U.S. 2013 National Climate Assessment: Key Findings

Scott Doney (WHOI)

U.S. Global Change Research Program

U.S. Global Change Research Program
National Climate Assessment

http://assessment.globalchange.gov

Elements in 2013 NCA Report

-The scientific basis for climate change

-Sectors

- water, energy, agriculture, ecosystems …

-Sectoral cross-cuts

- urban & infrastructure vulnerability, rural communities, biogeochemistry …

-Regions

- Northeast, Hawaii & Pacific Islands, …

-Biogeographical cross-cuts

- oceans & marine resources
- coastal zone, development, & ecosystems

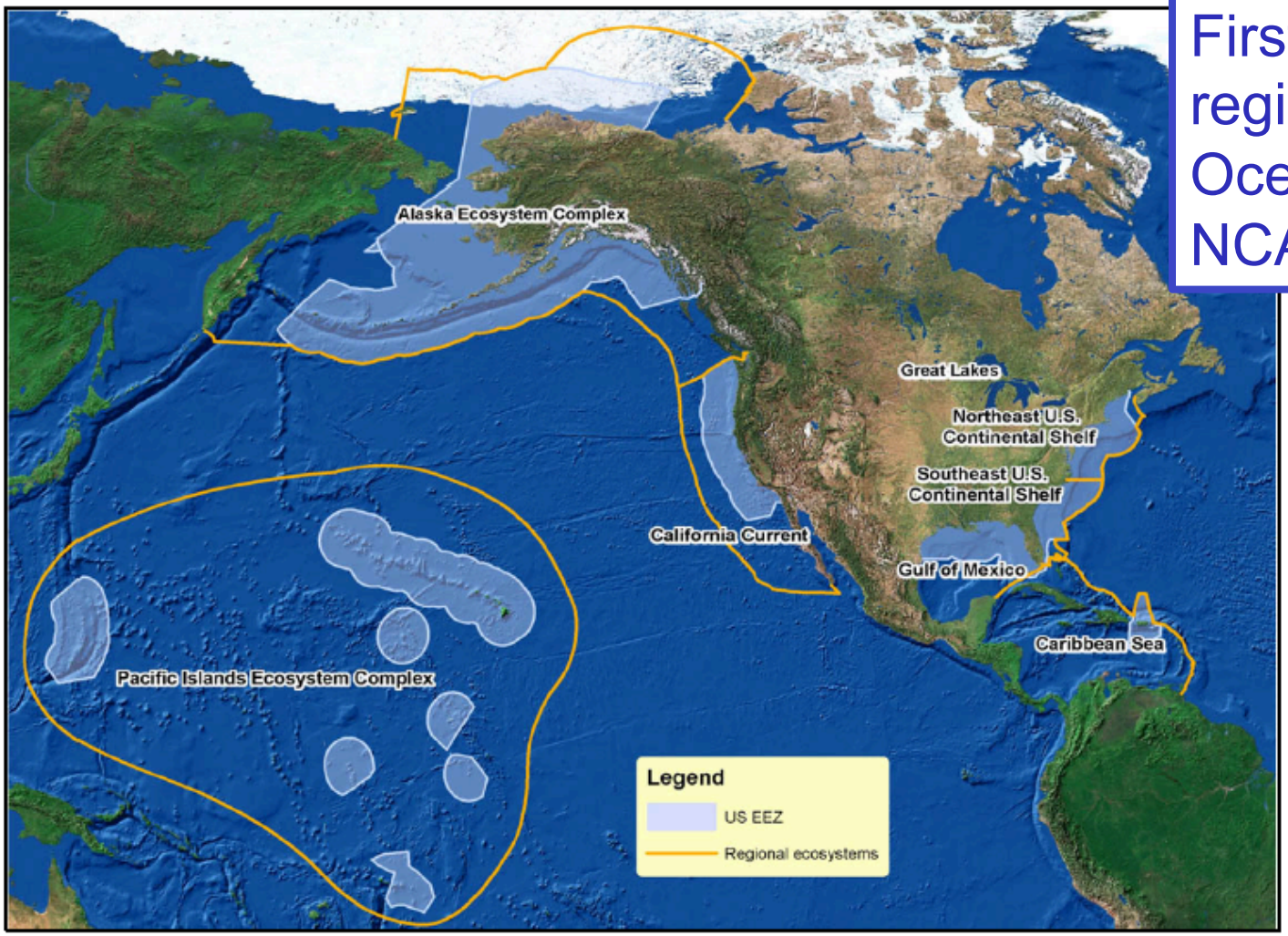
-Decision support, mitigation & adaptation

-Agenda for climate change science

Regions


Northwest
Great Plains
Northeast
Midwest
Southwest
Southeast and Caribbean
Alaska and Arctic
Hawaii and Pacific Islands

Oceans & Marine Resources Chapter

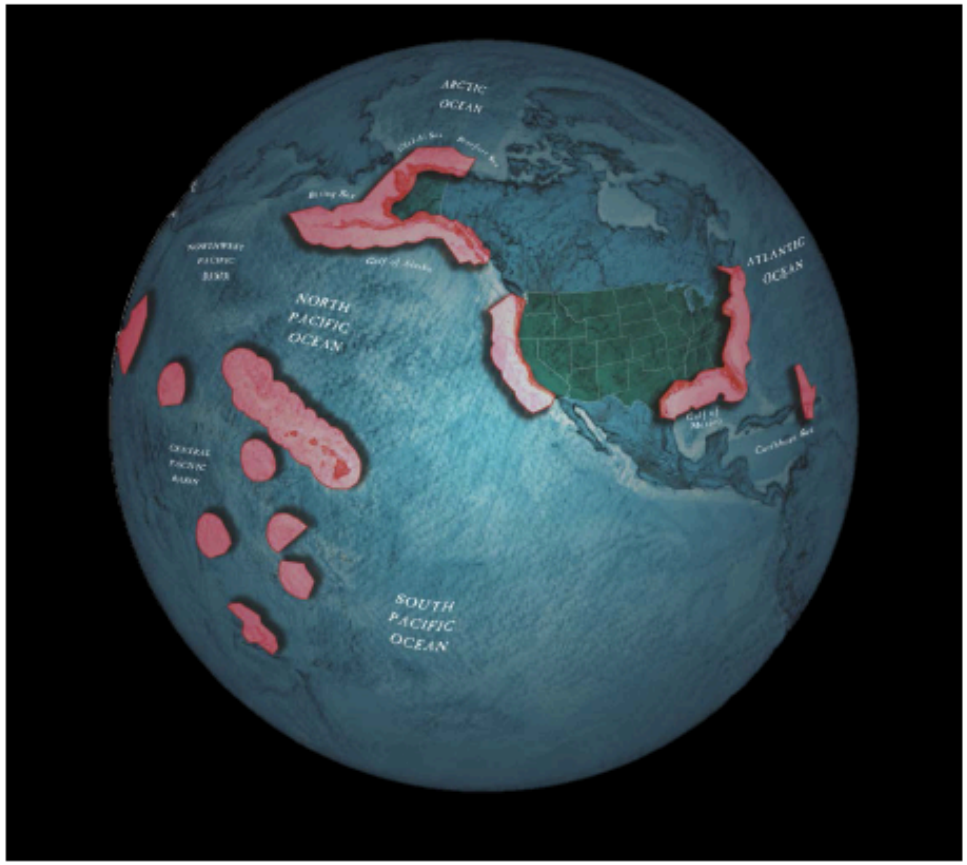


First time a specific regional chapter on Oceans included in NCA

Griffis & Howard, Technical Input (2012)

Technical Inputs & Reports

Oceans and Marine Resources in a Changing Climate



Technical Input to the 2013
National Climate Assessment

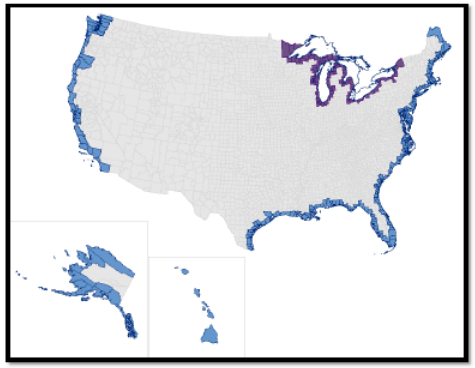
-Extensive input document organized by NOAA at request of NCADAC

NOAA Organized Technical Input Lead Authors

Roger Griffis (NOAA) & Jennifer Howard (NOAA)

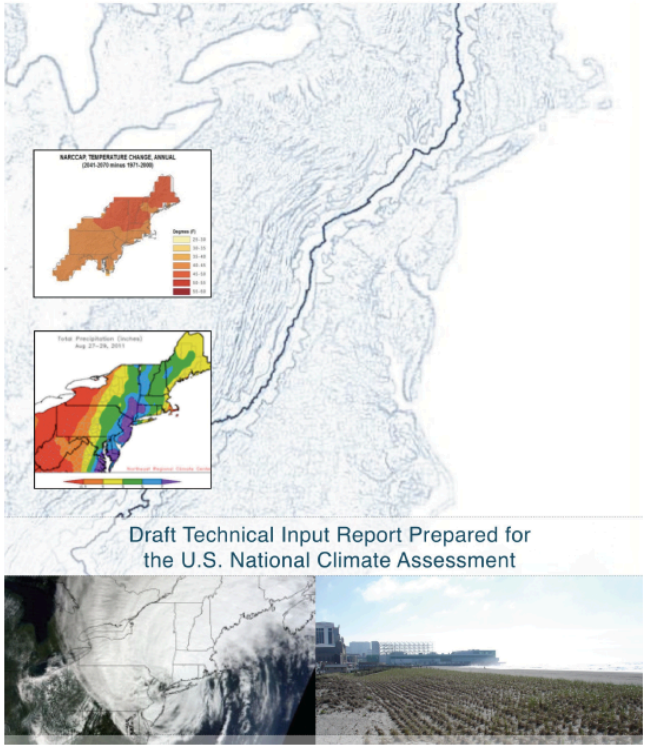
Other Available Technical Inputs

Coastal Impacts, Adaptation, and Vulnerabilities



A Technical Input to the 2013 National Climate Assessment

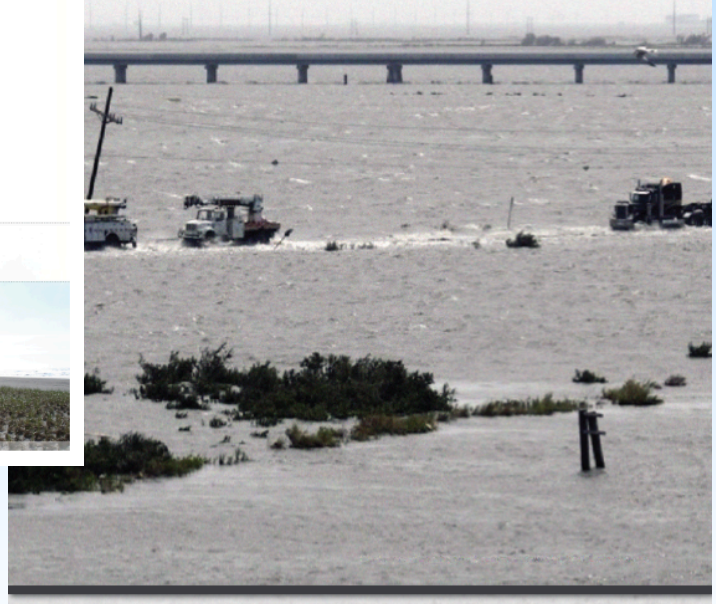
CLIMATE CHANGE IN THE NORTHEAST
A SOURCEBOOK



Draft Technical Input Report Prepared for the U.S. National Climate Assessment

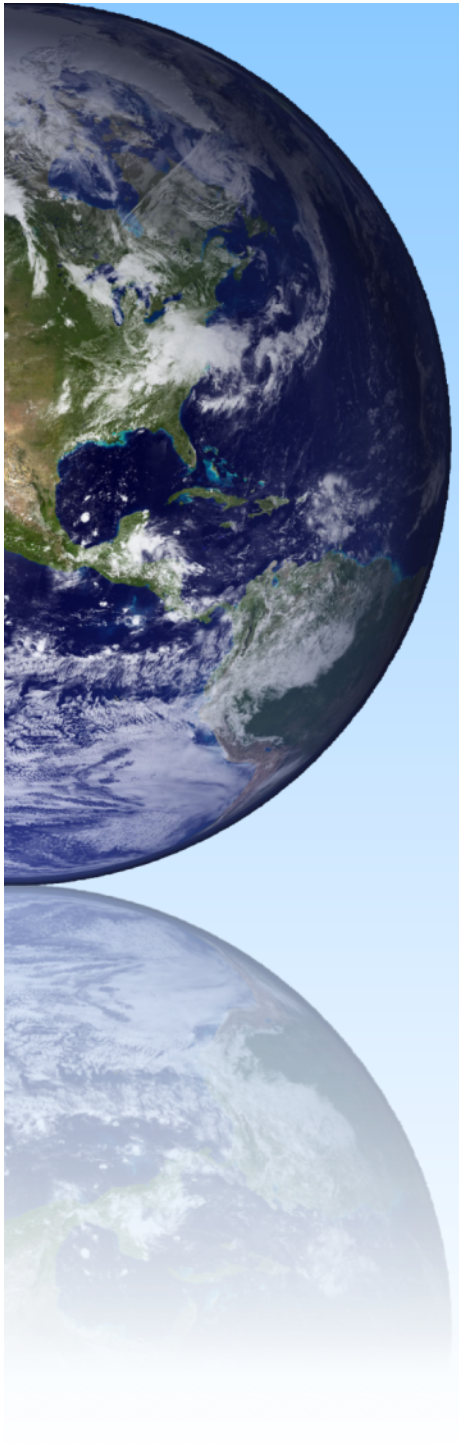
Global Sea Level Rise Scenarios for the United States National Climate Assessment

December 6, 2012



NOAA USGS science for a changing world SERDP DOD • EPA • DOE US Army Corps of Engineers.

http://www.globalchange.gov/what-we-do/assessment/nca-activities/695



Scenarios & Data Synthesis

-Regional climate trends

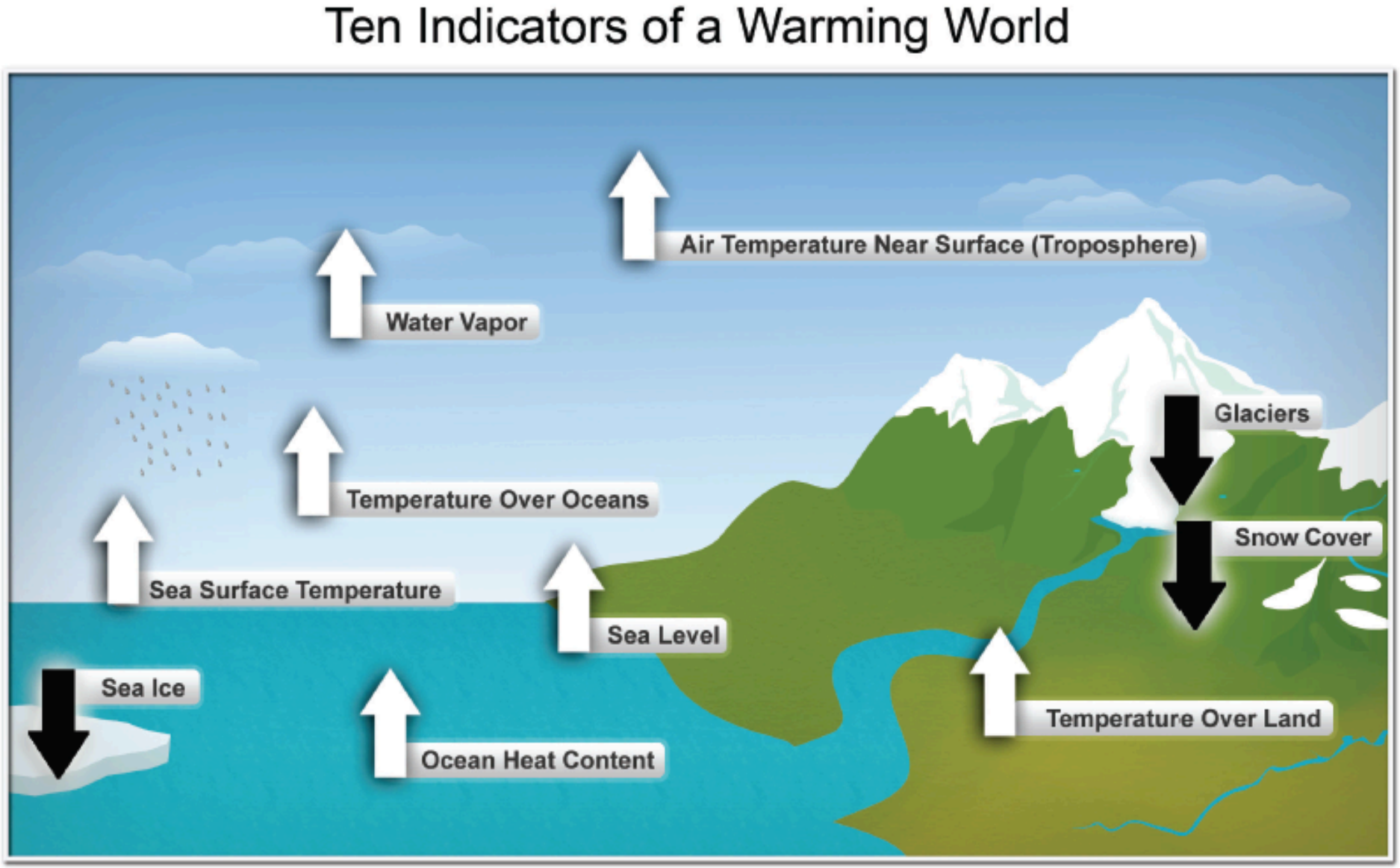
-Climate scenarios

- Coupled Model Intercomparison Project phase 3 (CMIP3)
- North American Regional Climate Change Assessment Program (NARCCAP)

