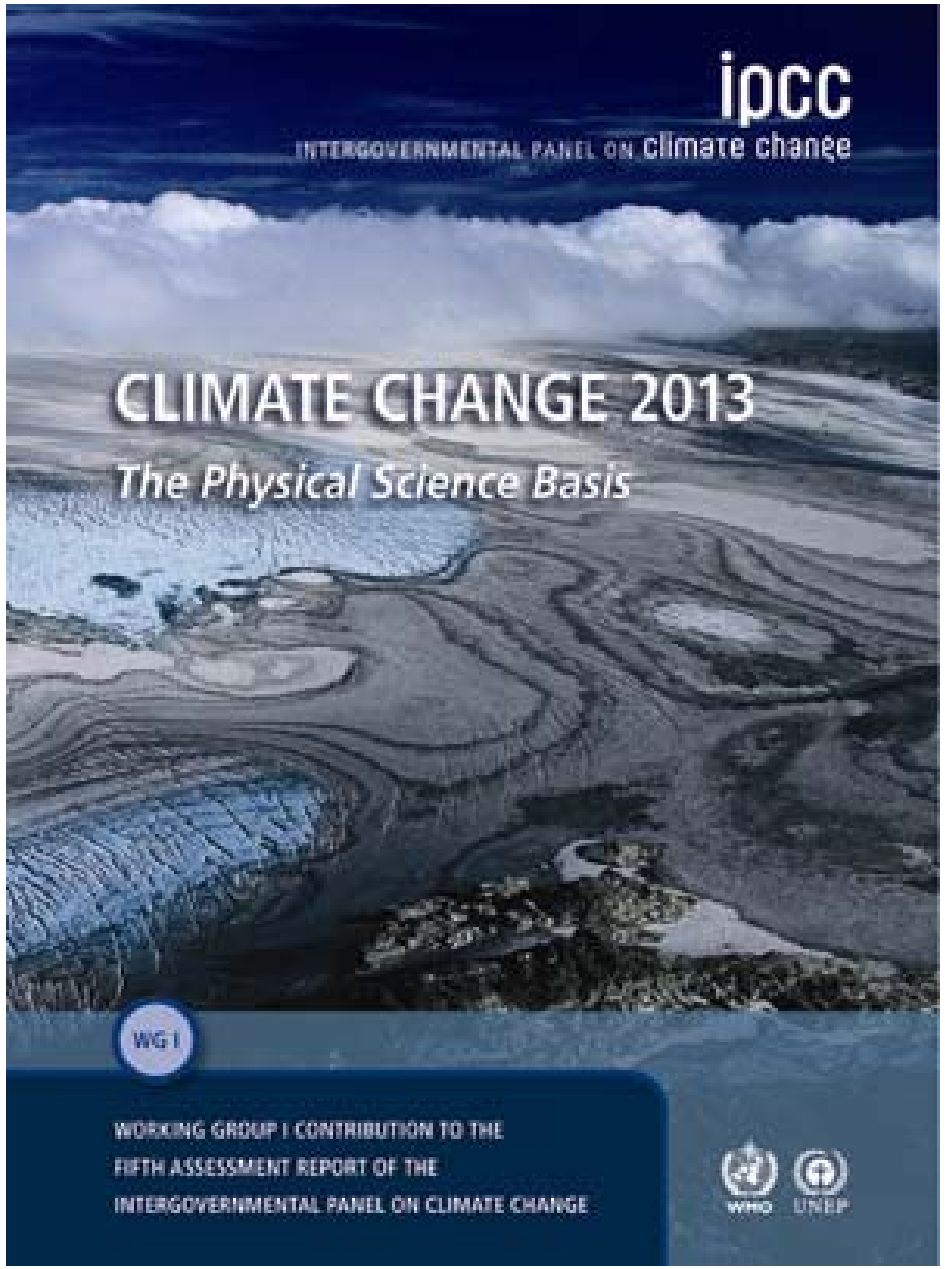
Sea Level Rise

What's in store for Miami?

David B. Enfield

UM-Rosenstiel & NOAA-AOML



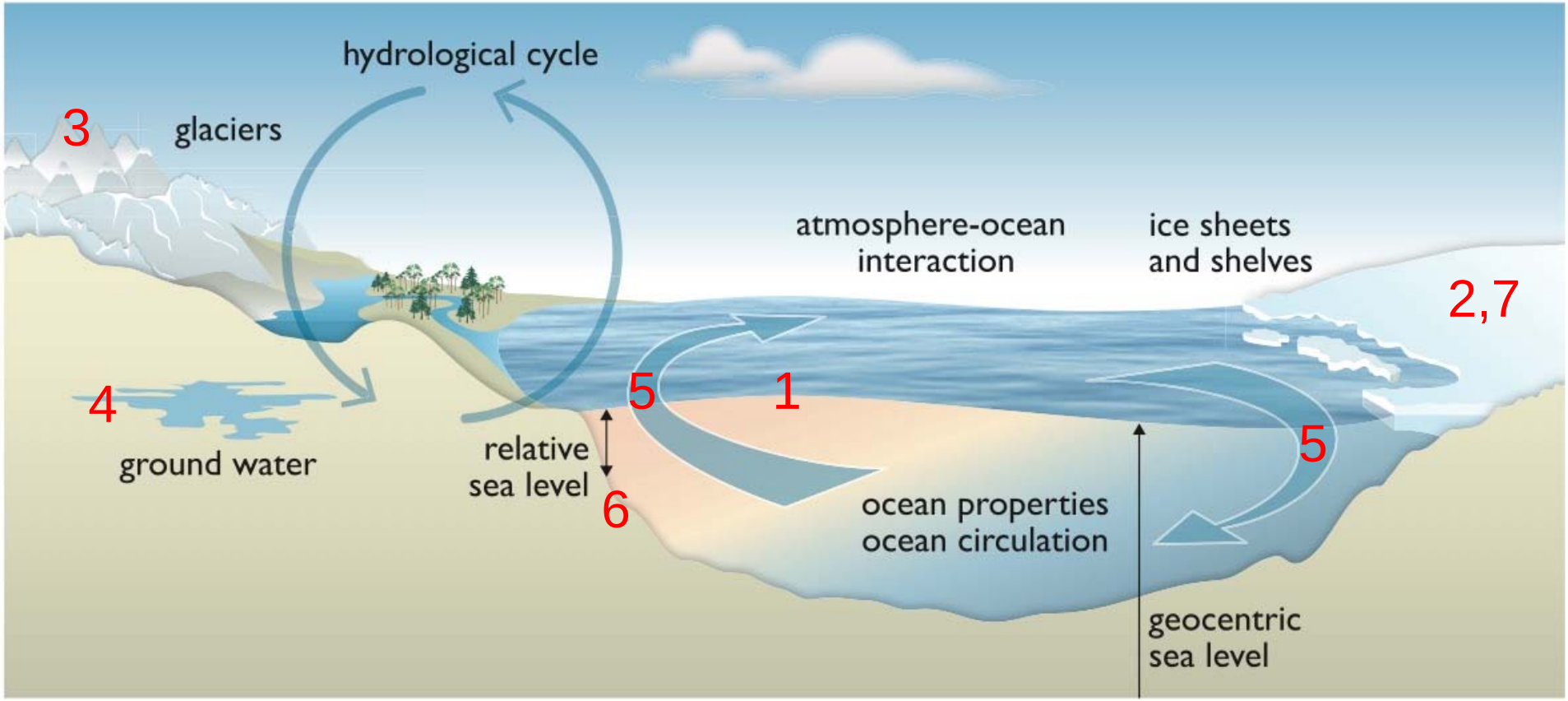
Wealth of information available at:

Intergovernmental Panel on Climate Change (IPCC) Working Group I, Fifth Assessment Report:

"Climate Change 2013: The Physical Science Basis."

(http://www.ipcc.ch/wg1)

Processes affecting regional sea level rise



Affecting global SLR:

1. Warmth of the ocean water column
2. Negative mass balance of ice sheets
3. Runoff from melting mountain glaciers
4. Changes in ground water storage

Affecting regional SLR:

5. Changes in ocean circulation
6. Subsidence or uplift of land

Wild card:

