

Variability of the North Atlantic Main Development Region

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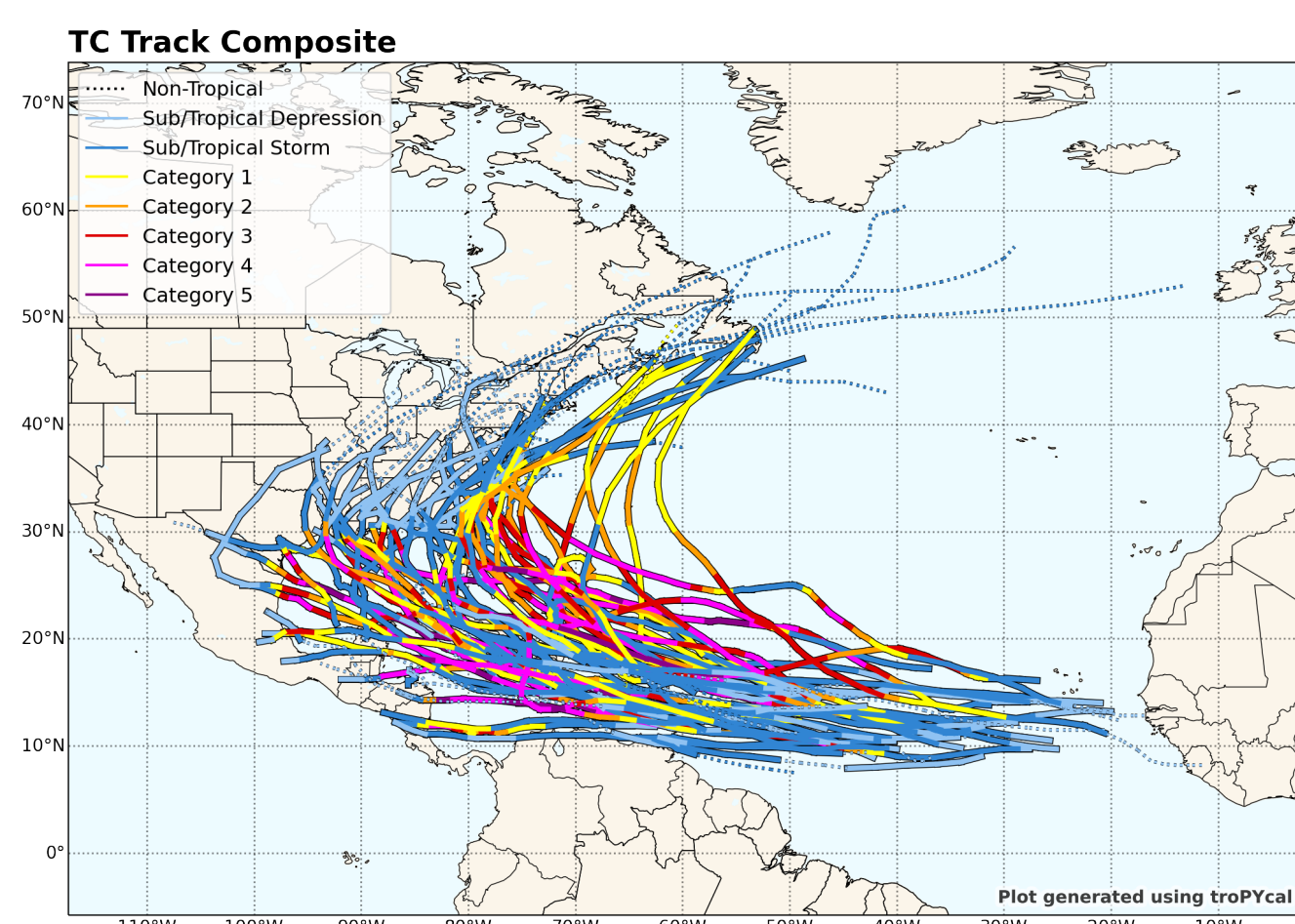


Motivation and Background

- Most tropical cyclones (TCs) develop during the peak of hurricane season in August & September in the **Main Development Region (MDR)**.
- The MDR is classically defined as the rectangle extending from 10-20°N and 10-60°W.
- The African Easterly Jet (AEJ) produces African Easterly Waves (AEW) that propagate eastward and can develop into TC if conditions are favorable.
- Large scale drivers such as **El Niño** and the **Atlantic Meridional Mode (AMM)** are known to have an impact on the environment of the MDR.
- This study aims to study variability in the MDR by grouping years or storms together based off common features and similar large scale atmospheric forcings.

