The Southeast Coastal Climate Network is dedicated to fostering regional leadership in mitigating and adapting to the challenge of global warming.

The Network promotes protection of the Southeast's uniquely vulnerable coastal resources by increasing local, state and national awareness of the threats and opportunities posed by climate change.

To join the SECCN: www.seccn.groupsite.com
To join the Florida Climate Alliance:
www.floridaclimatealliance.groupsite.com

The host organization for the Southeast Coastal Climate Network is

cleanenergy.org
Southern Alliance for Clean Energy

ICLEI is an international association of local governments as well as national and regional local government organizations that have made a commitment to sustainable development.

Over 1107 cities, towns, counties, and their associations worldwide comprise ICLEI's growing membership.

ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level.

ICLEI’s basic premise is that locally designed initiatives can provide an effective and cost-efficient way to achieve local, national, and global sustainability objectives.

Planning to Protect:
Helping SE Communities Think about Climate Change and Adaptation

ICLEI/SACE webinar January 28, 2010

Lynne M. Carter, Ph.D.
Associate Director, Southern Climate Impacts Planning Program, LSU
Associate Director, Coastal Sustainability Studio, LSU
Director, Adaptation Network, an Earth Island Institute Project

- **Southern Climate Impacts Planning Program**: NOAA/RISA, LSU and OU, State Climatologists, Southern Regional Climate Center

- Stakeholder-driven research: regionally relevant scientific research that results in critical information, products, tools, and education

- Engagement: partners, decision makers, and other stakeholders

- Southern U.S.: TX, OK, MS, LA, AR, TN

- Focus multi-hazard preparedness: severe storms, droughts, floods, hurricanes, extreme temperatures, etc., and coastal impacts of climate change and variability.

Key Messages

1. Climate change is here.
2. Climate change will have consequences for the region and the future will be different than the past.
3. Decisions today can reduce vulnerability through anticipation and action.

Key Messages

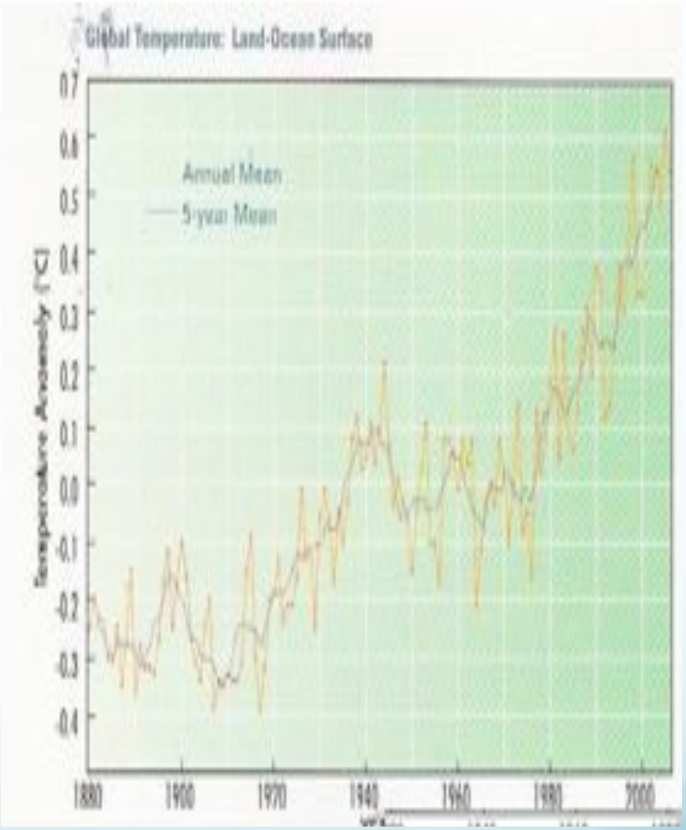
1. Climate change is here. We are already observing changes.
2. Climate change will have consequences for the region and the future will be different than the past.
3. Decisions today can reduce vulnerability through anticipation and action.

Climate change is here

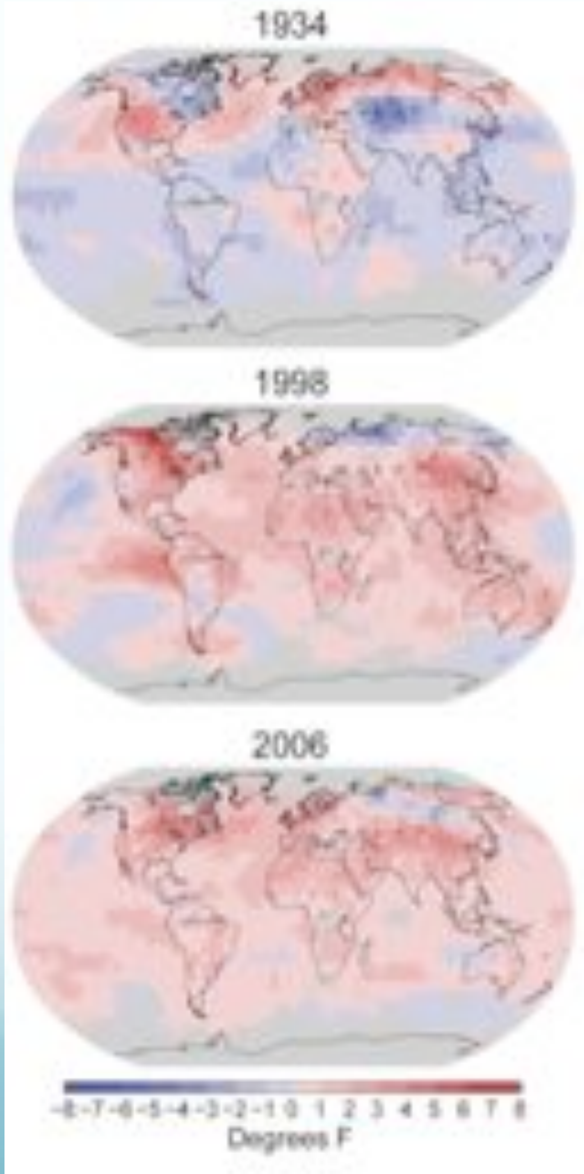
The climate is changing.

Can be seen in:

- increases in global-average surface and air temps
- widespread melting of snow and ice
- rising sea levels
- changes in precipitation patterns
- northward moving hardiness zones
- northward moving animals



Annual Temperature Differences



Maps show annual temperature difference from the 1961-1990 average for the 3 years that were the hottest on record in the United States: 1998, 1934 and 2006 (in rank order). Red areas were warmer than average, blue were cooler than average. The 1930s were very warm in much of the United States, but they were not unusually warm globally. On the other hand, the warmth of 1998 and 2006, as for most years in recent decades, has been global in extent.

From: Global Climate Change Impacts
In the US, 2009 pg 27

Changes Observed
temperature

- Average US temperature over 50 years increased more than + 2 °F (some locations more and others less than average)

- More frequent days above 90°F

- Increased frequency and intensity of heat waves and regional drought

Present-Day (1993-2008)
Average Change
from 1961-1979 Baseline

From: Global Climate Change Impacts
In the US, 2009 pg 28

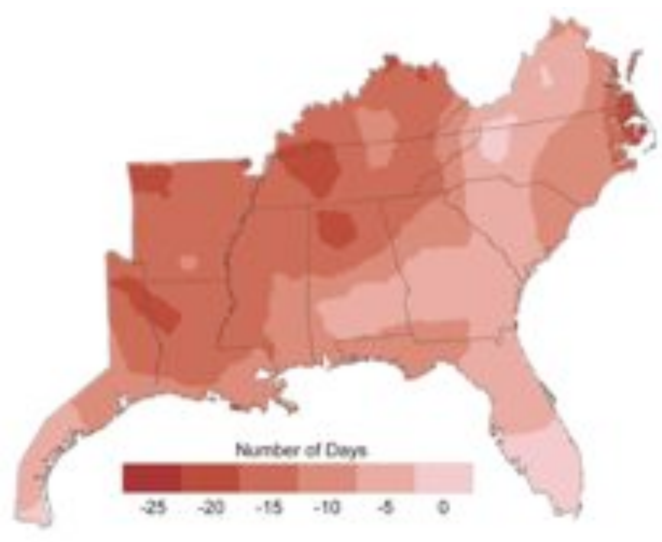
Local Changes to Temperature

Present-Day (1993-2008) Average Change from 1961-1979 Baseline
Change in Freezing days per year: since mid 1970s

- This region: temp declined from 1901 to 1970

- Since 1970 average SE temps increased + 1.6˚F and winter temps up + 2.7˚F

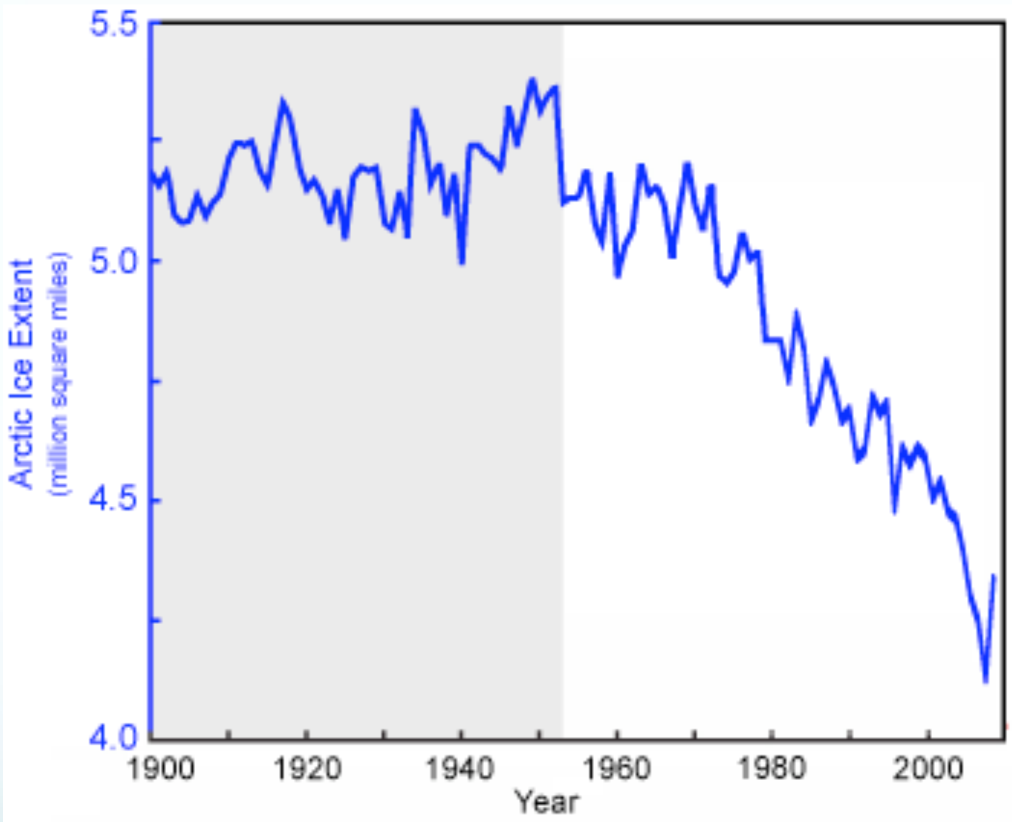
- Freezing days have declined by 4-7 days/yr for most of the region since mid-1970s: 20 fewer west LA; 5 fewer mid FL

