Should I Sell My Shore House?
NJ As a Natural Laboratory for Sea-level Change

Ken Miller, Chair of Geological Sciences (FAS)

Hurricane Isabelle, Avalon, NJ 9/18/2003

Ash Wed. Nor'easter, H. Cedars, 1962

"Storms: Extreme Sea-level Events" J. Church (IPCC)

December Nor'easter, LBI, 12/1993

December Nor'easter, LBI, 12/1992

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Flooding of NYC: *An Inconvenient Truth*

"If Greenland broke up and melted…this is what would happen to Manhattan. They can measure this precisely, just as the scientists could predict precisely how much water would breach the levee in New Orleans… the WTC memorial … would be underwater."

Al Gore

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

NYC after 5 m (15 ft) sea-level rise

Screenshot from the movie

Should I Sell My Shore House?

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Waretown, NJ

Exaggerations?

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

…en:

9/13/2006

Greenland melting puts NYC underwater

Convenient Distortions?

Climate of Fear

By Richard Lindzen

THE WALL STREET JOURNAL

There have been repeated claims that this past year's hurricane activity was another sign of human-induced climate change. Everything from the heat wave in Paris to heavy snows in

…rming that has occurred. In fact, …ke the most outlandish claims of alarm are actually demonstrating skepticism of the very science they say supports them. It isn't just that the alarmists are trumpeting model results that we know must be wrong. It is that

