

Hurricanes, Sea Level Rise, and South Florida's Challenging Future

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The Washington Post

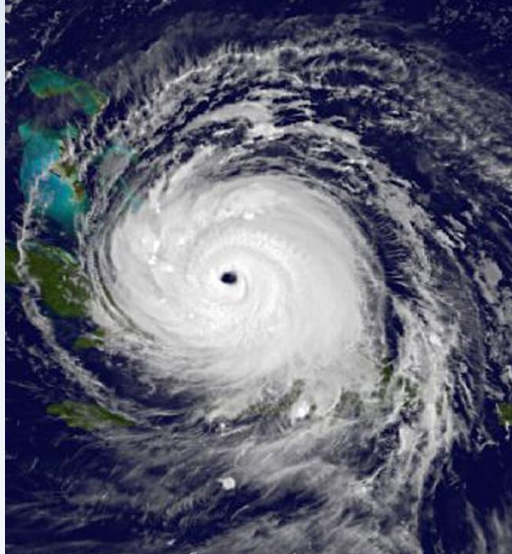


The Big Picture

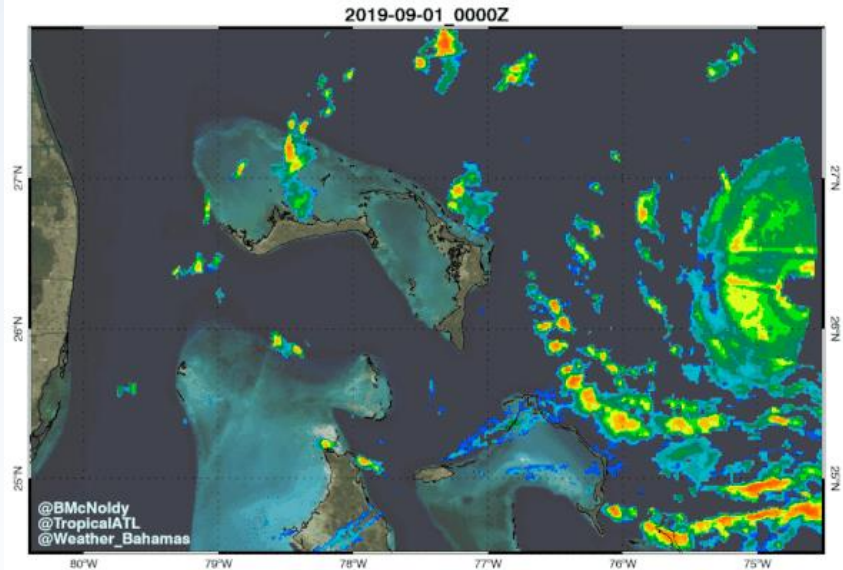
- Hurricanes have been a *significant threat* to life and property in South Florida since its settlement
- Sea level rise is perceived as a nuisance now, but it is a *slow-motion crisis*
- Climate change *will* increase the impacts of both threats
- Time to move beyond the “*if/when*” to “*now what?*”

What is a Hurricane?

- Large, strong low pressure system found over warm tropical oceans
- Winds near the center must be sustained at over 74 mph
- Organized with a central calm **eye**, a ring of intense thunderstorms with the strongest winds called the **eyewall**, then numerous **rainbands** that also include intense thunderstorms with heavy rain and violent wind
- Hurricane hazards include **wind, rain, storm surge, and tornadoes...** and these extend hundreds of miles from the storm's center

