Paleotempestology of Onslow Bay, NC

Scott Hippensteel

University of North Carolina at Charlotte

Sea Grant North Carolina

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

Methodology/Goal Findings Outreach

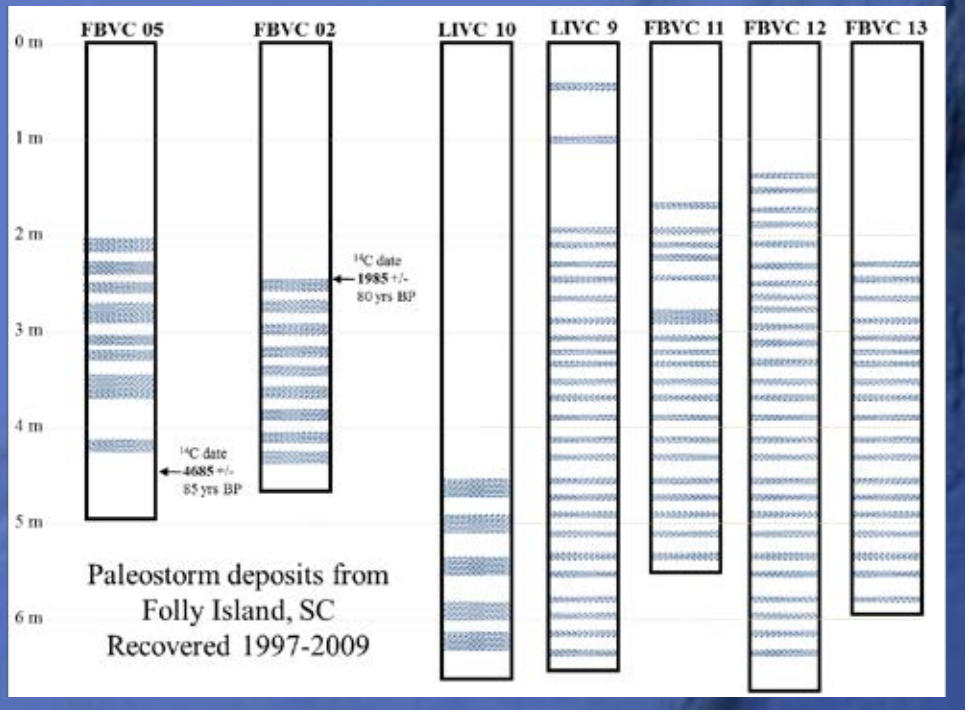
Methodology/Goal Findings Outreach

Onslow Bay Study

Sandpiper Pond

Price's Inlet

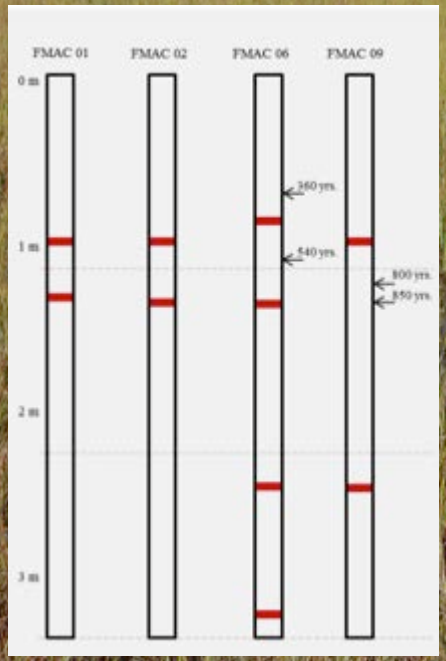
Folly Island

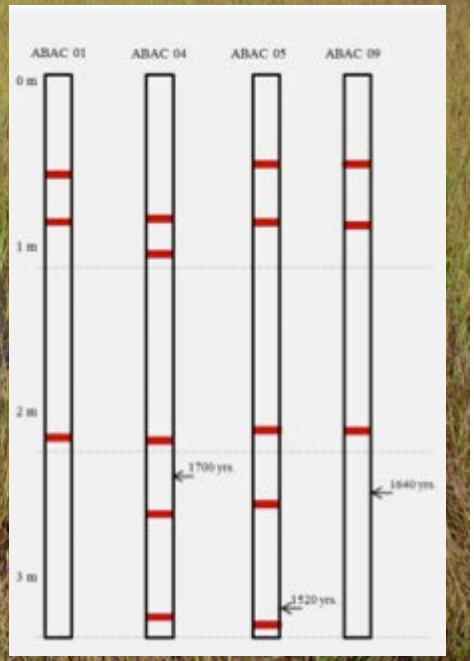


Paleostorm deposits from Folly Island, SC Recovered 1997-2009

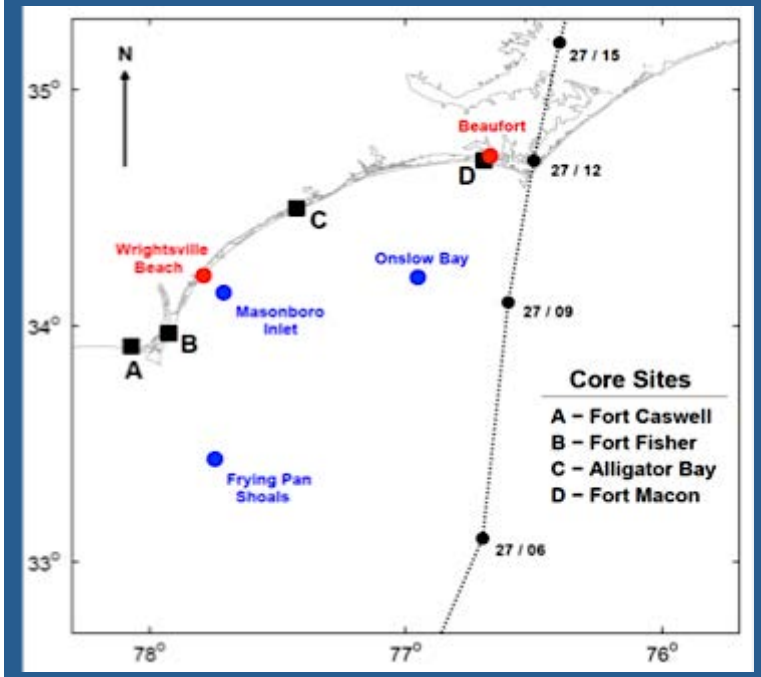
Methodology/Goal Findings Outreach

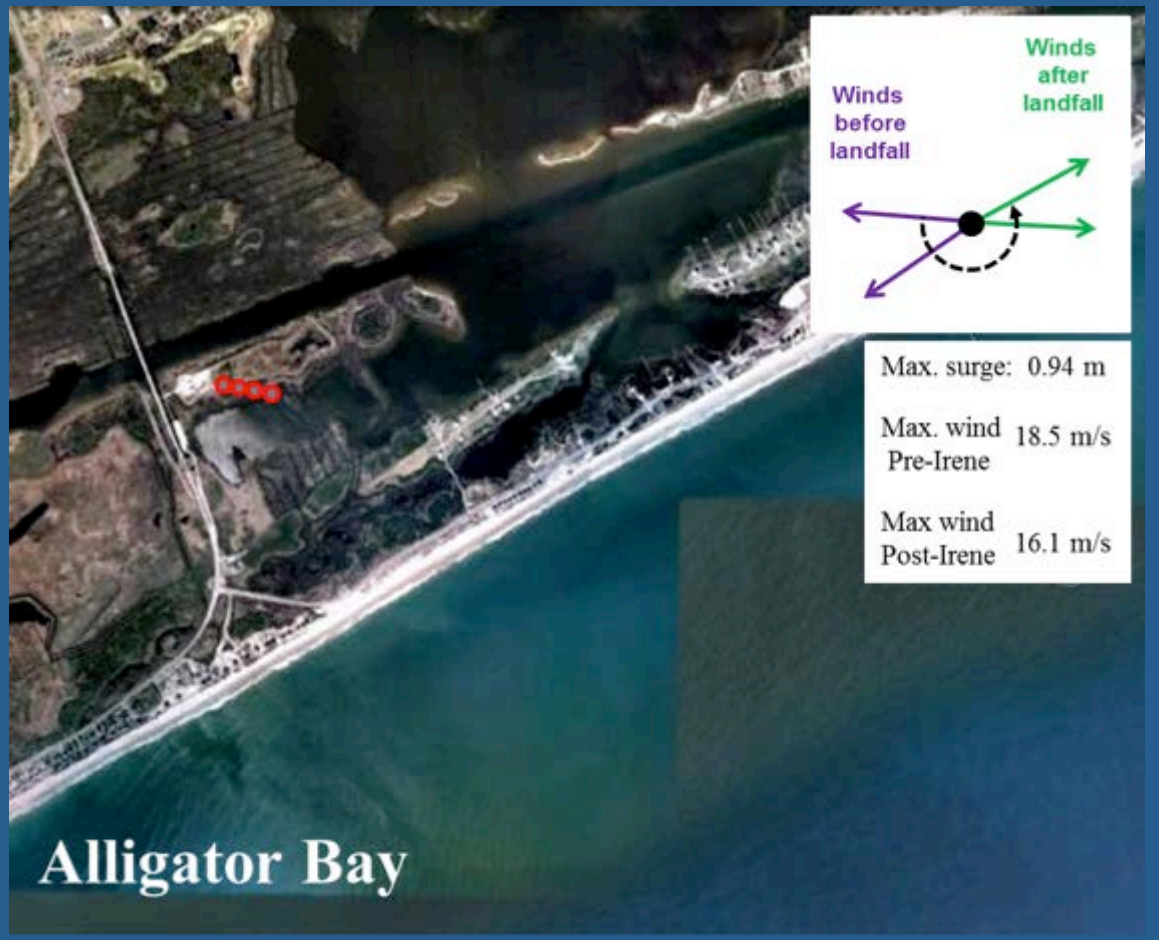
	Composite (total) Storm Deposits	Storms
- South Core Banks	0	0
- Tar Landing Bay	10	5-10 (?)
