

Unstoppable Sea Level Rise Demands Adaptation Now



Coastal Futures 2020

John Englander

London







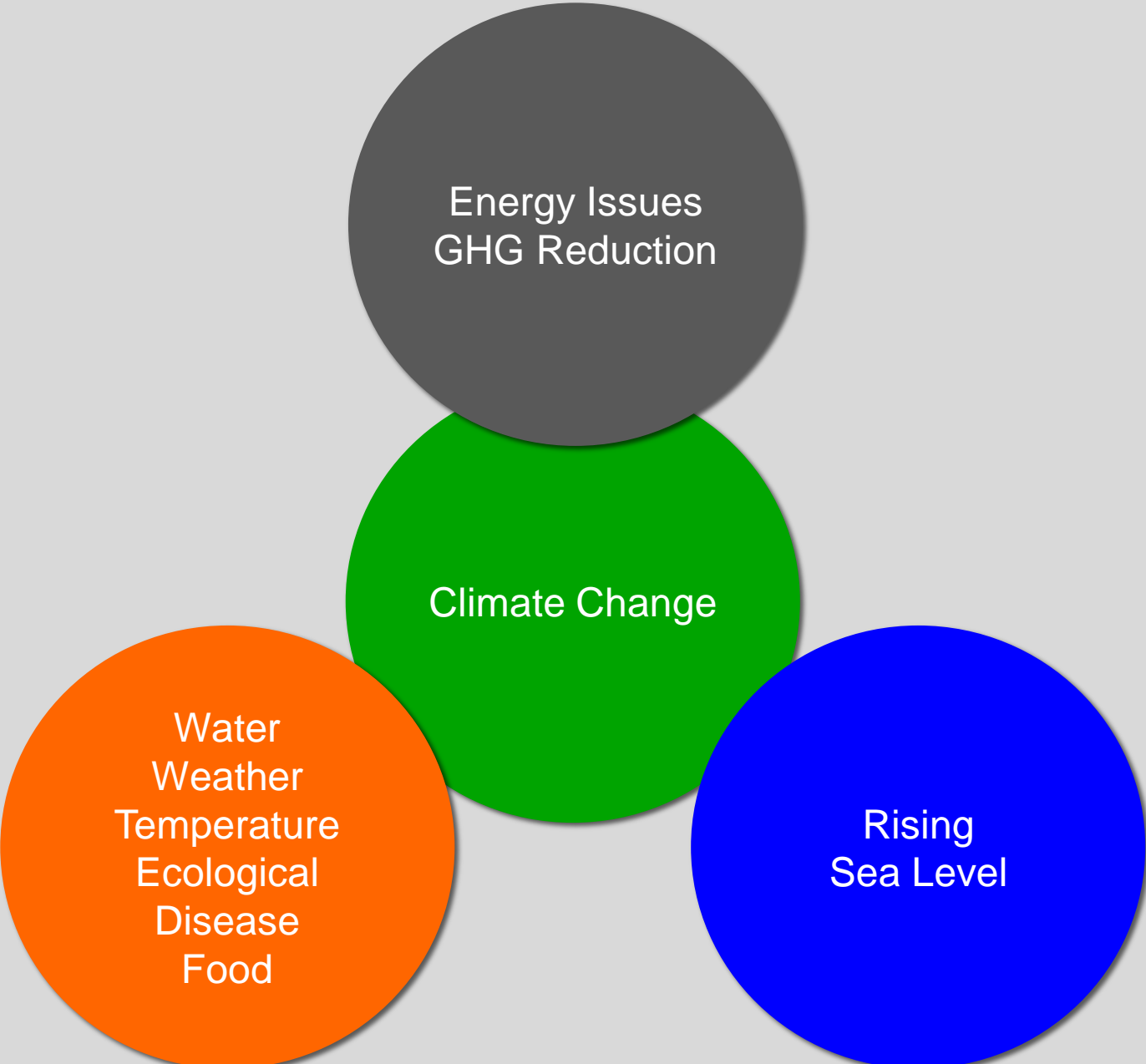








Climate Change



Energy Issues
GHG Reduction

Climate Change

Water
Weather
Temperature
Ecological
Disease
Food

Rising
Sea Level

Climate Change



ENERGY related: reduce CO2 emissions (Greenhouse Gases) to slow and eventually halt the warming

EFFECTS: extreme weather, rain, droughts, high heat, wildfires, ocean acidification, melting glaciers

RISING SEA LEVEL – can be slowed but not stopped this century – affects coastlines, migration, humanitarian, national security, real estate

5 Flood Factors + Erosion

1.Storms

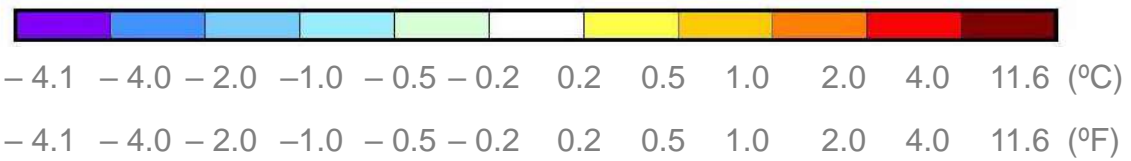
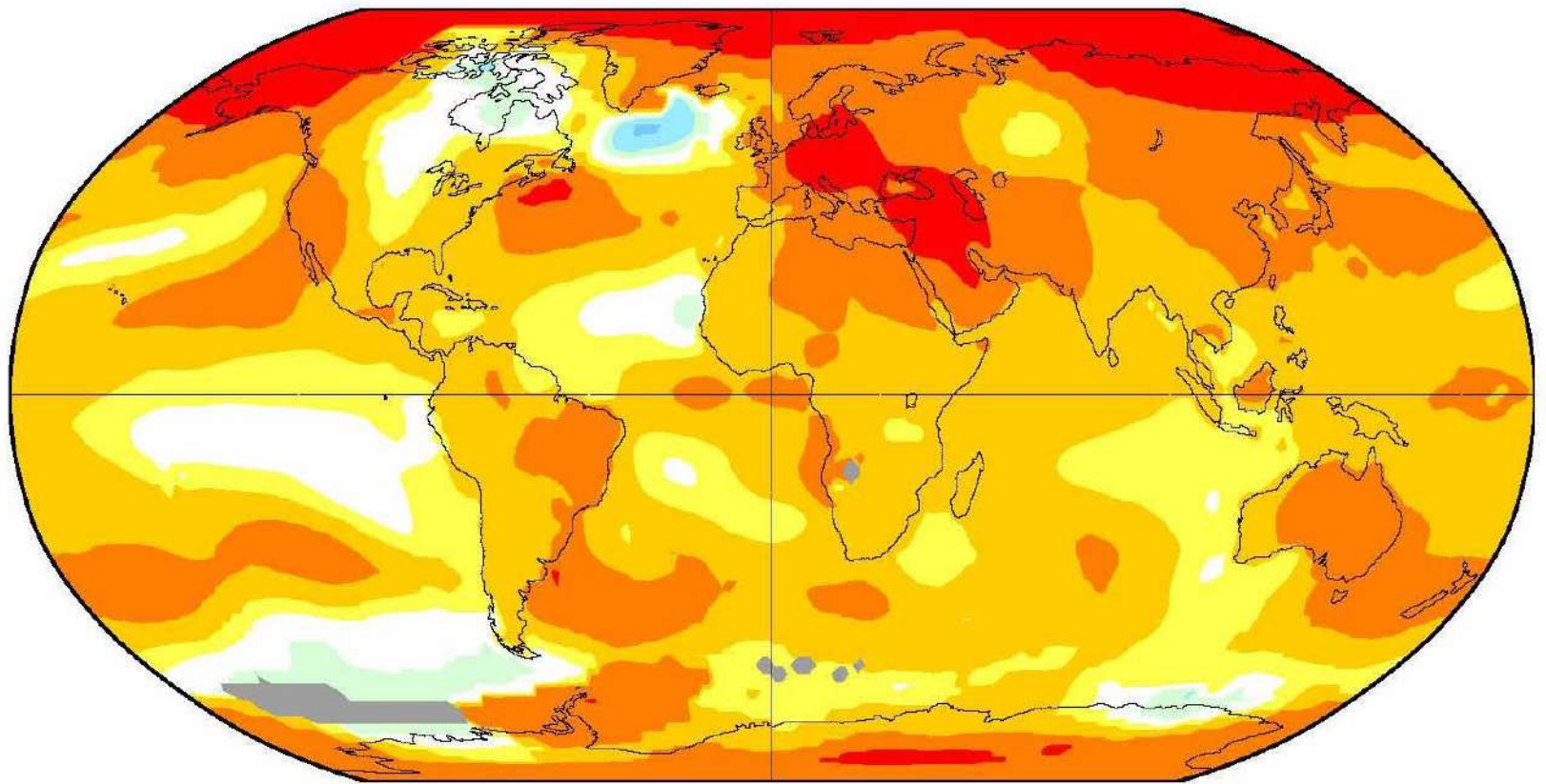
2.Rain

