**Assessing the Correlation Between Marine Heatwave Events and Tropical Cyclone Climatology in the Atlantic Basin**

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**Topic and Scope**

Assessing the correlation between marine heatwave (MHW) events and tropical cyclone (TC) climatology in the Atlantic Basin is important because it will lead to more accurate representation of TC frequency and intensification and in turn will better prepare people for the potential impacts. Furthermore, research on this topic will help progress the understanding of MHW’s and how they harm ecosystems in the water and on land. Tropical cyclones are a major threat to life and property, costing billions of dollars in damage annually, so it is crucial to figure out whether these events will be increasing in number and strength due to climate change induced SSTs increases, as well as the increase in MHW events.

SST anomalies' effect on hurricane season activity has been a popular research topic in recent years; scientists have studied the effect of North Atlantic and Western Pacific SST anomalies on Atlantic TC development. However, not much other current research is being conducted on this topic with the connection of GIS methods; we hope to change that with this project. The goal is to contribute to previous stated work on the topic by using GIS to determine if recent marine heatwaves (prolonged periods of highly anomalous SSTs) had any effect on the number of storms each year and their intensity. By looking at extreme events, we should be able to find the correlation (or lack thereof) of rising SSTs on hurricane development more easily. Summaries of some related research are as follows:

* Burnett (2021) found that 1) global tropical cyclone frequency is found to be proportional to the Coriolis parameter at the intertropical convergence zone, and that 2) many tropical cyclones occur even when the location of maximum sea surface temperature is shifted into the midlatitudes. This is valuable insight for our project because it indicates tropical cyclone frequency may be directly related to ocean temperatures, i.e., warmer sea surface temperatures could be correlated with the number of tropical cyclones forming. Furthermore, a relation to the location of the intertropical convergence zone means that if climate change shifts the ITCZ poleward, this could affect where tropical cyclones form (and maybe already has, if there’s been observed migration of the current ITCZ).
* Oey (2021) investigated if there was an increased likelihood of tropical cyclone rapid intensification over Warm Ocean Feature (WOF) through the use of a simple model. A WOF was defined as an area where the SST is anomalously warmer than the ambient SST. The model concluded that in today’s current climate tropical cyclones are not more likely to intensify over a WOF, but as the ocean warms, this likelihood of WOF-induced rapid intensification would increase.
* Saunders (2008) results “indicate that local sea surface warming was responsible for ∼40% of the increase in hurricane activity relative to the 1950–2000 average between 1996 and 2005. Our analysis does not identify whether warming induced by greenhouse gases contributed to the increase in hurricane activity, but the ability of climate models to reproduce the observed relationship between hurricanes and sea surface temperature will serve as a useful...” This reinforces the motivation behind doing a project on the impacts of anomalously warm SSTs on hurricane climatology; there is already considerable evidence which suggests they have a significant effect!
* West (2022) found that early-season hurricane activity is largely influenced by Atlantic sea surface temperature anomalies.

**Methodology**

For the MHW events, the NOAA Optimum Interpolated Sea Surface Temperature (OISST) data will be utilized to estimate the monthly averaged SST from the years 2010-2020. OISST comes in .nc file format which can be manipulated in python to create tables that can be plotted in ArcGIS. The python work needed can be directly done in the ArcGIS Python notebook. From the tables, feature classes will be created for each monthly SST. For the Tropical Cyclone frequency, we are interested in hurricane rapid intensification and the number of cyclones that occur each year. NOAA Hurricane archives will be utilized to get this information.

We will analyze whether there is a pattern using correlation. For rapid intensification, we will use the NHC definition “An increase in the maximum sustained winds of a tropical cyclone of at least 30 kt in a 24-h period.” If there is a correlation between the presence of a marine heatwave and either the number of tropical cyclones for that month, or the amount of rapid intensification occurrences, then we can determine that marine heat wave events are associated with anomalous tropical cyclone activity in the North Atlantic Basin. The correlation analysis can be done in either ArcGIS or in Excel.

We will use the hot spot analysis tool to identify MHWs using the SST data and then we will bind the polygons to the hurricane track data we obtain from the NHC. This will allow us to create maps identifying specific hurricanes that passed over an MHW event. We will also show the correlation, if any, between MHW events and intensification of hurricanes using a correlation table.

**Group Members’ Contribution**

Kenzie and Joshua wrote the topic and scope section of this proposal. Kenzie, Joshua and Zakkary each found related research and summarized it. Nickolas and Zakkary contributed to the methodology section of the proposal.

**References**

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