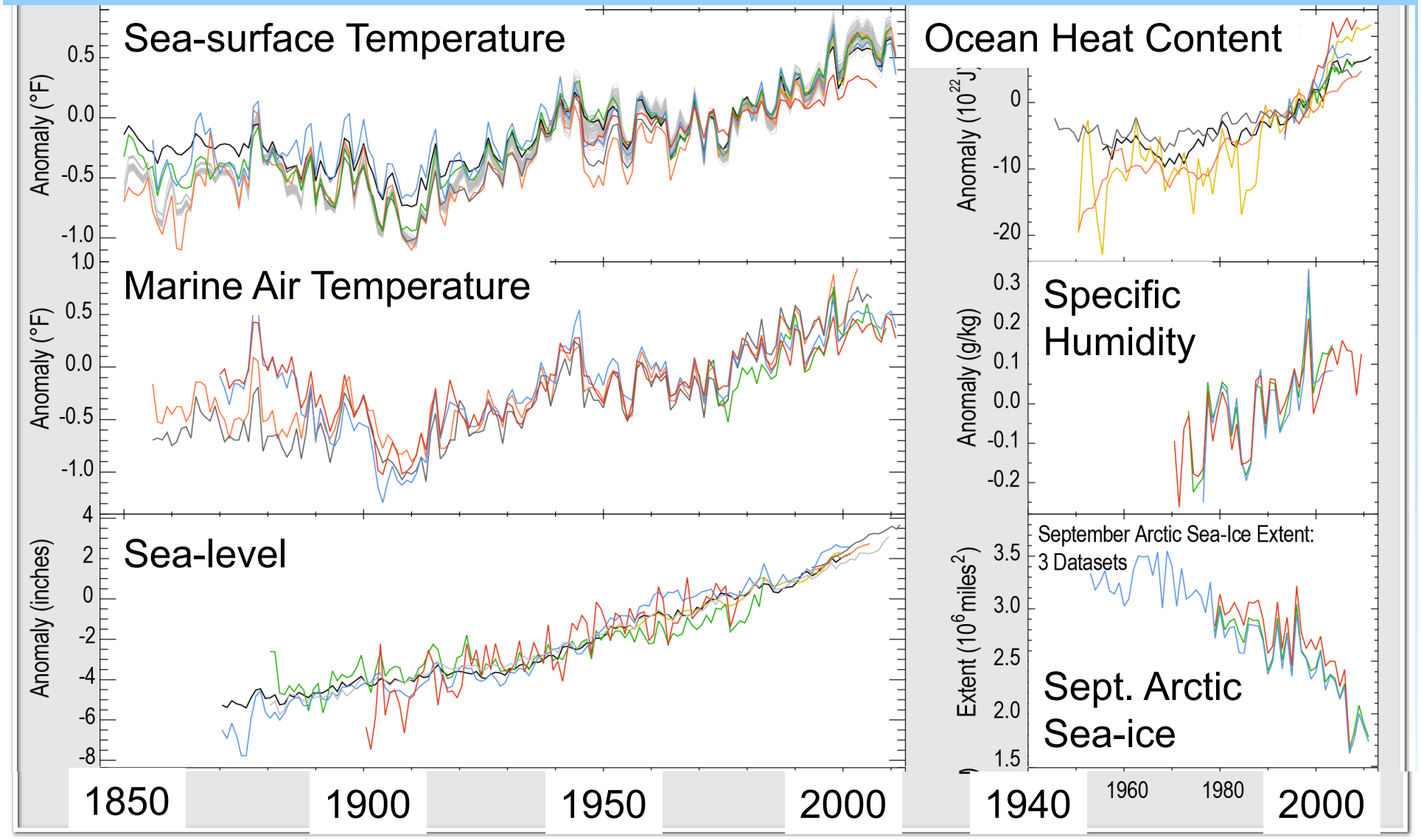
-Sea-level scenarios

http://scenarios.globalchange.gov/

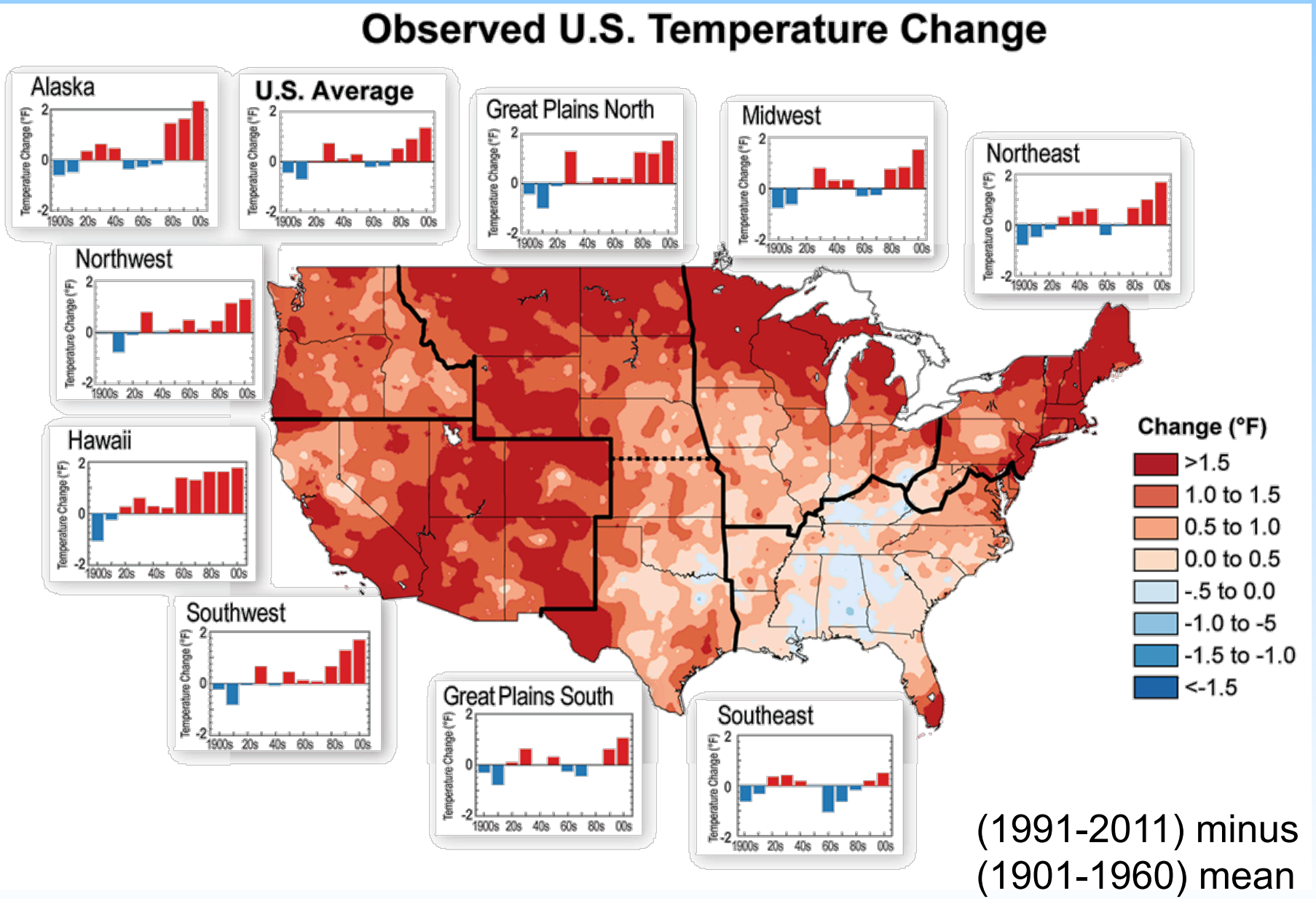
Global Climate is Changing



Global Climate is Changing

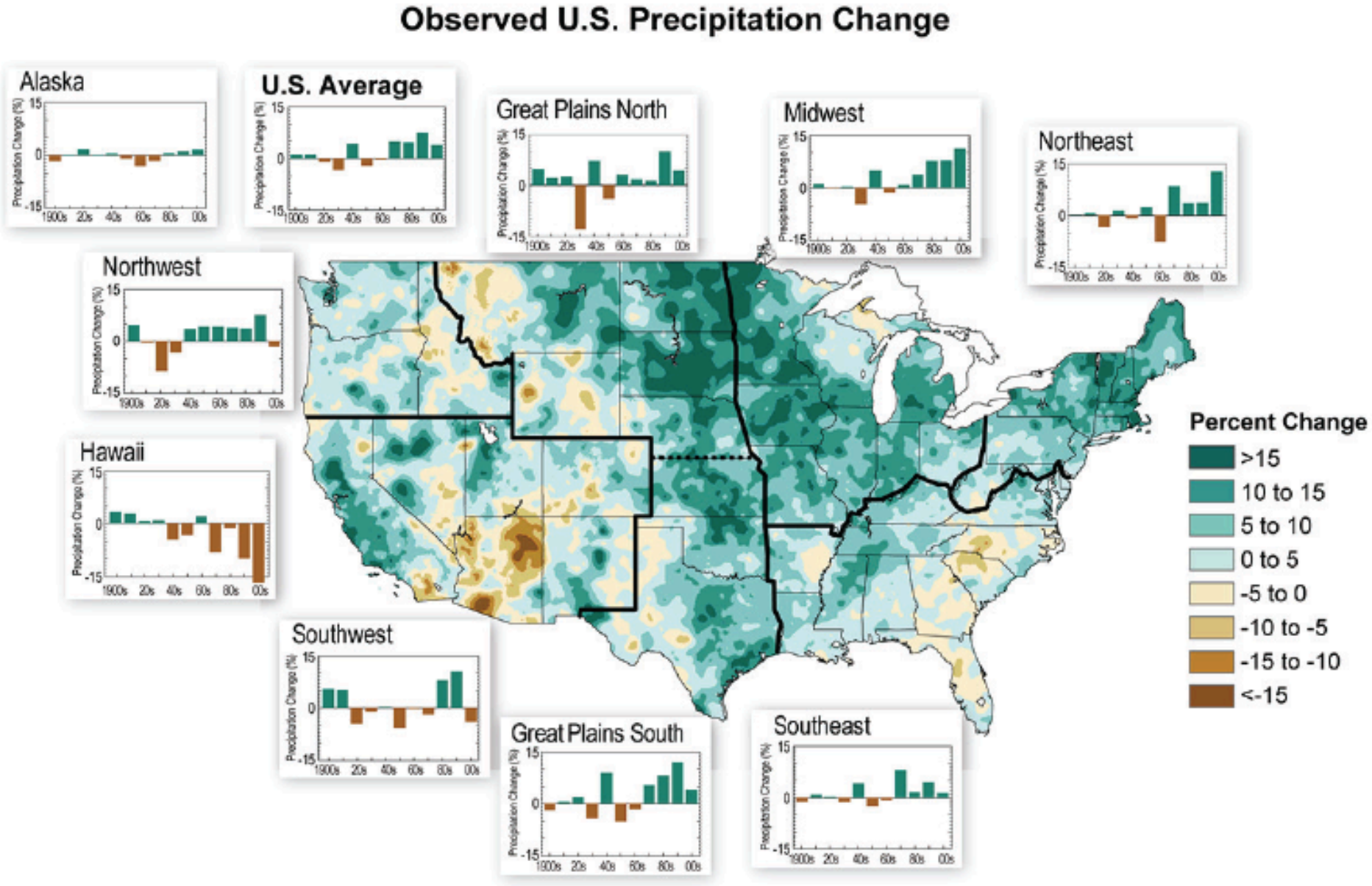


Change is Apparent Across the Nation

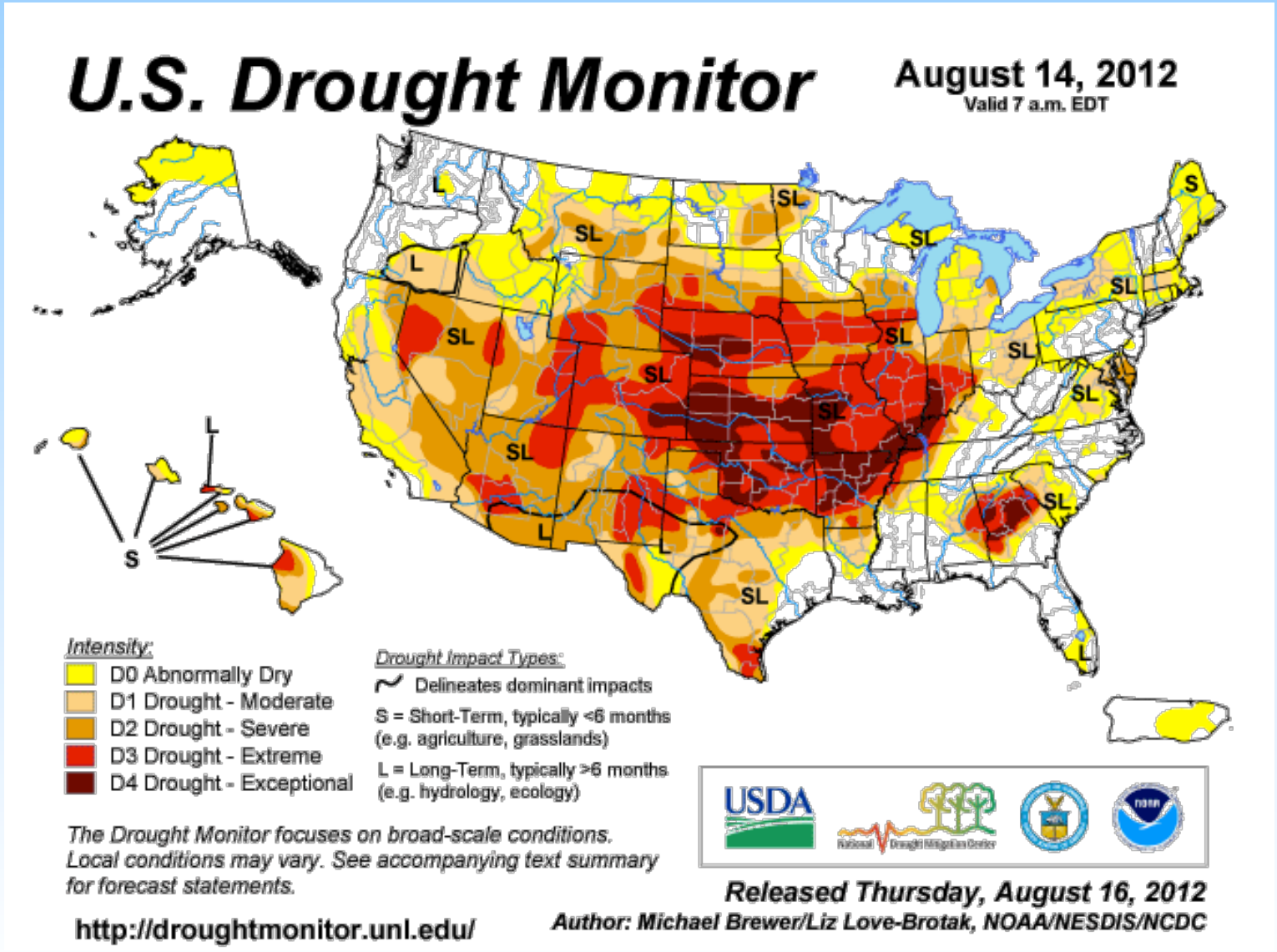


(1991-2011) minus
(1901-1960) mean

Change is Apparent Across the Nation

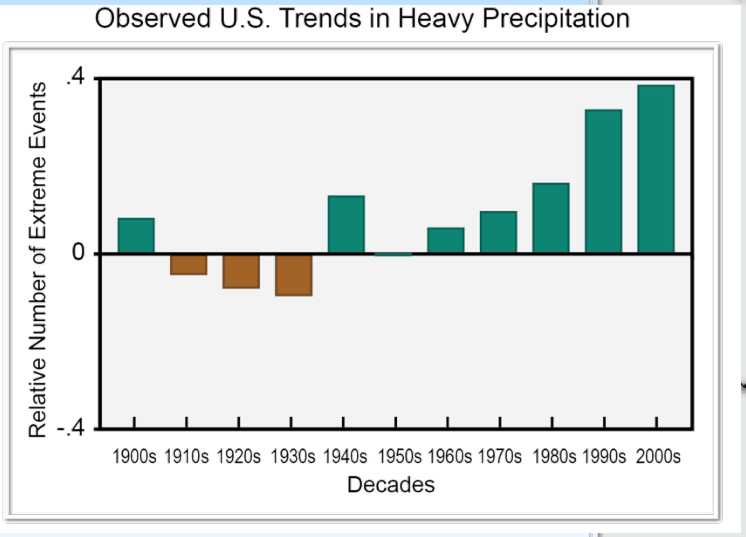


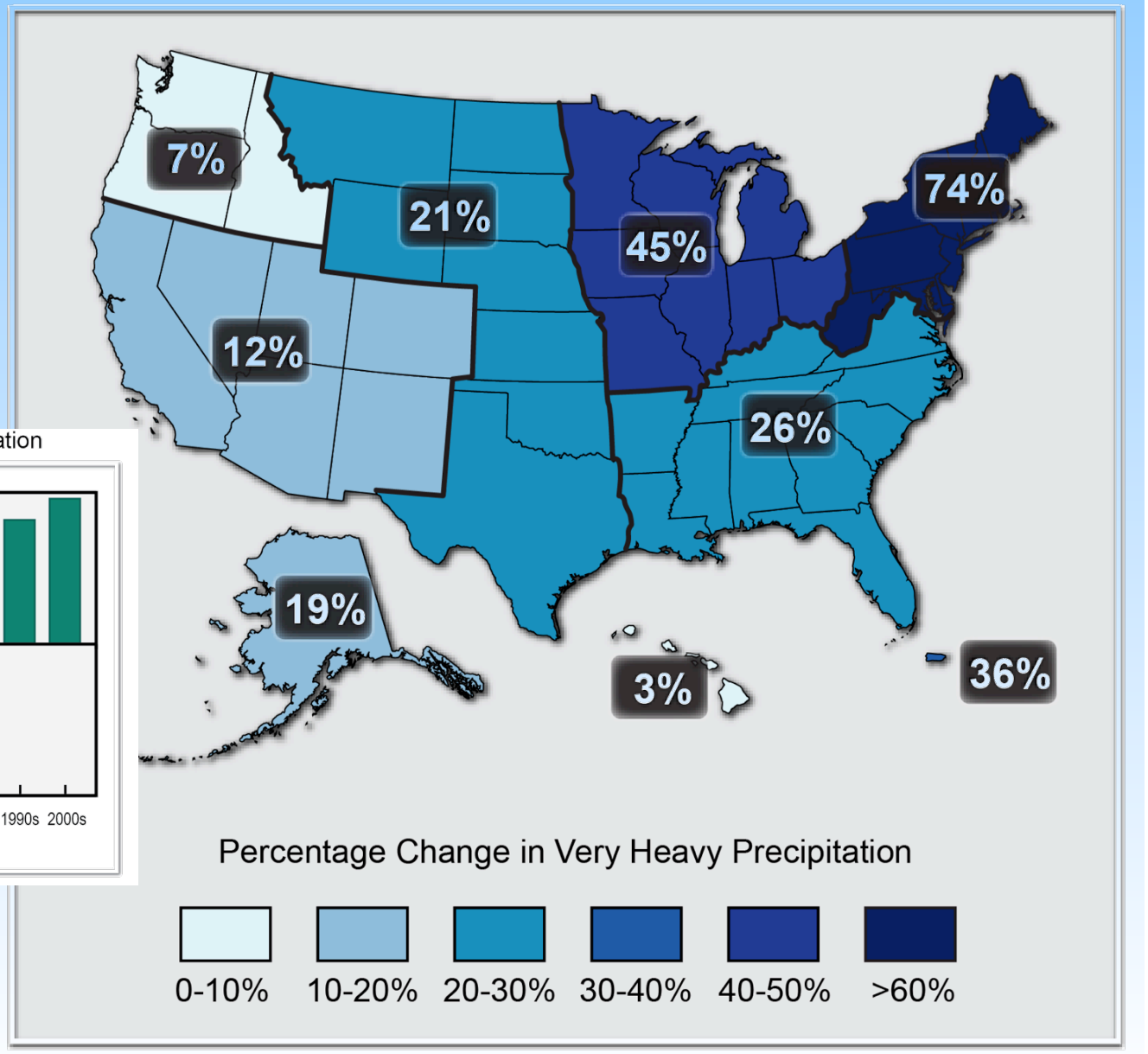