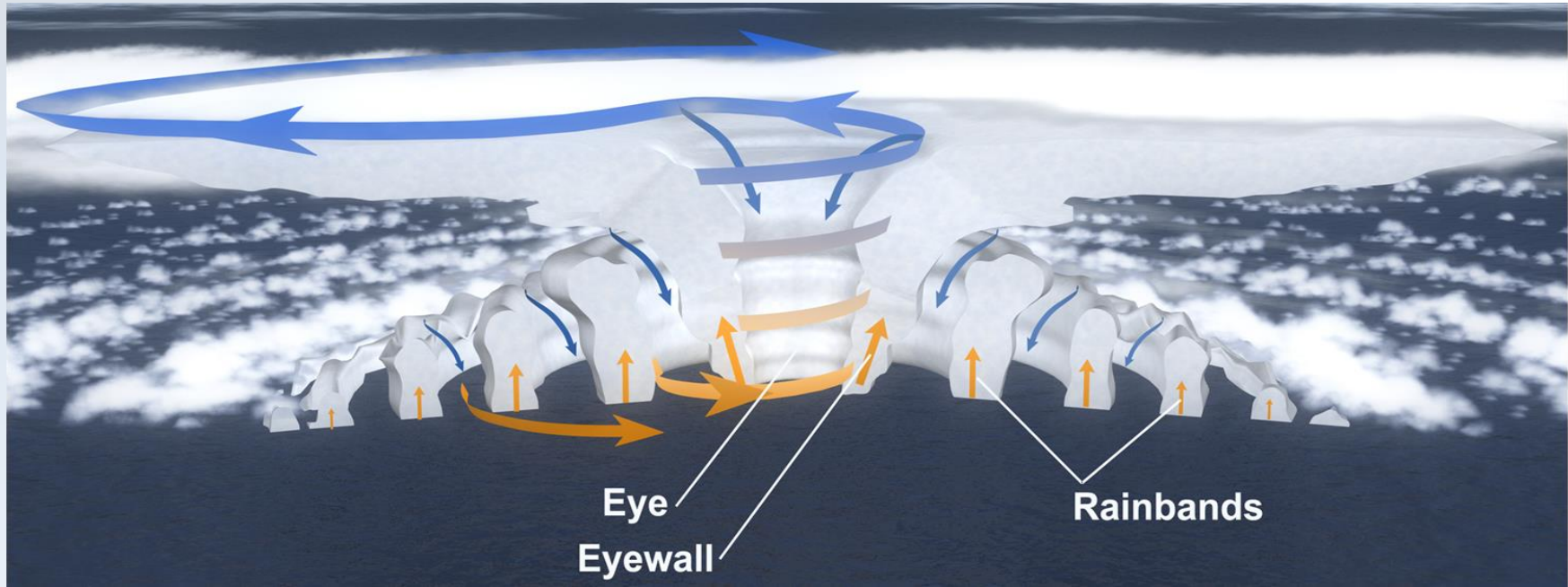


Satellite image of Hurricane Irma (2017)



Radar loop of Hurricane Dorian (2019)

What is a Hurricane?