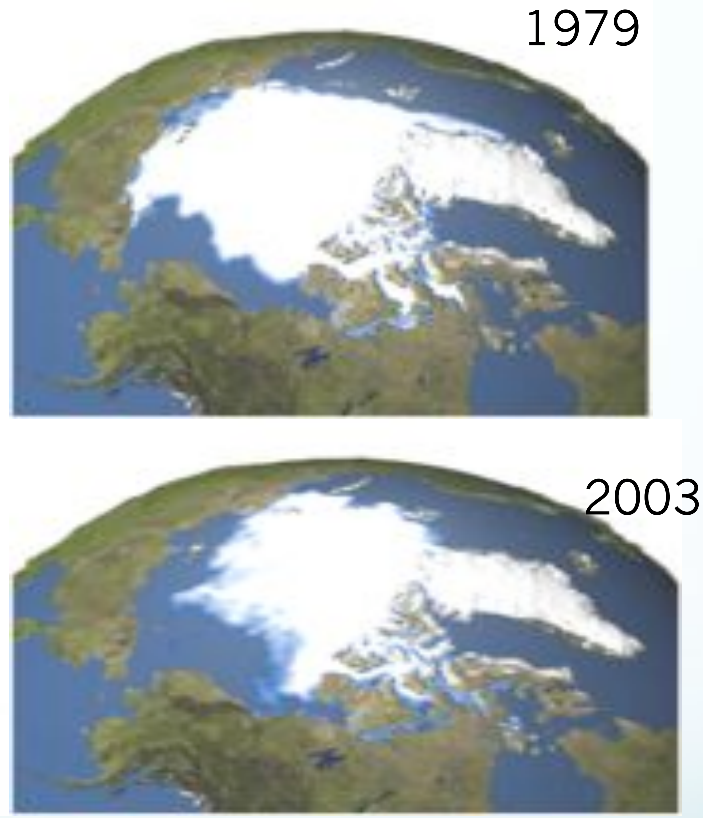


From: Global Climate Change Impacts in the US, 2009, pgs 28, 112

Arctic Sea-Ice Extent

Annual Average



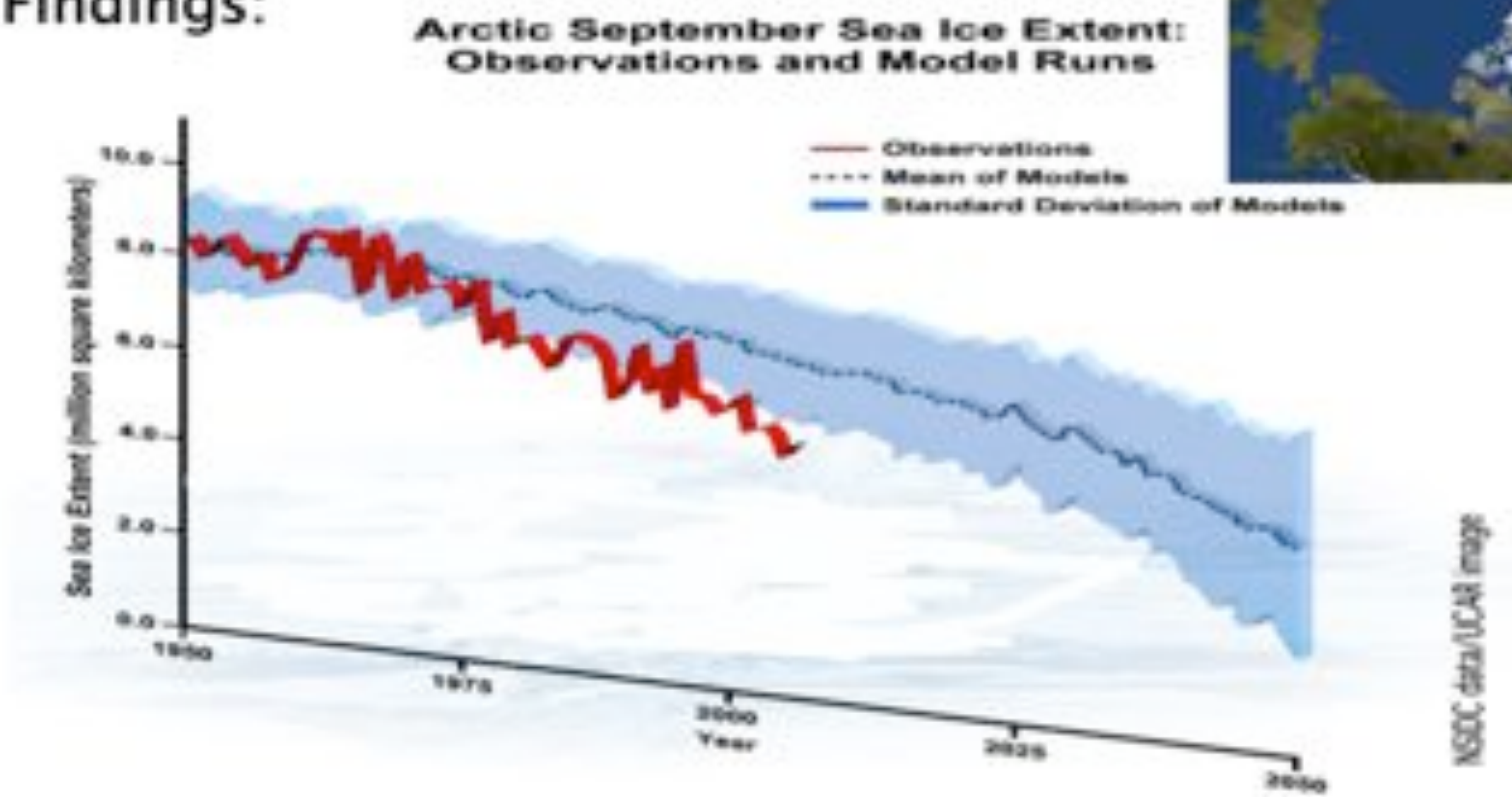


Observations of annual average Arctic sea-ice extent for the period 1900 to 2008. The gray shading indicates less confidence in the data before 1953.

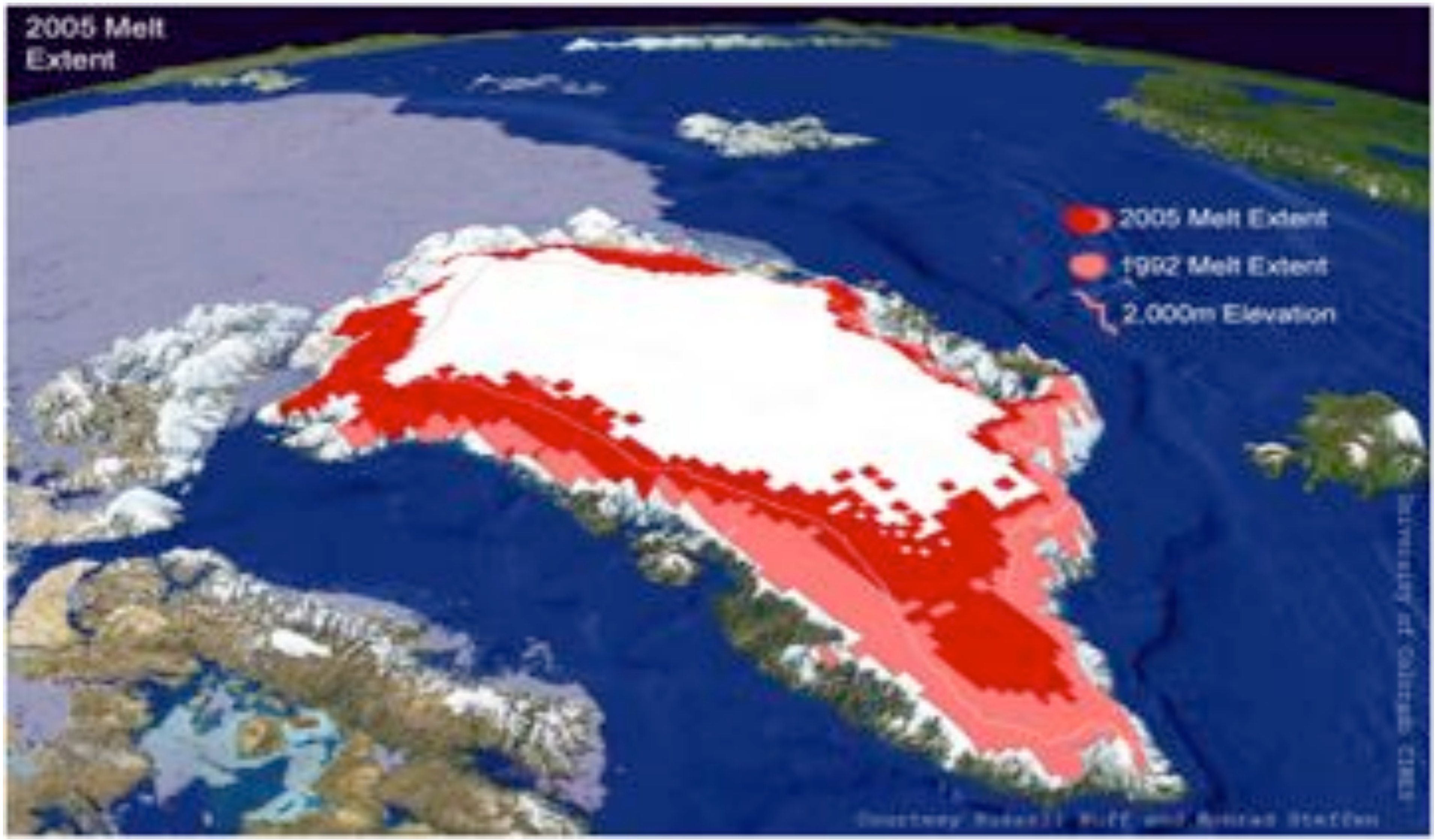
From: Global Climate Change Impacts In the US, 2009 pg 39
http://www.nasa.gov/centers/goddard/news/topstory/2003/1023esuice.html

Changes Observed
Melting Sea Ice

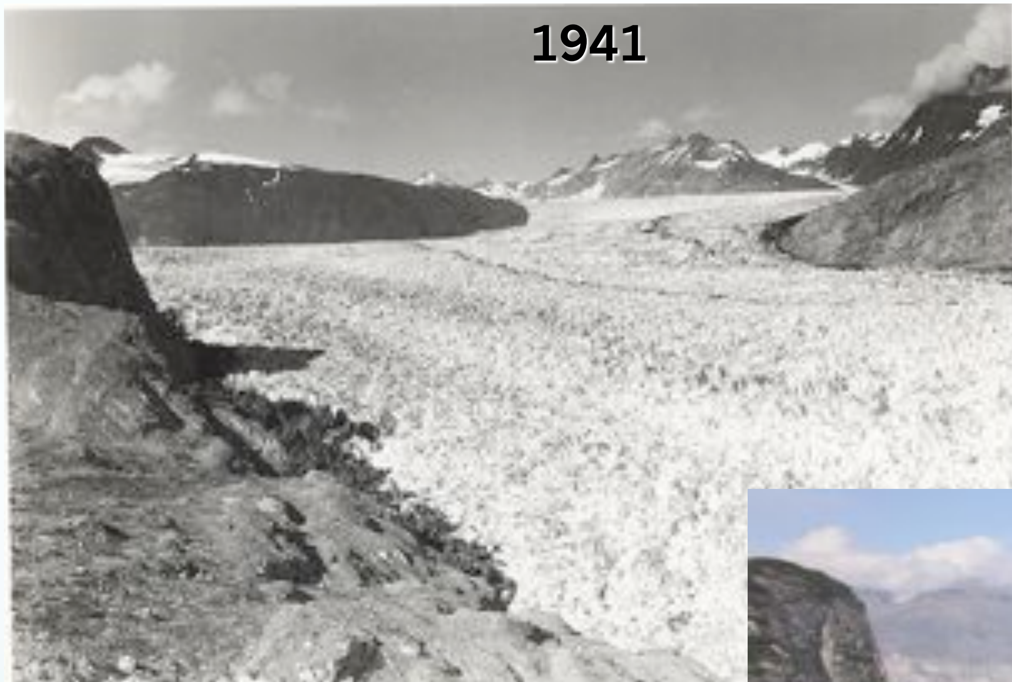
Recent Findings:



Changes Observed
Greenland Ice Sheet melt



Observed - Rapidly retreating glaciers

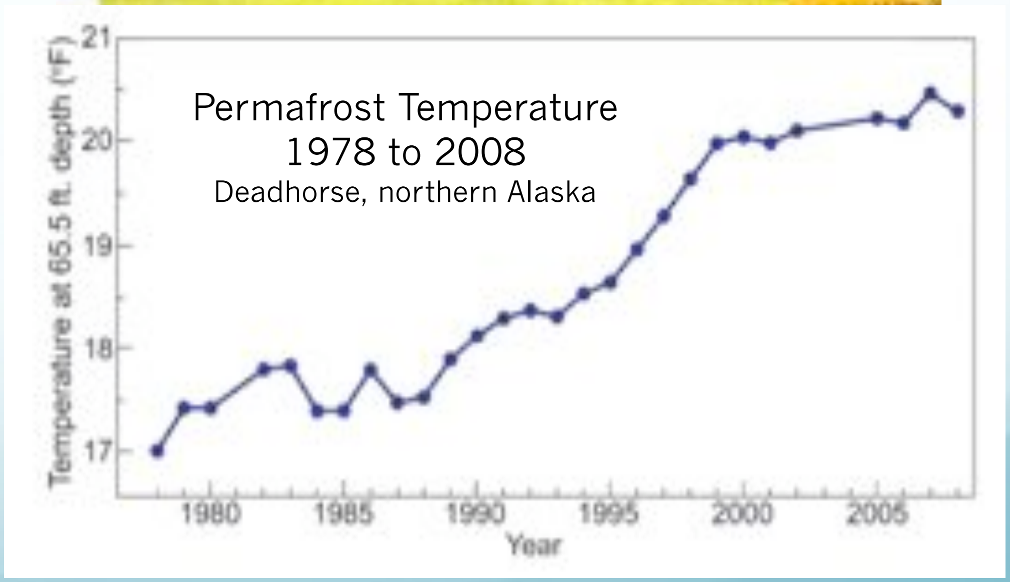


Muir Inlet, Alaska
Glacier Bay National Park
and Preserve

National Snow and Ice data center
http://nsidc.org/cgi-bin/gpd_run_pairs.pl

Observed Climate Changes

- Thawing permafrost
- Longer ice free seasons: oceans, lakes, rivers
- Earlier snow melt

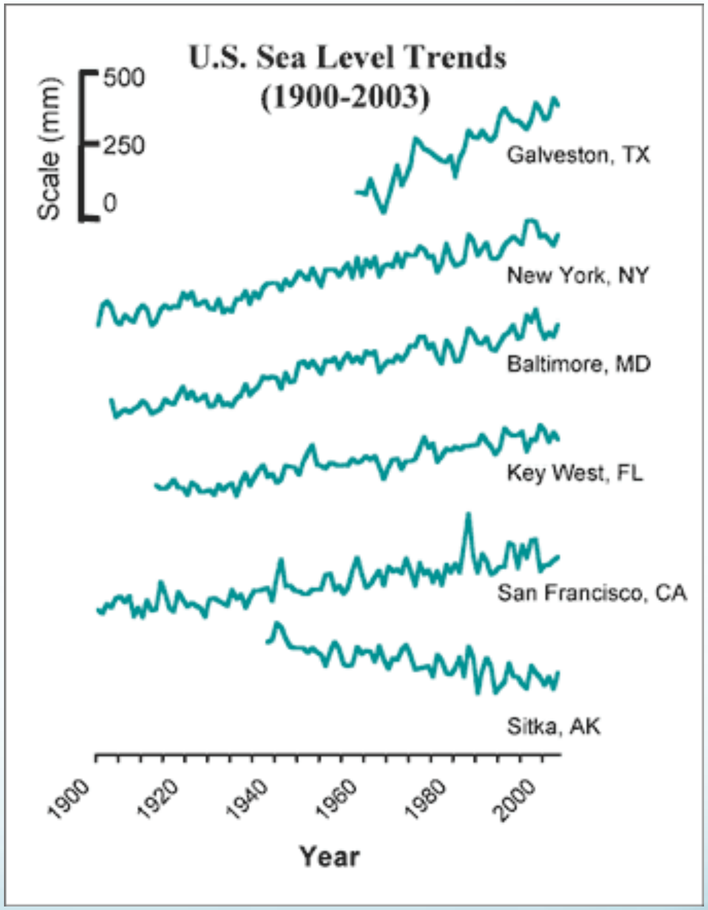


Changes Observed
Sea level

- Relative sea level depends on land rising/sinking
- Sea level rise is due to warming oceans and melting glaciers, land-based ice caps and ice sheets
- Warmer oceans also contribute to stronger hurricanes and more rainfall

