Progress in a Hindcast Simulation of the 1926 Great Miami Hurricane

- By
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- *GEER- Greater Everglades Ecosystem Restoration*
- *Coral Springs, Fl*
- *April 21, 2015*

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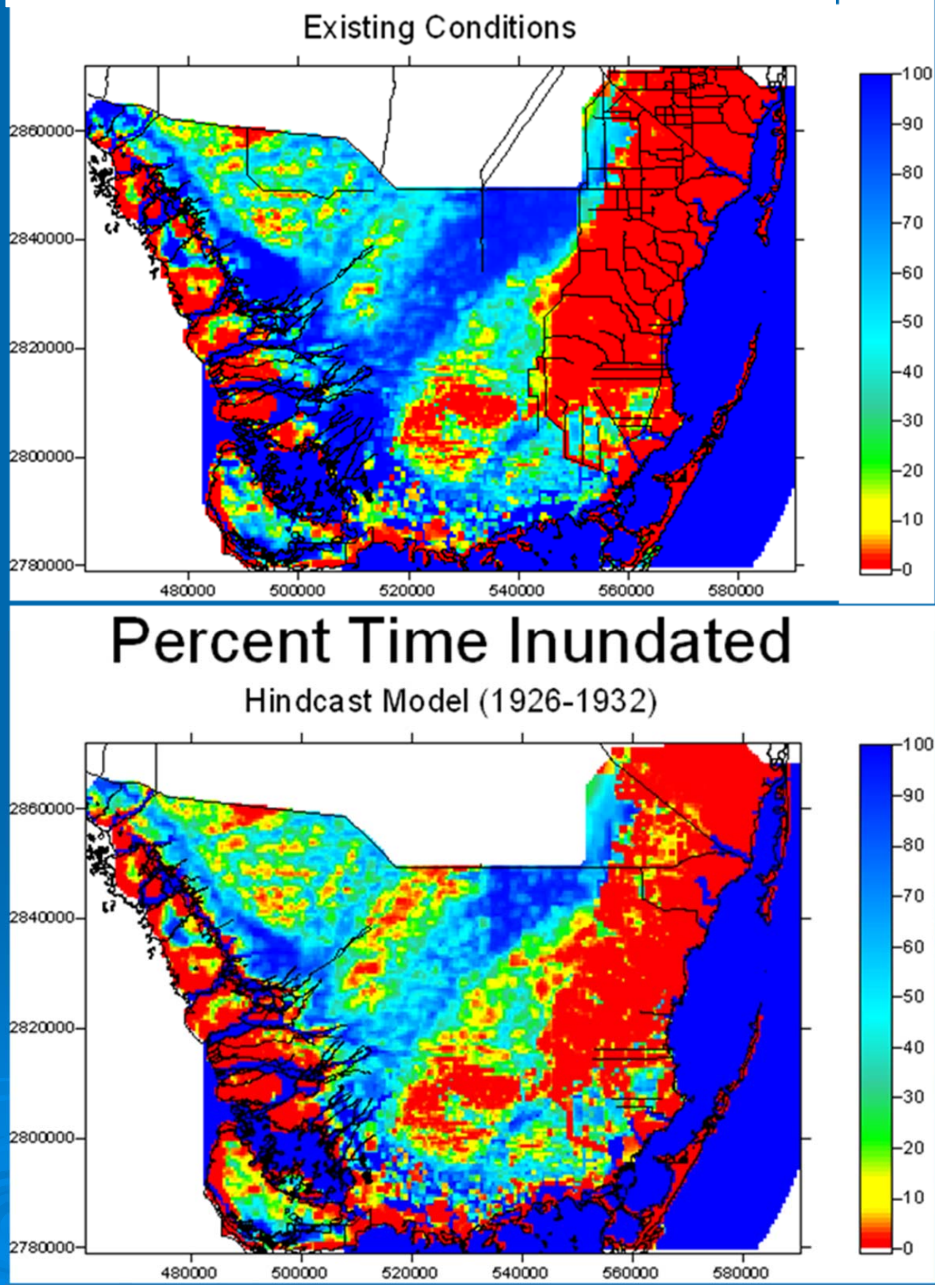
Hindcast

- Simulate historical period with FTLOADDS model to determine water levels, salinity, and flows and compare with historic aerial photography
- Represent historic storms and effects on coastal regimes
- Use results to develop insight into future



Distribution of Canals near Miami from 1920 - 1990

1920 1930 1940

1950 1960 1970 1990

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Renken (et al, 2005)

Great Miami Hurricane 9/18/1926

13th Avenue and Flagler – Sept. 19, 1926

↑ ~3.2 km to Biscayne Bay

← ~1.0 km to Miami River

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Storm Components Represented in Model

1. Rain
2. Wind
3. Surge

It is difficult to obtain historical data for all three of these components.

