

Beach Nourishment on the Florida East Coast

Past

Future



02/15/2017

Boca Raton

Erosion is the Main Reason for Beach Nourishment

- **Past** - Erosion on the east coast was mainly caused by inlets created or modified for navigation

How much occurred and how well nourishment worked



Shed Light

- **Future** - Erosion will mainly be caused by sea level rise

How much and how well nourishment will work



Past Erosion

- Common argument against fighting erosion has been:
 “You can’t fight Mother Nature”
- The fight on the east coast has not been with Mother Nature, but with inlets modified for navigation



Past Erosion

Pre-Beach Nourishment (1800s-1970)

County	Data Start
Nassau	1857
Duval	1853
St Johns	1858
Flagler	1872
Volusia	1873
Brevard	1874
Indian River	1880
St Lucie	1883
Martin	1883
Palm Beach	1868
Broward	1884
Dade	1866

Measurements
about every
1000 ft
(almost 2000
locations)

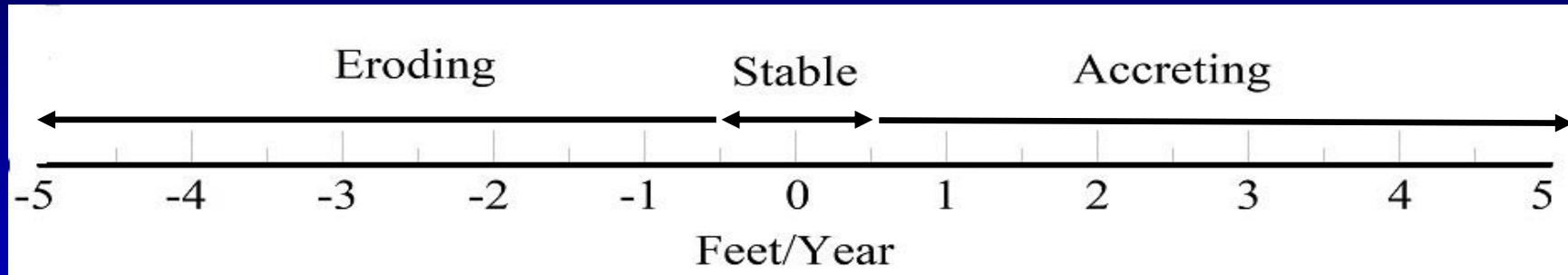


Shoreline
position data
from 1800s

- Determined shoreline change rates using data at all 2000 locations

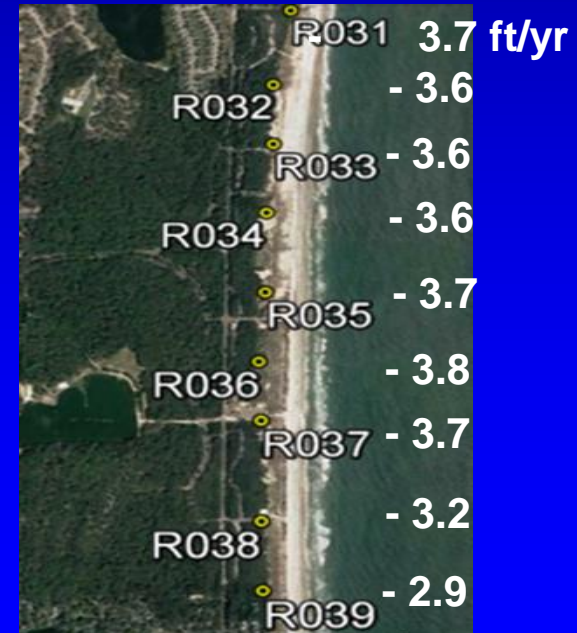
Eroding, Stable, Accreting

- Absalonsen and Dean (2011) determined shoreline change uncertainty of ± 0.5 ft/yr and defined this as stable



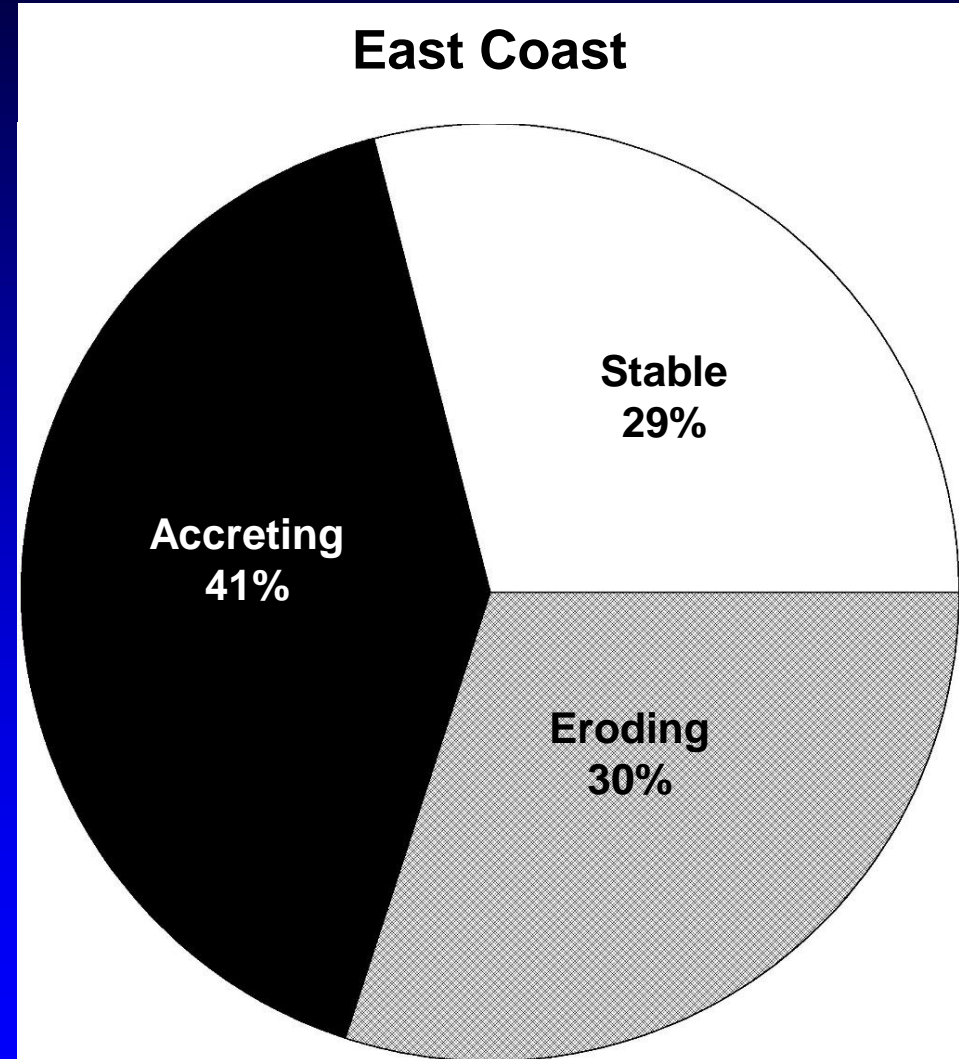
- Determined whether the shoreline was eroding, stable, or accreting at each of the 2000 locations