Eye
Eyewall

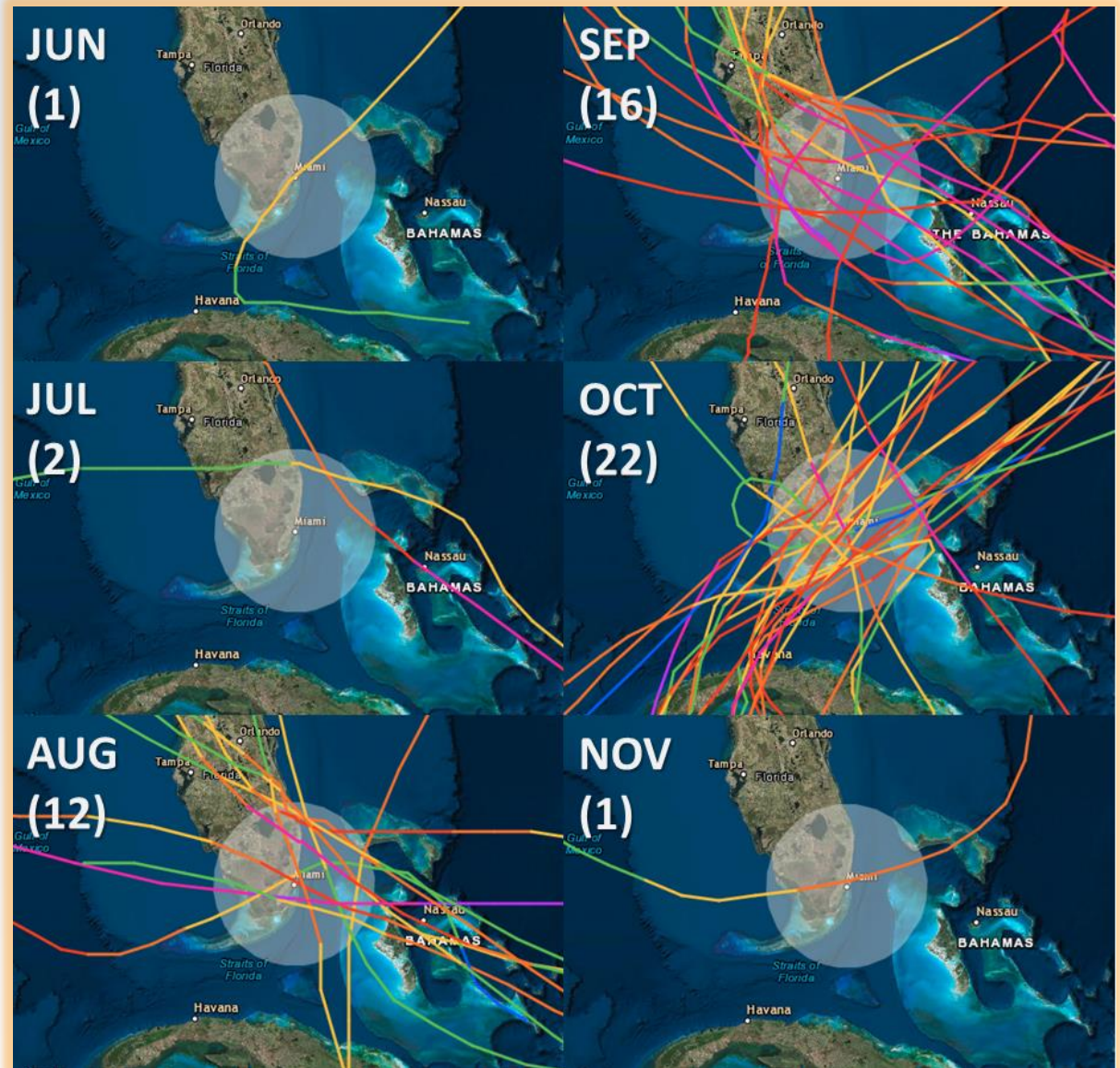
Rainbands

Typical eye diameter ~20 miles

Typical hurricane diameter ~300-400 miles

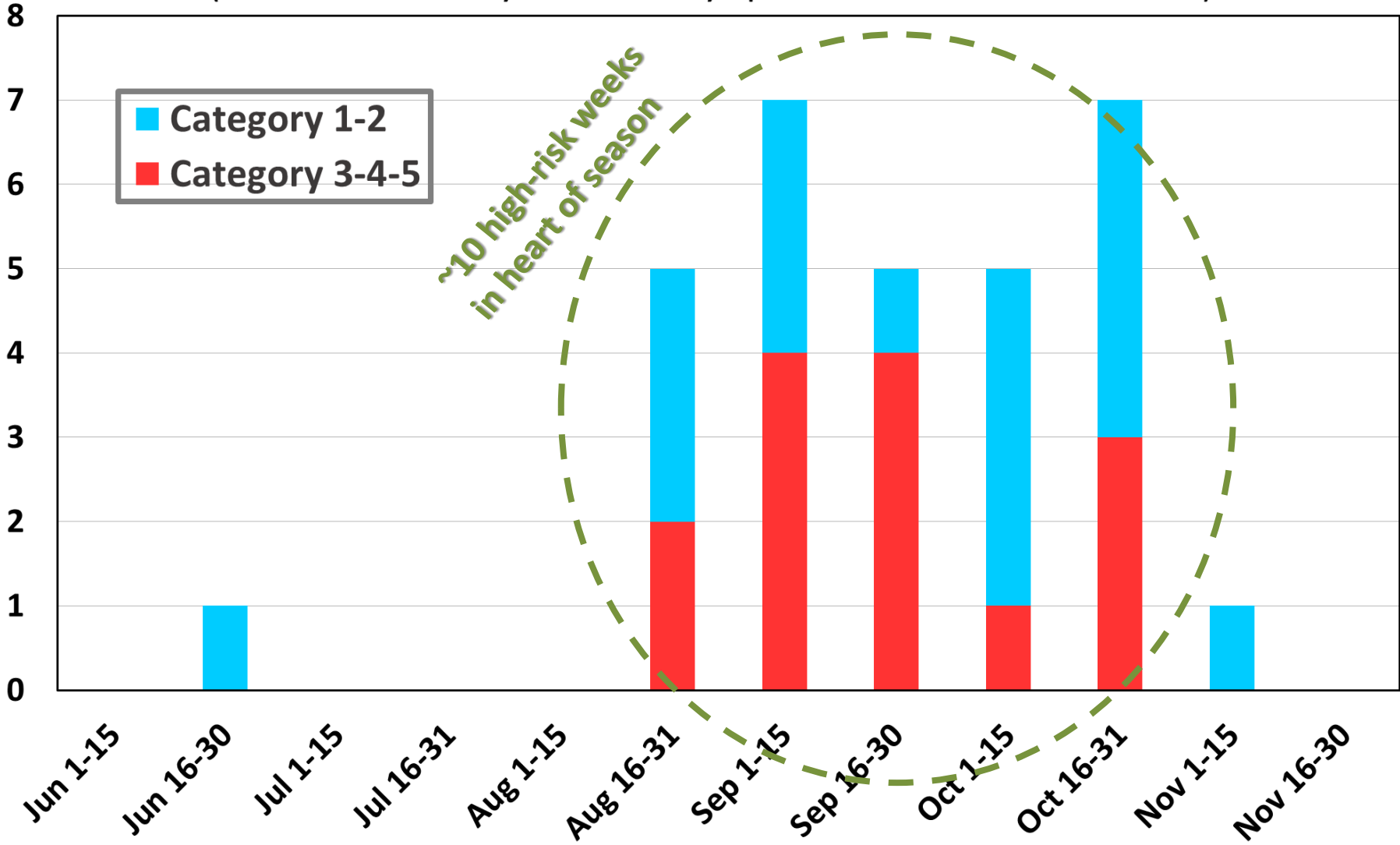
South Florida Hurricane Climatology

- Hurricanes that passed within 100 miles of Miami from 1851-2019 for each month of hurricane season
- Primary direction of approach varies with season
- October is historically the peak month for action here