Sea-Level Measurements

- Satellite altimetry back to 1993
- Tide gauges back to 1850

instruments / modern

- Coastal sediments

  back to 20,000 years ago

- Reef terraces

  back to 130,000 years ago

- Sequence stratigraphy

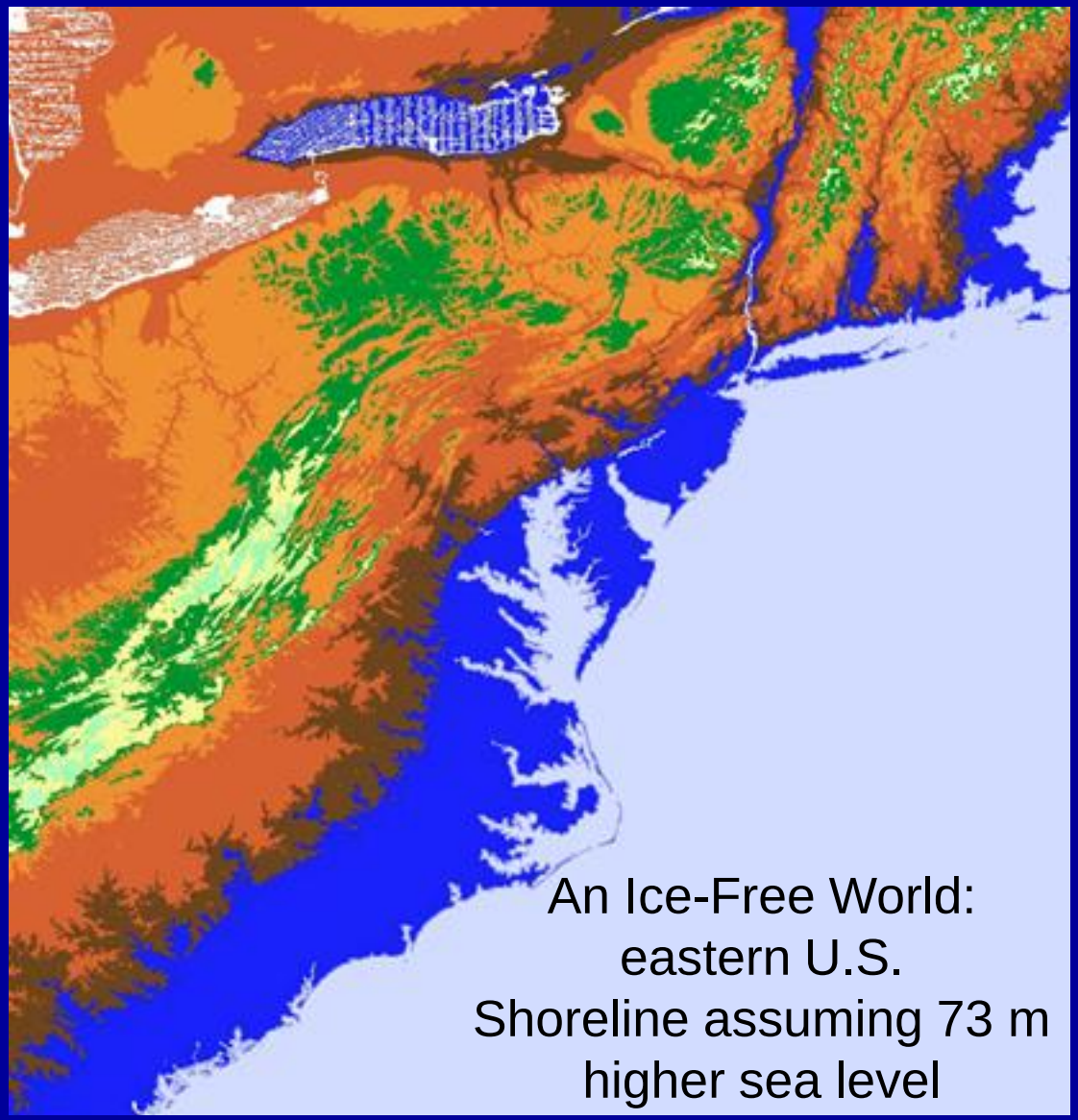
  back to 1,000,000,000+ years ago

Pre-anthropogenic

rock record / ancient

Geology needed to evaluate natural, pre-anthropogenic sea-level

Sea Level Was Very High in Past: Ice Free World & Tectonics

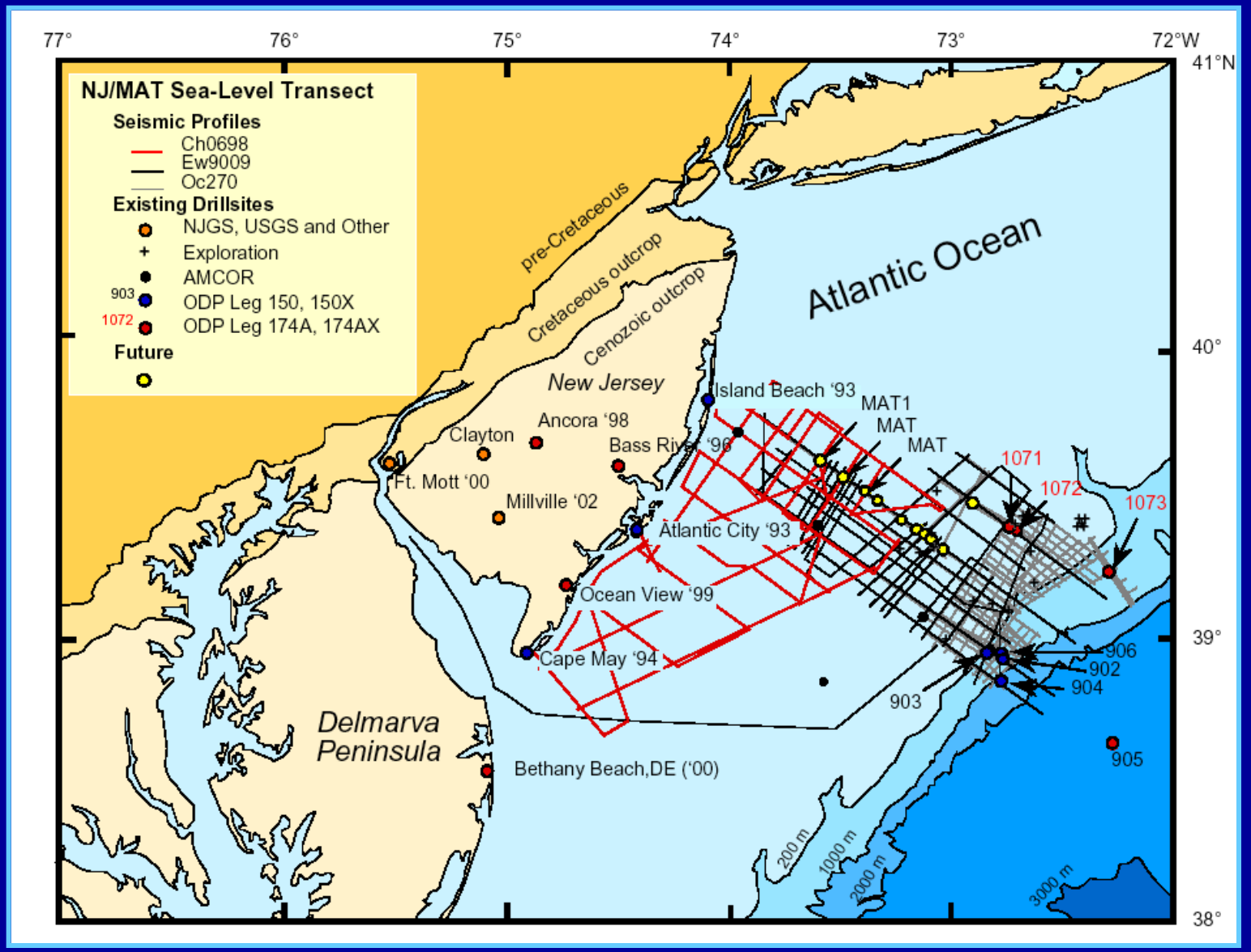


An Ice-Free World:
eastern U.S.
Shoreline assuming 73 m
higher sea level

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

http://www3.interscience.wiley.com:8100/legacy/college/levin/0470000201/chap_tutorial/ch12/images/le11_12.jpg

NJ/MAT Transect: Seismic Grids (3) & Boreholes

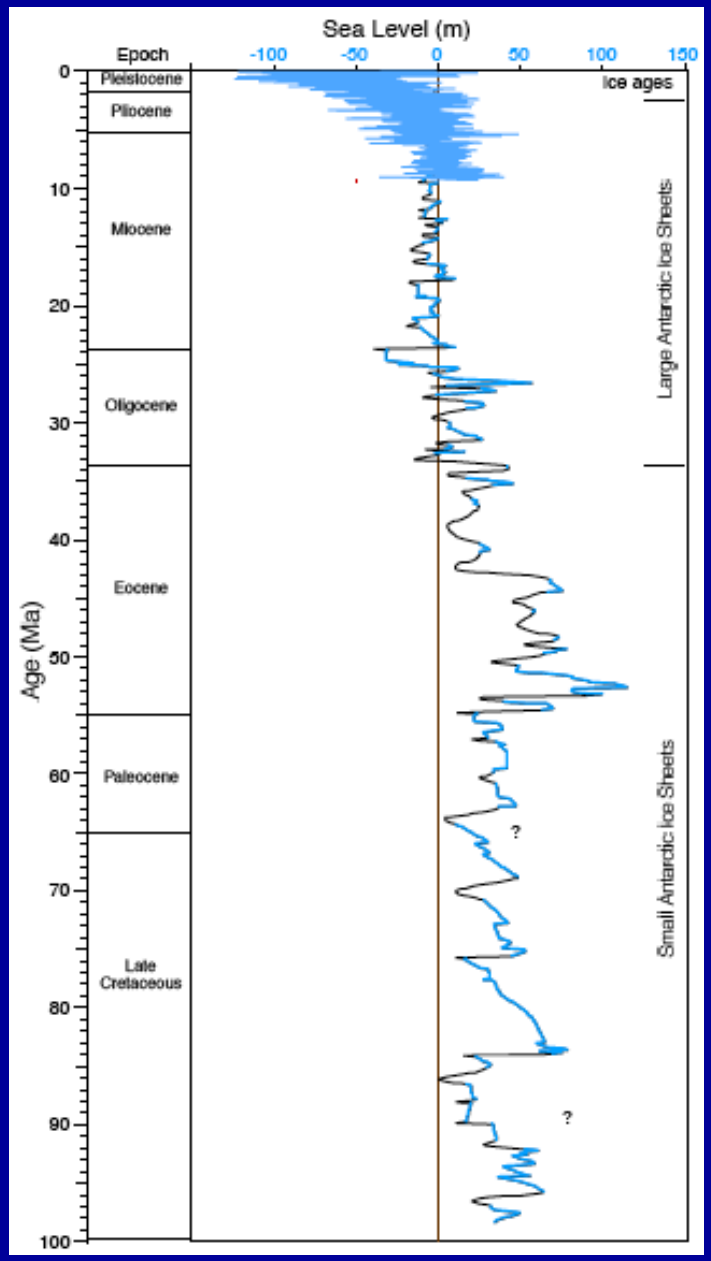


Natural laboratory for sea-level change on many time scales

Top: Island Beach, NJ; bottom: Atlantic City

Top: Cape May, NJ; bottom: *JOIDES Resolution*

A New Record of Sea-Level Change



Miller et al. (2005)
Sea level synthesis in *Science*

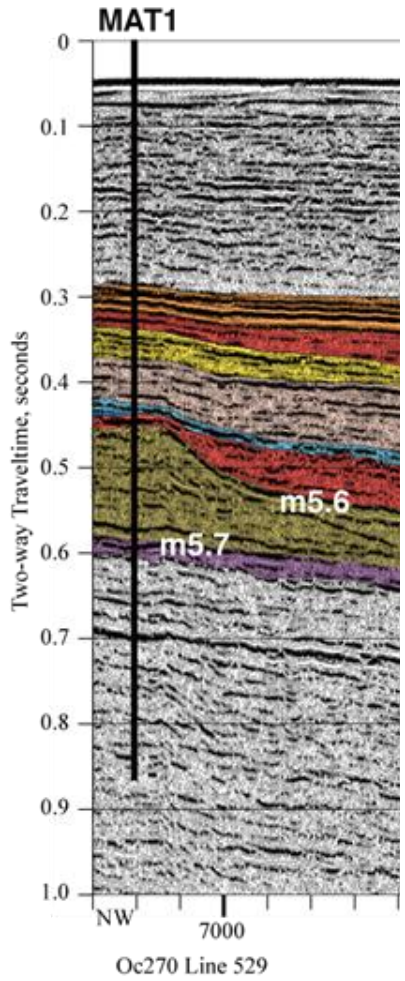
20-80 m sea level rises and falls

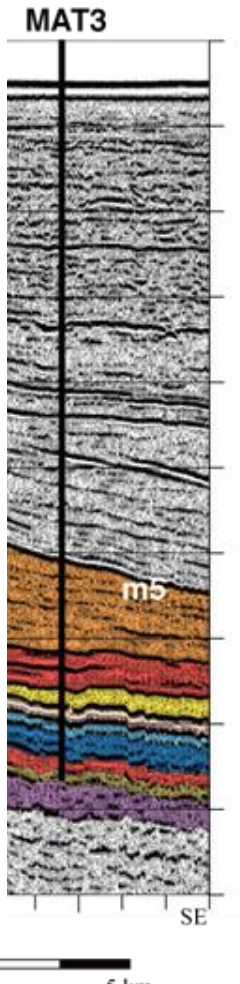
Even in supposedly ice-free Cretaceous Greenhouse

Radical ideas:
ephemeral ice sheets during the Greenhouse World

Sea level on 100 m higher 80 million years ago (thought 250 m)