Some extreme weather increasing; new & stronger evidence related to human activities.



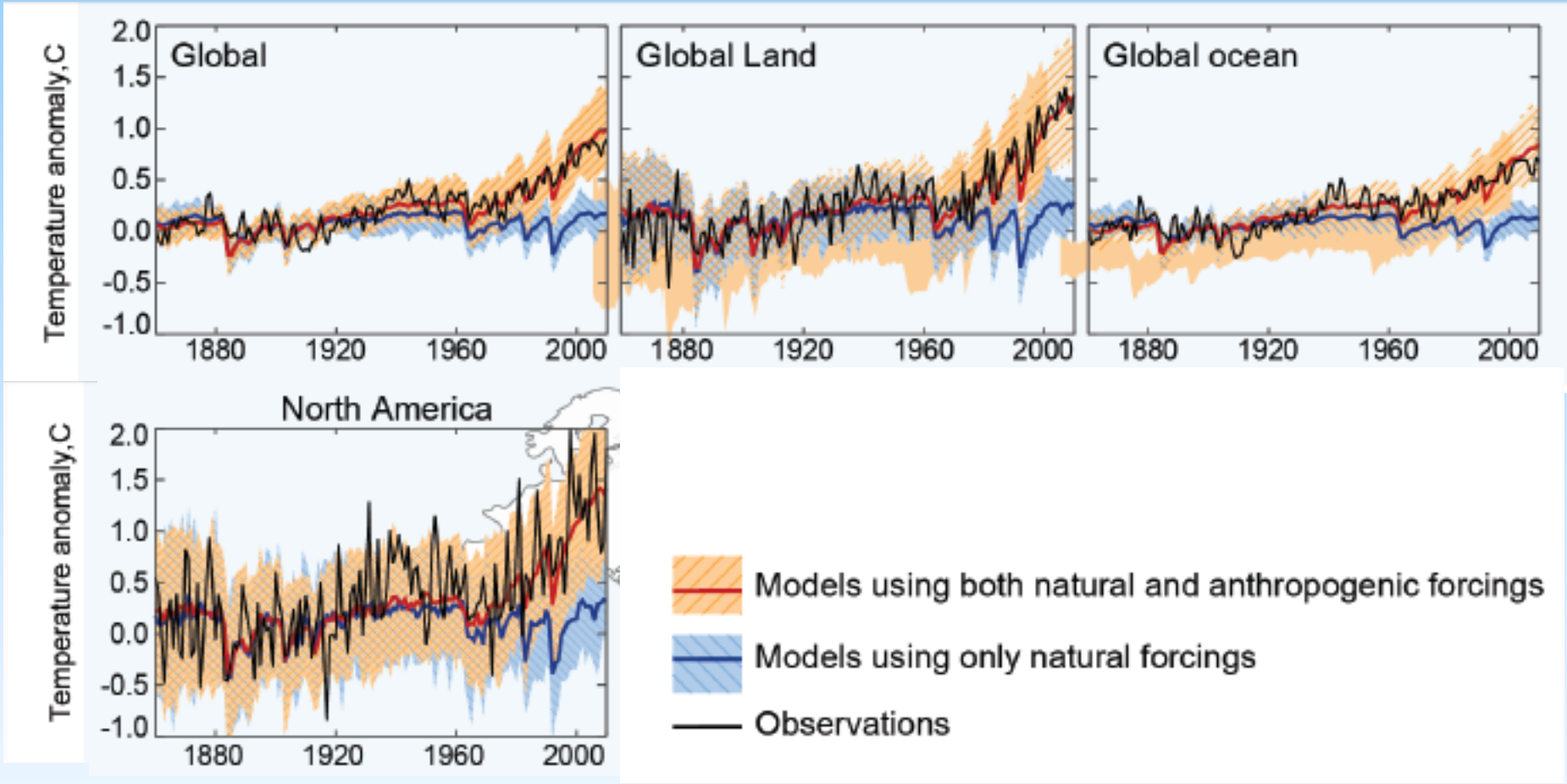
Impacts Already Evident

Trends in Heavy Precipitation

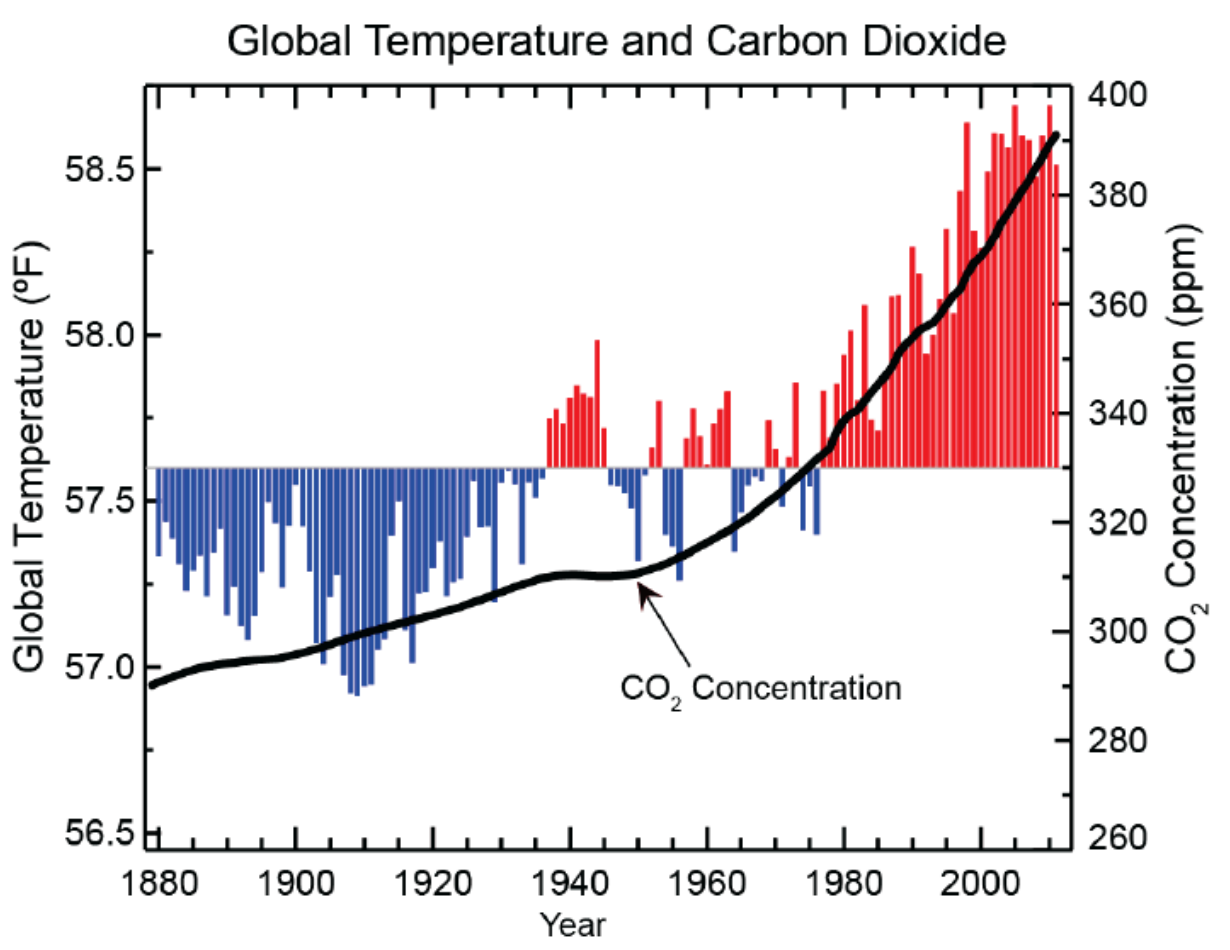




Increasing evidence that these changes are largely due to human activities

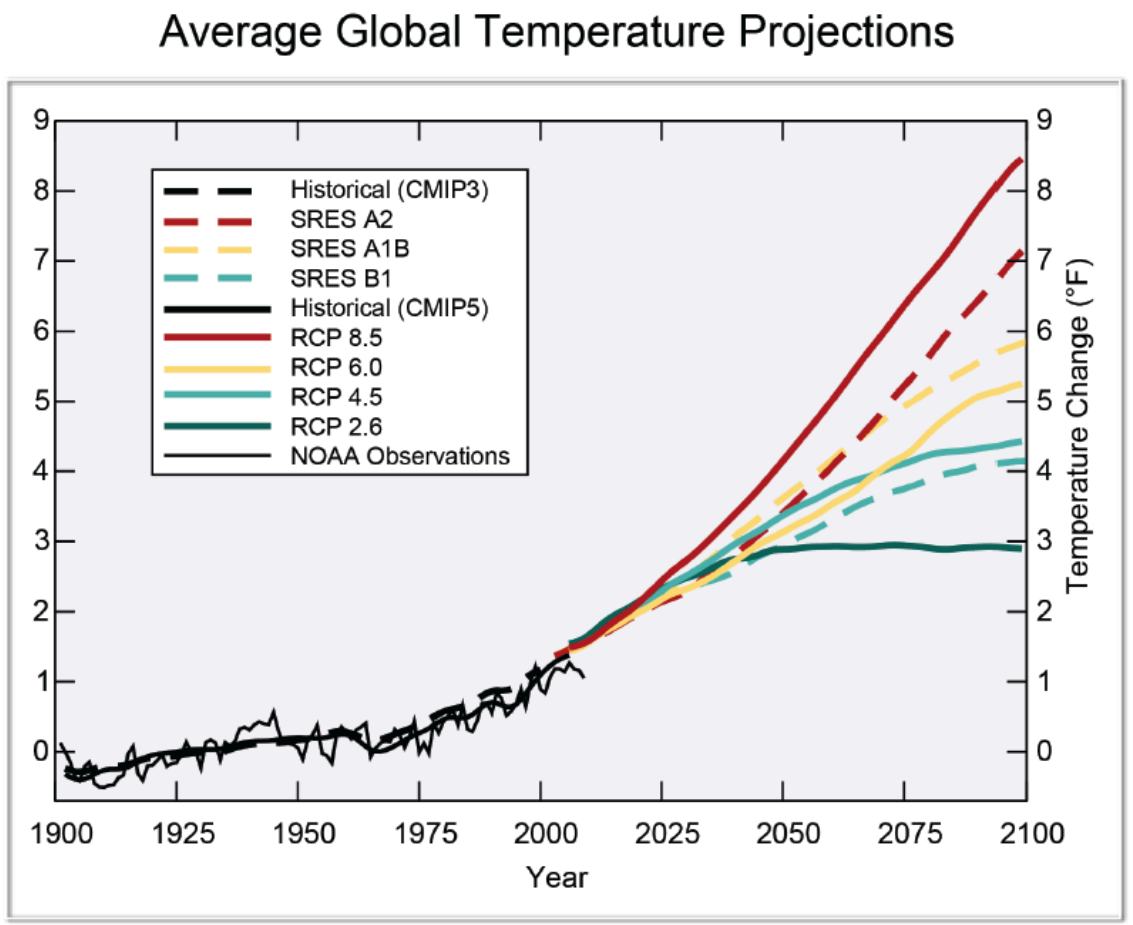


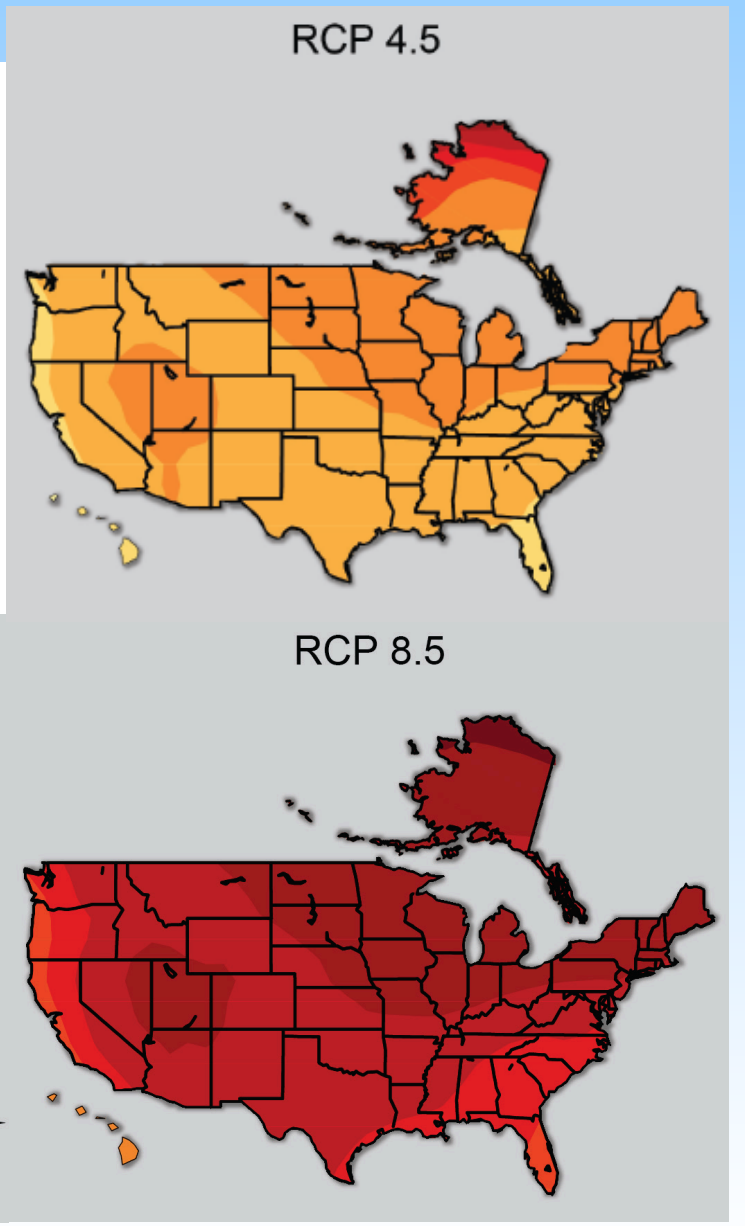
Human-induced climate change projected to continue and accelerate significantly if emissions of heat-trapping gases continue to increase.



