

# Adaptation 101: Katharine Jacobs

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UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM



# What is Adaptation...

## And why does it matter?



1979

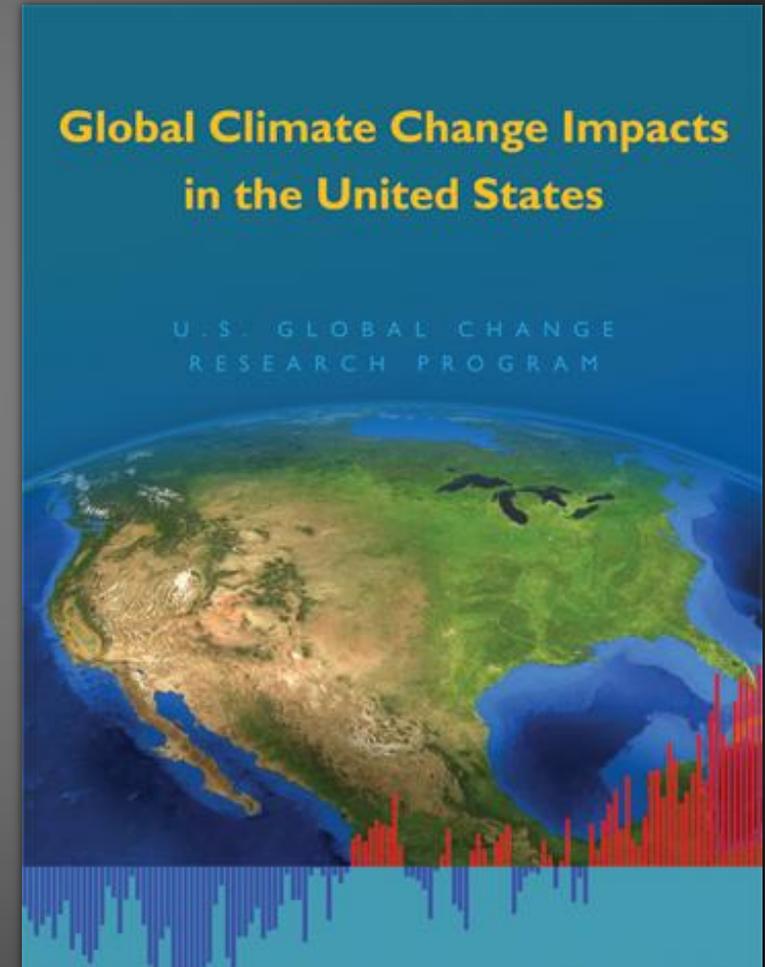


2007



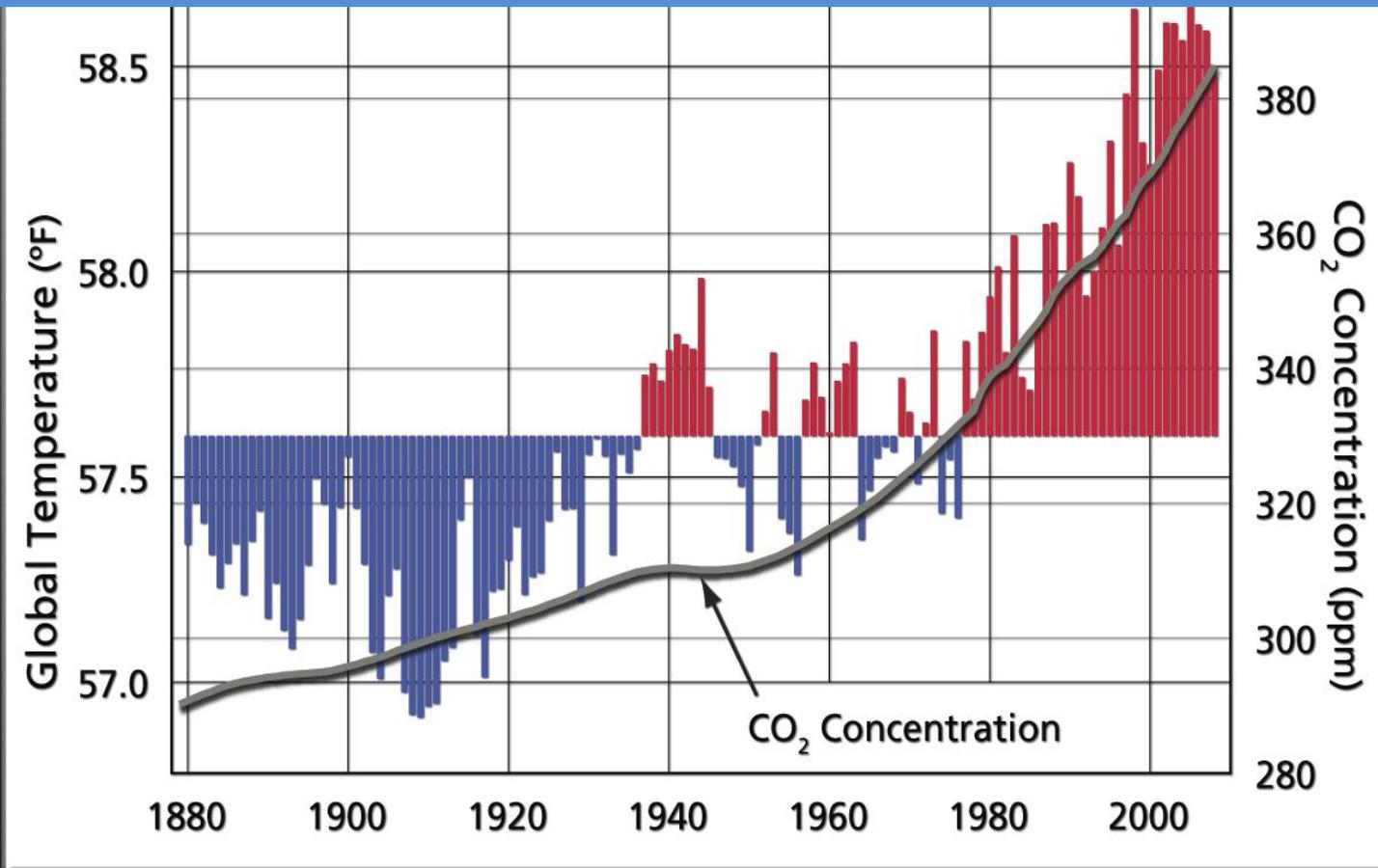
# Climate changes are underway in the U.S. and are projected to grow

- ✓ Increasing temperature
- ✓ Increasingly intense downpours
- ✓ Rising sea level
- ✓ Rapidly retreating glaciers
- ✓ Thawing permafrost
- ✓ Longer growing season