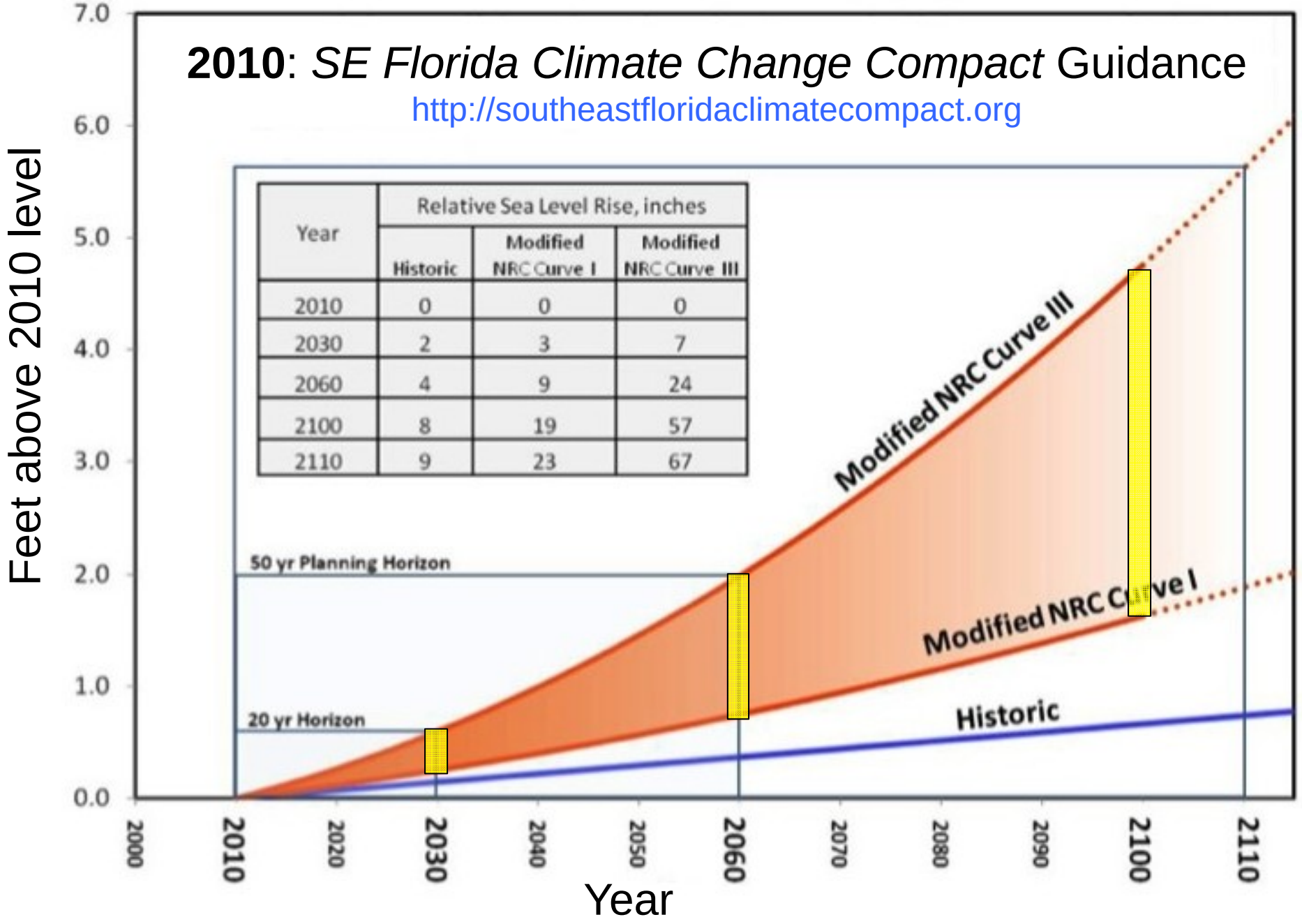
7. Ice sheet ‘collapse’

Sea Level Rise Scenarios for South Florida

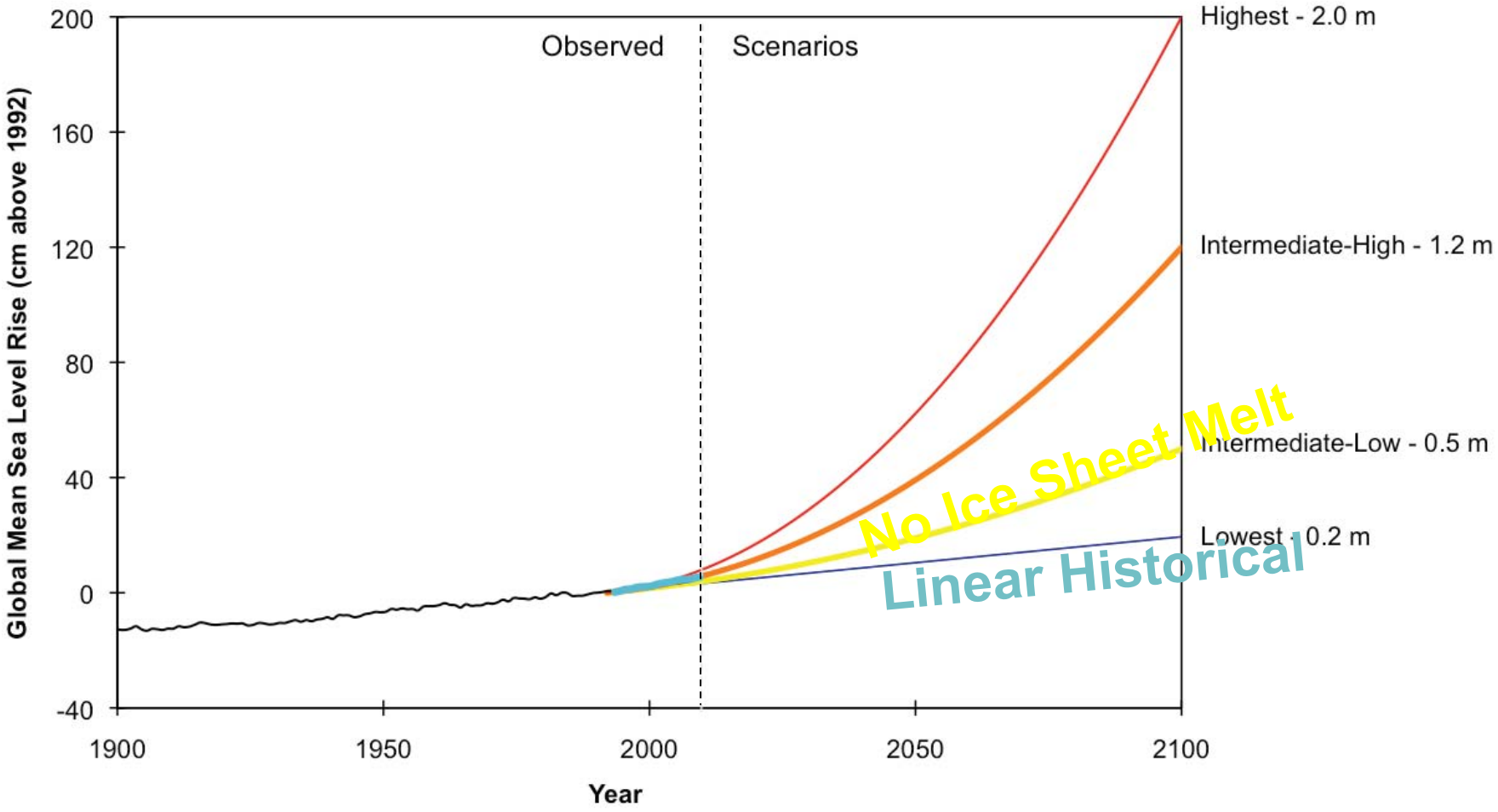
2010: *SE Florida Climate Change Compact* Guidance

http://southeastfloridaclimatecompact.org

Year	Relative Sea Level Rise, inches		
	Historic	Modified NRC Curve I	Modified NRC Curve III
2010	0	0	0
2030	2	3	7
2060	4	9	24
2100	8	19	57
2110	9	23	67



Most Recent Government Projections of Global Sea Level

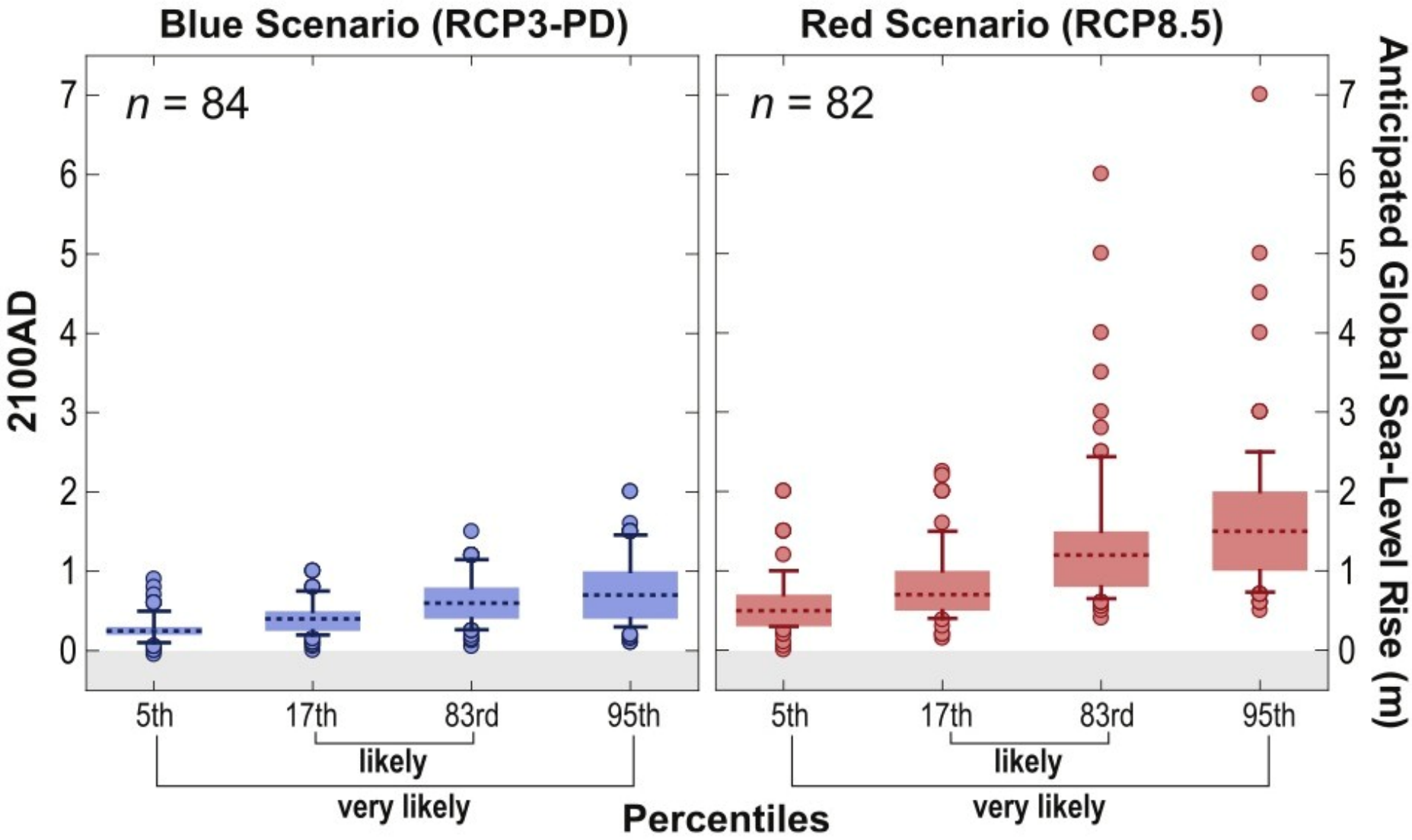


NOAA, Dec 6, 2012

In: "Global Sea Level Rise Scenarios for the United States National Climate Assessment"

