Climate Change Impacts on Chesapeake Bay

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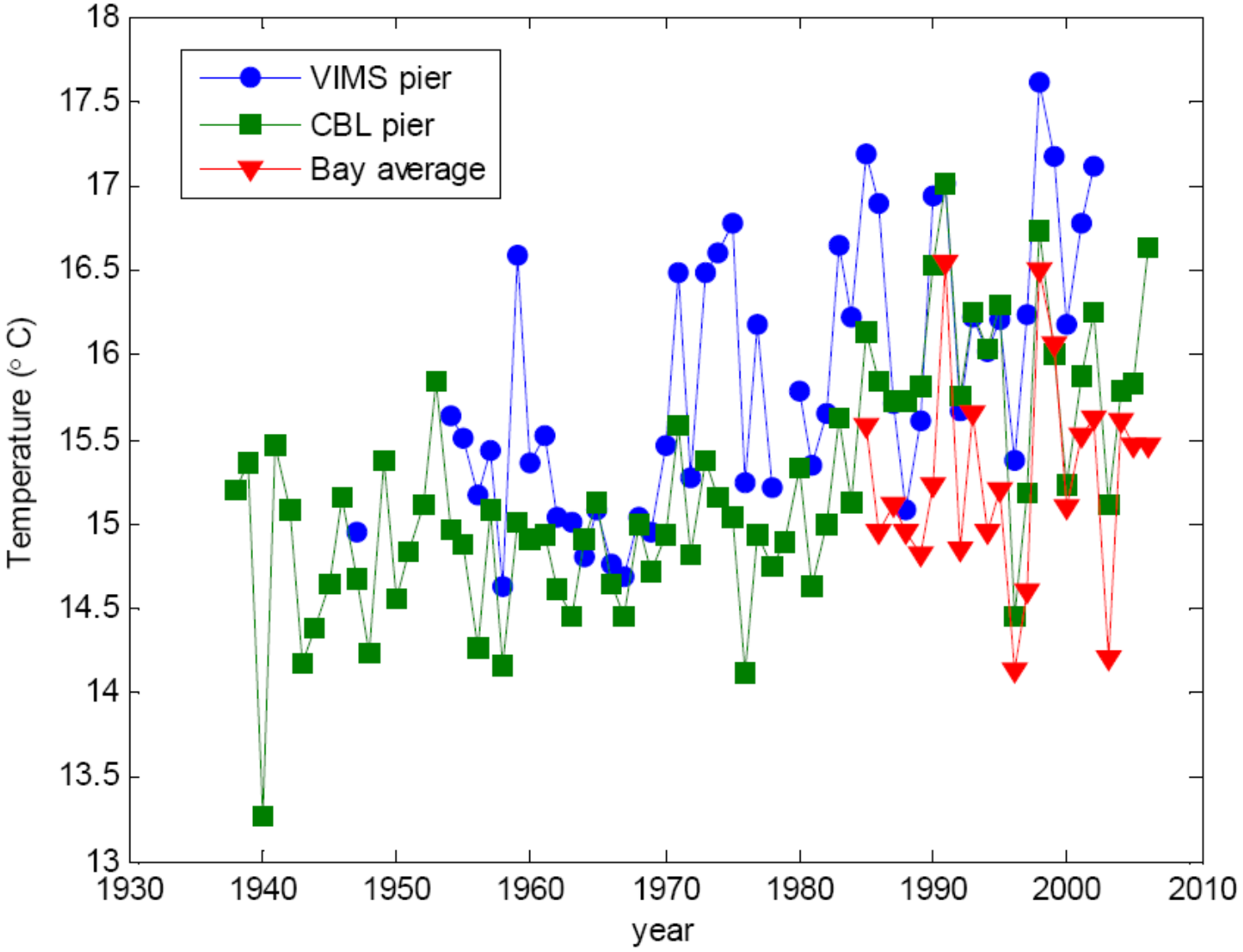
What do we know locally?

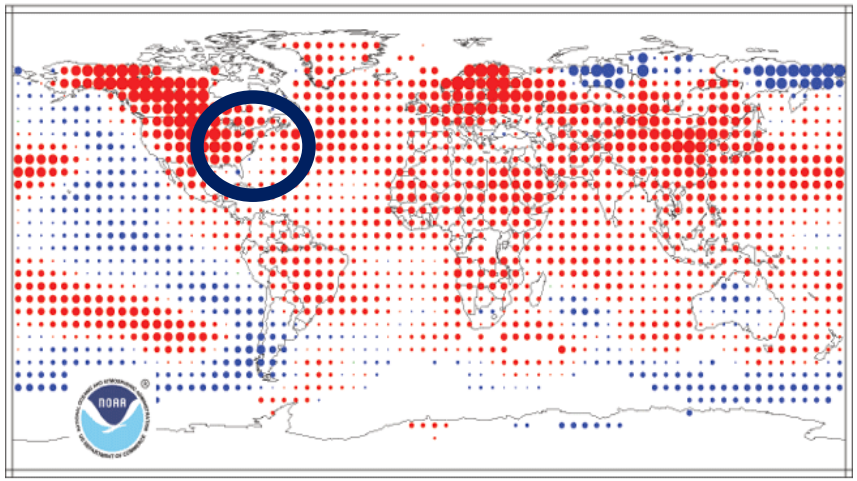
- Temperature increase
- Storm frequency
- Precipitation changes
- Sea level rise
- Natural resource impacts
- Human system risks