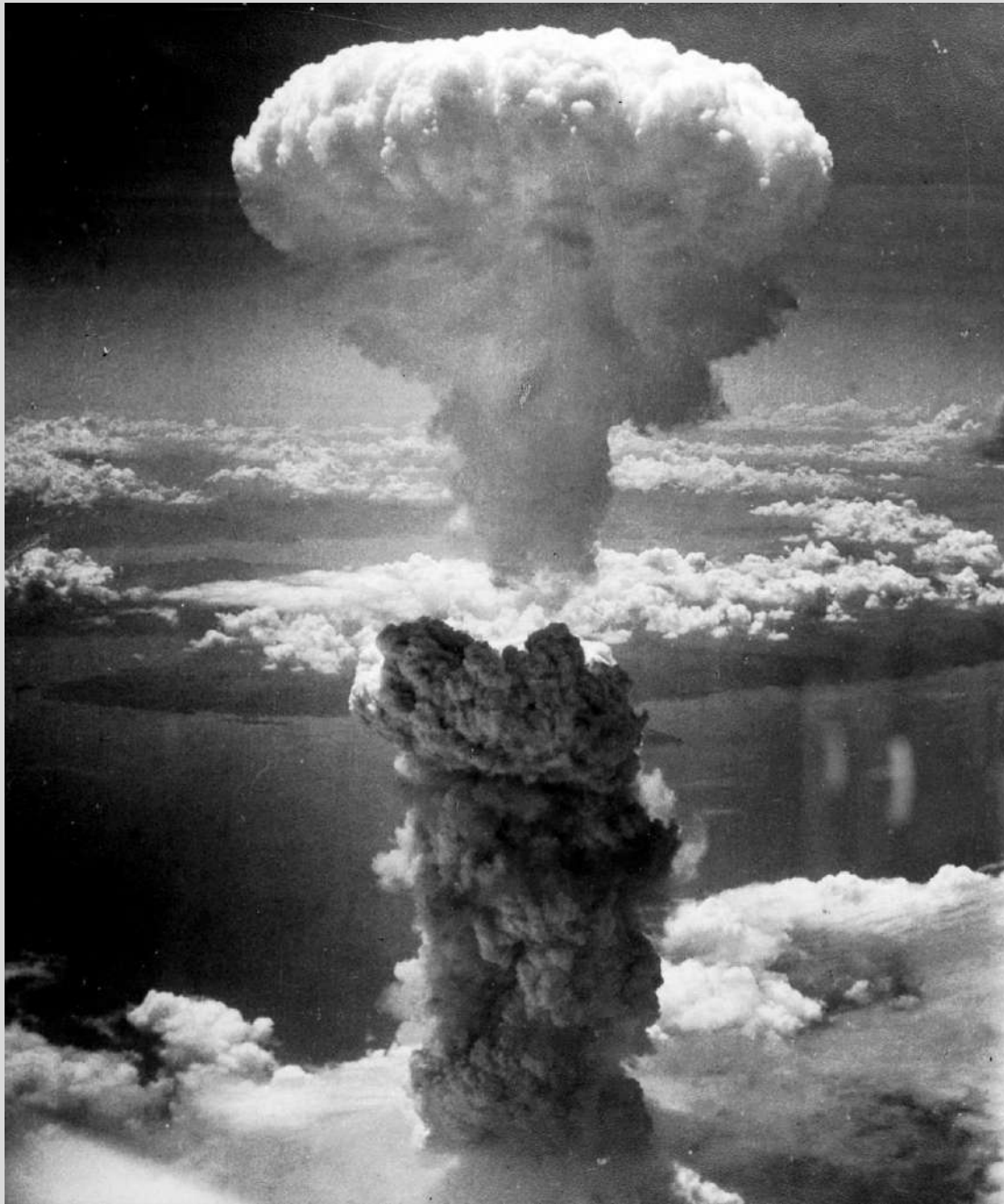
3.Runoff

4.Extreme Tides

5.Rising Sea Level

6.Erosion





GHG Traps Excess
Heat equal to 500,000
atomic bombs a day.
5 every second, 24 / 7
93% of the heat is
stored in the ocean.



MELTING ICEBERGS

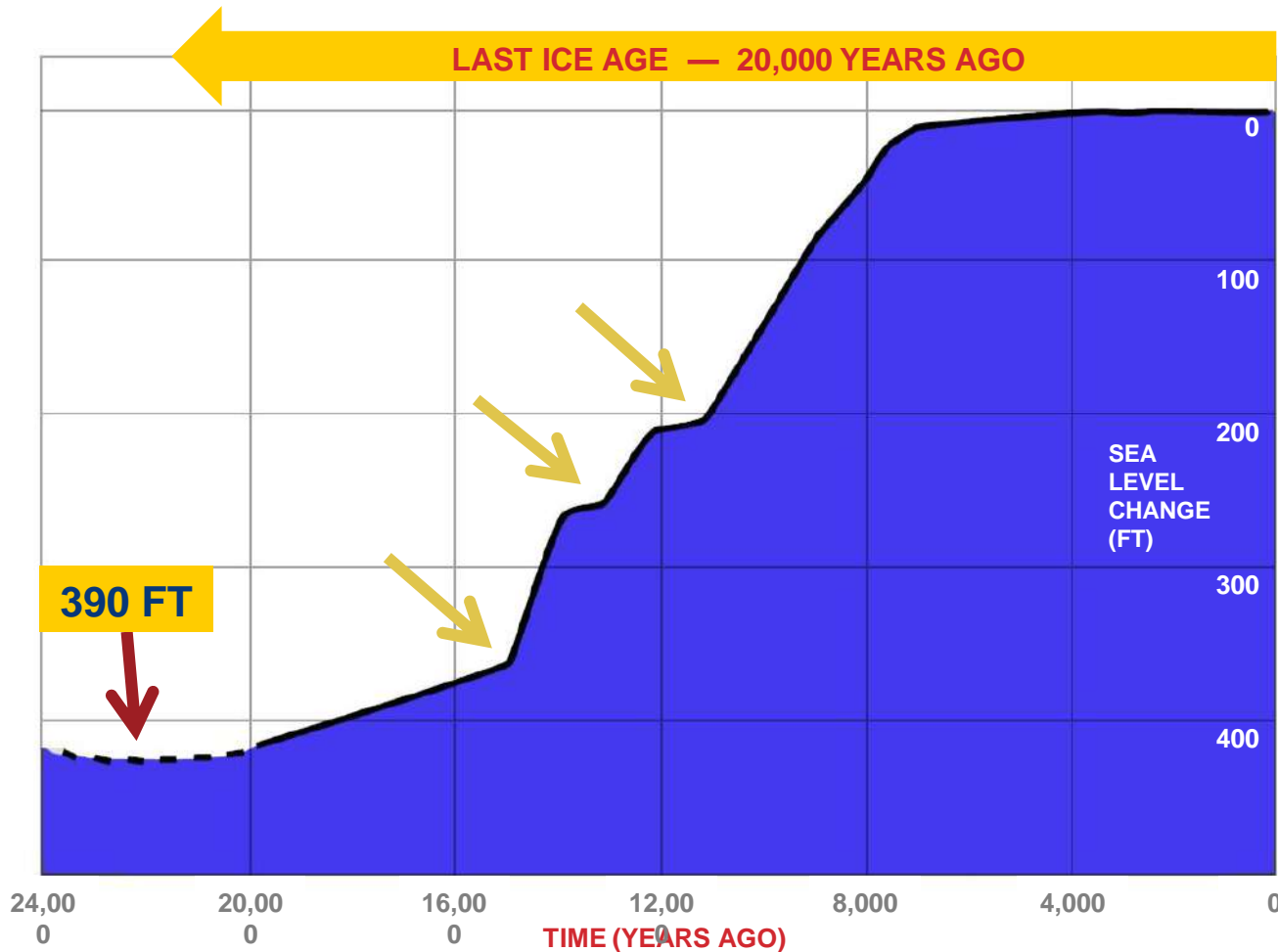
have no effect on sea level



ICE ON LAND: MAIN CAUSE OF SEA LEVEL RISE



LAST ICE AGE SEA LEVEL



Miami Tower, Bank of America



**ICE
AGE**
THE MELTDOWN

Sea level Rise Since Last Ice Age

– Last 18,000 years

Doggerland and Doggerbank



Land above Sea-Level:

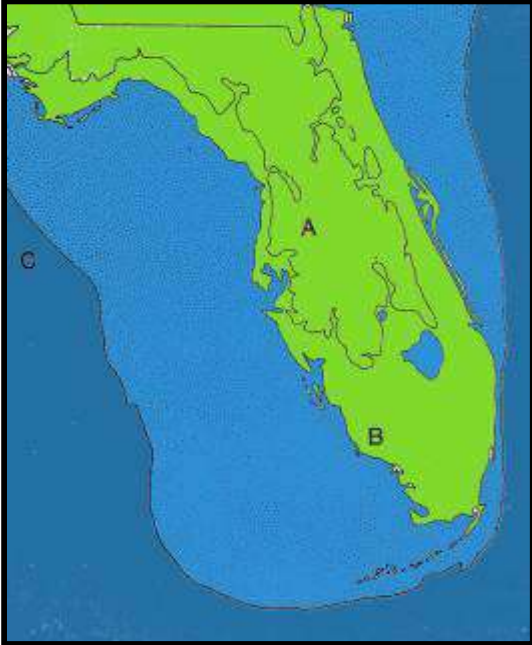
- 16,000 BC
- 8,000 BC
- 7,000 BC
- Doggerbank 5,500 BC
- ★ Storrega landslide
- ancient lake