Assessment of 90 experts of sea level rise by 2100

Horton et al. (2014)



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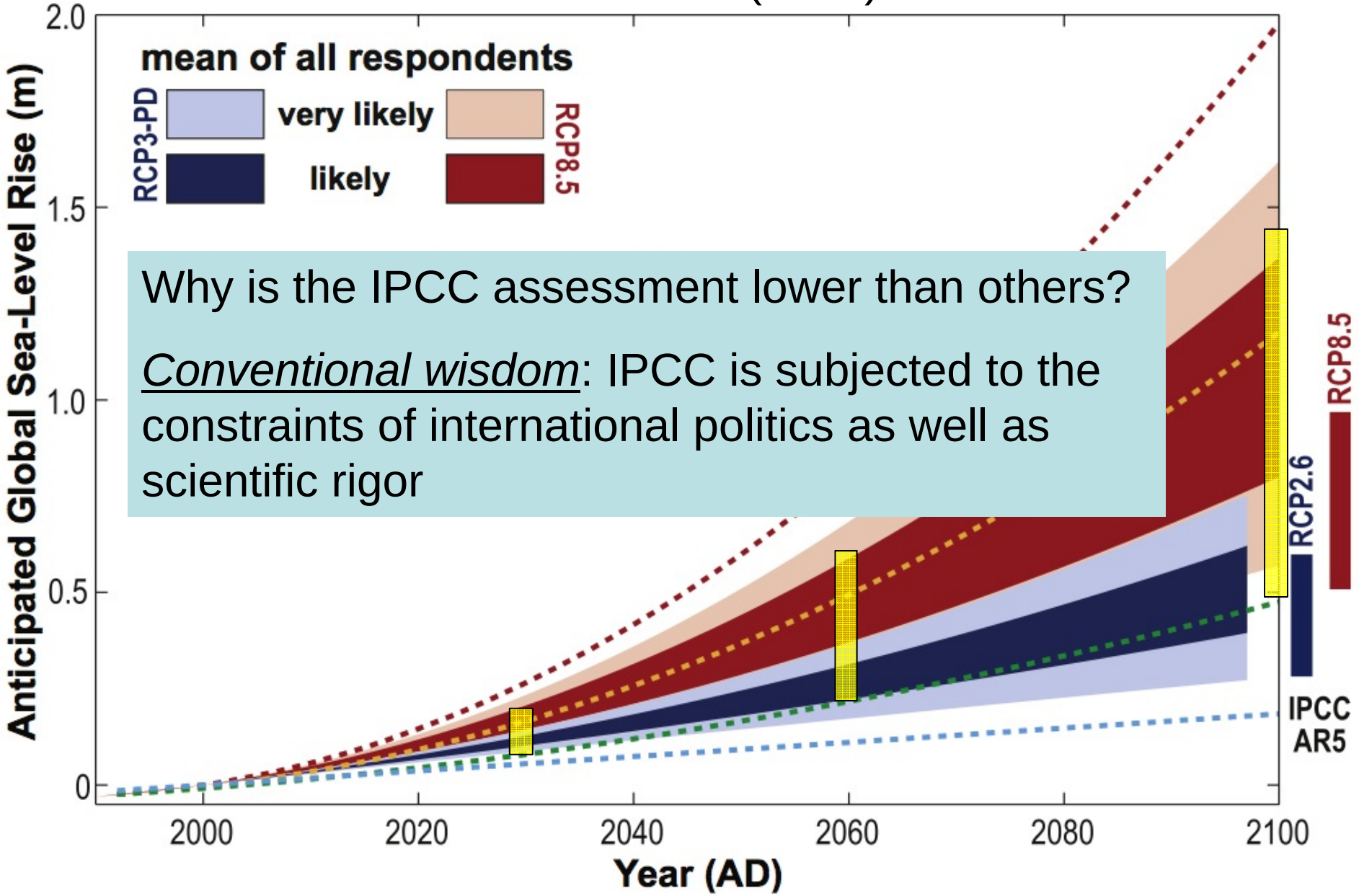


Why is the IPCC assessment lower than others?

Conventional wisdom: IPCC is subjected to the constraints of international politics as well as scientific rigor

IPCC statements regarding why their projections are lower than others

Process-based models (IPCC) are ones where the significant ice processes are represented physically in the global climate models

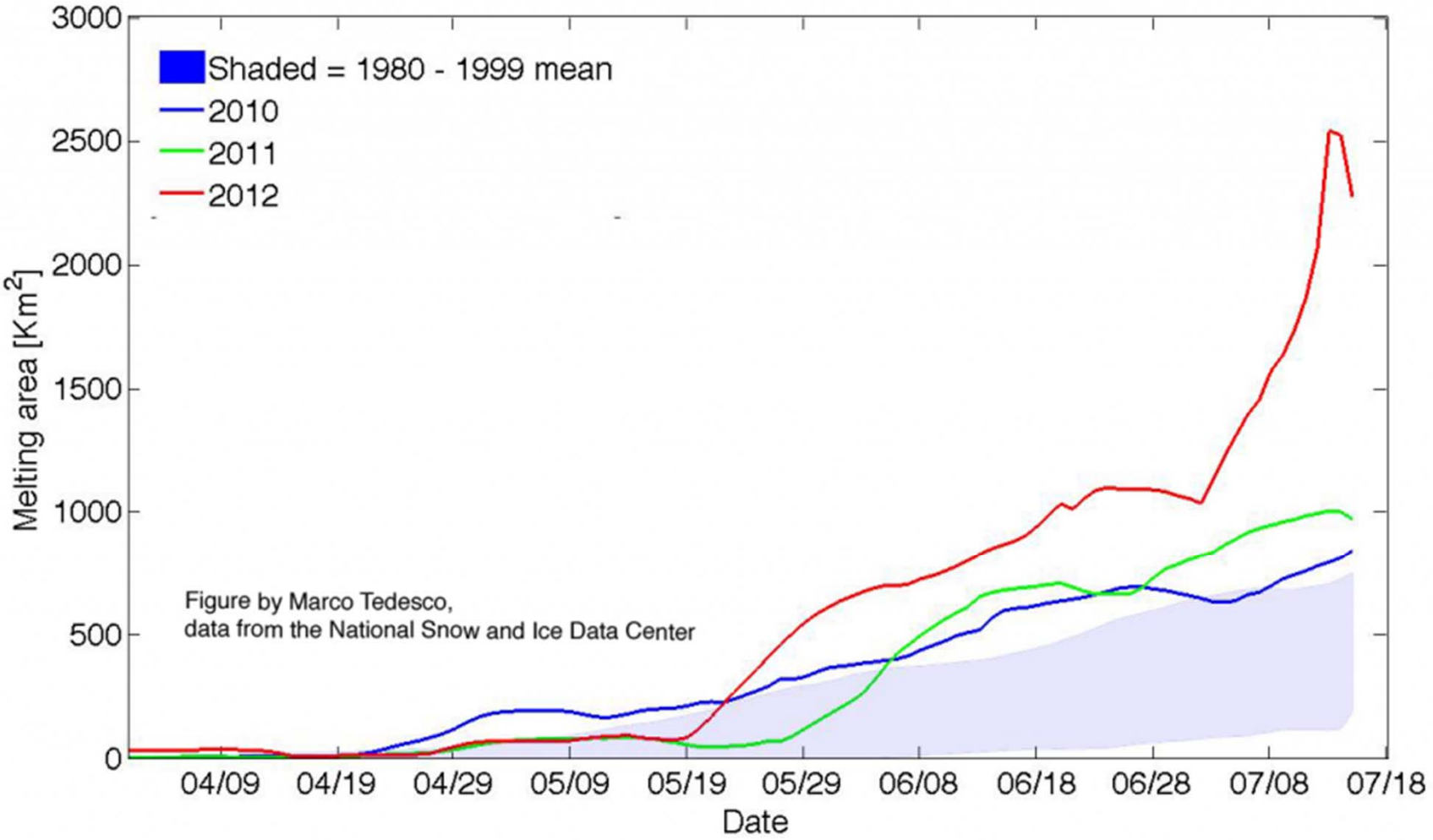
Semi-empirical models finesse the physical processes by using the historical relationship between global temperature and sea level

"Some semi-empirical models project a range that overlaps the process-based *likely* range while others project a median and 95th percentile that are about twice as large as the process- based models. In nearly every case, the semi-empirical model 95th percentile is higher than the process-based *likely* range."

"Despite the successful calibration and evaluation of semi-empirical models against the observed 20th century sea level record, there is no consensus in the scientific community about their reliability, and consequently *low confidence* in projections based on them."