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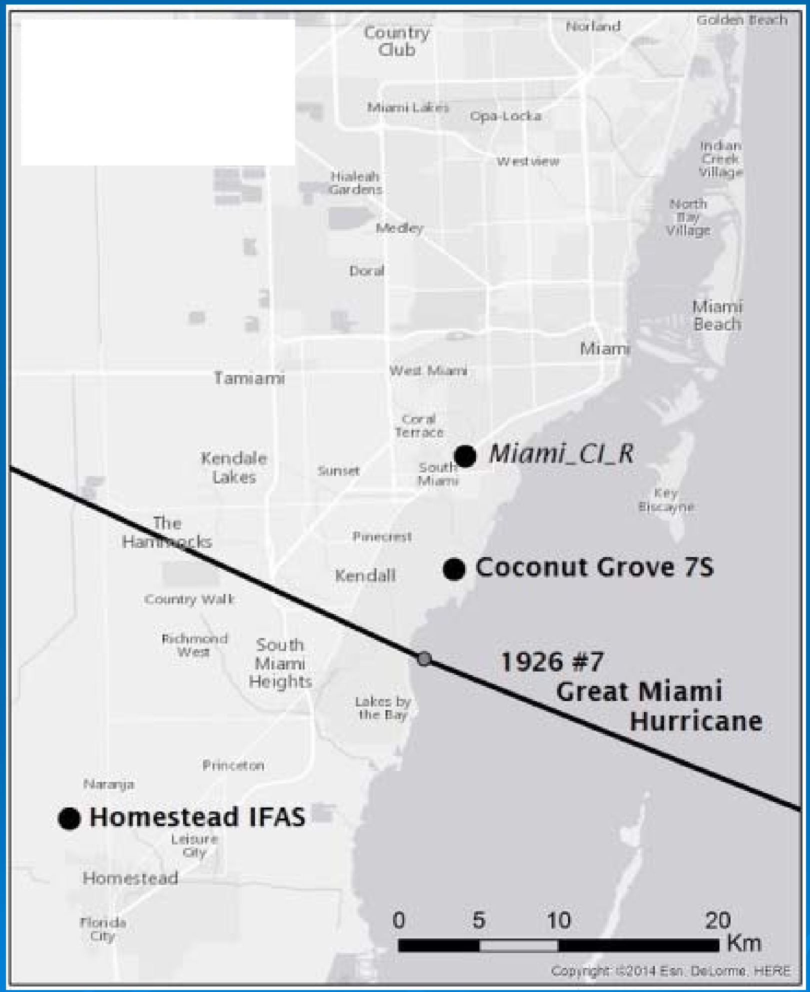
Rain Gages for BISECT Hindcast



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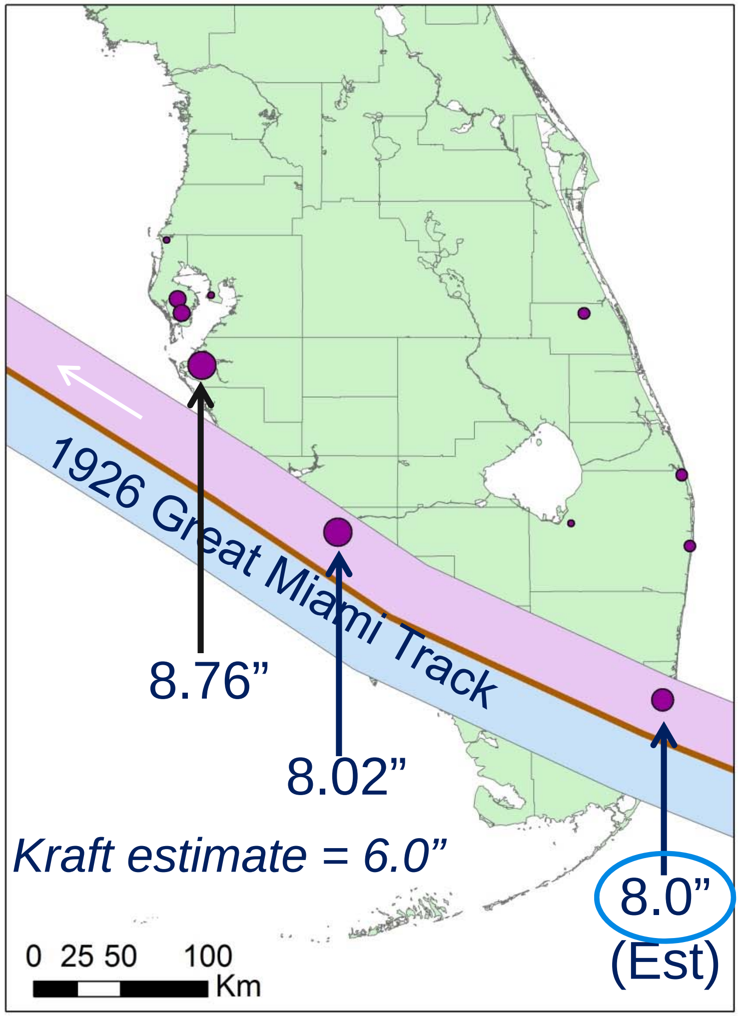
1926 G. Miami Rain Values - NHC



