Hurricanes: Now and in the future

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FMSEA
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63 (31 major) Hurricanes Passed Through South Florida from 1851-Present

South FL peak season = October
Hurricane Season

Atlantic Tropical Cyclone Climatology (1851-2015)

- Tropical Storms
- Hurricanes
- Major Hurricanes

Daily Average Number of Active Storms


YOU ARE HERE
Does size matter?

However, Hurricane Andrew was a small storm but was devastating for Miami-Dade.
Hurricane Recipe

Low Vertical Wind Shear → Moist Atmosphere → Deep Layer of Warm Ocean
Hurricanes & climate change

"Alright, Alright, Alright"

HURRICANE MATTHEW

105 mph SAT Early AM

120 mph FRI Early AM

125 mph THU Early AM

130 mph WED Early AM

JAMAICA HAITI

4-Oct-16 11:15 EDT
The future of hurricanes

What does a climate modeler look at?

Observations of the past 150 years of climate

+ Equations for dayyyyyyyys
  (The Navier-Stokes equations – similar to those used for weather forecasting)

↓

Projections of future climate

Question: How does this relate to hurricanes?
The future of hurricanes

Hurricanes strongly depend on both the ocean and atmosphere

Both the ocean and atmosphere will get warmer, but the spatial differences in temperature may change

Temperature distribution is very important

Let’s consider the ocean and atmosphere separately to understand why
The atmosphere

Outflowing air (colder)

Inflowing air (warmer)

Benger et al. (2006): Hurricane Katrina
The atmosphere

Options

Whole atmosphere warms

Upper atmosphere relatively cooler

**Better – temperature difference between upper and lower atmosphere doesn’t change**

**Bad because it promotes convection/disturbance development**
Atlantic SSTs will **definitely warm** due to climate change

**Question:** Does this mean more intense tropical cyclones?

**Answer:**

**Better Answer:**

There are two possibilities:

A. Warmer Atlantic = more intense hurricanes

B. Warmer Atlantic but it warms at the same rate as the rest of the tropics

*No relative difference = no hurricane activity change (Vecchi et al., 2008)*
Options A and B

Option A

Atlantic is warmer
→ hurricanes more intense

Option B

Atlantic is warmer but temperature relative to the rest of the tropics same as today
→ No change in intensity

(Vecchi et al., 2008)
Could it be both?

Projected Changes in Atlantic Hurricane Frequency over 21st Century

- Trop. Storm+ Cat. 1 Hurr.
- Cat. 2+3 Hurricane
- Cat. 4+5 Hurricane

Bender et al. (2010)
If Hurricane Andrew (1992) happened again, but with a higher sea level, what would we expect?

SLOSH storm surge prediction

In 1992 Andrew had up to 17 feet of storm surge:
SL + 1 foot: more of Miami-Dade would be flooded by 17 ft storm surge
SL + 2 feet: storm surge would be up to 18 feet
SL + 3 feet: storm surge would be up to 20 feet

Courtesy of Brian Soden
Conclusions

• We don't know if hurricanes will become more intense in the future.
• It's very likely that they will frequently be stronger.
• Combined with SL rise this could be devastating for the USA.