Engineering, Adaptation and the National Climate Assessment

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Climate Change and America's Infrastructure
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Main themes

- Challenges of climate change for engineered systems
- Introducing the draft National Climate Assessment (ncadac.globalchange.gov)
- Role of ecosystem services and ecosystem based approaches in engineering
- Reframing the role of engineering in adaptation and resilience
- The importance of sustained assessment

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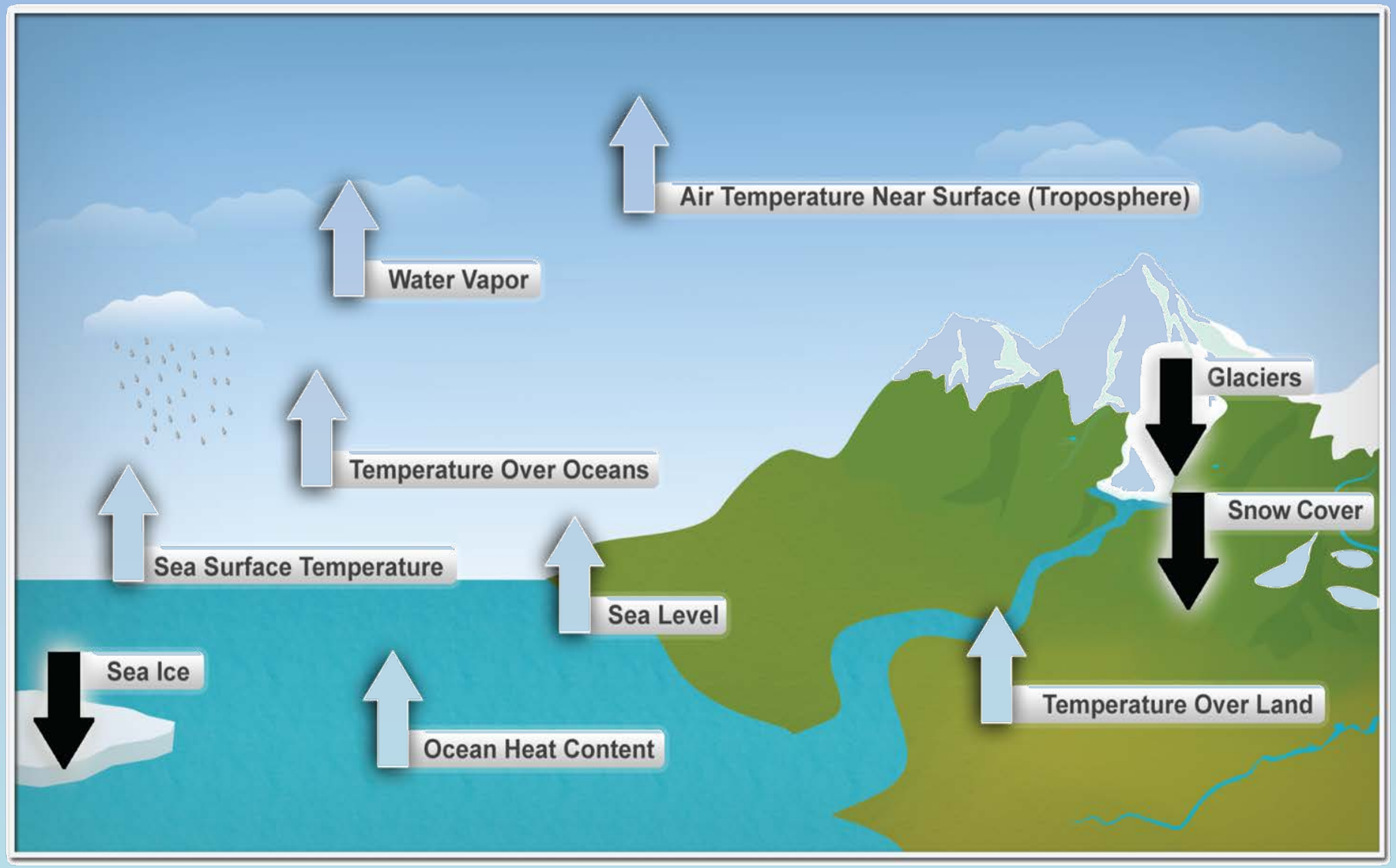
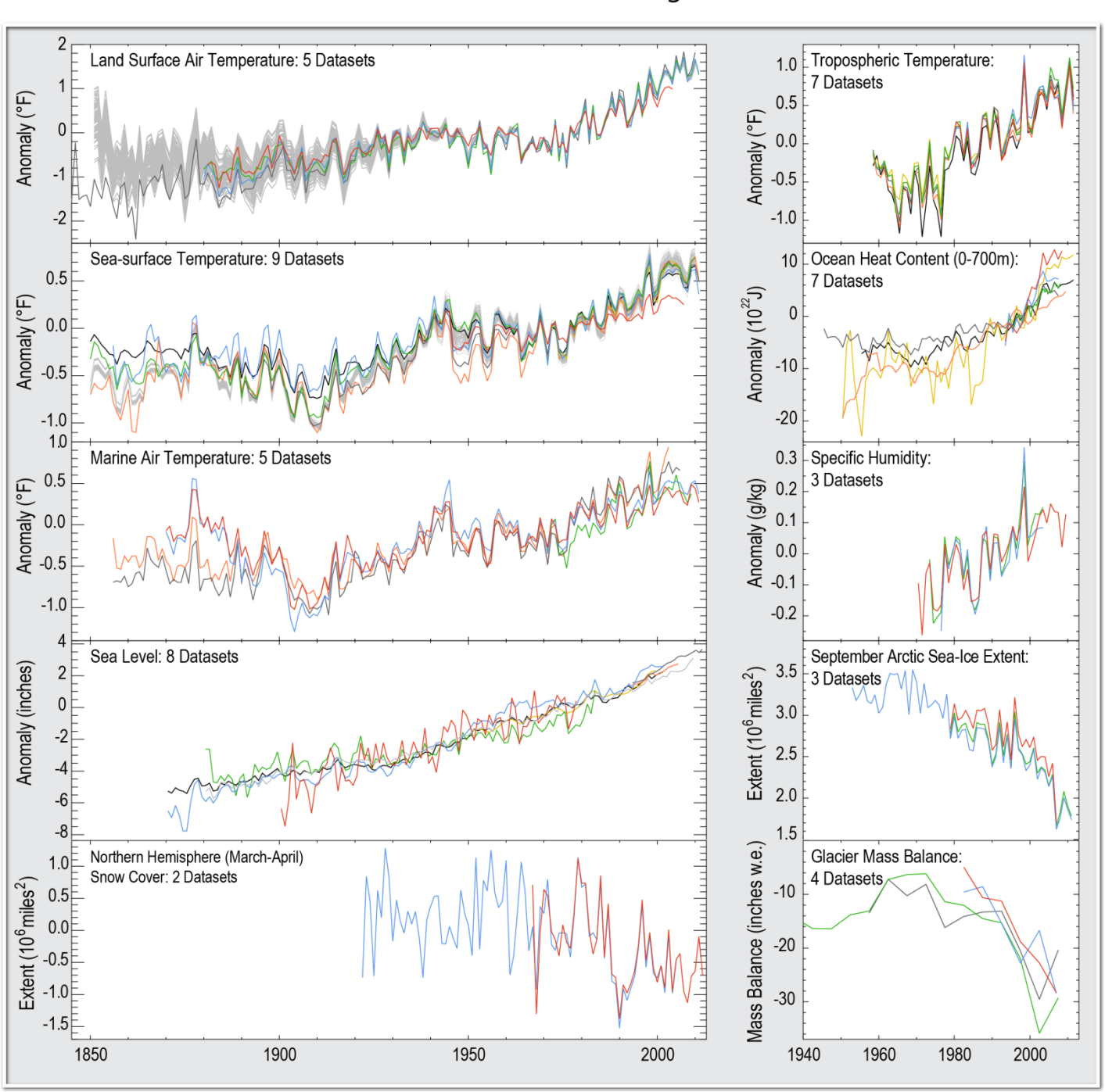
Global Climate is Changing