Contemporaneous estimate of Great Miami rainfall

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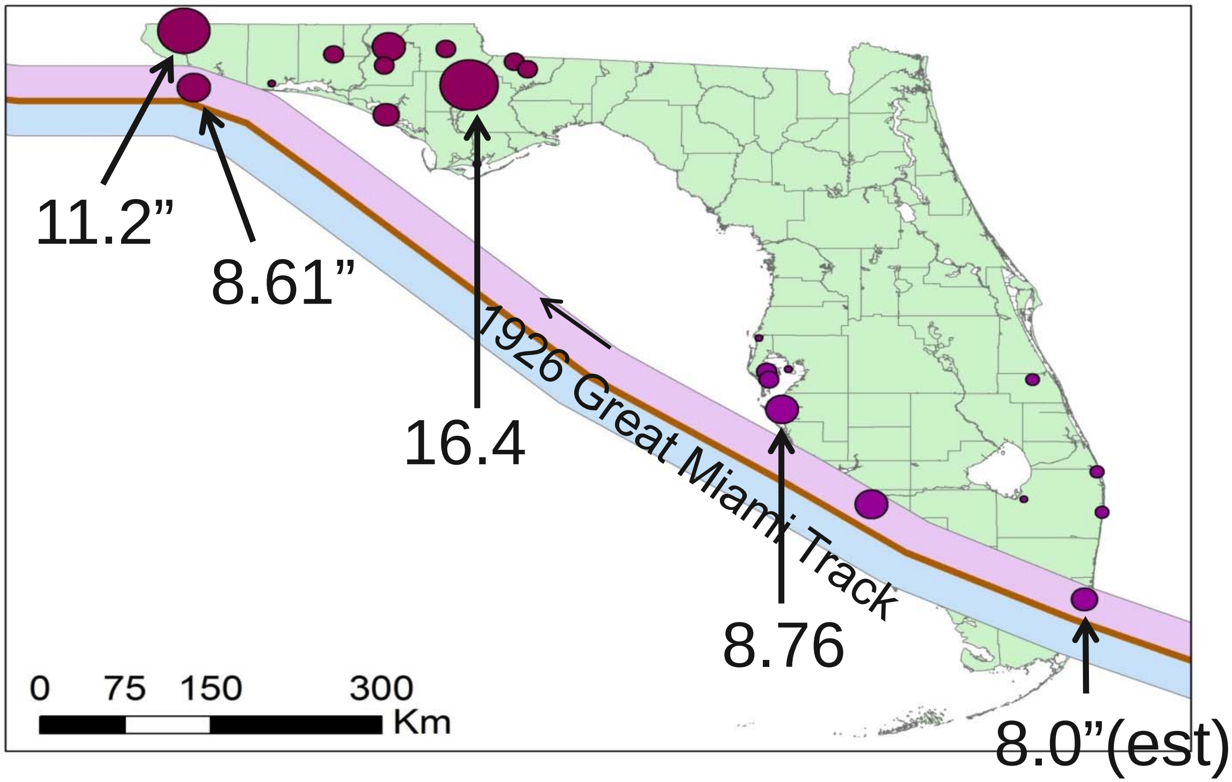
1926 Great Miami Hurricane Rain Values



1926 Rainfall Sensitivity Analysis

➢3 Possible Conditions

1. 6 inches – Our Estimate (*Kraft technique)*
2. 8 inches – 1926 Contemporary Estimate
3. 10 inches – Worst Case Estimate

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Representing Storm Surge

- What is height and duration of surge?
- How is momentum of surge best represented?

Storm Surge Height from Jarvinen (HURDAT)

- Our Estimate use 8’
- “observed high water marks at all locations, including the **7.4 foot value** that we measured at the Charles Deering location.” (HURDAT)

- Alternative estimates 15’ & 12’
  - (Wikipedia & Miami Herald)