Chesapeake Bay water temperature



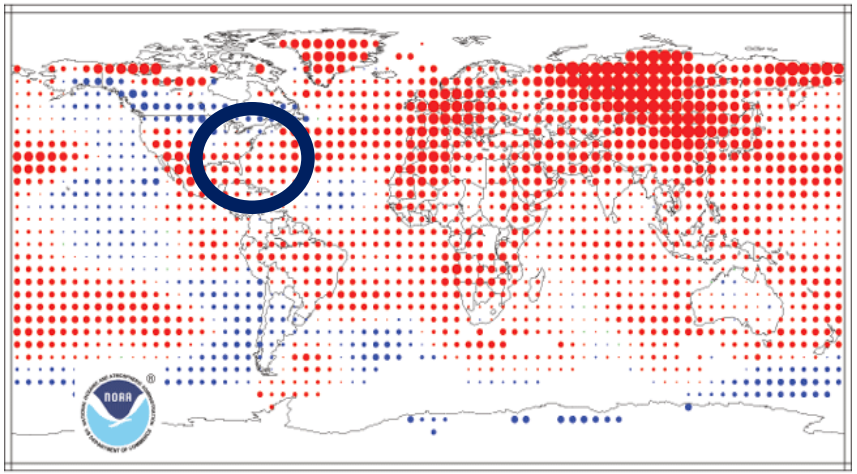
Dec-Feb Temperature Trends

1979-2003



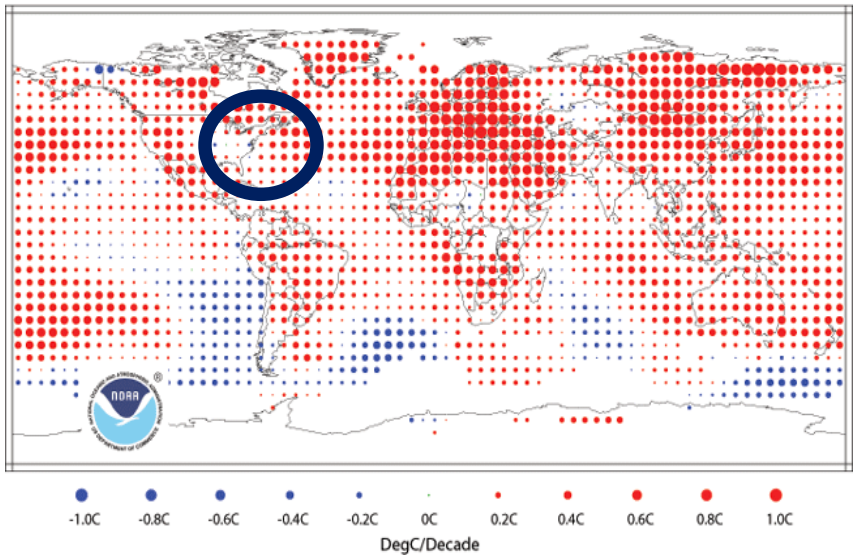
Mar-May Temperature Trends

1979-2003



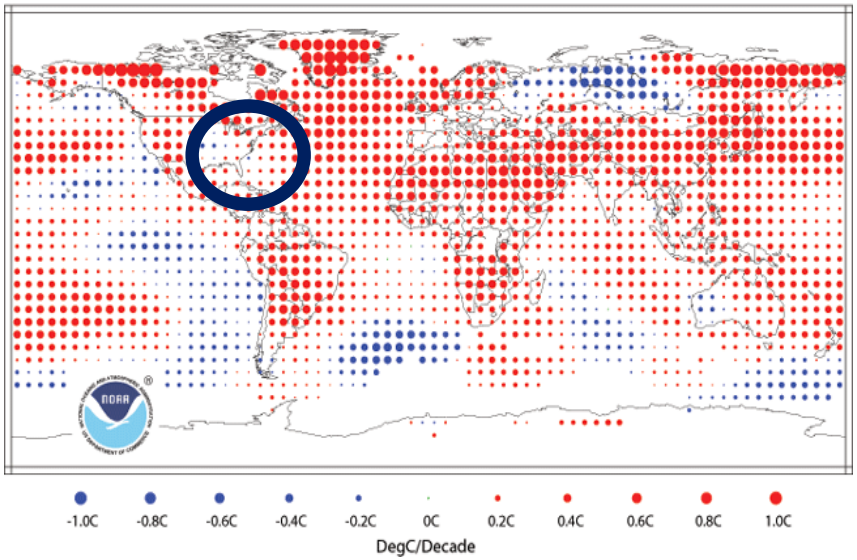
Jun-Aug Temperature Trends

1979-2003