IODP Ex. 313: NJ/Mid-Atlantic Transect

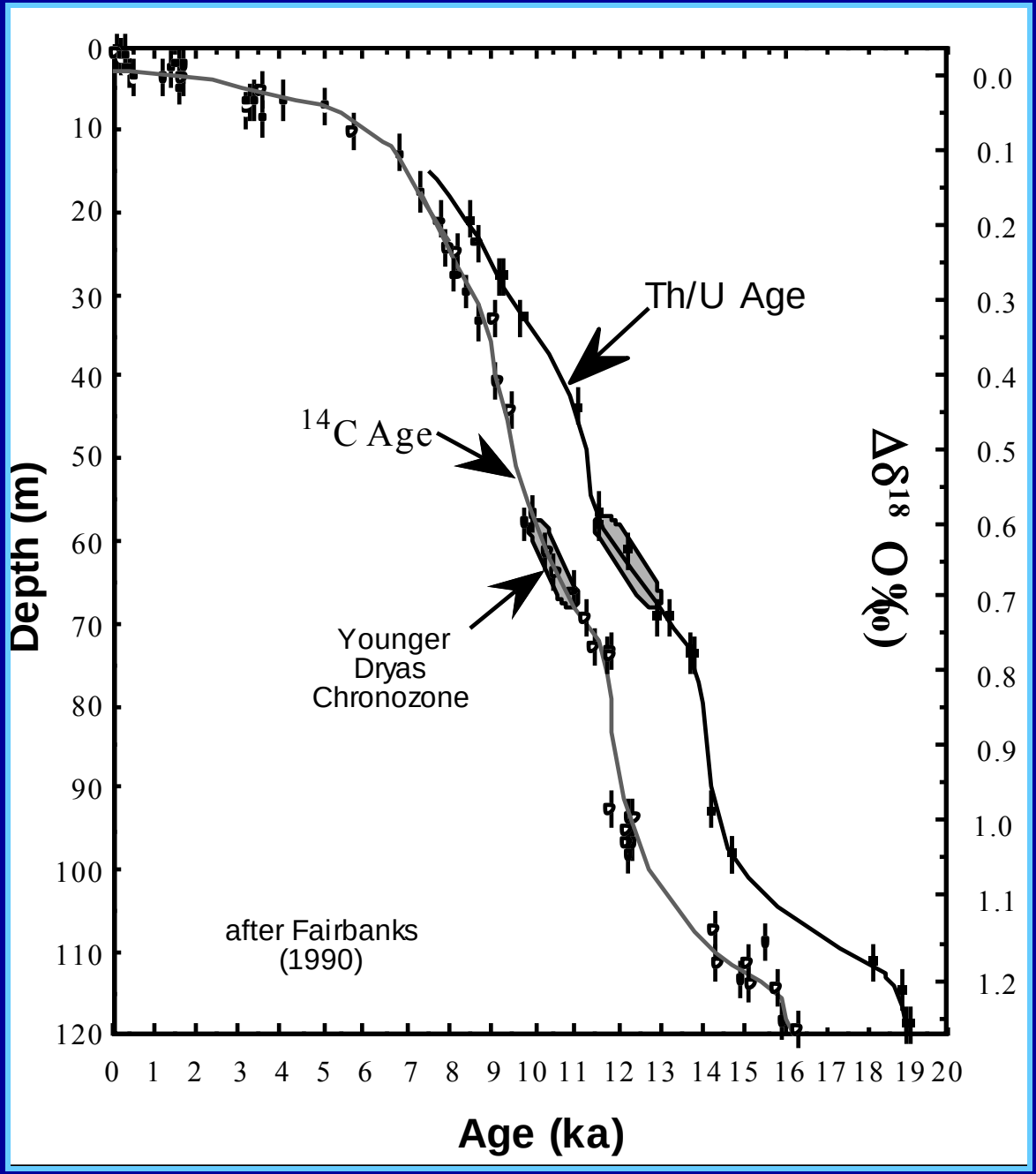




Summer 2007

Integrated Ocean Drilling Program

Barbados Curve



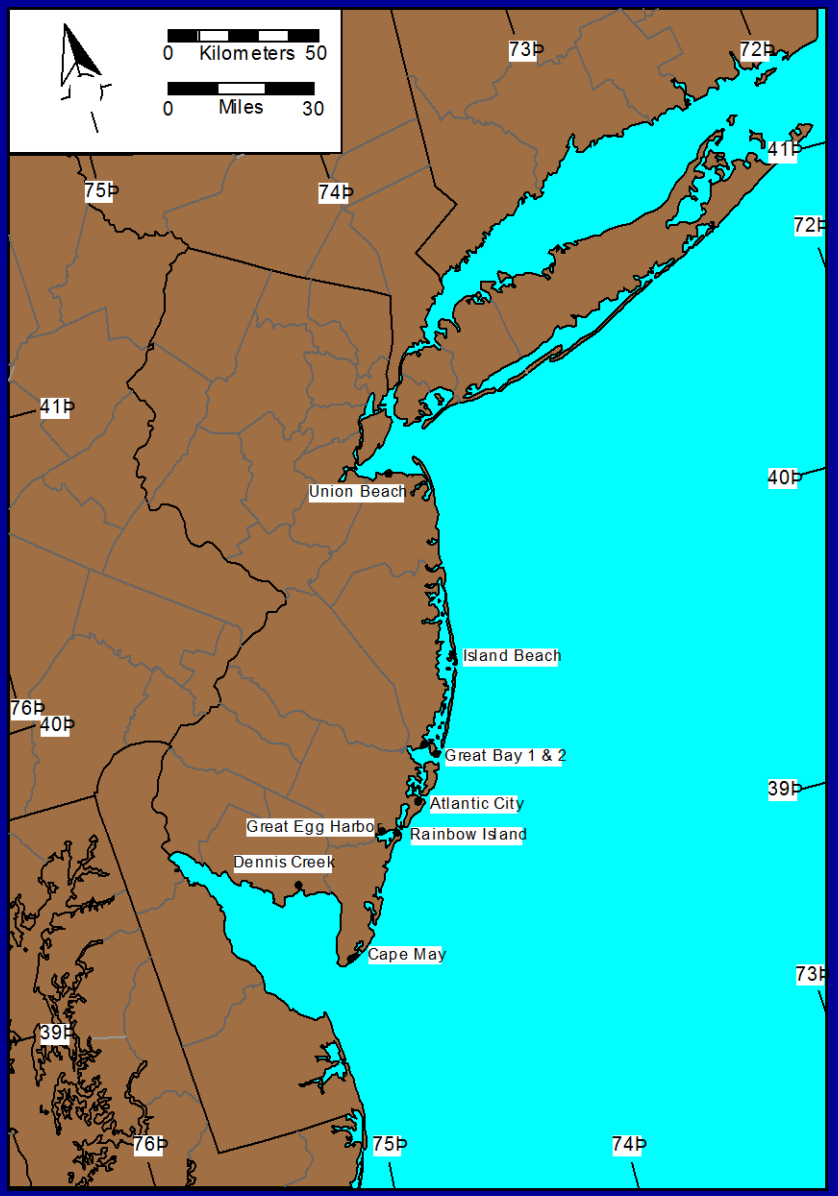
Barbados lowstand
A. palmata (fossil sunshine)
120 m below present day 18 ka
(Fairbanks, 1989)

120 m ± 5 m lowstand
Last Glacial Maximum

Rate up to 20 m/1000 yr
(2 cm/yr @ 14 ka MWP1a)