- ✓ Longer ice-free season in the ocean and on lakes and rivers
- ✓ Earlier snowmelt
- ✓ Changes in river flows



# Global Temperature and Carbon Dioxide

Carbon Dioxide levels are higher than they have been in 800,000 years; global average temperatures have been rising in tandem with increased concentrations of greenhouse gases

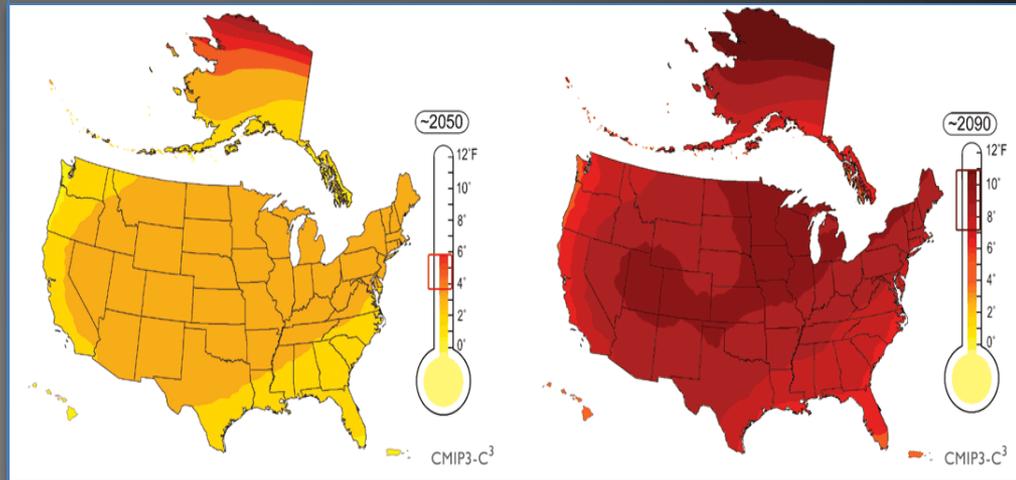


Temperatures have already risen in the US an average of 1.5 degrees F in the last 50 years and could rise 2 to 11 degrees in the next century....