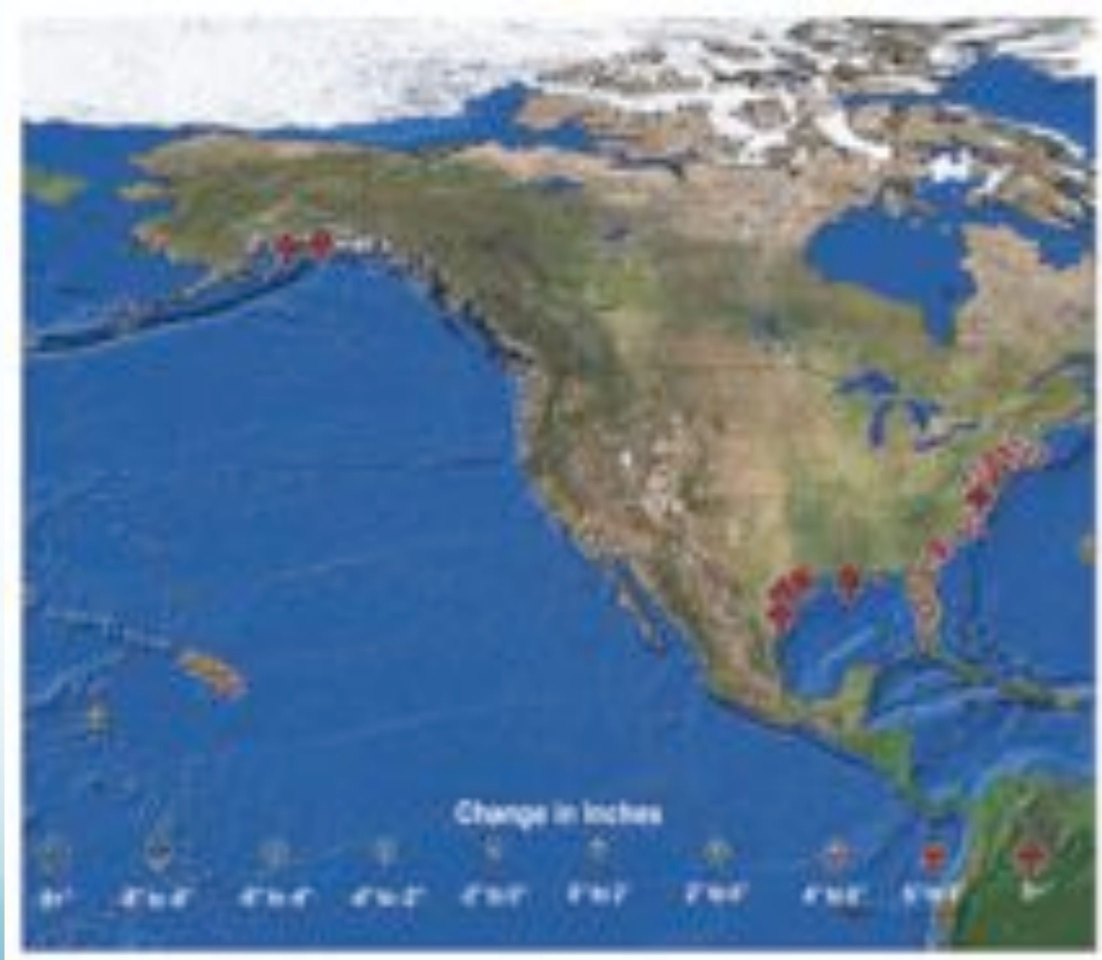
Observed US Climate Changes

Sea level rise:
4-8 inches global average



From: EPA website

Changes Observed
Sea level: 1958-2008

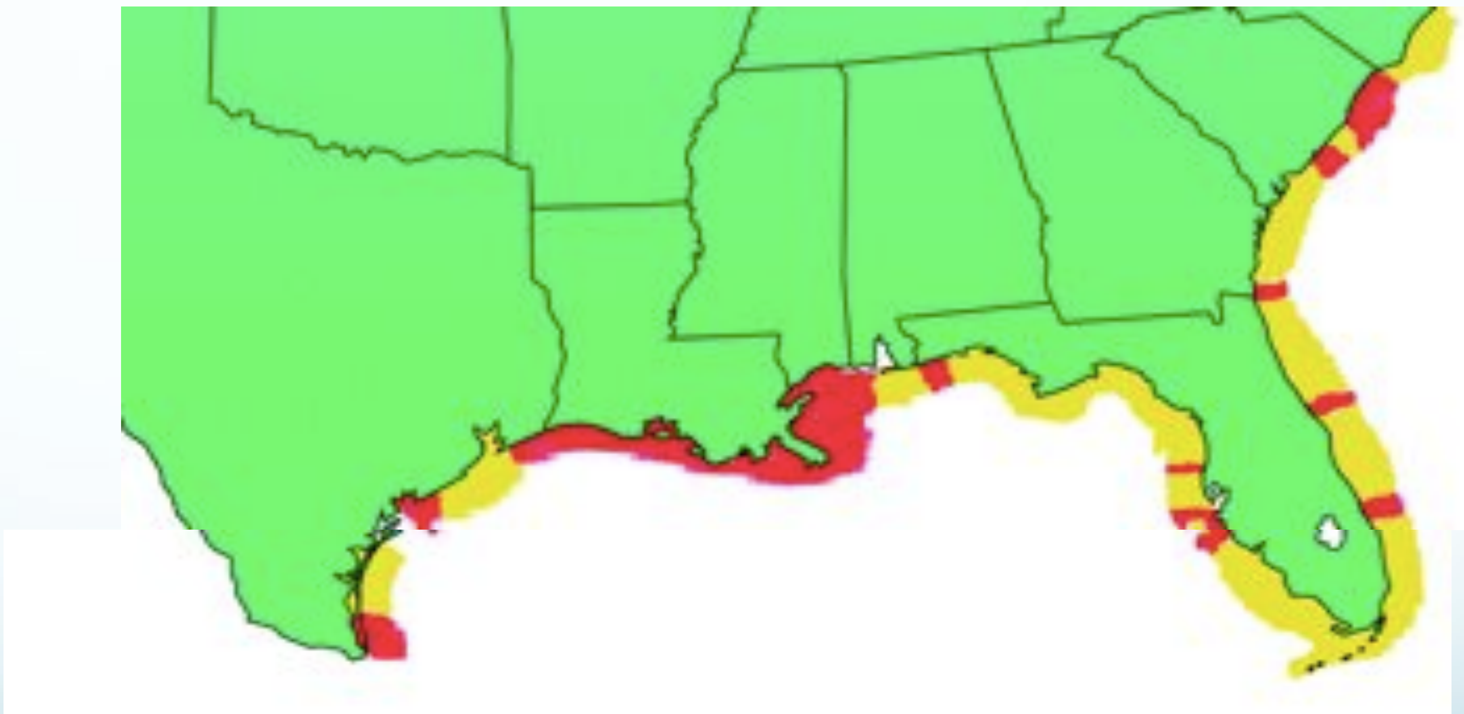


Some areas along the Atlantic and Gulf coasts - increases greater than 8 inches over the past 50 years.

From: Global Climate Change Impacts In the US, 2009 pg 37

Observed US Climate Changes

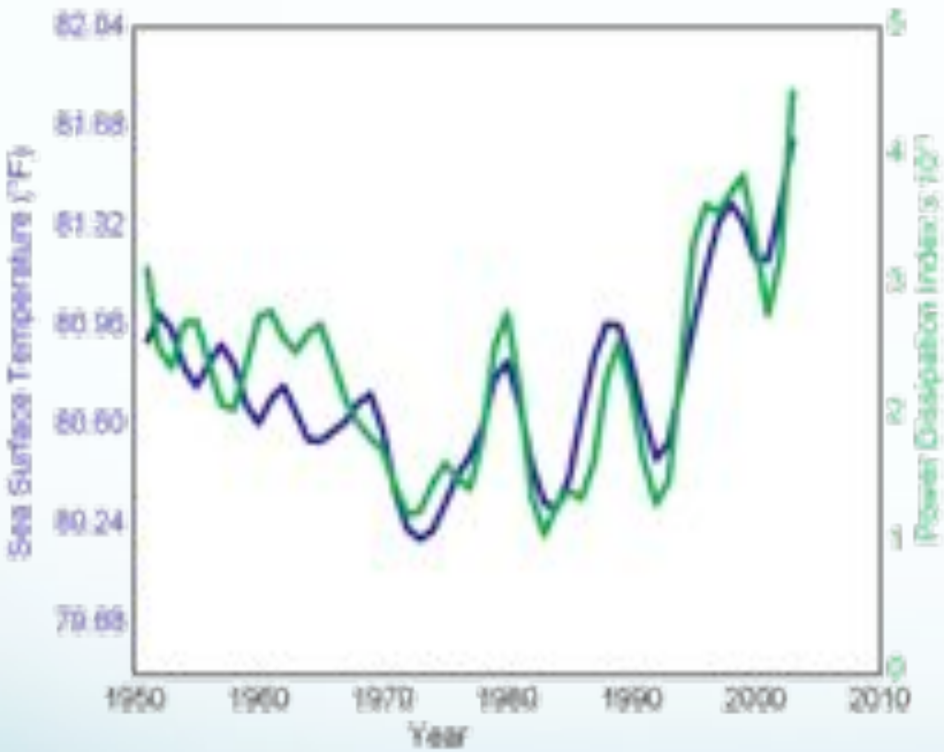
(eroding areas vulnerable)



Red= severely eroding   Yellow= moderately eroding

From US National Assessment

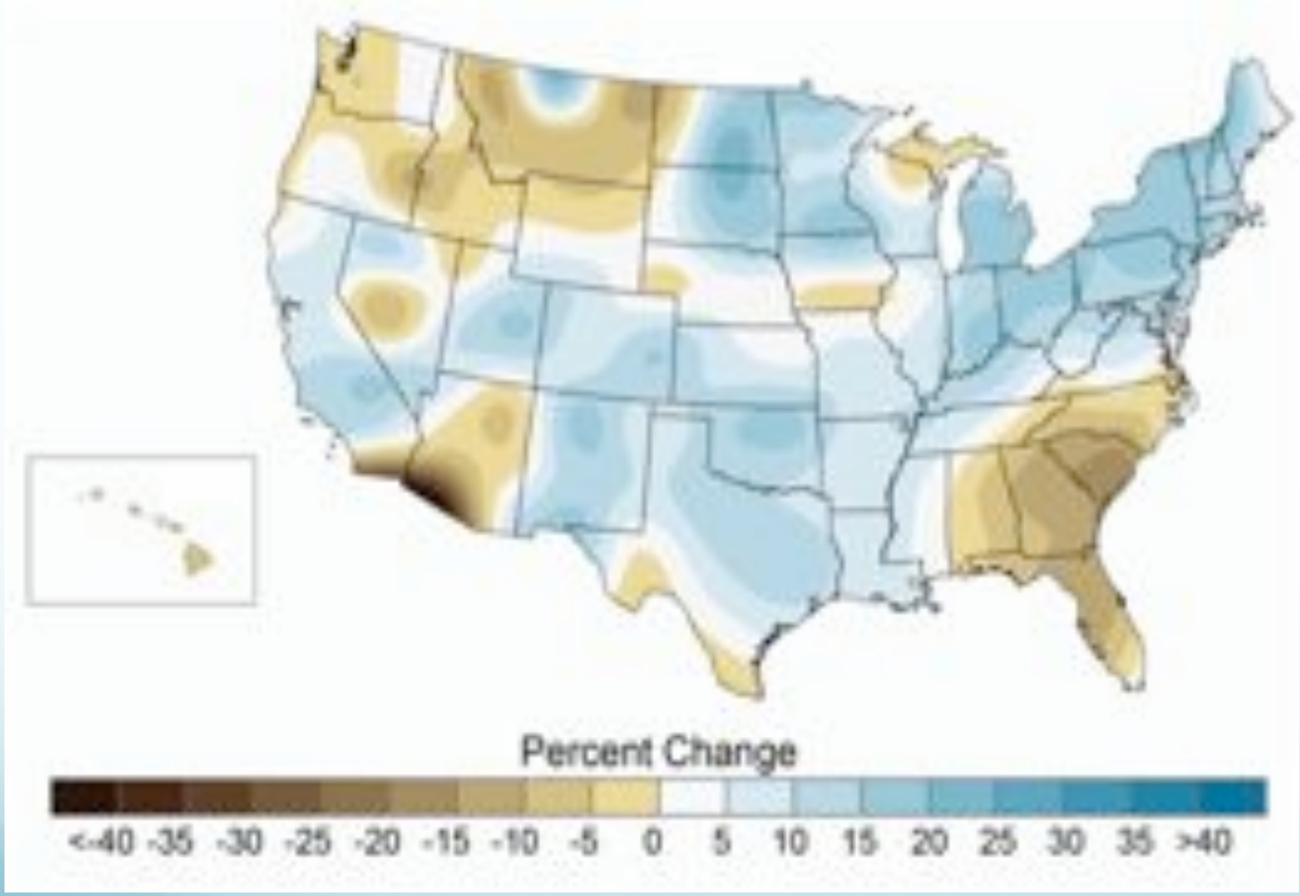
Observed Relationship between SST & Hurricane Power in the N. Atlantic Ocean



Observed sea surface temperature (blue) and the Power Dissipation Index (green), which combines frequency, intensity and duration for N. Atlantic hurricanes. Hurricane rainfall and wind speeds are likely to increase in response to warming. Analyses of model simulations suggest that for each 1.8°F increase in tropical sea surface temperatures, rainfall rates will increase by 6 to 18%.

From: Global Climate Change Impacts
In the US, 2009 pg 35

Changes Observed
precipitation: annual average 1958-2008



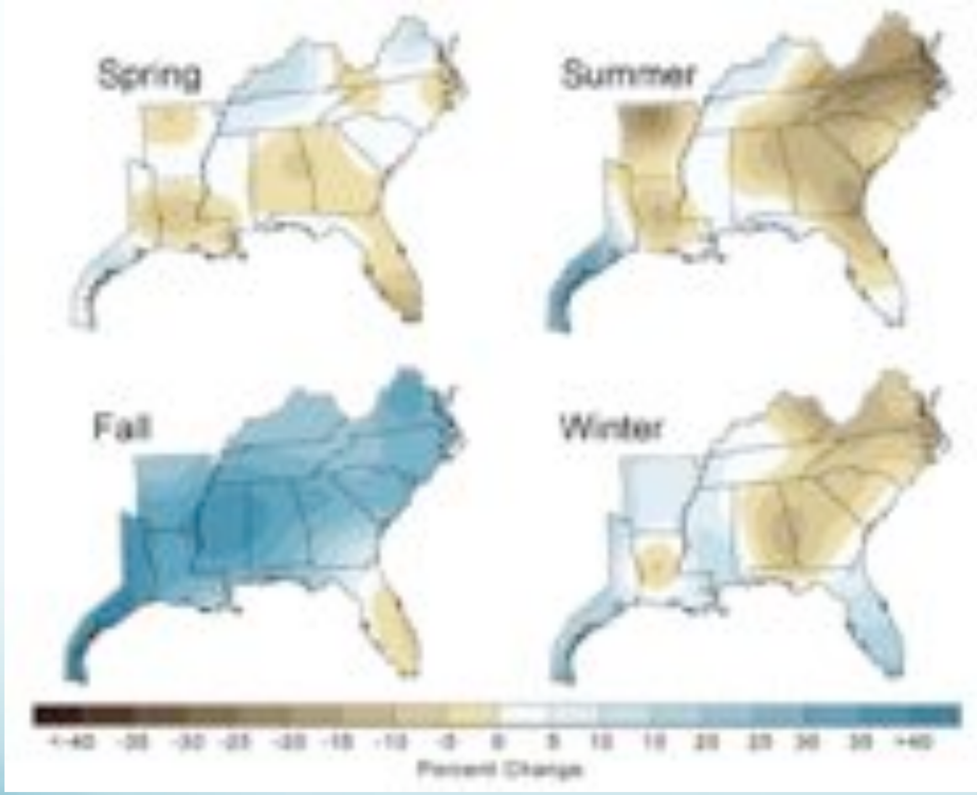
U.S. annual average precipitation has increased about 5 percent over the past 50 years

There have been important regional differences.

From: Global Climate Change Impacts In the US, 2009 pg 30

Local Changes in Precipitation

Observed Changes in Precipitation
1901 to 2007



Average **fall** precipitation in the Southeast *increased* by 30% since the early 1900s, **summer** and **winter** precipitation *declined* by nearly 10 % in the eastern part of the region.