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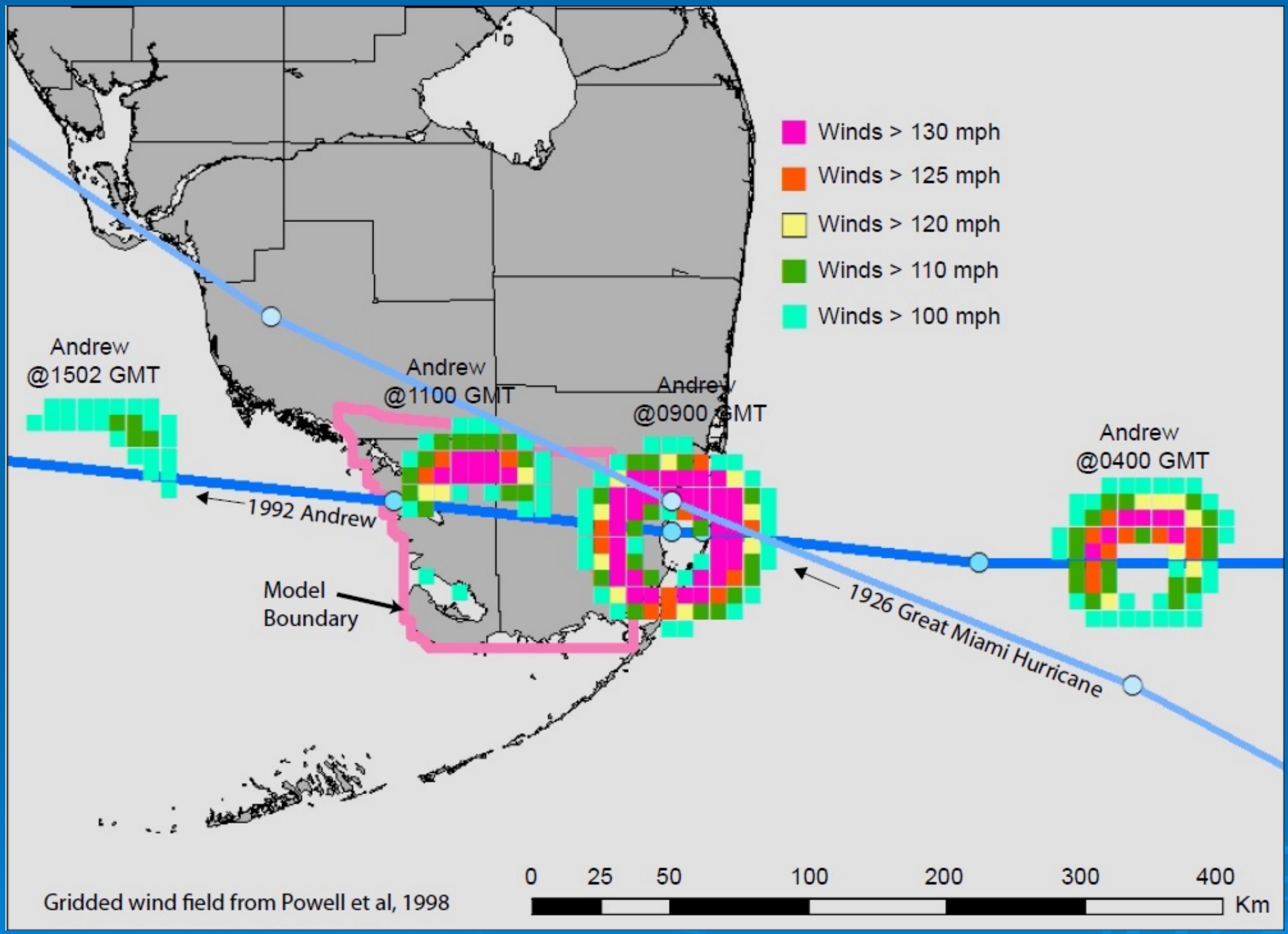
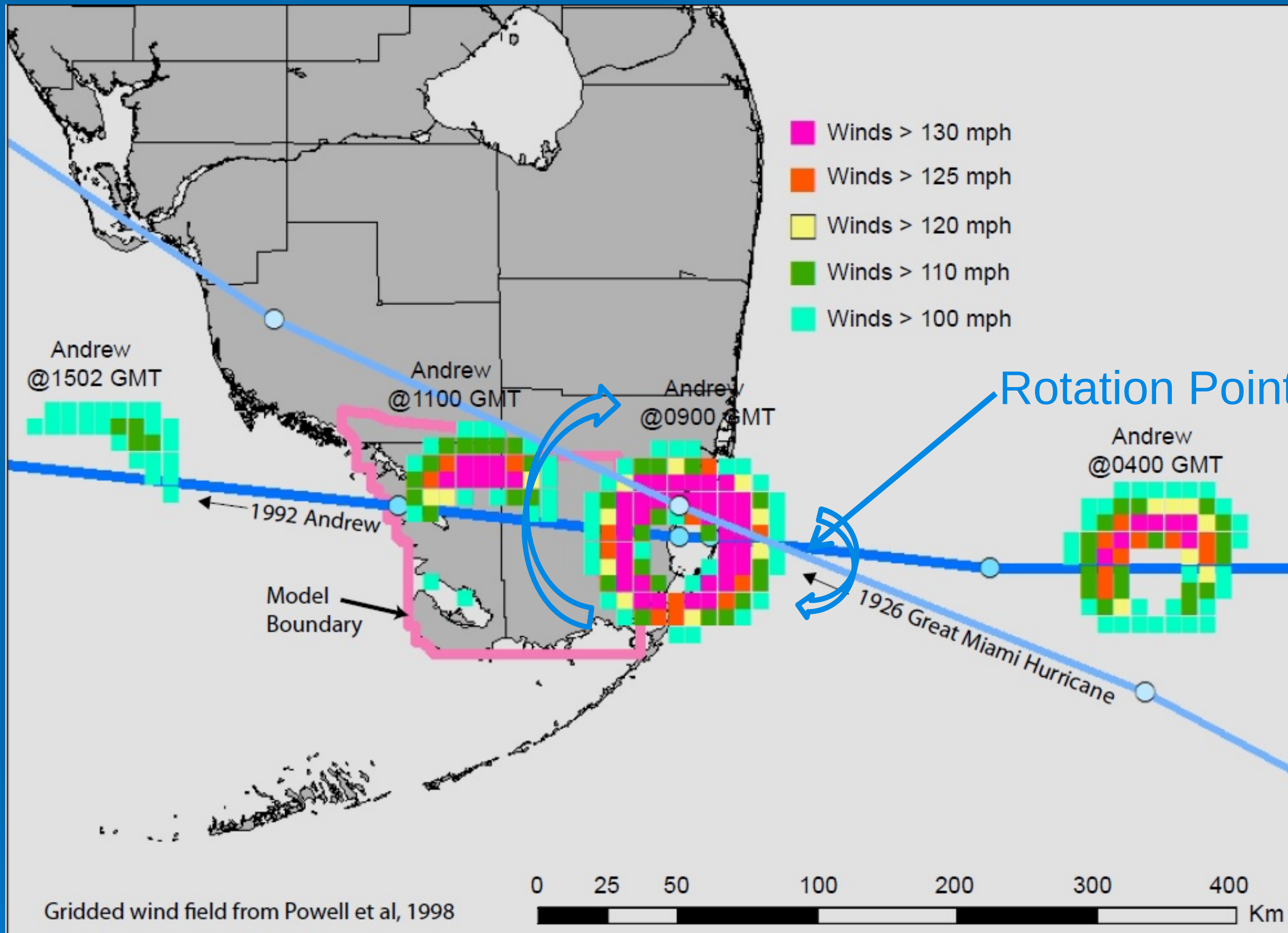
Use Andrew as a proxy for 1926 storm surge?