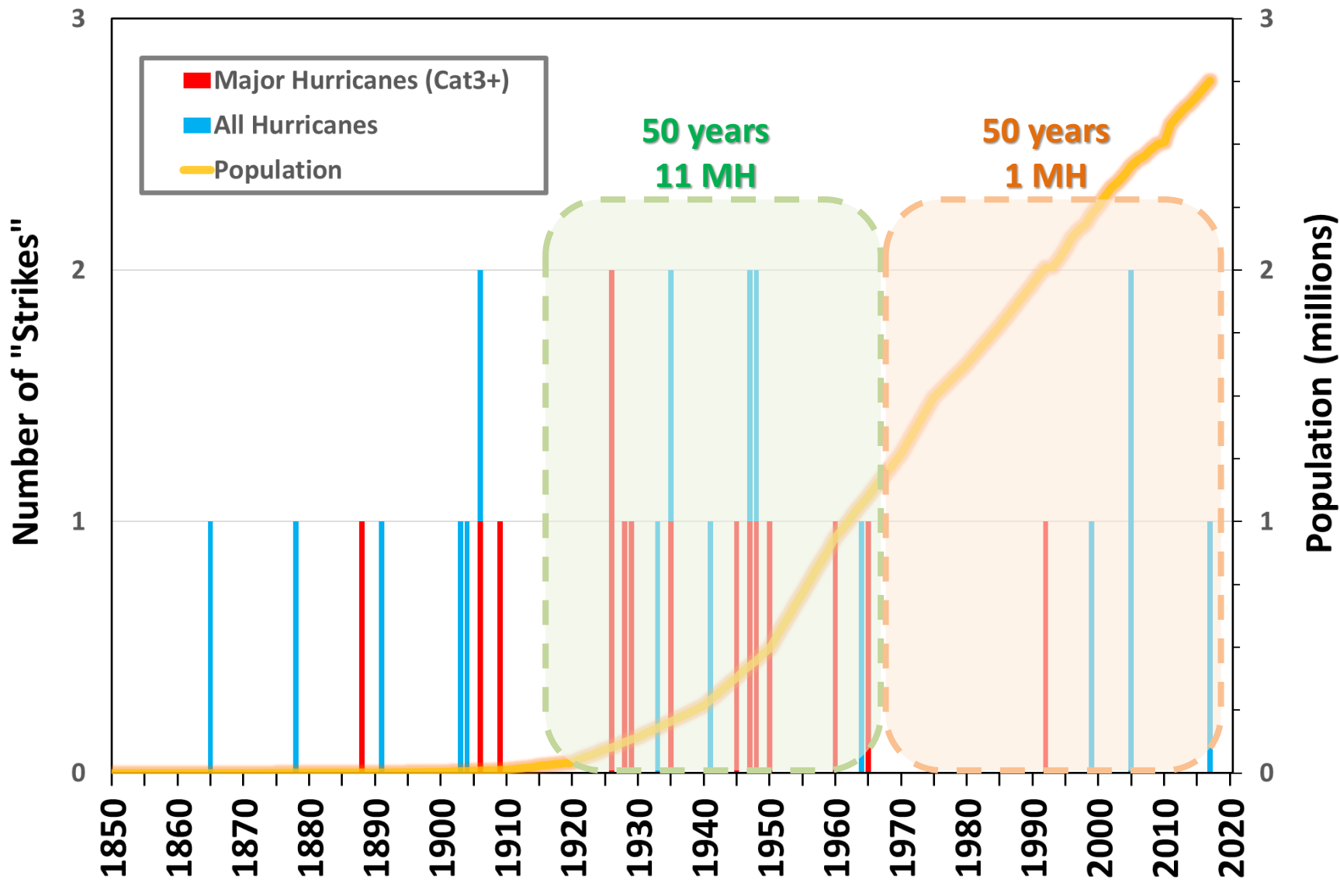
Miami-Dade County Hurricane Strikes (1851-2019)

("strike" counted when any location in county experiences sustained hurricane-force wind)



Miami-Dade County Hurricane Strikes and Population

("strike" counted when any location in county experiences sustained hurricane-force wind)