Southern Florida has experienced a nearly 10 % *drop* in precipitation in spring, summer, and fall.

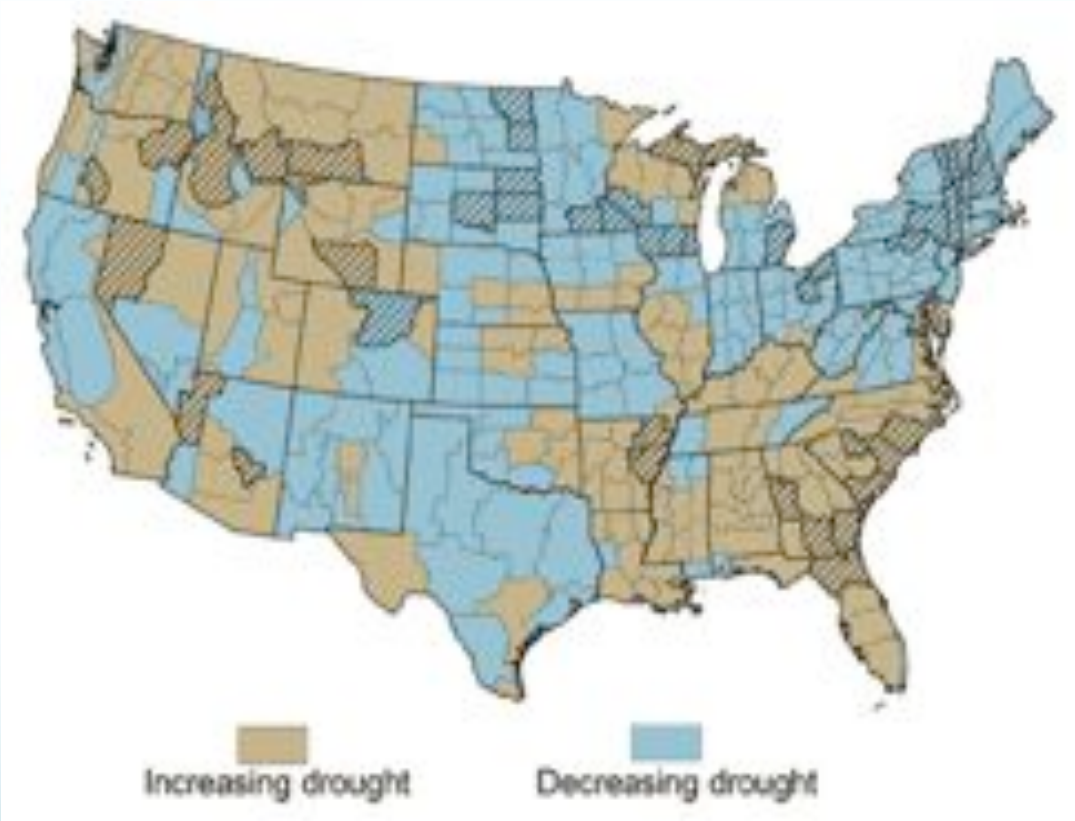
The percentage of the Southeast region in drought has *increased* over recent decades.

From: Global Climate Change Impacts in the US, 2009, pg 111

Changes Observed

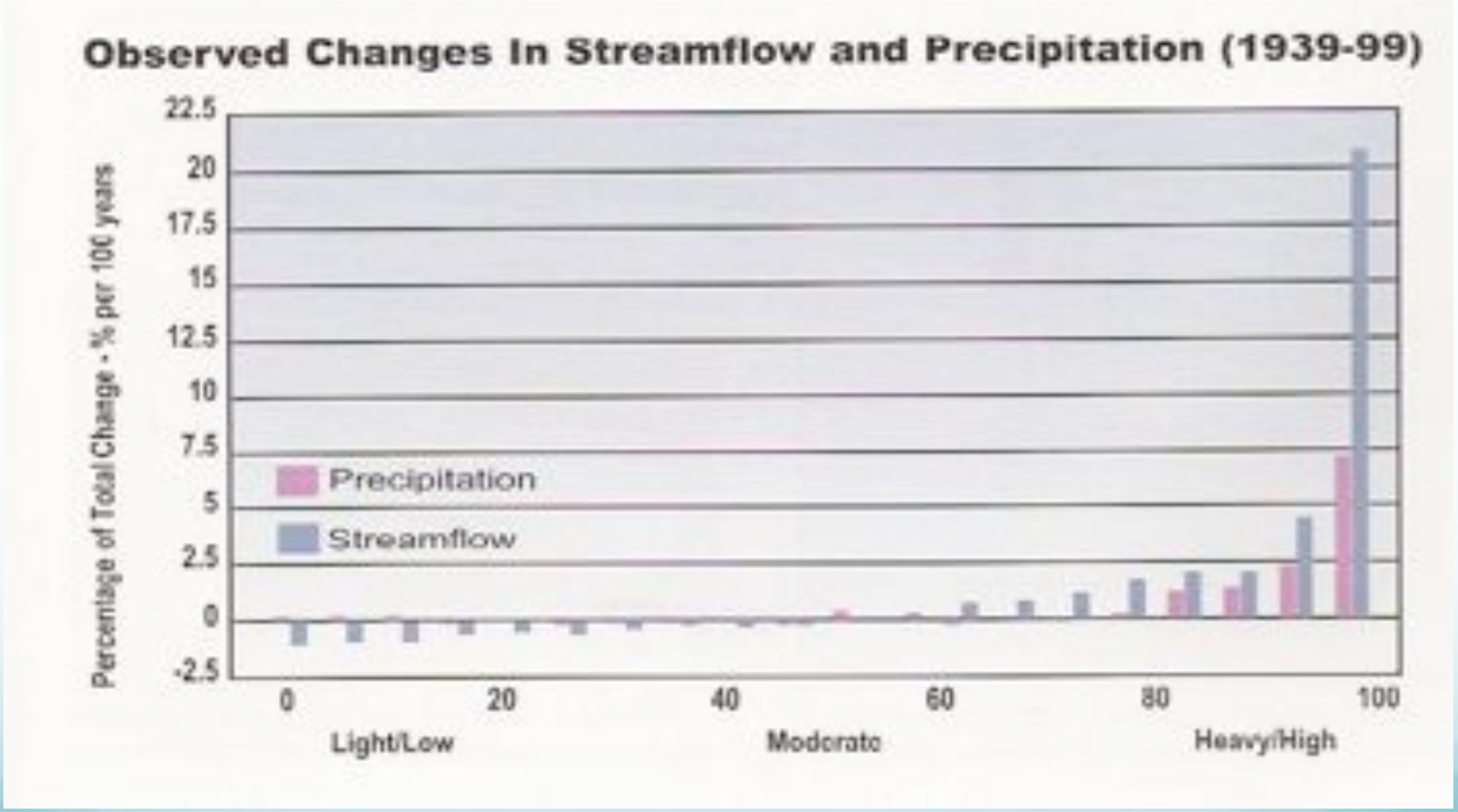
precipitation: drought trends 1958-2007

End-of-summer drought trends as measured by the Palmer Drought Severity Index in each of 344 U.S. climate divisions. [144] Hatching indicates significant trends.



From: Global Climate Change Impacts In the US, 2009 pg 43

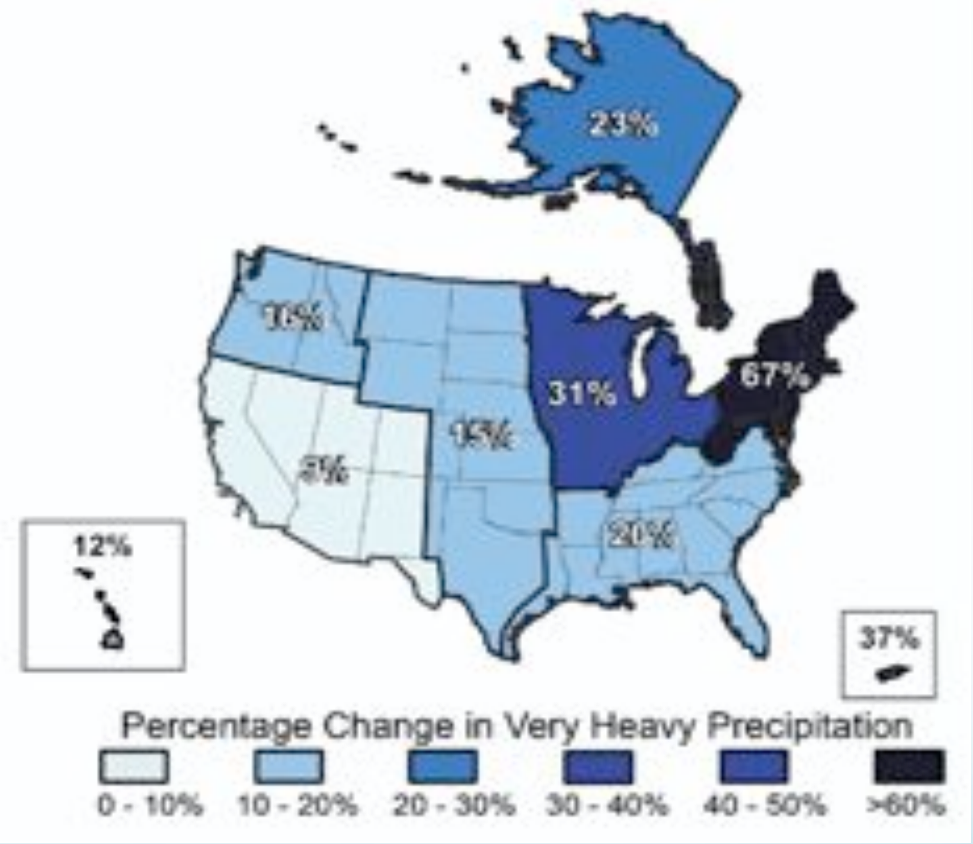
Observed Changes in streamflow and precipitation



From US National Assessment

Changes Observed
precipitation: intensity and amounts

- Heavy downpours + 20% average in US over past century
- Northeast and Midwest highest
- Precipitation + 5% average
- Shifting patterns show wet areas wetter, dry areas drier
- Trend likely to continue



Increases in Very Heavy Precipitation the heaviest 1 % of all daily events from 1958-2007

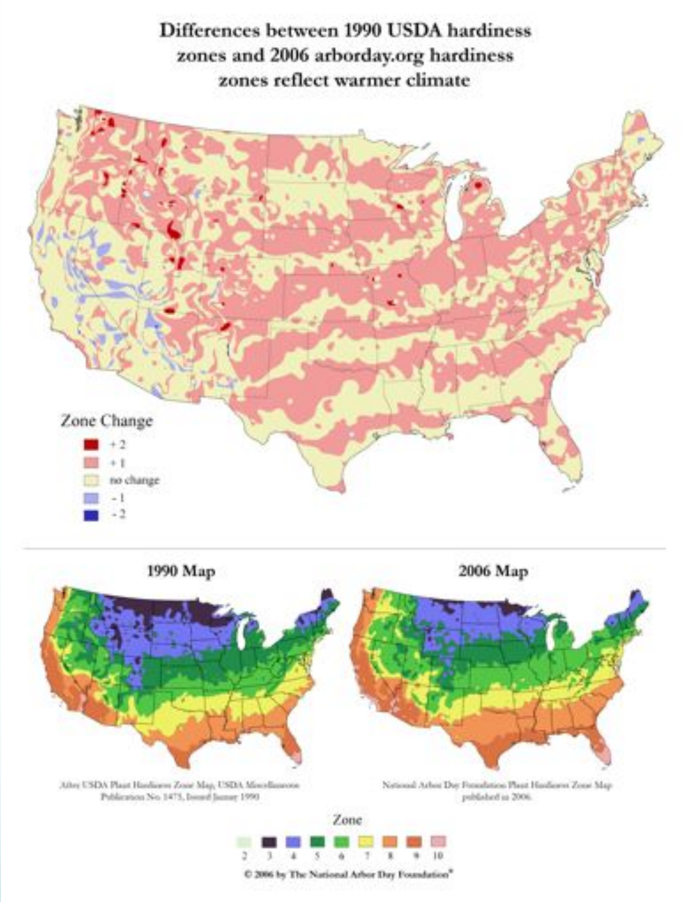
From: Global Climate Change Impacts in the US, 2009 pg 32

Observed US Climate Changes
Hardiness zones: 1990-2006

Longer growing seasons

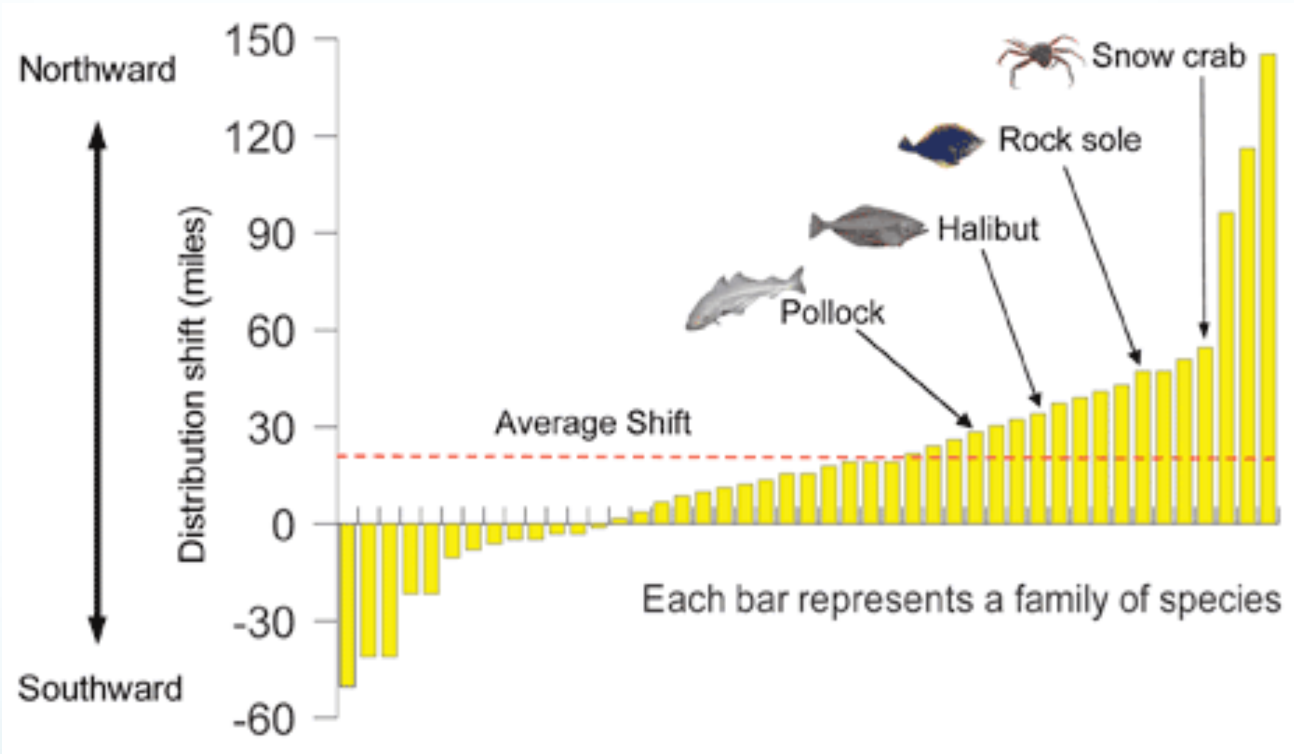
Represented by changes in hardiness zones: 1990-2006

Animated map of change on web: google ‘hardiness zones’



From: USDA website

Marine Species Shifting Northward 1982 to 2006



From: Global Climate Change Impacts in the US, 2009, pg 144

As air and water temperatures rise, marine species are moving northward, affecting fisheries, ecosystems, and coastal communities that depend on the food source. On average, by 2006, the center of the range for the examined species moved 19 miles north of their 1982 locations.