Ten Indicators of a Warming World



Global Climate is Changing



NCA Climate Science News

- Rapid change at high latitudes (sea ice decrease, permafrost warming, glacier melt)
- Accelerating sea level rise better documented
- Altered water cycle – groundwater depletion, floods and droughts, seasonal shifts in flood peak
- Heat in the oceans will affect the climate system for years to come
- Oceans absorbing 25% of emitted CO_2, increasing acidity
- Human contributions to global change; attribution of some extreme events (heavy precipitation, heat waves) to human contributions

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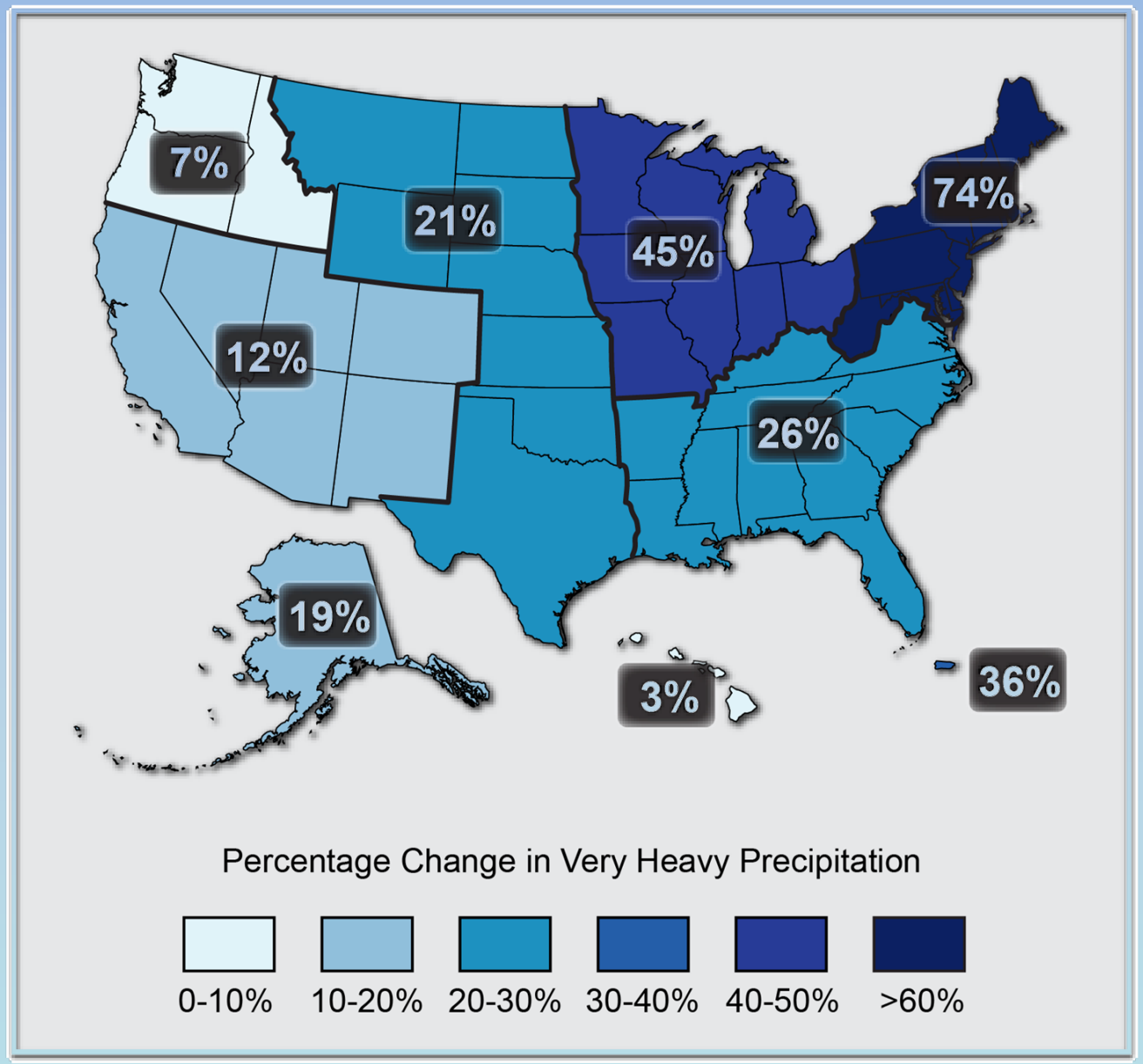
Percentage Change in Heavy Precipitation