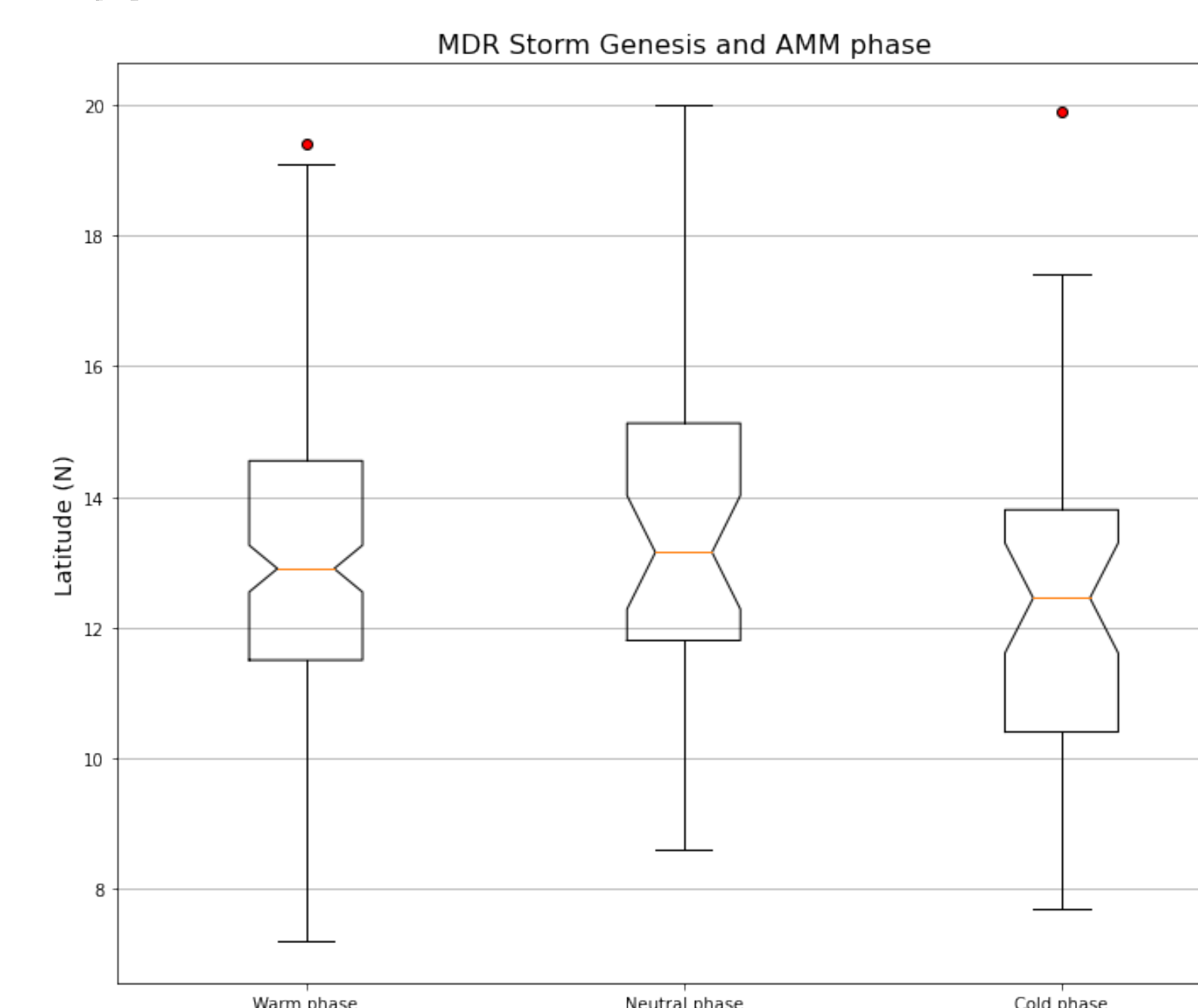
