

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

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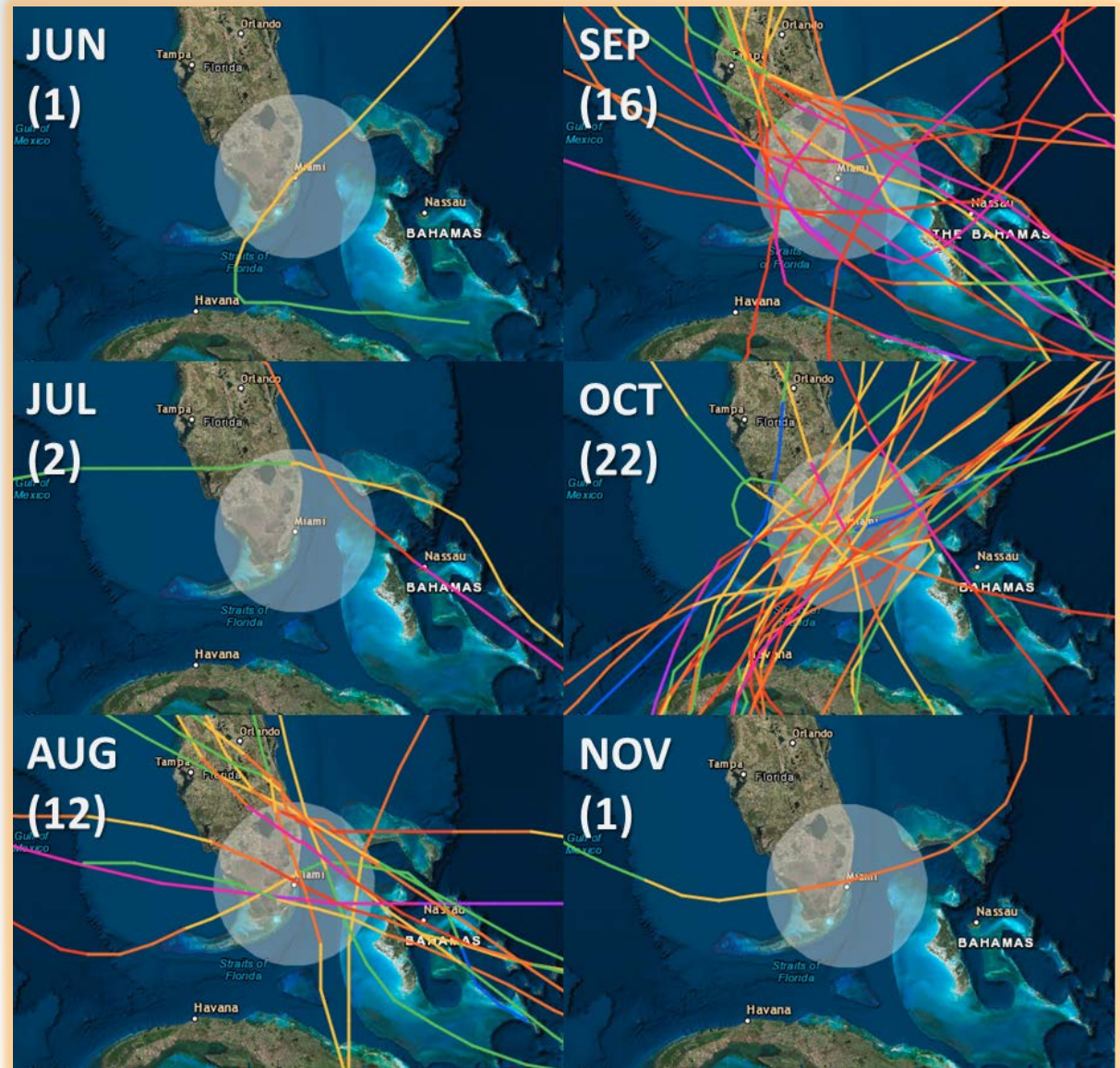