The Future of Hurricanes

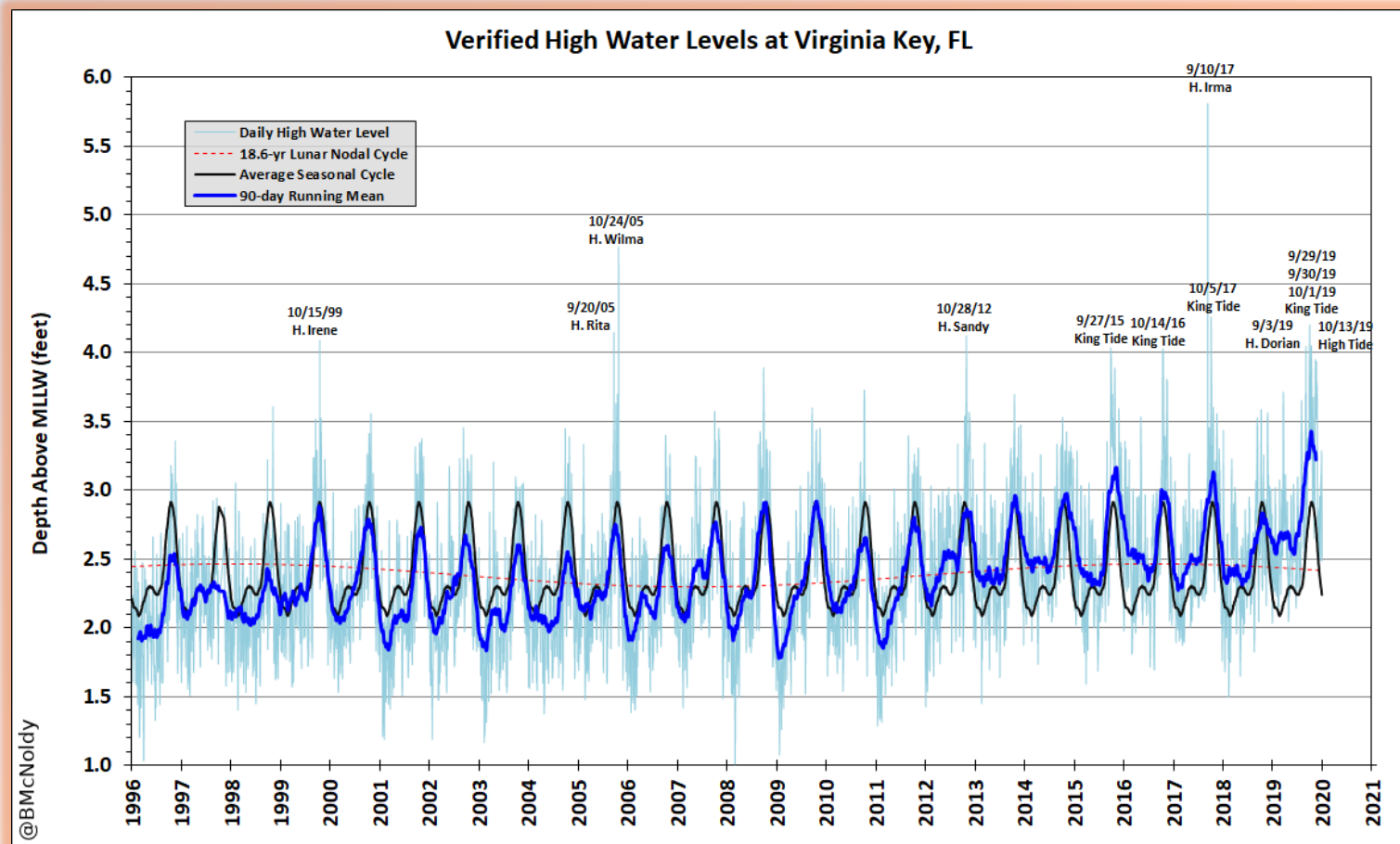
- No distinguishable trend of increasing **frequency**
- Some signal of increasing **intensity** on climate scales
- Some signal of increasing **rainfall** on climate scales
- No individual hurricane (or any weather event) is caused by **climate change**
- Even if hurricane activity remains constant, the **impact continues to grow** as population and infrastructure grows – WE'RE PUTTING MORE STUFF IN HARM'S WAY, ON PURPOSE!

Sea Level Rise

- Globally, sea level rise is driven by ice melt and thermal expansion of the ocean (roughly equal contributions)
- Locally, water level is altered by the Gulf Stream transport among many other things
- Prediction of these factors decades into the future comes with A LOT of uncertainty

