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Research Plan

An Analysis of the Relationship Between Cyclogenesis Latitude and Sea Surface Temperature (SST) Anomalies

(A) Rationale:

Current research in tropical meteorology points towards the possibility of a poleward shift in the average yearly location of cyclone location of maximum intensity (LMI) in the Pacific Ocean (Emmanuel et al., 2014). This poleward trend was also discovered for yearly cyclogenesis latitude (Camargo & Daloz, 2016). Sources such as the National Oceanic and Atmospheric Administration attribute this long-term shift to the expansion of the tropics (Emmanuel et al., 2014). This term refers to an increase in the size of the region with tropical-like weather (Birner et al., 2018).

Though these findings are noteworthy, the development of merely a trend line will not aid in predicting yearly variability of tropical cyclogenesis. It is important to study factors that contribute to short-term variability in order to improve the accuracy of immediate cyclone prediction, not just long-term cyclone prognostication. Being able to predict whether the average cyclogenesis latitude of one year will be higher or lower than the previous year is an important step forward in achieving this goal. Previous research already points at the possibility of sea surface temperature (SST) anomalies playing a major role in the variability of yearly cyclogenesis patterns (Huo et al., 2015).

The aim of this investigation is to expand on current speculations by determining whether the analysis of Northeast Pacific SSTs during the cyclone off-season (December to April) will help to predict future tropical cyclogenesis patterns. Doing so will potentially provide cyclone models with the ability to roughly predict average cyclogenesis latitudes of future storm seasons prior to their occurrence. This aids in statistically communicating a potential storm threat prior to its occurrence, an outcome that would be highly favored by individuals advocating for better storm preparation (Rappaport, 2000).

(B) Research Question/Hypothesis:

Research Question (i):

Can the yearly variability of average cyclogenesis latitudes in the Northeast Pacific Ocean be predicted by analyzing changes in SST anomalies during the off-season?

Hypothesis (ii):

I hypothesize that analyzing the average latitude of a high temperature threshold like that of the tropics during the off-season serves as a precursor for cyclogenesis patterns of the corresponding subsequent year.

(C) Procedure/ Data analysis:

1. Genesis latitudes of individual cyclones will be obtained for the years 1980-2018 from the Weather Underground database (Weather Underground, 2019). Genesis will be defined as the first point at which a cyclone has a windspeed greater than or equal to 30 knots.
2. Averages of the individual latitudes for each year will be calculated and a table of values will be created.
3. Sea surface temperature map image paths will be collected for the months of December through April (off-season for Pacific cyclones) from the available years of 1996-2018.

This will be performed by saving SST maps from the NOAA database as image files (NOAA, 2018). An absolute path of the image will then be used by an algorithm for analysis.

4. Development of an algorithm using Enthought Canopy with the following criteria:
   a. An input statement that asks for the absolute path of the sea surface temperature map image file.
   b. For loops that specify what section of the map to collect data from (performed by specifying a range of x and y values).
   c. Utilize the "getpixel" function to provide coordinates of each image pixel with a color corresponding to a certain temperature threshold.
   d. Lastly, provide an average function to be performed on the y values obtained from the "getpixel" function in order to provide the average latitude of a certain temperature threshold in the months of December through April for each year analyzed.
5. The strength of relation between the average latitude of a certain SST threshold in a given off-season and the average cyclogenesis latitude of the subsequent year will be determined by calculating the correlation coefficient. This analysis may also be performed for a range of temperature thresholds and off-season months from December to April of each examined year to determine which combination serves as the most accurate predictor for future cyclone variability.

Risk and Safety: N/A for Comp Science project

(D) Bibliography:

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NO ADDENDUMS EXIST