Close correlation between CO_2 and temperature years

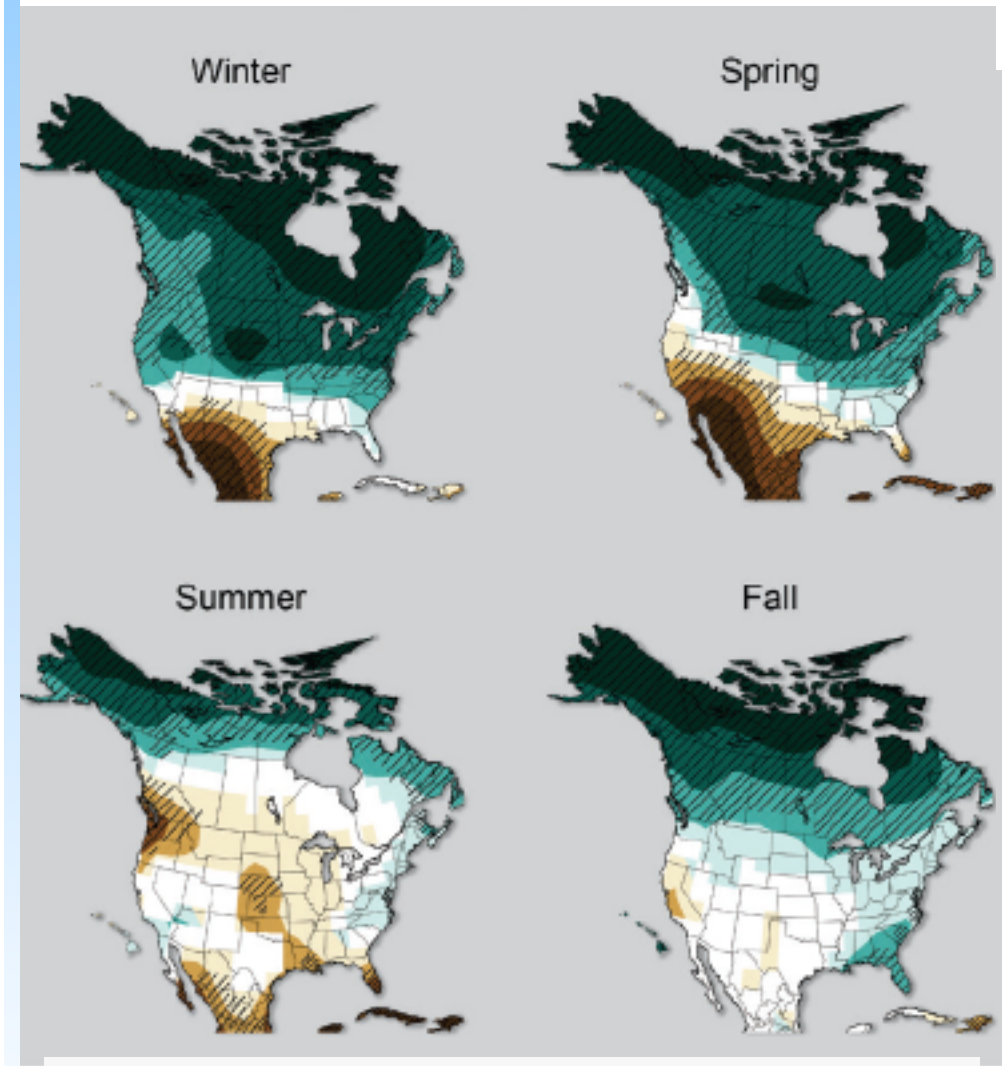
Projected change in average temperature under different emissions scenarios



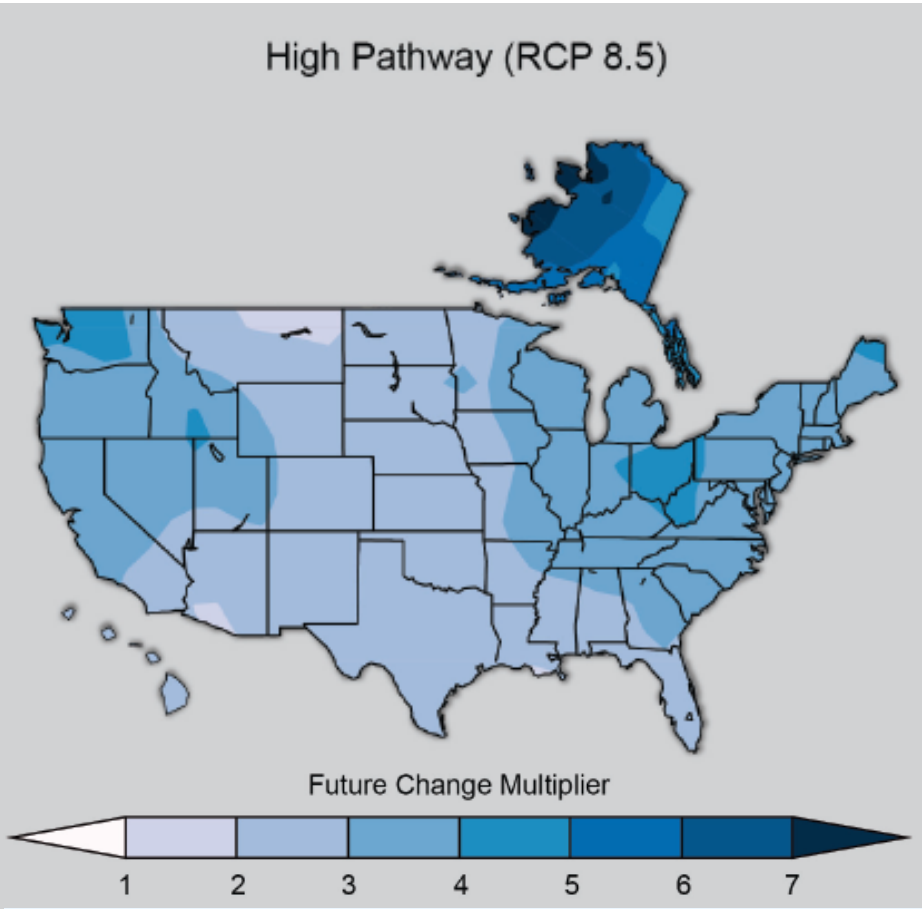


Water Cycle, Precipitation & Extreme Weather

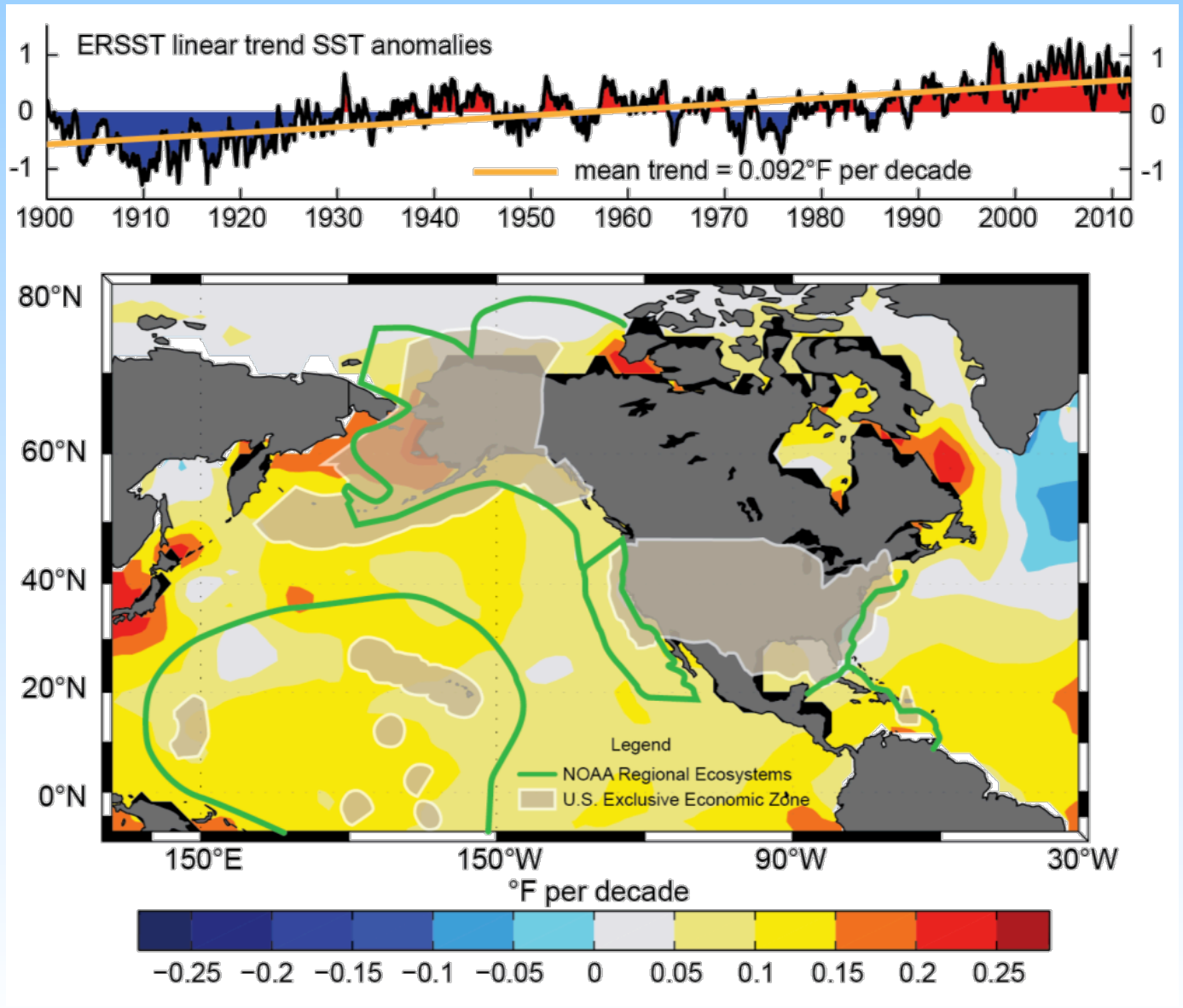
Wet => Wetter; Dry => Drier

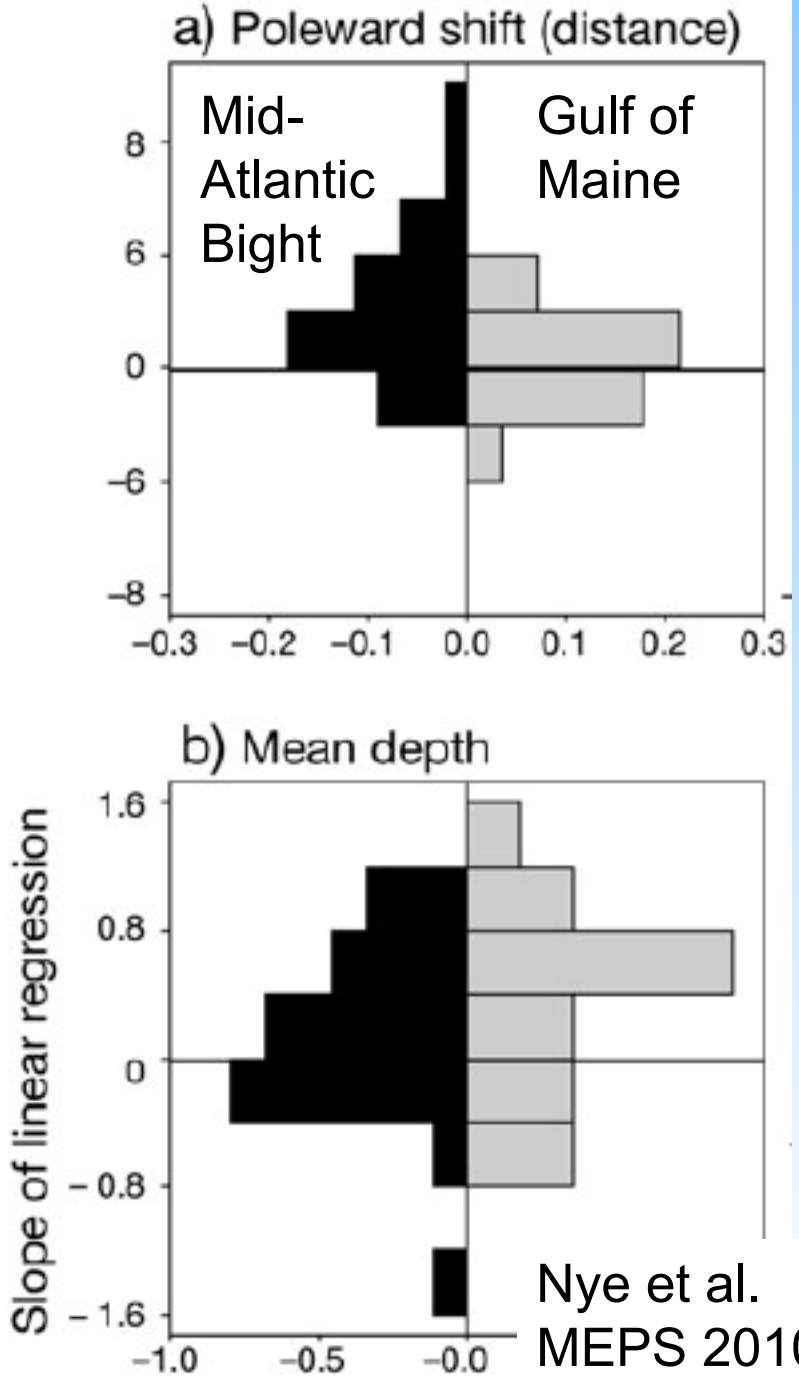


Rare heavy precipitation events become more common



Impacts of continued ocean warming on climate, ocean circulation, chemistry, and ecosystems





Nye et al. MEPS 2010

Habitat losses & altered distribution, abundance, and productivity of many marine species

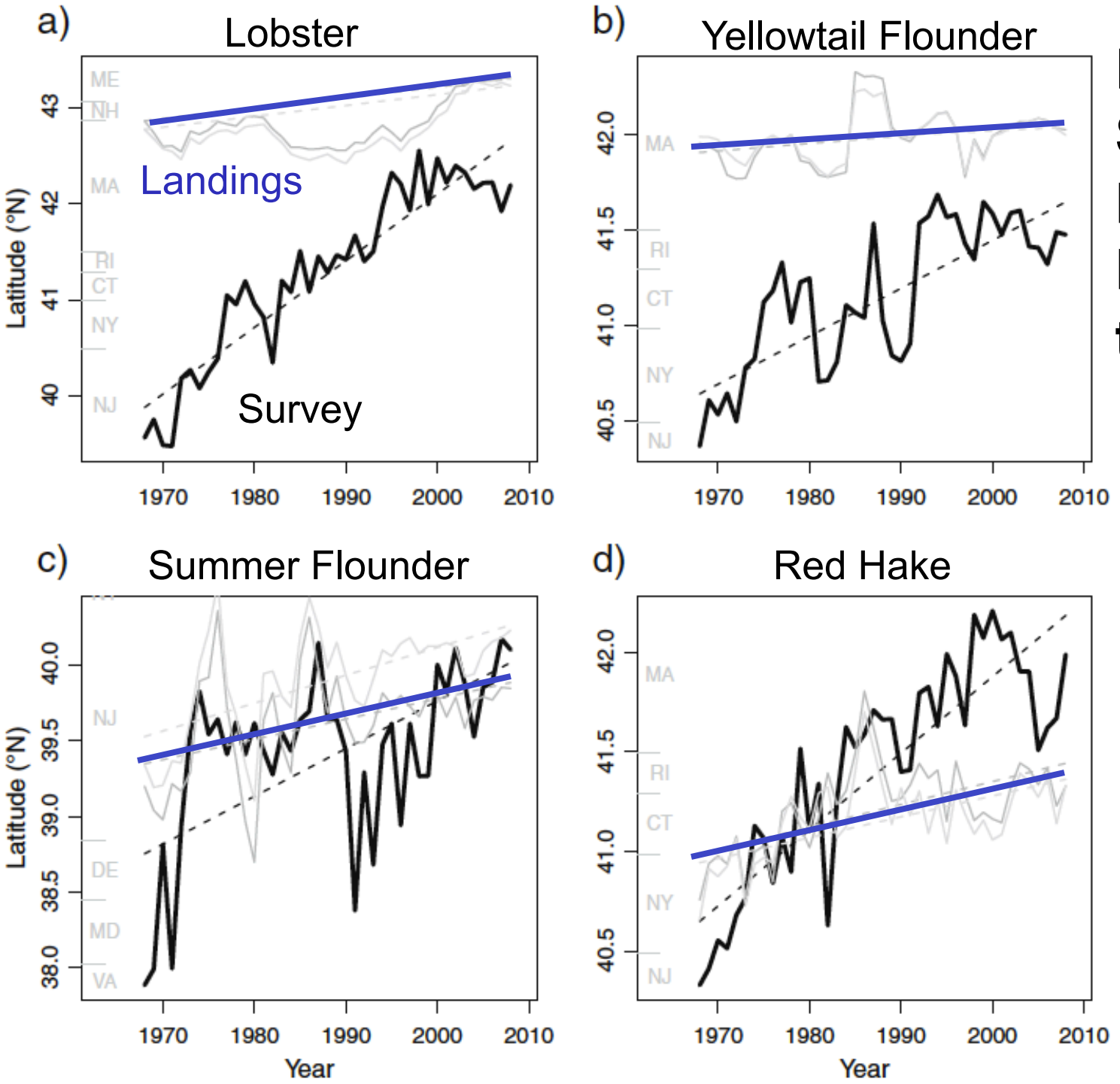
-Ranges shifting poleward and deeper
-Abundance changes that vary fishery by fishery

