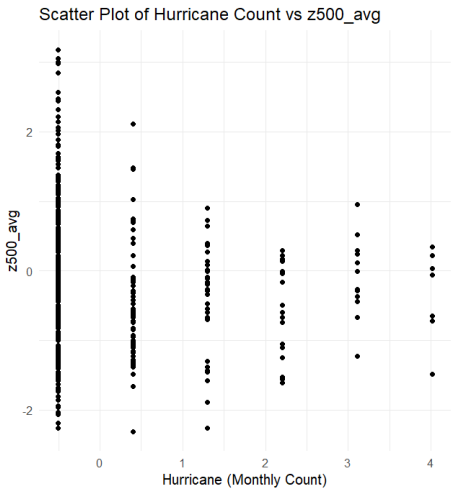

Figure 10: Plot of the standarized version of the hurricane counts vs Z500avg.

Comment on Wind Variables

The variables depicted from figure 10 up to figure 14 present an heteroschedastic pattern, while the zzwnd ori variables seems to have a light negative trend..

3.5 Other Variables

- **nina1**: This variable, possibly related to the La Niña condition in region 1, has not been plotted.
- **nina3.anom**: This variable, indicating anomalies possibly related to La Niña conditions in the NINO3 region, has not been plotted.

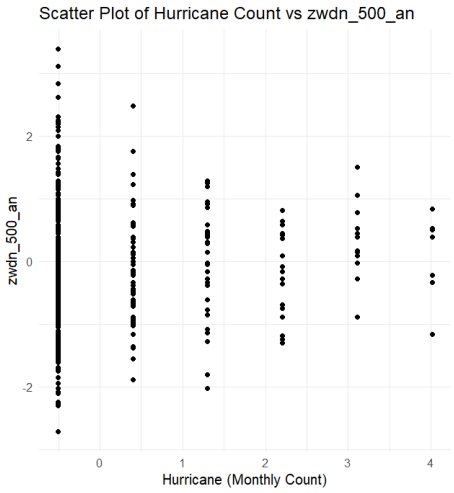

Figure 11: Plot of the standardized version of the hurricane counts vs ZWND 500 an

- **time_series2.zwdn_200_an**: Wind data at 200 millibars analyzed or annualized, has not been plotted.
- **time_series2.OLR**: Outgoing Longwave Radiation, which is a measure of energy emitted from the Earth into space; often used in climate studies, has not been plotted.
- **time_series2.Oni**: Oceanic Niño Index, used to measure the intensity of El Niño or La Niña conditions over a three-month running mean, has not been plotted.

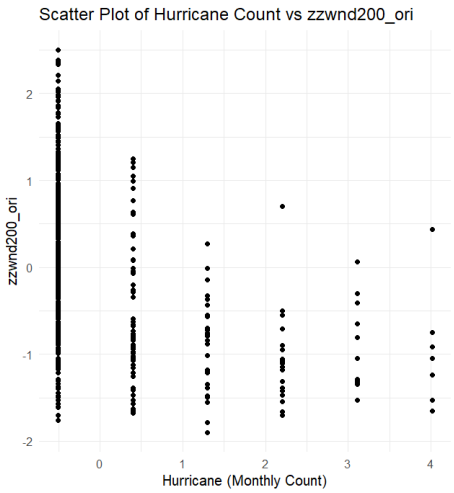

Figure 12: Plot of the standardized version of the hurricane counts vs the standardized ZZWND200 ori index.

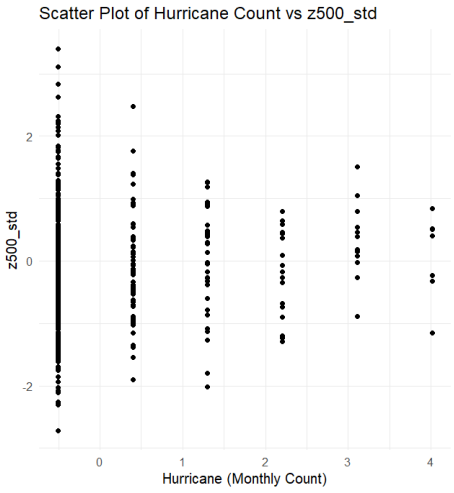

Figure 13: Plot of the standardized version of the hurricane counts vs Z500 std

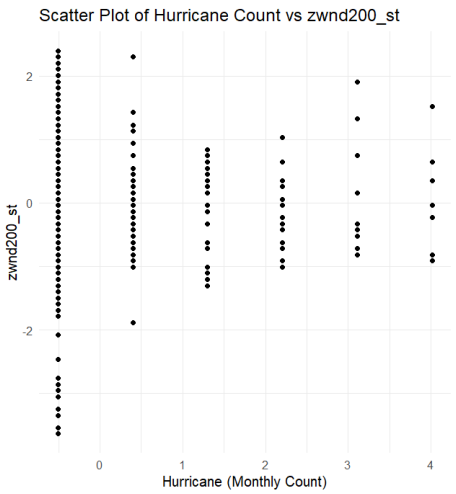

Figure 14: Plot of the standardized version of the hurricane counts vs the standardized Zwnd200 st index.

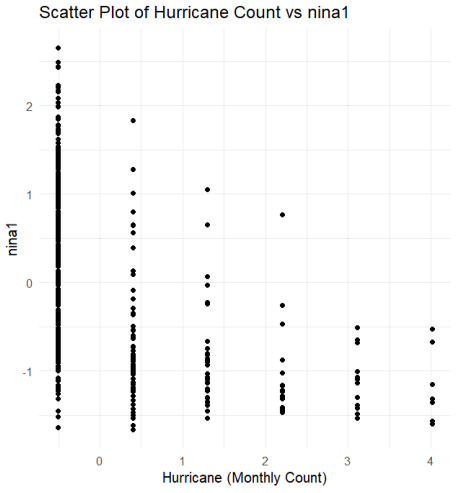

Figure 15: Plot of the standardized version of the hurricane counts vs the standardized Nina1 index.

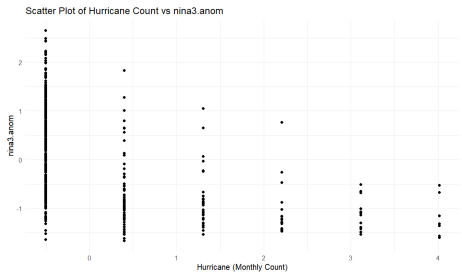

Figure 16: Plot of the standardized version of the hurricane counts vs NINA3 st

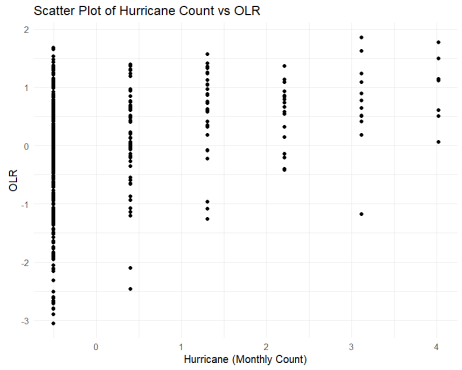

Figure 17: Plot of the standardized version of the hurricane counts vs the standardized OLR index.

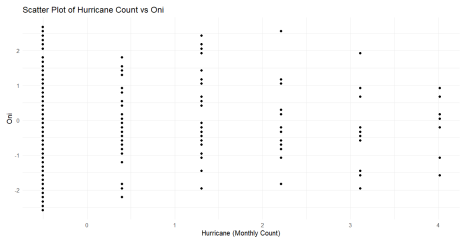

Figure 18: Plot of the standardized version of the hurricane counts vs the standardized OLR index.