Change based on 1901 – 1960 average, top 1% of all daily events

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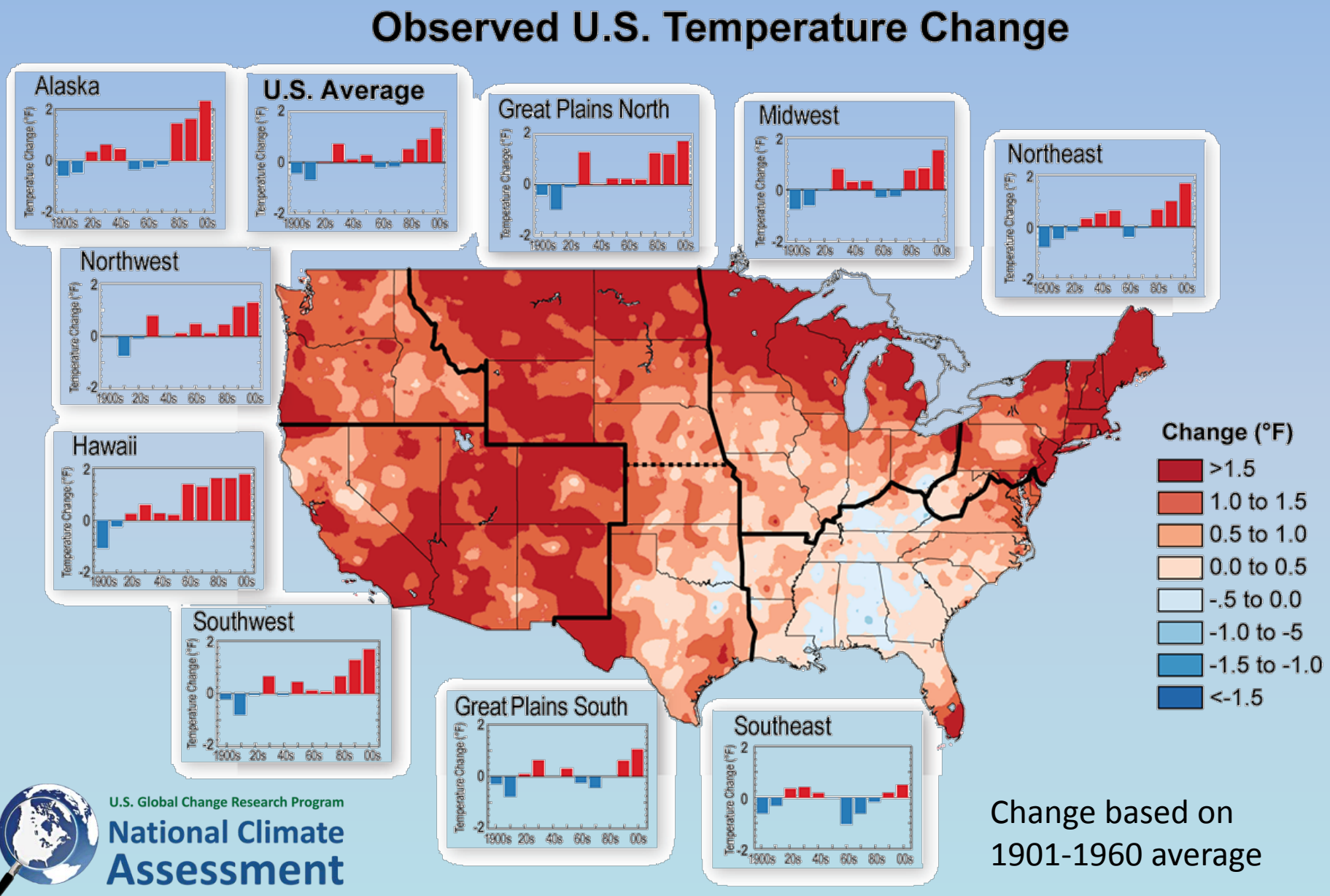
Change is Apparent Across the Nation



