Using Modern Hurricane Wind Data to Supplement Hydrodynamic Hindcast and Futurecast Models

M. Dennis Krohn, Eric D. Swain, Thomas J. Smith, III, & Catherine A. Langtimm

U.S. Department of the Interior
U.S. Geological Survey
Rationale For Using Hindcasts of Hydrodynamic Models

• “Predicting” past events helps validate hydrodynamic model.
• Hindcasts closer to large uncertainties inherent to futurecasts.
• Can modern wind fields supplement missing historical data?
• Help with futurecasts?
Hydrodynamic Models in S. Florida

BISCAYNE + TIME = BISECT
Hydrodynamic Model Portrays Results in Terms of Salinity and Inundation

BISECT model projection of salinity for 60 cm of Sea-Level Rise

Range 0 – 35 psu
0.5 km x 0.5 km grid cell
Historic Storm Tracks

Hurricane Database (HURDAT)
- Every 6 hours
- Wind Speed, Direction, Forward Speed, Pressure?
- Back to 1851

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Date</th>
<th>Wind Knots</th>
<th>Speed Km/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Miami</td>
<td>1926</td>
<td>9/18</td>
<td>125</td>
<td>18</td>
</tr>
<tr>
<td>Okeechobee</td>
<td>1928</td>
<td>9/17</td>
<td>115</td>
<td>14</td>
</tr>
<tr>
<td>Andros Island</td>
<td>1929</td>
<td>9/28</td>
<td>85</td>
<td>11</td>
</tr>
</tbody>
</table>

(Landsea et al, 2008; 2012)
3 Intervals Chosen for Hindcasts

- **1926 – 1932 “Far-Hindcast”**
  - Data-poor; Chosen to span 1st air photo coverage

- **1934 – 1940**
  - Chosen for air photo coverage and PEST analysis

- **1996 – 2002 “Near – Hindcast”**
  - Data-rich; Used to develop hydrodynamic model
Objective

Use wind values of modern storms as estimate for wind variability in hindcast

Hurricane Wilma
Oct. 24, 2005
11:18 GMT
Gridded Surface Wind Analysis for Hurricane Wilma

Powell et al, 1988
Why choose Gridded Surface Wind Analysis Product?

Mobile Bay

Hurricane Ivan – 9/16/2004

Mobile Bay

Track of Ivan

5 Km

Gulf of Mexico

Breached Island

Overwashed Island

Destroyed Houses

Collapsed Building

USGS
Extent of Gridded Surface Wind Analysis for Hurricane Wilma

10/24/2005
Deriving 4x4 Hindcast Grid from Wilma Gridded Wind Data

24 Gridded Surface Wind Analysis points

4 x 4 Windfield Grid to fit BISECT Model area
Comparison of 4x4 Wind Grid to Full Resolution Wind Grid

4 x 4 Wind Grid

Full Resolution Wind Grid

~33 km

~22 km

1996 - 2002 “Near-Hindcast”
Results 1926 – 1932 Hindcast

Miami Beach, 1926

www.srh.noaa.gov/mfl/?n=miami_hurricane
1928 Okeechobee Storm as seen in 1926-1932 Hindcast

Sept 17, 1928

“Δ” Inundation
Initial Hindcast
1926 Great Miami Hurricane

Sept. 17, 1926

Sept. 18, 1926

Sept. 19, 1926

Sept. 20, 1926
Measuring Storm “Δ Inundation” from 1926 – 1932 Hindcast

1926 Great Miami

1928 Okeechobee

1929 Andros Is.

1926 Great Miami

1928 Okeechobee

1929 Andros Is.

Km²

847

1788*

779

*No Input Data
Modern -> Hindcast Winds

Hurricane Wilma

1926 Hurricane Analogy

-> Transformation of Wind Fields
1926 Miami Hurricane Hindcast

9/17/1926

with hurricane spatially-uniform wind

9/18/1926

with hurricane spatially-variable wind

without hurricane wind
Predicted Long Term Hydrologic Effects from Hindcast Wind Field

Surface Water

Groundwater

Swain et al, in prep.
Summary

- 1926 – 1932 hindcast shows good relation to historical events.
- Can make estimates of missing data.
- Able to simplify modern wind data.
- Modern wind surrogates for hindcast.
- *First steps in making futurecasts...*