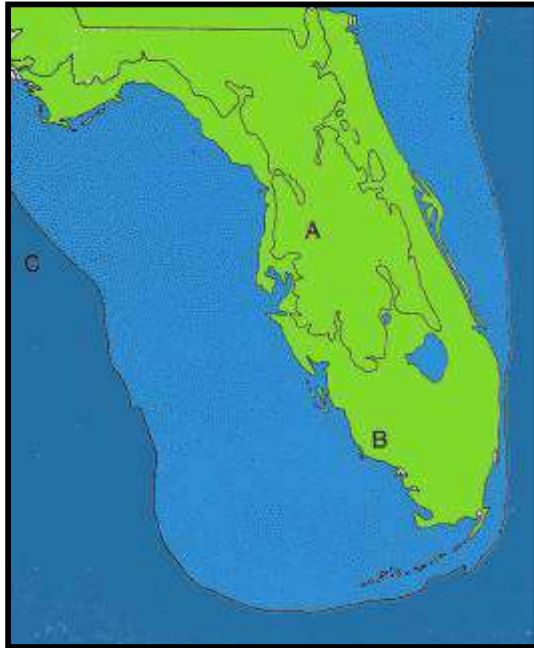
Vistula-Würm glaciation (115,000 to 10,000 BC)
Greatest extent of the ice shield c. 20,000 BC