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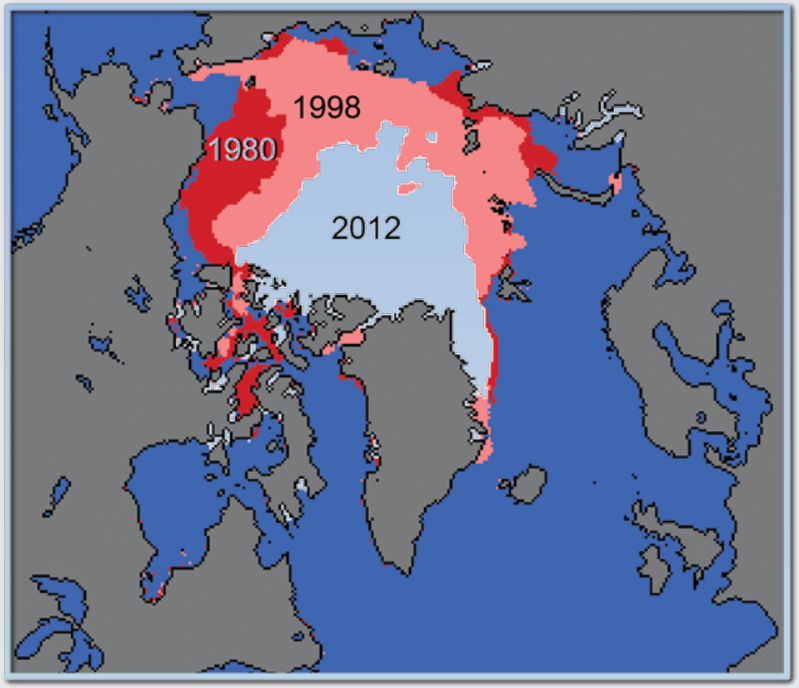
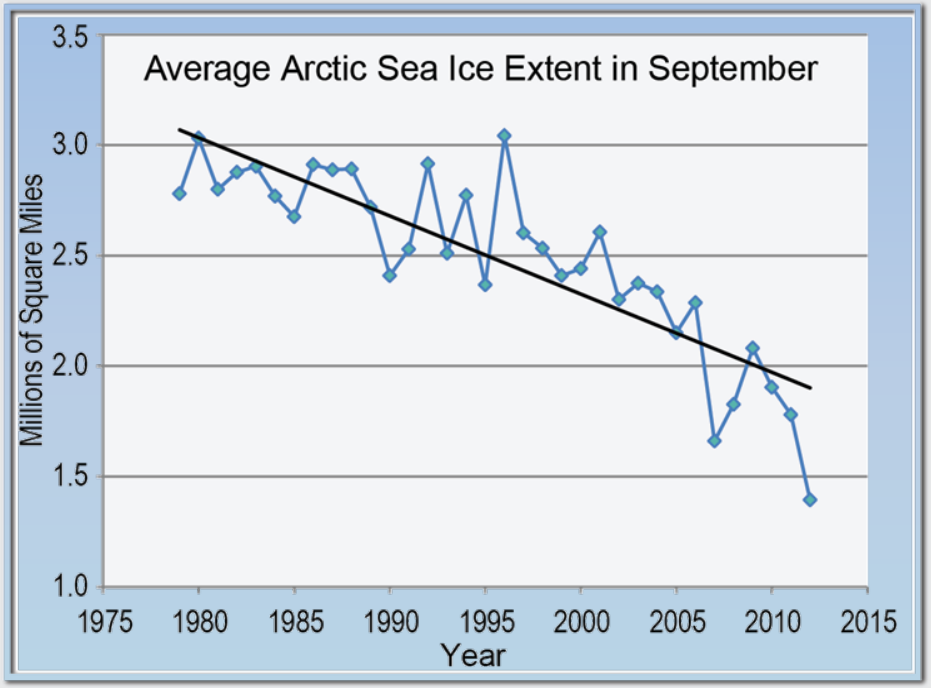
Change based on 1901-1960 average