The Big Picture

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

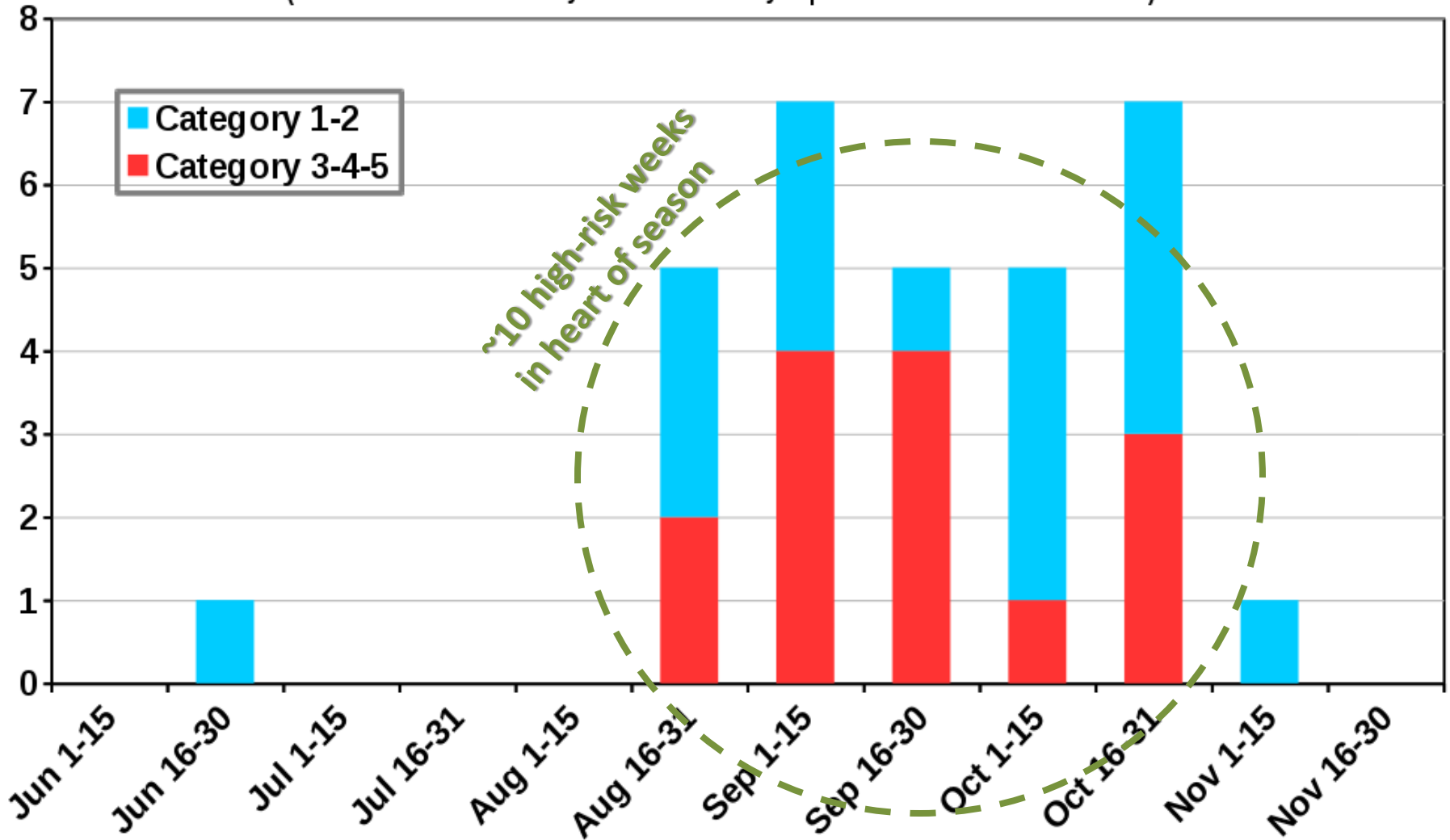
South Florida Hurricane Climatology

- Maps show all hurricanes that passed within 100 miles of Miami from 1851-2017 for each month of hurricane season
- Primary direction of approach varies with season
- October is historically the peak month for action here
- *Average* return period for any category of hurricane is 3.1 years



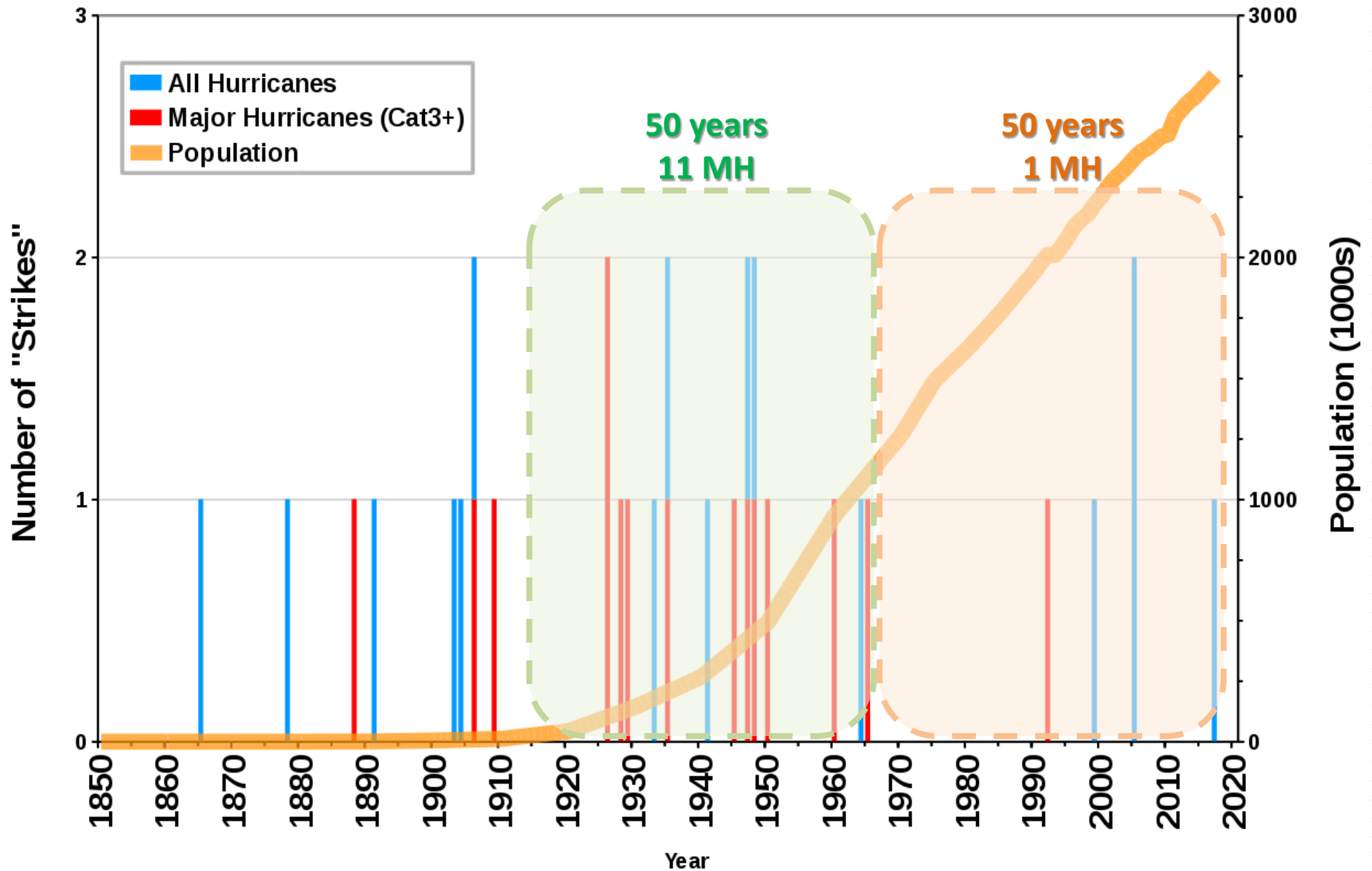
Miami-Dade County Hurricane Strikes (1851-2017)