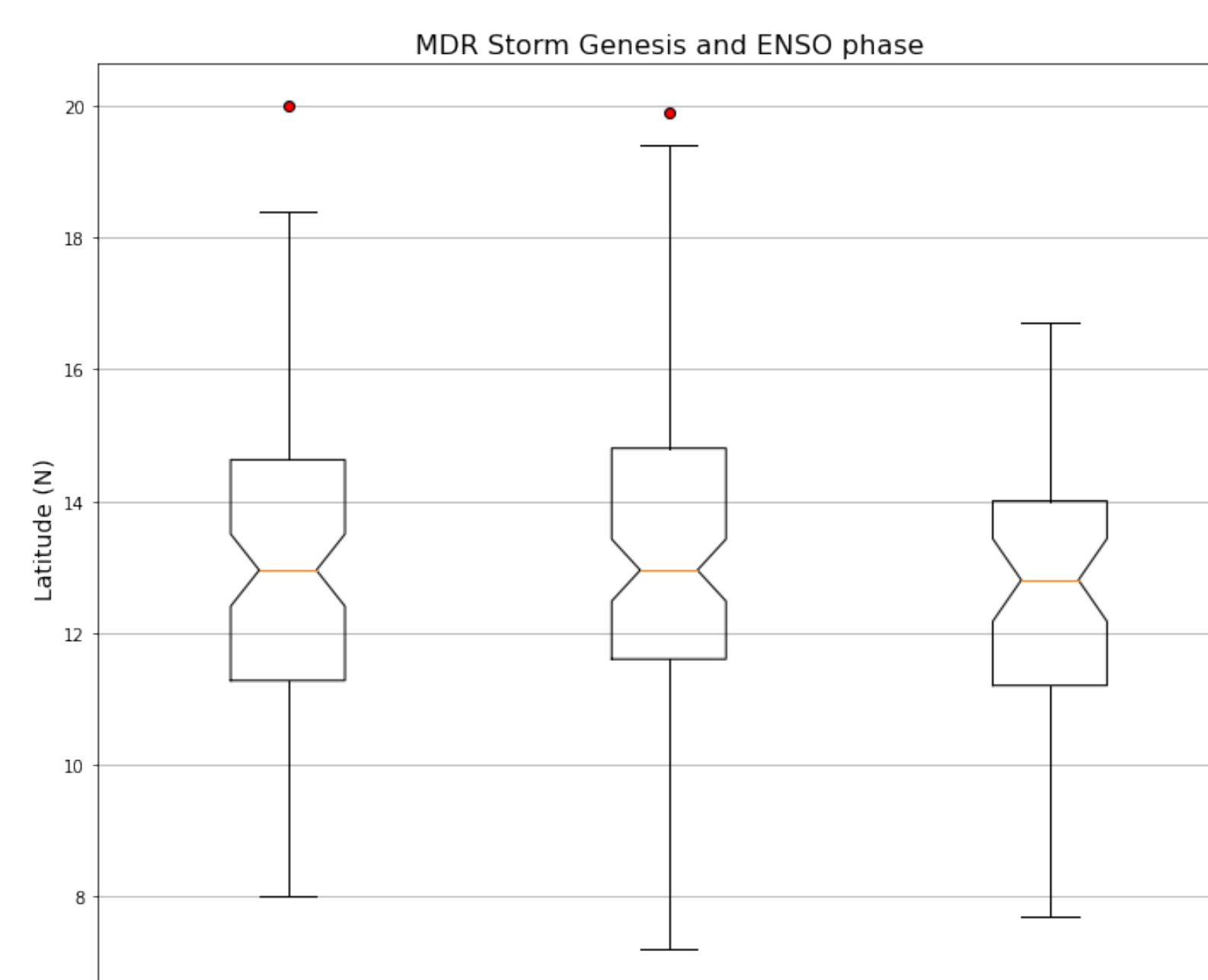
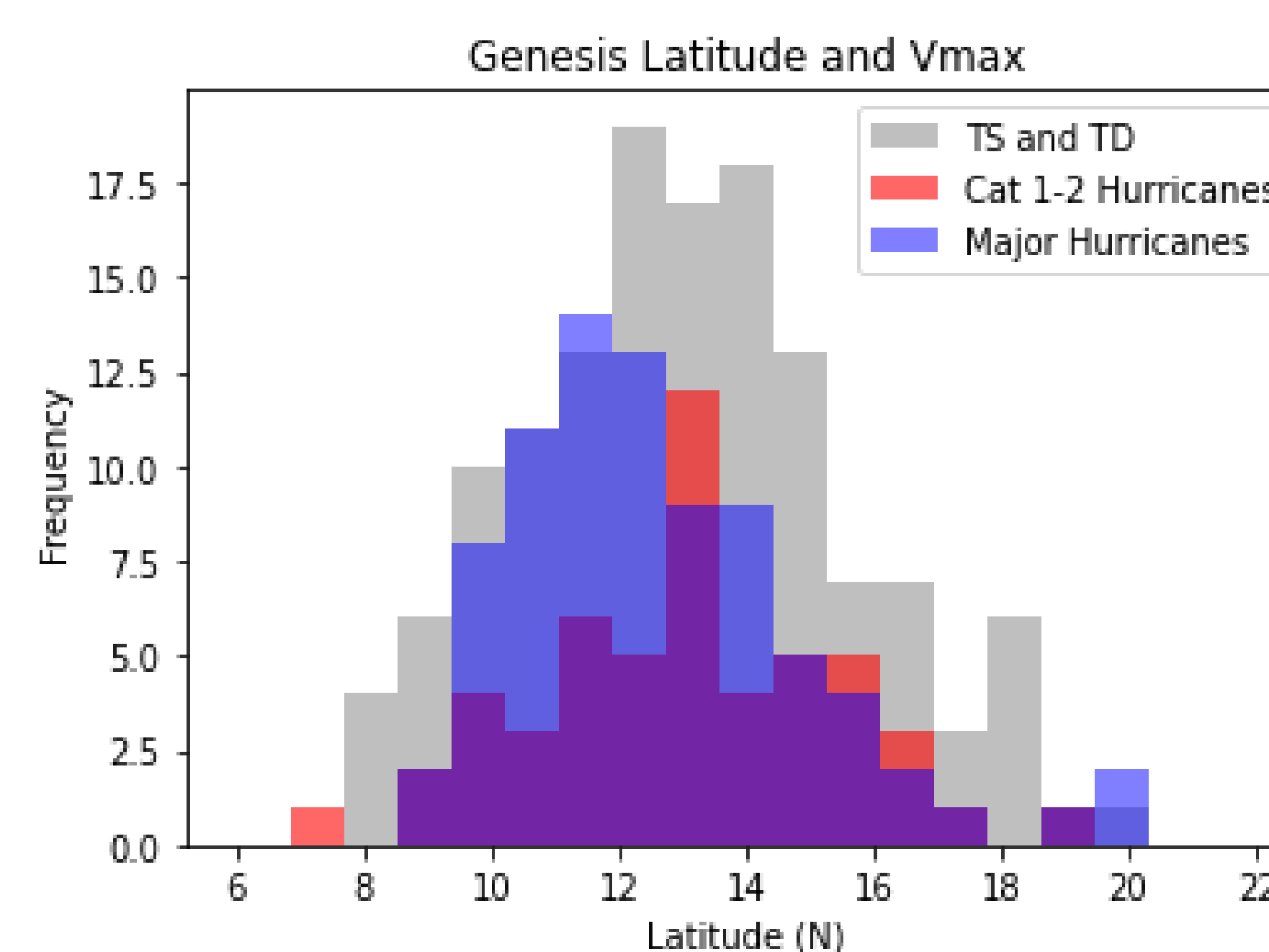