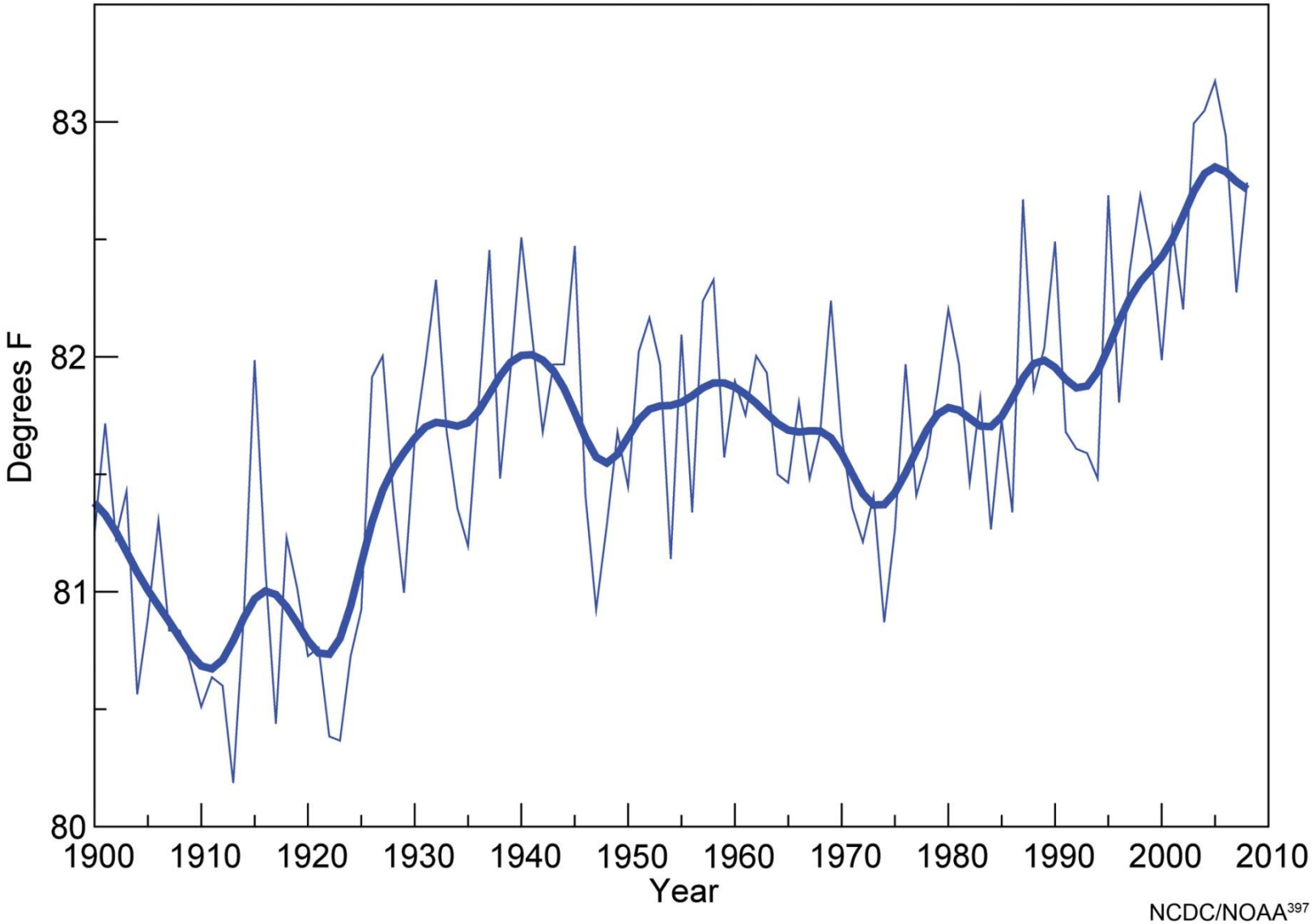


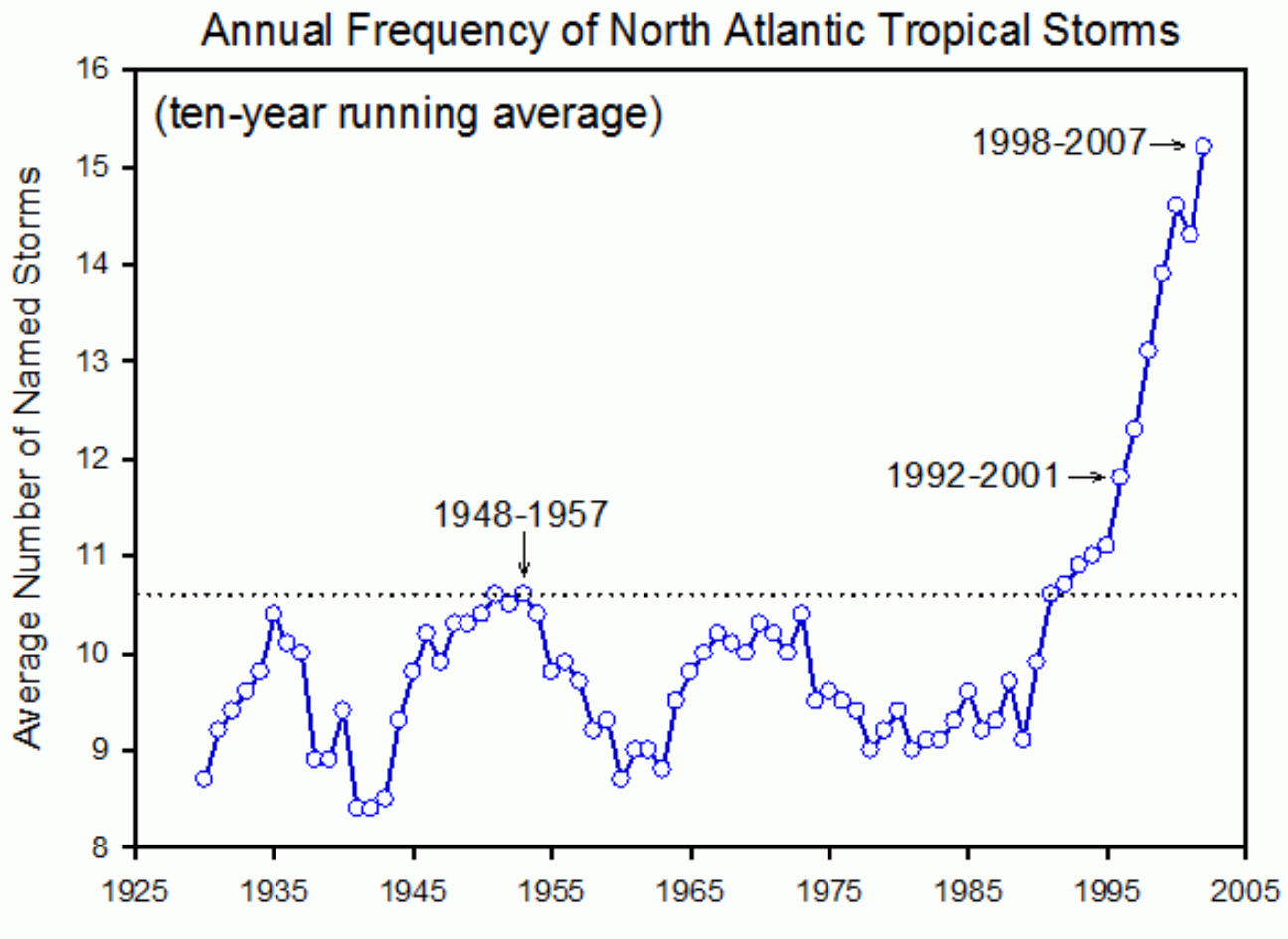
Sept-Nov Temperature Trends

1979-2003

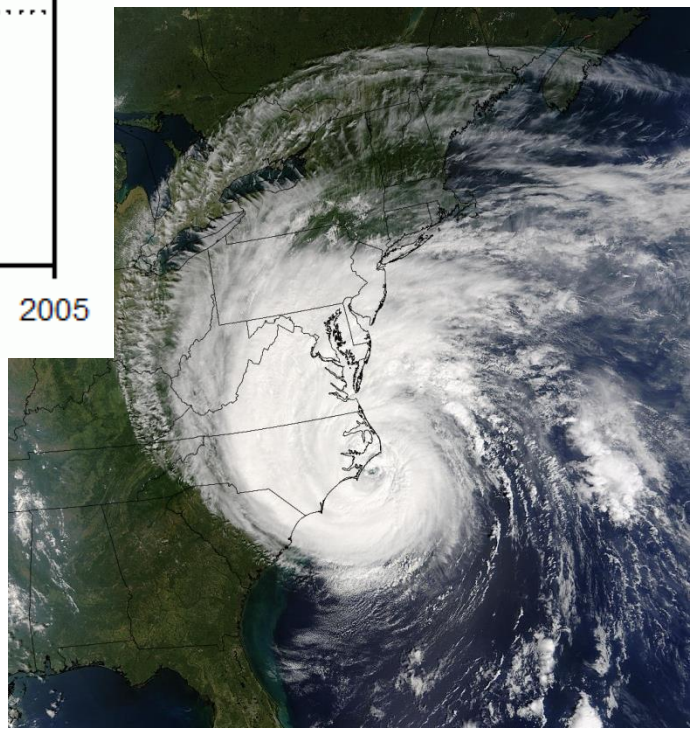


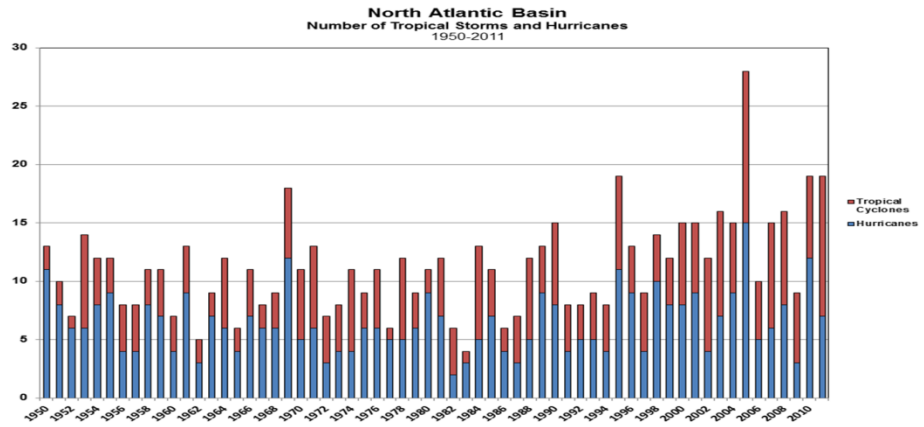
Atlantic ocean surface temperature during peak hurricane season