Example: Atlantic Beach
Duval County



Pre-Beach Nourishment (1800s - 1970)

- 70% of shoreline was stable or accreting
- Shoreline on average advanced + 75 ft
- Beyond inlets, only 9% of shoreline eroded despite sea level rise
- Substantial onshore sand transport (Houston and Dean, 2014)



Where Has Nourishment Been Placed?

Florida DEP has published 3 volumes of Strategic Beach Management Plans (2015) for the east coast

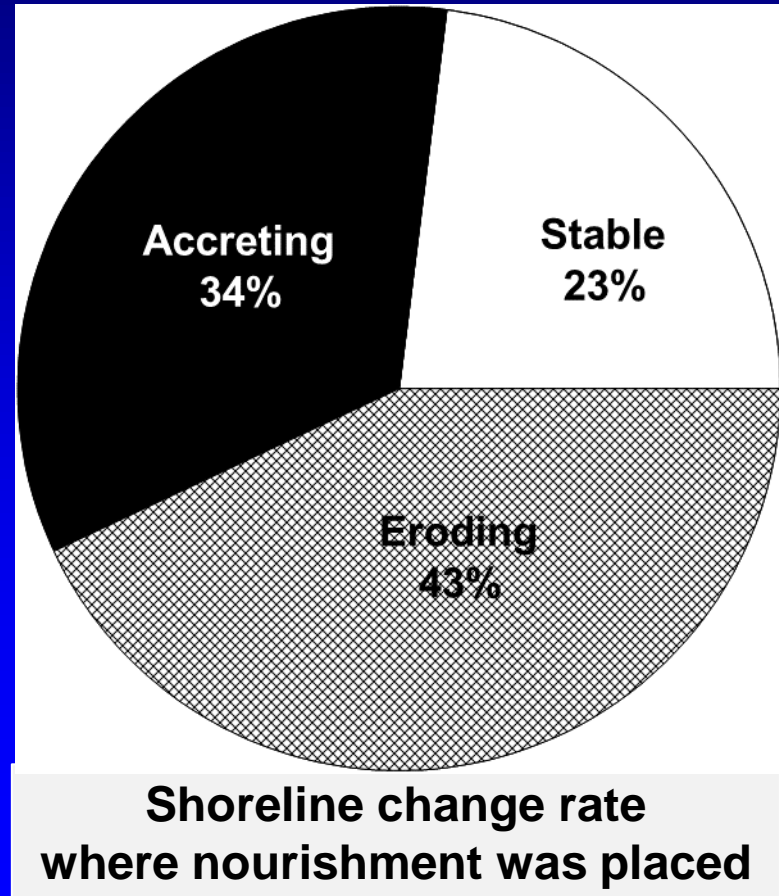
Date Completed	Volume (CY)	Source	Placement Location	Length (Mi.)
October 1980	2,877,200	Offshore borrow area	R31-R80	10.1
1985	1,284,400	Jacksonville Harbor	R41-R53	2.3
1986	308,650	Offshore borrow area	R52-R67	2.5
1987	849,770	Offshore borrow area	R67 to R80	2.5
1991	300,000	Offshore borrow area	R44-R52.5	1.6
November 1995	1,200,000	Offshore borrow area	R47-R80	7
2003	120,000	Jacksonville Harbor	R72-R80	1.5
August 2005	615,198	Offshore borrow area	R43-R53 and R57-R80	5.9
August 2011	689,015	Offshore borrow area	R43.5-R53 and R57-R80	5.9

Duval County



Beach Nourishment (1970 - 2015)

- Over 200 beach nourishment projects
- Over 120 million yd³ of sand placed
- Shoreline advanced 80 ft on average
- Only 43% of nourishment placed on eroding beaches
 - Beach encroachment
 - Recognition that wide beaches protect



Beach Encroachment - Miami Beach



Recognition That Wide Beaches Protect Hurricane Sandy, New Jersey

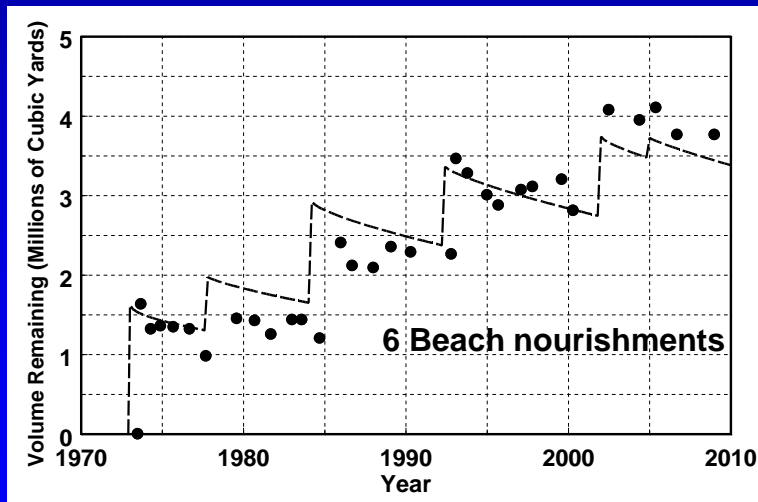
- *“Where there was a federal beach fill, there was no major damage - no homes destroyed”* (Associated Press, 2012)
- *“At locations without beach nourishment, the destruction was complete”* (New Jersey Star-Ledge, 2012)



Encroachment and Desire for Wide Beaches for Protection

- Delray Beach dunes leveled in 1920s
- Beaches widened 80 ft from 1883 to late 1960s