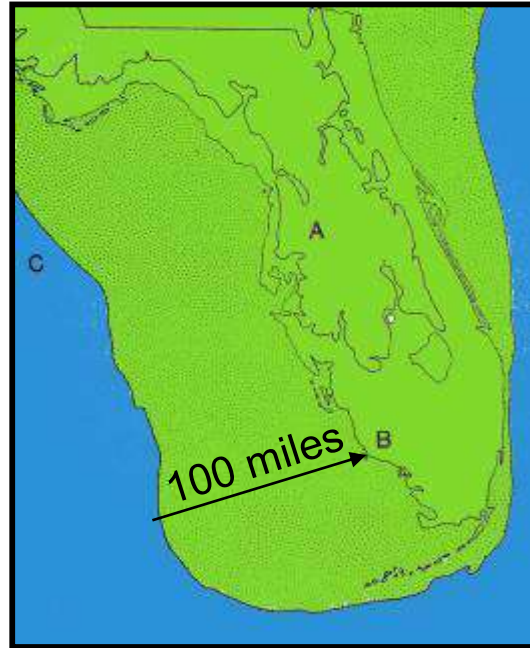
Today



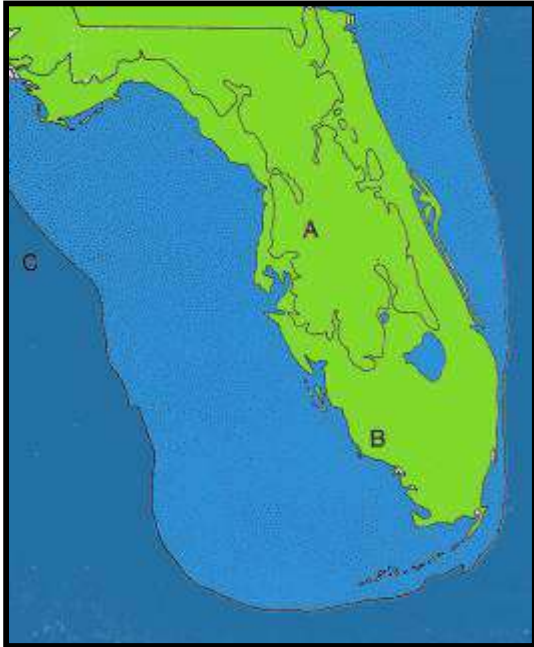
Today



20,000 yrs ago



Today

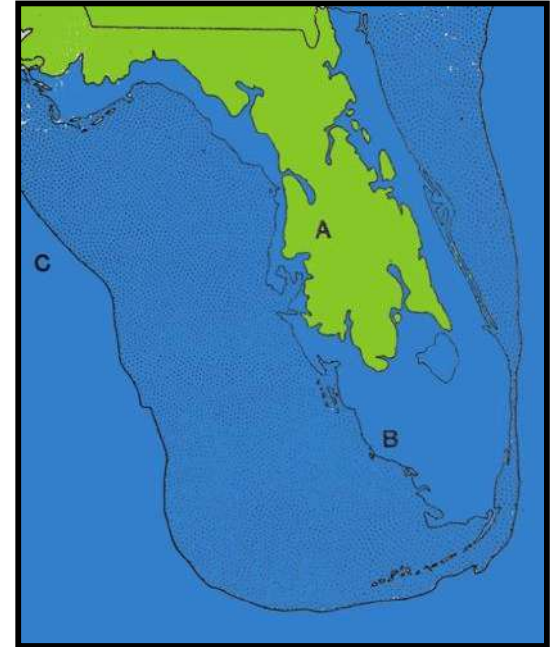


20,000 yrs ago



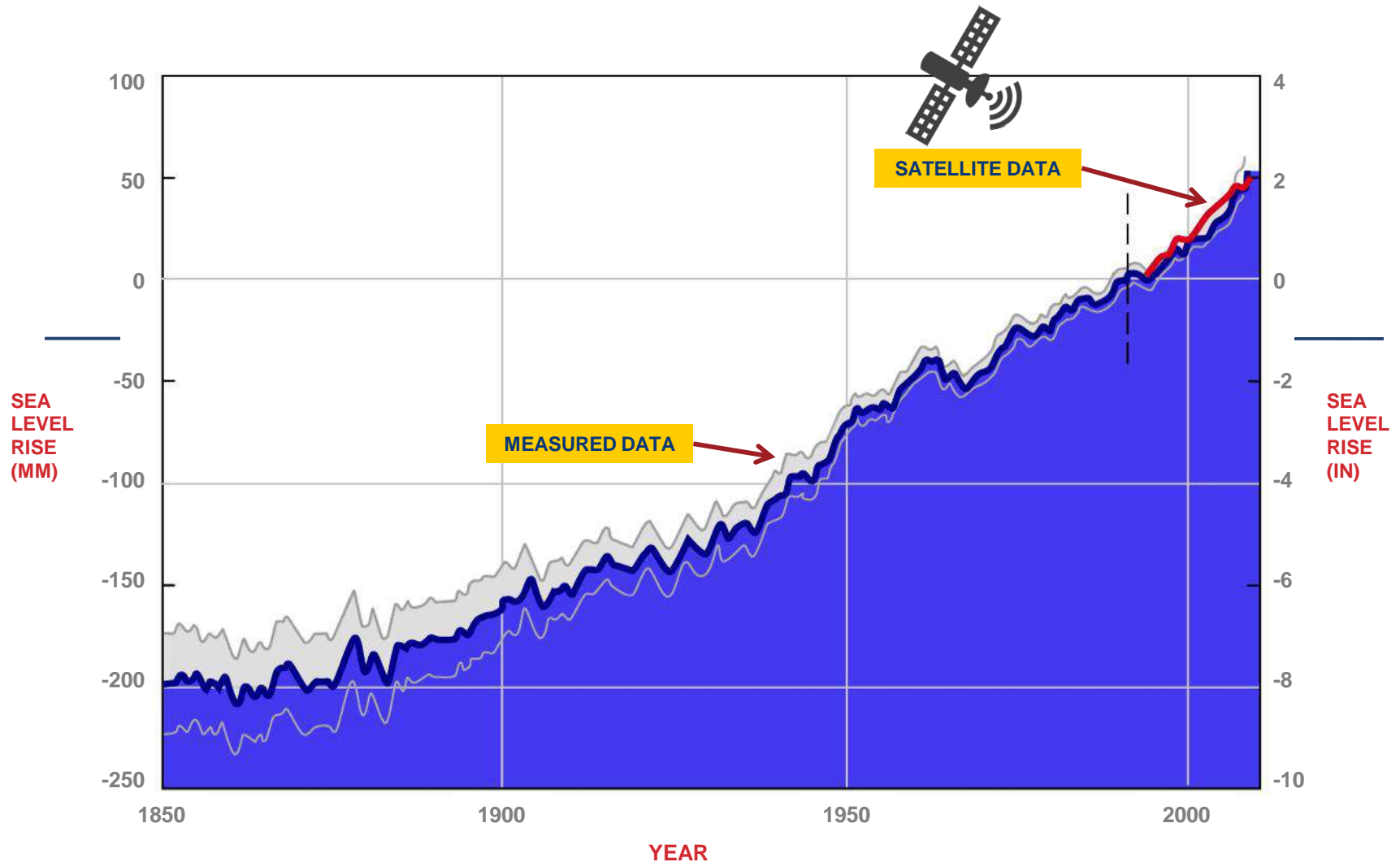
-390 feet

120,000 yrs

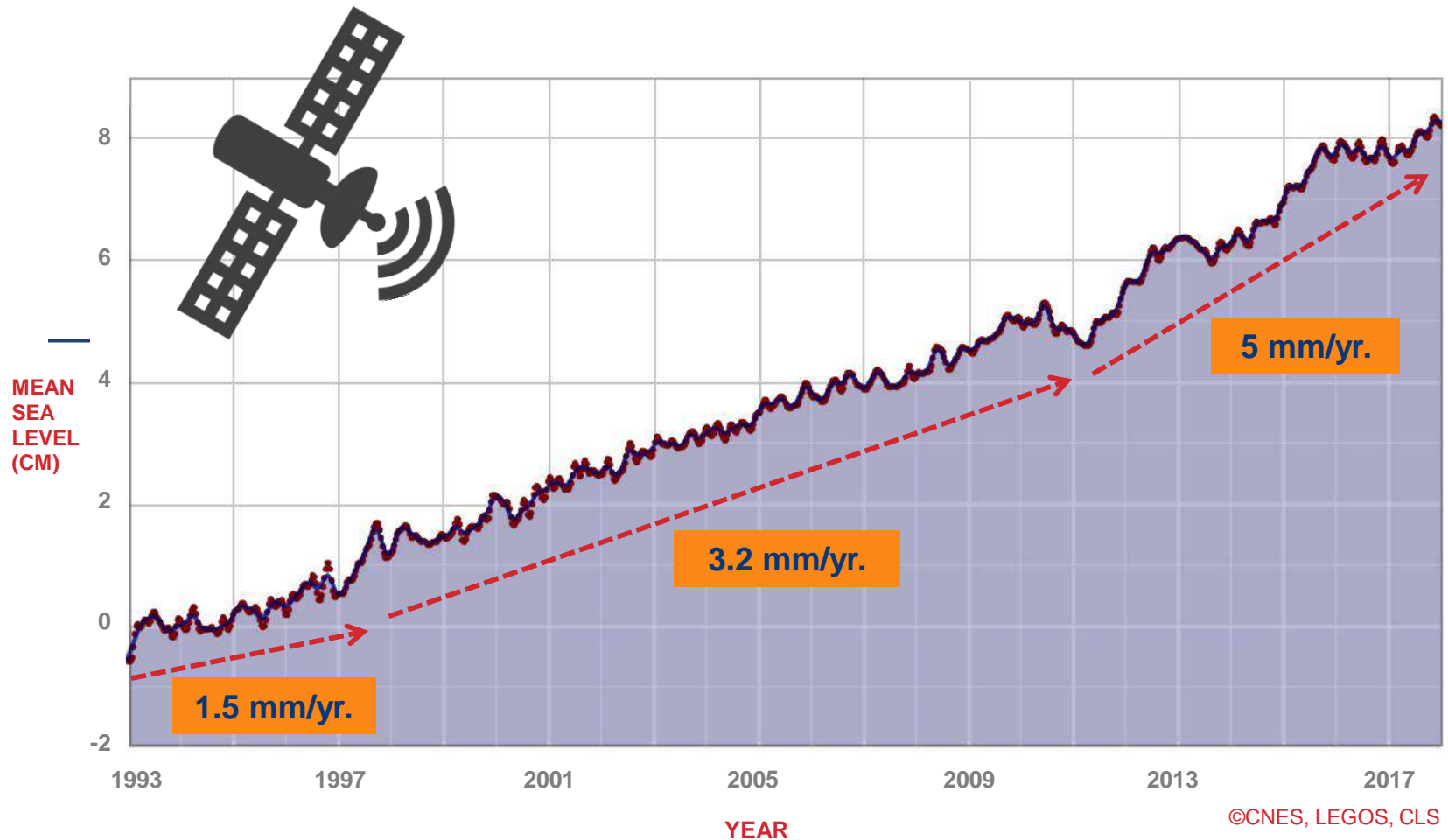


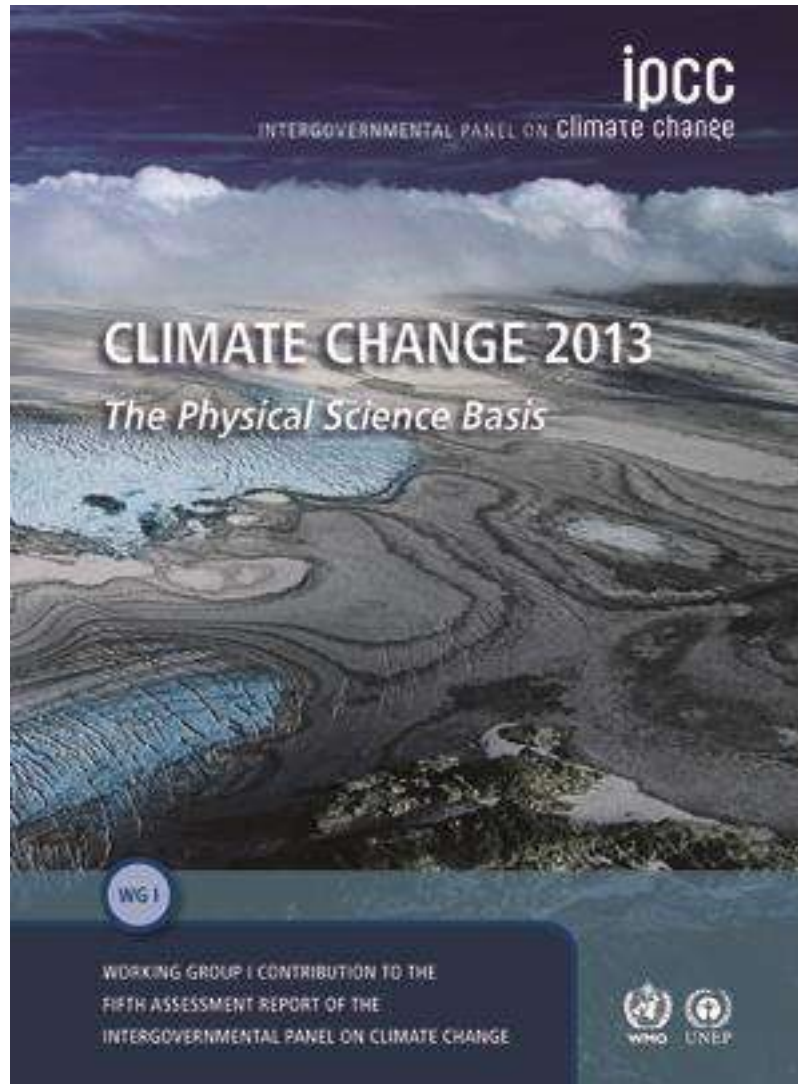