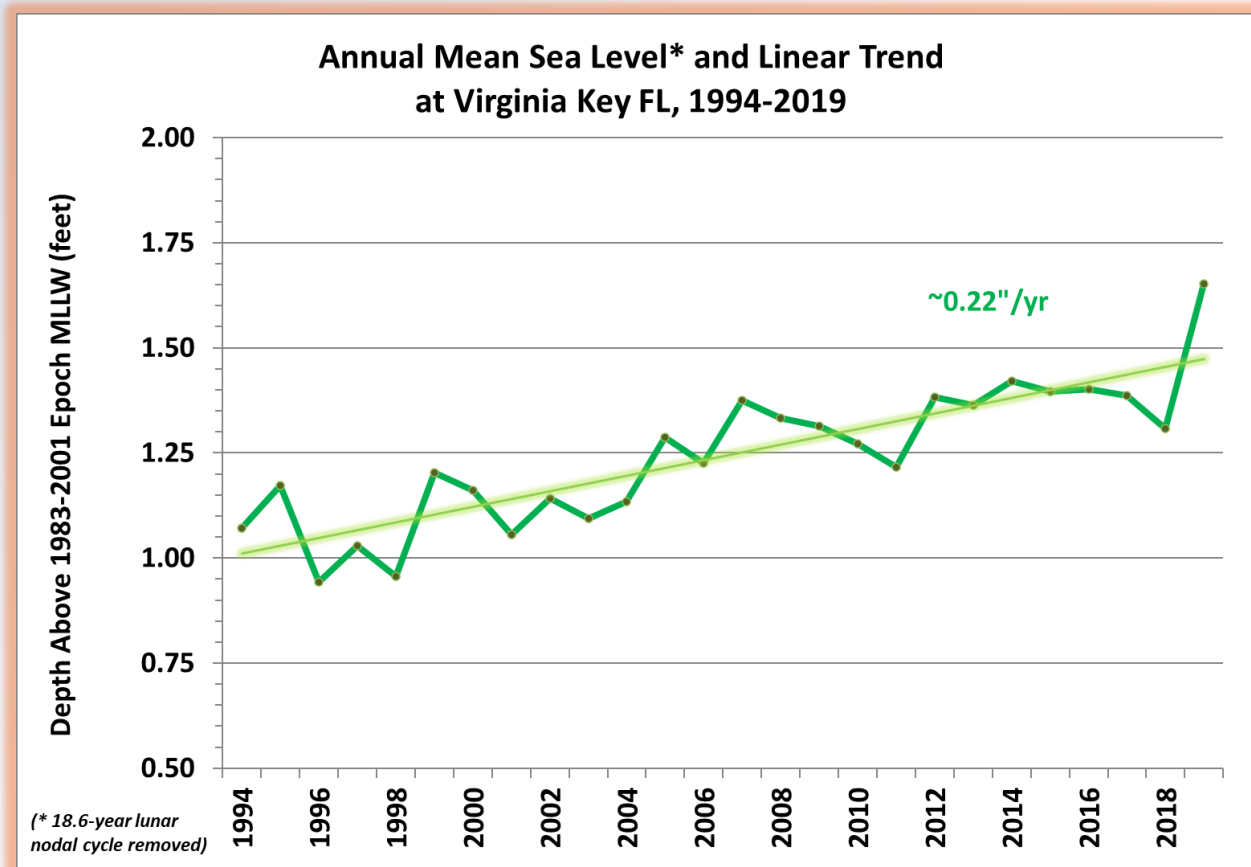
Sea Level Rise Observations

- Highest water levels used to be associated only with hurricanes... King Tides can be comparable now!



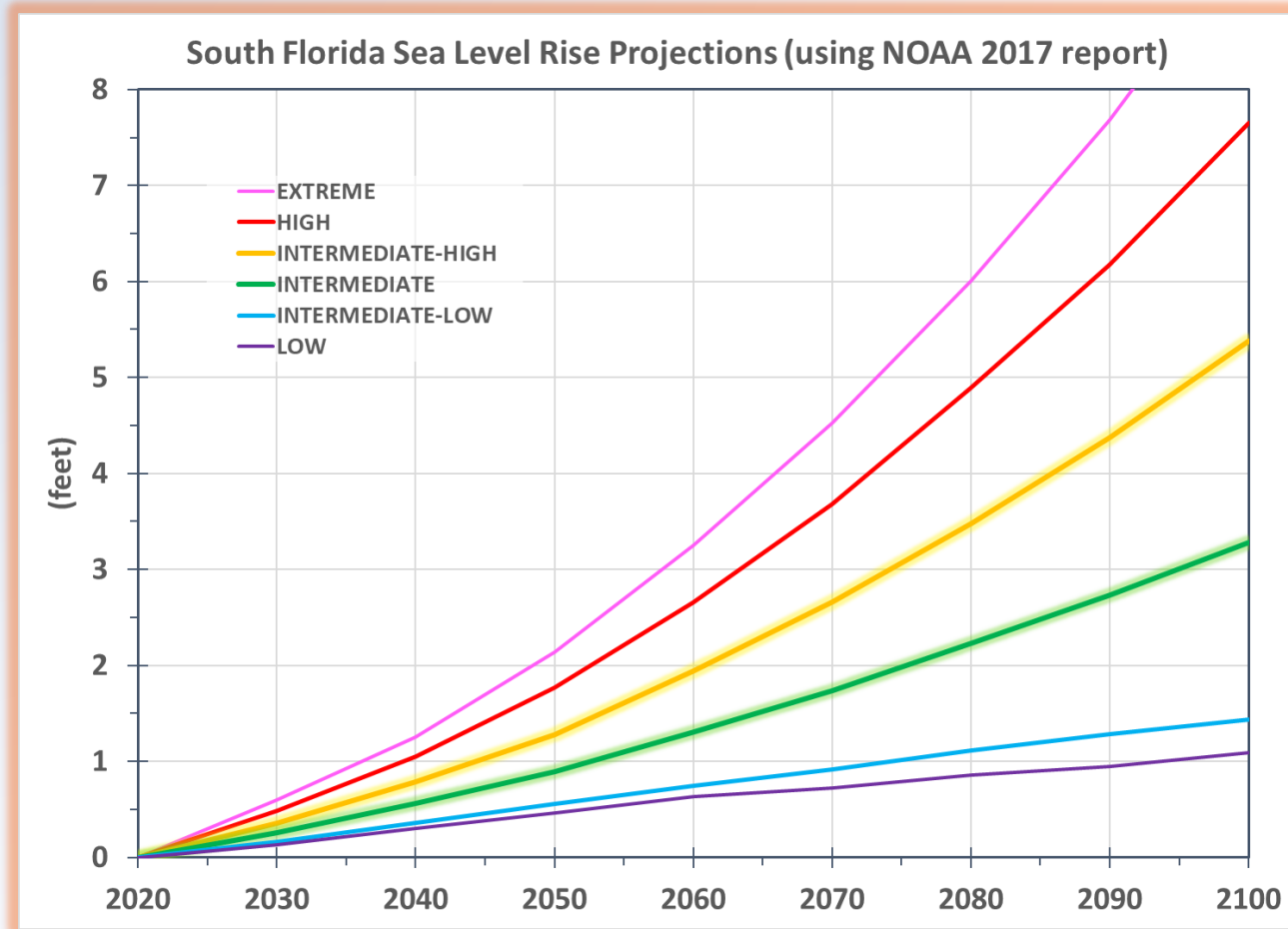
Local Trends in Sea Level Rise

- There is interannual variability, but the upward trend is undisputable.
- Sea level has risen about 5.5 inches in past 25 years here