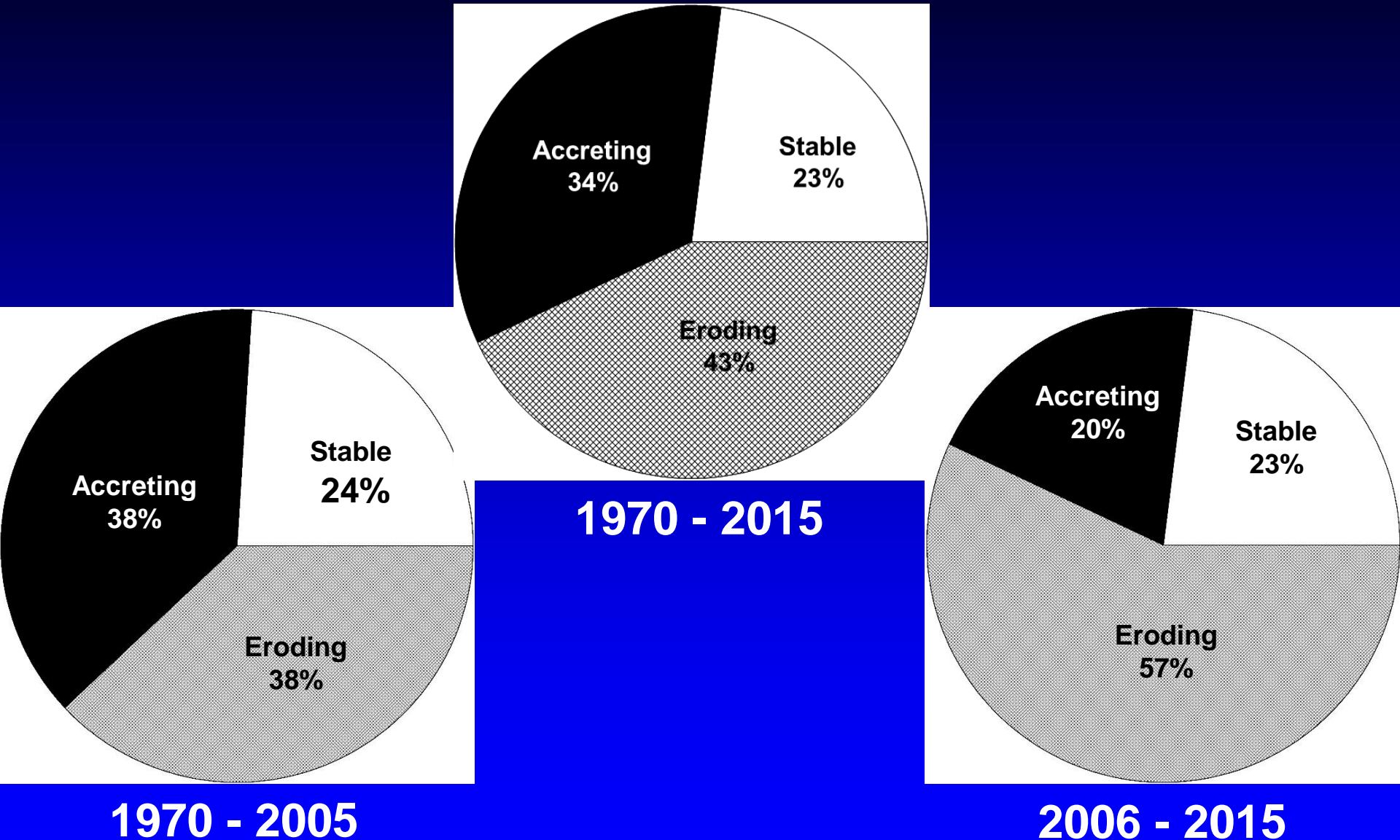
Situation in late 1960s



Delray Beach today

- Using beach nourishment, dunes rebuilt and the shoreline advanced 250 ft

Improving Nourishment Placement



1970 - 2005

1970 - 2015

2006 - 2015

Future Shoreline Change

Positives

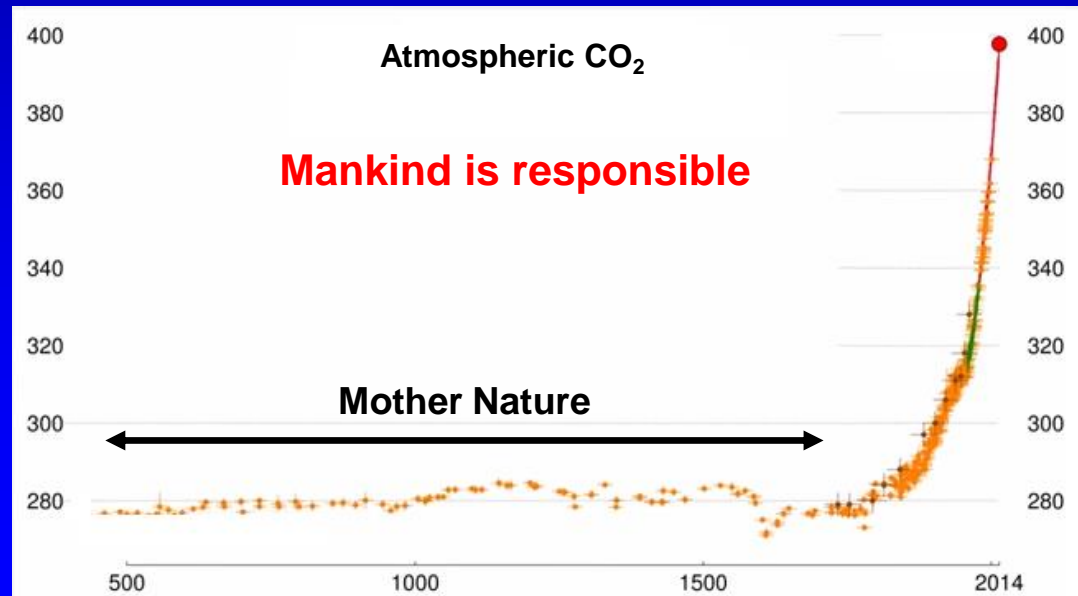
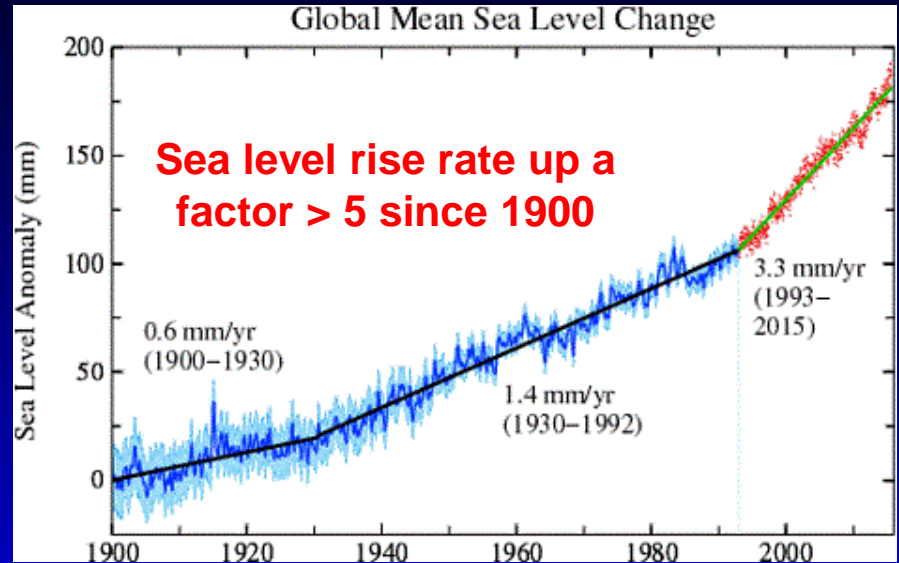
- Inlet shoals no longer building
- Sand bypassed around many inlets
- Sand no longer disposed in ocean
- Onshore transport continues
- Setback lines limit encroachment
- Nourishment being placed on eroding beaches