- Hope Pole Creek	0	0
- Bear Island	0	0
- Alligator Bay	16	6-16 (?)
- Wrightsville Beach	0	0
- Fort Fisher	0	0
- Battery Buchanan	0	0
- Oak Island	0	0





Methodology/Goal Findings Outreach





Methodology/Goal Findings Outreach

Coastal Geology
Applied Paleontology
Environmental Micropaleontology

Methodology/Goal Findings Outreach

GROUNDWORK

Paleotempestology and the pursuit of the perfect paleostorm proxy

Scott P. Hippensteel, Dept. of Geography and Earth Sciences, University of North Carolina, 9201 University City Blvd., Charlotte, North Carolina 28223, USA, shippens@uncc.edu

Growing populations and recent hurricane activity along the Atlantic and Gulf coastlines have made clear the need for a more accurate and extensive record of storm activity. The paucity of historical descriptions of hurricane strikes along the southern Atlantic coast limits their use as a predictive tool. Only three Category 5 hurricanes have made landfall in the United States since 1900, as a result, the likelihood of a major storm impacting this region cannot be accurately determined using historical records. Proxy records collected from marginal marine environments offer the potential to extend this record back several thousand years, providing better statistical constraints on hurricane prediction and a better understanding of the influence of global warming on catastrophic hurricane development.