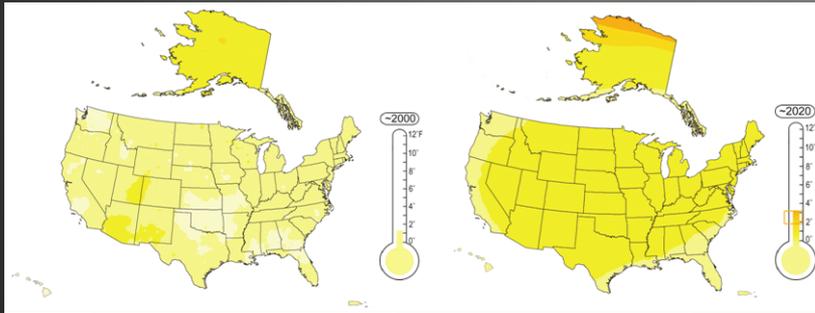
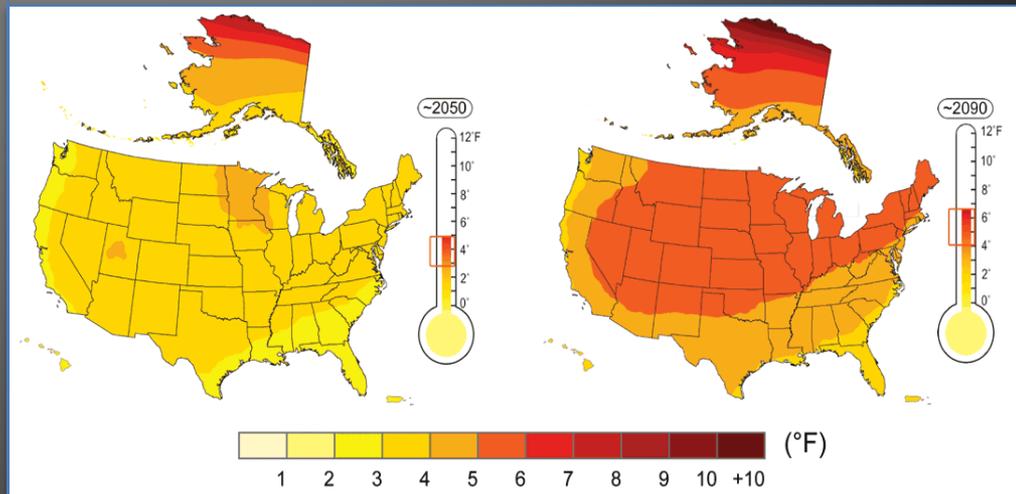
Projected Temperature Change (°F)  
from 1961-1979 Baseline

Mid-Century (2041-2059 average)    End of Century (2081-2099 av.)

*Higher Emissions Scenario*



*Lower Emissions Scenario*



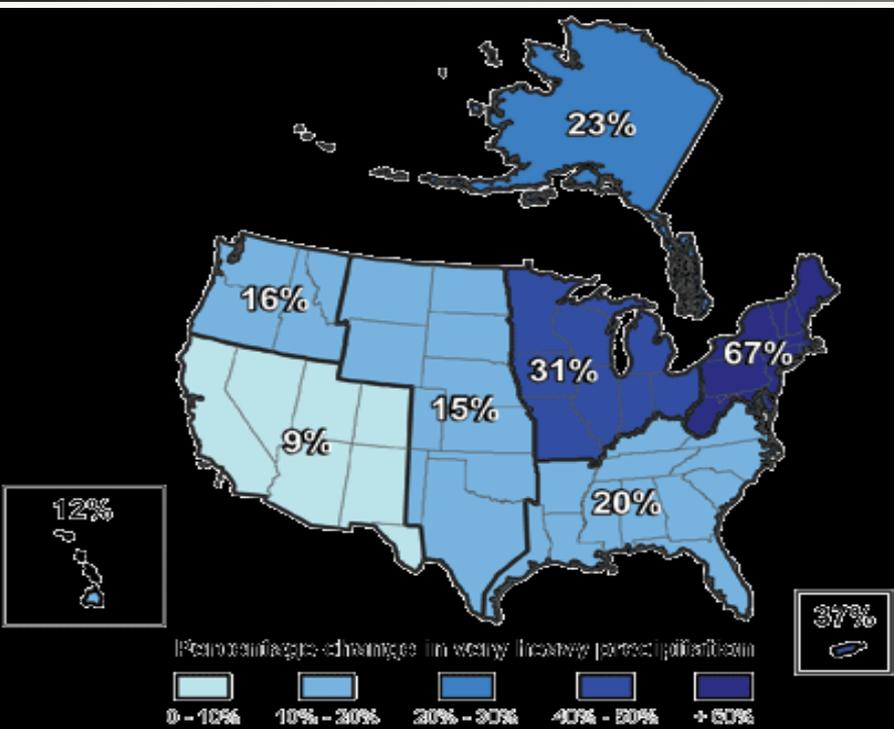
Recent Change  
(1993-2007)