Future Shoreline Change

Big Negative

Sea level rise is going to increase significantly

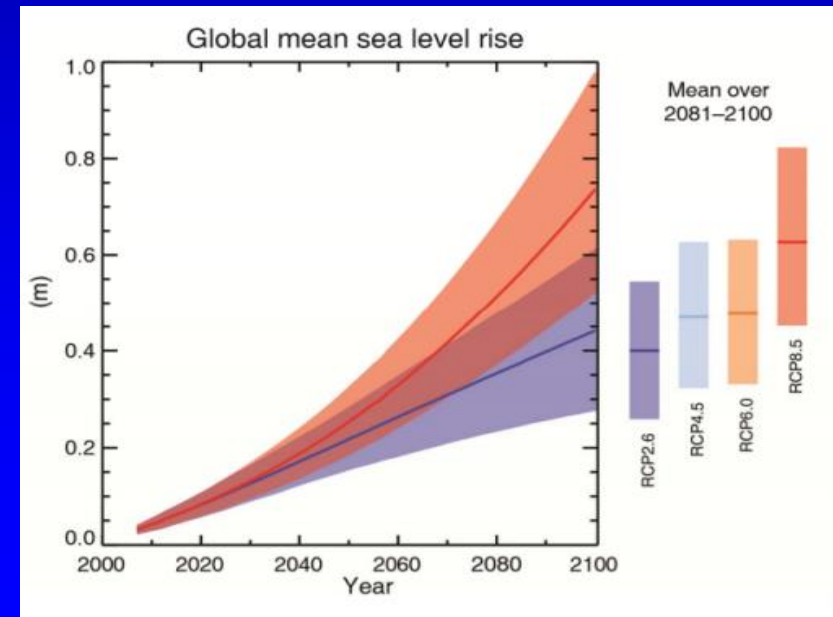
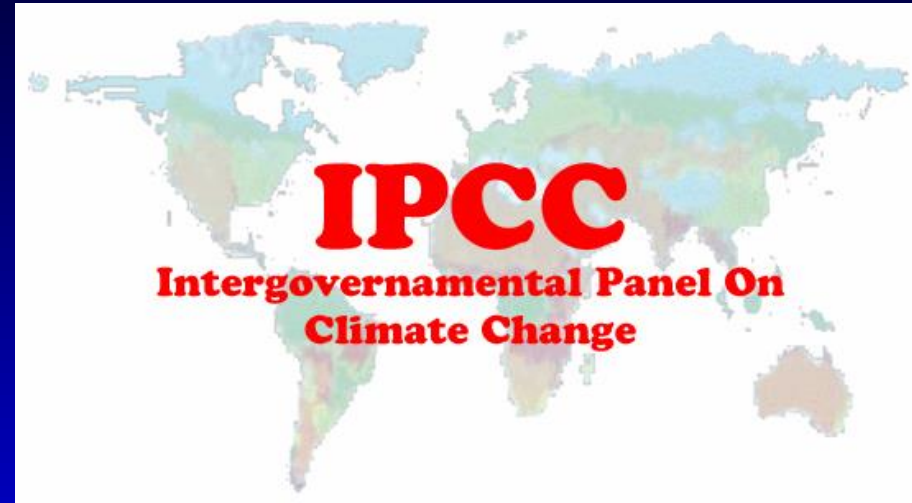


Sea Level Rise in the Future?