Key Messages

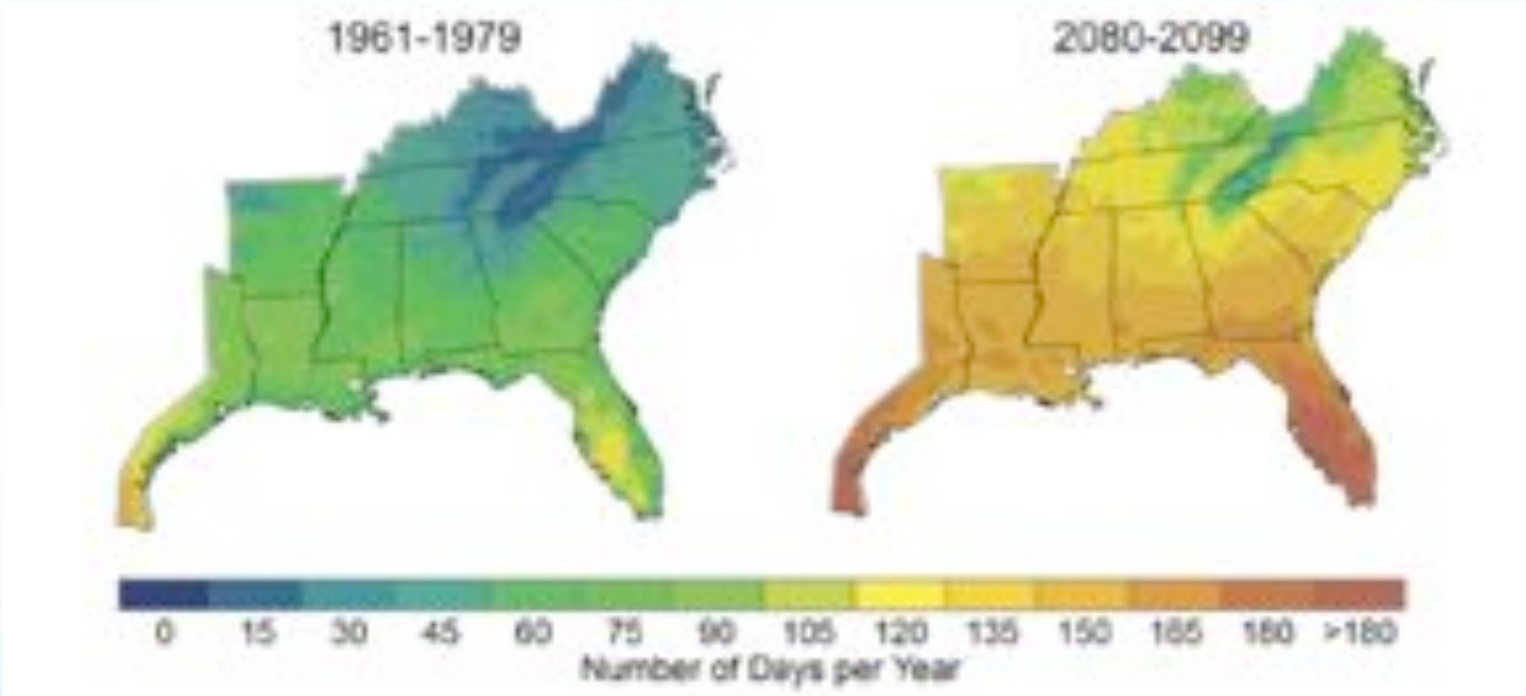
1. Climate change is here.

   We are already observing change.

2. Climate change will have consequences for the region and the future will be different than the past. Specific local impacts will vary.

3. Decisions today can reduce vulnerability through anticipation and action.

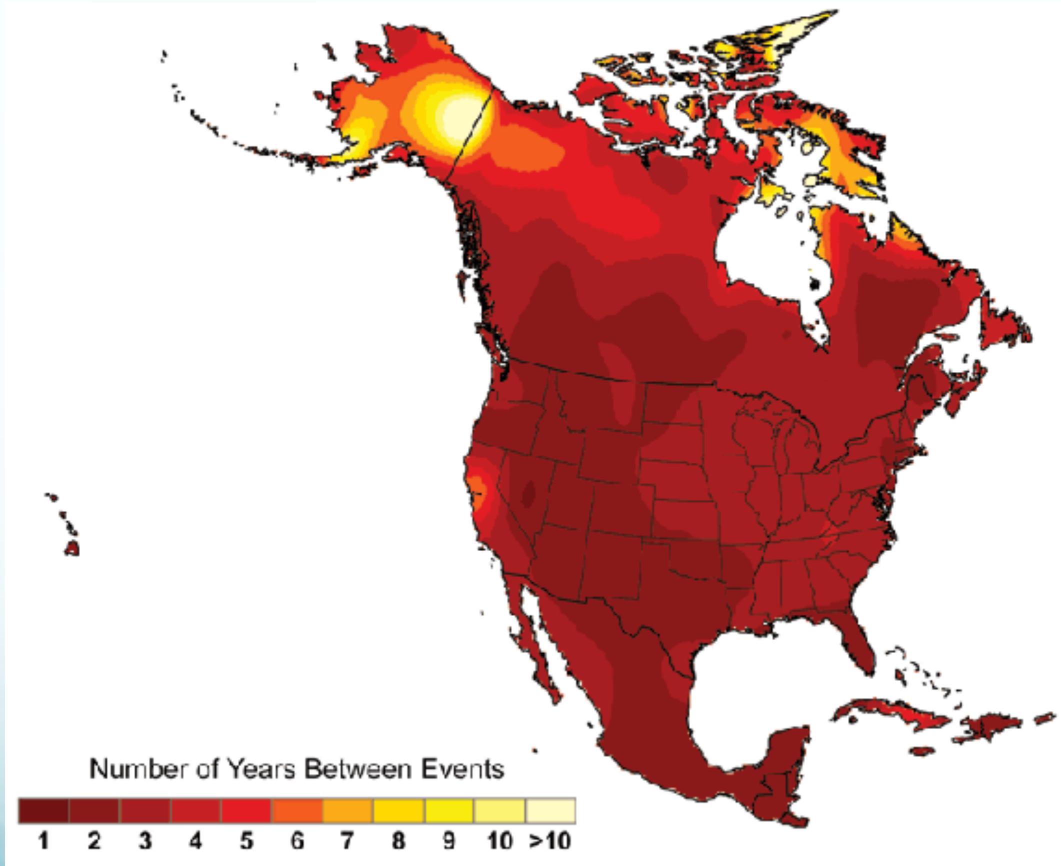
Number of Days per Year with Peak Temperatures over 90°F (high emissions)



The number of days per year with peak temperature over 90°F is expected to rise significantly, especially under a higher emissions scenario[91]. By the end of the century, projections indicate that North Florida will have more than 165 days (nearly six months) per year over 90°F, up from roughly 60 days in the 1960s and 1970s. The increase in very hot days will have consequences for human health, drought, and wildfires.

From: Global Climate Change Impacts in the US, 2009, pg 112

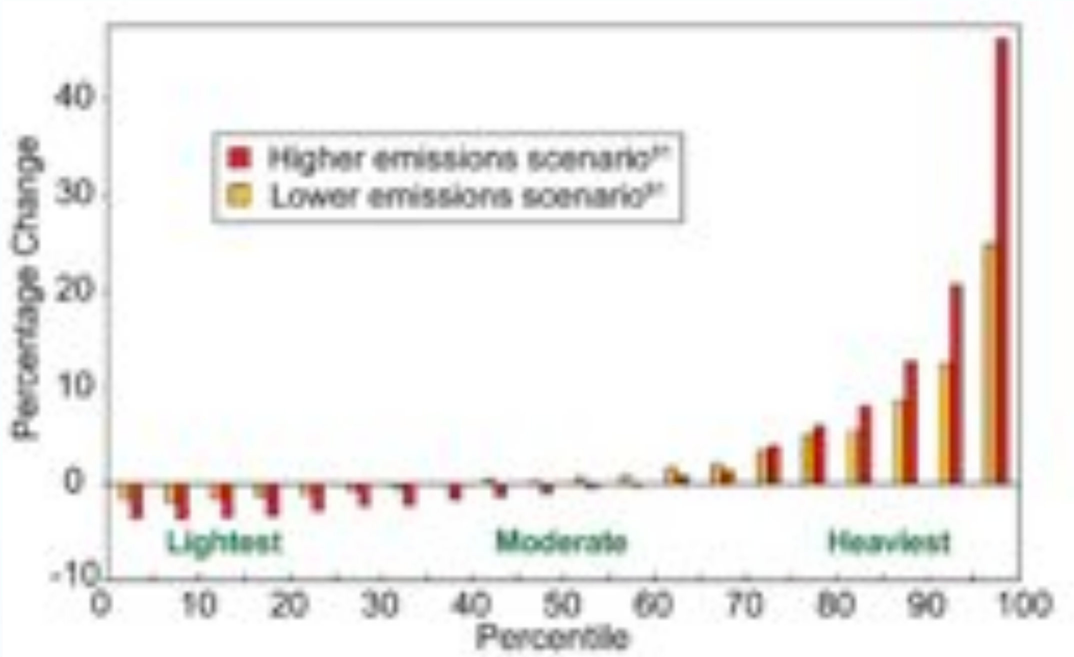
Projected Frequency of Extreme Heat: 2080-2099



Simulations indicate how currently rare extremes (a 1-in-20-year event) are projected to become more commonplace. A day so hot that it is currently experienced once every 20 years would occur every other year or more frequently by the end of the century under the higher emissions scenario.[91]

From: Global Climate Change Impacts In the US, 2009 pg 33

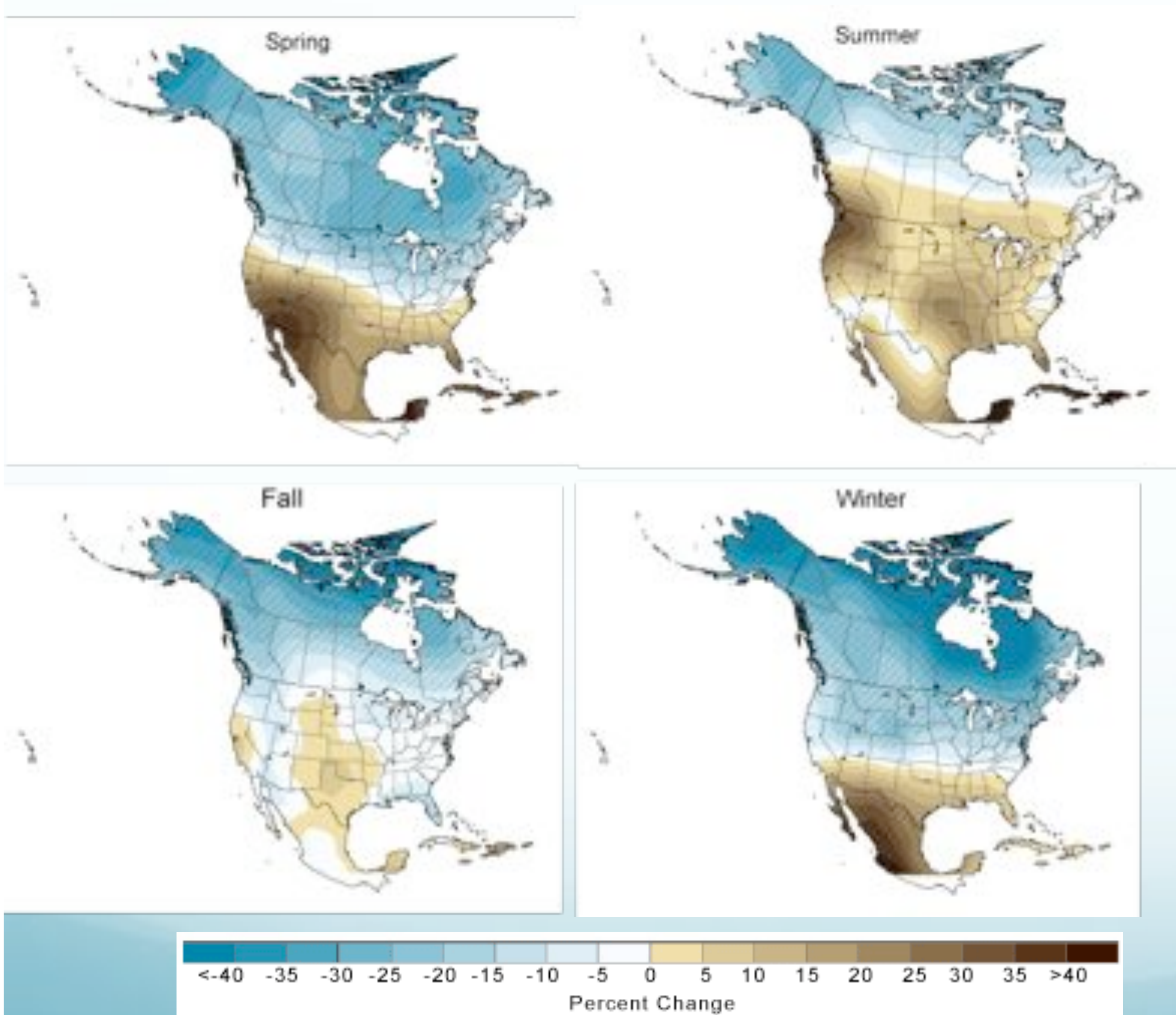
Projected Change in Precipitation Intensity: change from 1990s average to 2090s average



Amount of precipitation falling in light, moderate, and heavy events in North America. Projected changes are displayed in 5 percent increments from the lightest drizzles to the heaviest downpours. Lightest precipitation is projected to decrease, while the heaviest will increase, continuing the observed trend. The higher emission scenario yields larger changes. Projections are based on the models used in the IPCC 2007 Fourth Assessment Report.

From: Global Climate Change Impacts in the US, 2009 pg 32

Projected Change in N. American Precipitation



Late Century (2080-2099): higher emissions scenario.