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



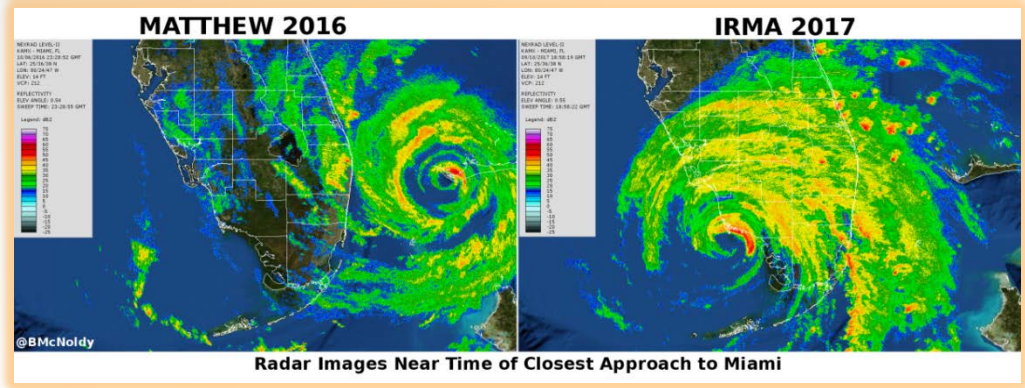
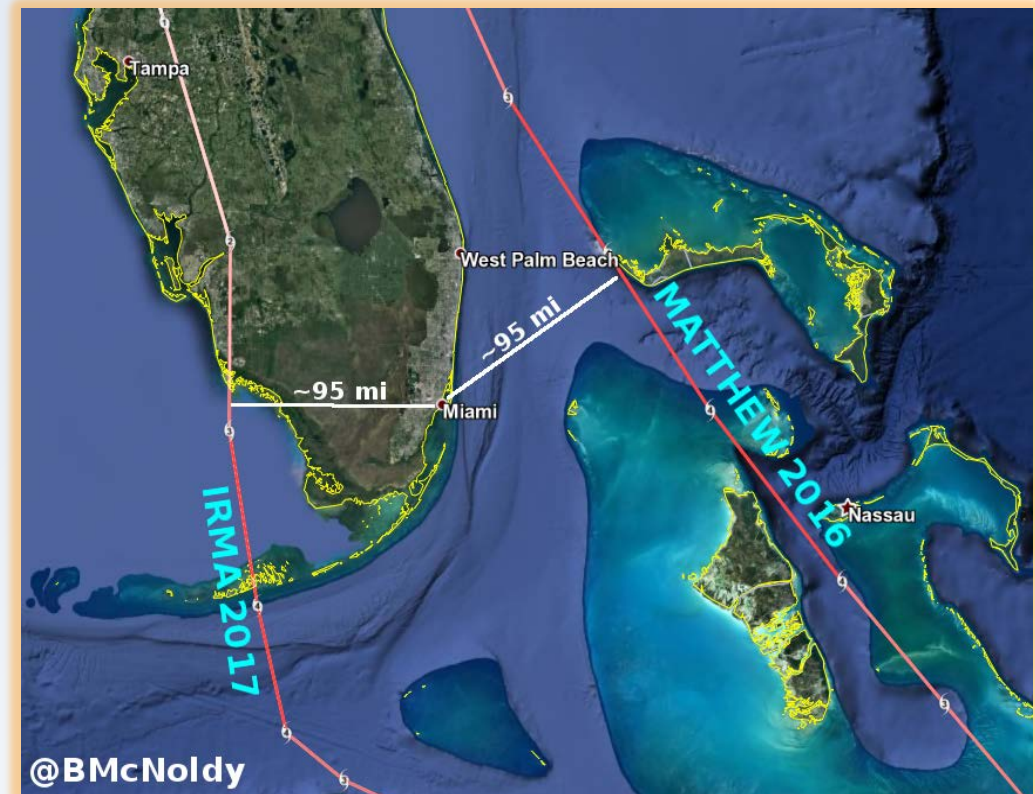
Miami-Dade County Population and Hurricane Strikes

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



Some VERY Close Calls

- The centers of Matthew (2016) and Irma (2017) both passed 95 miles from us... and both were Category 3-4 hurricanes at their closest approach.
- Irma had a larger wind field and we were in its “dirty” front-right quadrant for several hours: *much bigger impact.*



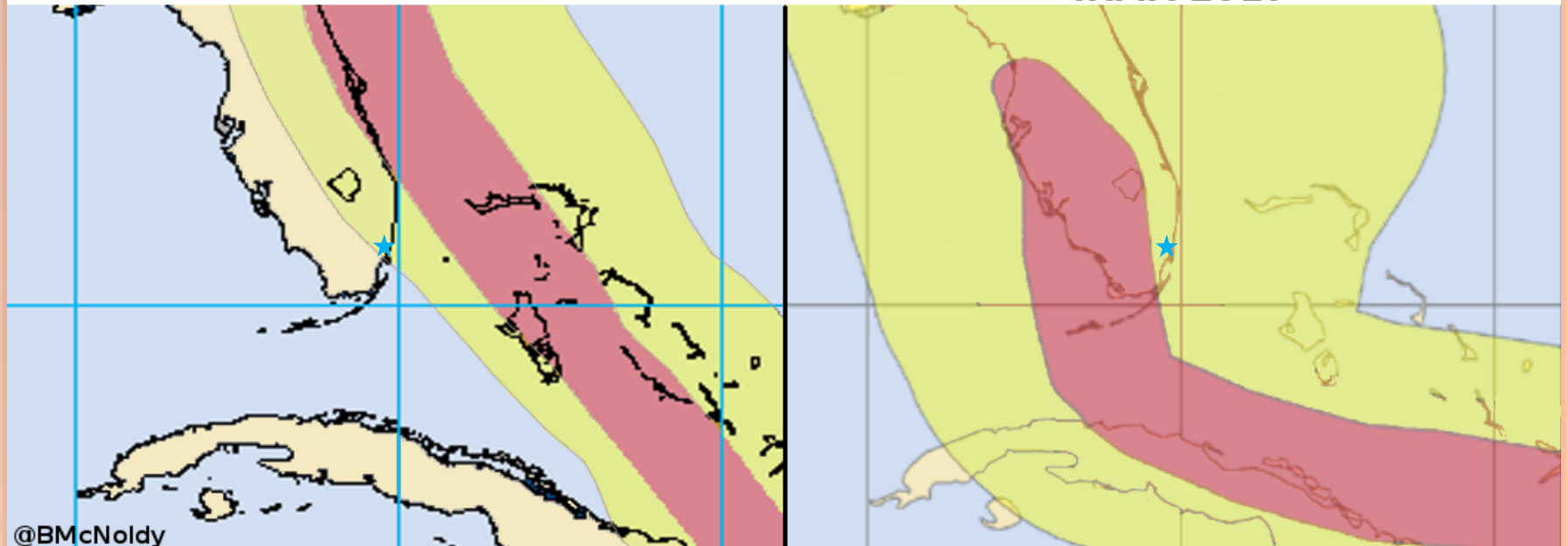
Radar Images Near Time of Closest Approach to Miami

Some *VERY* Close Calls

- Miraculously, we did not experience hurricane conditions from either of them here!
 - But, we can now appreciate how destructive and disruptive even a strong tropical storm can be