IPCC has the only credible sea level rise projections

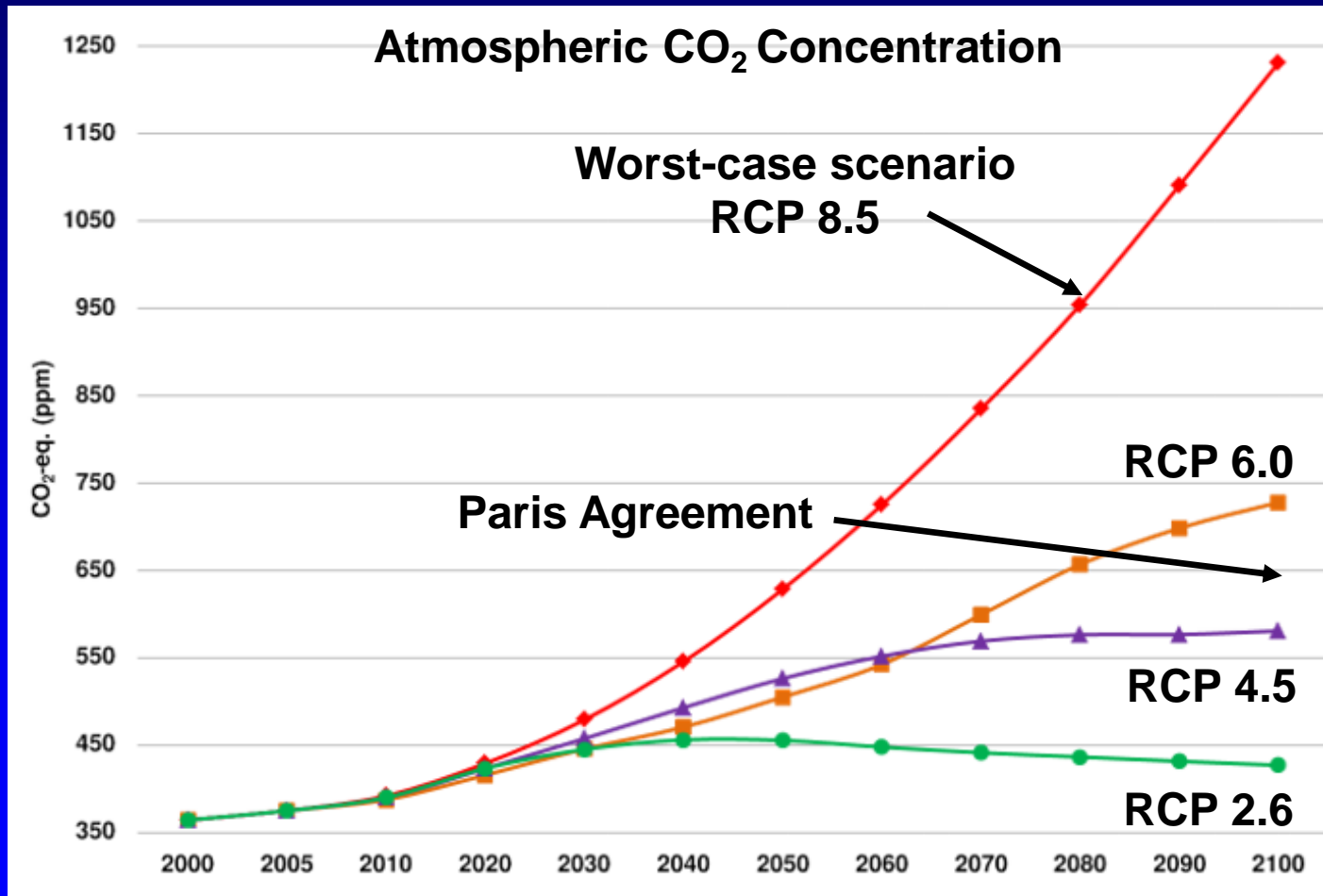
- It developed CO₂ scenarios and temperature projections used by all
- IPCC projections were made by 71 of the world's sea level experts

Country	Number	Country	Number
USA	19	Norway	2
Great Britain	12	Sweden	2
Netherlands	10	Austria	2
Australia	7	Belgium	2
Germany	5	Japan	2
Canada	4	Denmark	1
France	2	India	1



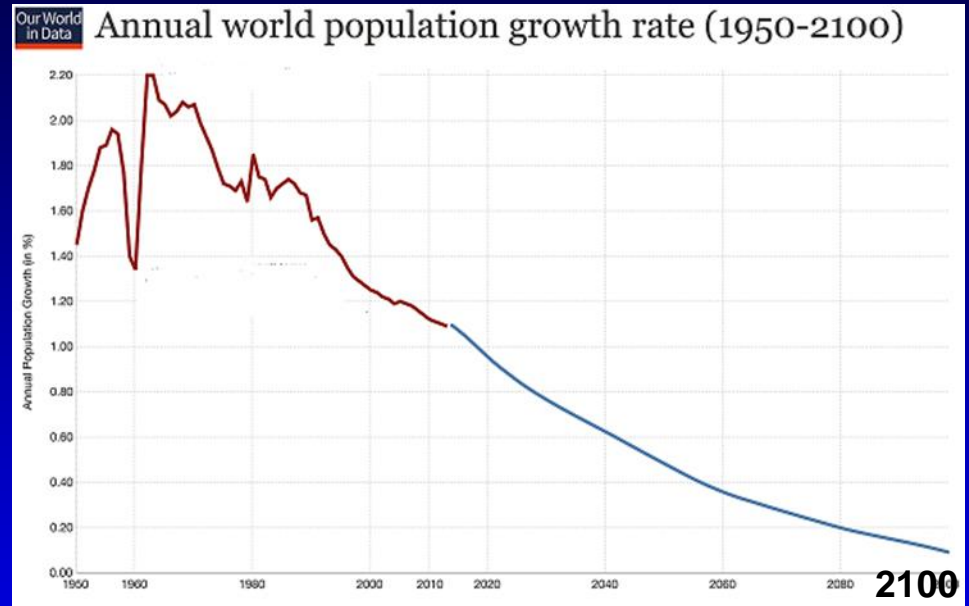
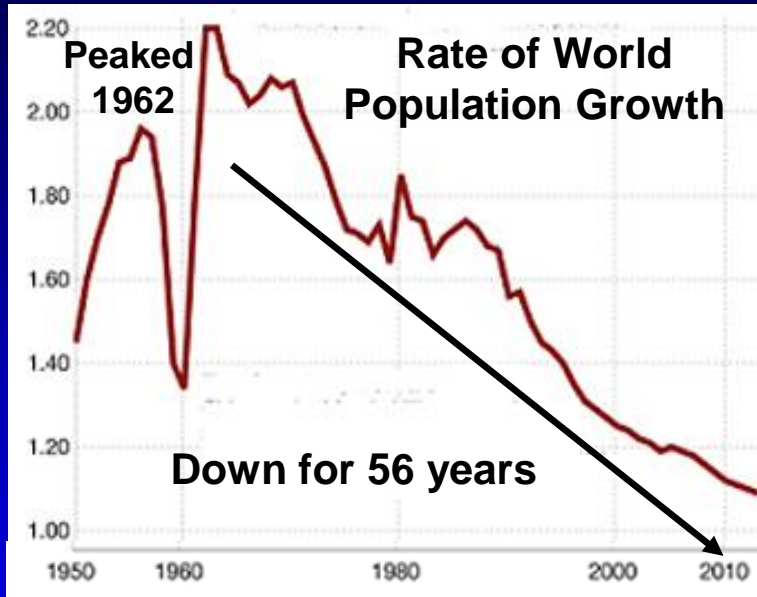
IPCC CO₂ Scenarios

- At past nourishment rates, the east coast will accrete on average except for the upper level rise of the worst scenario (Houston, 2016)