Change is also Apparent Across the Arctic

Arctic Sea Ice Decline





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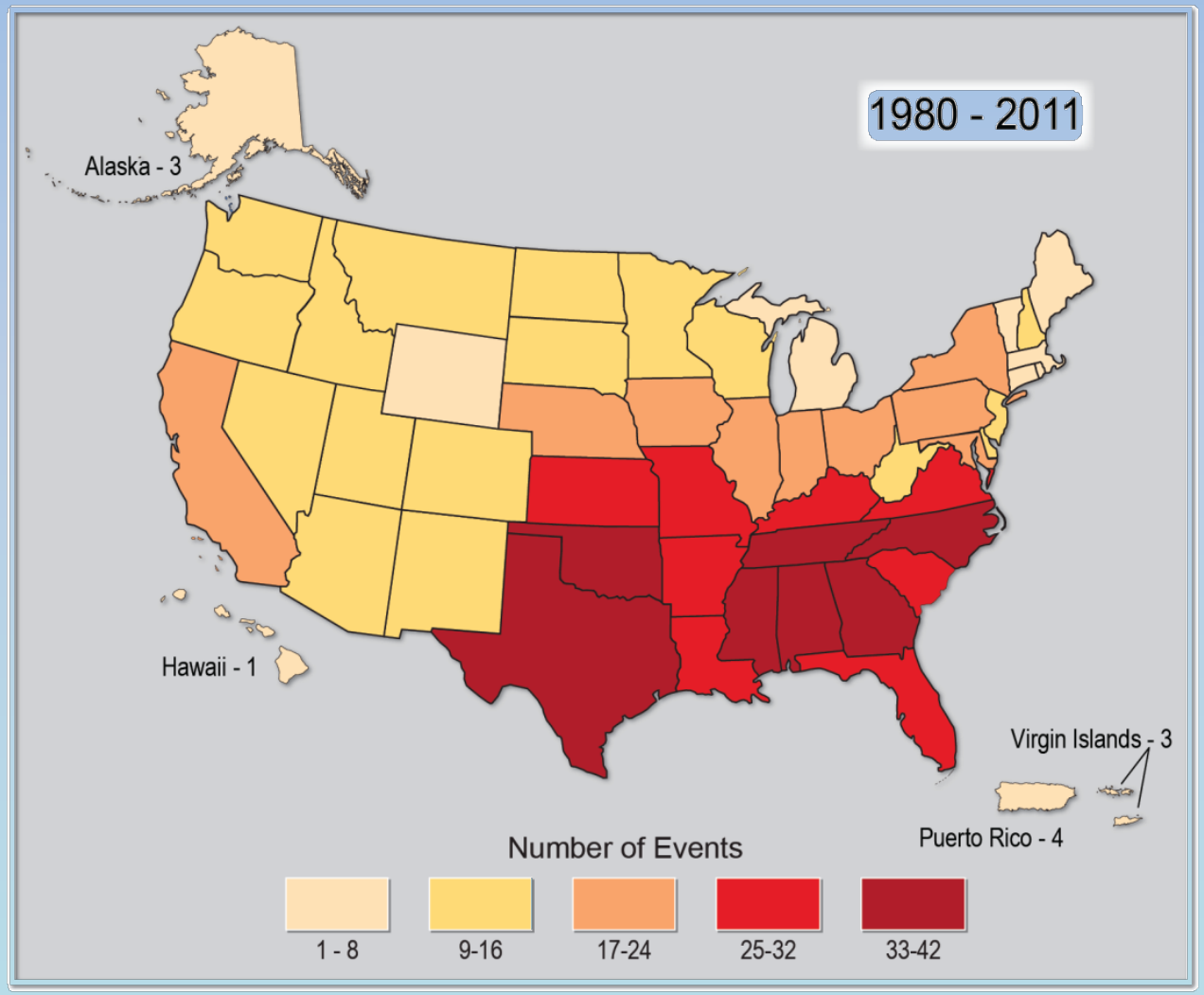
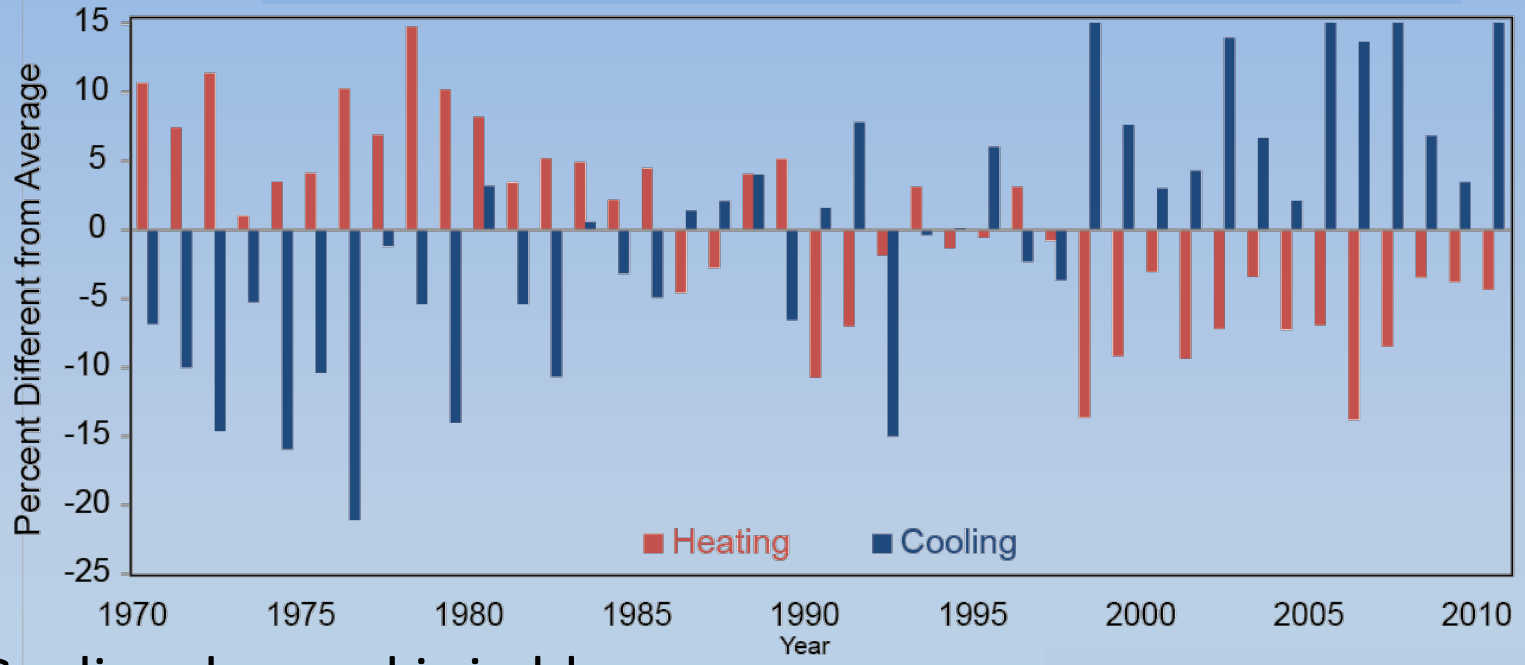
Sea ice extent in 2012 was 40% below recent median