Many would say there is also low confidence in the process-based models because of our poor knowledage & data

Record summer ice melt in Greenland over past decade

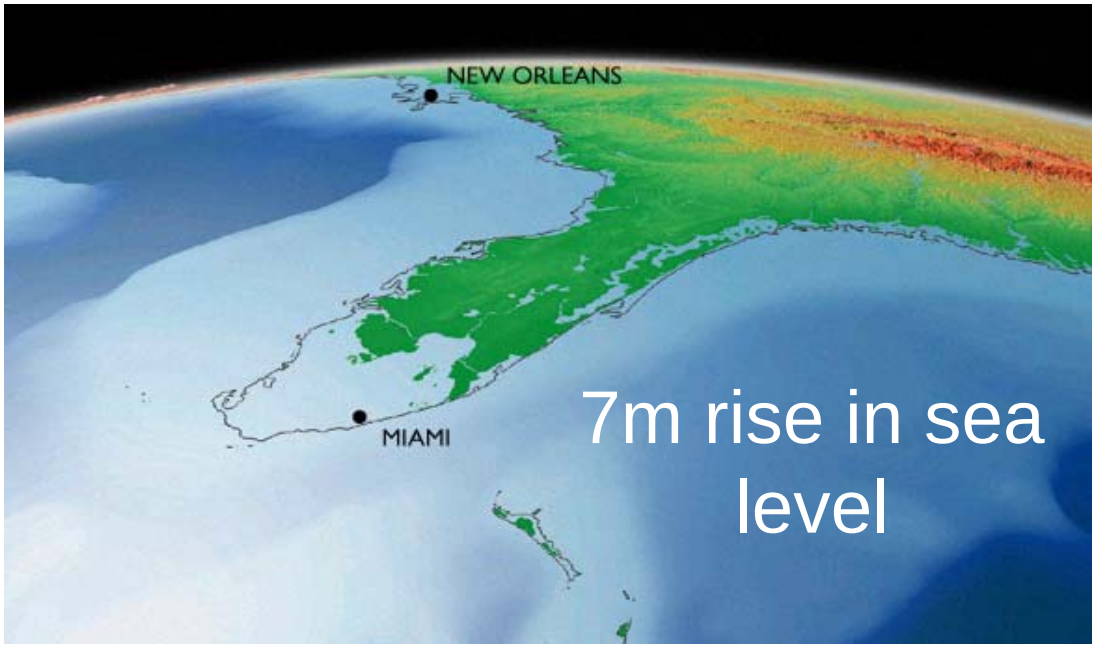


Sea Level Rise in the future

Melting ice sheets?

- Greenland: 7.4 m (25') potential
- Antarctica: 74 m (250') potential
  - West Antarctica (7 m)
  - East Antarctica (67 m)

West An
particula
much is
sea level, buttressed by two ice shelves that could break up.



Approximately 25% of US population lives in area that would be flooded by a 7m rise.

IPCC statements regarding the possibility of ice sheet ‘collapse’ leading to significantly greater sea level rise

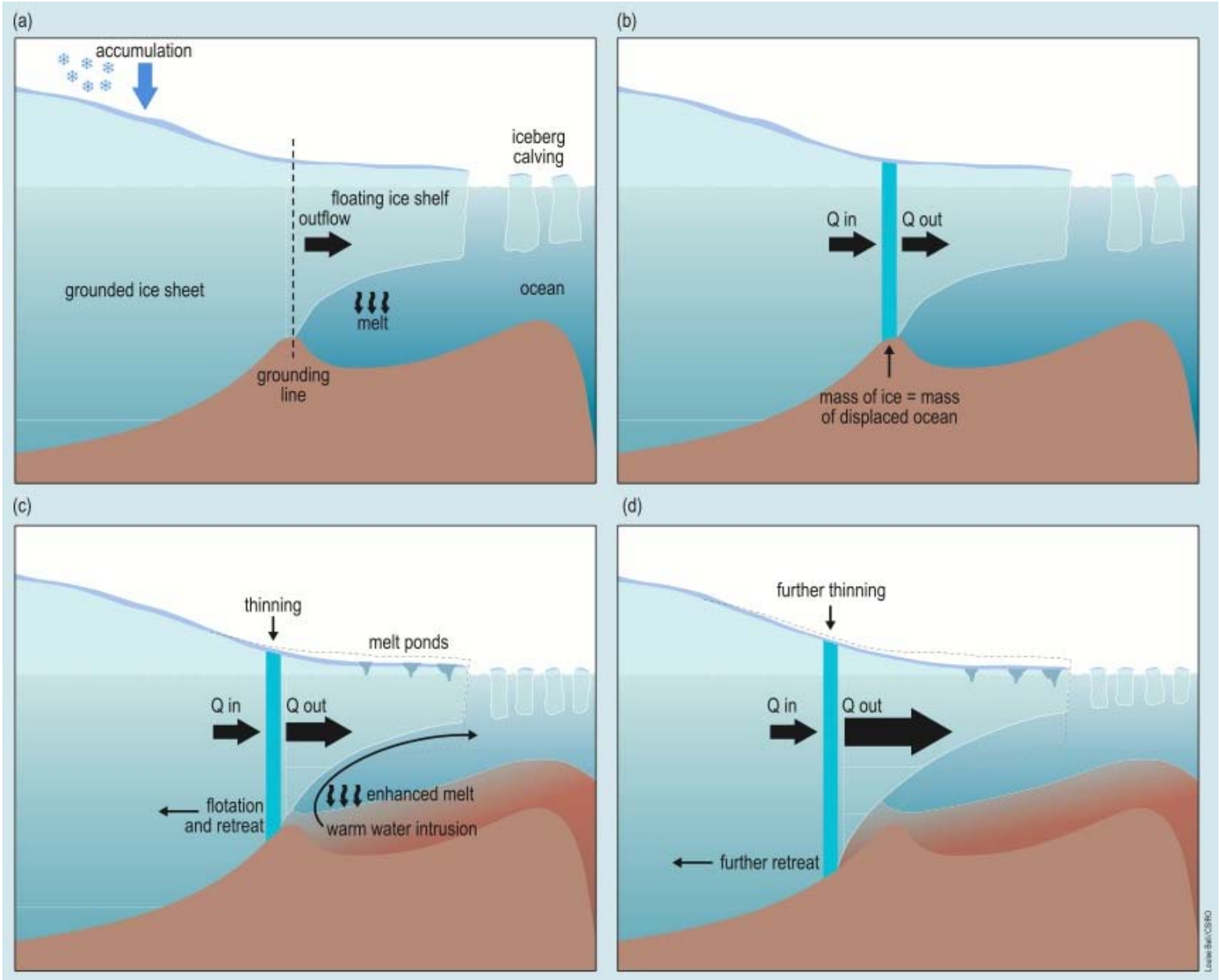
“We have considered the evidence for higher projections and have concluded that there is currently insufficient evidence to evaluate the probability of specific levels above the assessed *likely* range.”

“Based on current understanding, only the collapse of marine-based sectors of the Antarctic ice sheet, if initiated, could cause global mean sea level to rise substantially above the *likely* range during the 21st century.”

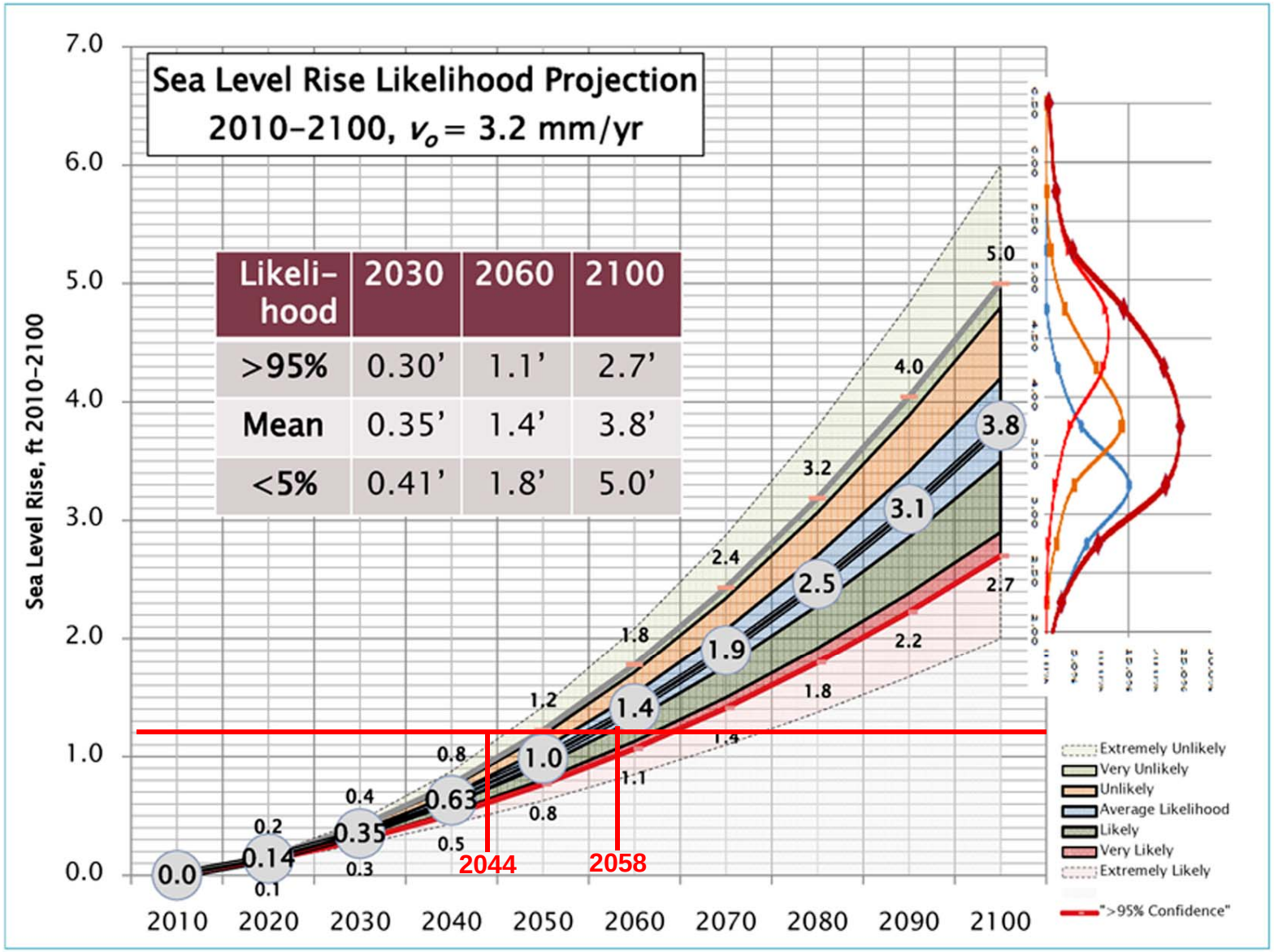
Rather than a ‘collapse’, it makes more sense to talk of a potential ‘instability’ whereby outlet glaciers in Antarctica could enter a phase of accelerated ice melt once forced to retreat landward from their grounding lines (see next slide).