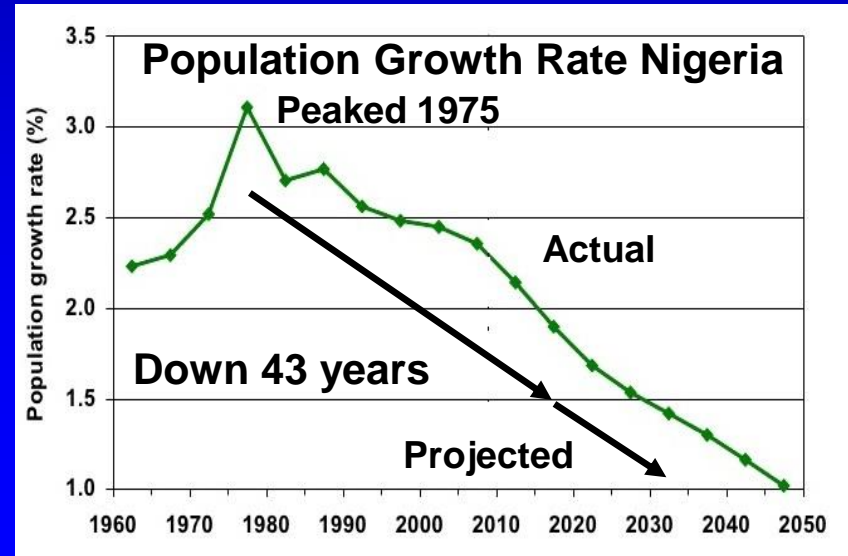
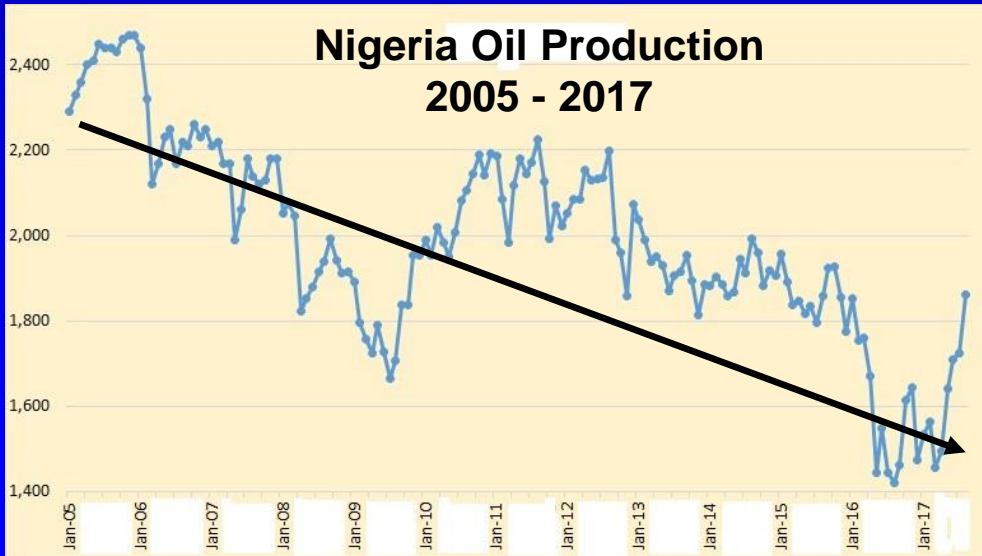
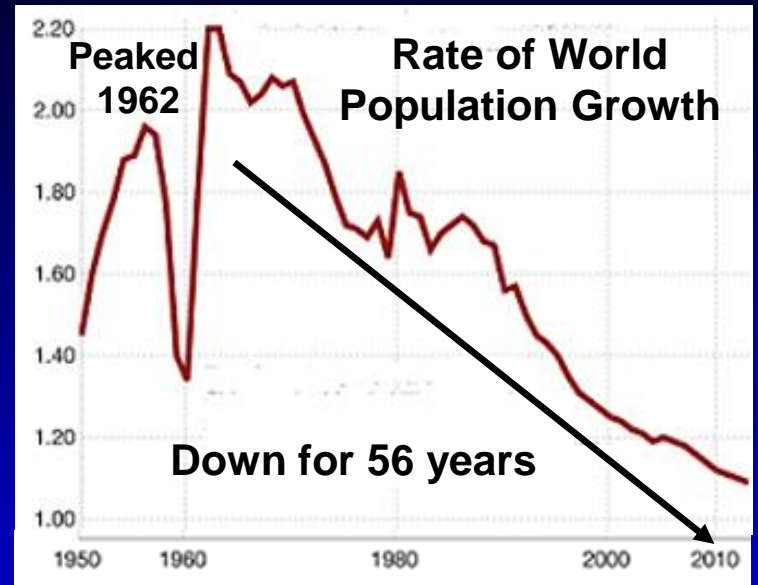
RCP 8.5 Scenario Assumes

- Gigantic world population growth that is at odds with reality



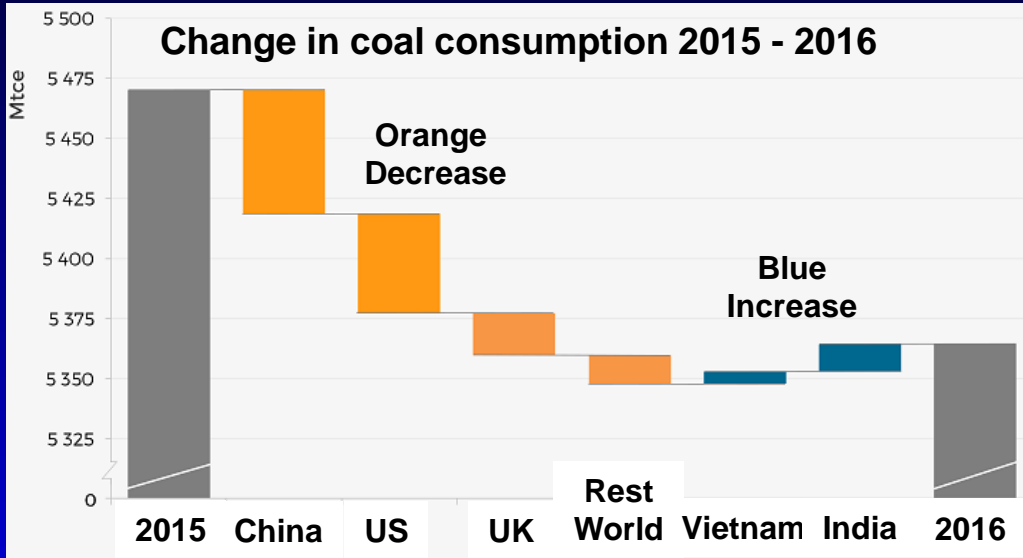
RCP 8.5 Assumes

- Nigeria's population will be 1.5 billion in 2100 – twice Tampa's population density
- Nigeria cannot feed its current population – it imports \$22 billion in food annually