+ 25 feet

20TH CENTURY SEA LEVEL RISE

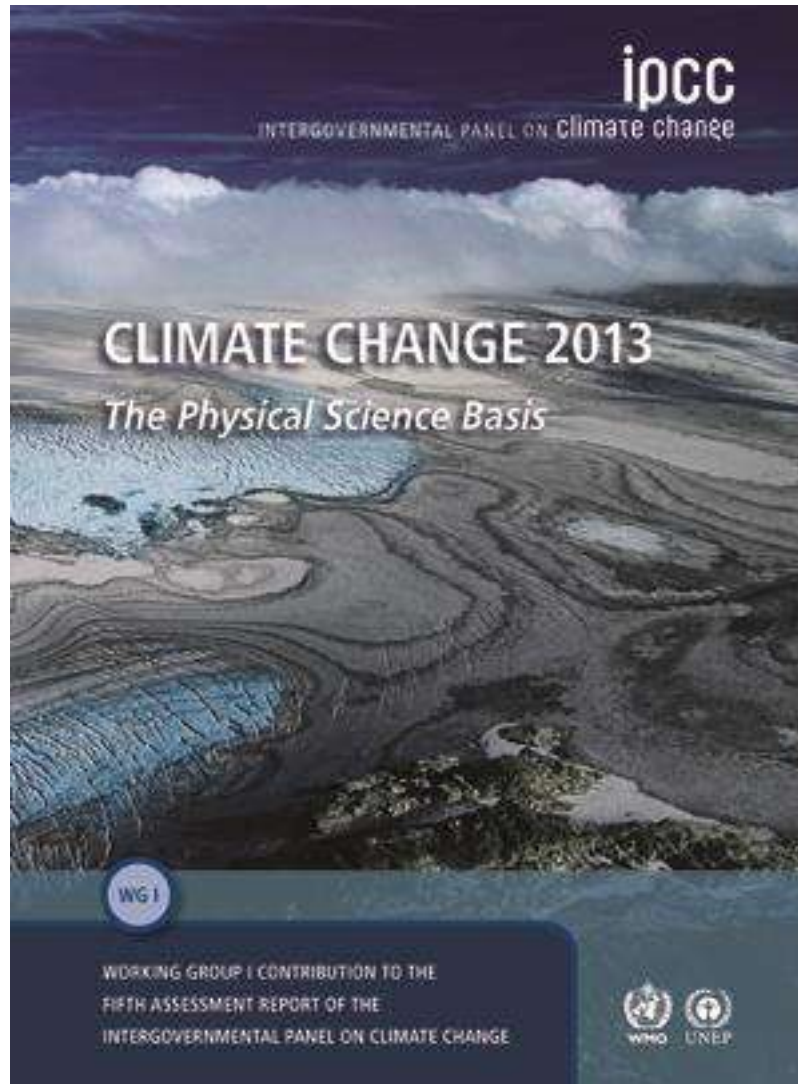


RATE IS ACCELERATING

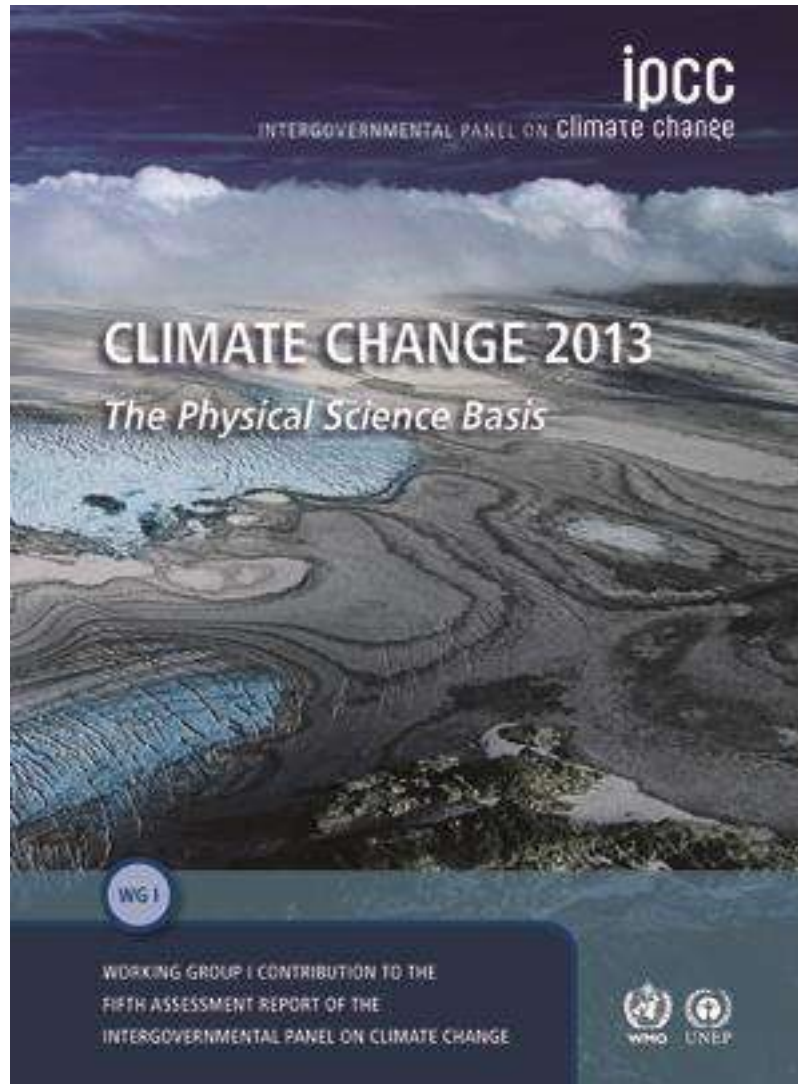




IPCC Sea Level Rise Projections



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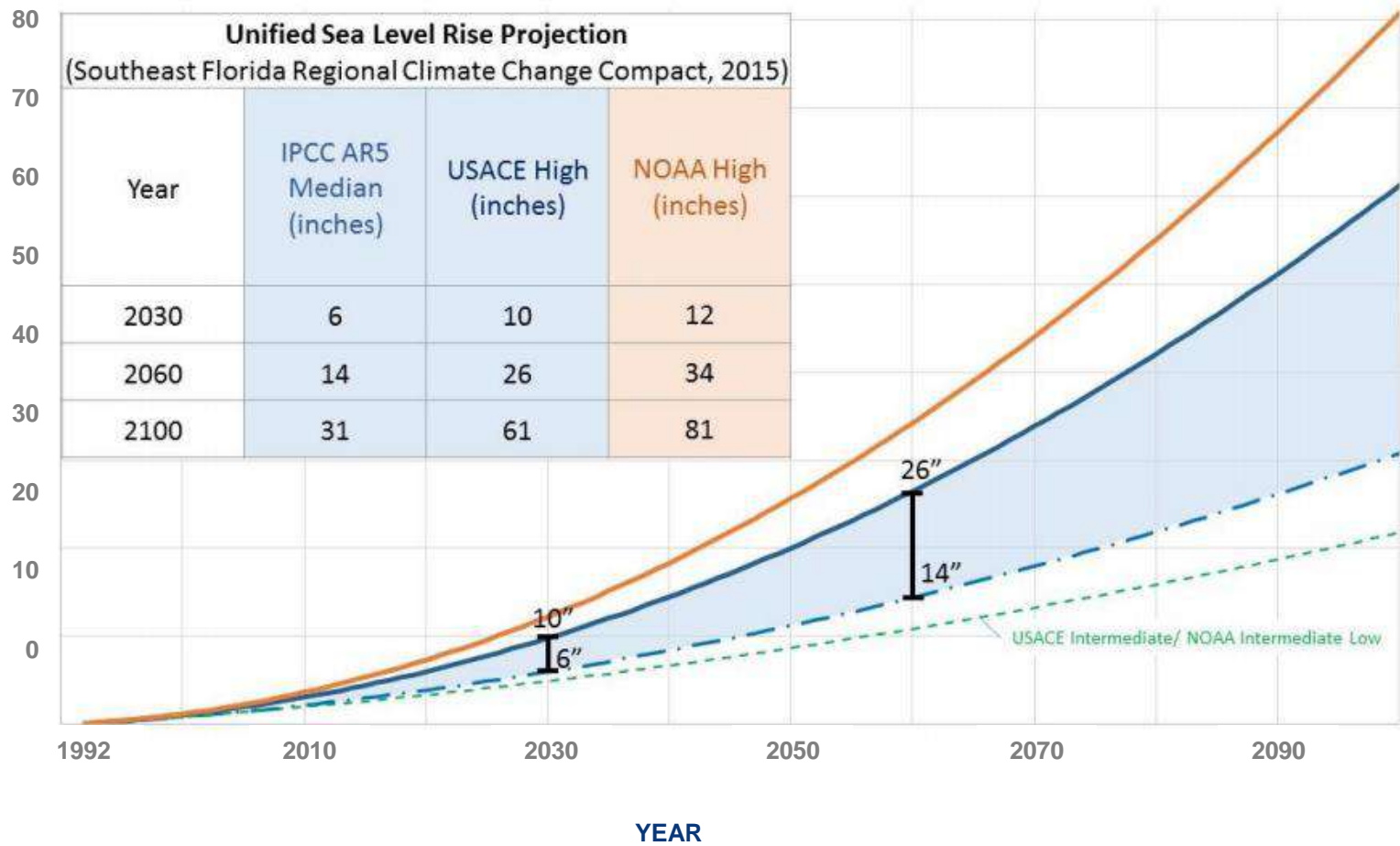


IPCC Sea Level Rise Projections

4th Scenario (RCP 8.5)