- No published SLOSH model exists for 1926 storm
- SLOSH data includes momentum information not in water-level data

Andrew Winds >100 mph

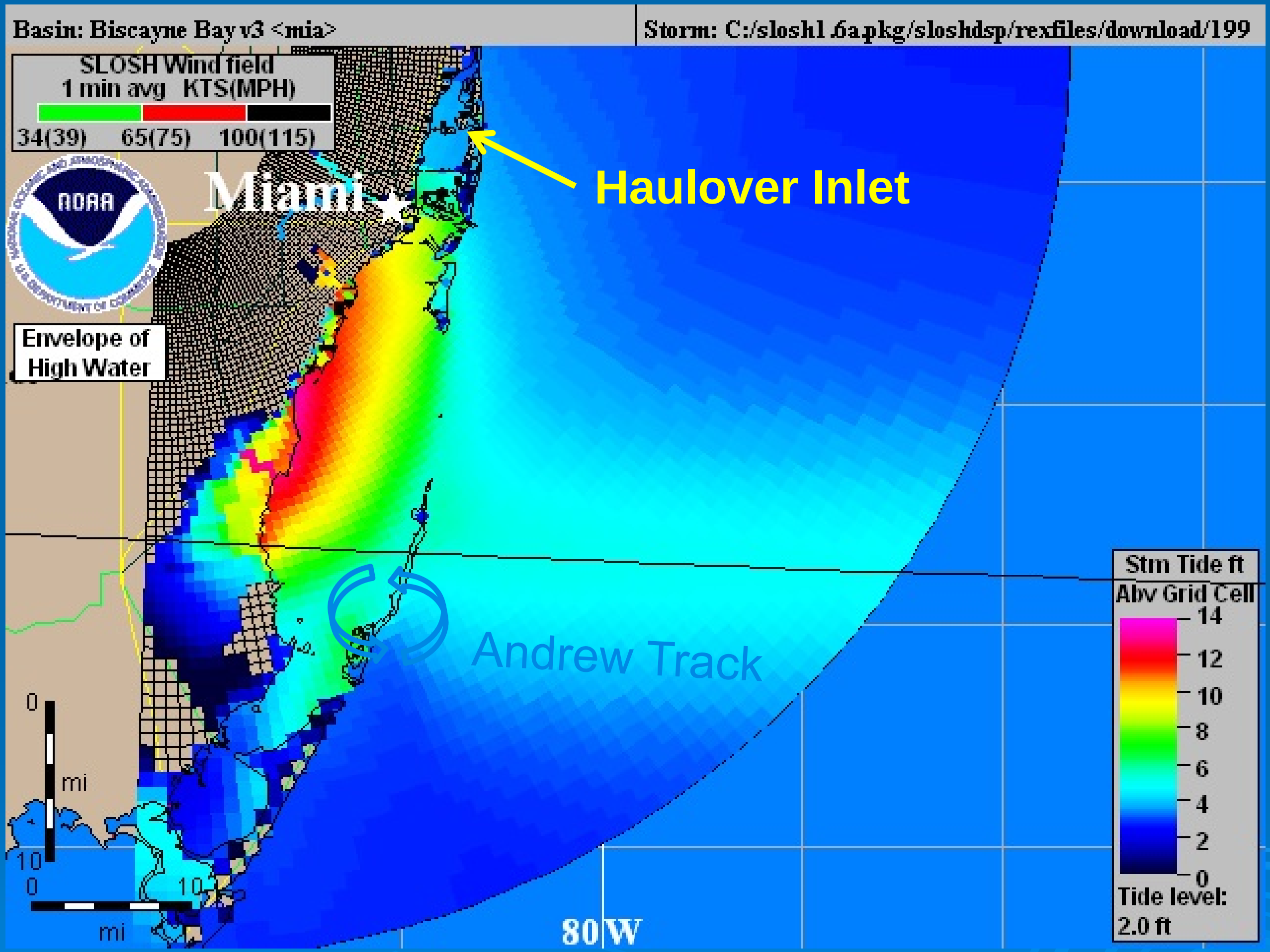


Andrew Winds >100 mph



Simulation would rotate Andrew Wind Fields to 1926 Storm Track

SLOSH Model of Andrew Surge



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ISECT Hindcast Simulations

- 1926 – 1932 Hindcast (1928 Air Photos)
- 1934 – 1940 2nd Hindcast (1940 Air Photos)
- 1996-2004 FTLOADDS Calibration Simulation