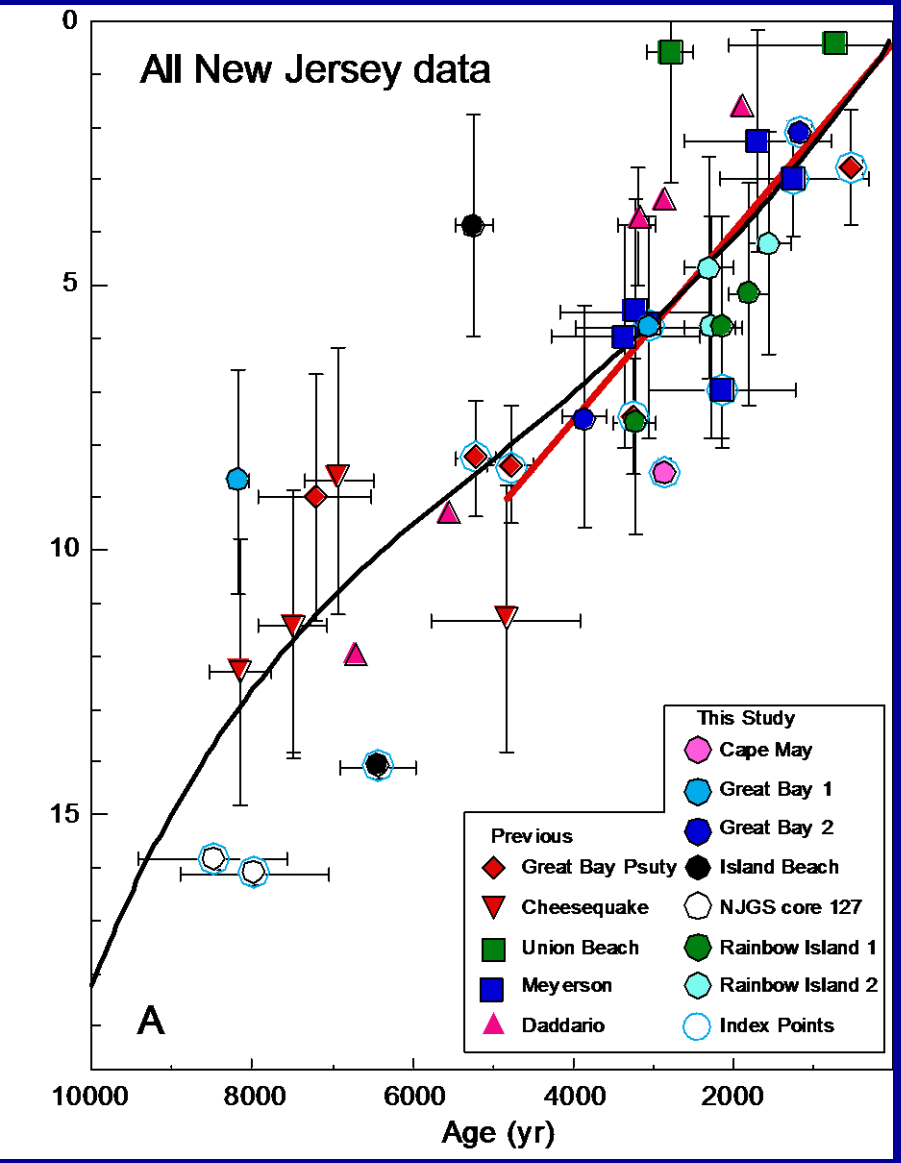
NJ Sea Level Rise past 5000 years

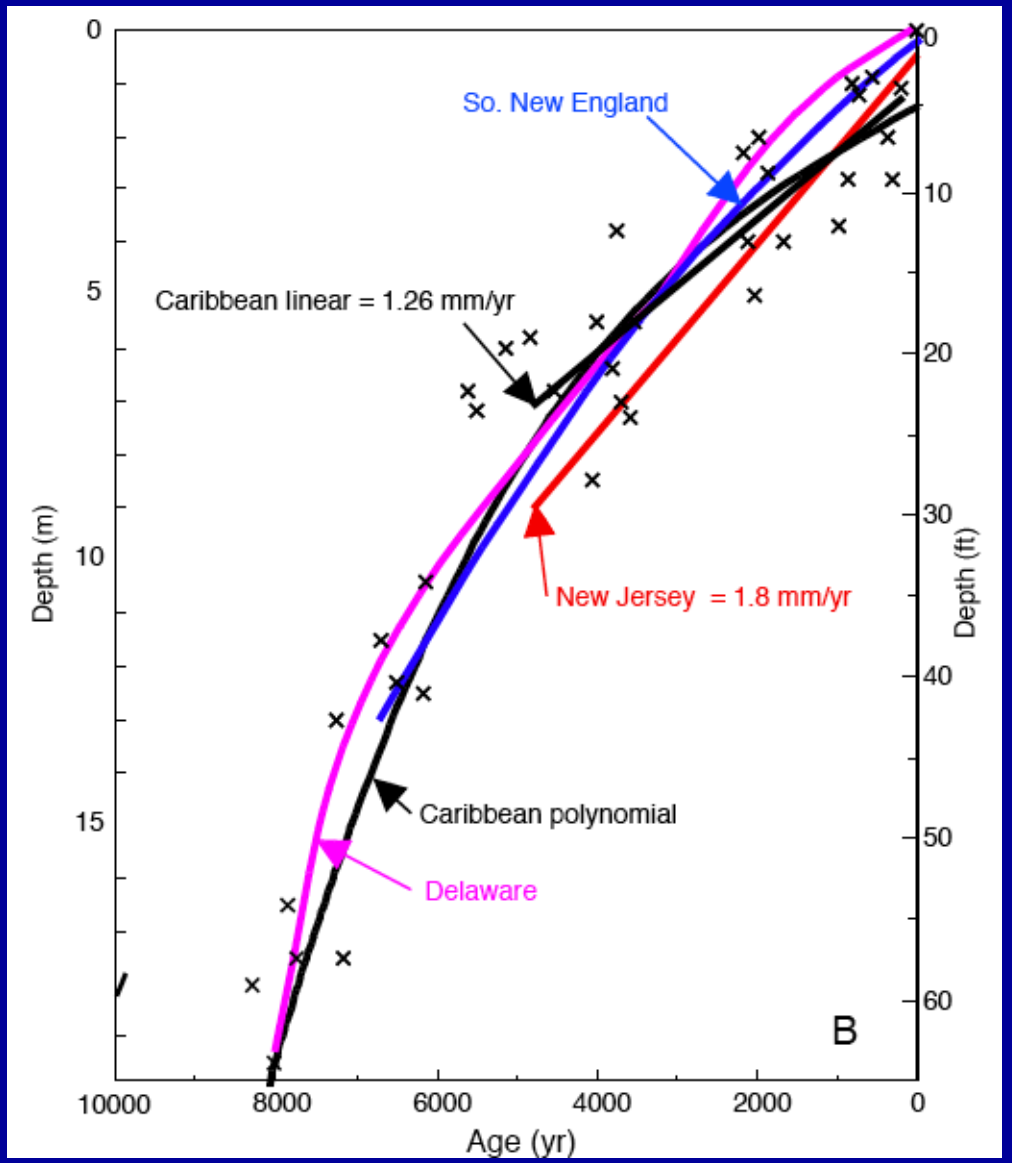
QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.



Sea-Level Rise past 5000 y

New Jersey = 1.8 mm/y regional rise; global 1 mm/y

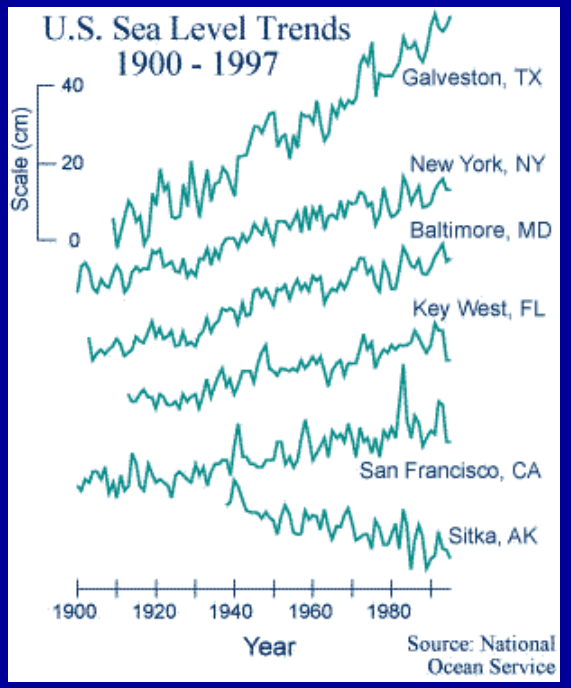




Global Sea Level Is Rising

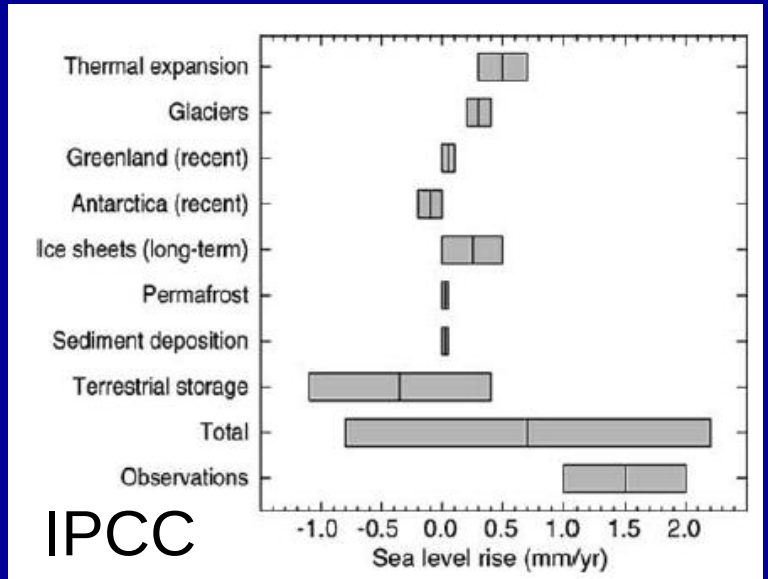
~1.8 mm/yr tide gauge data 1900-2005
0.7 inches/ 10 yr