MATTHEW 2016

IRMA 2017



Tropical Storm and Hurricane Wind Swaths

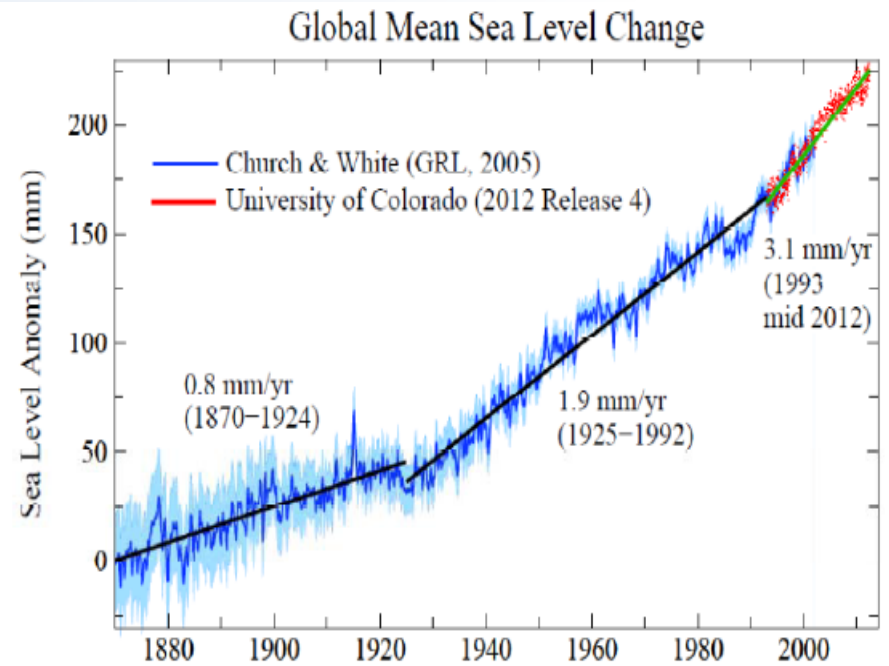
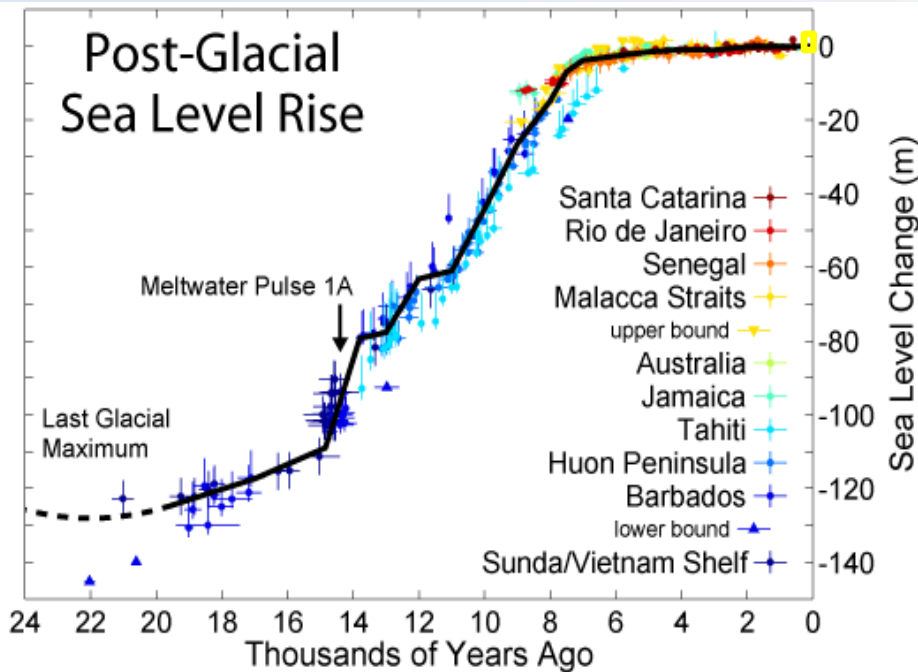
@BMcNoldy

The Future of Hurricanes

- No distinguishable trend of increasing **frequency**
 - In Florida specifically, they're actually becoming somewhat less frequent over past 165 years!
- Minimal signal of increasing **intensity** on climate scales
- Minimal signal of increasing **rainfall** on climate scales
- No individual hurricane (or any weather event) is caused by **climate change**
- Hurricane landfalls are **low-probability high-impact** events
 - Hard to plan for, but must be taken into account in building and infrastructure design here
- Even if hurricane activity remains constant, the **impact continues to grow** as population and infrastructure grows
 - How can the economic impact be minimized??

Sea Level Rise: Historical Context

- Since peak of most recent glacial period, sea level has risen about 400 feet.
- Since Industrial Revolution, sea level has risen nearly 1 foot.