Sea Level @2100

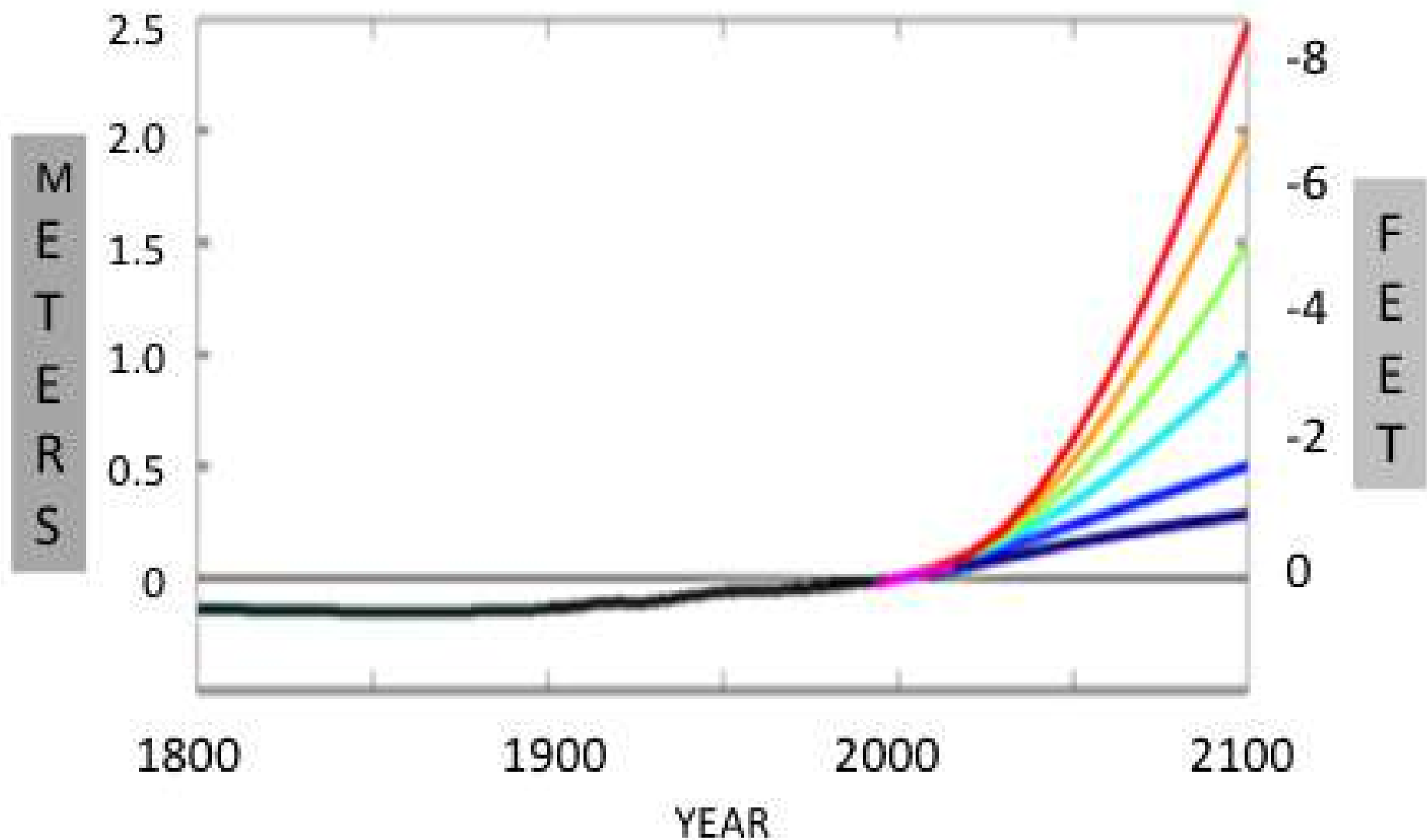
+92 cm



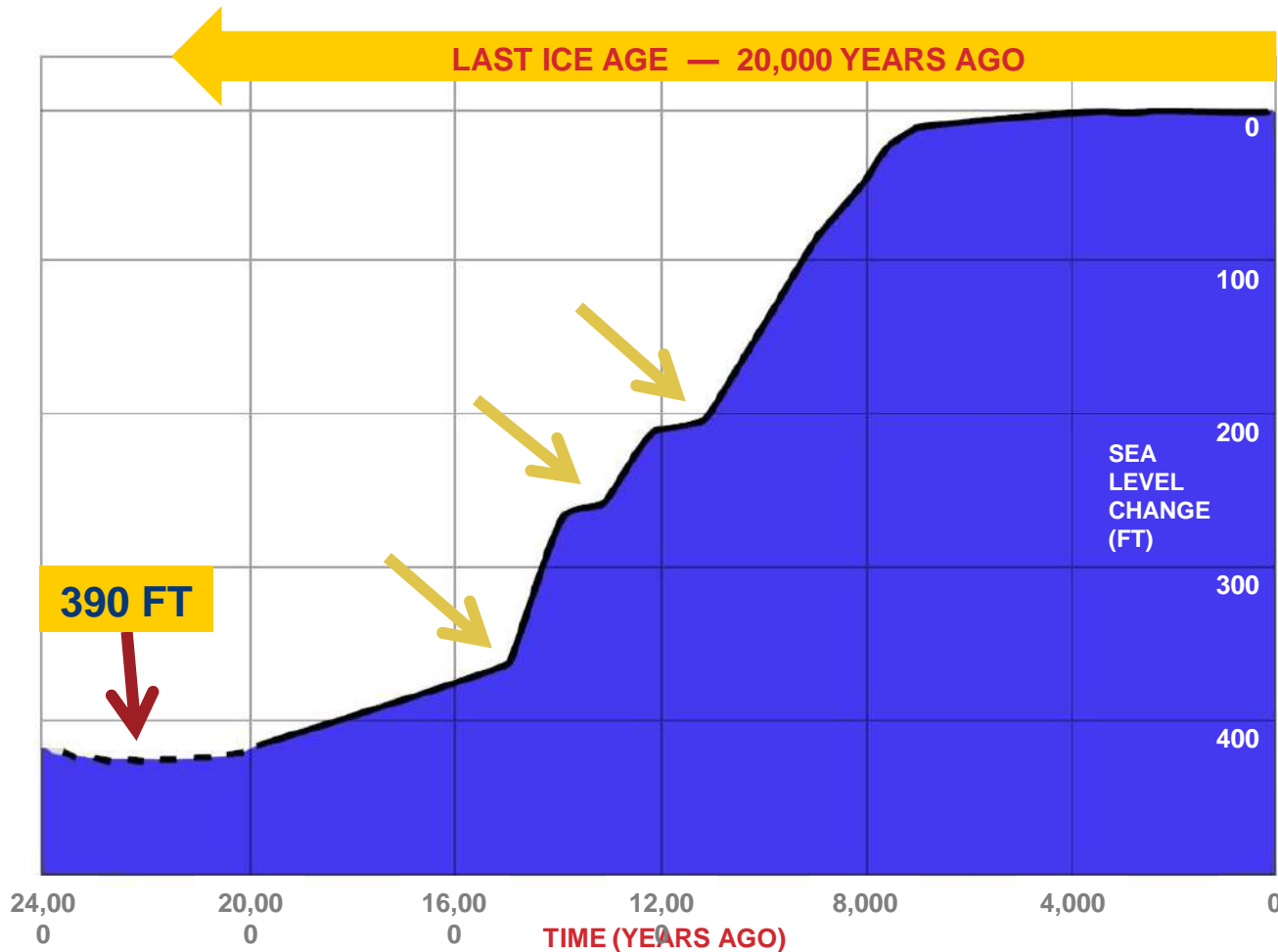
Southeast Florida Regional Climate Change Compact - 2015