~2.8±0.4 mm/yr satellite data 1993-2003
1.1 inches/ 10 yr

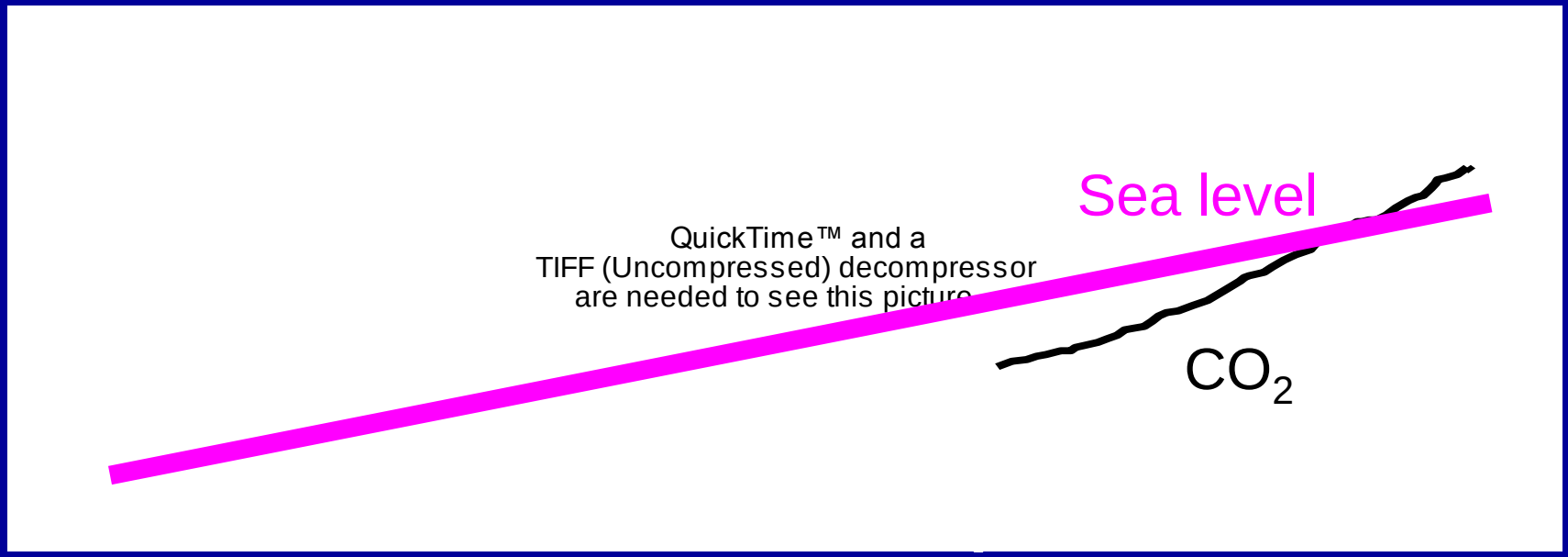


Causes

- Thermal expansion:
  global warming ~0.6°C since 1900 = 1.1 mm/yr sea-level rise
- Ice melting?
  0.6 mm/yr from alpine glaciers
  0.15 mm/yr from Greenland
  (Cazenave & Nerem, 2004)