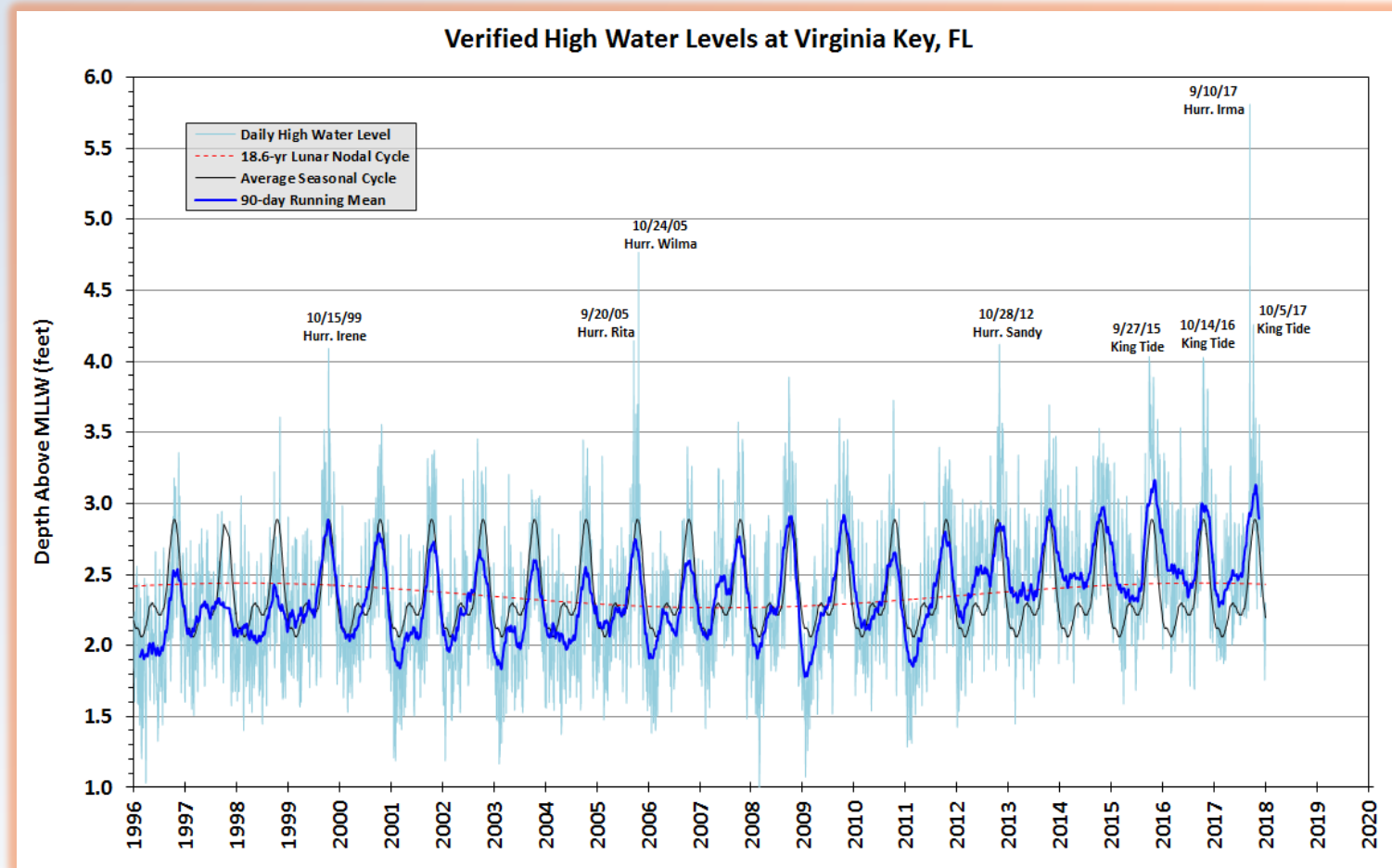


Sea Level Rise

- Globally, sea level rise is driven by ice melt and thermal expansion of the ocean (roughly equal contributions)
- Locally, the global average is altered by the Gulf Stream transport (more SLR when Gulf Stream slows down, and it's slowing down!) among other things
- Prediction of these factors decades into the future comes with A LOT of uncertainty