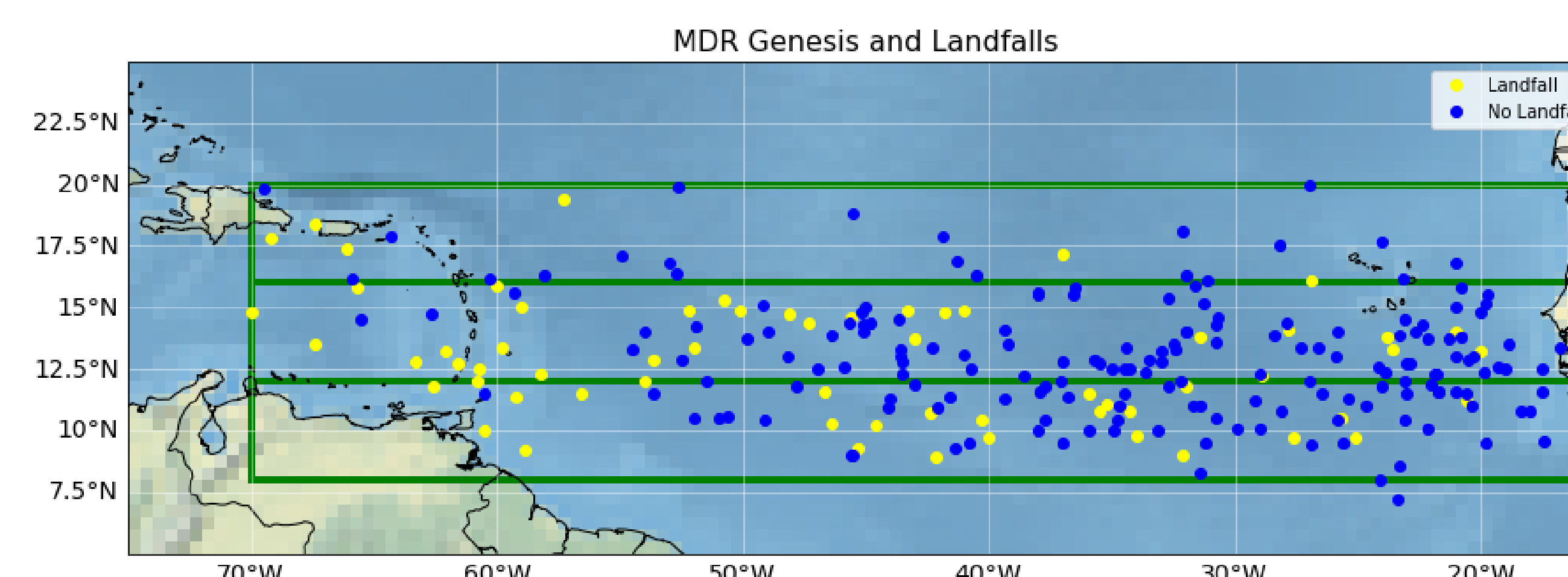