“This potential additional contribution cannot be precisely quantified but there is *medium confidence* that it would not exceed several tenths of a meter of sea level rise during the 21st century.”

How an ice sheet instability could occur



Current SLR guidance for the 4-county Compact



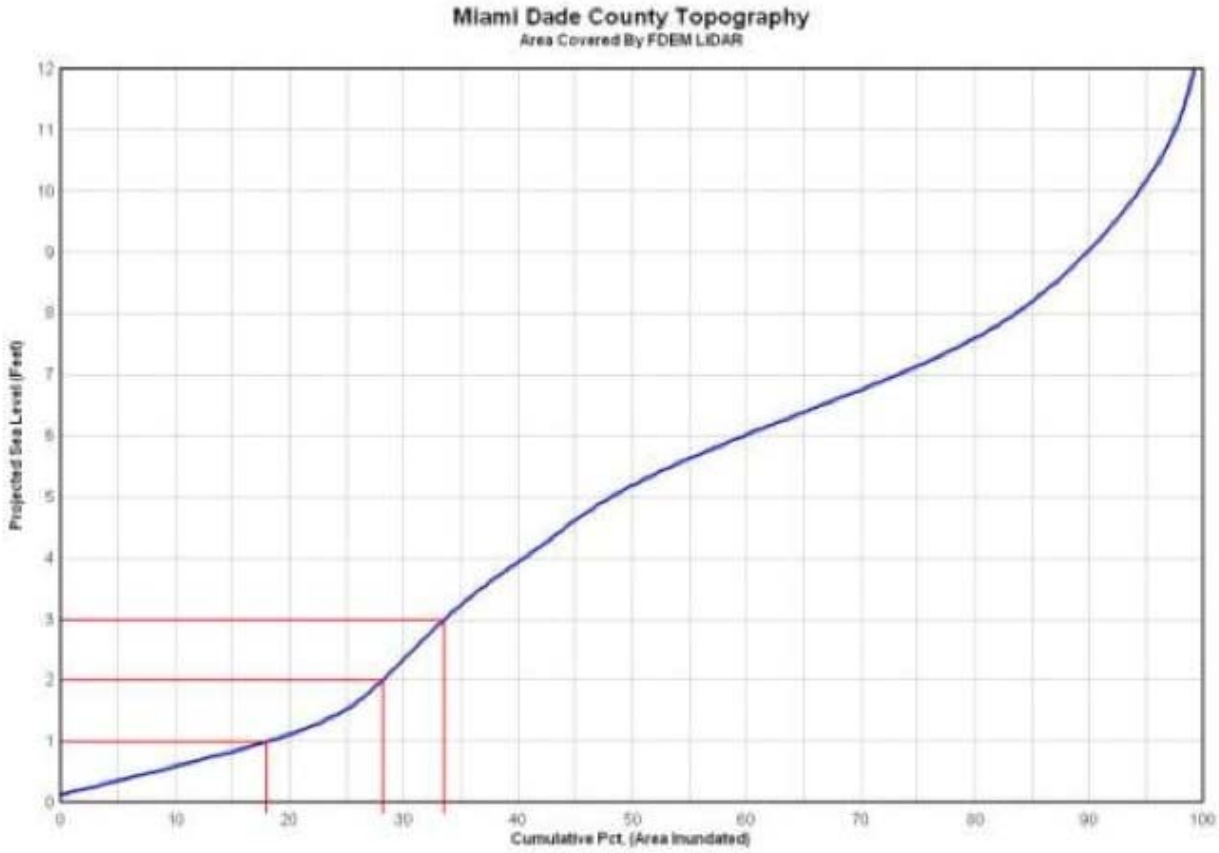
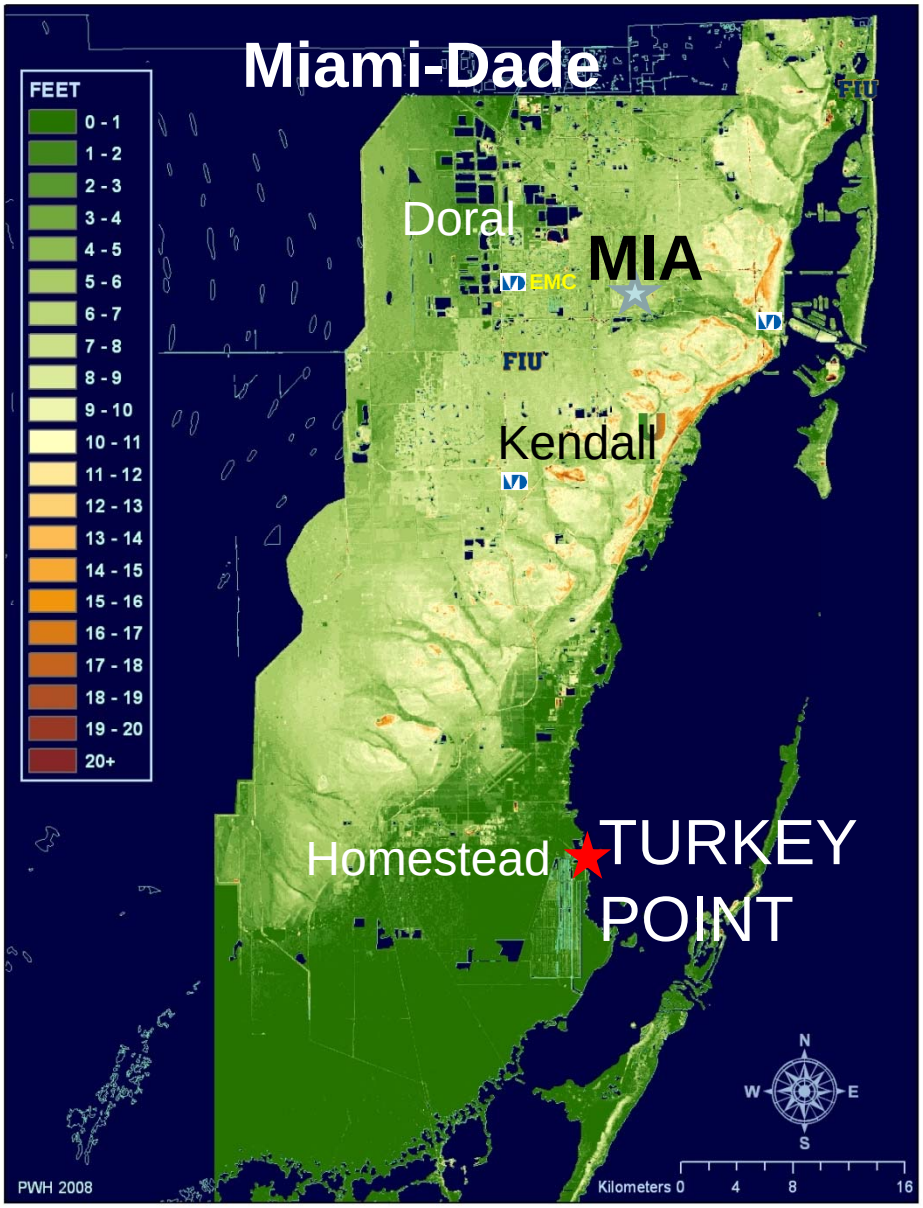
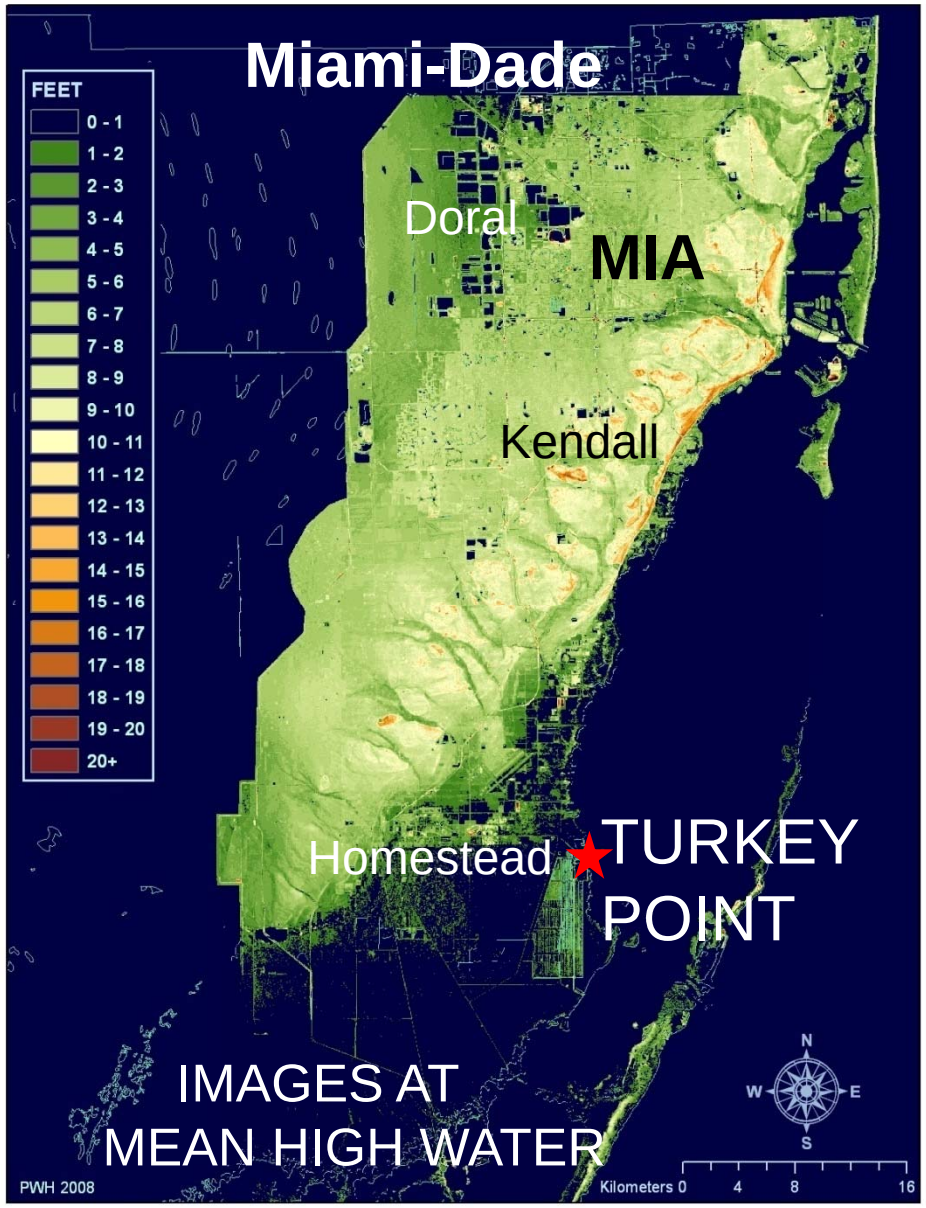