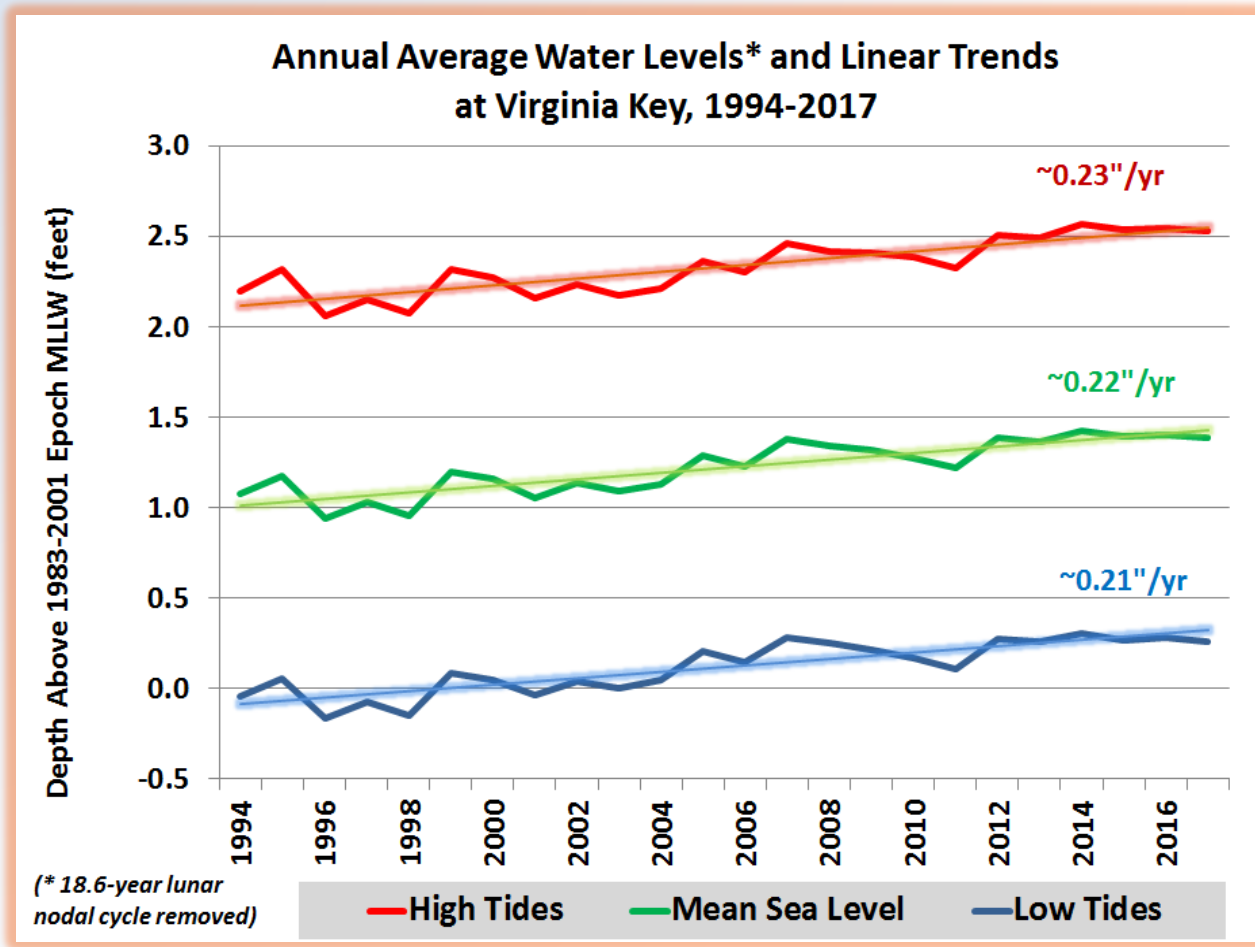
Sea Level Rise Observations

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



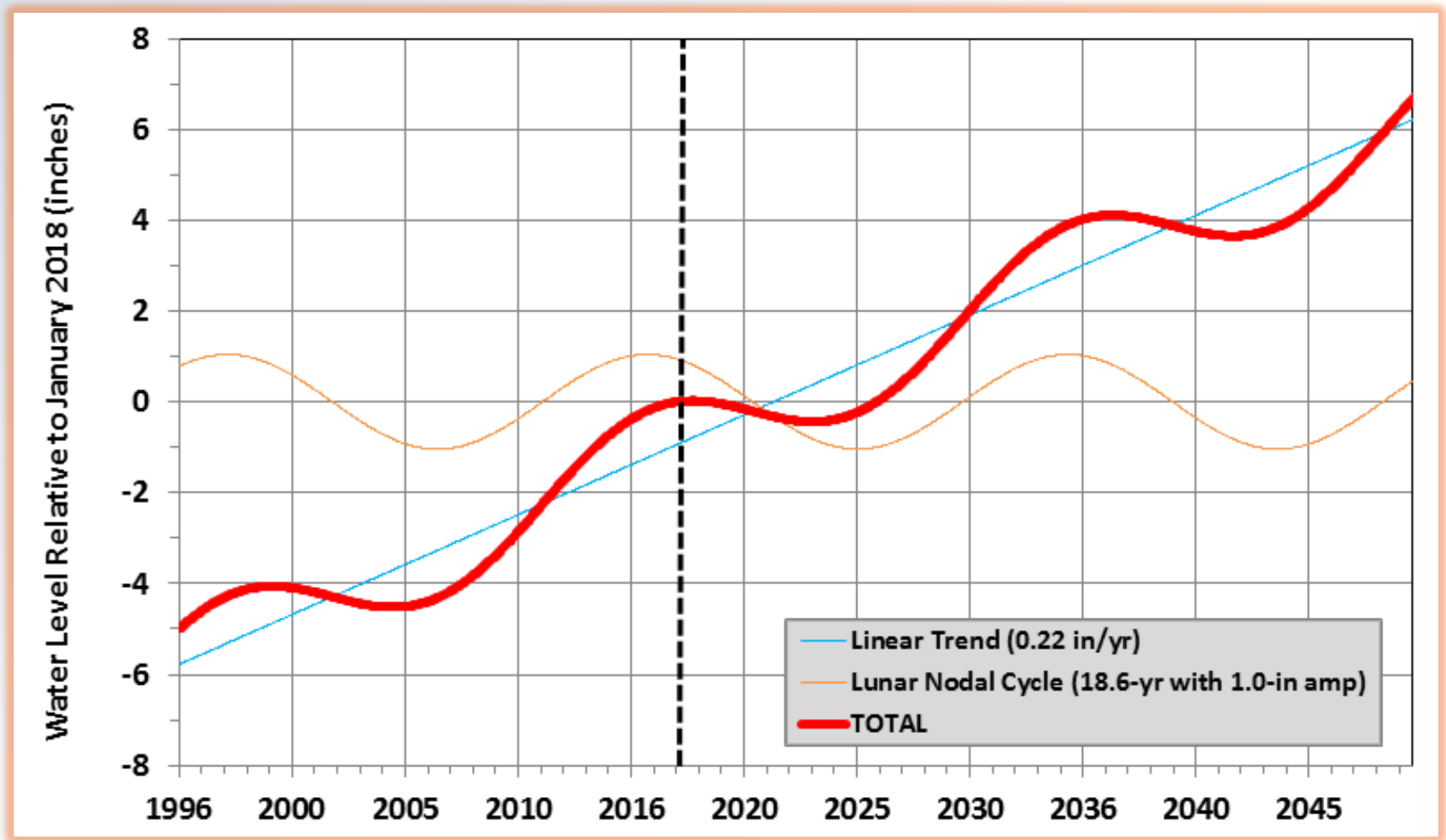
Local Trends in Sea Level Rise

- There is interannual variability, but the upward trend is undisputable.



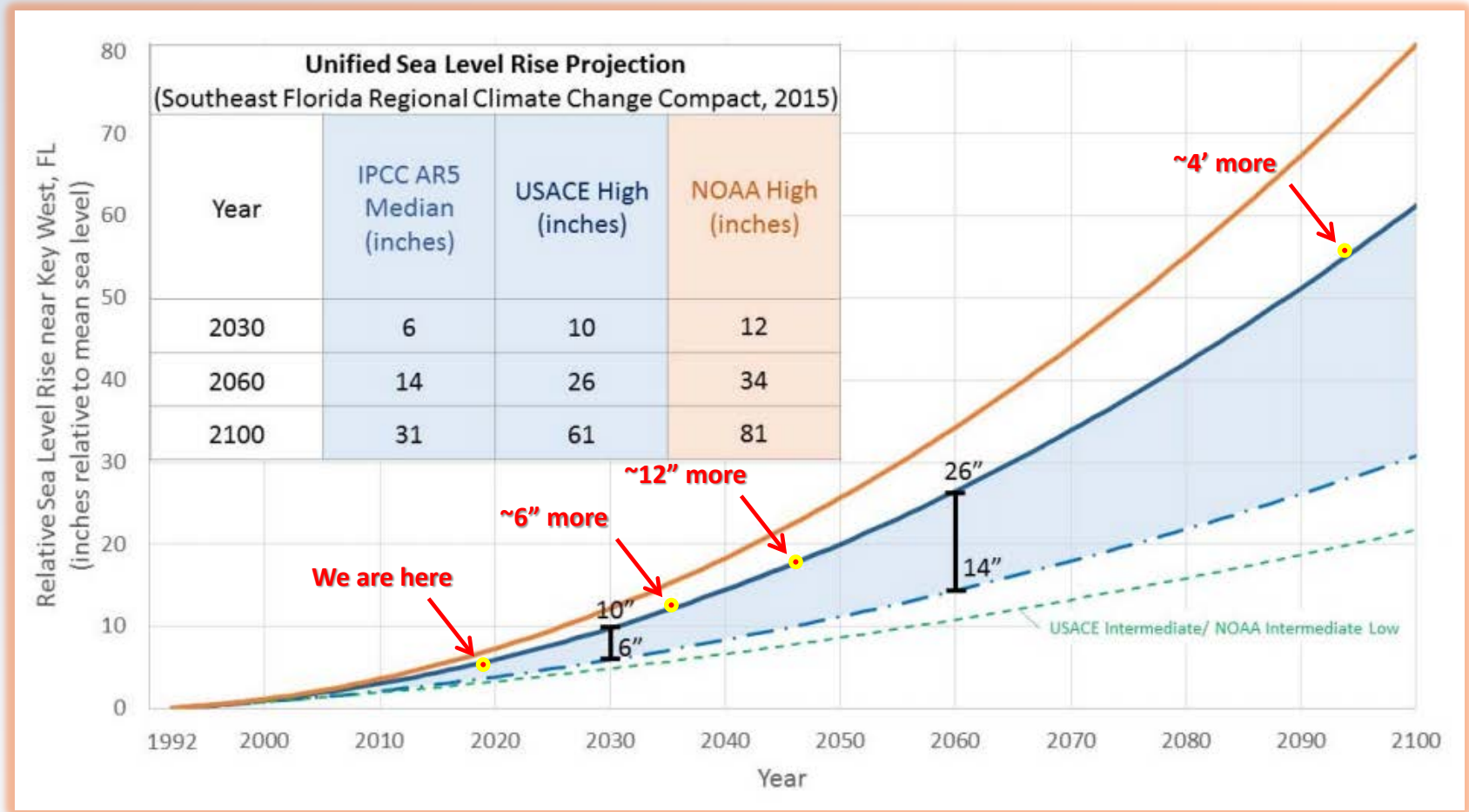
“Lunar Nodal Cycle”?