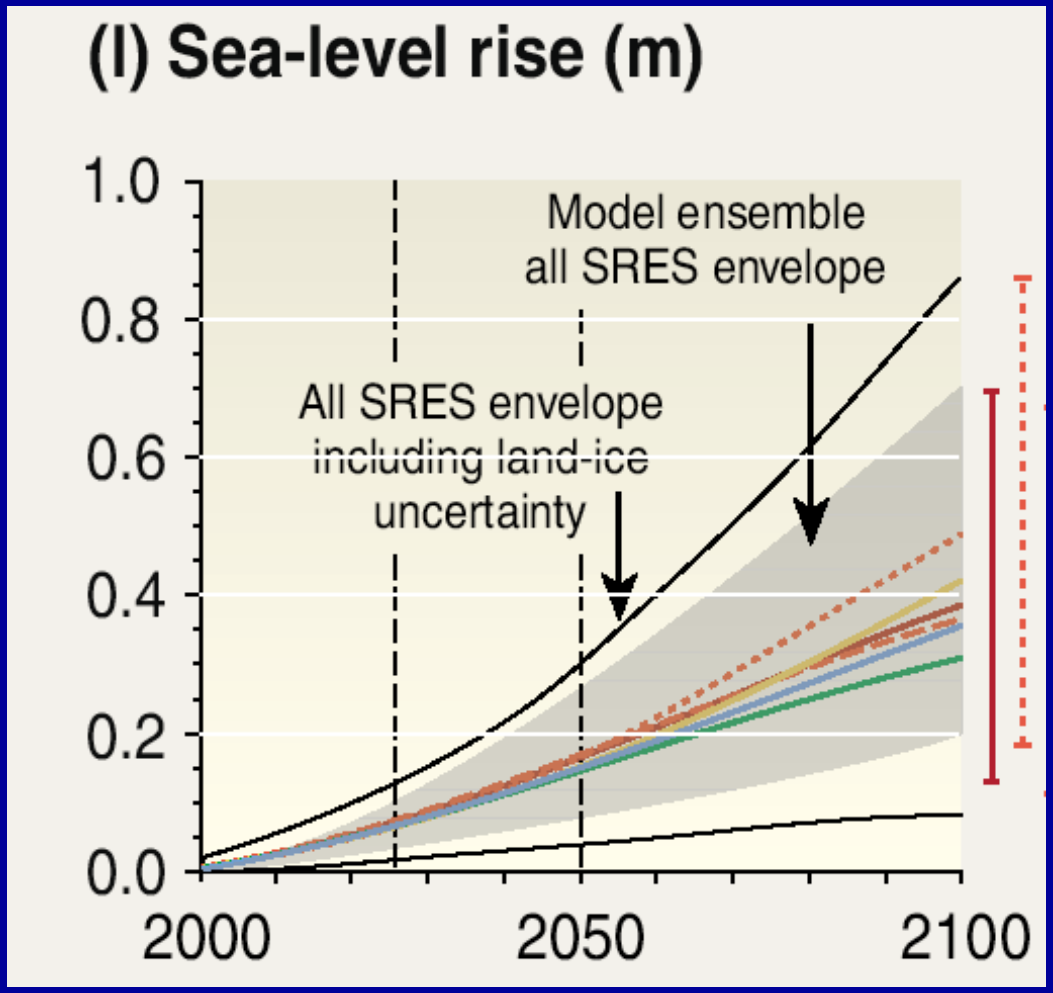


Global Warming

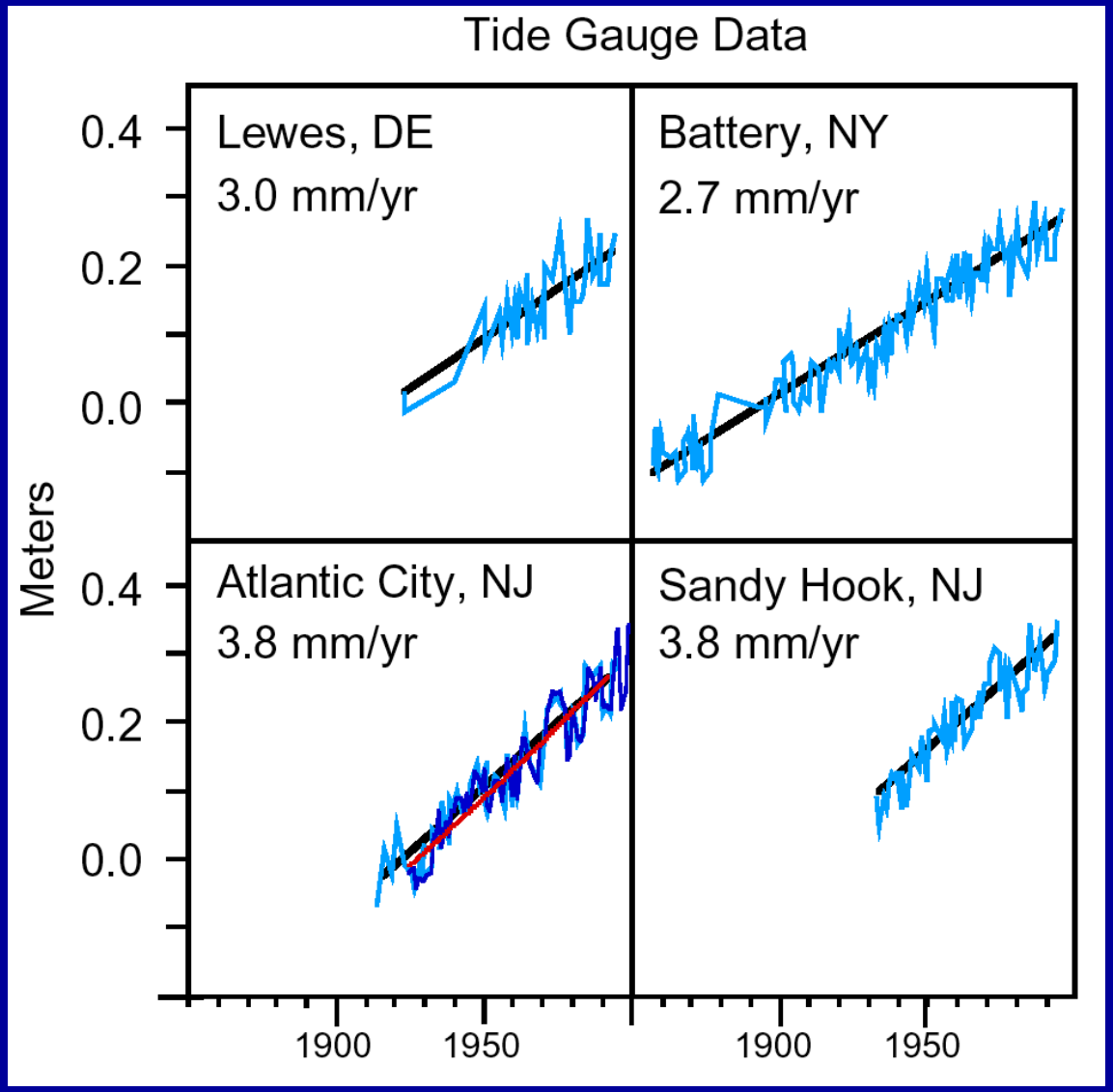


Sea-Level Forecast

Global warming: water expands = rising sea level
Rising sea level: 40 cm (1.25 ft) rise next 100 yr
1 m (3.3 ft) in next 200 yr



Global, Regional, and Local Effects



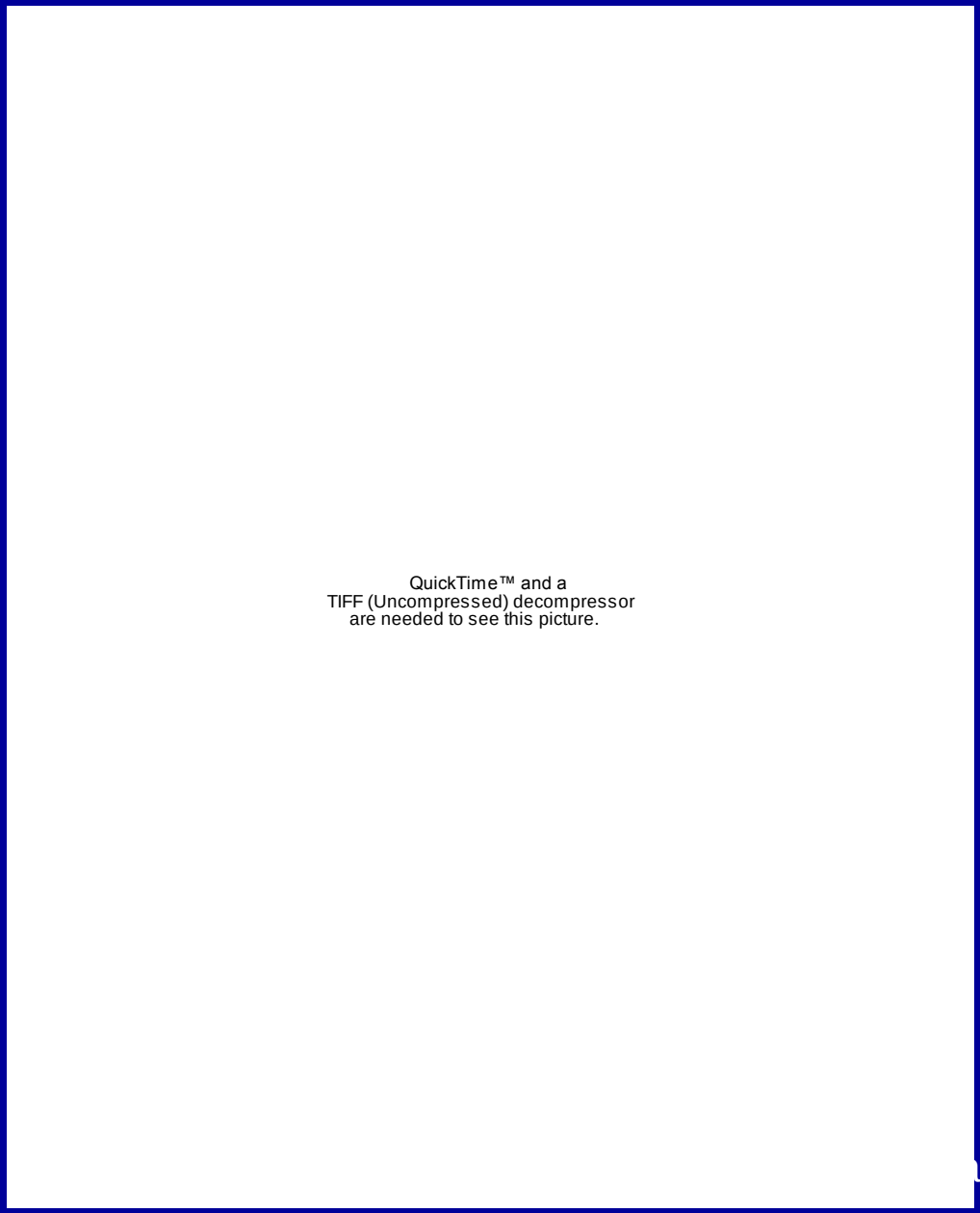
Psuty and Collins (1986)

NY/NJ/DE region higher sea-level rise

Processes:

- Global (eustatic) rise
  1.8 mm/yr
- Regional subsidence
  flexural unloading
  Laurentide removal
  1 mm/yr
- Local subsidence
  due to water withdrawal & compaction
  1 mm/yr

Effects of Sea-Level Rise: Coastal Flooding



Coastal marshes cannot retreat as they must to survive sea-level rise

Increased effects of storm surges

10:30:03 AM Wed, October 12, 2005

ampics/NJ05/pageimg_9850.jpg.html

Effects of Sea-Level Rise: Land Loss

Function of rise and gradient (1:1000)
Sea level rise by 2100 ~40 cm (1.2 ft) IPCC
?Worst case scenario by 2100 ~1 m (3 ft)
Would result in a natural movement beach 1200-3000 ft
Fight back with replenishment ($ and often does not work)

Estimated land area susceptible to inundation at case study area, Cape May Point, New Jersey. After Cooper et al. (2005)

Effects of Global Warming: Storms (Extreme Sea-level Events)

Have storms increased?

1) Storm frequency: debatable

1) Hurricane intensity: Yes

Storms: NJ most damage from Nor'easters

Hurricanes (cat. 1 or >) hits

Should I Sell My Shore House?