- Combine 1926 – 1940 Hindcast Simulation

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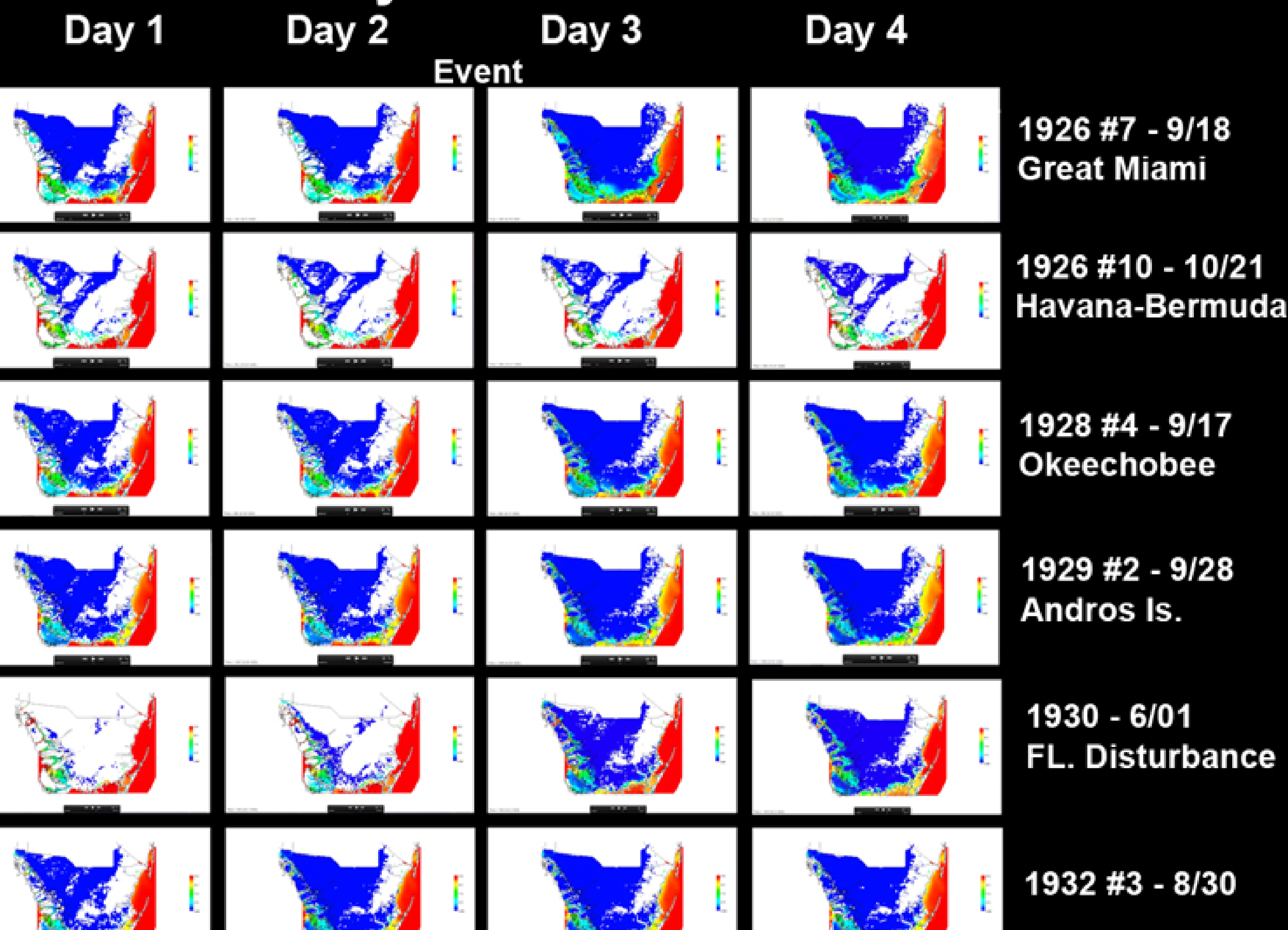
