

The Archaeology of Climate Change in the Caribbean

Jago Cooper

Introduction

This interdisciplinary research project aims to learn lessons from the past to help modern day communities live through the impacts of climate change in the Caribbean. The islands of the Caribbean are sensitive to changes in the climate systems of the North Atlantic. This research attempts to bring together paleoclimatic, paleoenvironmental and archaeological data to examine how past human communities lived through the impacts of climate variability and climate change during the mid to late Holocene. The study of these past human communities can reveal 6000 years of human knowledge in the face of rising sea levels, intensifying hurricane activity and marked precipitation variation. These impacts of climate change are ongoing and are currently the focus of intense political and popular debate in the Caribbean as "global climate change is the most serious threat to sustainable development facing CARICOM (Caribbean Community) states" (Caribbean Community Climate Change Centre, 2009:6). This research attempts to utilize the time depth of human experience to examine the impacts of climate change on past human societies and enable a better understanding of potential mitigation strategies that can be developed to build safe and sustainable futures for Caribbean communities.

The Impacts of Climate Change

Sea Level Rise

During the last 6000 years of human occupation there has been over 5m of relative sea level rise in the Caribbean. This research has collated regional and local paleoenvironmental and bathymetric data to model and reconstruct the impacts of known relative sea level change in the Caribbean (Cooper and Boothroyd, 2010). These studies suggest long term relative sea level rise created short-term high impact flooding events. Coastal inundations flooded pre-Columbian coastal settlements and dramatically changed coastal and marine ecology.

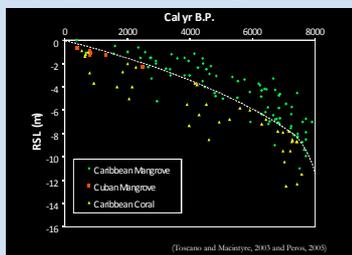


Figure 1 Accumulated regional sea level data for the Caribbean

Hurricane Activity

Hurricanes represent one of the most high profile climatic hazards in the Caribbean. This research project has drawn together paleotempestological data for past hurricane events as well as proxy data for past meteorological conditions in the Hurricane formation zones of the North Atlantic. This study shows periodic changes in the frequency and intensity of hurricane activity in the Caribbean over the past 6000 years. There is evidence for latitudinal clustering of hurricane landfalls and for periods of more and less intense hurricane activity over time. This research has also examined the human experience of the hurricane impact and the effects of wind shear, coastal storm surges and post-precipitation flooding on past human communities.

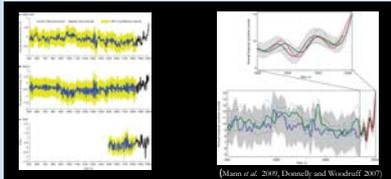


Figure 2: Accumulated regional hurricane data from paleotempestological studies in the Caribbean and proxy evidence from the North Atlantic

Precipitation Variation

Paleoclimatic and paleoenvironmental data from the Caribbean indicate that there have been some significant shifts in precipitation patterns during the mid to late Holocene. There is evidence for regional millennial period shifts from wetter to drier periods due to the long term movement of the Inter Tropical Convergence Zone as well as more high frequency inter-annual variation due to North Atlantic Oscillation and El Niño events. Therefore this research has considered the different timescales of precipitation variation and the way this variability would have been experienced by past societies.

Multi-Temporal and Multi-Spatial Methodology

Regional

One of the most challenging aspects of interdisciplinary research is to correlate the divergent temporal and spatial scales of different disciplinary data sets, in this case climatic phenomena and human lifecycles. At a regional scale, we can identify and correlate broad regional patterns in past human behaviour, such as island colonization and the development of agriculture, with regional climatic conditions. However these regional correlations between climate and human behaviour lack the validity of high-resolution data compatibility and these research questions have to be examined at spatial scales more conducive to archaeological research.