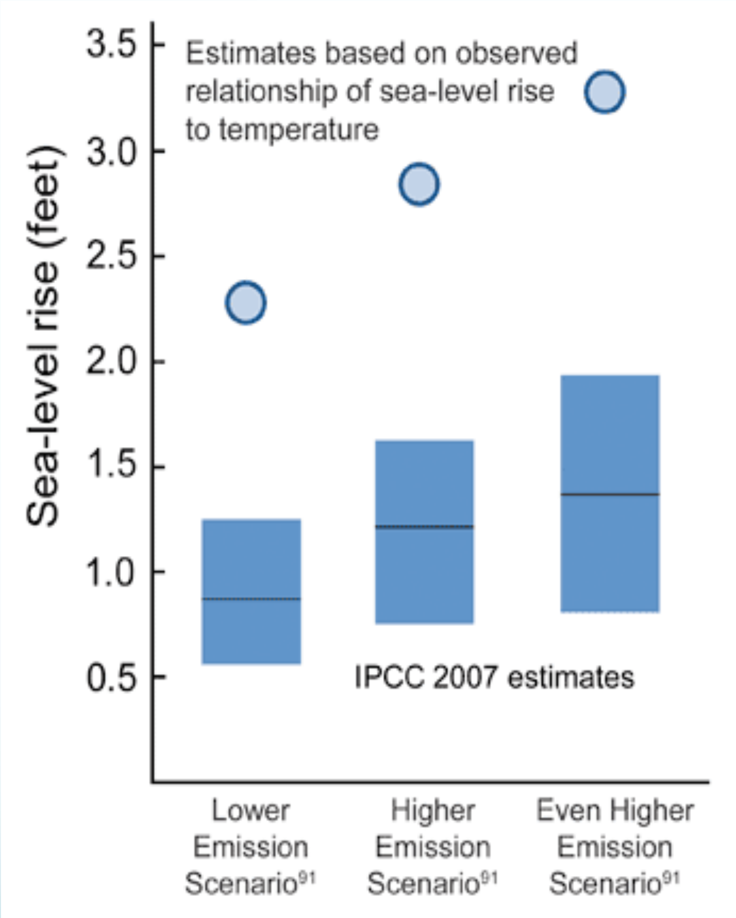
For spring, climate models agree that northern areas are likely to get wetter, and southern areas drier.

There is less confidence in exactly where the transition between wetter and drier areas will occur.

Highest confidence in the hatched areas.

From: Global Climate Change Impacts In the US, 2009 pg 31

Projected Sea-Level Rise

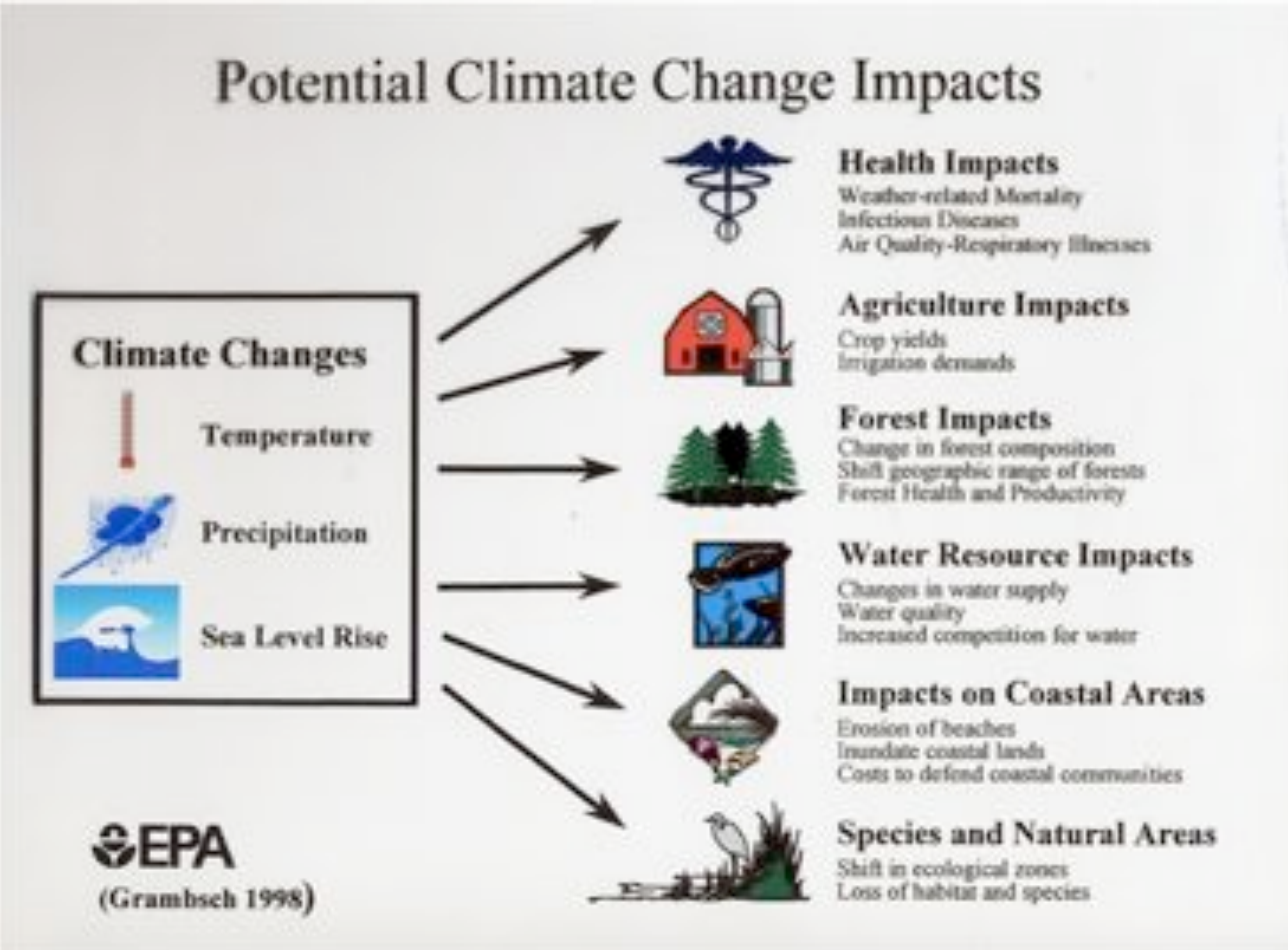


Estimates of sea-level rise by the end of the century for three emissions scenarios.[91]
IPCC 2007 projections (range shown as bars) exclude changes in ice sheet flow.[90]

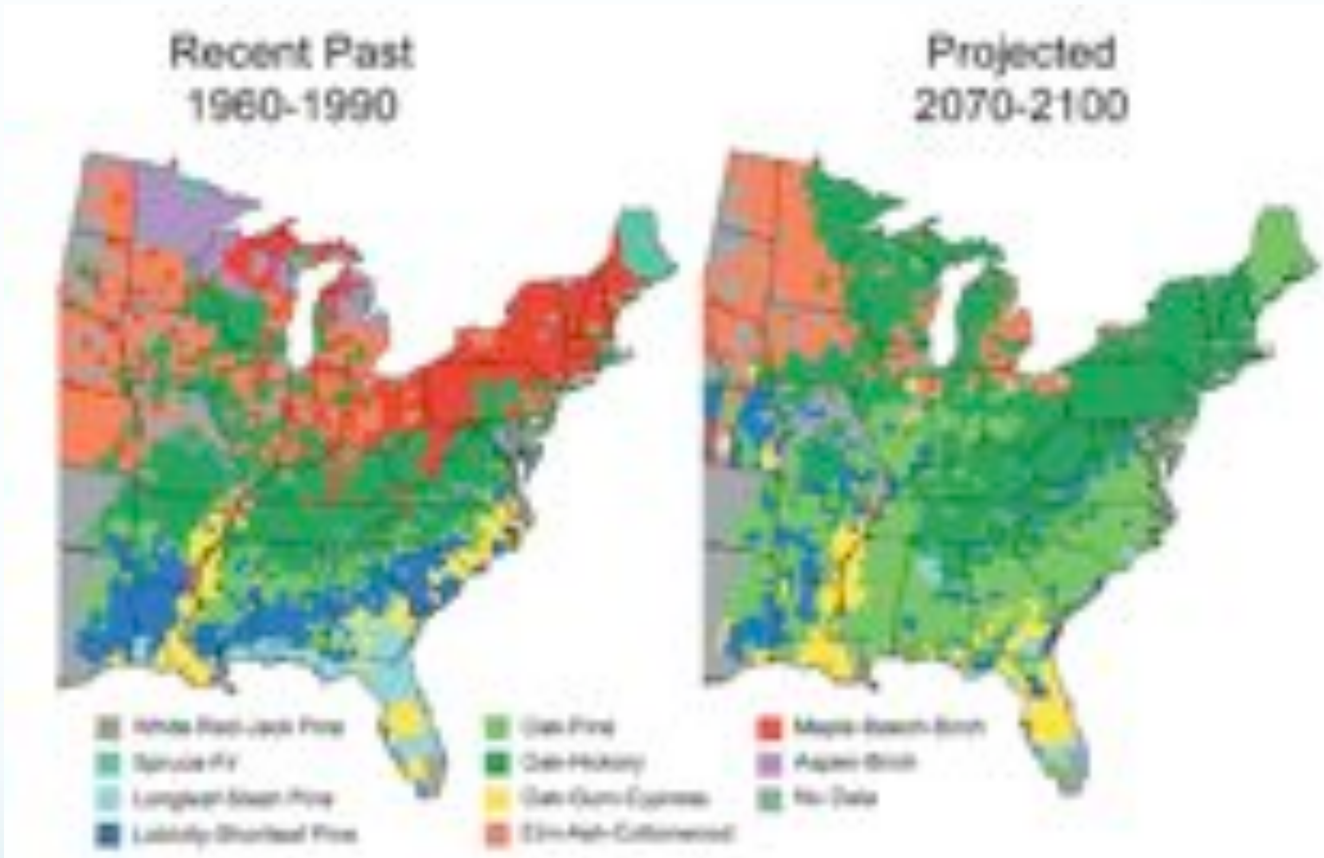
Light blue circles represent more recent, central estimates derived using the observed relationship of sea-level rise to temperature.[103]

Areas where coastal land is sinking, for example by as much as 1.5 feet in this century along portions of the Gulf Coast, would experience that much additional sea-level rise relative to the land.[128]

From: Global Climate Change Impacts In the US, 2009 pg 150


Potential Climate Change Impacts
Climate Changes
Temperature
Precipitation
Sea Level Rise
Health Impacts
Weather-related Mortality
Infectious Diseases
Air Quality-Respiratory Illnesses
Agriculture Impacts
Crop yields
Irrigation demands
Forest Impacts
Change in forest composition
Shift geographic range of forests
Forest Health and Productivity
Water Resource Impacts
Changes in water supply
Water quality
Increased competition for water
Impacts on Coastal Areas
Erosion of beaches
Inundate coastal lands
Costs to defend coastal communities
Species and Natural Areas
Shift in ecological zones
Loss of habitat and species
EPA
(Grambsch 1998)

Projected Shifts in Forest Types



The maps show current and projected forest types.
Major changes are projected for many regions.

From: Global Climate Change Impacts in the US, 2009, pg 81

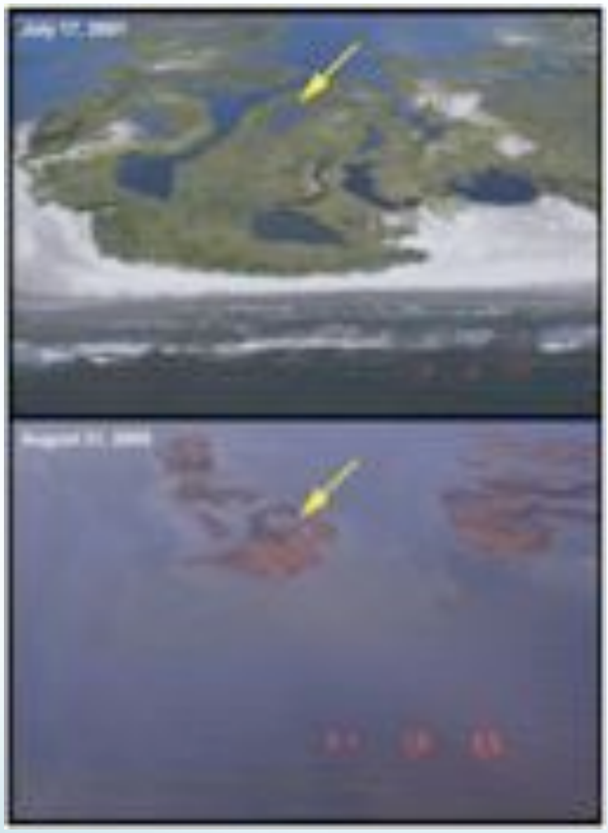
Lake Lanier, GA December 2007

In Atlanta and Athens, Georgia, 2007 was the second driest year on record.

Among the numerous effects of the rainfall shortage were restrictions on water use in some cities and low water levels in area lakes.

From: Global Climate Change Impacts in the US, 2009, pg 113

Land Lost during 2005 Hurricanes



217 square miles of land and wetlands were lost to open water during hurricanes Rita and Katrina.

The photos and maps show the Chandeleur Islands, east of New Orleans, before and after the 2005 hurricanes; 85 percent of the islands' above-water land mass was eliminated.

From: Global Climate Change Impacts in the US, 2009, pg 114

The Great Flood of 1993 caused flooding along 500 miles of the Mississippi and Missouri river systems. The photo shows its effects on U.S. Highway 54, just north of Jefferson City, Missouri.