Near-Term Projected  
Change  
(2011-2029)

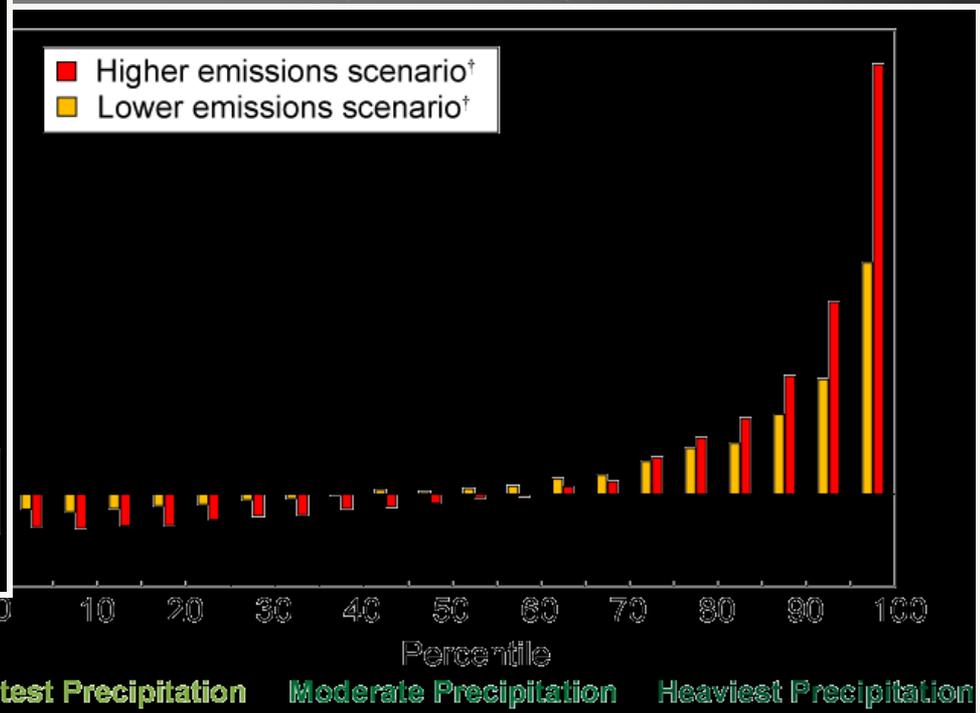


# Precipitation patterns are changing...

Observed Increases in  
Very Heavy Precipitation  
(1958 to 2007)



Projected Change in Precipitation Intensity  
(2080-2099)

