

Evidence for increased hurricane frequency for the Gulf of Mexico Basin over the past 4,000 years

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Abstract

The processes controlling hurricane formation, magnitude, and track have been heavily debated in recent years. Here, we derive a detailed record of past hurricane impacts in south Texas for ~4000-900 cal. yrs BP from sediment core analysis, and compare this to the historic hurricane record from 171 yrs BP- present.

1. Introduction

Hurricane magnitude and frequency increase during historic times has been linked to numerous mechanisms, from the steady rise in annual sea surface temperatures to ENSO variations. Several previous studies have attempted to study tropical storm frequency and magnitude trends from storm overwash sediment records. Although these studies have provided valuable data for the Atlantic Ocean and eastern Gulf of Mexico (Florida and Alabama), none have targeted the northwestern Gulf of Mexico.

2. Objective

To better quantify these relationships, it is necessary to compare hurricane frequency and magnitude regionally over centennial to millennial timescales.

3. Analyses

Thirty-seven 7.6 cm diameter vibracores up to 2m in length were collected for this study. Four of these cores yielded a hurricane record. We then obtain grain size data, radiocarbon ages, and detailed sedimentological descriptions. Grain size data was obtained using a Malvern Mastersizer 2000 particle analyzer. Mollusc species were radiocarbon dated at the Keck Carbon Cycle AMS Facility at UC-Irvine. Radiocarbon ages were calibrated from radiocarbon to calendar years using Marine04.

4. Discussions

Using known historic hurricane landfalls in Laguna Madre, Texas, we calculate an approximate landfall probability increase from .7% (from ~4000-900 cal. yrs BP) to 7.6% (past 171 yrs). Comparison of our data to previous studies in Western Lake, FL and Lake Shelby, AL reveals similar hurricane frequency trends and suggests an increase in landfall probabilities from an average of .4% (3400-500 yr BP) and .4% (3,500-700 yr BP), respectively, to 8.5% (153 yr BP-present) and 10% (110 yr BP-present), respectively. Additionally, our findings correlate well with a 5,000 yr hurricane record of intense storm strikes from Laguna Playa Grande in Vieques, Puerto Rico, a location likely affected by Atlantic hurricanes entering the Gulf.

5. Conclusions

Data spanning much of Texas suggests overall warm, dry conditions with high frequency oscillations (lasting ~500 yr) of cool, wet conditions from ~4,000 to 1,000 yr BP. Hurricane landfall frequency changes in the Gulf were likely regulated by these changing atmospheric conditions. During warmer, drier periods, hurricanes were less likely to impact the Gulf Coast than during cooler, wetter periods. For the past ~1000 yrs, a cool, wet climate regime has prevailed.

6. Acknowledgement

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7. References

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