Projections for the Coming Decades

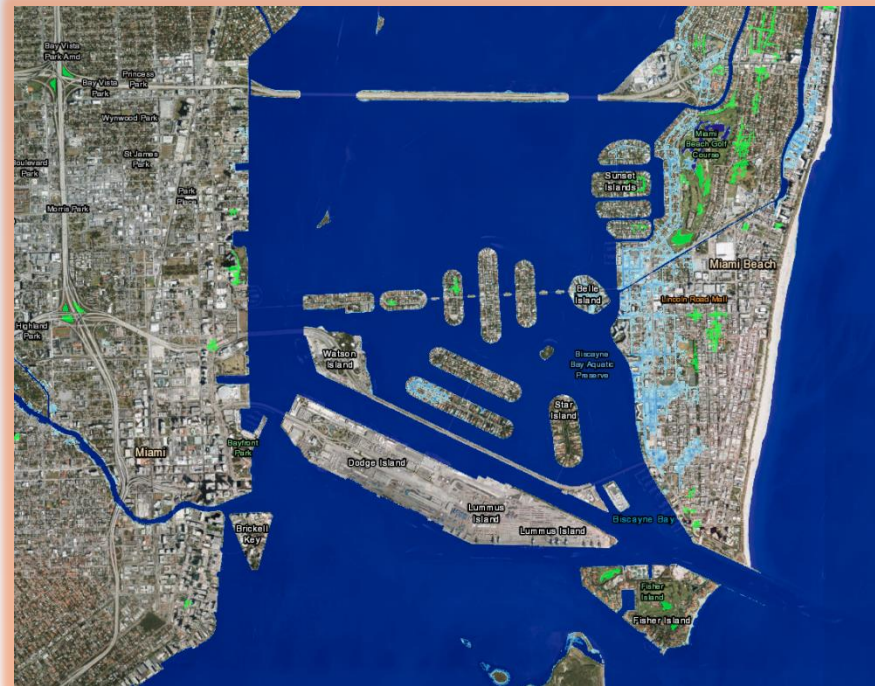
- Uncertainty increases with time... lots of unknowns, but all projections show an *acceleration* of SLR (not a constant rate)



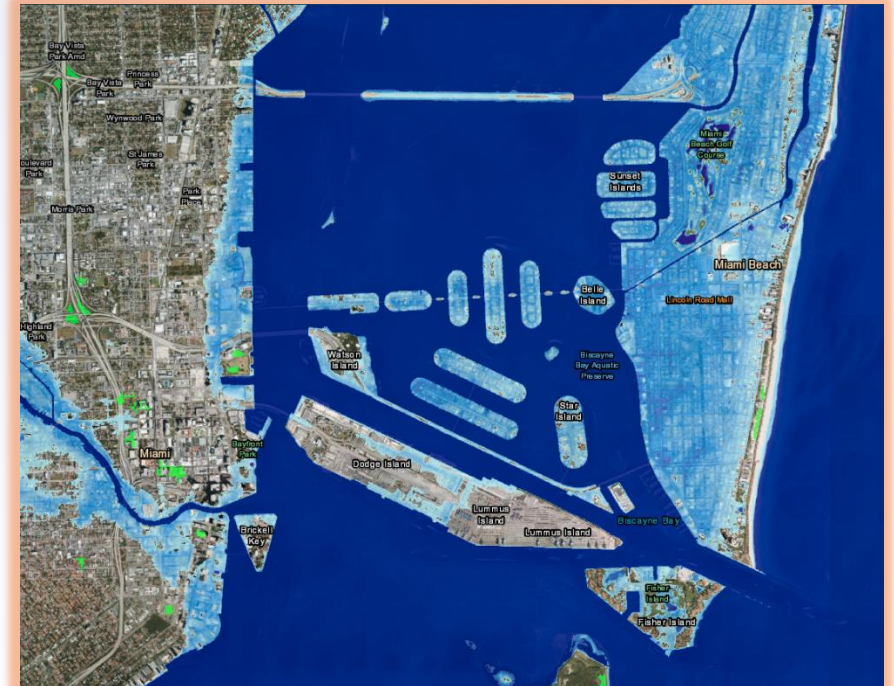
High Tides Now and in 2100

- King Tide “nuisance flooding” only affects a few areas during a few days each year now.
 - It *will* get worse, so start adapting now!