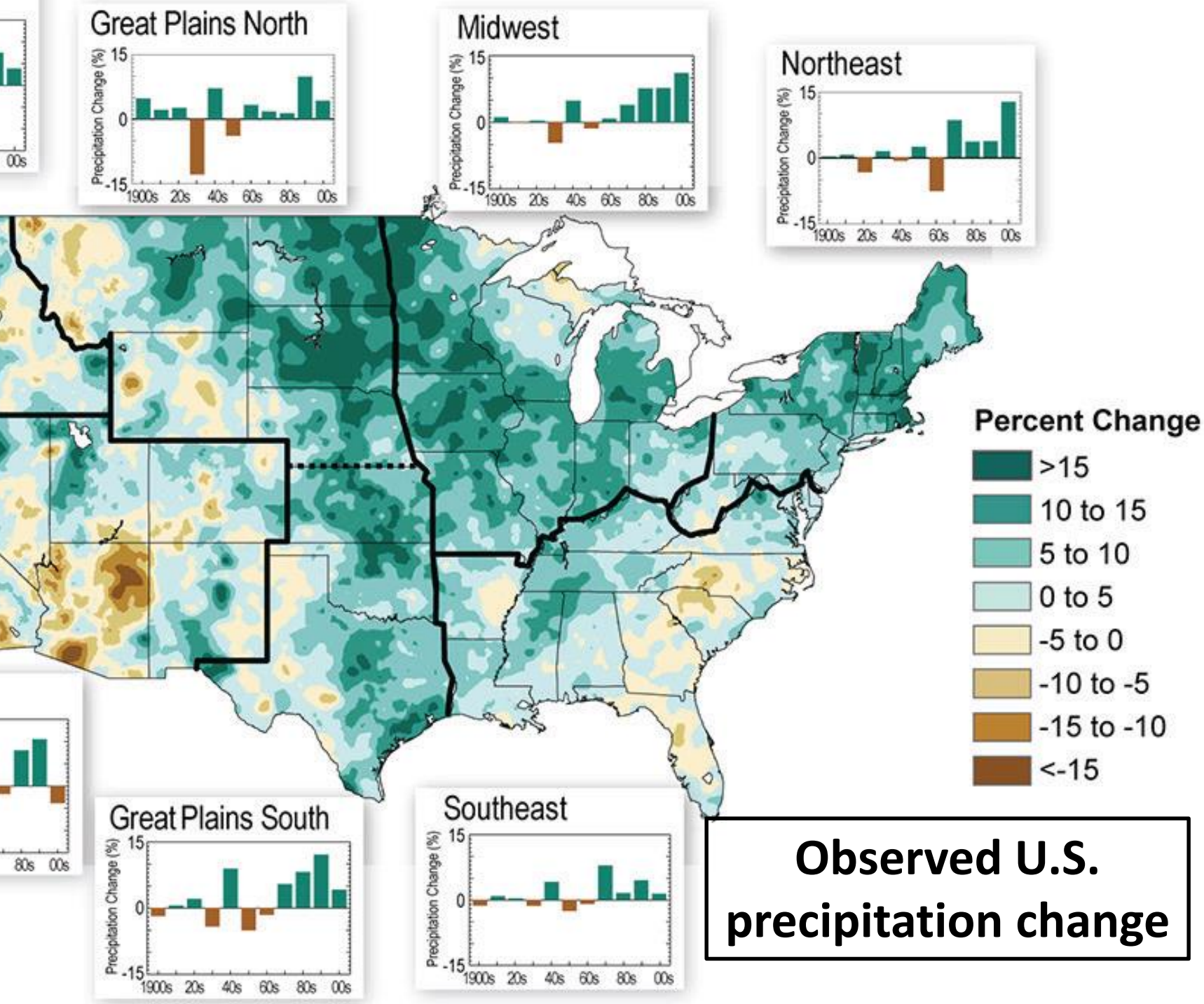




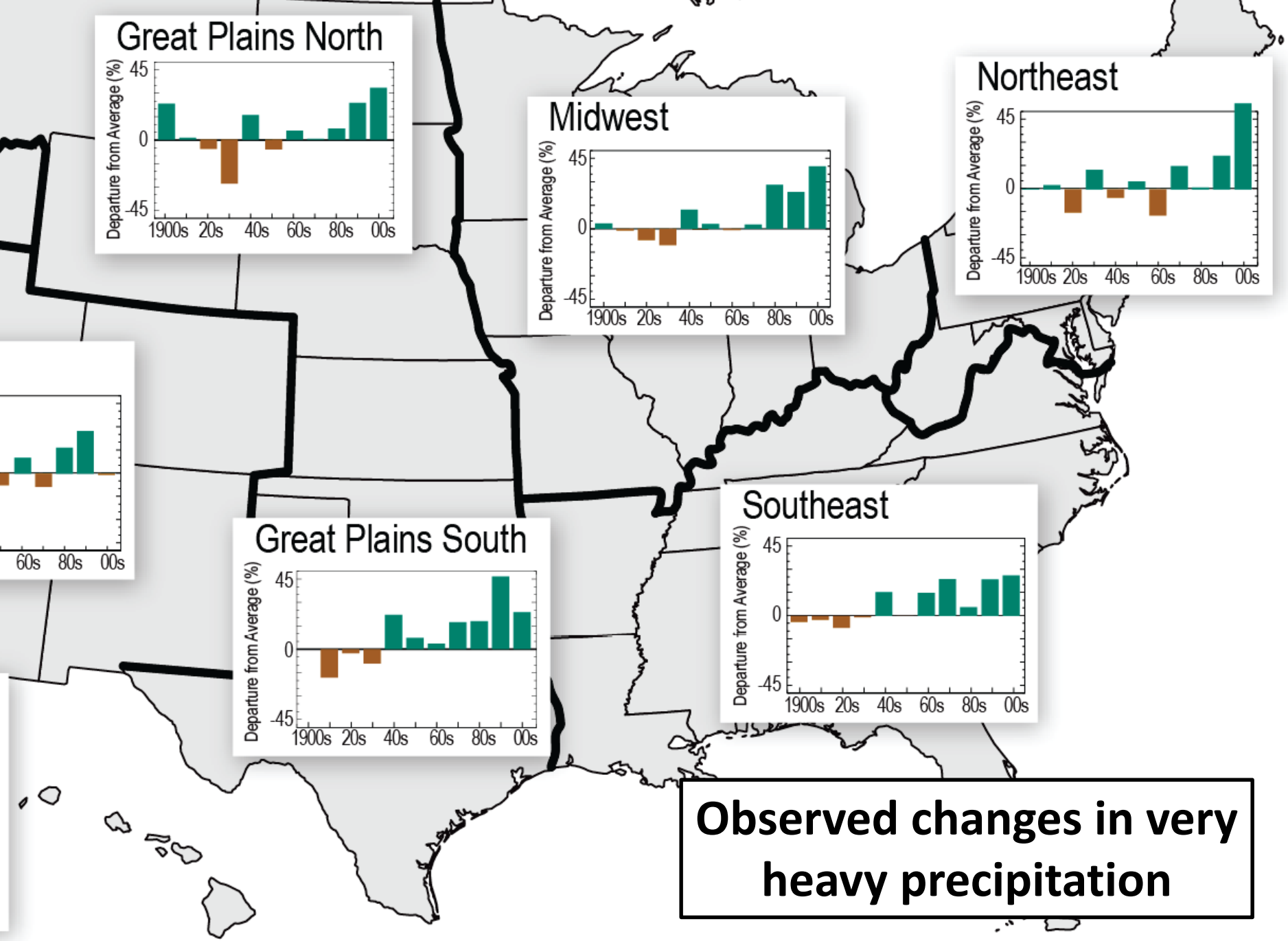
Hurricane Isabel



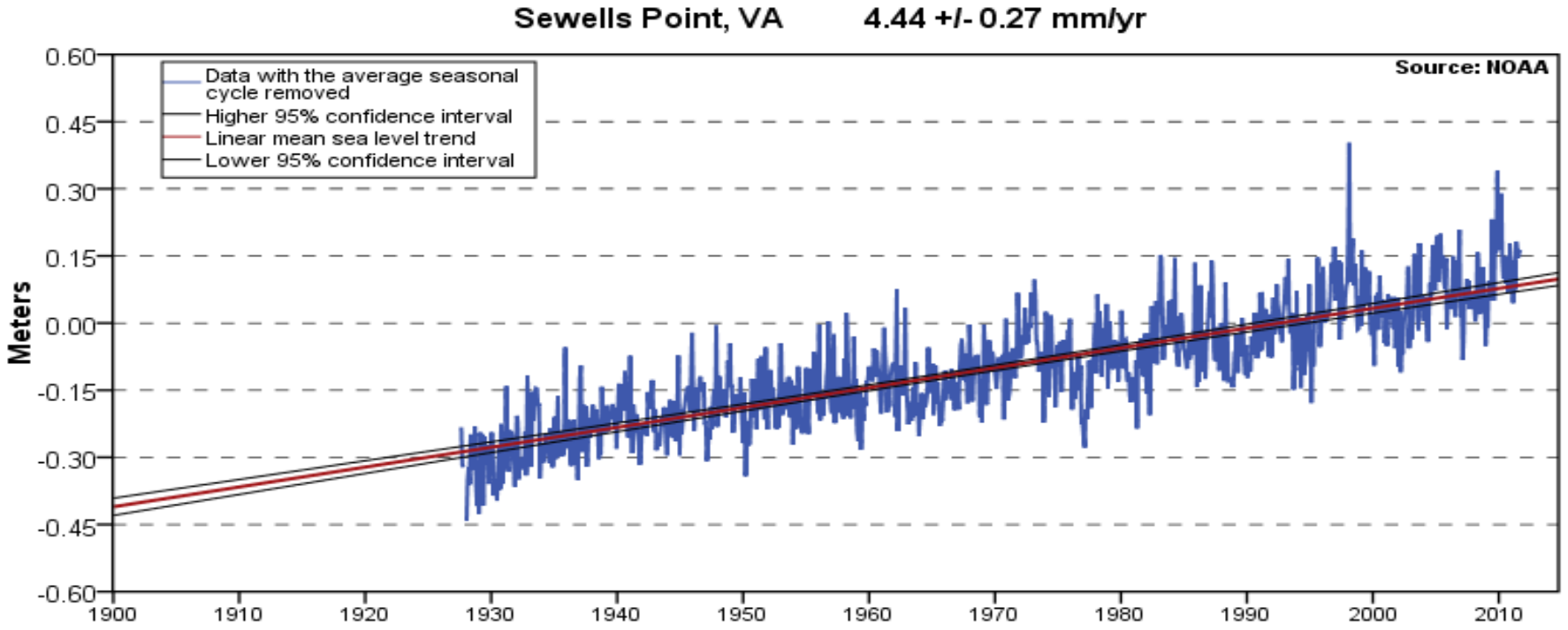


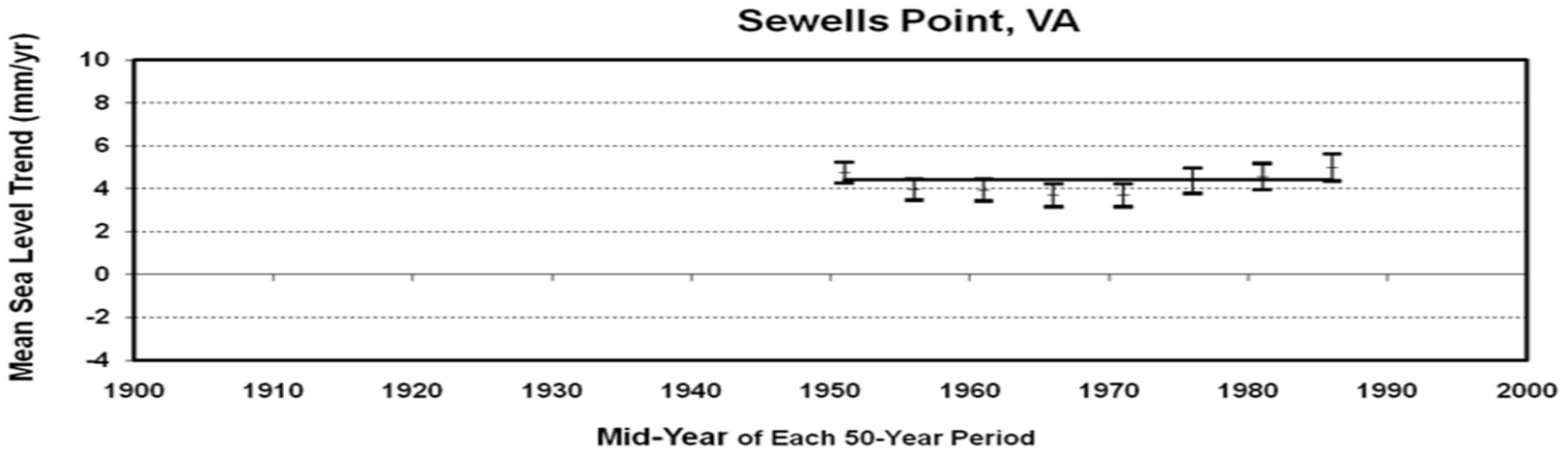


Observed U.S. precipitation change

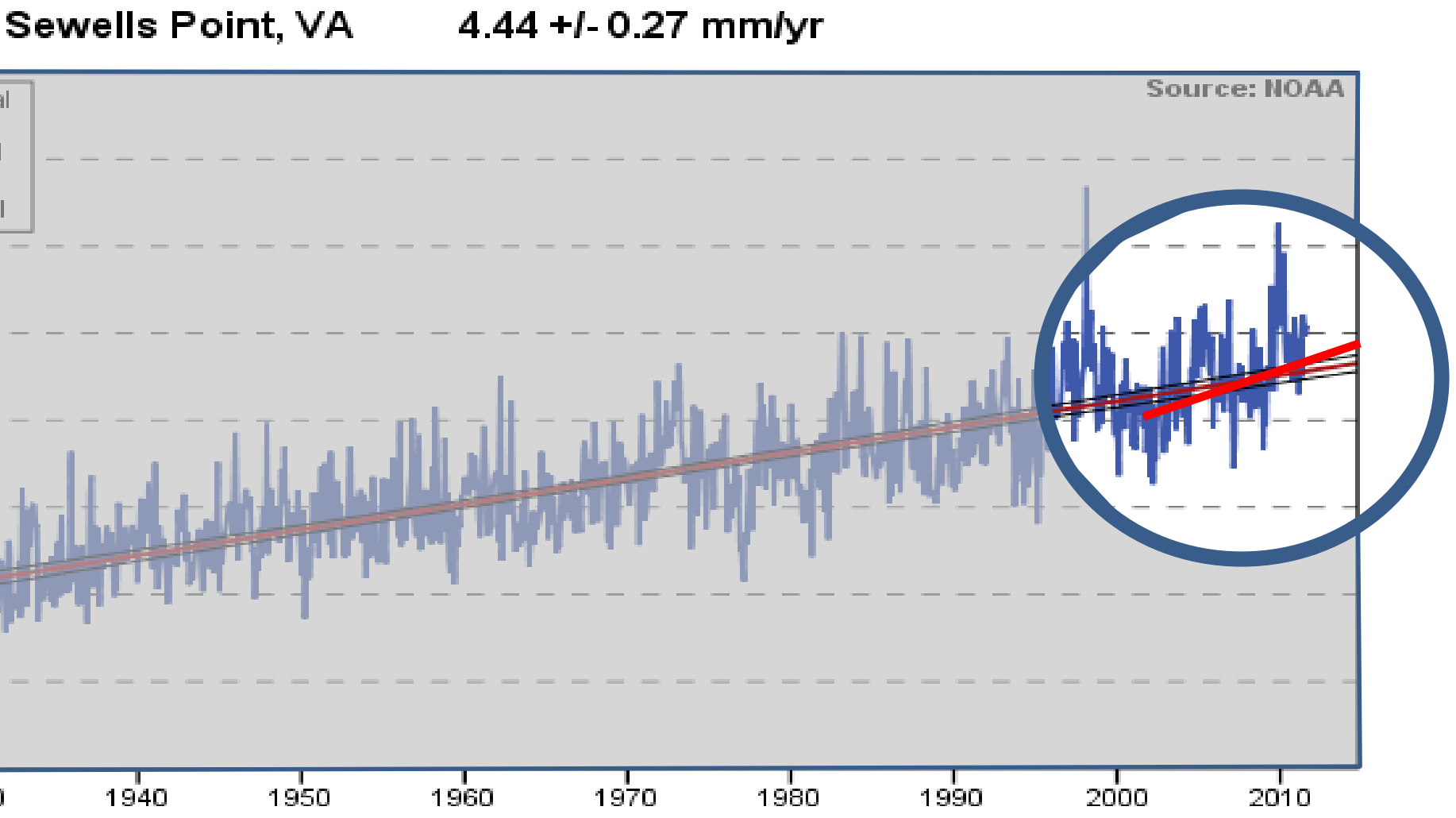

Great Plains North
Departure from Average (%)
45
0
-45
1900s 20s 40s 60s 80s 00s
Midwest
Departure from Average (%)
45
0
-45
1900s 20s 40s 60s 80s 00s
Northeast
Departure from Average (%)
45
0
-45
1900s 20s 40s 60s 80s 00s
60s 80s 00s
Great Plains South
Departure from Average (%)
45
0
-45
1900s 20s 40s 60s 80s 00s
Southeast
Departure from Average (%)
45
0
-45
1900s 20s 40s 60s 80s 00s
Observed changes in very heavy precipitation