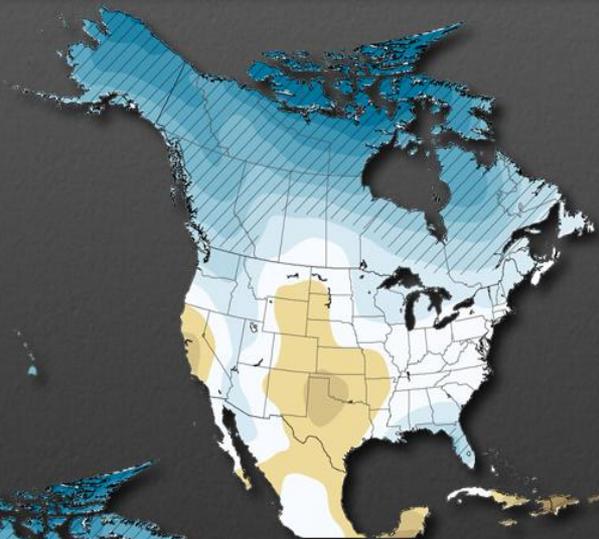


# Projected Change in North American Precipitation

Percent Change

Fall

2080 - 2099



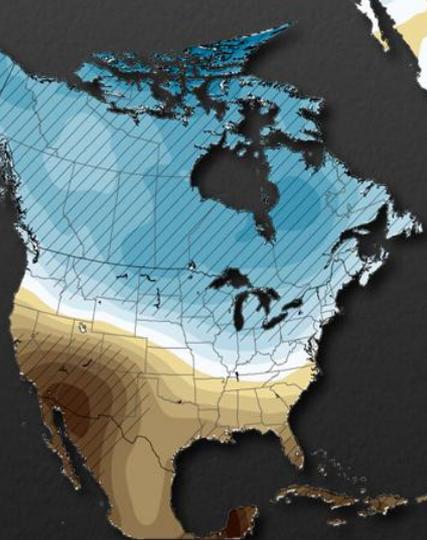
Winter

2080 - 2099



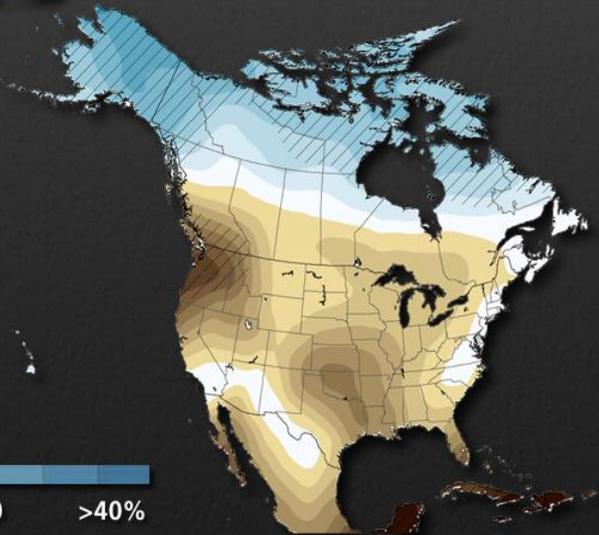
Spring

2080 - 2099

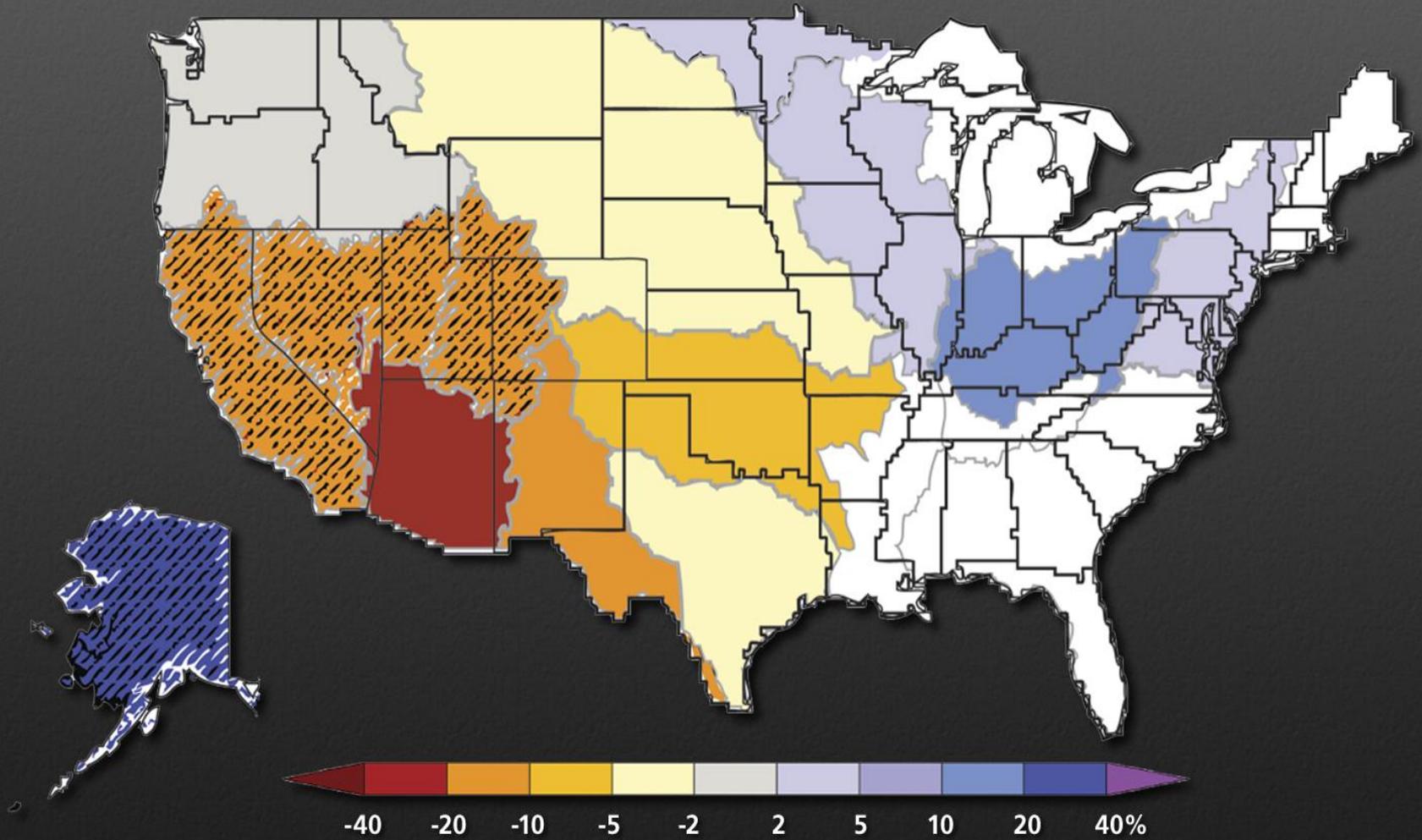


Summer

2080 - 2099

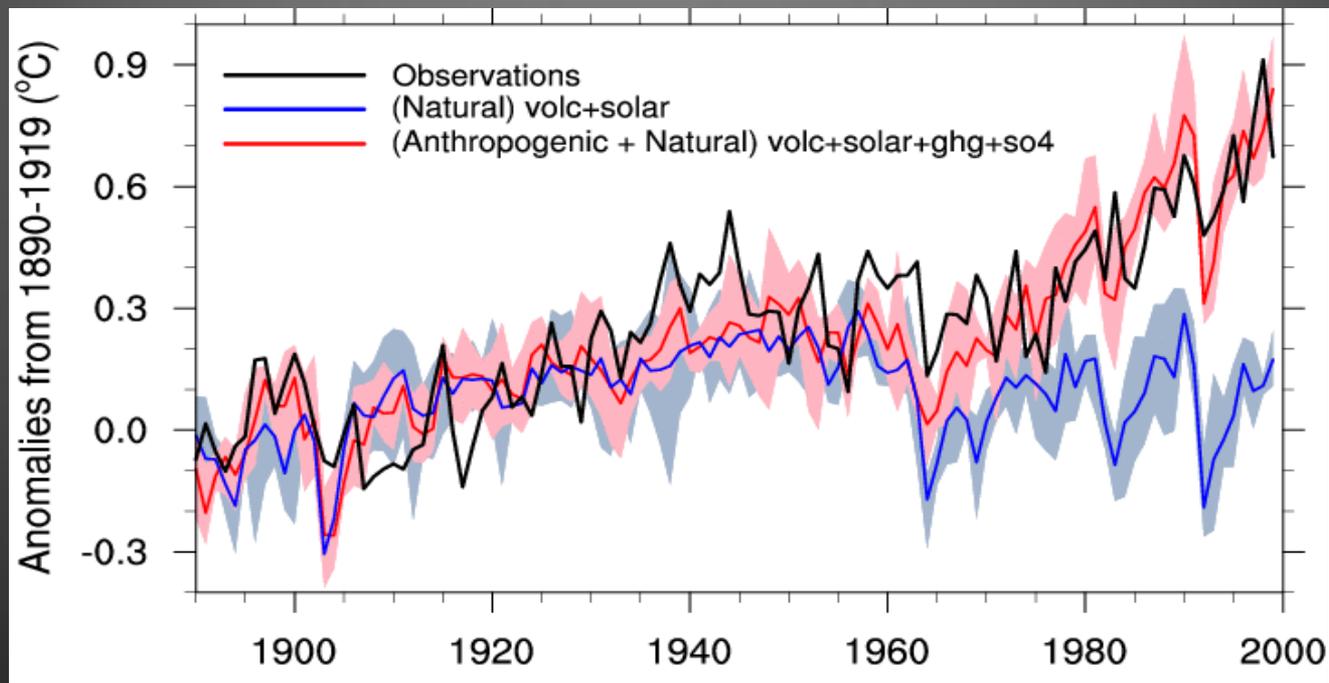


# Projected Changes in Annual Runoff 2041 to 2060



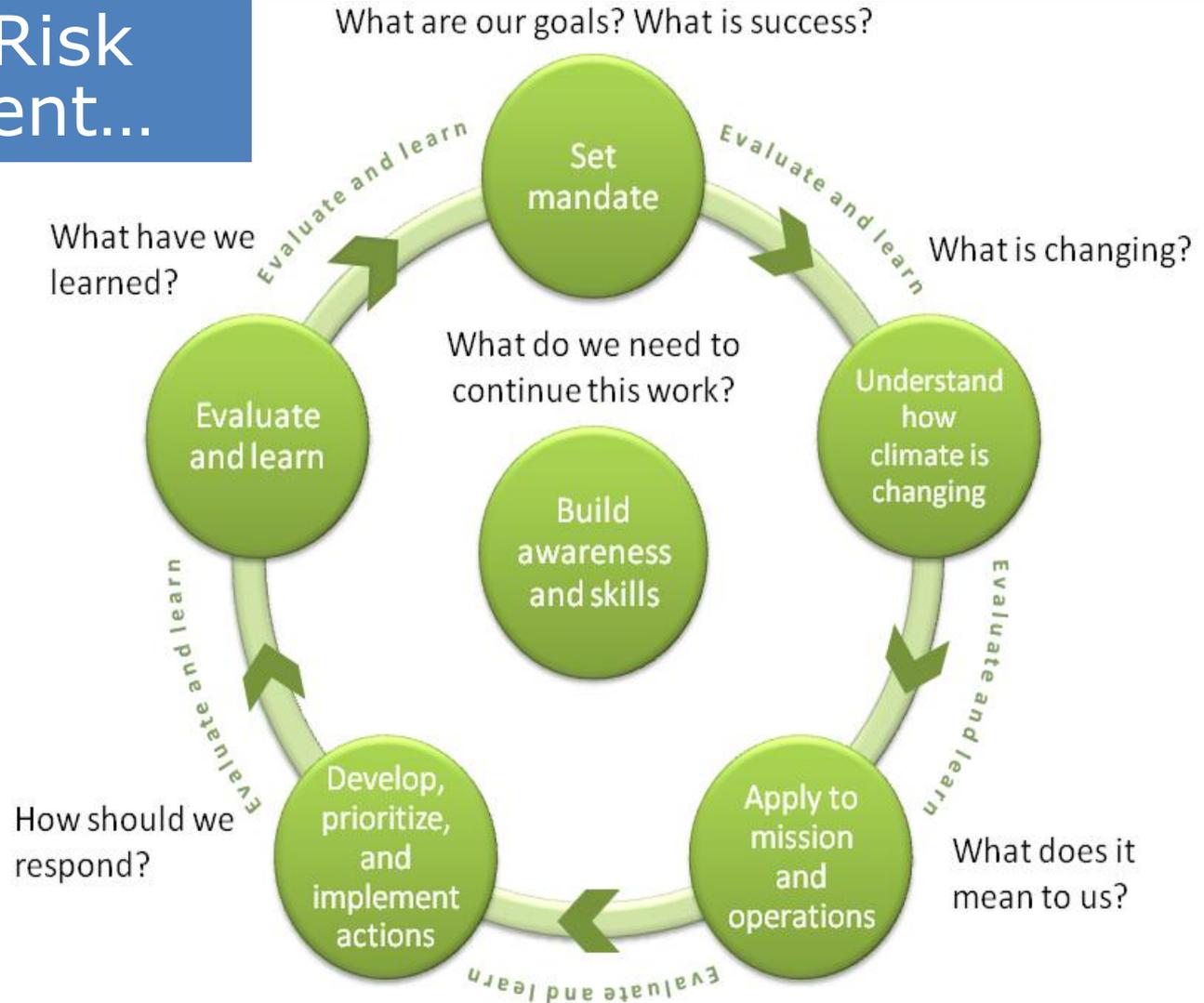
# One definition:

- Adaptation: Adjustment in human or natural systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects (ACC Adapting)



# A common sense approach:

Adaptation is  
Iterative Risk  
Management...



# Examples of Adaptation:

## Improving Urban Air Quality

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



# Adaptation: reframing the things we do every day

- Managers make decisions with imperfect information all the time – why is climate change different?
- Adaptive management – deliberate learning by doing
- Co-benefits – justify action by addressing other priorities
- Small institutional and legal changes can make a big difference, eg eliminating conflicting mandates
- Potential for partnerships and economic opportunity
- An excuse to do the things that make sense anyway, integrated planning, changes to the National Flood Insurance program, etc.