Do not sell your shore house: insure!
Best estimate 40 cm (1.2 ft) by 2100
Though *Time* may be right, worry
?Worst case 1 m (3 ft) by 2100

View of NY harbor from *JOIDES Resolution* in an ice-free world (73 m rise)

Increased storm intensity

More erosion

More cost to replenish

Loss of marshland

Lose beaches

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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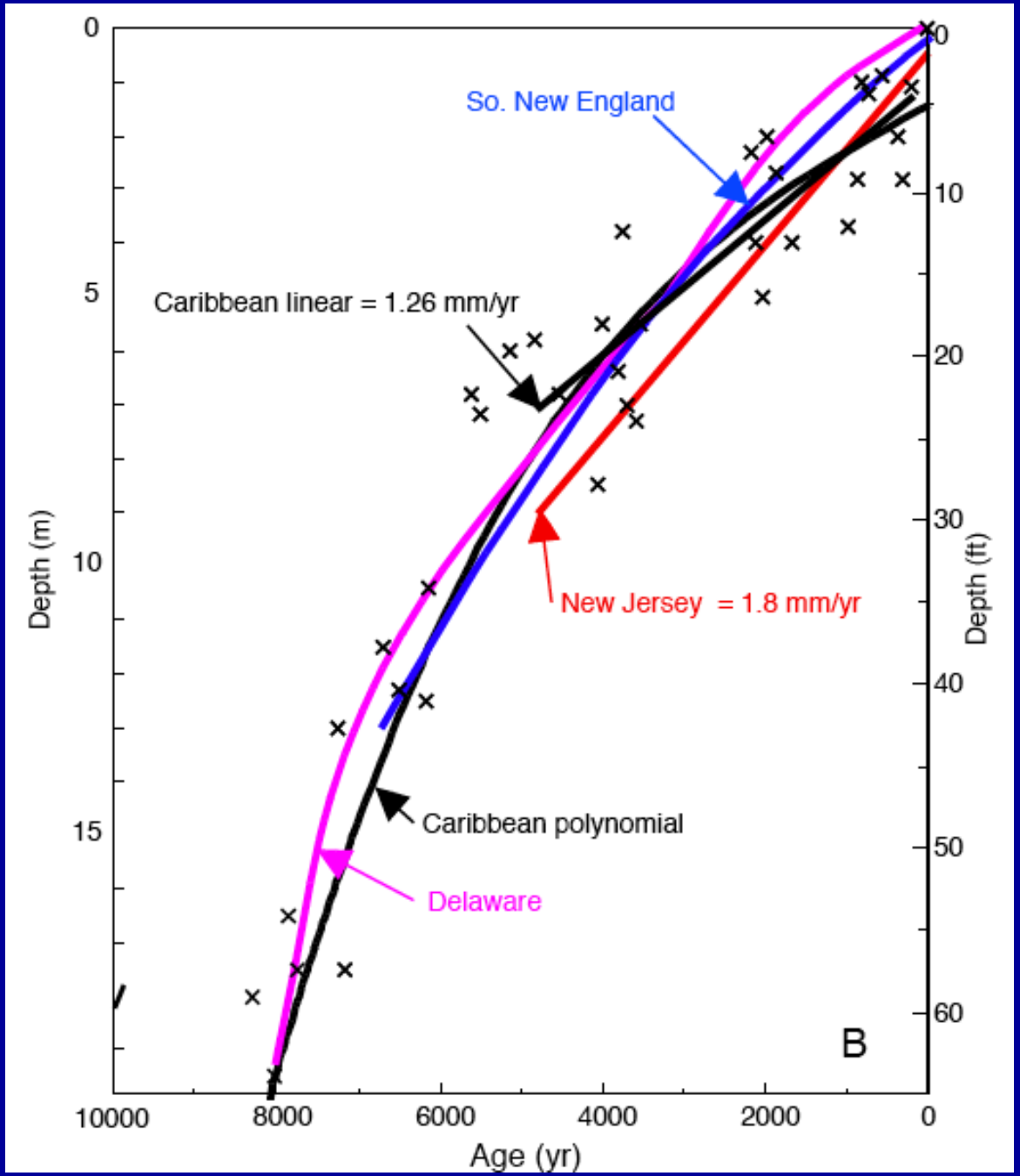
IPCC (2001)



Global Rise

- Fairbanks (1989) summary of Lighty Caribbean reefs
- 1.1 mm/y
  5000-200 yBP
- Global rise 5000 ka to ~1800:

  1 mm/yr

1.5 m Sea-level Rise Impacts U.S. Coast

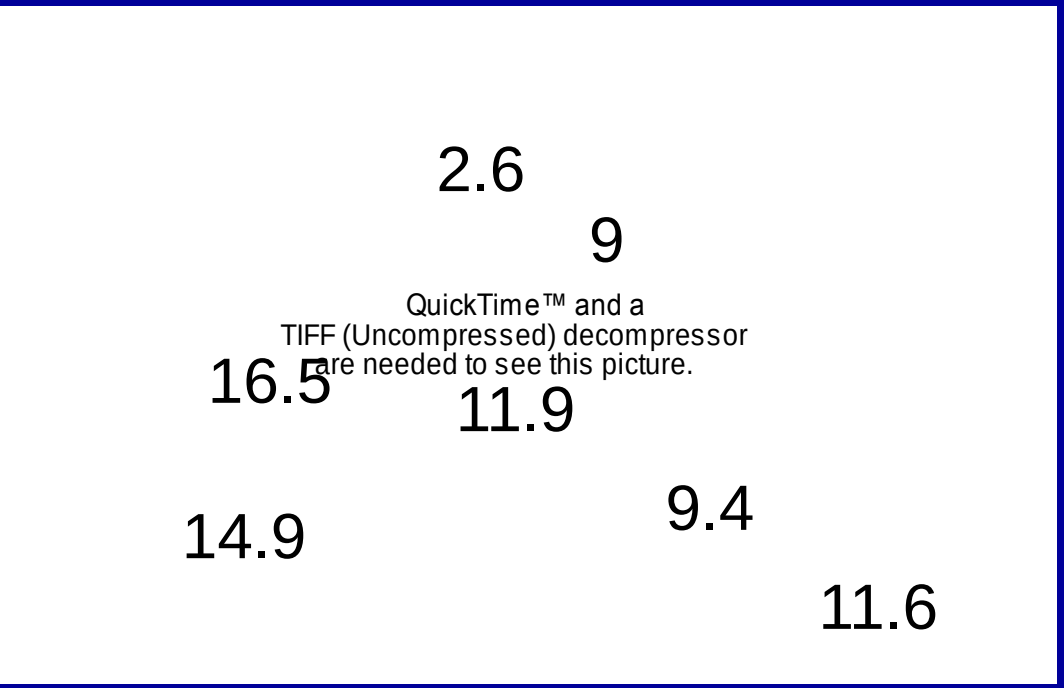
Titus and Richman,
Climate Research,
CR 18:205-228 (2001)

1.5 m (5 ft)