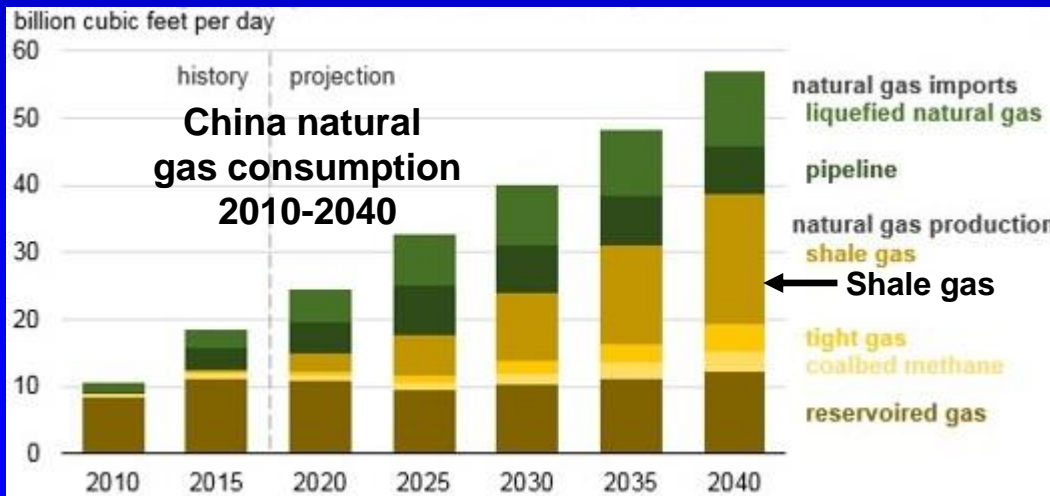
RCP 8.5 Assumes

- Population increase causes energy use to triple, led by coal

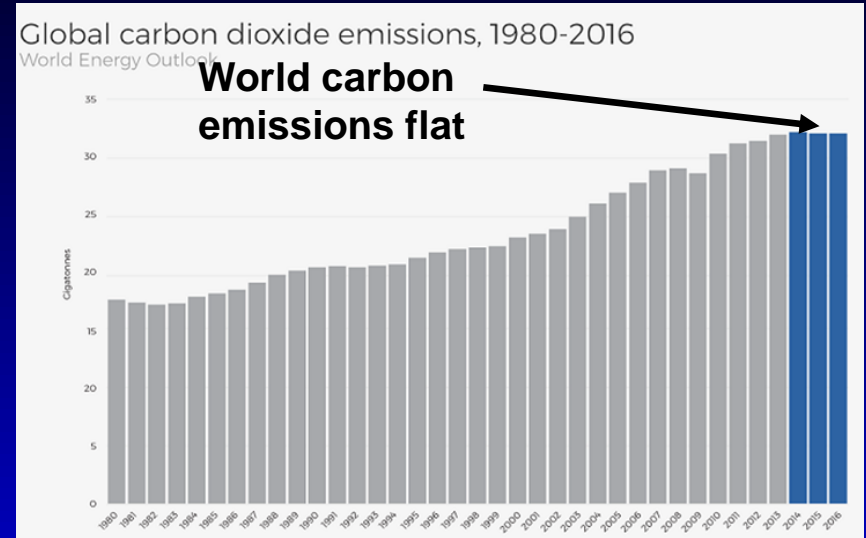


2017 Headlines

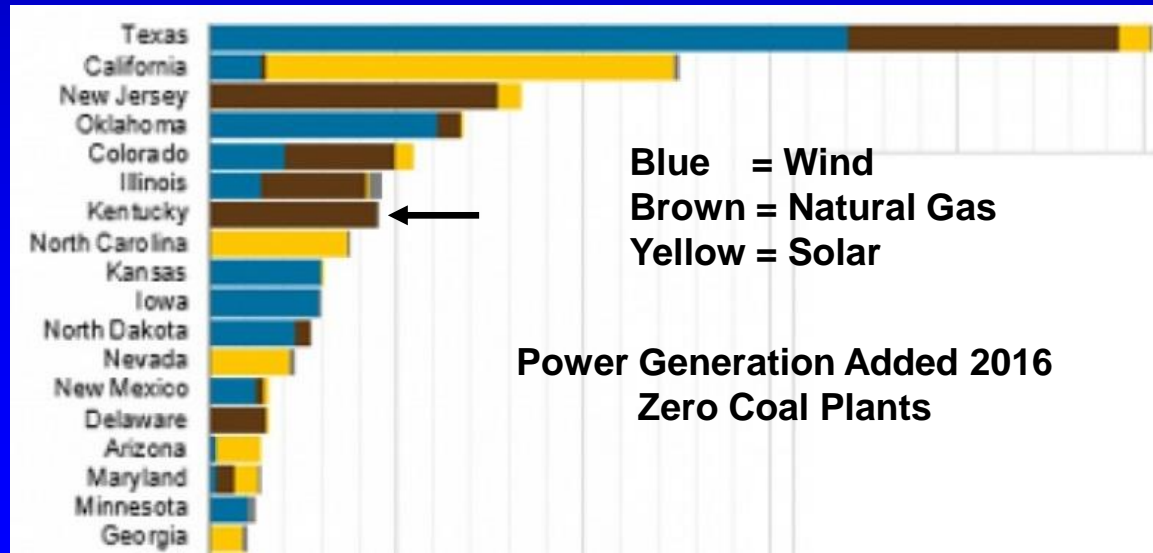
- “China and India stop construction on 100 coal electric plants”
- “Coal power is in a ‘death spiral’ in the European Union”



RCP 8.5 Assumes



- 55% of new world power generation in 2016 was from renewable energy
- U.S. retired 8 GW of coal plants in 2016
- Added 9 GW natural gas, 8.7 GW wind, 7.7 GW solar (65% renewable)



IPCC Sea Level Rise Projections

IPCC Sea Level Rise Projections to 1990-2100			
Scenario	Low (ft)	Most Probable (ft)	High (ft)
RCP 2.6	0.9	1.4	2.0
RCP 4.5	1.2	1.7	2.3
RCP 6.0	1.3	1.8	2.4
RCP 8.5	1.7	2.4	3.2