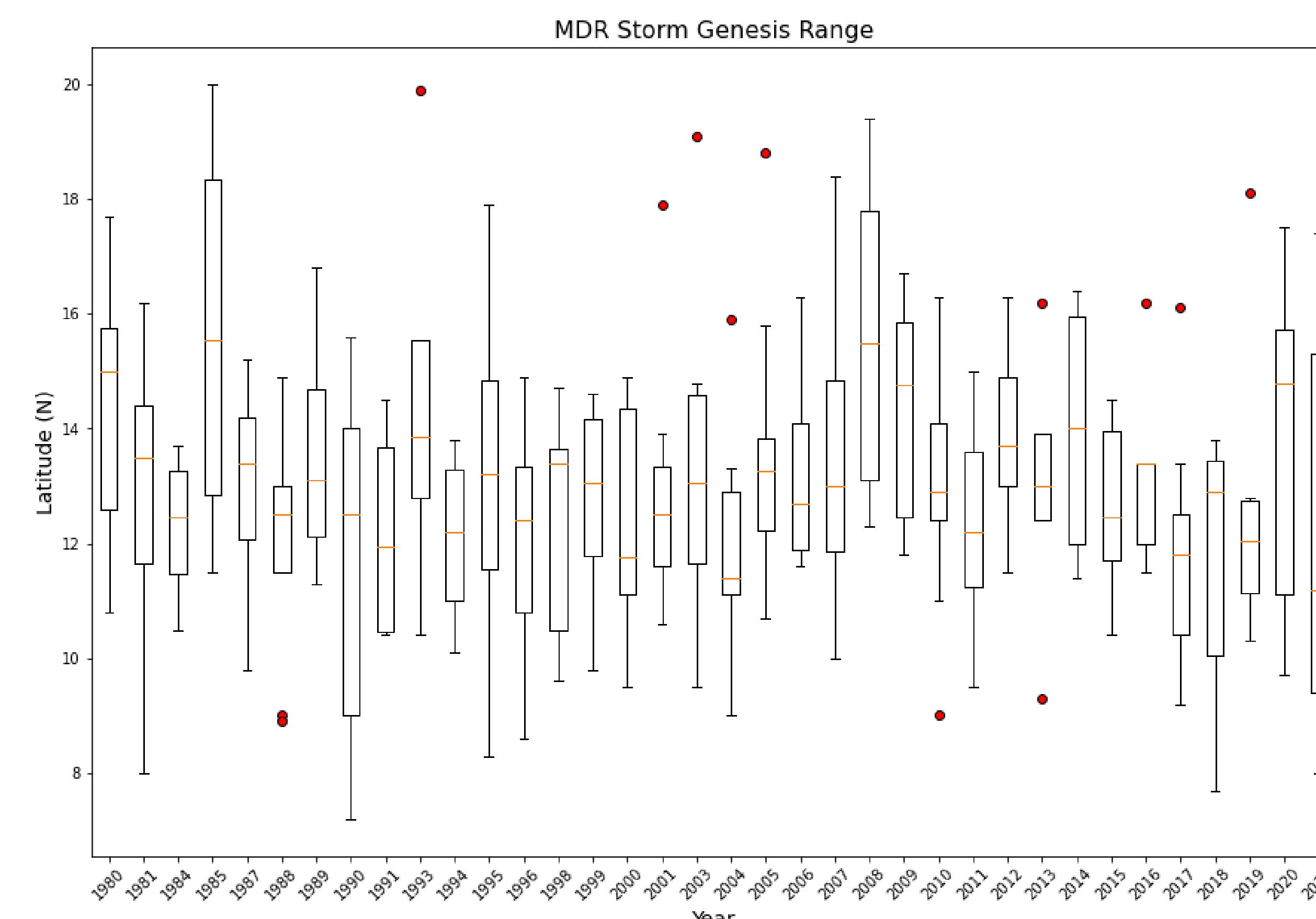
Methods