Sea level changes in Virginia





Sea level changes in Virginia

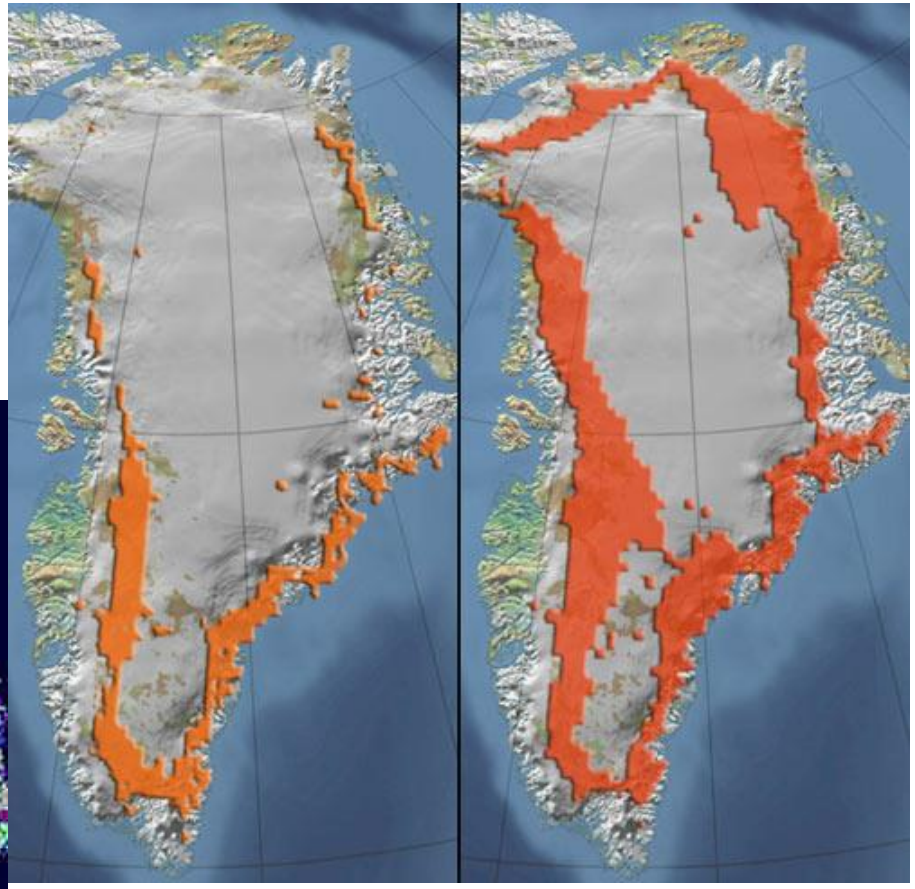


Relative sea level rise in Virginia

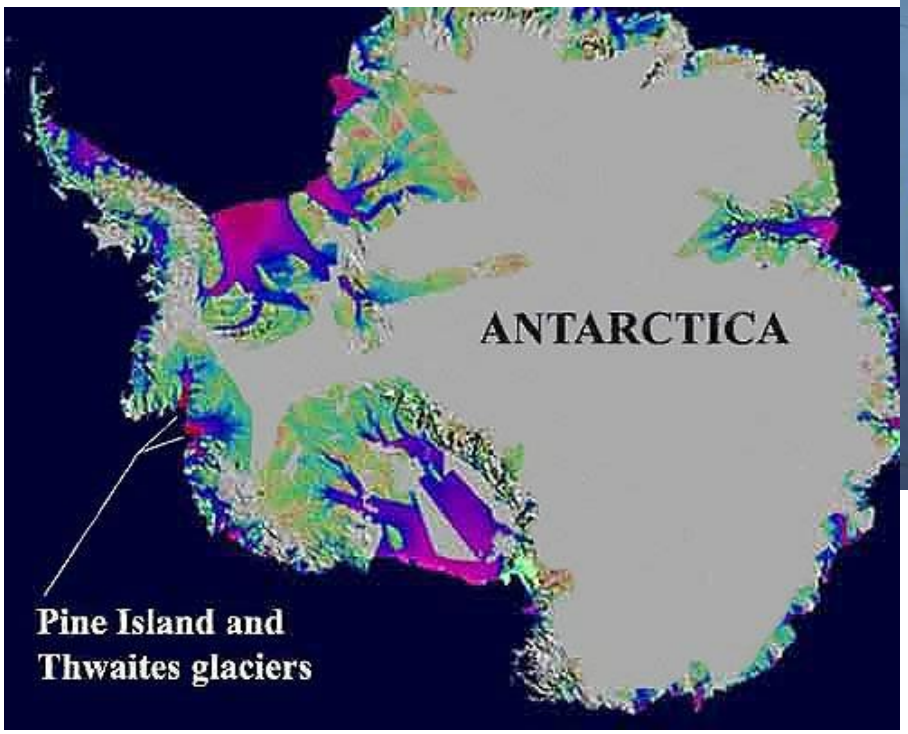
- Global sea level rise (2 - 4 mm/yr)
  - Melting ice caps
  - Warming (expanding) ocean water
- Land sinking (1 – 3 mm/yr)
  - Isostatic glacial rebound
  - Local subsidence
    - Ground water withdraw
    - Meteor crater sediment compaction
- Ocean circulation