Regional Fisheries Impacts

Species	Direction of Impact
Atlantic cod (*Gadus morhua*)	Negative
Atlantic croaker (*Micropogonias undulatus*)	Positive
Atlantic lobster (*Homarus americanus*)	Ambiguous, but perhaps more negative
Atlantic sea scallop (*Placopecten magellanicus*)	Negative
Blue crab (*Callinectes sapidus*)	Negative

Table 4-4. *Known or expected direction of social and economic impacts on some major northeast commercial and recreational species (based on Hare* et al.*, 2010; Fogarty* et al.*, 2008; Frumhoff* et al.*, 2007).*

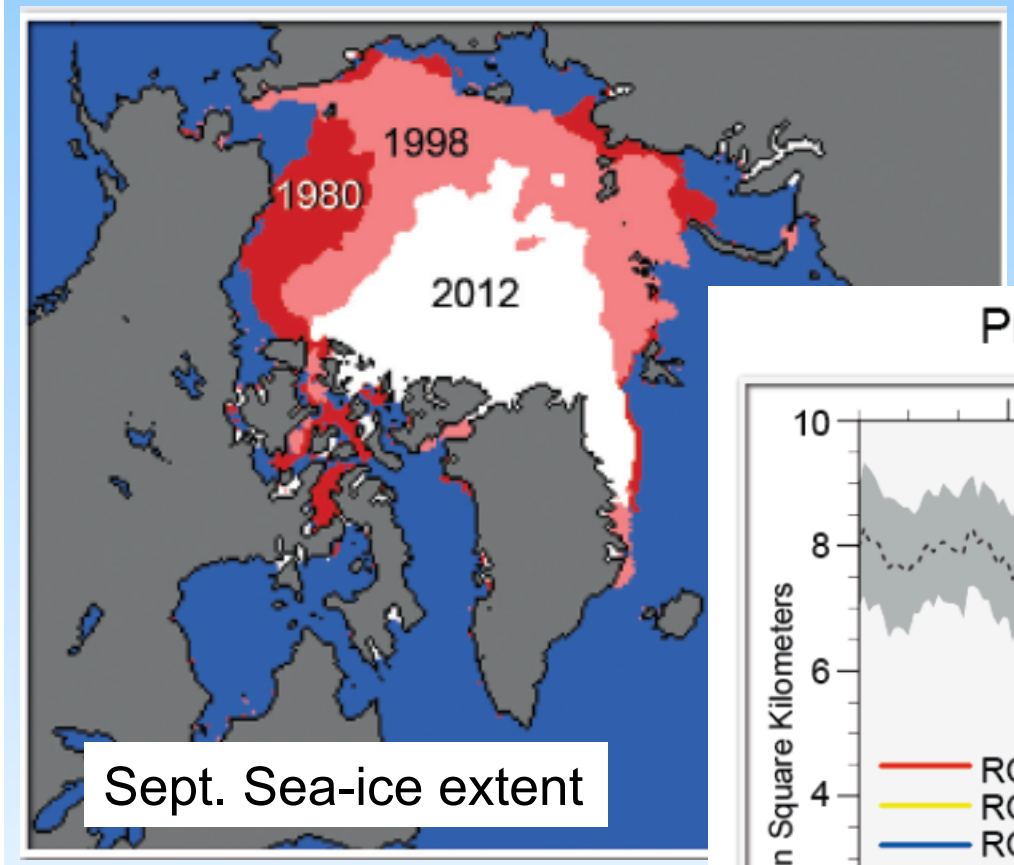
Griffis & Howard,
Technical Input (2012)

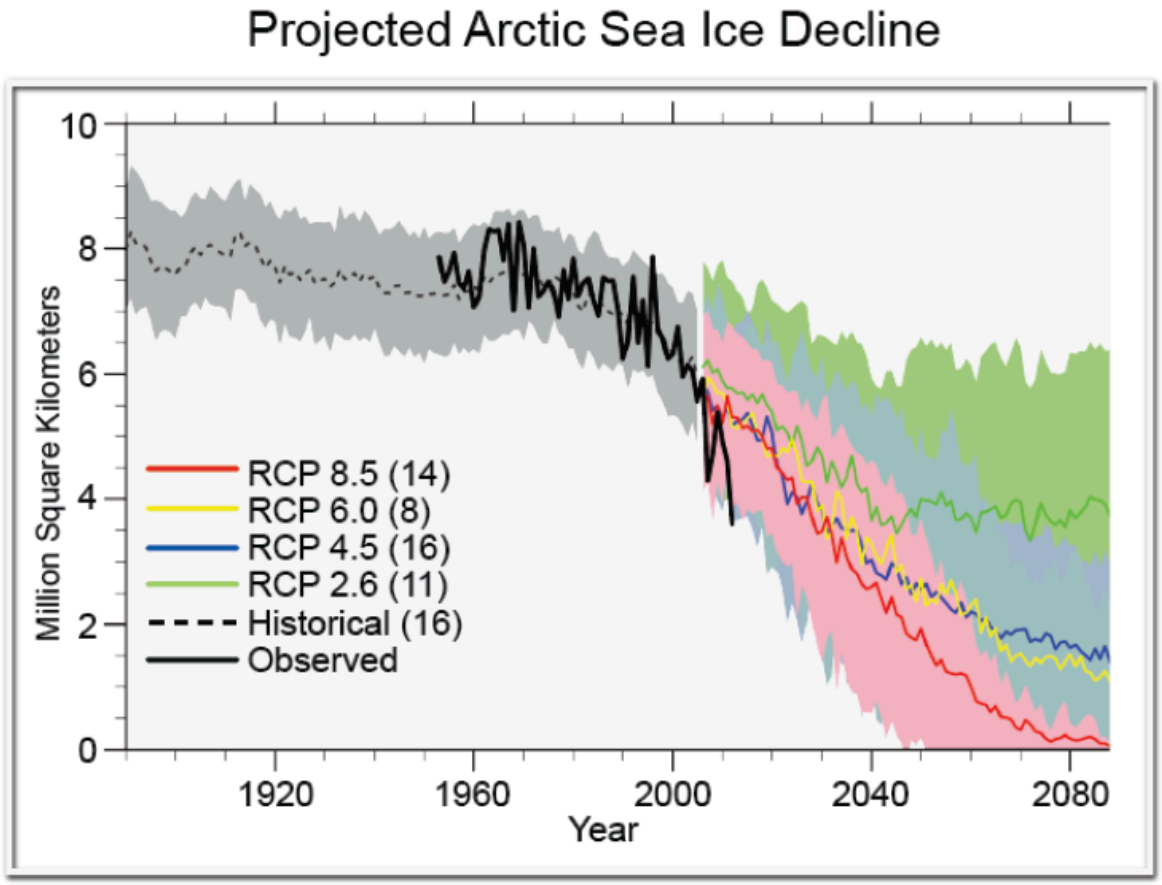


Lagged Social-Ecological Responses to Climate

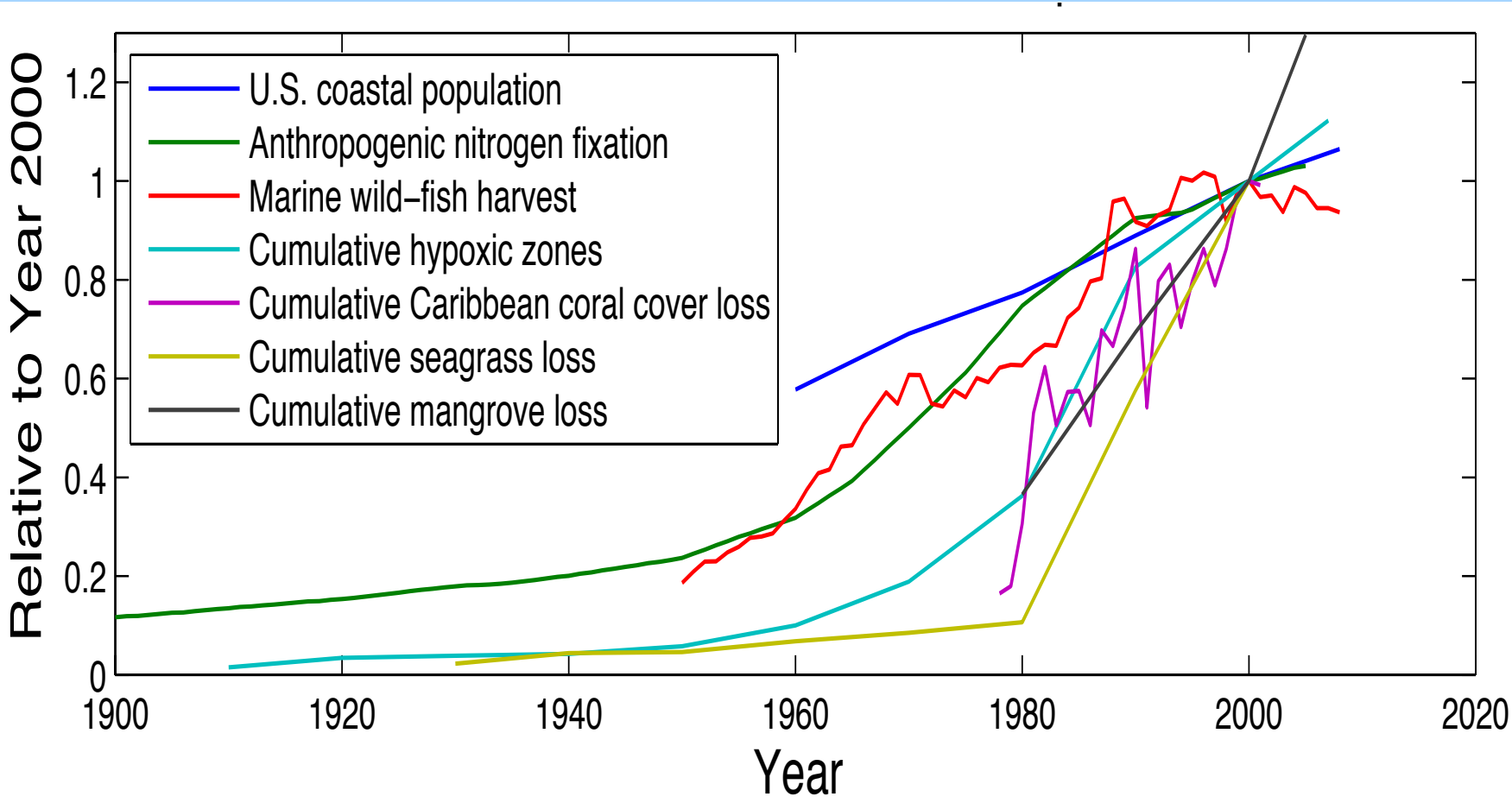
Pinsky & Fogarty Climatic Change 2012

Changing Arctic Ecosystem





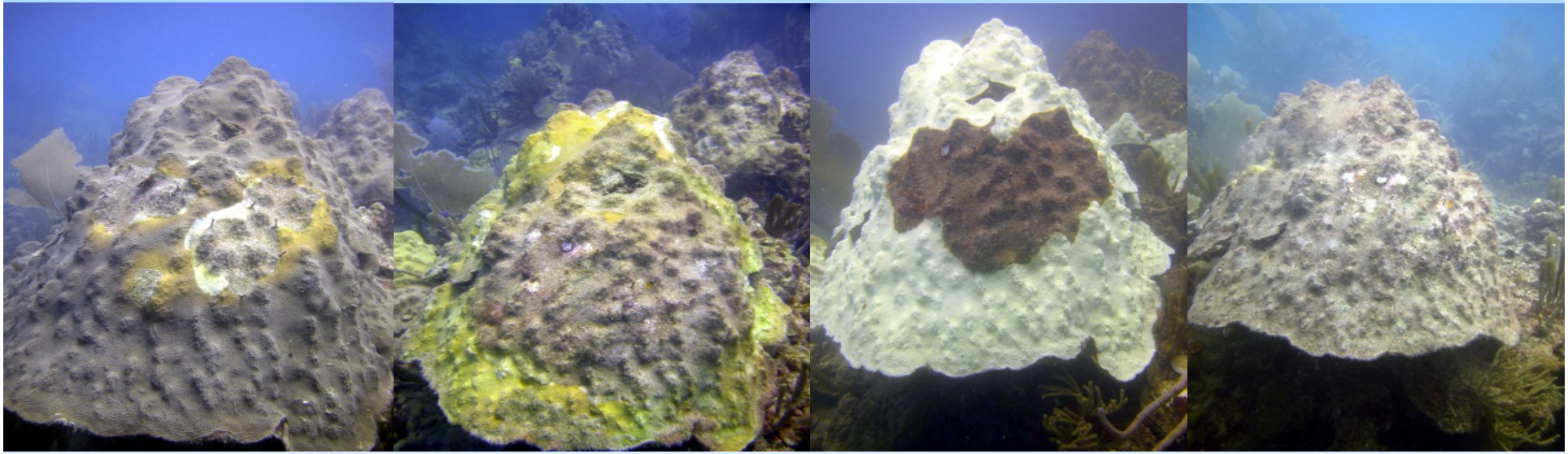
Coastal ecosystems are particularly vulnerable to climate change because many have already been dramatically altered by human stresses



Doney et al.
Ann. Rev. Mar. Sci. 2012

Rising sea surface temperatures have been linked with increasing levels and ranges of diseases of humans and marine life

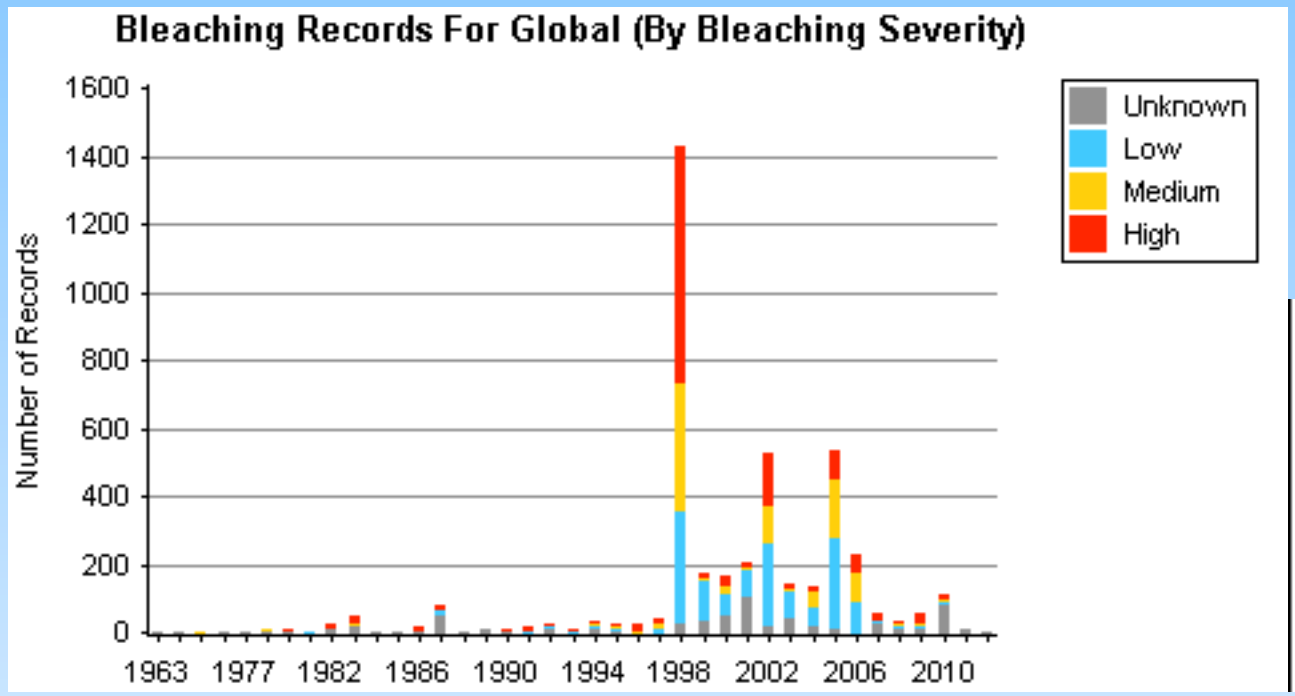
Warming →

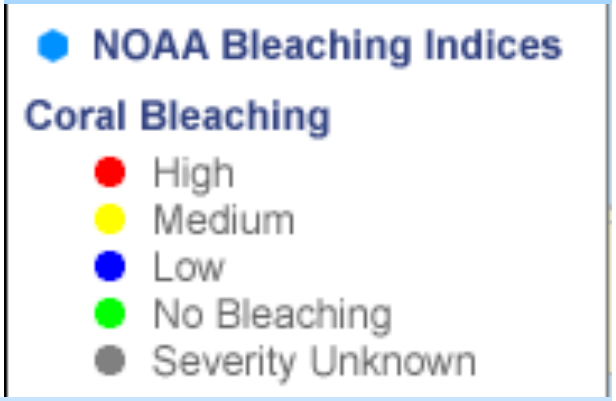


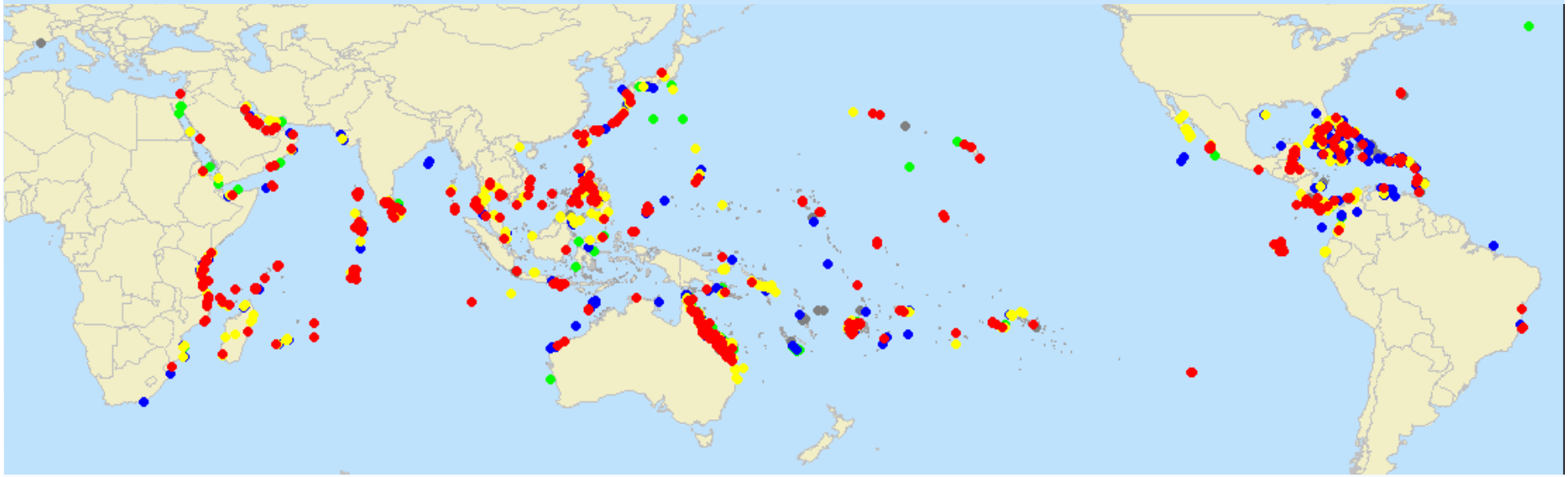
Diseased Coral | Bleaching | Dead Coral

-Healthy corals have symbiotic algal
-Heat stress leads to increased disease, bleaching & possible death