From: Global Climate Change Impacts in the US, 2009, pg 120

Gulf Coast Area Roads at Risk from Sea-level Rise

50-100 yrs/4 ft: $100s of billions potentially at risk

- 2400 mi. major roadways inundated
- 24% of interstate highways; 28% secondary roads <4ft
- 246 miles freight lines subject to permanent flooding

This region: 6 of top 10 freight gateways threatened by SLR

- 7 of 10 largest ports located here
- 2/3 US oil imports through this region/ports

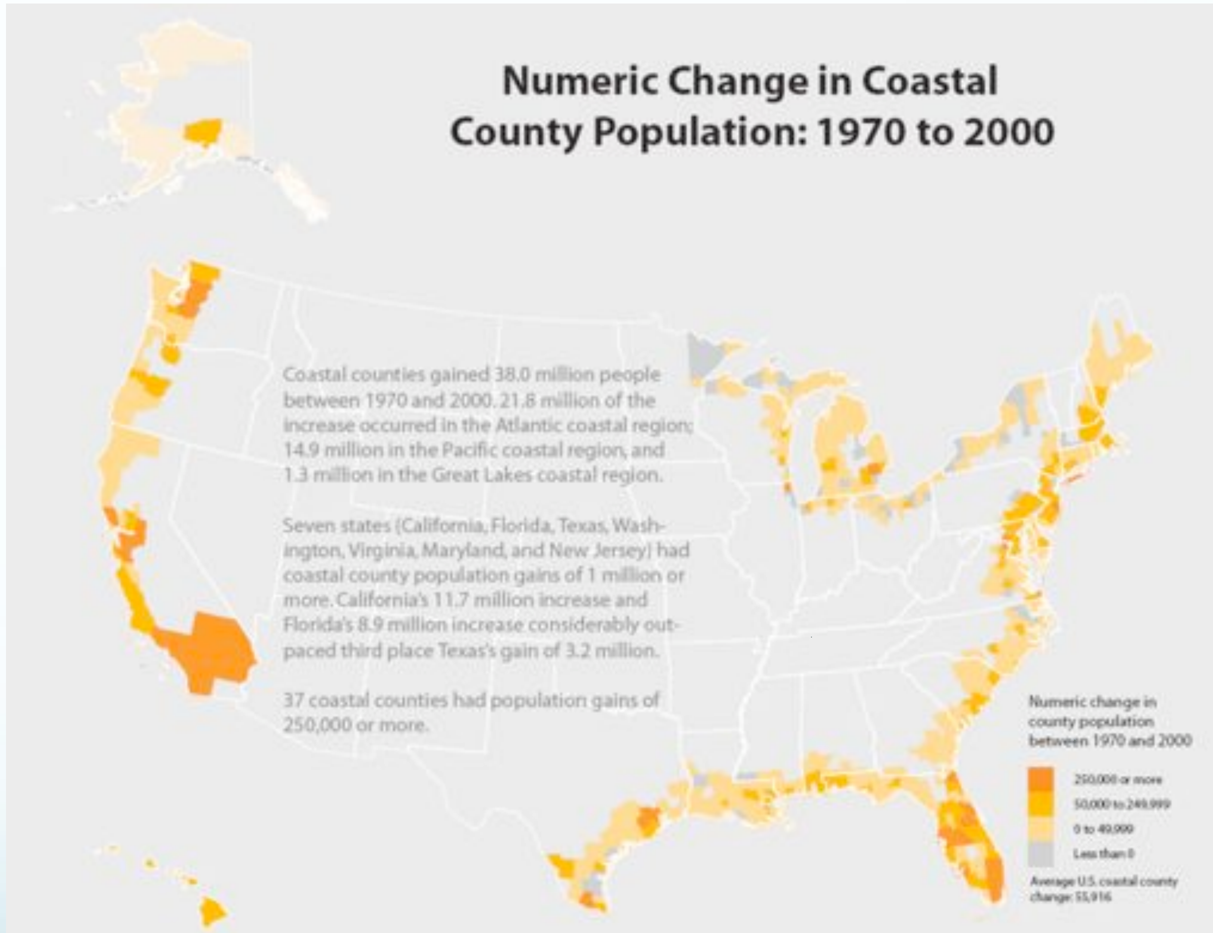
More than Regional Importance

Figure 2.4 Combined truck flows shipped domestically from Louisiana, 1998.
Source: CCSP Gulf Coast Transportation Study

Social Changes

+38 million

Florida +8.9
Texas +3.2



Coastal Population: NC to Texas

1950 10.2 million 7% US pop.
2006 34.9 million 12% US pop.

Nearly 250% increase

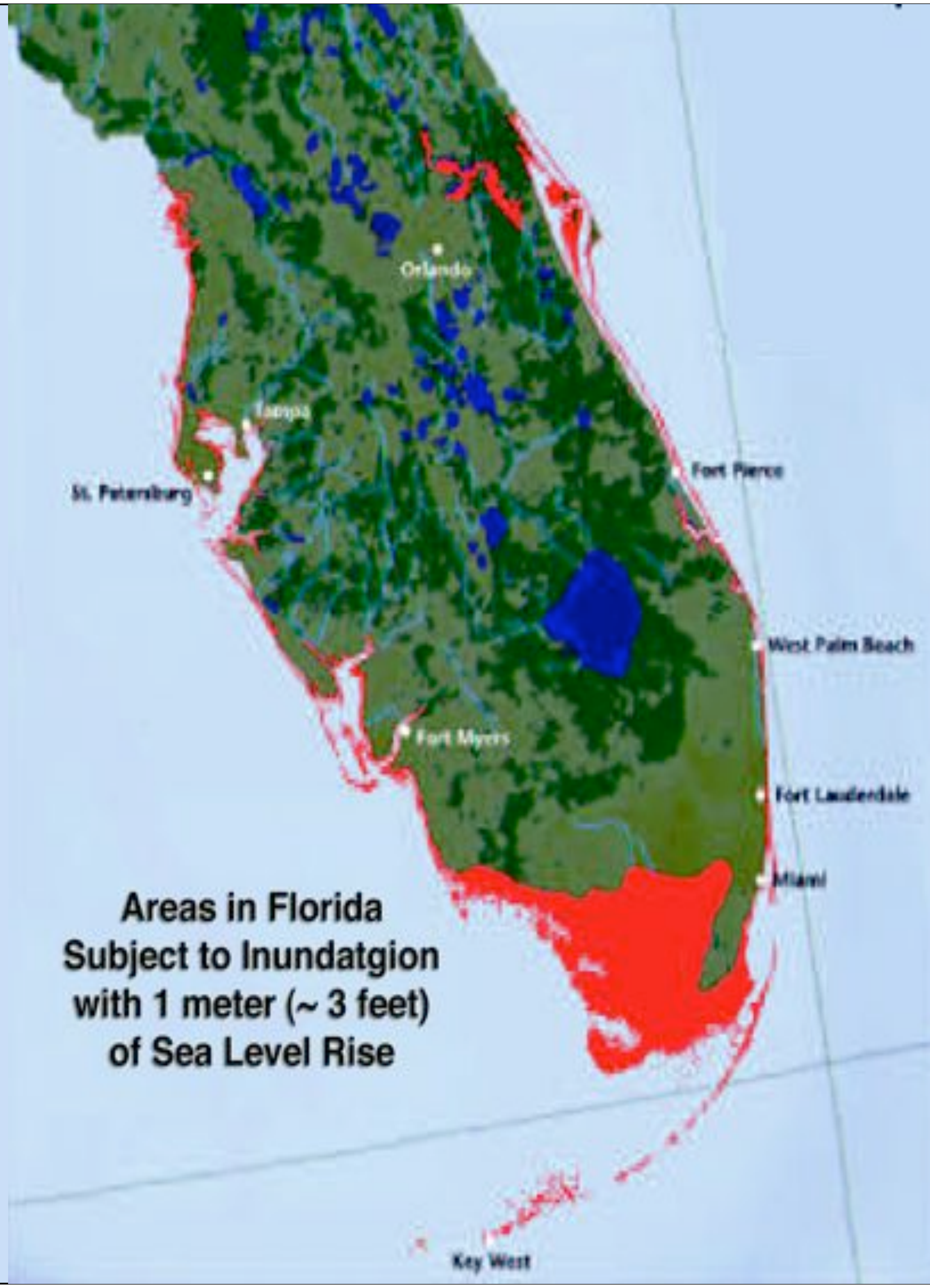
Florida ~ ½ of total increase

3/20 most populous areas in US

New Orleans:
-50% population after Katrina

US Census Bureau 2007

Figure 3.19 Geographic distribution of hurricane landfalls along the Atlantic and Gulf Coast regions of the United States, from 1950 to 2006. (Source: NOAA, National Climate Data Center, Asheville, NC)


Orlando
Tampa
St. Petersburg
Fort Pierce
West Palm Beach
Fort Myers
Fort Lauderdale
Miami
Key West
Areas in Florida Subject to Inundatgion with 1 meter (~ 3 feet) of Sea Level Rise

Florida's Energy Infrastructure: At Risk

From sea-level rise and storm impacts

Delivery of petroleum products by barge

Other energy interdependencies major issues in recovery from recent major hurricanes

From: Global Climate Change Impacts in the US, 2009, pg 59

Key Messages

1. Climate change is here.

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Two Responses to a Changing Climate

Mitigation: reduce emissions; energy efficiency; alternative energies, etc.

Implementation: NOW and save money

Impacts on climate change: 50-100 yrs.

Adaptation: planning ahead; incorporating likely future climate states into regular planning; taking action

Implementation: NOW and in future

Impacts on community: Now and Future.

There is a 3rd possible response . . .

Community Context

Climate Change
not the only challenge
to be juggled

Communities have:

- A lot to lose from climate impacts: slr, storms, water issues, health impacts, forest fires, etc.
- Limited resources and tight budgets: competition – elderly, economy, energy, environment
- Much to gain from opportunities: economic dev., energy savings, avoided costs
- Relevant authorities: blgd and dev permits (influence land use), building codes, public transit
- Opportunity to learn from and work with other communities

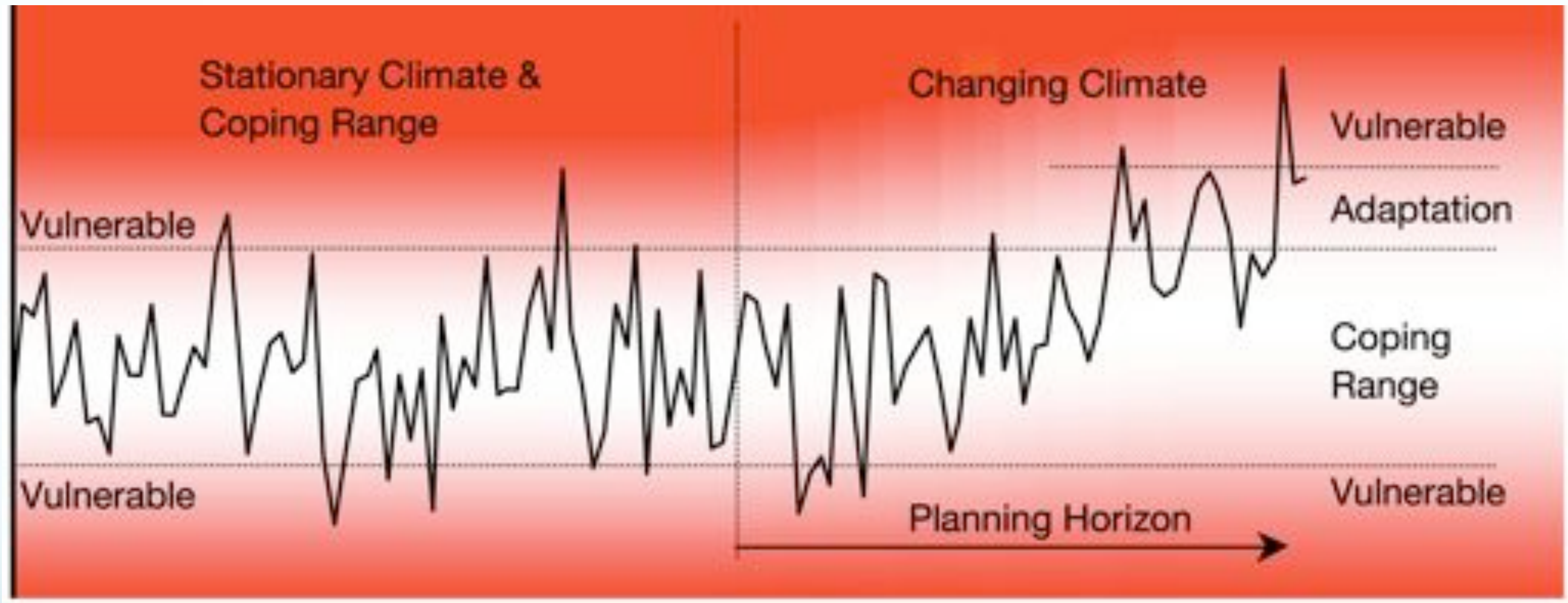
Adaptation

- No “top 10” Adaptation Actions
- Adaptations are location and issue specific
- Adaptive capacity is uneven w/in & across

society: resources ($, info., expertise); political will; stringent policies and regulations; not automatically translate into reduced vulnerability

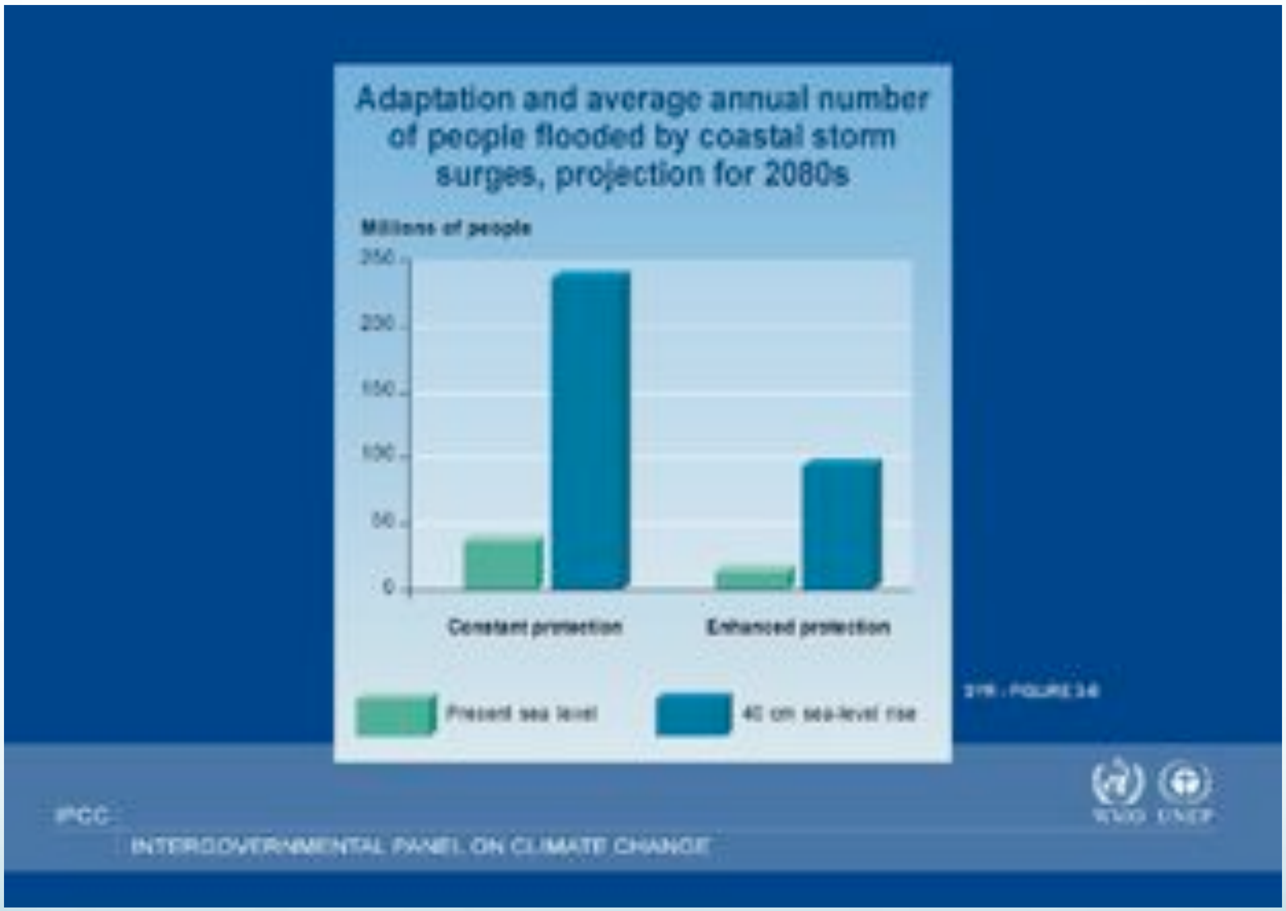
- Scale of info must match scale of issue
- Rarely *only* because of climate change: multiple stressors; hazard management
- Climate change - a moving target: requires continuous reassessment

Adaptation helps



From IPCC 2007

Adaptation helps



From IPCC 2007

Adaptation Example

Responding to Sea-Level Rise and Storm Surge

- Protect: build hard structures such as levees and dikes (although this can actually increase future risks by destroying wetlands and also by creating a false sense of security that causes more development in vulnerable areas)
- Accommodate rising water: elevate roads, buildings, and facilities; improve flood control structure design; enhance wetlands
- Retreat: accommodate inland movement through planned retreat; require setbacks for construction; improve evacuation planning.