Media usually reports



97.5% chance less than 3.2 ft

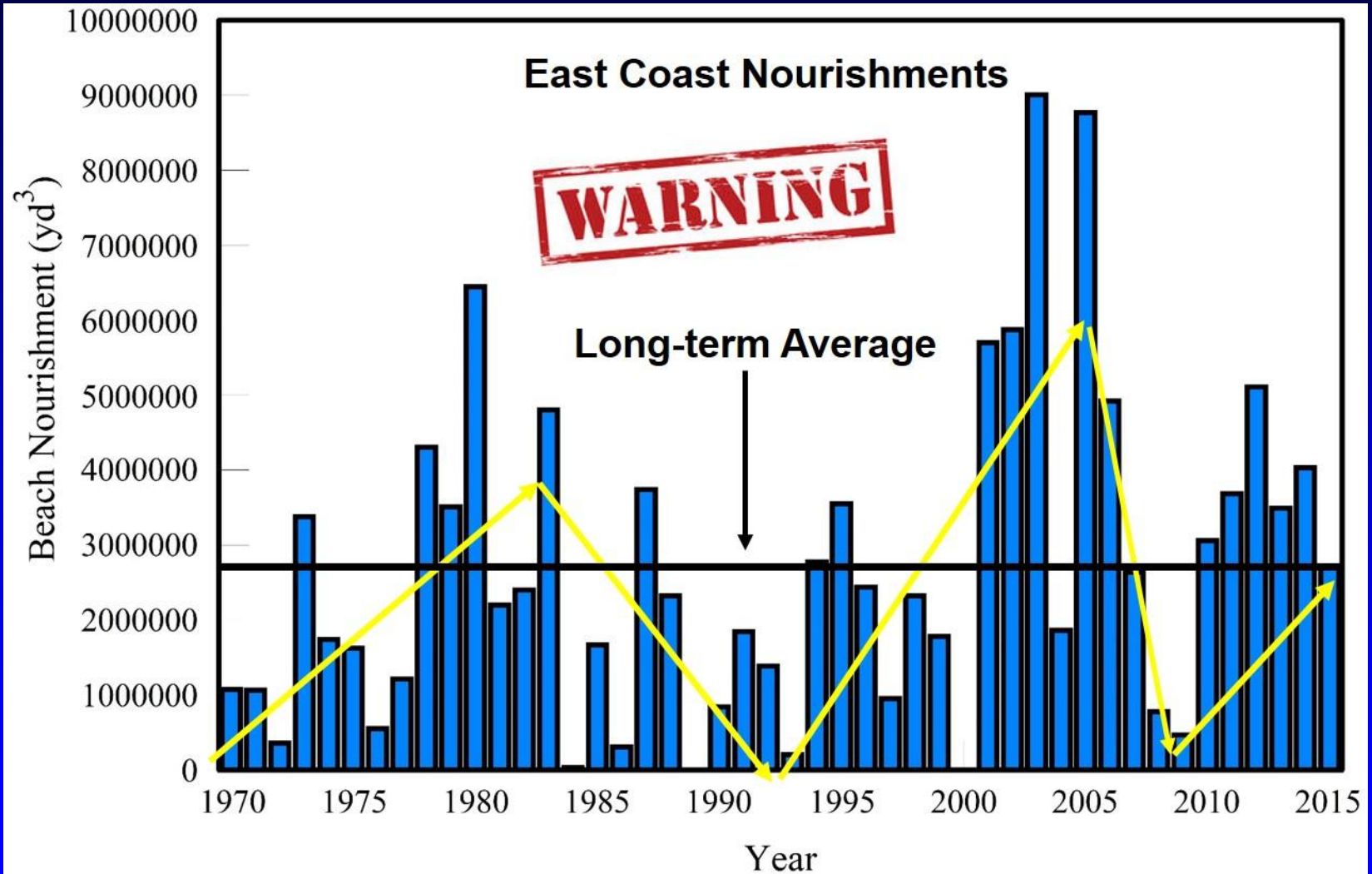
Extraordinarily Unlikely X 2.5% chance = Almost Impossible
RCP 8.5

Future Shoreline Change for RPC 8.5

- If beach nourishment remains at past rates (Houston, 2016)
 - East coast will accrete for next 50 years for all scenarios (accreted 155 ft on average 1800s-2015)
 - Will accrete to 2100 except for RCP 8.5 upper level rise (12% increase in nourishment would offset)
- Caveats
 - Past nourishment rate must be maintained
 - Sea level rise cannot be >> IPCC projections



Past Rate Must be Maintained



Sea Level Rise >> IPCC Projections

- **Headline – “New NOAA sea level rise projections dramatically increase to 8.2 feet” (CBS News, 2017)**
- **NOAA report: If RCP 8.5 occurs, there is a 0.1% chance (1 chance in 1000) that sea level will rise 8.2 ft**



- **NOAA report: If RCP 8.5 occurs, there is an 83% chance the rise will be less than the IPCC upper level rise of 3.2 ft**

Summary - Shoreline Change on Average

- 1800s – 1970 Shoreline advanced 75 feet
- 1970 – 2015 Shoreline advanced 80 feet
- 2015 – 2065 Shoreline will advance for all IPCC scenarios
- 2065 – 2100 Shoreline will advance except for upper rise of scenario RCP 8.5

NOT

(If nourishment rate maintained)

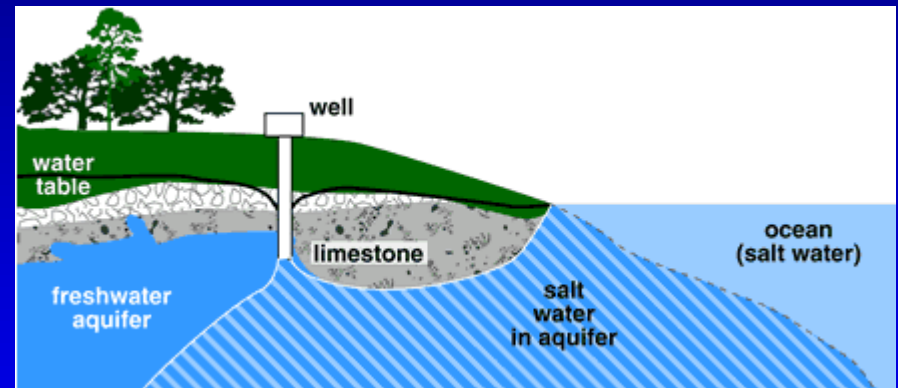


Sea Level Rise - Other Problems



- Back-bay flooding

- Salinity Intrusion



- Environmental –
Wetlands Drowning

Conclusions

- Less than half of beach nourishment placed on eroding beaches – we can do better
- Beach nourishment can offset IPCC sea level rise – **if** the rate of placement is maintained
- Nourishment is **the** strategy to mitigate coastal sea level rise, but strategies are needed for all rise impacts



The End