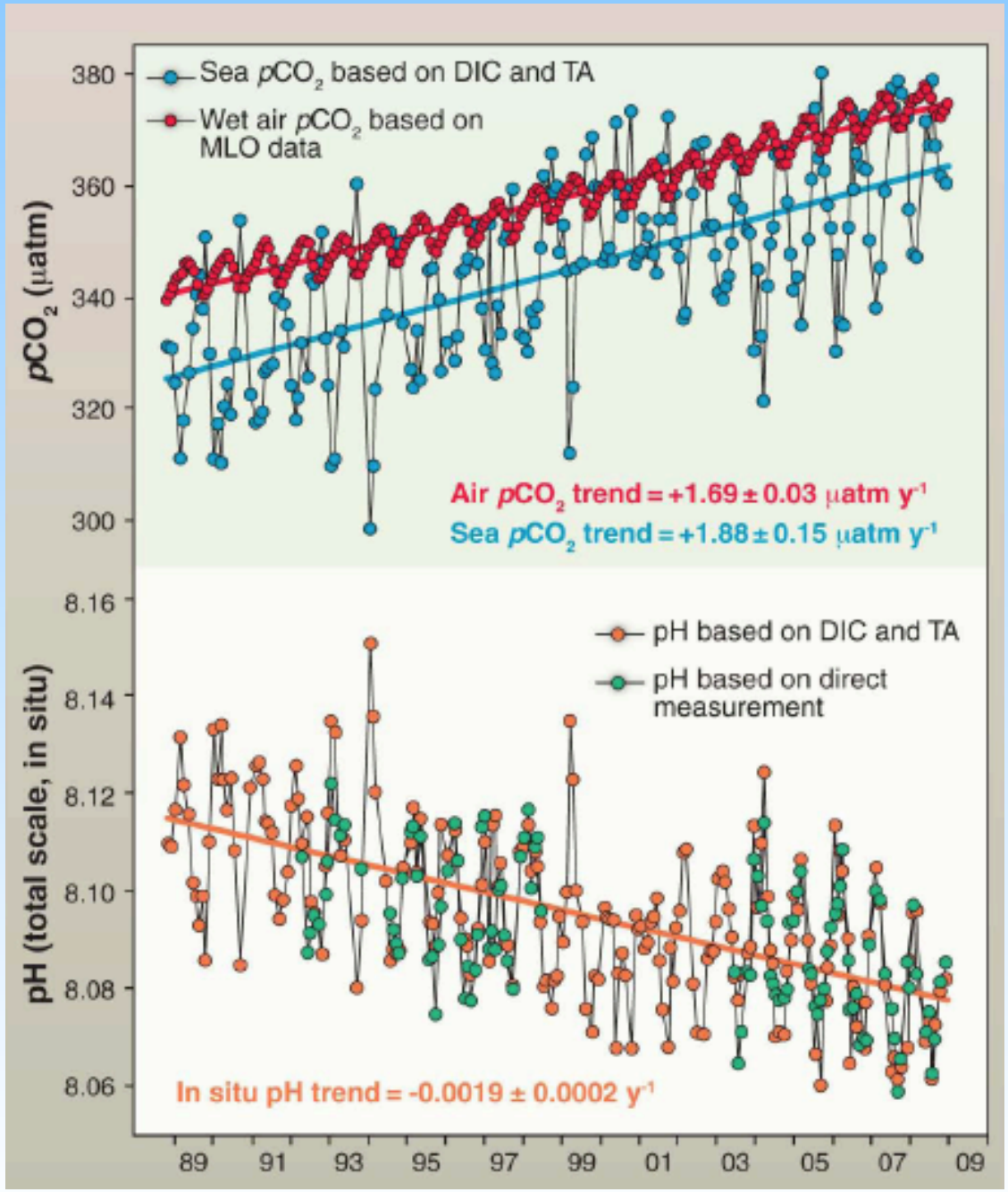
Coral Bleaching Events







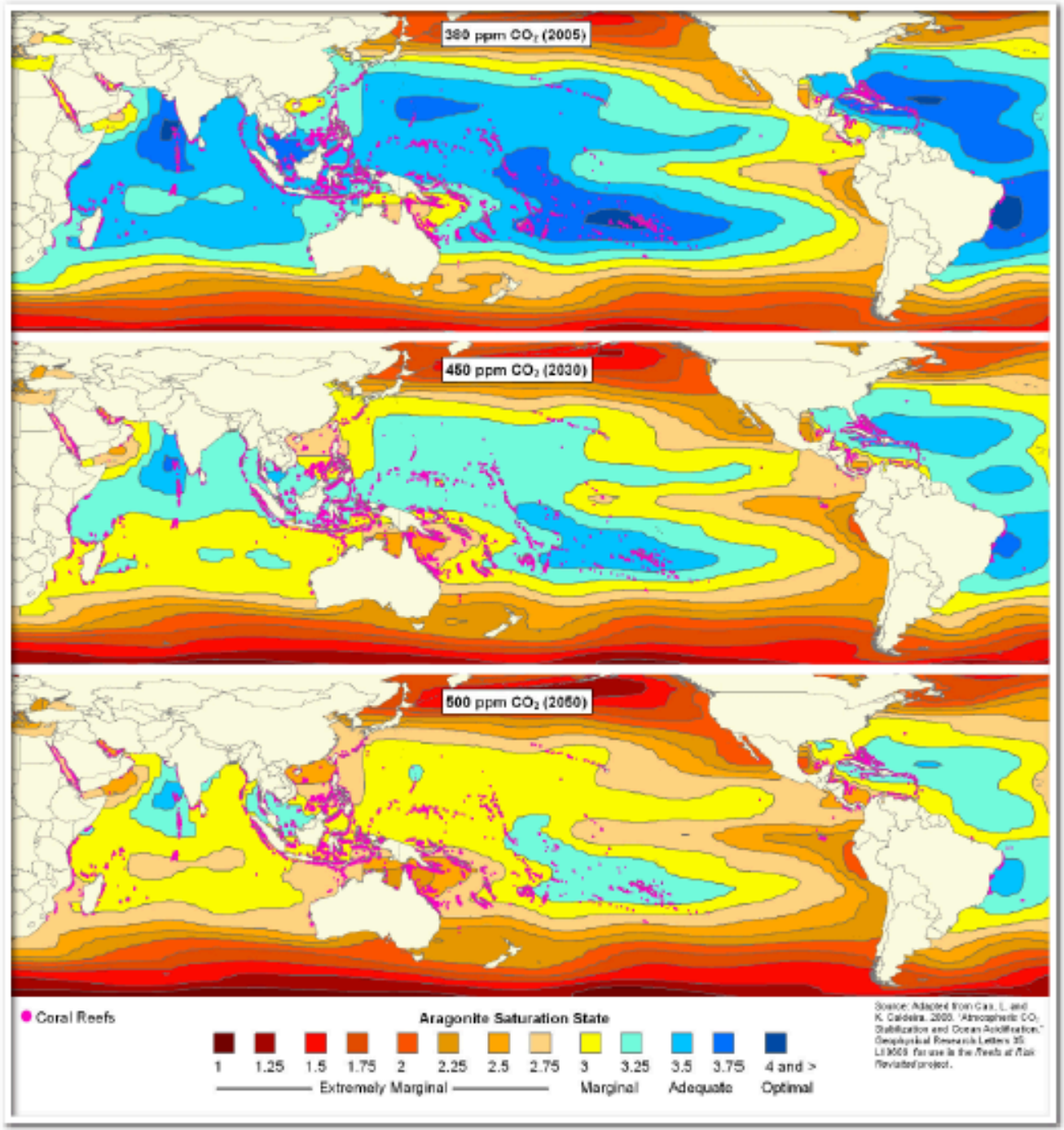
www.reefbase.org



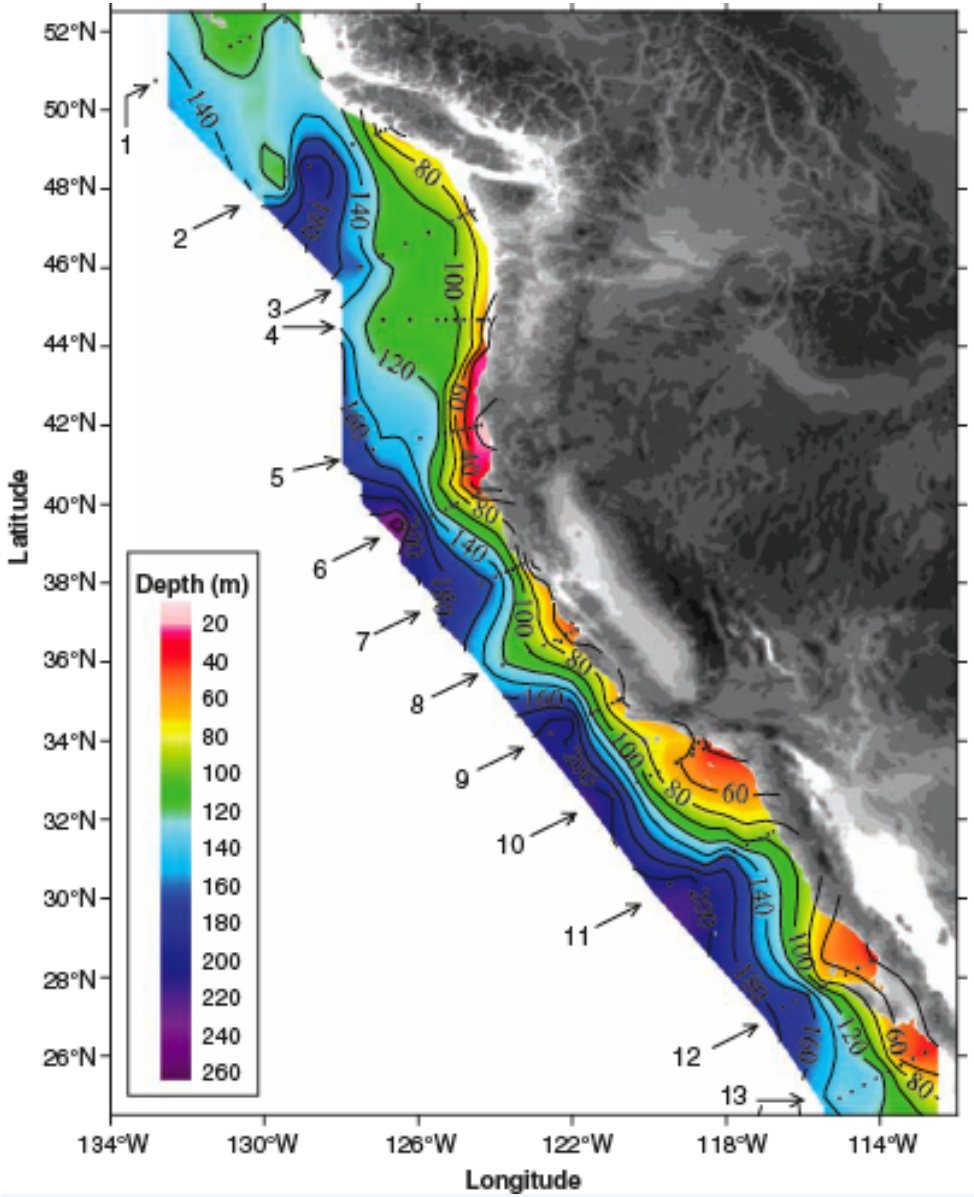
Ocean acidification will alter marine ecosystems in dramatic yet uncertain ways

Doney et al. Ann. Rev. Mar. Sci. 2009
Dore et al. PNAS 2009

Ocean Acidification



Collapse of Pacific NW Oyster Hatcheries

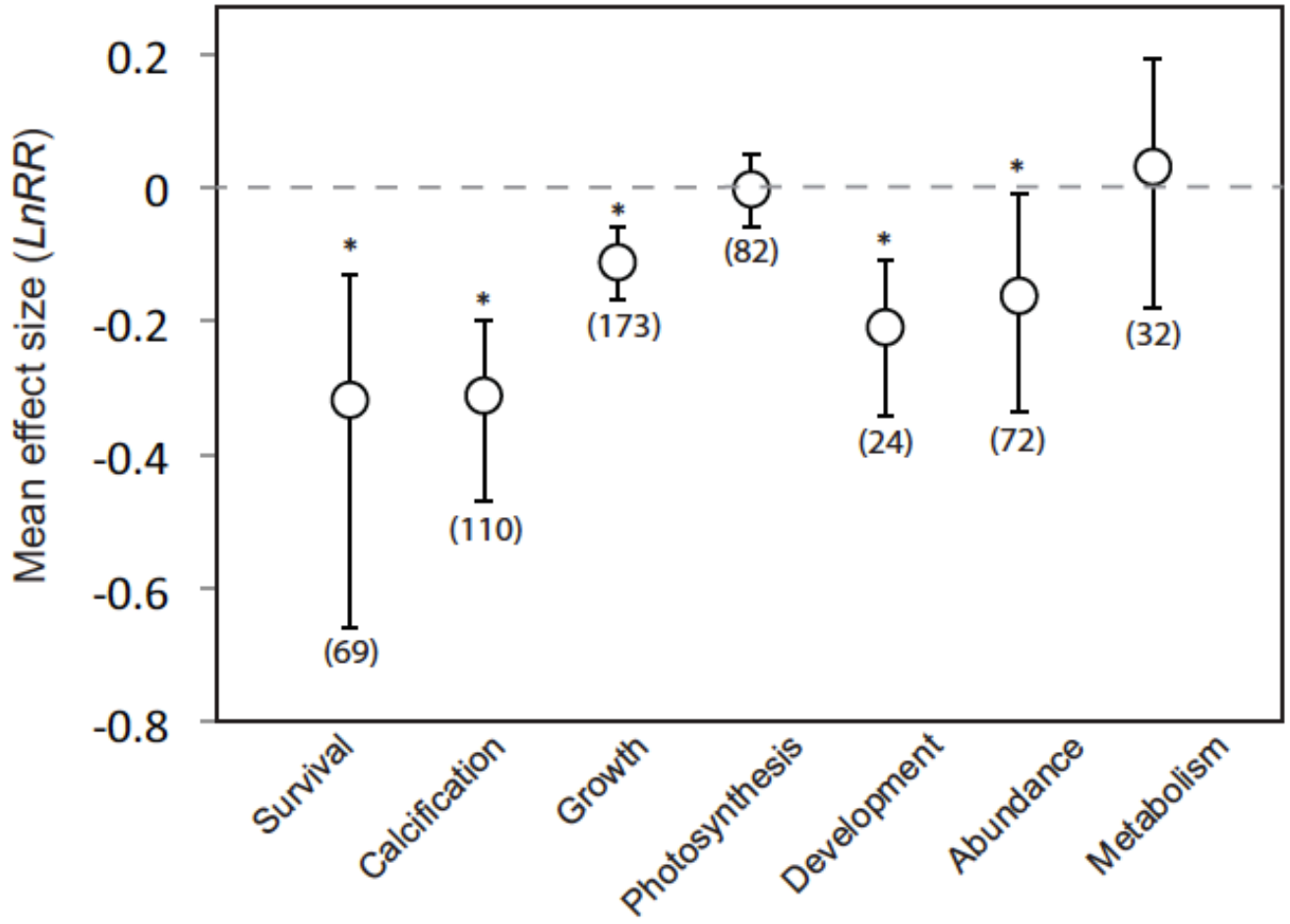


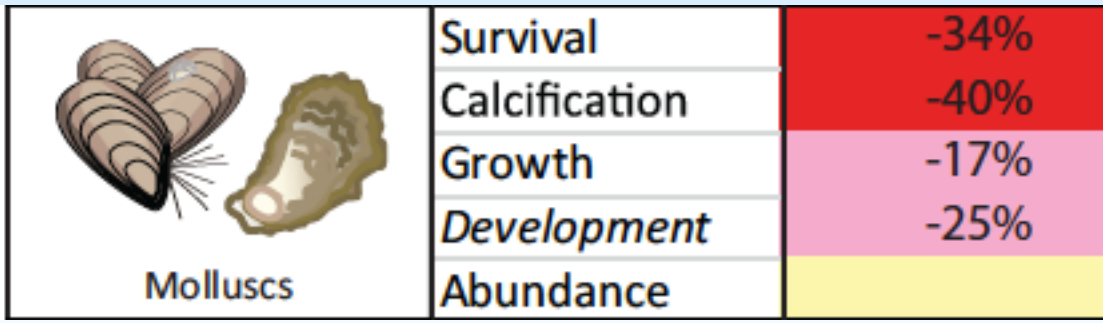
The Seattle Times

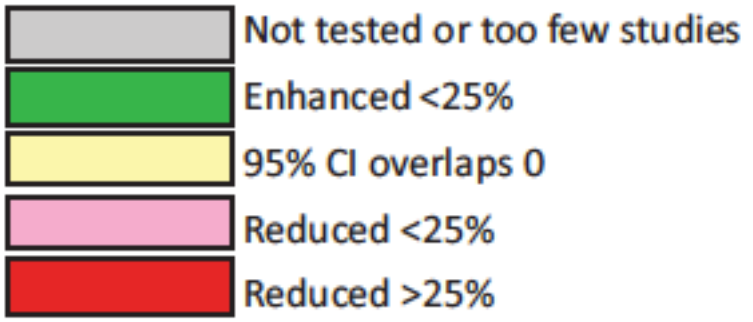
Oysters in deep trouble: Is Pacific Ocean's chemistry killing sea life?