Table 8. The Percent of Land with Elevations Below Sea Level for the Urban Portion of Miami-Dade County for 1-3 Foot Sea Level Rise Scenarios. This table is derived from the hypsographic curve (Fig. 4). Note that each foot of rise produces a different percent of land area at elevations below sea level. This non-linearity through time is an important concept to apply to adaptation planning.

SLR Rise (Feet)	Land with Elevations Below Sea Level (%)	Change (%)
1	18.2	-18.2
2	28.2	-10.0
3	33.6	-5.4



Present topography

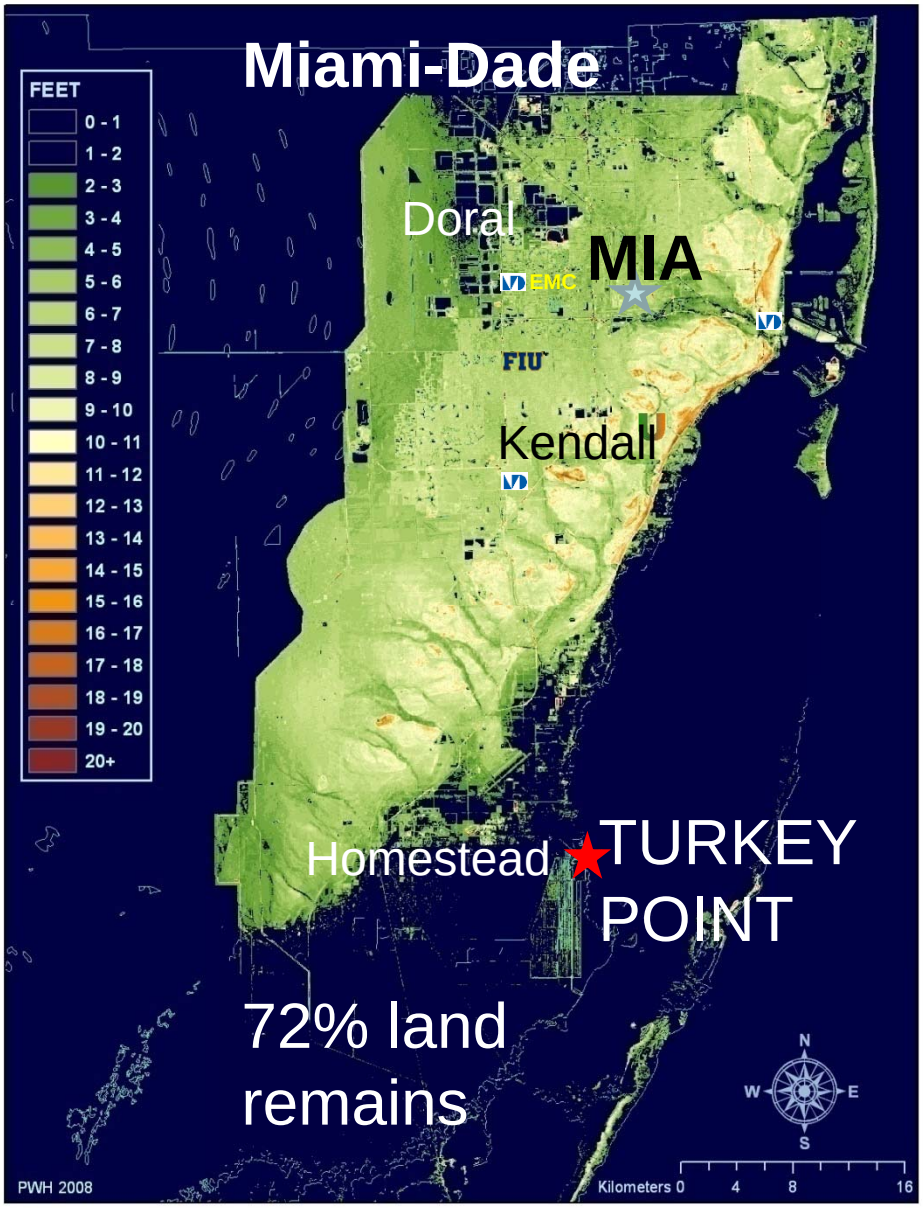


1 Foot Sea Level Rise (2031-2042)

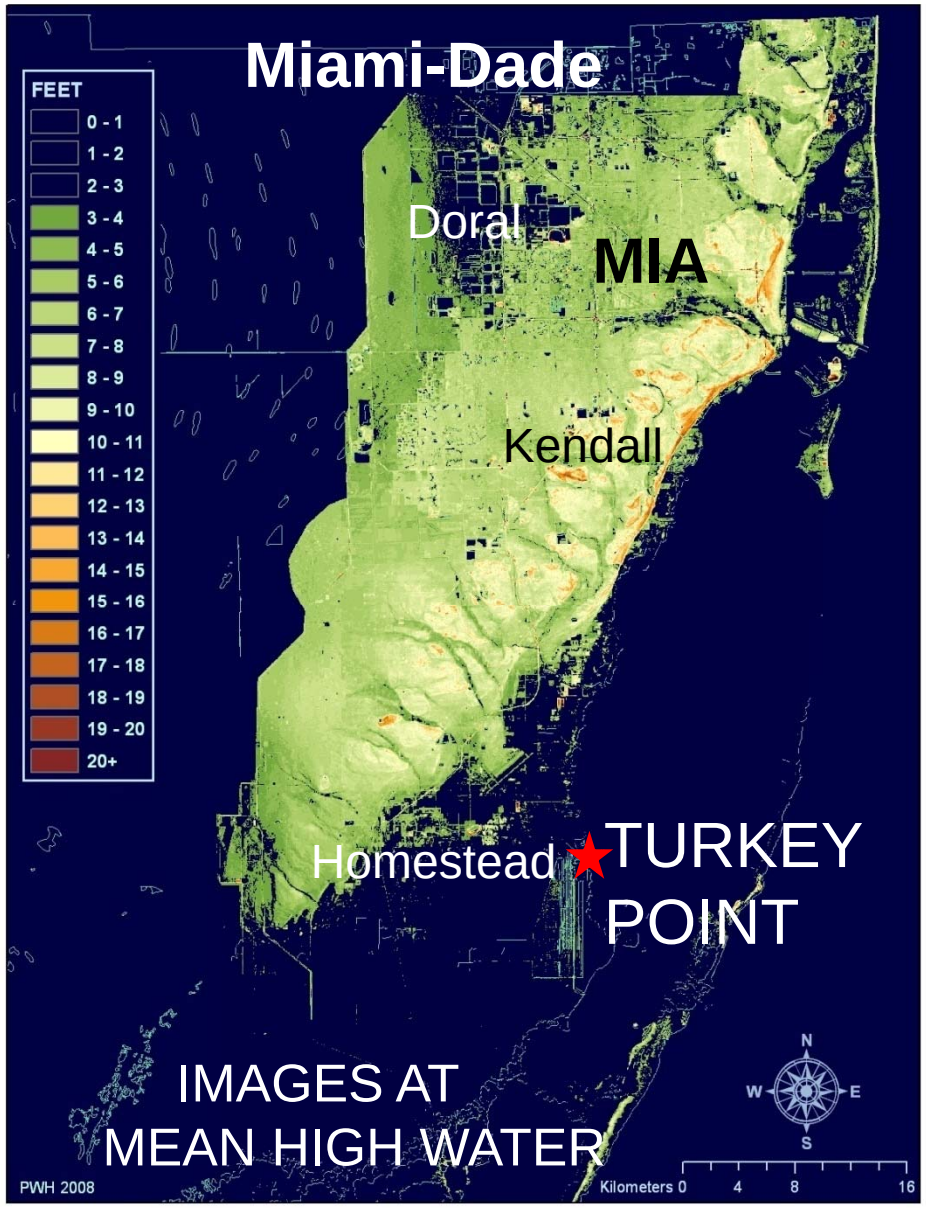
LiDAR elevation data

SLIDE #5 – H.R. Wanless, 2012

from P. Harlem,



2 Feet Sea Level Rise (2048-2066)

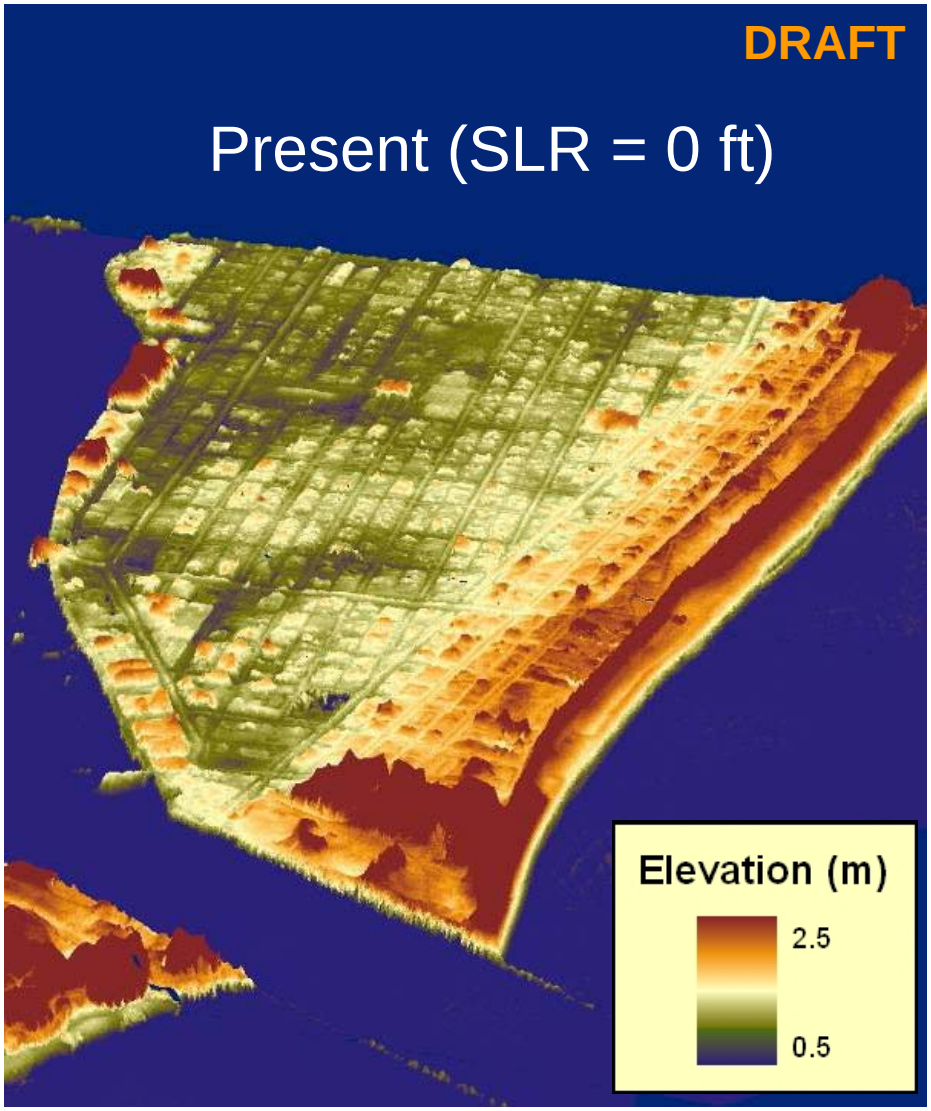


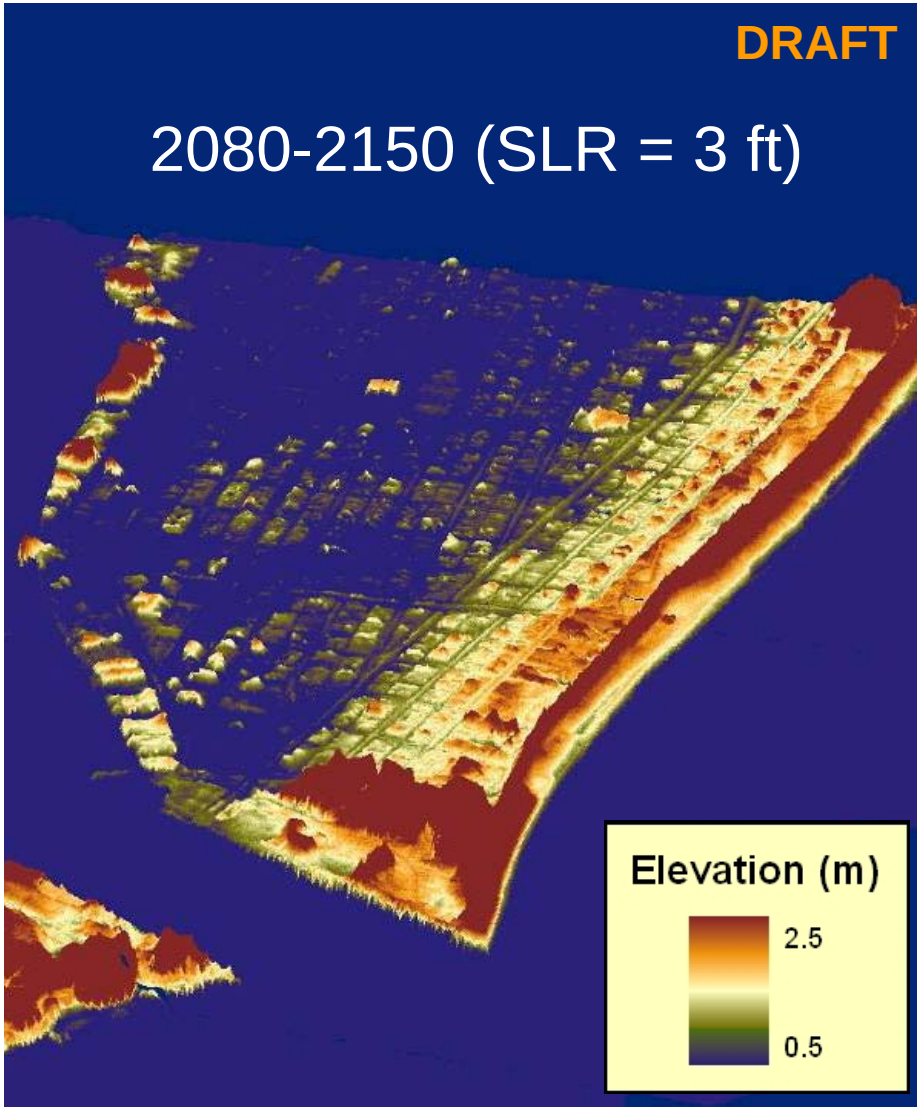
3 Feet Sea Level Rise (2063-2085)

Inundation projections using LiDAR elevation data

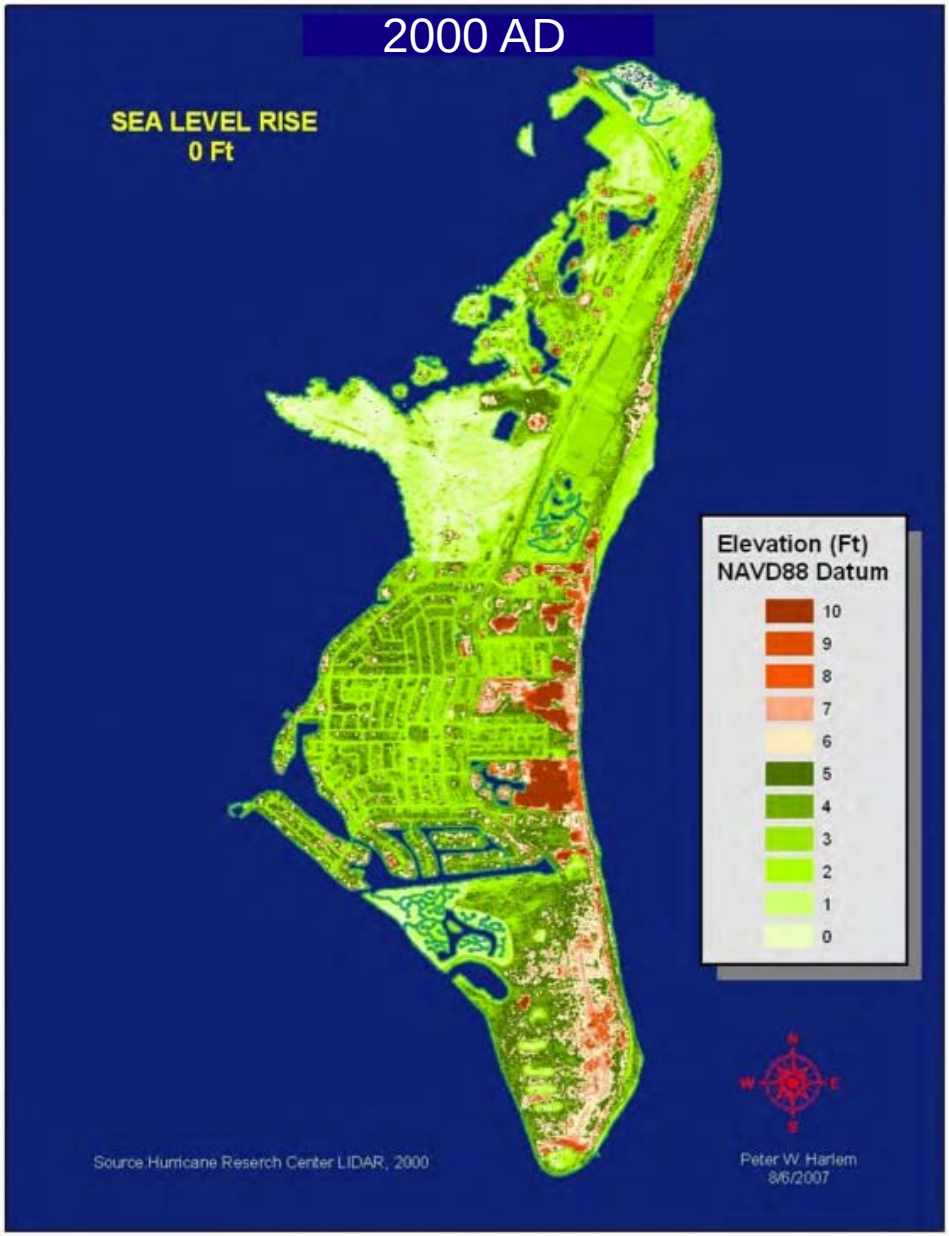
SLIDE #6 – H.R. Wanless, 2012 from P. Harlem,