rise causes beach to migrate 1500 m

1:1000 gradient

Lessons from the Southern Louisianna

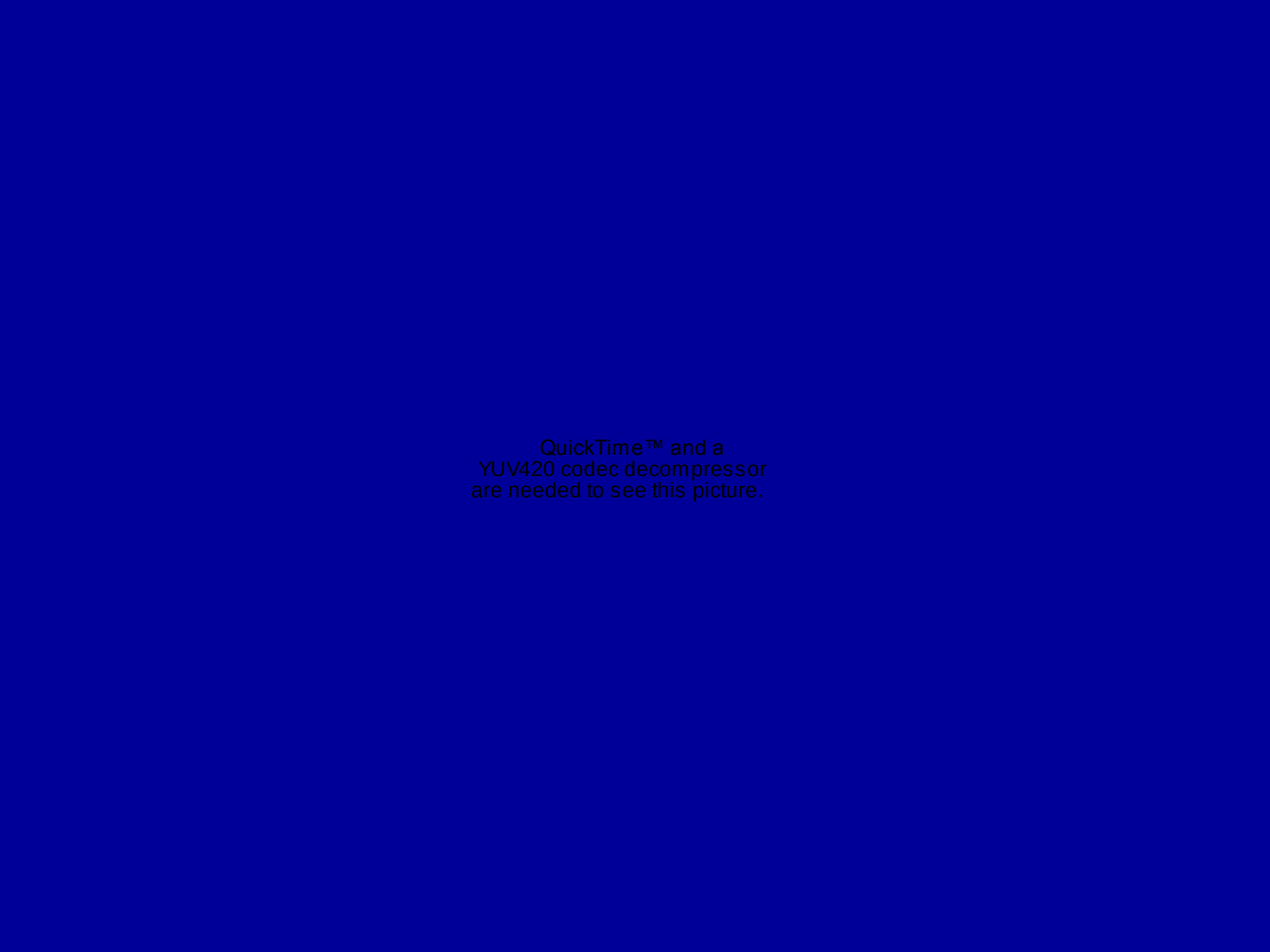


http://coastal.er.usgs.gov/LA-subsidence/figure1.html

Top: land loss in yellow
2.6-16.5 mm/year subsidence
vs. NJ 2-3 mm/year

But the real effect is storms!

http://coastal.er.usgs.gov/hurricanes/katrina/photo-comparisons/dauphin.html


QuickTime™ and a
YUV420 codec decompressor
are needed to see this picture.

Venice: Poster Child for Sea-level Rise

Effects of Global Warming on the Jersey Shore

View of NY harbor from the *JOIDES Resolution*
in an ice-free world (73 m rise)

- Increased storm intensity
- More erosion
- More cost to replenish
- Loss of marshland
- Lose beaches

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Gore World

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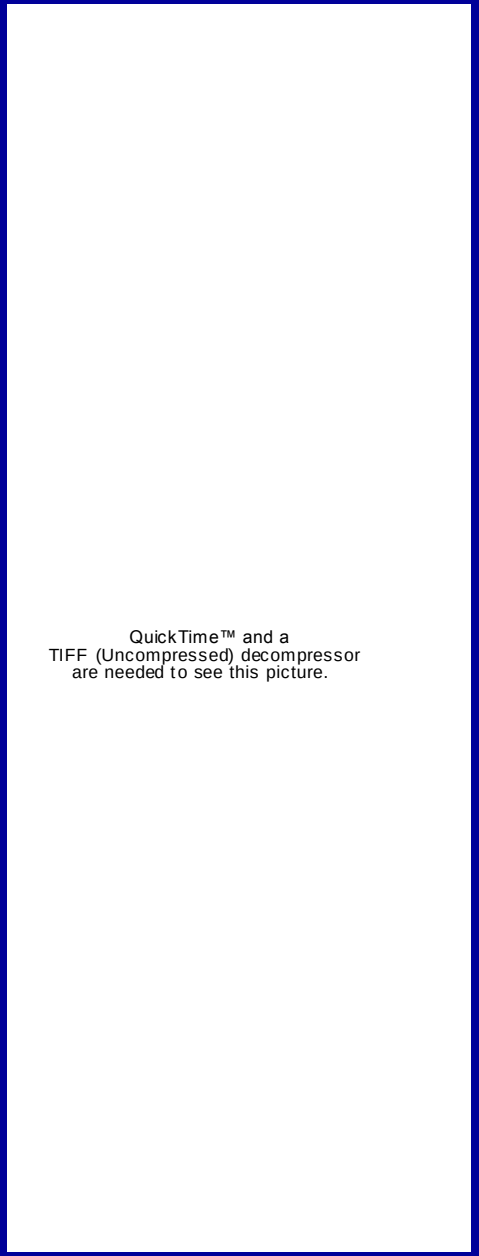
IPCC (2001)

Especially New Jersey

?Worst case scenario by 2100 ~1 m (3 ft)



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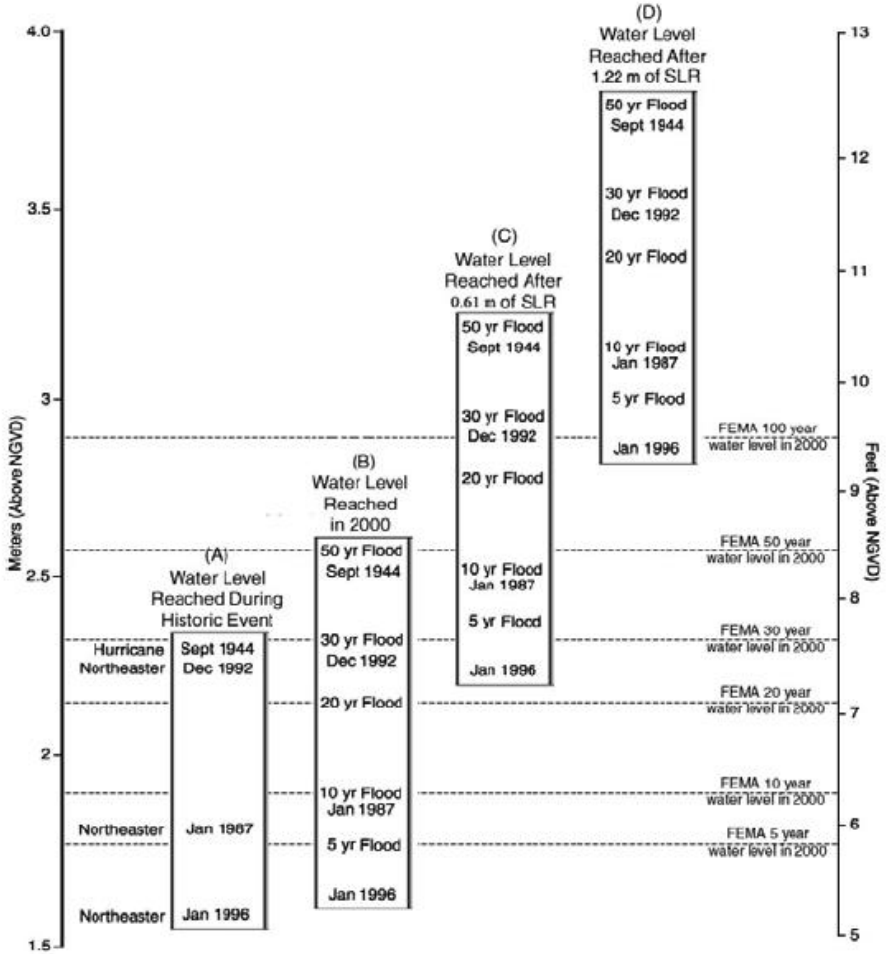

. Potential impact of sea level rise on tidal surge frequency and flood water levels in Atlantic City, New Jersey.

Increased effects of storm surges

After Cooper et al. (2005) derived from Psuty