STEVE RINGMAN / THE SEATTLE TIMES

Meta-analysis of biological impacts

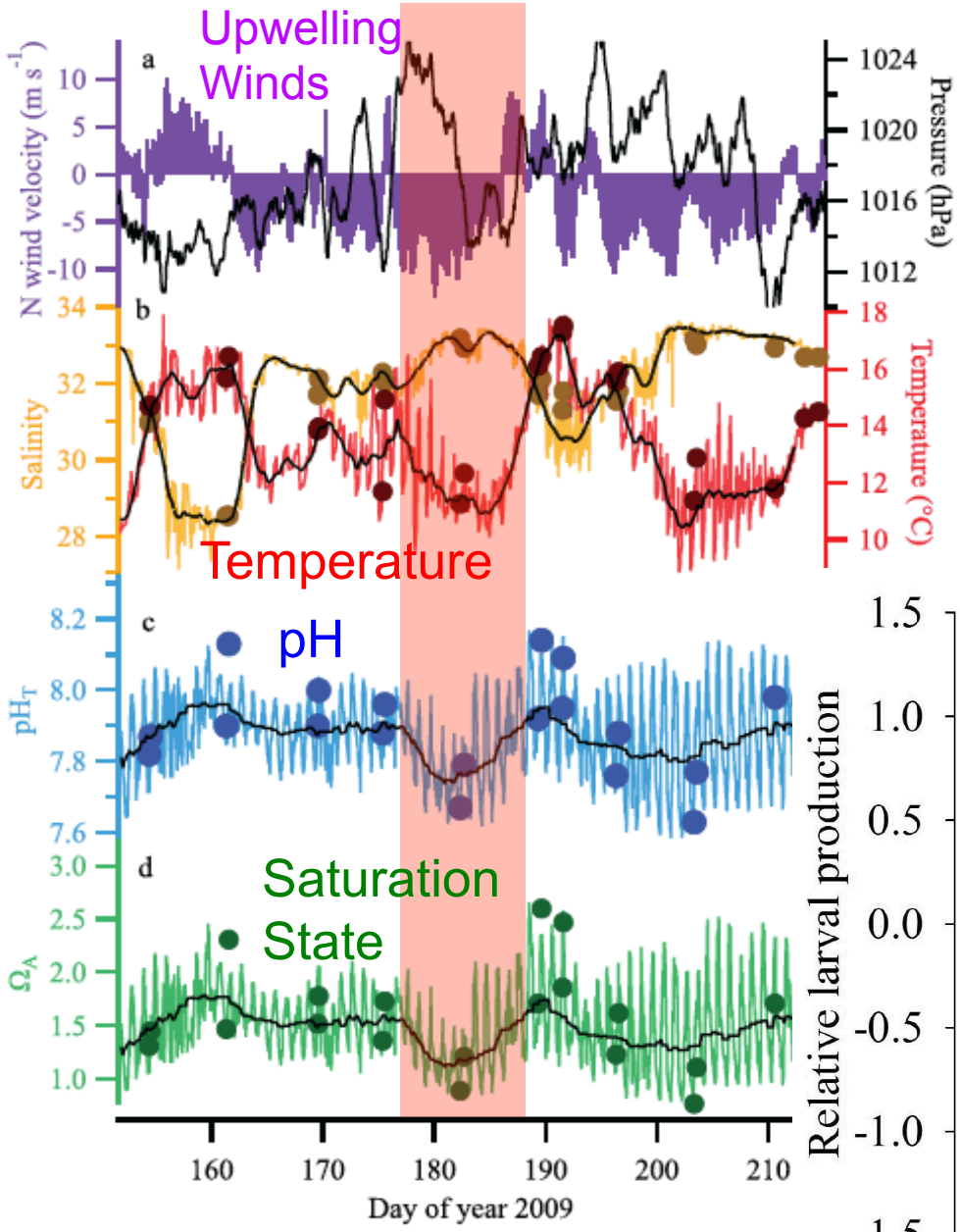


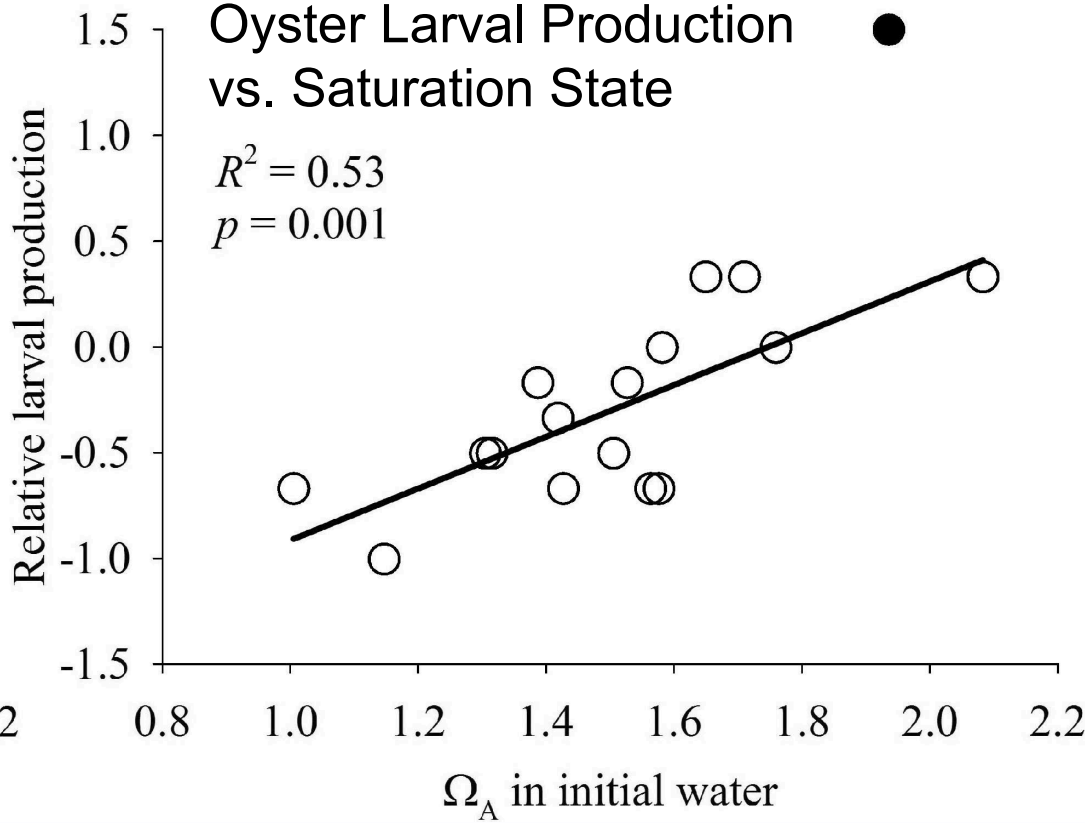




Kroecker et al. (Ecology Letters, 2010; submitted)

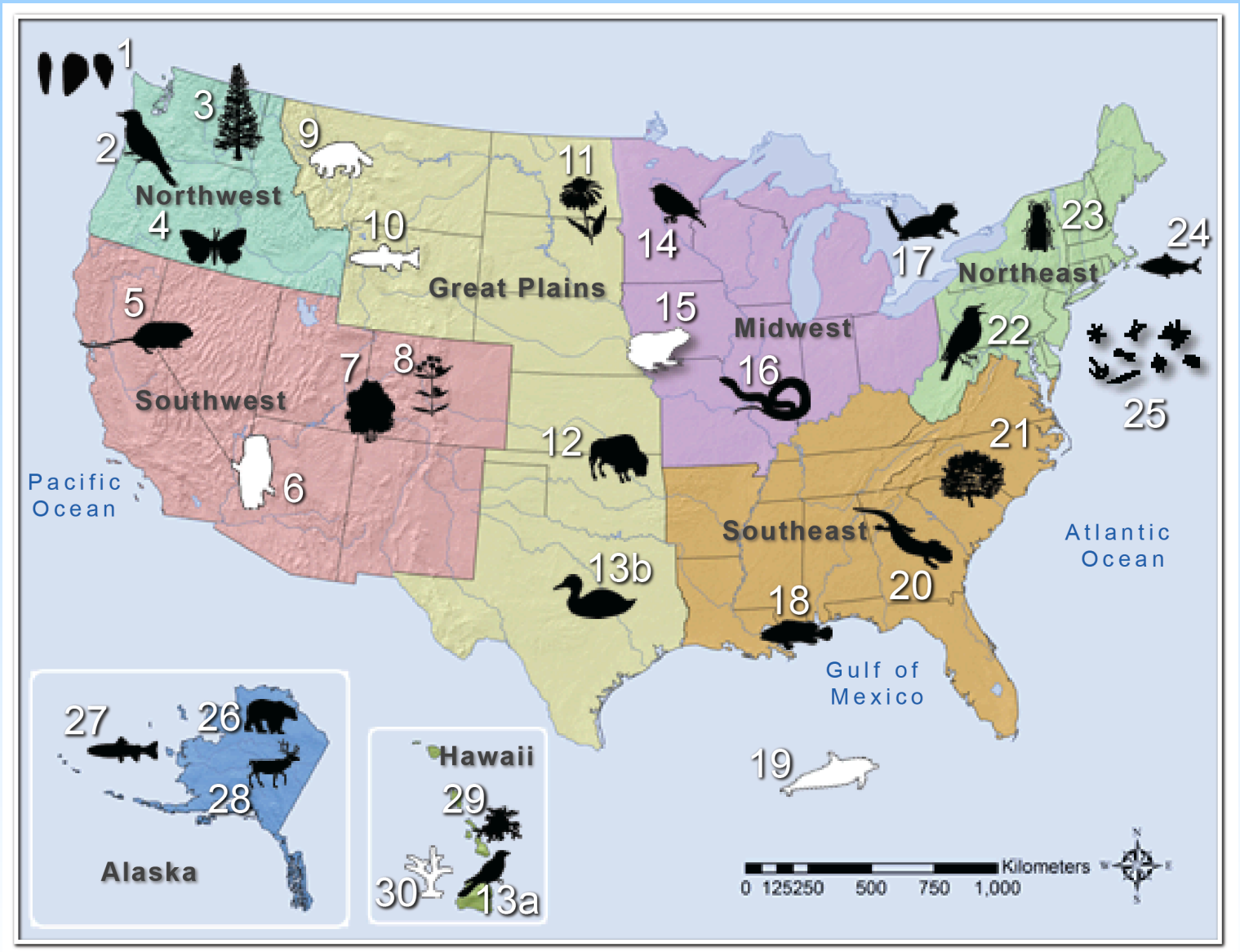
Reduced Larval Production During Upwelling Events