National

This research has been built upon collaborative fieldwork with the Cuban Ministry of Science, Technology and Environment, conducted throughout Cuba since 2003. Part of this collaboration has been the development of a national heritage environment database integrated with a GIS platform (Cooper, 2007). This GIS platform can help identify the impacts of climate change on long-term social development in Cuba. Analysis shows distinct patterns in pre-Columbian site distributions associated with the impacts of relative sea level rise, precipitation variation and hurricane storm tract activity. Once identified at a national scale these patterns can be studied in more detail at individual sites in local case study areas.



Figure 3: Maps showing pre-Columbian site distribution and impacts of sea level rises

Local

Recent fieldwork for this research has included a detailed archaeological and paleoenvironmental survey of a 2000 sq km case study area in north central Cuba. Archaeological excavations and artefact analyses have provided a detailed reconstruction of local pre-Columbian settlement locations, household architecture designs and food procurement strategies. Further research by Matthew Peros has enabled the reconstruction of local relative sea level change and potential hurricane activity in the same case study area. This high-resolution inter-disciplinary local perspective can greatly enhance our understanding of how past human communities lived through the impacts of climate change.

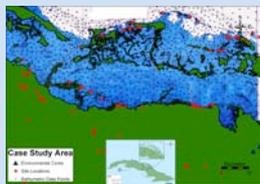


Figure 4: Map of pre-Columbian sites, paleoenvironmental core locations and bathymetric data points used to identify the local impacts of relative sea level change

Learning from the Time Depth of Human Experience

Settlement Location

Pre-Columbian settlements are found in protected locations in the landscape that could mitigate the impacts of known environmental hazards (Cooper and Peros, 2010). A recent flood protection program has implemented this pre-Columbian data to identify improved locations for new settlement construction in Holguin province (Valcarcel Rojas 2006). Archaeological and ethno-historical evidence indicates pre-Columbian settlements used nearby cave systems as hurricane shelters.



Figure 5: Map analysing changing pre-Columbian settlement locations through time and photographs highlighting the different flood risk of pre-Columbian and modern settlement locations following hurricane Ike in 2008

Household Architecture

Pre-Columbian house structures provide an opportunity to reconsider the relative vulnerability of household architecture designs in the Caribbean (Valcarcel Rojas and Cooper et al., 2006). Hurricane wind shear would remove the thatched lightweight superstructure but radiocarbon dates show the structural house posts of pre-Columbian structures remained in situ and in use for over 300 years. Therefore, if residents survive the storm event by moving to nearby shelters, the real impact of the hurricane is the speed with which human communities can return to 'life as before'. Pre-Columbian house structures, in contrast to modern houses, can be rebuilt within days of hurricane events with minimal labour and locally available materials.



Figure 6: Excavation of pre-Columbian house in the case study area and photographs of one modern house and one reconstructed pre-Columbian house being rebuilt six days after hurricane Ike destroyed the village of El Chorro de Maíta in Holguin

Food Procurement Strategies

Pre-Columbian communities established long-distance food exchange networks that included a wide variety of different environmental zones reducing the likelihood that they would all be affected by the same disaster. This diversification of locally available resources in tandem with long distance exchange networks supported by strong social bonds provided pre-Columbian communities was a useful mitigation strategy to deal with the short to mid term effects of local environmental stress.

Summary

- The Caribbean has not had a stable climate during the past 6000 years of human occupation and pre-Columbian communities lived through some major impacts of climate change
- Pre-Columbian settlement locations, household architecture designs and food procurement strategies helped mitigate the impacts of climate change
- The human experience of 'change' defines the key hazards to any society and therefore the vulnerability of human communities needs to be contextualised within the different timescales at which the impacts of climatic and environmental change occur
- Resilient communities require a range of mitigation strategies to provide social stability throughout periods of climatic instability and environmental stress
- This research highlights the non-linear relationship between climate, environment and society and therefore thresholds and tipping points provide an important comparative theme for the study of climate systems and human societies
- Modern day communities should use the full time depth of human experience to help develop current disaster management strategies in the Caribbean

Please contact Jago at jc329@le.ac.uk for full references and further reading