Canes on Canes:
Keeping South Florida Prepared During the Calm Before the Storm

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Outline

• The Science of Hurricanes
• Why and When South Floridians Must Be Weather-Ready
• Understanding the Uncertainty in Hurricane Forecasts
• Hurricane Hazards in a Changing Climate
The Science of Hurricanes
Tropical Cyclone Tracks

Cyclones

Typhoons

Hurricanes

Cyclones
Typical eye is ~20 miles wide

* The center can have an **eye**, characterized by calm winds and sometimes clear skies.
* The eye is then surrounded by an abrupt wall of intense thunderstorms and an area typically with the strongest winds: the **eyewall**.
* Outside of the eyewall, there are typically spiral **rainbands**... these can also be quite strong and contain damaging winds, heavy rain, and even tornadoes.
# The Saffir-Simpson Intensity Scale

<table>
<thead>
<tr>
<th>Category</th>
<th>Maximum Sustained Winds</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical Depression</td>
<td>&lt; 40 mph</td>
<td>Tie down your trash can and outdoor furniture.</td>
</tr>
<tr>
<td>Tropical Storm</td>
<td>40-73 mph</td>
<td><strong>Dangerous winds</strong>: Tree branches and loose objects can cause isolated damage to houses and people.</td>
</tr>
<tr>
<td>Category 1 Hurricane</td>
<td>74-95 mph</td>
<td><strong>Very dangerous winds will produce some damage</strong>: Roof damage, large tree branches, many power lines down leading to power outages.</td>
</tr>
<tr>
<td>Category 2 Hurricane</td>
<td>96-110 mph</td>
<td><strong>Extremely dangerous winds will cause extensive damage</strong>: Roof and siding damage, some trees uprooted. Extended power loss and road blockages likely.</td>
</tr>
<tr>
<td>Category 3 Hurricane</td>
<td>111-130 mph</td>
<td><strong>Devastating damage will occur</strong>: Significant home damage, road blockage, extended electricity AND water outages.</td>
</tr>
<tr>
<td>Category 4 Hurricane</td>
<td>131-155 mph</td>
<td><strong>Catastrophic damage will occur</strong>: Major home damage or destruction, road blockages, power and water outages could last up to months.</td>
</tr>
<tr>
<td>Category 5 Hurricane</td>
<td>&gt; 155 mph</td>
<td><strong>Catastrophic damage will occur</strong>: Most homes/trees/etc. destroyed. Affected area uninhabitable for weeks or months.</td>
</tr>
</tbody>
</table>
Classic Lifecycle: Disturbance - Category 5

Day 0, Disturbance
Day 1, 35mph Depression | Day 2, 46mph Tropical Storm
Day 3, 63mph Tropical Storm | Day 4, 92mph Hurricane | Day 5, 127mph Hurricane
Day 6, 150mph Hurricane | Day 7, 144mph Hurricane | Day 8, 155mph Hurricane
Does Size Matter?

• **Yes**, the bigger a storm is, the more area it will affect with rain, wind, and storm surge, but...
• A larger storm is not necessarily a stronger storm and vice versa.
Why and When South Floridians Must Be Weather-Ready
When is it Time to Tune in?

Atlantic Tropical Cyclone Climatology (1851-2013)

- Tropical Storms
- Hurricanes
- Major Hurricanes

Daily Average Number of Active Storms

- Sep 8
- Sep 9
- Sep 10
With Great Weather Comes Great Responsibility?

Hurricanes affecting South Florida since 1851
58 (31 major) Hurricanes Passed Through South Florida from 1851-Present
It’s not “IF”, It’s “When”

- South Florida is one of the most frequently hit sections of the entire US coastline
- Average of one hurricane per 3 years and one major hurricane every 5.2 years
Our Hurricane Drought

Miami-Dade County Population and Hurricane Strikes

("strike" counted when any location in county experiences >64kt sustained wind)

- 50 years
- 17 hurricanes (11 Cat3+)
- 50 years
- 4 hurricanes (1 Cat3+)

Number of "Strikes"

Year

Population (1000s)
The Uncertainty of Forecasting Hurricanes

This "Cone of Uncertainty" thing is like some kind of bad broken record!
1) Taking Measurements
Variety of instruments define initial conditions (starting point for forecasts)

2) Model Predictions
Weather models on the world’s fastest super computers predict the future state of the weather based on current information and approximate equations
3) “Ensemble” of Forecasts
Different equations, initial conditions, and modelling techniques lead to a variety of predictions.

4) The Official Forecast
Forecasters at the National Hurricane Center examine computer model forecasts and issue the official forecast based on what they deem as the most likely scenario.
What is the Cone?

- The “forecast cone” or “cone of uncertainty” predicts the path of the storm center.
- The cone is designed so there’s a 2/3 chance the storm center will remain inside of it.
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- It is not an impacts cone!
What is the Cone?

- The “forecast cone” or “cone of uncertainty” predicts the path of the storm **center**.
- The cone is designed so there’s a 2/3 chance the storm center will remain inside of it.
- The same size cone is used all season long for all storms, but uncertainty changes for each storm.

“smaller error = narrower cone”
Hurricane Hazards and Climate Change

- Storm Surge
- Wind
- Rain
- Tornadoes
- Waves/Rip Currents
Storm Surge: Needs More Attention

• The #1 cause of deaths in hurricanes
• Storm surge is produced by water being pushed toward the shore by the storm winds
• Low pressure of hurricane has little impact on surge in comparison to the wind
A Long-Distance Relationship

Hurricane Ike (2008) Wind, Position and Storm Surge/Storm Tide Data

Hourly storm position and intensity
+ Tropical Storm
+ Category-1 Hurricane
+ Category-2 Hurricane
+ Category-3 Hurricane
+ Category-4 Hurricane
+ Category-5 Hurricane

Observed High Water Marks
Surge
- < 4 feet
- 4-8 feet
- 8-12 feet
- 12-16 feet
- > 16 feet

Storm Tide
- < 4 feet
- 4-8 feet
- 8-12 feet
- 12-16 feet
- > 16 feet

Storm position and intensity data provided by Elsner and Jagger at Florida State Univ
Storm surge data provided by SCIPP/SURGEDAT
Could we see this type of flooding in South Florida?

Hurricane Katrina (2005): New Orleans
Hurricane Andrew’s Storm Surge (1992)  

Hurricane Wilma’s Storm Surge (2005)  

Up to 13 feet

 Courtesy of Dr. Brian Soden, University of Miami Rosenstiel School of Marine and Atmospheric Science
So... Know Your Zone
Lessons Learned

• Hurricanes and tropical storms are expansive low-pressure systems defined in the media only by their fastest observed wind speed.

• August through October is the peak of hurricane season for the U.S. but September and October are South Florida’s busiest months.

• The “cone of uncertainty” shows where the center of the storm will go 2/3 of the time, but the storm’s impacts can extend far beyond the cone (even if the track forecast is correct).

• Tropical cyclones have a variety of hazards, but storm surge is responsible for the most damage and deaths.
Thank You!
Mèsi!

The “Canes on Canes” team from University of Miami Rosenstiel School, from left: Brian McNoldy, Falko Judt, Kieran Bhatia, Jason Godwin and Matt Onderlinde.
(Not pictured: Pete Finocchio, Marybeth Arcodia)