melting ice caps

seasonal ice melting in Greenland
1992 and 2002

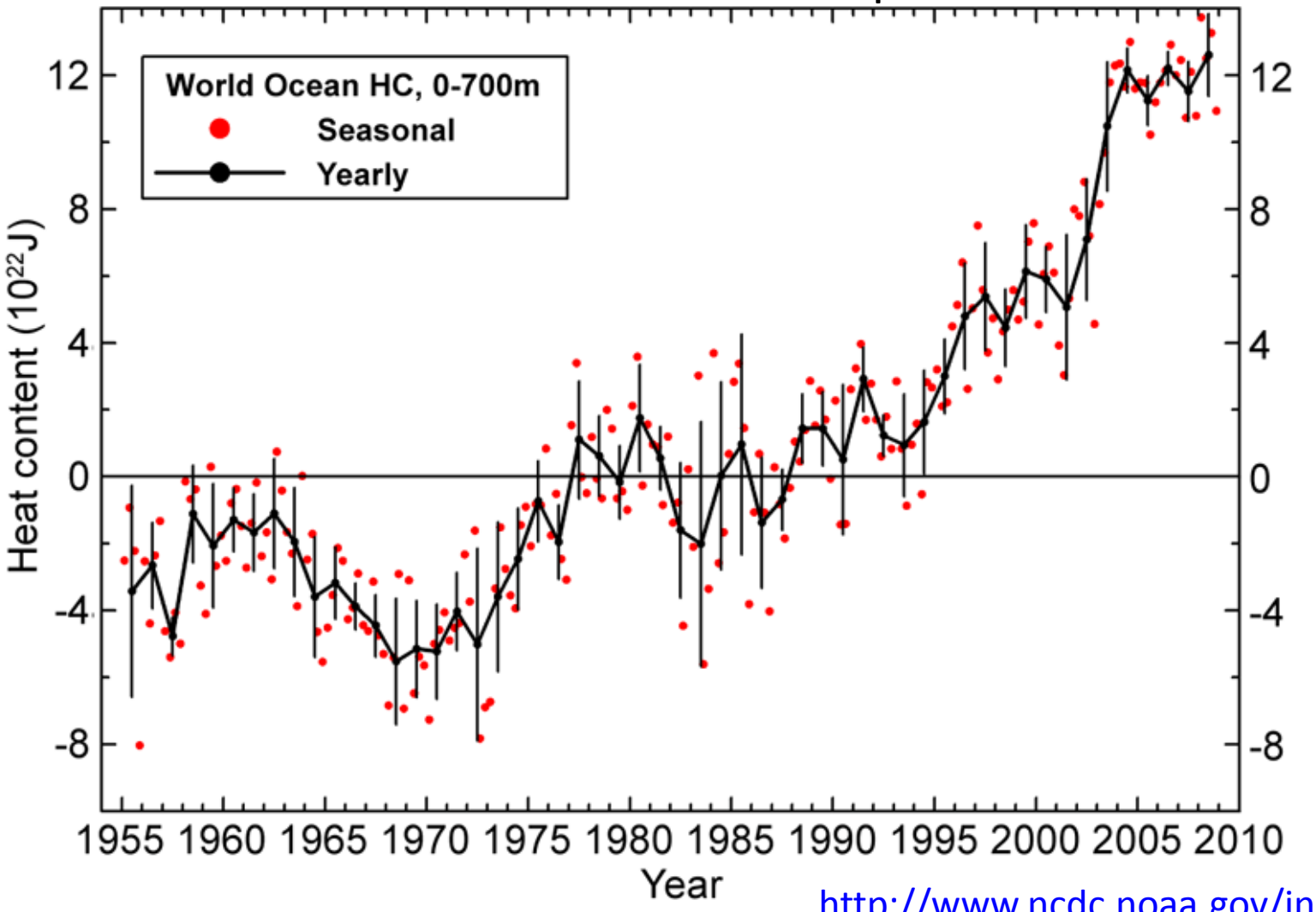


areas of ice sheet melting in Antarctica



warming ocean water

World ocean heat content - top 700 meters

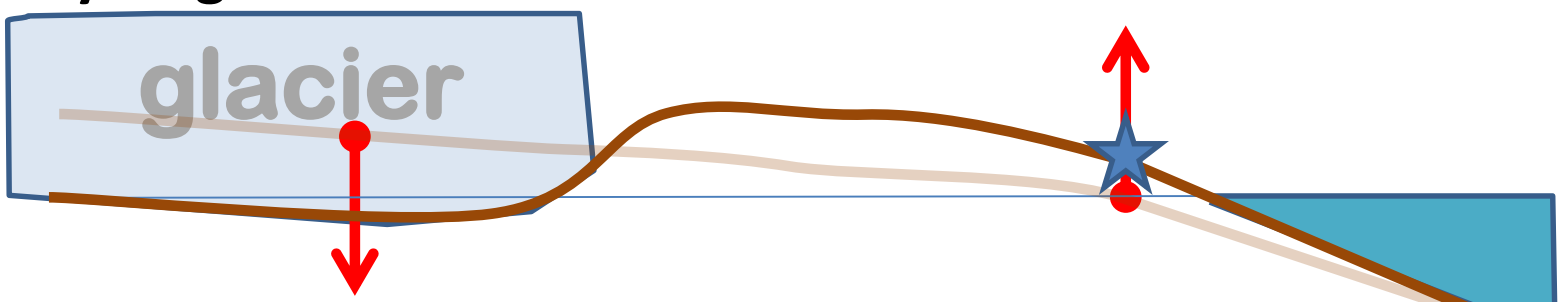


http://www.ncdc.noaa.gov/indicators/

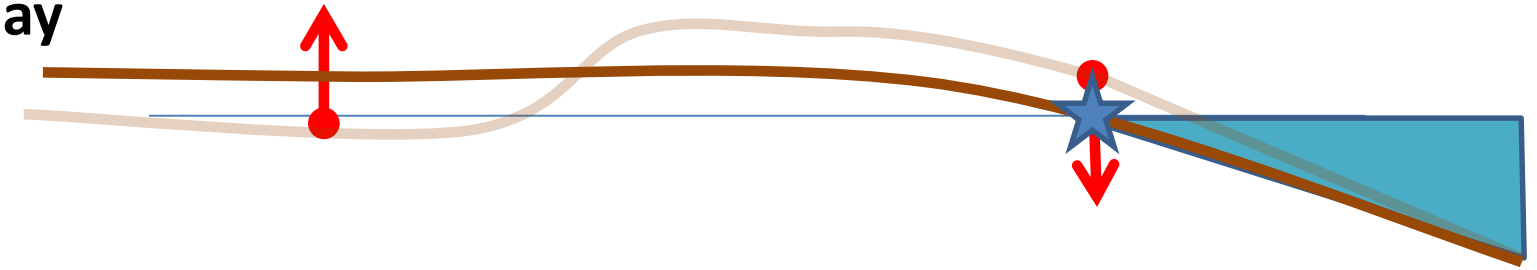
isostatic glacial rebound

100,000 yrs ago

20,000 yrs ago

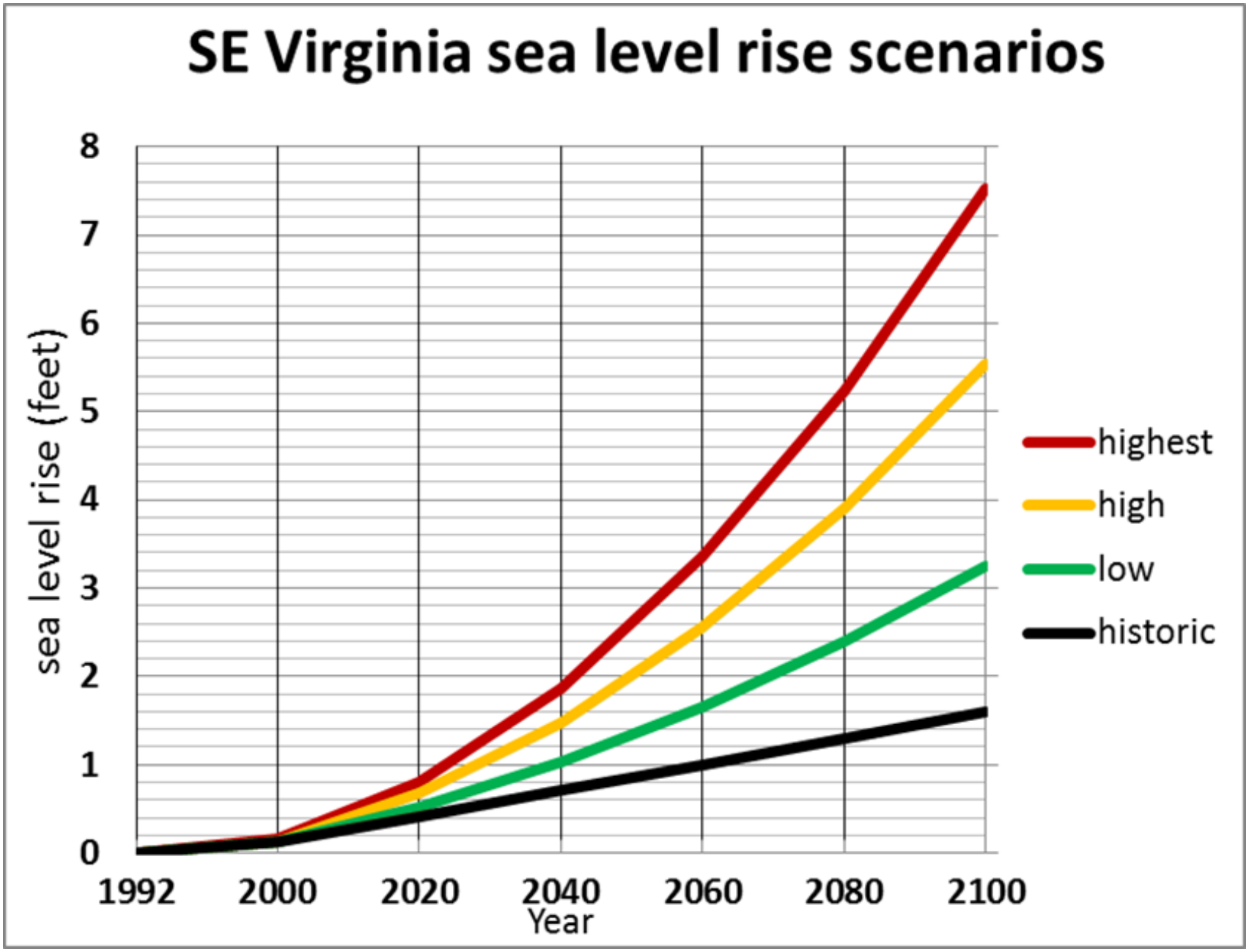


today

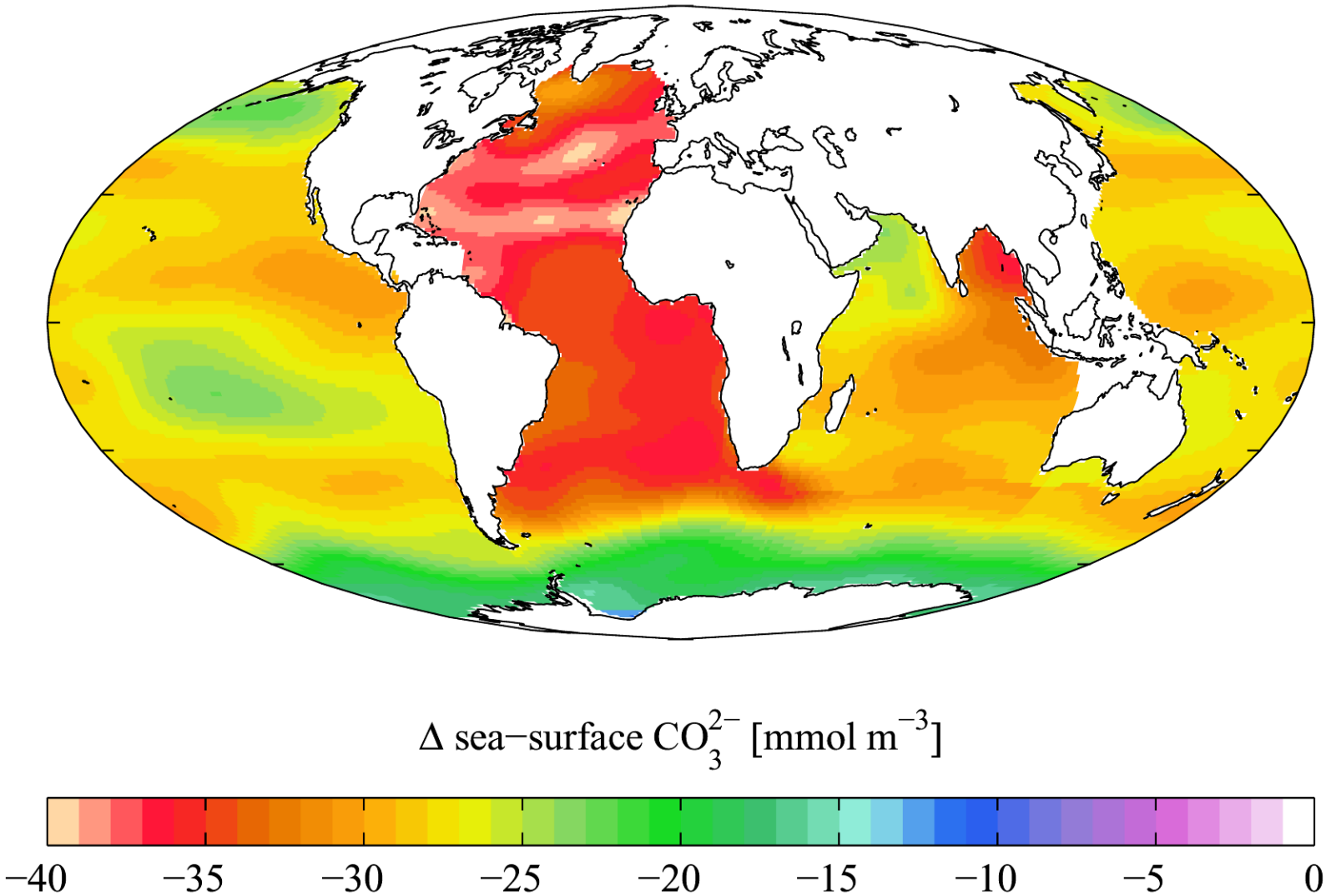



Atlantic Meridional Overturning Circulation
North Atlantic Current
Gulf Stream
North Atlantic Deep Water
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google earth

SE Virginia sea level rise scenarios



Change in sea surface carbonate ion from 1700s to 1990s



Currently anticipated changes by 2100

- Temperature +2°C to +5°C
- Storms
  - intensity probably increase
  - frequency may increase
- Precipitation
  - increase in fall
  - decrease in summer
- CO_2 increase affects water acidity
  - carbonate -45%
  - pH -5%
- Sea level +3 to +5 ft