- The 18.6-year LNC affects apparent SLR...



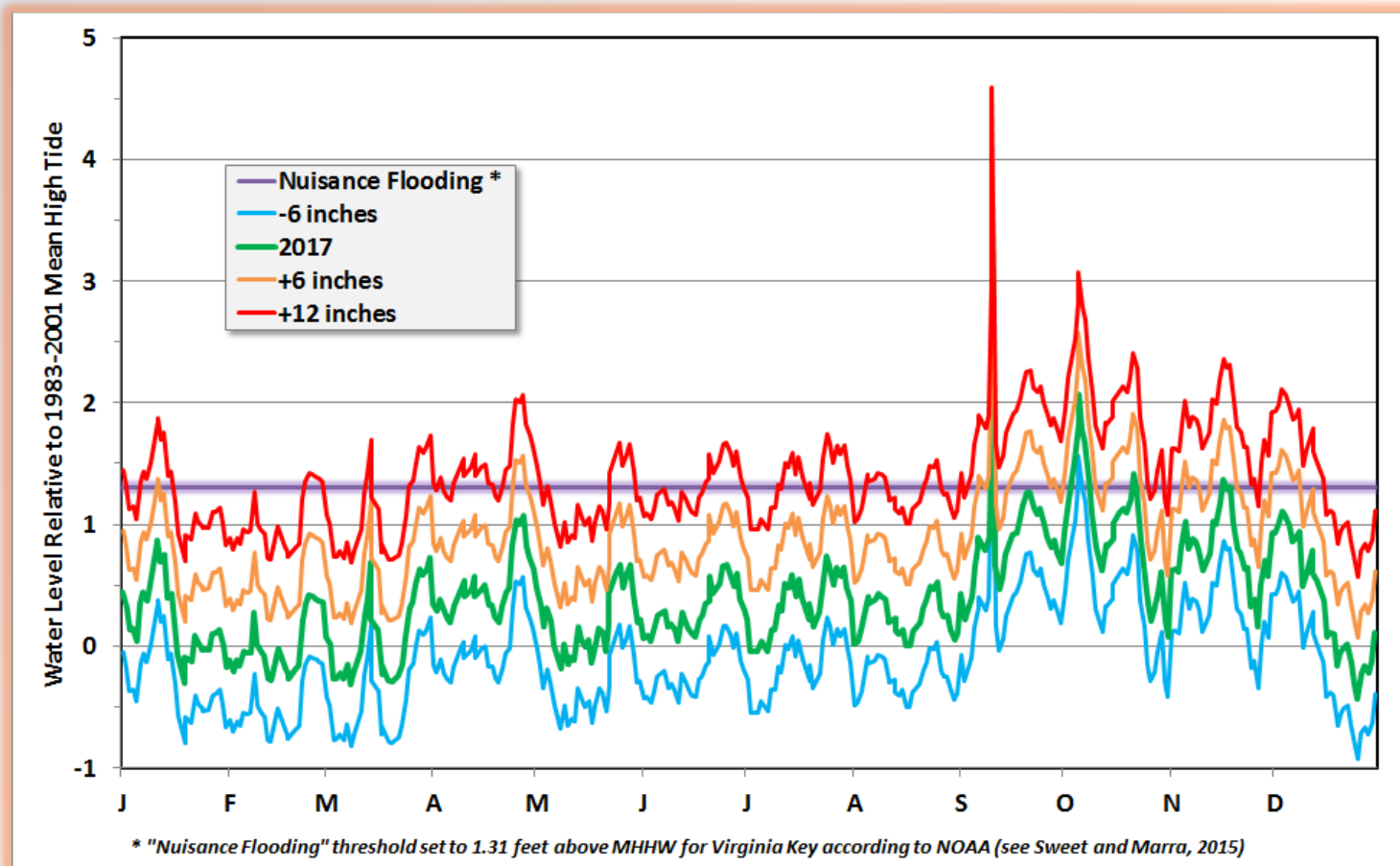
Projections for the Coming Decades

- Uncertainty increases with time... lots of unknowns, but all projections show an acceleration of SLR



2017, 2037, 2047, ...

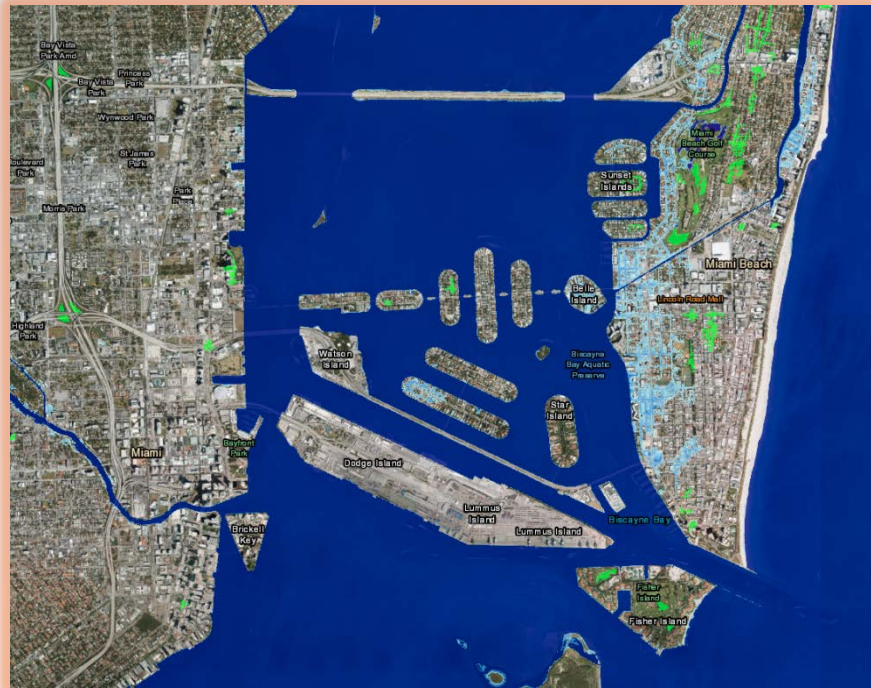
- Take sample year (2017) and simply add time to see impact on number of “nuisance flooding” days