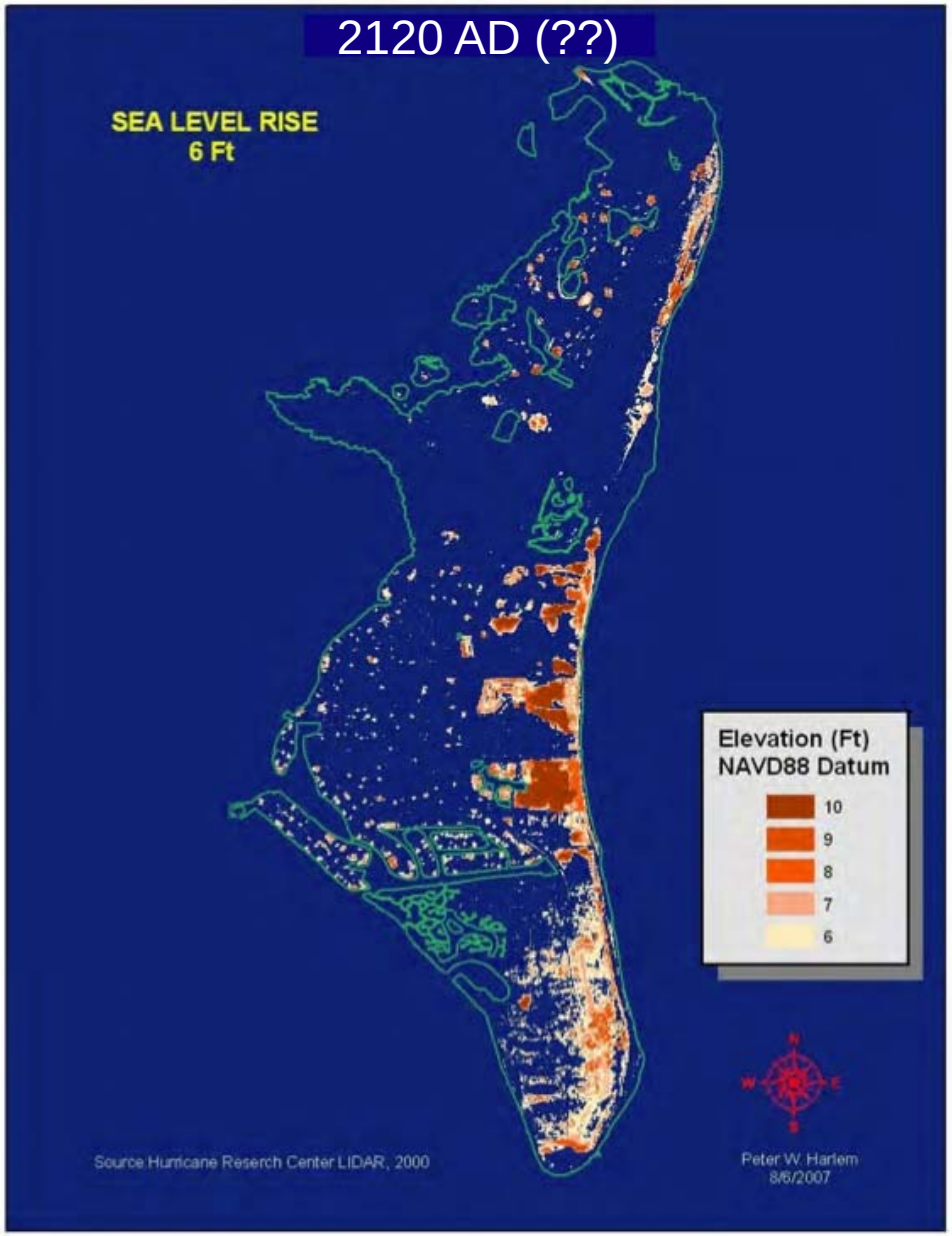
South Beach Area Showing present & Future Conditions.



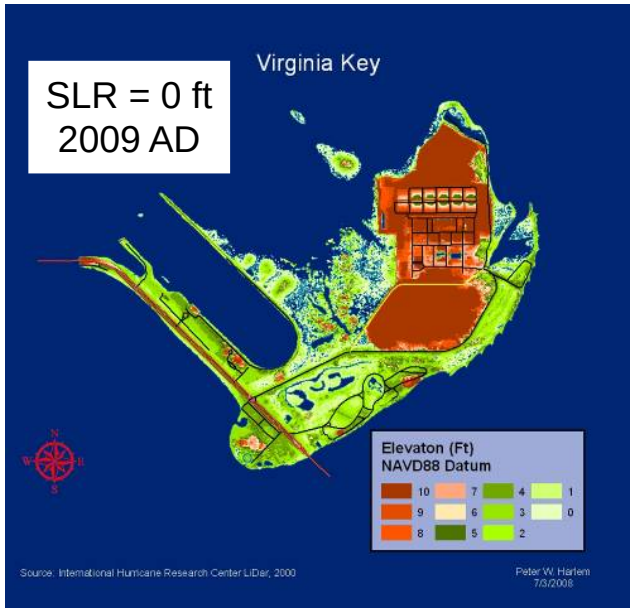


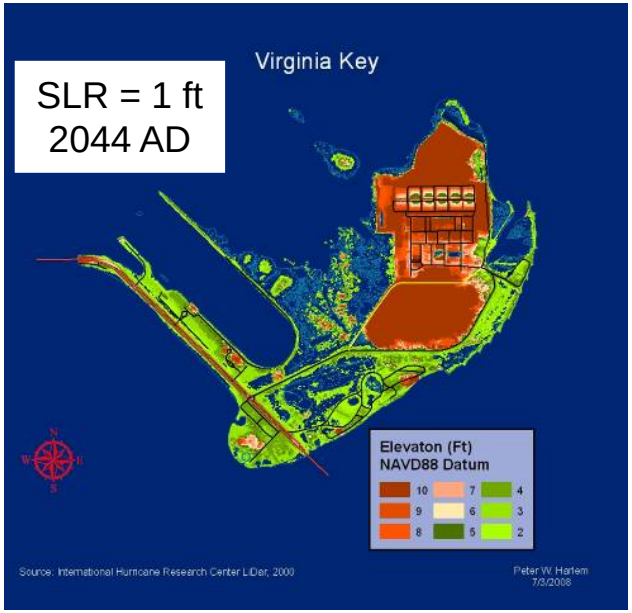
Key Biscayne — Now and Future

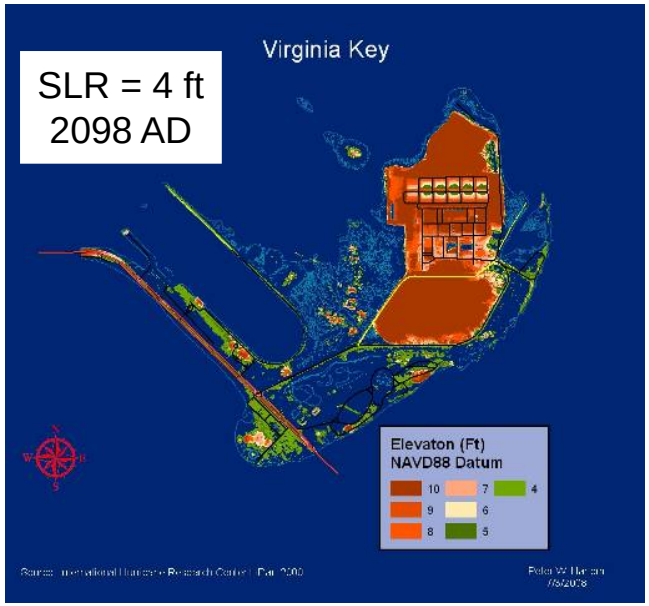


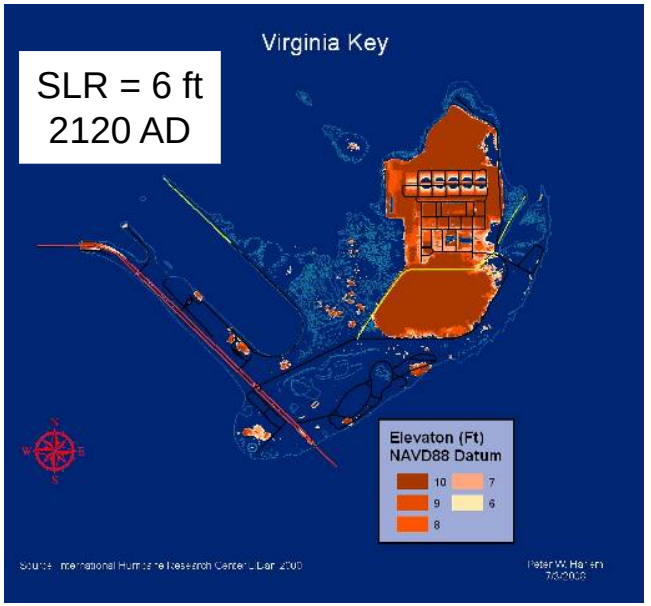


Sea Level Rise on Virginia Key










The End
Any questions?

Useful Websites

IPCC Working Group I, Fifth Assessment Report
www.ipcc.ch/wg1

SE Florida Climate Change Compact
southeastfloridaclimatecompact.org

NOAA SLR viewer
www.csc.noaa.gov/slr/viewer/#

Climate Central SLR viewer
sealevel.climatecentral.org/ssrf/florida

YouTube SLR animation
www.youtube.com/watch?v=inf-Wj2Xm40