Six Projections for Rising Sea Level

2017 NOAA Technical Paper 083



LAST ICE AGE SEA LEVEL

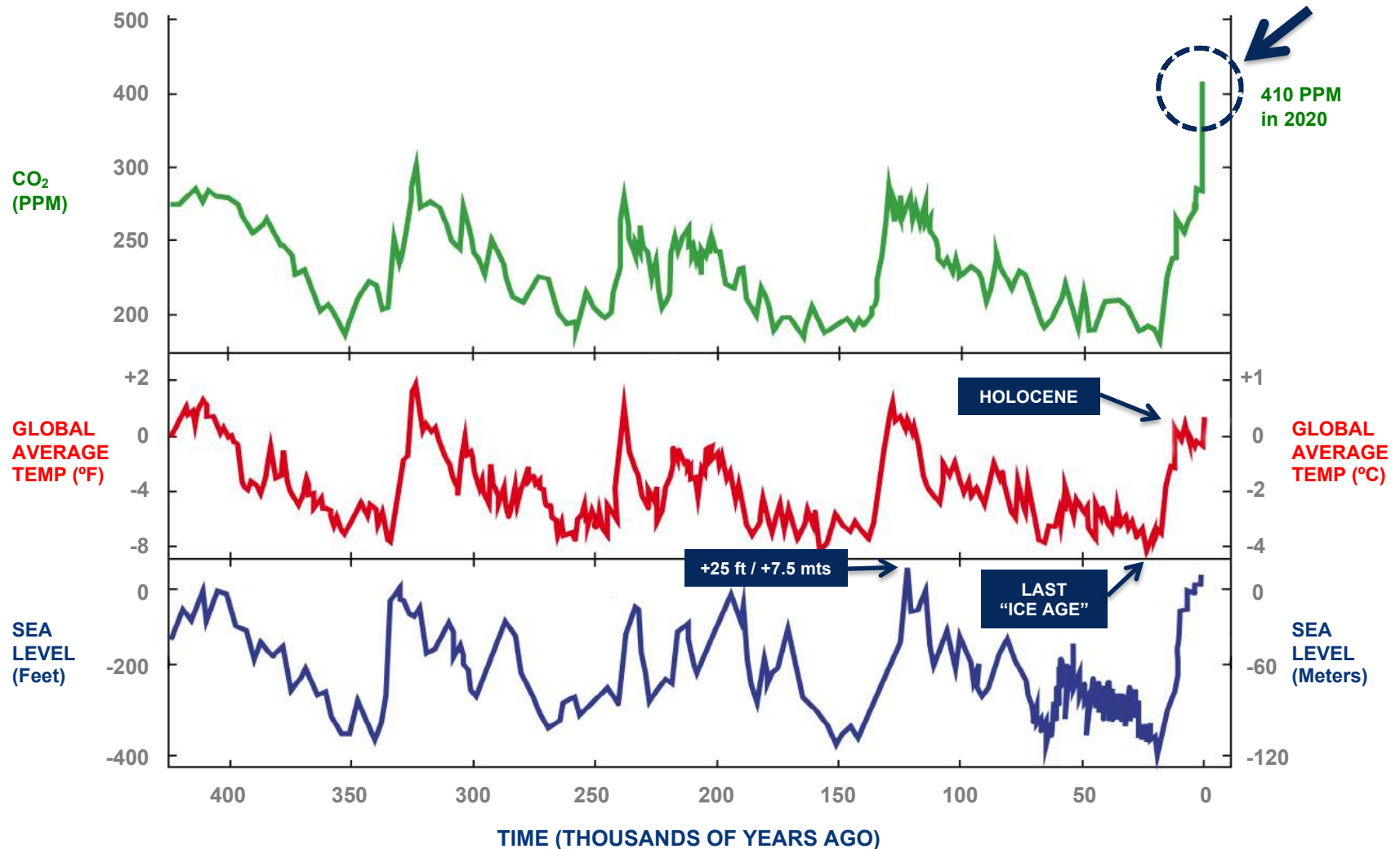


Miami Tower, Bank of America

Sea Level, Temperature & CO₂

move together over thousands of years – 4 “ice age cycles” shown

Based on Work of James Hansen & Makiko Sato

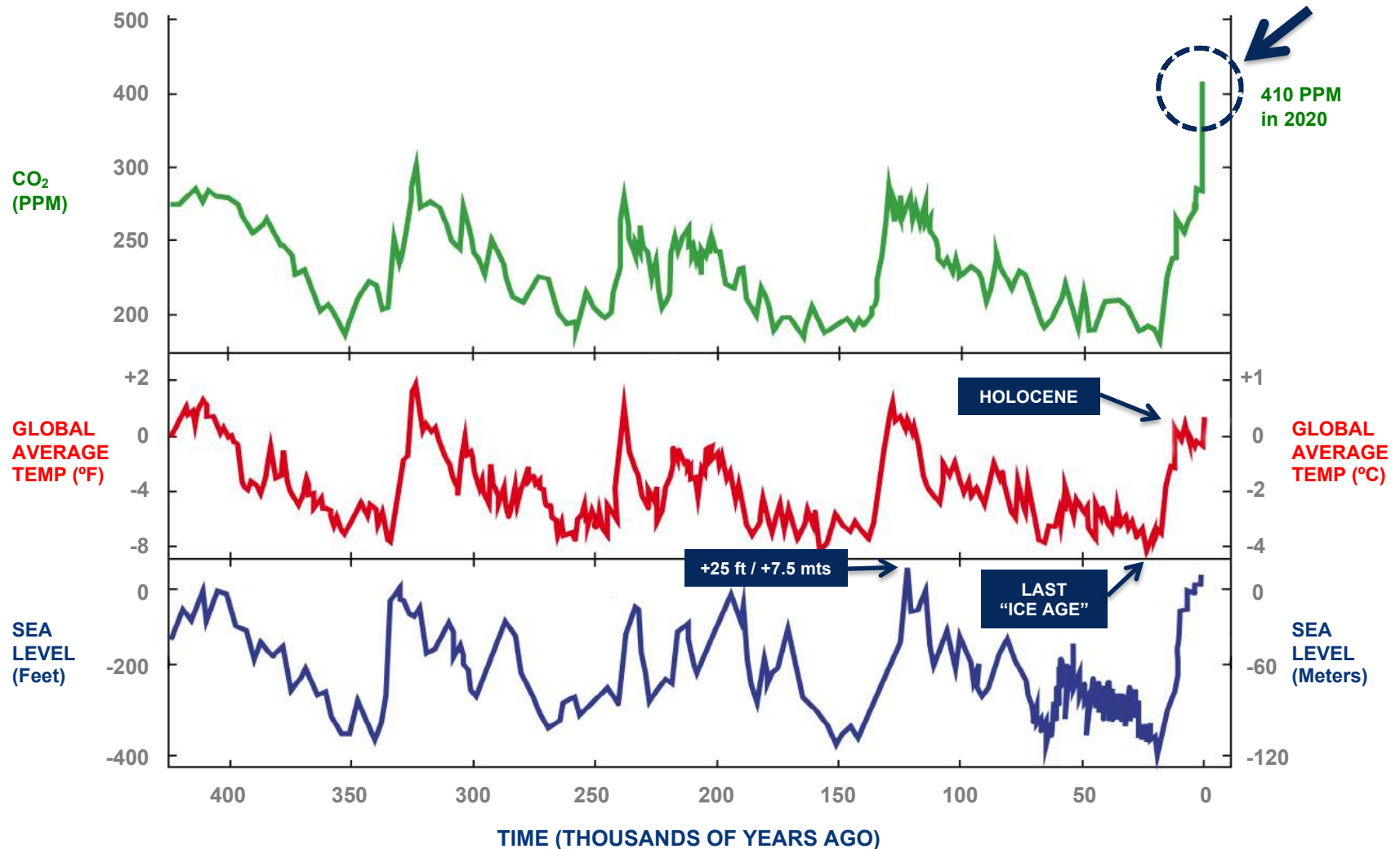




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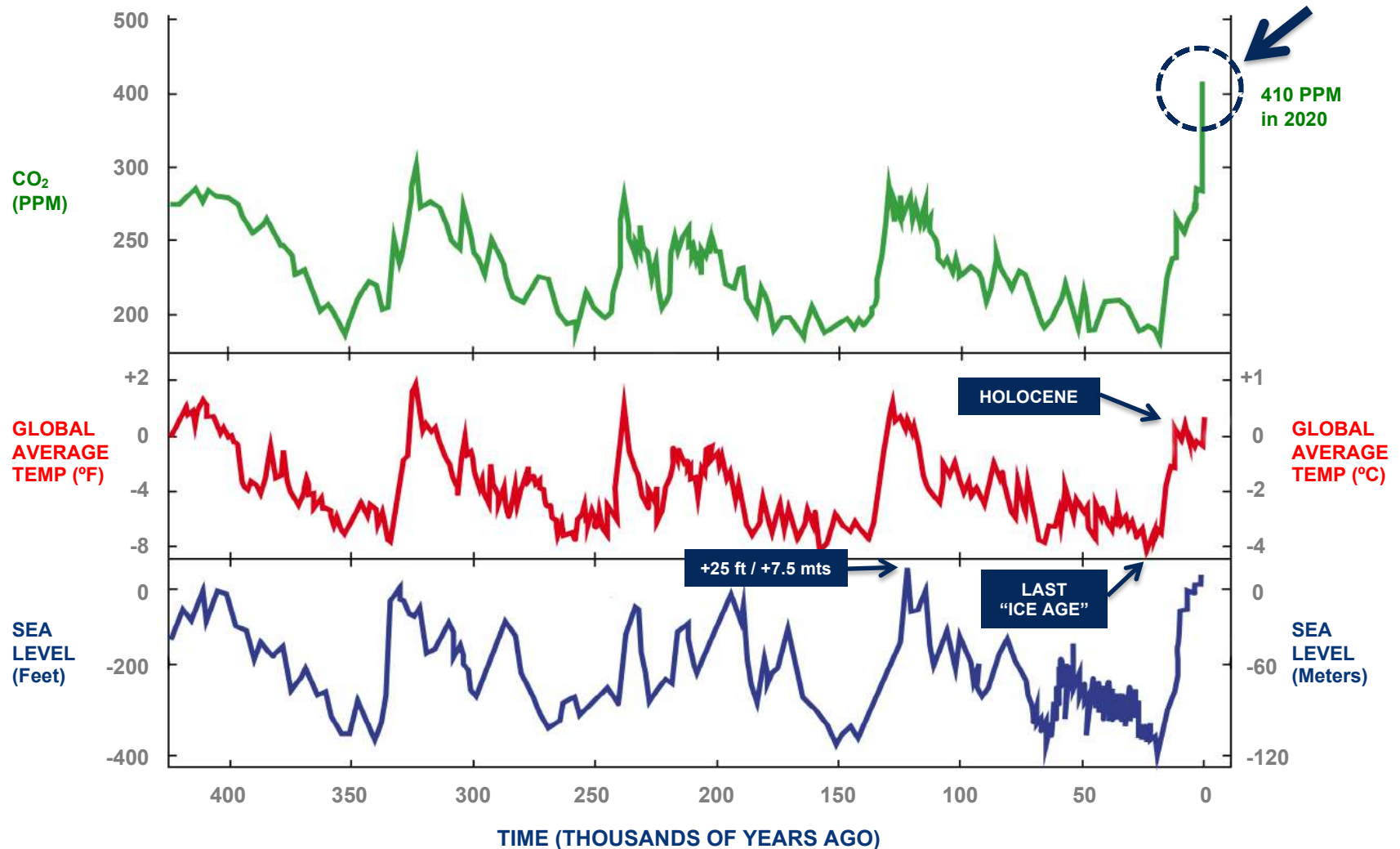


24 m / 1°C

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SOME SALTY TRUTHS

- Rising seas and shifting shorelines are unstoppable, regardless of GHG reduction
- Every inch makes short term flooding worse
- Impossible to predict precisely
- Vulnerable property values will be discounted much sooner than people expect
- Property values go “underwater” 3 ways...

WHAT CAN YOU DO

- **Educate yourself & others**

- Friends, family, neighbors, business associates
- Investment advisor
- Elected Officials: local, state, federal – revise building codes

- **Evaluate your assets**

- Based on vulnerability, age, \$, % at risk
- Modify asset, sell it (move), or enjoy!