Courtesy of Jack Pellette, NWS

Adaptation example: Protect

New Orleans Raised Levee

Adaptation example: Accommodate

Raising a Sewage Treatment Plant in Boston

• Boston's Deer Island sewage treatment plant built 1.9 feet higher than it would have been - to account for future sea-level rise.

• The planners assessed what could be easily and inexpensively changed later, vs those things that would be more difficult and expensive to change later. So increased the plant's height, but will build protective barriers when needed.

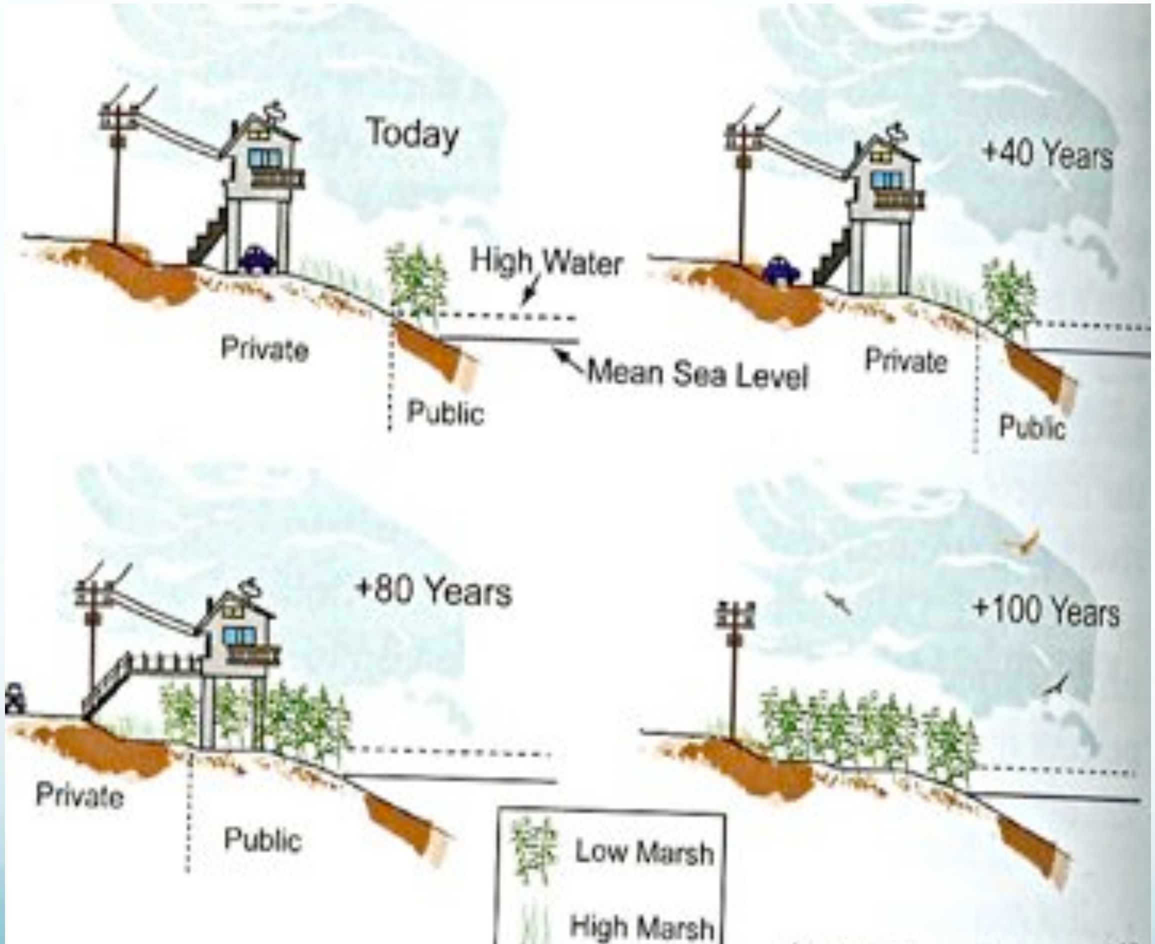
Adaptation example: Accommodate

Climate-Proofing Roads

- Completion of perimeter road on U.S.-affiliated island altered in response to projected climate change
- Road placed higher to account for sea-level rise
- Improved drainage system installed to handle heavier rainfall
- Louisiana: elevating Highway 1 above 500-yr flood level and building higher Bridge over Bayou LaFourche

Adaptation example: Retreat

Preserving Coastal Wetlands



Rolling Easements:

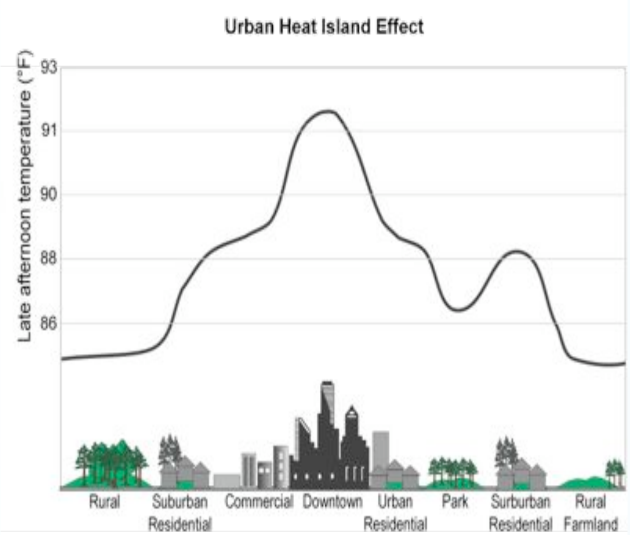
Many states allow some development near shore – but no armoring, set-backs based on erosion rates, small & removable structures, etc.

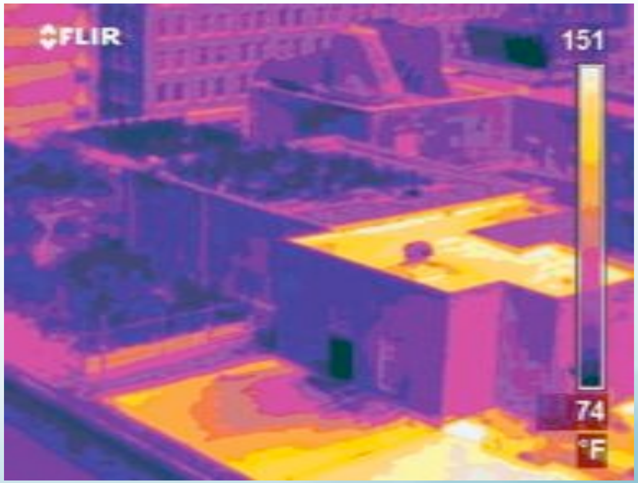
Recognize nature's right-of-way to advance inland.

Adaptation Example

Heat waves

- Local weather service issues heat alerts
- Provide tips on how vulnerable people can protect themselves
- Use buddy system to check on elderly residents
- Public utilities voluntarily refrain from shutting off services for non-payment
- Extend hours for public cooling places
- Install reflective or green roofing and plant trees in urban areas to help cool urban heat island



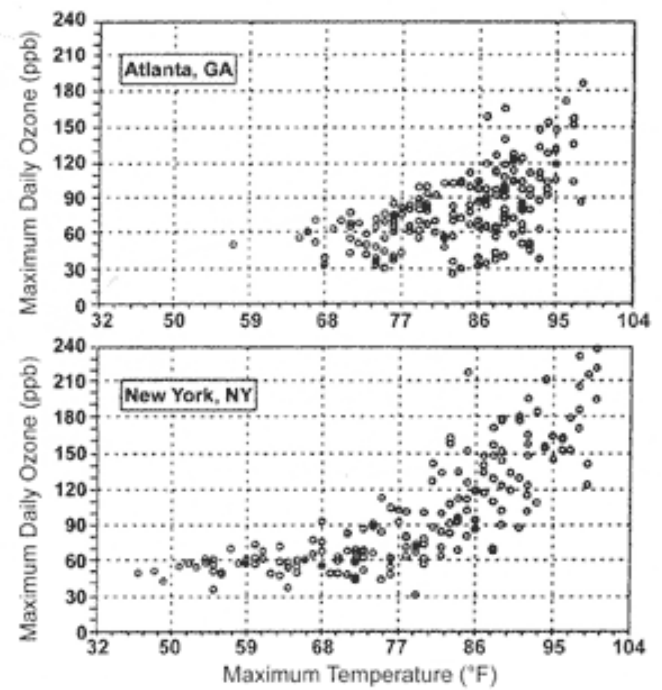


"Green roofs" are cooler than the surrounding conventional roofs.

Adaptation Example

Improving Urban Air Quality

- Refuel vehicles after dark
- Encourage mass transit use by offering free rides on Air Quality Alert Days
- Encourage residents to limit car travel, especially during day
- Conserve energy
- Avoid outdoor burning



Adaptation Examples

Agriculture

- Switch to plant species that mature earlier and are more resistant to heat and drought
- Alter planting dates
- Increase crop and livestock diversity
- Minimize need for external inputs such as irrigation

Fire due to drier conditions

- Thin trees and bushes near structures
- Select ignition-resistant building materials and design features
- Position structures away from slopes
- Develop emergency plans and evacuation procedures

Other Adaptation Examples

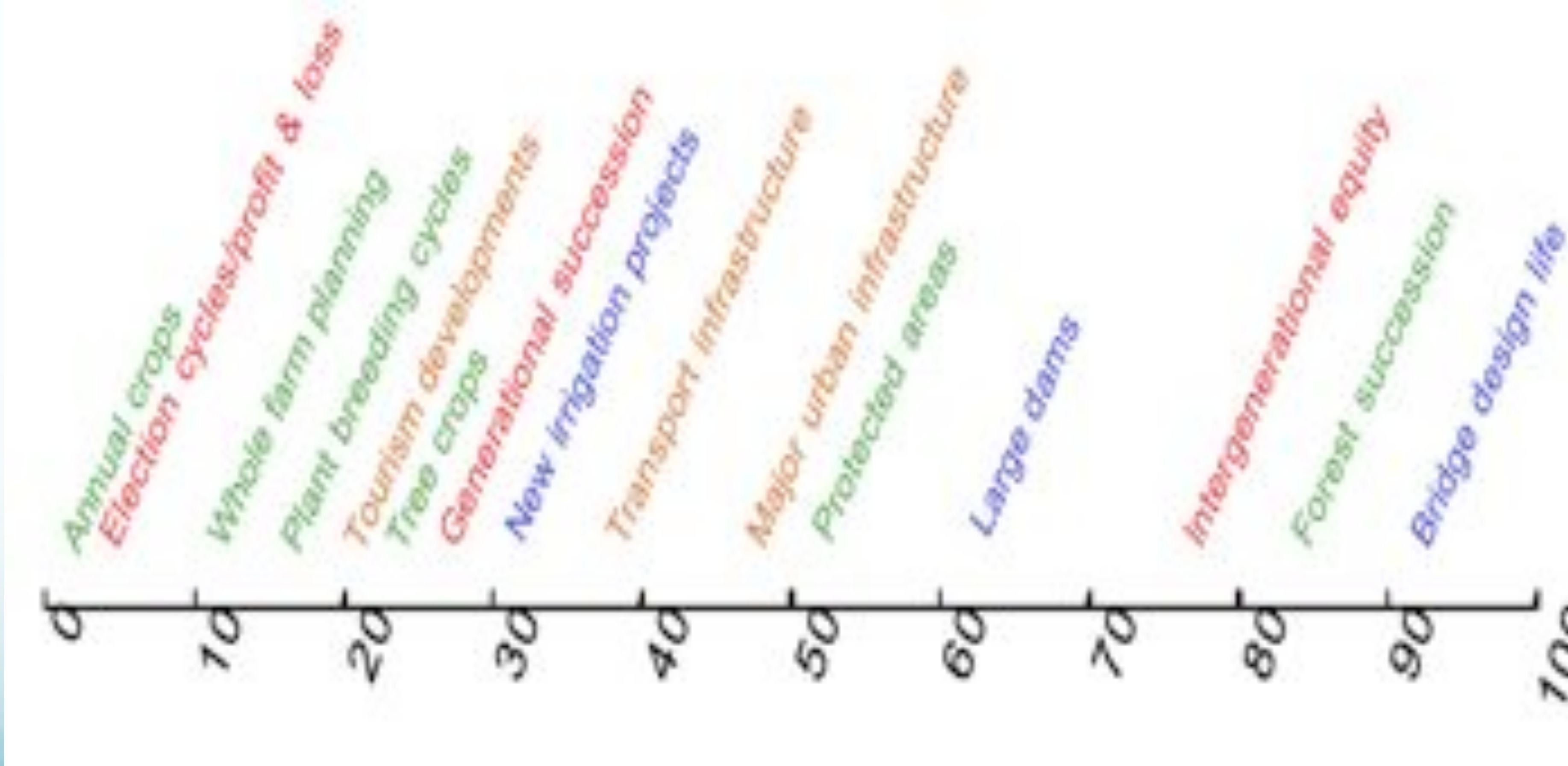
Declining water resources

- Increase public awareness
- Encourage water conservation
- Fix water distribution systems to minimize leakage
- Increase freshwater storage capacity
- Explore alternative sources including importing water, desalinating seawater, and using treated wastewater

Unmanaged ecosystems

- Establish baselines for ecosystems and their services
- Identify thresholds
- Monitor for continued change
- Restore ecosystems that have been adversely affected
- Identify refuge areas that might be unaffected by climate change and can be preserved
- Relocate species to areas where favorable conditions are expected to exist in the future

Adaptation Planning: Many Timeframes



Source: Linda Mearns, UCAR

We can plan ahead … or we can react.

We can anticipate, plan, act.

Or we can just respond.

Questions?

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http://www.southernclimate.org

www.adaptationnetwork.org
resources