Tropycal, a python module for hurricanes, was utilized to find all systems that formed from 7-10°N and 10-70°W during 1980-2021.



- National Hurricane Center (NHC) best track data are used to find the starting coordinates, maximum wind, seasonal Accumulated Cyclone Energy (ACE), lowest central pressure, and if it underwent rapid intensification (RI).
- Oceanic Nino Index (ONI), a 3 month mean from July-August-September AMM index is calculated for each season, and if the storm made landfall in North America.
- Systems are grouped by these different large scale atmospheric forcings and commonalities to observe patterns and latitudinal clusterings in the MDR. Statistical testing is used to show significance at the 95% confidence level.

Results



Conclusions

- In the 1980-2021 period, the **variability of TC genesis in the MDR is significant** with respect to the mean and variance.
- While there were minimal differences in latitudinal clustering between depressions, storms, and minimal hurricanes; **major hurricanes, in general, tended to form further south in the MDR** with a mean of 12.1°N and had a smaller variance.
- TCs that made landfall in North America typically formed south of 15°N with a larger clustering to the west of 40°W. The MDR had very few systems forming overall north of 16°N possibly due to a dry mid-level troposphere.
- Using this proxy for estimating the annual variation of the MDR, there were only meager latitudinal shifts when isolating the effects on the Tropical Atlantic SSTs by ONI and AMM.

Future Work and Recommendations

- Including other large-scale drivers that modulate Atlantic SST's and TC activity such as the Madden-Julian Oscillation (MJO) and North Atlantic Oscillation (NAO).
- Taking a climatological average of the AEJ zonal winds and looking at anomalies for individual years.
- Using an AEW tracker, one can examine the developers vs the non-developers and check for potential differences.

References and Acknowledgments

NHC Best Track: <https://ftp.nhc.noaa.gov/atcf/btk/>
Tropycal: <https://tropycal.github.io/tropycal/index.html>
ONI: <https://origin.cpc.ncep.noaa.gov/ONI.php>
AMM: <https://psl.noaa.gov/data/timeseries/monthly/AMM/>

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