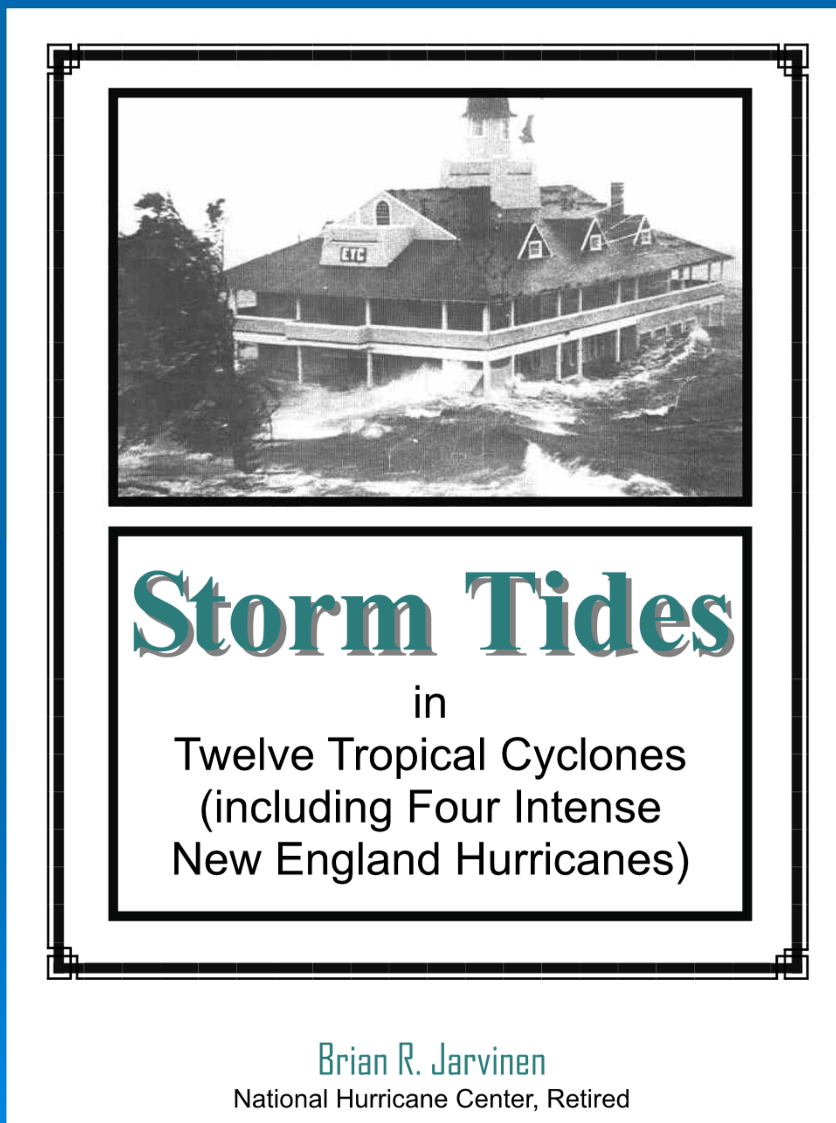
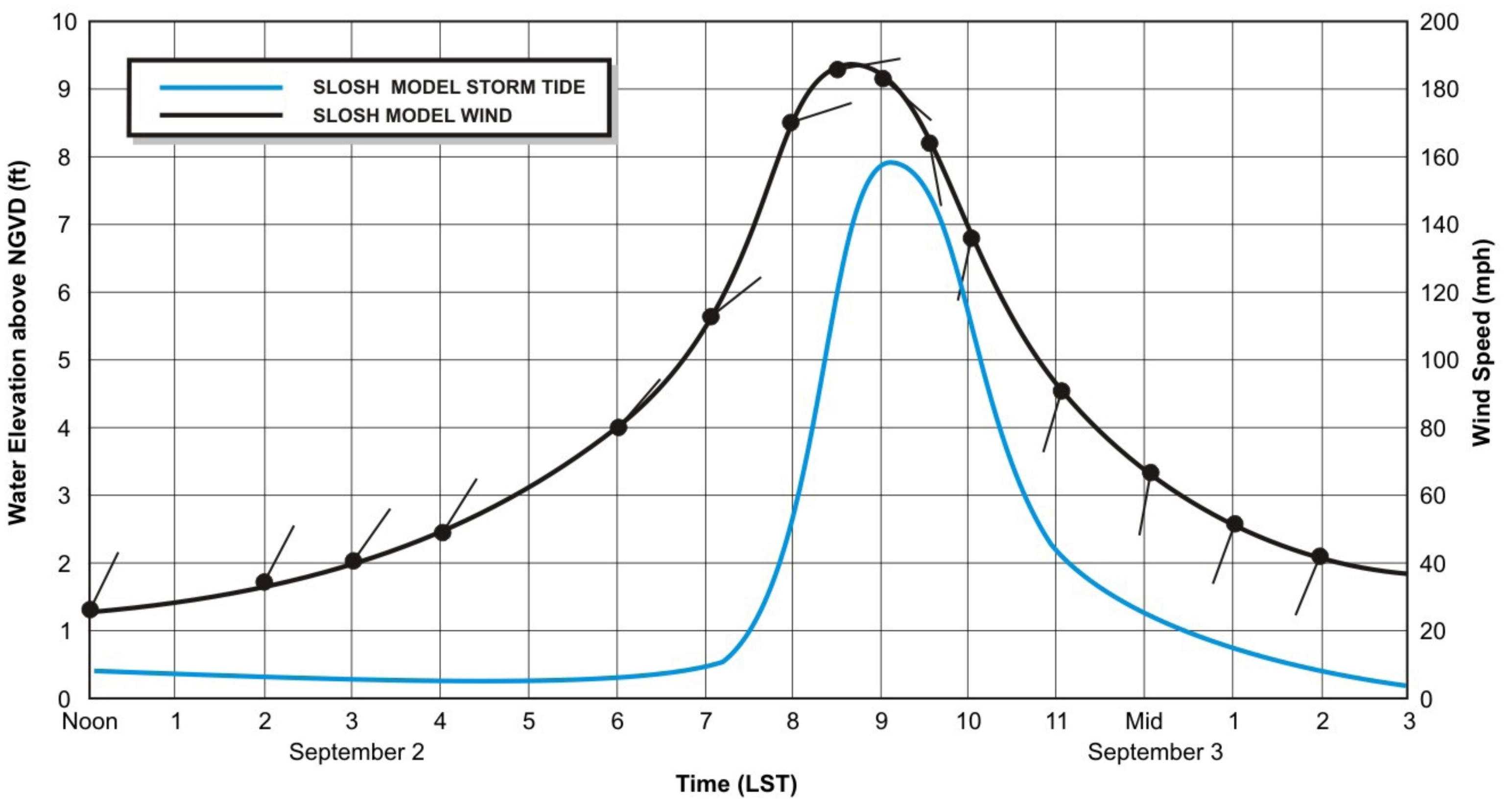
BISECT Salinity Hindcast of 1926 - 1932 Events