Although definitive paleostorm deposits from North America date back to the Oligocene, "paleotempestology" is a relatively new field of research (Nott and Hayne, 2001). Two proxy approaches developed independently in the early 2000s from two different geographic regions; the resulting storm records offer interesting insights into the problems associated with the contrasting methodologies. At the same time that a research team from Louisiana State University was using sedimentary criteria to detect storm deposits in the coastal lakes of Louisiana, I was finding offshore indicative foraminifera (and Oligo-Miocene taxa!) in bedsel sand layers from the back barrier marshes of South Carolina (Liu and Fearn, 1993, 2000; Hippensteel and Martin, 1999, 2000; Liu, 2000, 2004). Over the next decade, several follow-up studies from the same and different regions led to a series of debates as to the validity of each approach (Donnelly et al., 2001, 2005a, 2005b, 2006; Scott et al., 2003; Donnelly, 2005; Hippensteel et al., 2005; Lambert et al., 2008; Liu et al., 2008).

Previous sediment-based paleostorm proxies have been hindered by two primary issues. First, studies based on sand layers in marshes and coastal lakes have been criticized because the mechanism of deposition was not always well documented, and the source of the sediments was not clearly defined (Owen, 1999, 2002, 2006; Liu et al., 2005). Second, the depositional history of many marsh records is short, especially in New England and the mid-Atlantic (Donnelly et al., 2001; Travis, 2005). The use of microfossil-enriched storm layers from near Charleston, South Carolina, avoided both limitations. The mechanisms for deposition is well understood because the storm deposits contain offshore indicative foraminifera, and the record extends into at least the mid-Holocene (Hippensteel and Martin, 1999, 2000).

The micropaleontological proxy is not without problems or critics, however. The exact taxa included on a list of "offshore indicative" genera and the role of bioturbation in the preservation of storm deposits has been strongly debated (e.g., Scott et al., 2005, 2007; Hippensteel et al., 2005; Hippensteel, 2006). Further, the geochronology established for many of these studies is questionable. The washover deposits themselves are, by their very nature, the product of severe reworking of ancient offshore sediments. Dating the foraminifera in such deposits directly would yield the age of the fossils (Oligo-Miocene), not the time of storm deposition.

As a result, the quality, completeness, and comprehensiveness of the storm record from the southeastern Atlantic is not known. Barrier islands are dynamic environments, which, in a transgressive setting, roll over on themselves, destroying or obscuring the backbarrier storm record. Additionally, marsh subenvironments in a transgressive setting will shift through time. In South Carolina, for example, paleostorm frequency appears to be decreasing through time, with more storms lower in the marsh strata (Hippensteel and Harris, 2006; Hippensteel, 2006). Is this apparent decrease in catastrophic storm events a result of climate change or an artifact of the insidious processes of bioturbation and reworking? Is taphonomy partly to blame for the potentially poor preservation, or even absence, of some microfossils in the storm deposits? These marsh subenvironments have, after all, been flooded from high marsh to low marsh, and the primary bioturbators present, fiddler crabs, prefer the low marsh. Before paleotempestology can reach their potential as a tool for paleoclimate researchers, these geological and biological factors need to be better understood.

The field of paleotempestology has never been of more importance. Prehistorical storm data would be more valuable in the current period of climate change, despite the frustratingly elusive nature of the "ideal" paleostorm record. This ideal paleostorm record, wherever and whenever it is discovered, will have four interrelated characteristics:

1. The deposits will display a clear link to the source of sediments and the mode of deposition. This may be because of the foraminifera present in the deposit, some other

Journal of
Coastal Research

An International Forum for the Littoral Sciences

Charles W. Finkl
Editor-in-Chief

Published by

27th JCR Year of Service

IT'S TIME!—RENEW YOUR MEMBERSHIP & SAVE 15%

CELEBRATE GSA'S 125TH ANNIVERSARY

GSA TODAY

A PUBLICATION OF THE GEOLOGICAL SOCIETY OF AMERICA®

The geological legacy of Hurricane Irene: Implications for the fidelity of the paleo-storm record