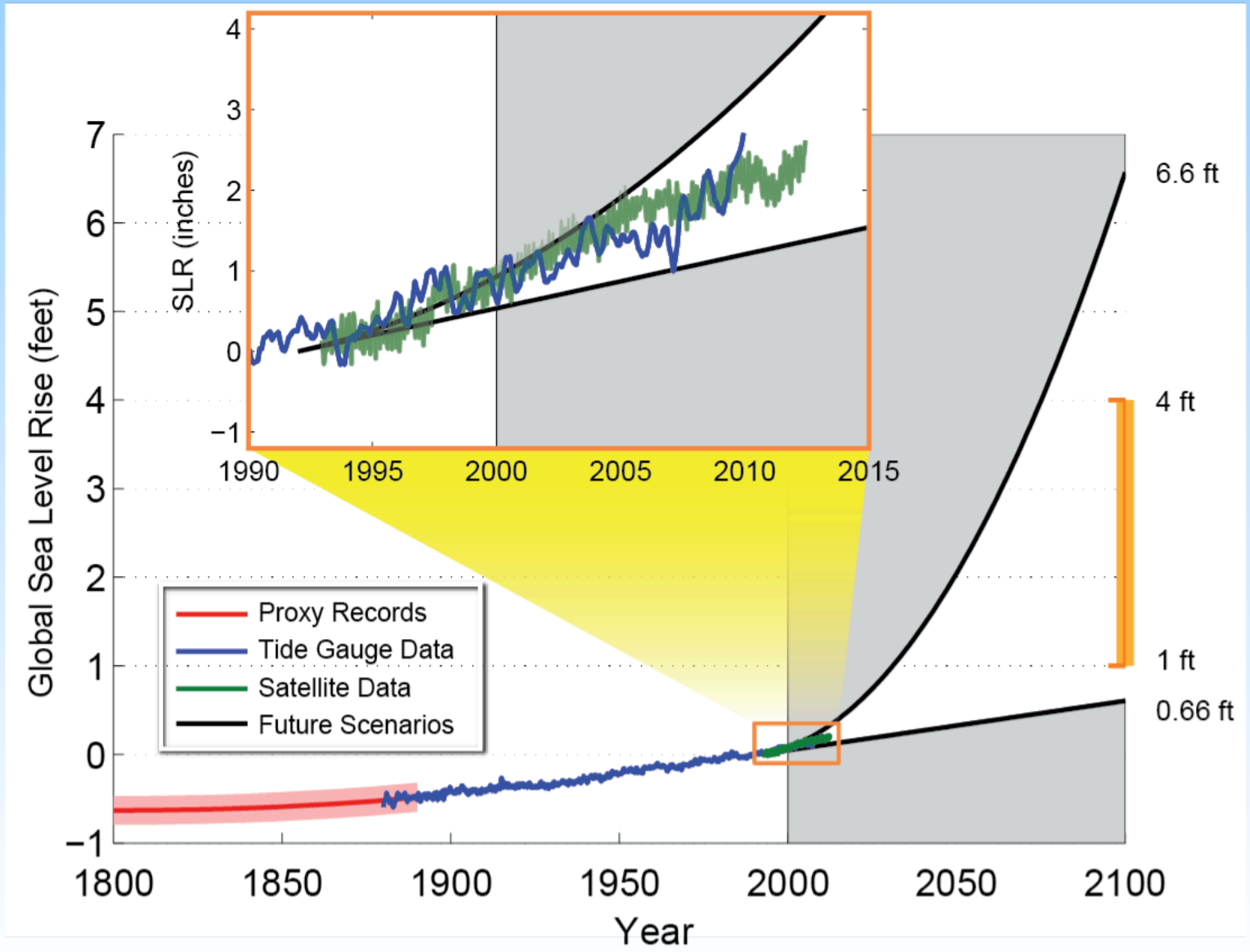


Barton Limnology & Oceanography 2012

Biological Responses to Climate Change

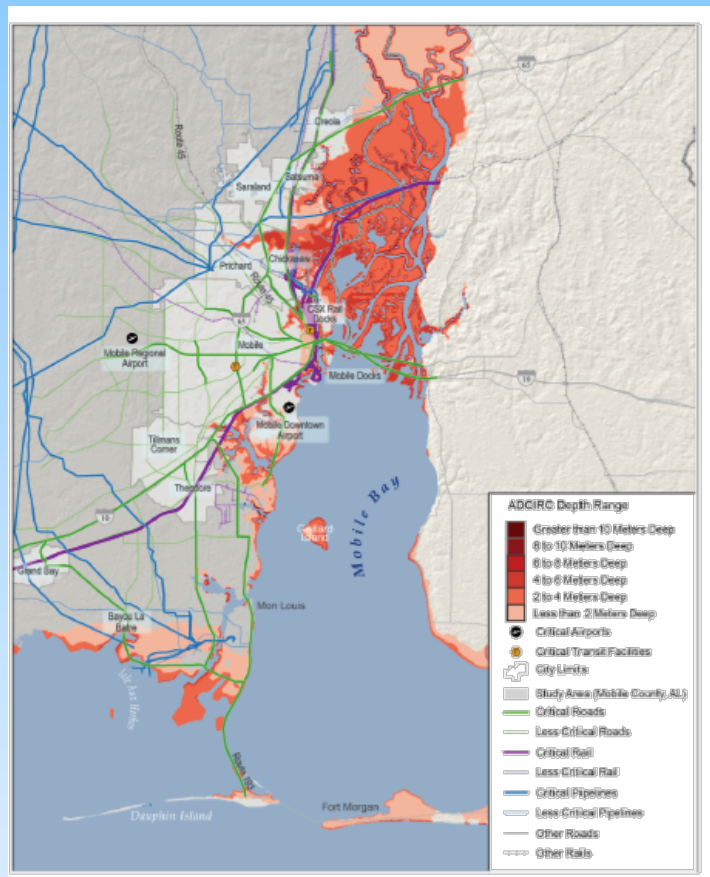


Projected range of sea level rise compared to last 100 years

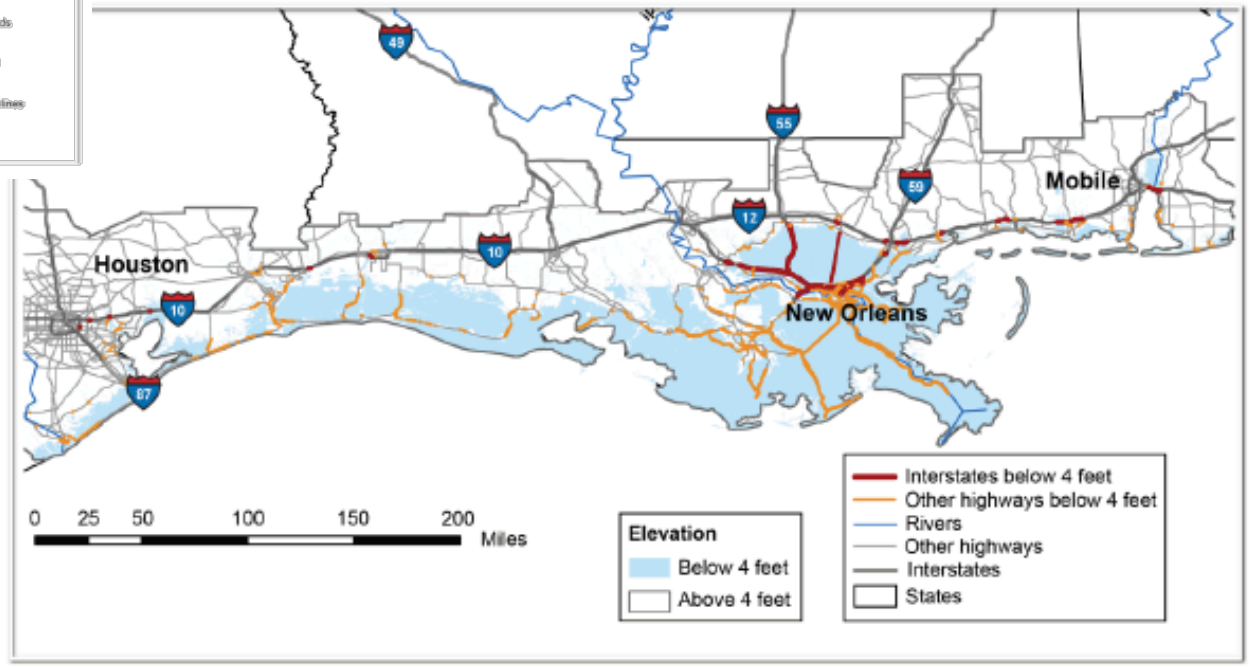


Infrastructure Affected

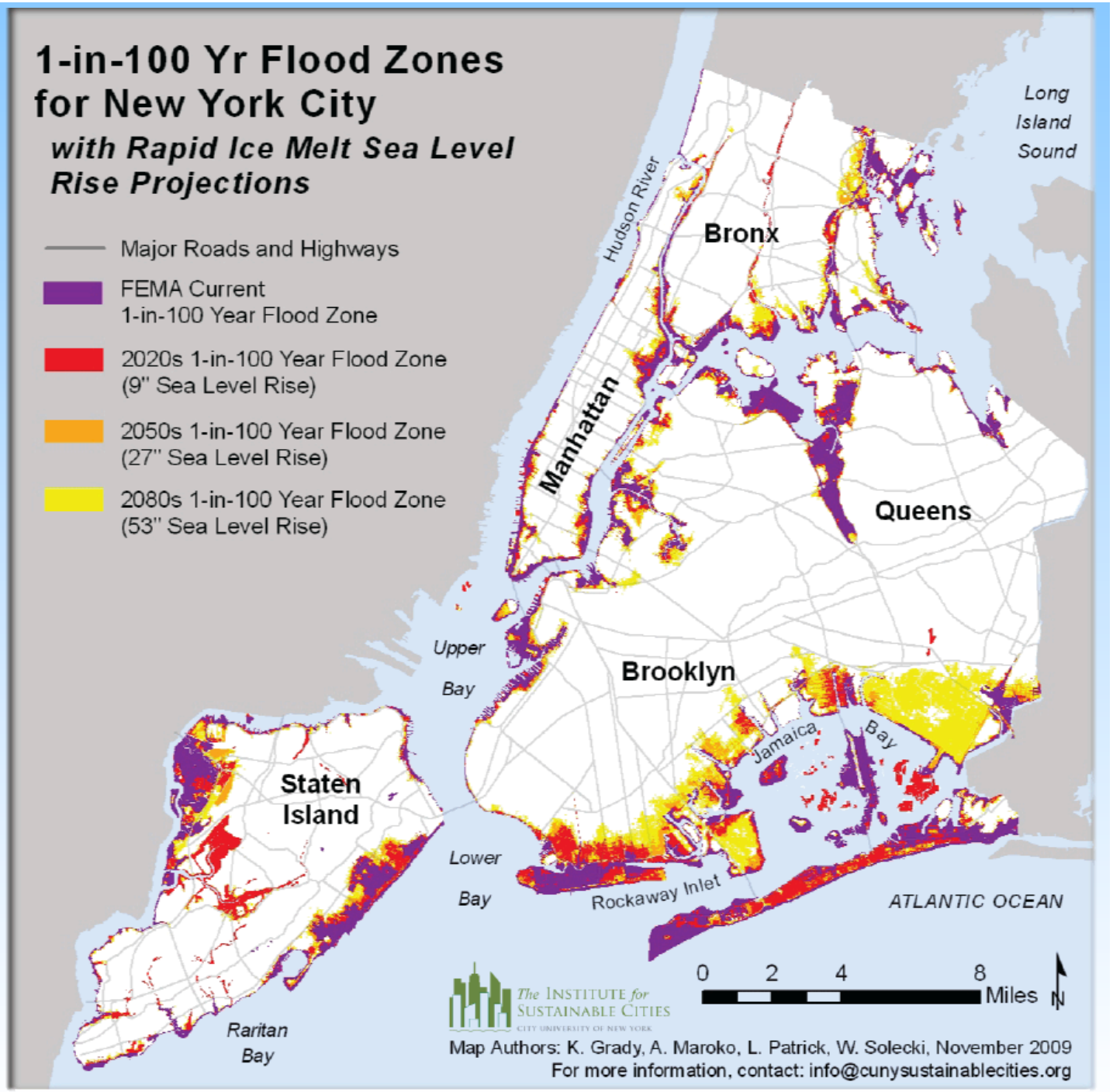
Gulf Coast Transportation Hubs at Risk



Impact of Sea Level Rise and Storm Surge on Mobile, Alabama

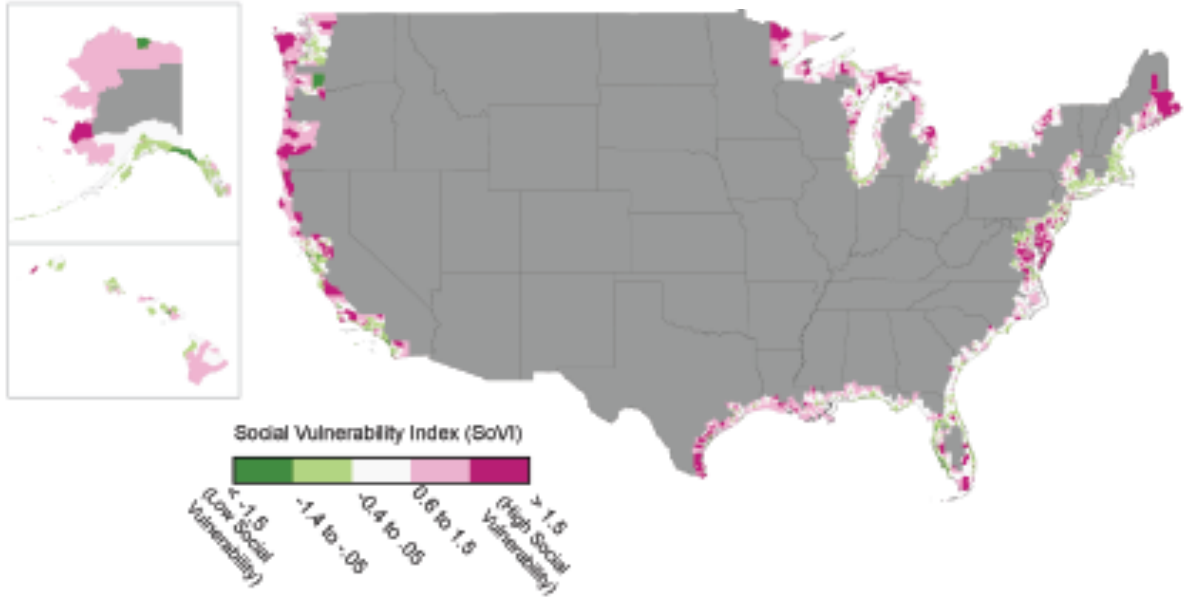


Infra-structure Affected

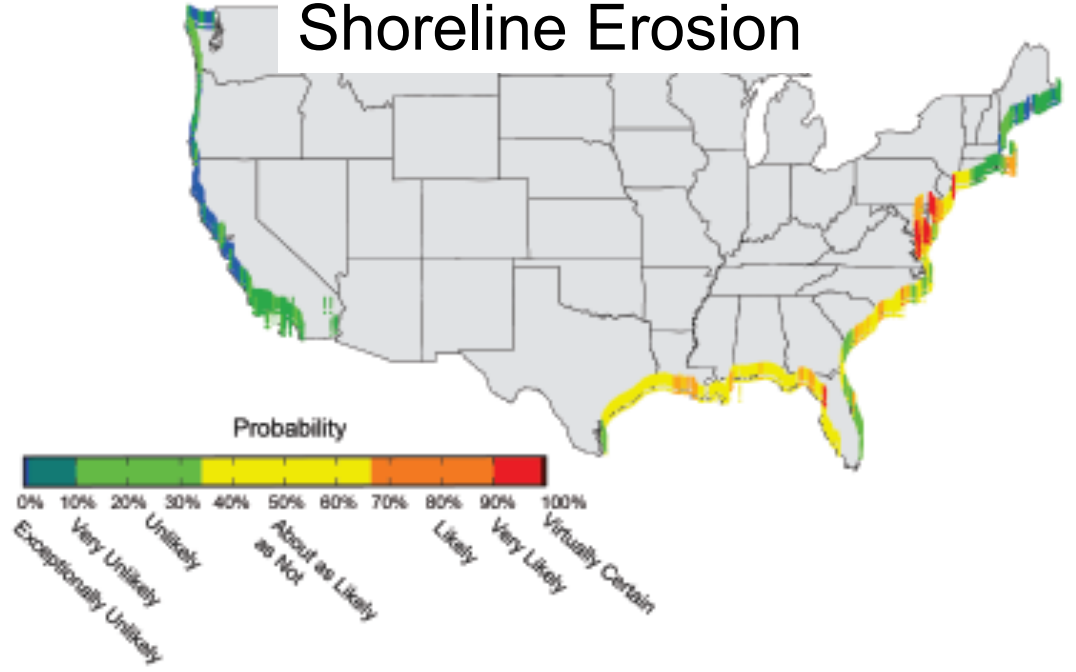


Socioeconomic disparities create uneven exposures and sensitivities to coastal risks

Social Vulnerability Index



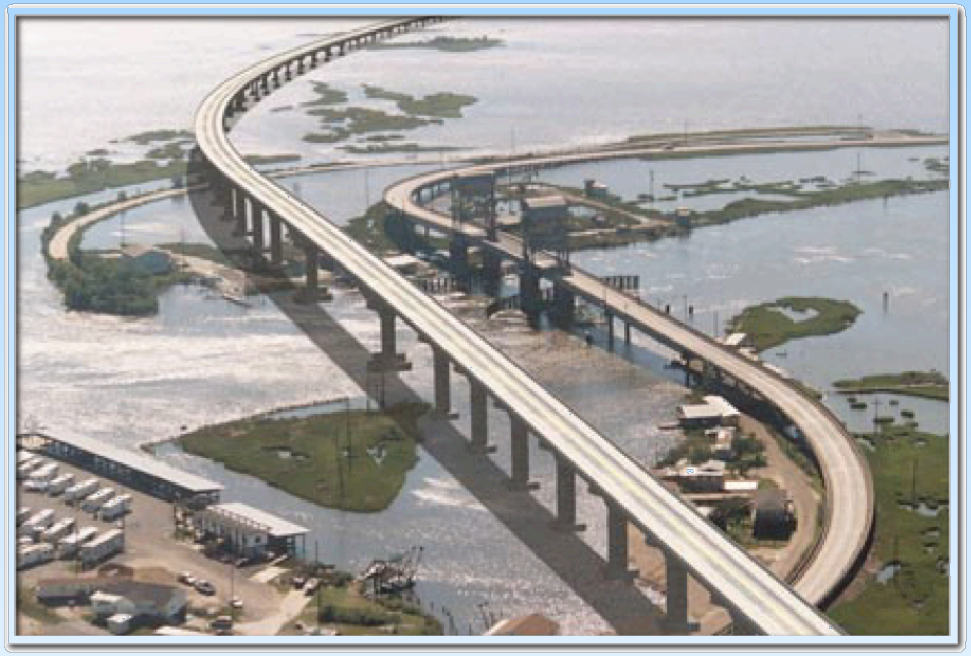
Shoreline Erosion



Adaptation & Mitigation

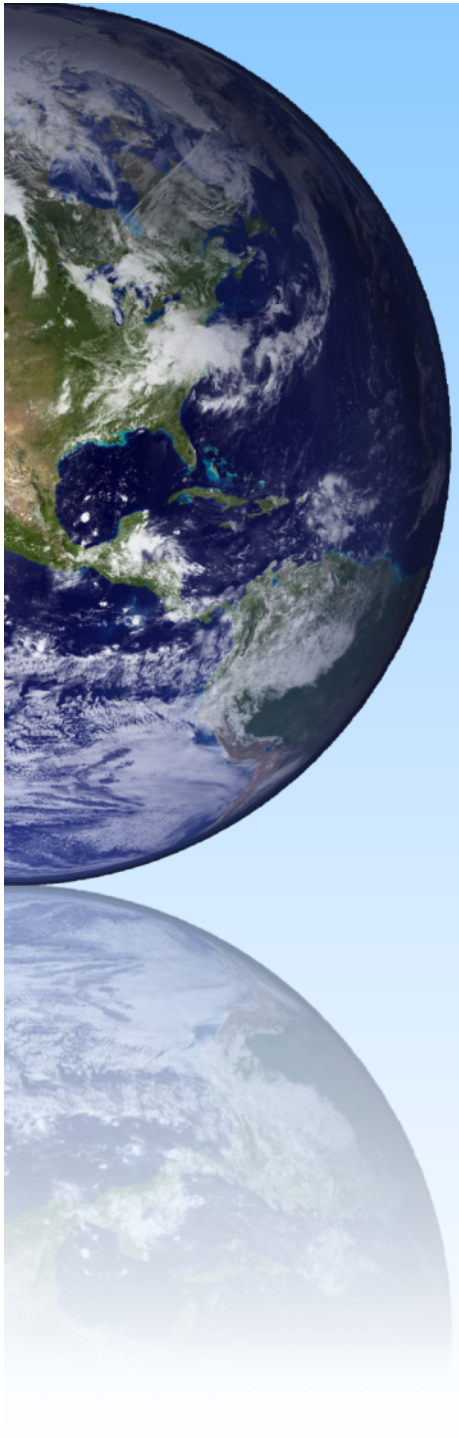
Ecosystem Restoration

Adaptation Possibilities for Coastal Infrastructure



National Climate Assessment

U.S. Global Change Research Program



NCA Key Findings

-Changing global climate due primarily to burning of fossil fuels

-Extreme weather & climate events

-Climate change continue & accelerate

-Impacts on human sectors already evident

-Human health & well-being threatened

-Infrastructure adversely affected

-Reduced water supply reliability

-Adverse impacts to crops and livestock

-Altered biodiversity & locations of species

-Changing life in warmer & more acidic ocean

-Adaptation & mitigation planning, but limited progress with implementation

Draft Review

- Draft of NCA released for review Jan. 14th, 2013
- Comments can be submitted by the public, agencies and individual agency employees through April 12th, 2013 at:

  http://ncadac.globalchange.gov

- All comments will be responded to; both comments and responses will be publicly available
- Only comments submitted via the official online comment forms will be accepted