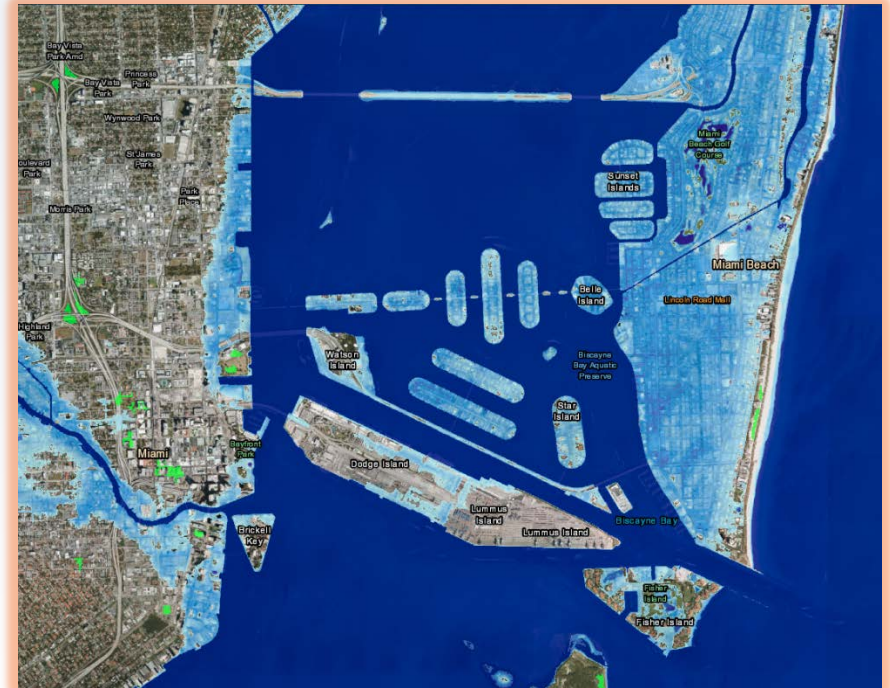
High Tides Now and in 2100

- 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)

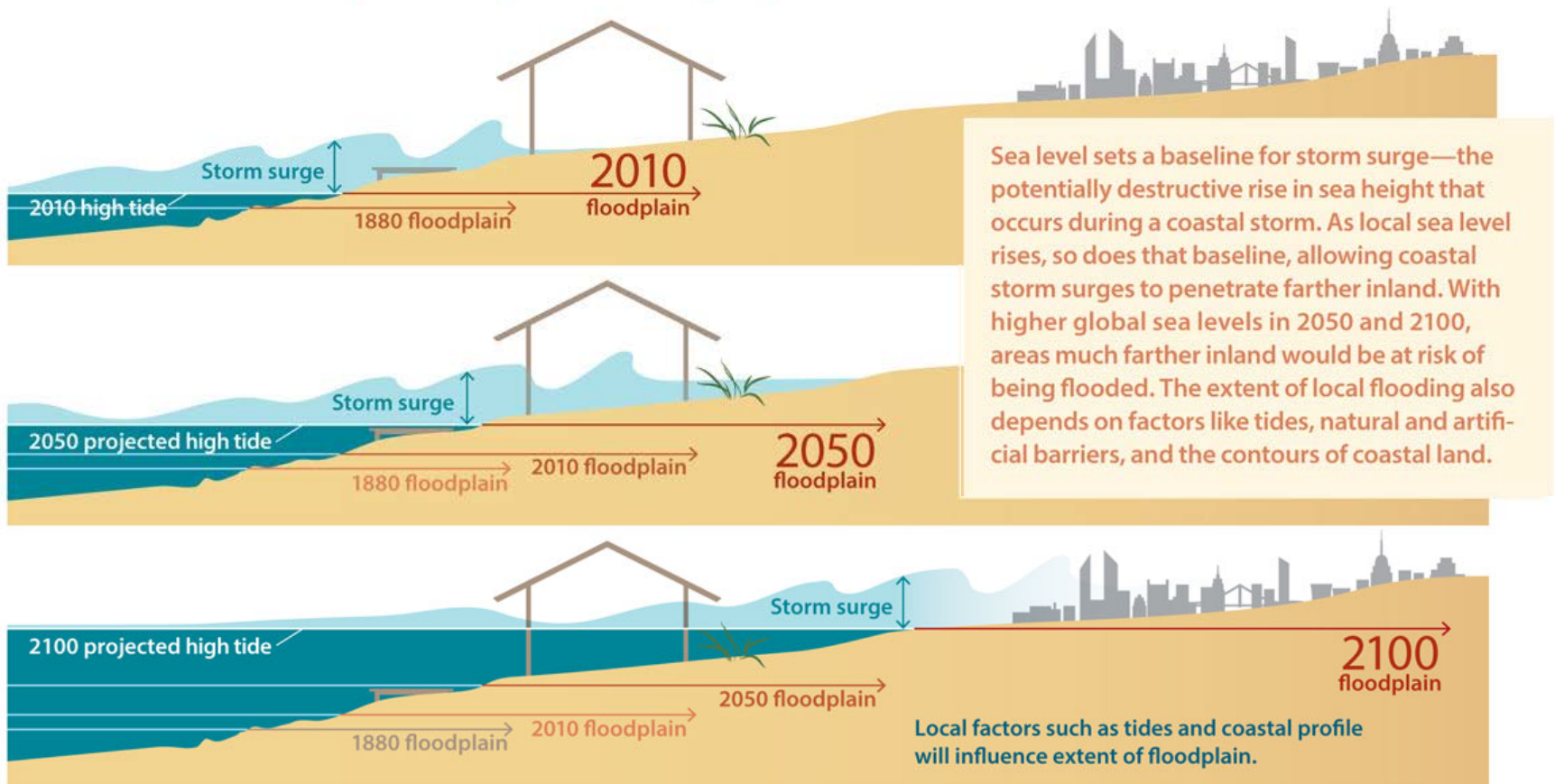


Highest tides in 2100!
(assuming ~4 feet of SLR)



Bad Mix: Hurricanes & SLR

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



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The Solution?



Thank You!

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