consequences of climate change: **fisheries**

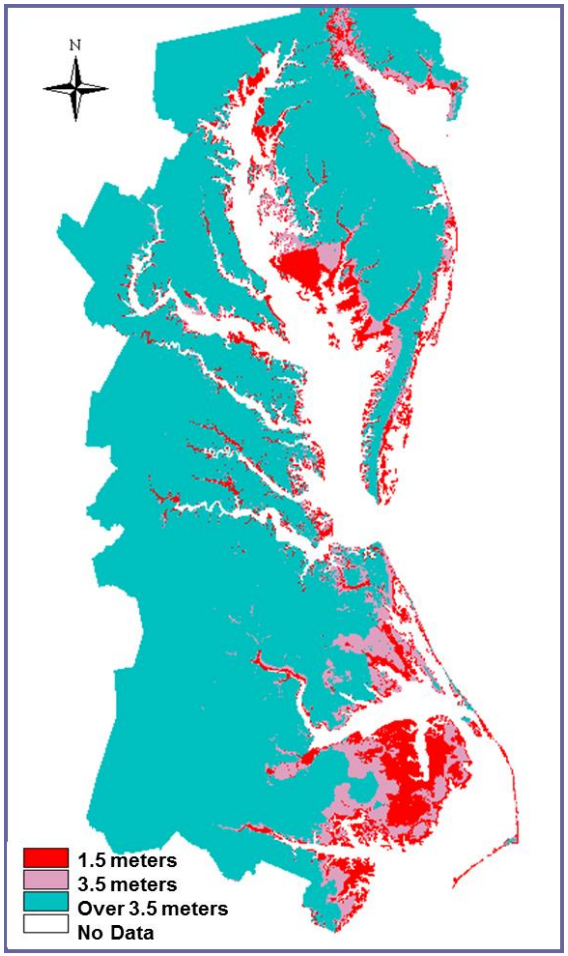
decreasing

- soft clams
- yellow perch
- white perch
- striped bass
- black sea bass
- tautog
- summer flounder
- winter flounder
- scup

increasing

- southern flounder
- cobia
- Spanish mackerel
- mullet
- tarpon
- black drum
- red drum
- spotted sea trout
- spot
- Southern Kingfish

consequences of climate change: **marshes**



consequences of climate change: **HABs**

high nutrient loads (existing)

\+ increased temperature (global warming)

\+ higher salinities (sea level rise)

\+ reduced flushing times (summer droughts)

\+ greater stratification

cyanobacteria blooms

consequences of climate change

trophic uncoupling

rainfall

↓

nutrients

↓

phytoplankton

↓

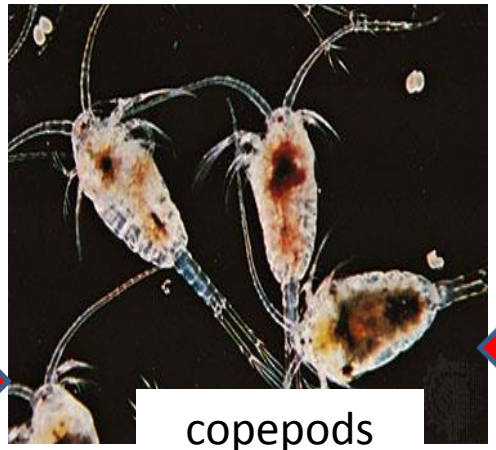
zooplankton

↓

juvenile fish

consequences of climate change

warm
dry



copepods

juvenile fish

jellyfish

Chrysaora quinquecirrha

ctenophore

Mnemiopsis leidyi

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