# Reframing: Expand the solution set to include new technologies and practices

Expand portfolio of technology solutions:

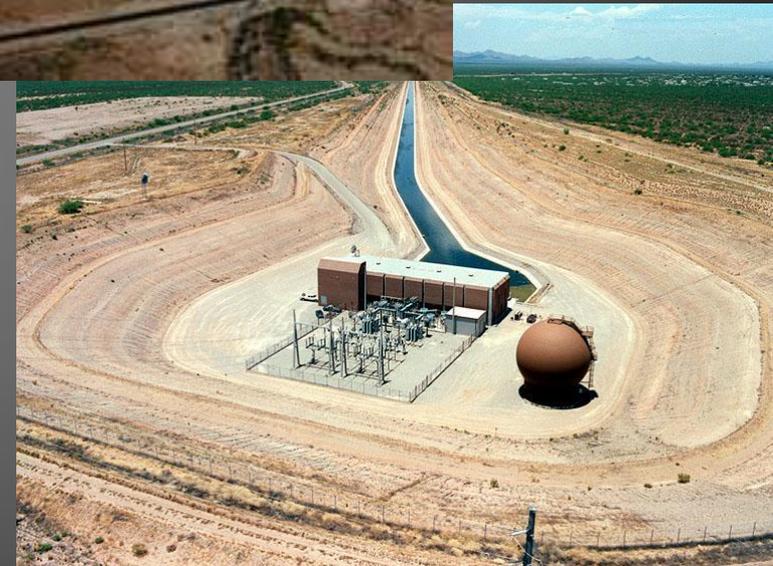
- desalination,
- reuse and recharge of municipal wastewater,
- rainwater harvesting,
- improved management of floodflows,
- integration/redundancy of delivery systems for reliability



# Reframing: Mainstreaming adaptation into every day decisions

- US Infrastructure is aging and needs replacement. Re-evaluate engineering assumptions re: potential for more extreme events and longer-term droughts

Non-stationarity: the past is no longer an analogue for the future



# Adaptation

- The magnitude and rate of future change depends on whether we act to limit emissions, and how the earth system reacts to the resulting emissions trajectory
- Should we act proactively in anticipation of change and mobilize to reduce the effects, or simply prepare to react as the impacts arrive?

REPORT  
IN BRIEF

**America's CLIMATE CHOICES**

## Adapting to the Impacts of Climate Change

Much of the nation's experience to date in managing and protecting its people, resources, and infrastructure is based on the historic record of climate variability during a period of relatively stable climate. Adaptation to climate change calls for a new paradigm—one that considers a range of possible future climate conditions and associated impacts, some well outside the realm of past experience. Adaptation is a process that requires actions from many decision-makers in federal, state, tribal, and local governments, the private sector, non-governmental organizations, and community groups. However, current efforts are hampered by a lack of solid information about the benefits, costs, and effectiveness of various adaptation options, by uncertainty about future climate impacts at a scale necessary for decision-making, and by a lack of coordination. Therefore, a national adaptation strategy is needed to support and coordinate decentralized efforts. As part of this strategy, the federal government should provide technical and scientific resources that are currently lacking at the local or regional scale, incentives for local and state authorities to begin adaptation planning, guidance across jurisdictions, shared lessons learned, and support of scientific research to expand knowledge of impacts and adaptation.

**A**cross the United States, impacts of climate change are already in evidence. Some extreme weather events such as heat waves have become more frequent and intense, cold extremes have become less frequent, and patterns of rainfall are likely changing. For example, the proportion of precipitation that falls as rain rather than snow has increased across the western United States. Arctic sea ice has been reduced significantly over the past 30 years.

Even if emissions of greenhouse gases were substantially reduced now, climate would continue to change for some time to come and the potential consequences for humans and ecosystems are significant. It has been estimated, for instance, that a heat wave of the same magnitude as the 2003 European heat wave could cause more than five times the average number of expected heat-related deaths in a large American city; projected deaths in New York City alone, for one such event, could exceed the current national summer average. In ecosystems, changing climate could alter the distribution patterns of plant and animal species, reduce the productivity and abundance of species, and change habitats. Sea level has been rising, most likely at a faster rate than in



Image from U.S. Army Corps of Engineers

recent history, threatening the natural and built environments on the coasts and in fresh water systems, especially when combined with effects of more intense coastal storms.

This report, part of the *America's Climate Choices* suite of studies requested by Congress, discusses the impacts of climate change and how we as a nation can begin adapting to them in beneficial ways, exploring activities underway at state and local levels, adaptation options, and how the nation can become better prepared to make adaptation choices.

National Academy of Sciences • National Academy of Engineering • Institute of Medicine • National Research Council

# Adaptation

- Adaptation is not a choice – our choice is whether to adapt proactively or respond to the consequences.
- We have always adapted to variability – but now the trends are moving outside of human experience and we need to be prepared.
- Adaptation requires a paradigm shift, focusing on managing risks. We know the trends, but not the magnitude.