At a Deeper Level...

- **Don't panic**
- **Assess your vulnerability**
- **General Guideline: Plan for the first meter as soon as possible**
 - **Elevate**
 - **Retreat**
 - **Invest**

RISEING SEAS: THE ENGINEERING CHALLENGE.

Institution of
**MECHANICAL
ENGINEERS**



Improving the world through engineering

12 November 2019

IMechE - London

SAFE-Design Heights Future Flooding

“Englander 9 Box Matrix”

| | 30 years | 60 years | 100 years |
|-------------------------|----------|----------|-----------|
| <u>Risk Sensitivity</u> | | | |
| Low | 30 cm | 60 cm | 2 m |
| Medium | 60 cm | 1.3 m | 4 m |
| High | 1 m | 2 m | 6 m |

Figures shown are global average estimates for illustration only.

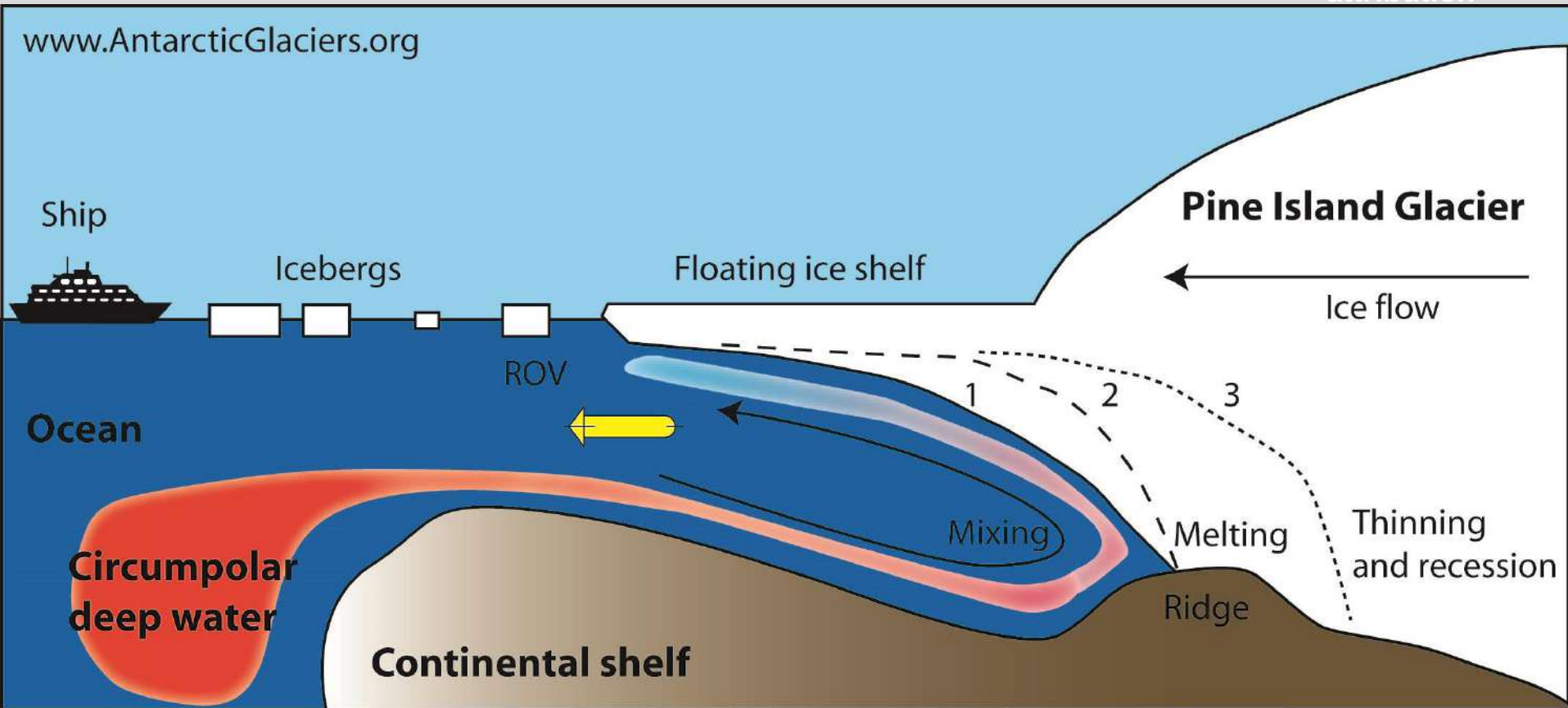
The New York Times

Lead Story - June 13, 2018

Antarctica Is Melting Three Times as Fast as a Decade Ago

The continent's rate of ice loss is speeding up, which is contributing even more to rising sea levels.





1. Early 1970s. Pine Island Glacier is grounded at a bedrock ridge.
2. Warm, inflowing Circumpolar Deep Water melts the base of the glacier. The glacier steepens and accelerates.
3. Present day, observed by a remotely operated vehicle (ROV). Glacier is thinning and receding.

Only two major sources of potential sea level rise (SLR)

Greenland =
24 feet of SLR



Antarctica =
186 feet of SLR

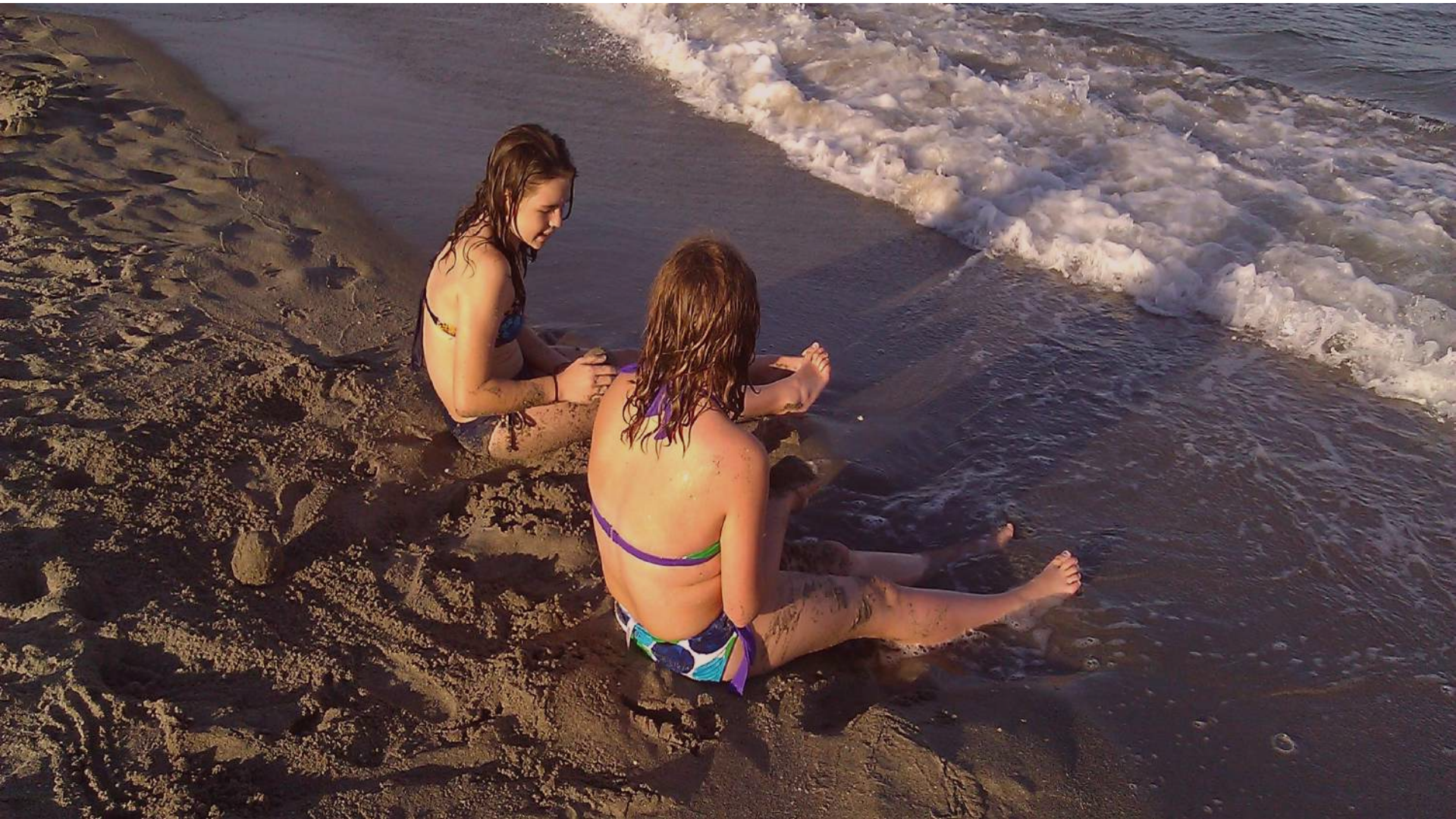




WE CAN DESIGN FOR
FLOODING



WE MUST RISE WITH THE TIDE





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