1935 Labor Day Storm SLOSH Model



1935 Labor Day - SLOSH Time Series



SLOSH Wind Profile and SLOSH model storm tide hydrograph in feet above NGVE for the Labor Day Hurricane near the RMW on the right side.

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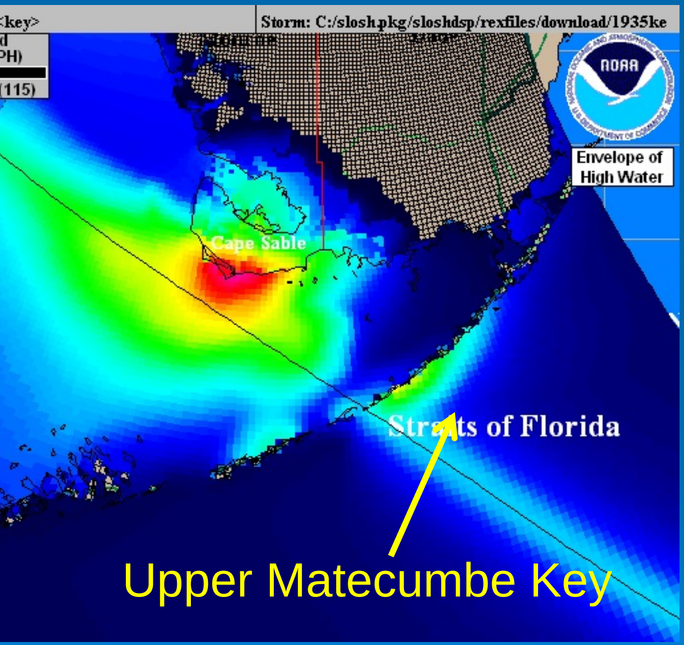
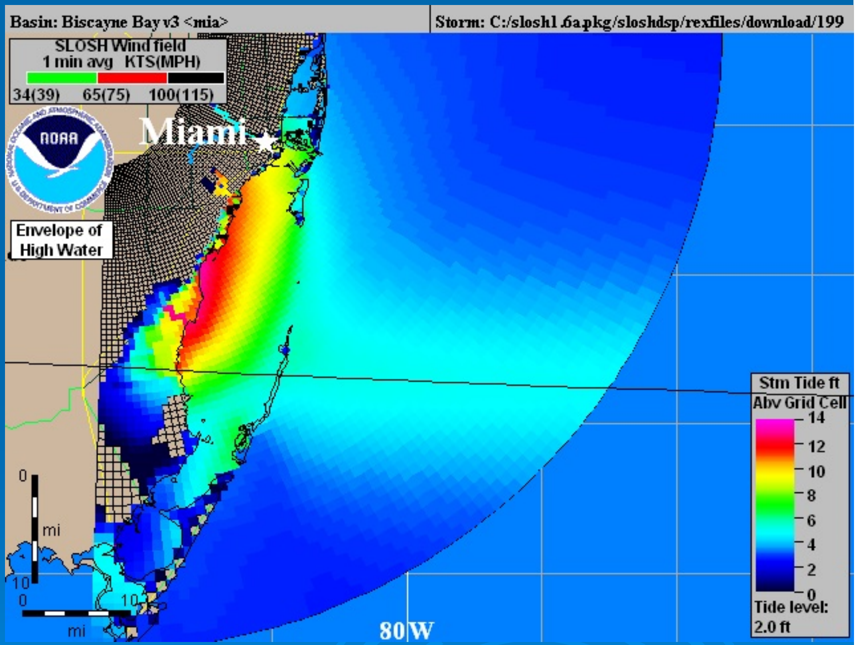
SLOSH Model Comparisons

- 1935 Labor Day SLOSH Model



- 1992 Andrew SLOSH Model



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Swain et al. Ecological Processes (2015) 4:4
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Ecological Processes
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Numerical computation of hurricane effects on historic coastal hydrology in Southern Florida

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Abstract

Introduction: Numerical models are critical for assessing the effects of sea level rise (SLR), hurricanes, and storm surge on vegetation change in the Everglades National Park. The model must be capable of representing short-timescale hydrodynamics, salinity transport, and groundwater interaction. However, there is also a strong need to adapt these numerical models to hindcast past conditions in order to examine long-term effects on the distribution of vegetation that cannot be determined using only the modern record.

Methods: Based on parameters developed for a numerical model developed for the recent 1996 to 2004 period, a hindcast model was developed to represent sea level and water management for the period of 1926 to 1932, constrained by the limited hydrology and meteorology data available from the historic past. Realistic hurricane-wind and storm surge representations, required for the hindcast model, are based on information synthesized from modern storm data. A series of simulation scenarios with various hurricane representations inserted into both hindcast and recent numerical models were used to assess the utility of the storm representation in the model and compare the two simulations.

Results: The comparison of the hindcast and recent models showed differences in the hydrology patterns that are consistent with known differences in water delivery systems and sea level rise. A 30× lower-resolution spatially variable wind grid for the hindcast produced similar results to the original high-resolution full wind grid representation of the recent simulation. Storm effects on hydrologic patterns demonstrated with the simulations show hydrologic processes that could have a long-term effect on vegetation change.

Conclusions: The hindcast simulation estimated hydrologic processes for the 1926 to 1932 period. It shows promise as a simulator in long-term ecological studies to test hypotheses based on theoretical or empirical-based studies at larger landscape scales.

Keywords: Hindcast; Numerical models; Hurricanes; Wind fields; Storm surge; Sea level rise; Coastal hydrology

Introduction

Hurricanes and cyclones are major drivers of coastal ecological processes at all levels of biological organization from populations to communities to ecosystems and operate across a hierarchy of spatial and temporal scales (Michener et al. 1997). Hurricane and cyclone effects are receiving greater emphasis and study worldwide with recent high-profile devastating landfall storms (i.e., Hurricane Katrina 2005, Superstorm Sandy 2012, Super Typhoon Haiyan 2013) but also with climate change resulting in rising sea levels and intensification of tropical cyclones (Khairoutdinov and Emanuel 2013) with unpredictable potential effects.

Extensive research in the Greater Everglades, Florida, USA (Figure 1), conducted as part of the development of a major project to restore the historical hydrology of this unique system (http://www.evergladesplan.org/) has documented the role of changing sea levels and hurricane disturbance on the formation of the Everglades (Ogden et al. 2005; Obeysekera et al. 1999; Davis et al. 2005) and enhanced understanding of many coastal ecological processes. For example, empirical field studies identified the importance of storms on ecosystem structure and function in mangrove estuaries (Davis et al. 2004), the role of mangroves as buffers to storm surge (Zhang et al. 2012),

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Questions?

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