Highest tides now...
(during King Tide season)

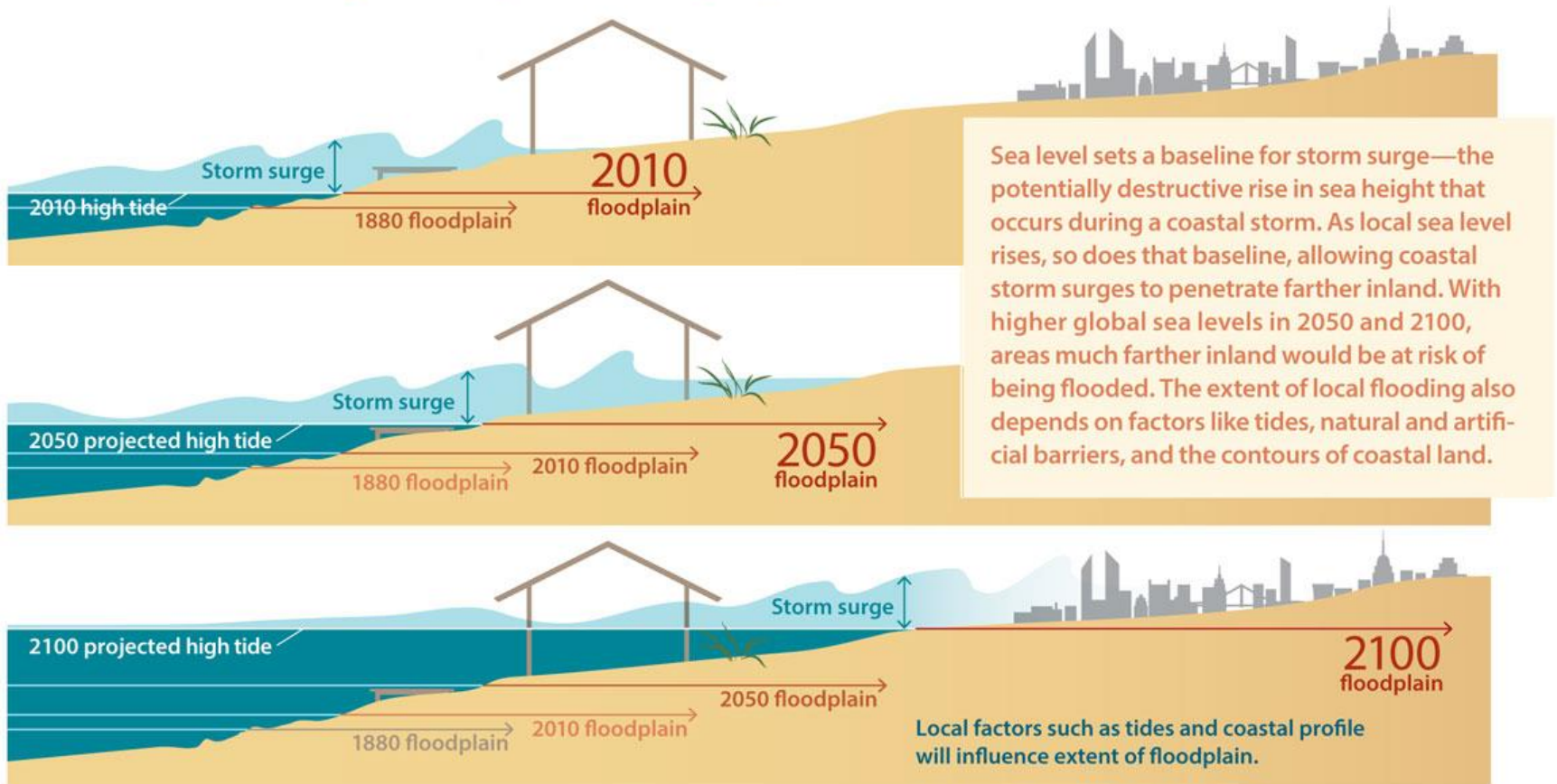


Highest tides in 2100!
(assuming ~4 feet of SLR)



Bad Mix: Hurricanes & SLR

Storm Surge and High Tides Magnify the Risks of Local Sea Level Rise



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Summary

- Hurricanes are not going away
 - They are trending toward becoming stronger & wetter
- Sea level rise is not going away
 - It is trending upward at an increasing rate
- Flooding due to storm surge, rainfall, and high tides (and their combinations) will become more frequent and more severe as the baseline water level increases due to sea level rise.

The Solution?



Thank You!

- Contact

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- Website: <http://bmcnoldy.rsmas.miami.edu/>
- Twitter: [@BMcNoldy](https://twitter.com/BMcNoldy)

Interactive Science

- Websites where you can probe past hurricanes, visualize sea level rise, peruse tide gauge data, and contribute to rainfall observations
 - <https://coast.noaa.gov/hurricanes/>
 - <https://coast.noaa.gov/slr/>
 - <https://tidesandcurrents.noaa.gov/>
 - <https://www.cocorahs.org/>

The Warming Trend

- In bigger cities, the observed warming is due to climate change AND land use change!
 - “Urban Heat Island”