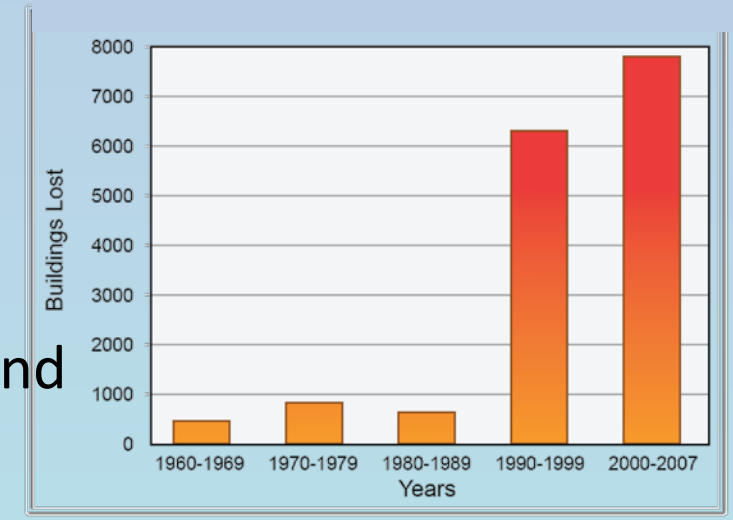
Billion Dollar Weather/Climate Disasters in last 30 years



Infrastructure Affected



Cooling demand is in blue - Warming demand in red – change since 1970



Building loss from fires in CA in wildland –urban interface

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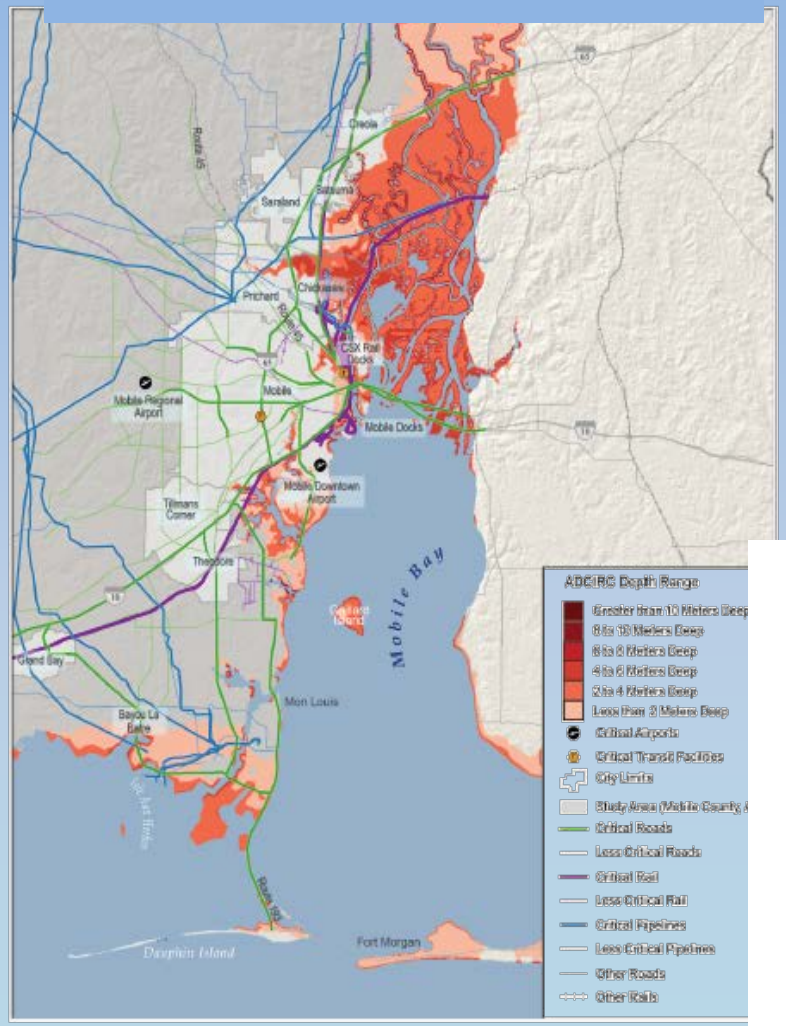
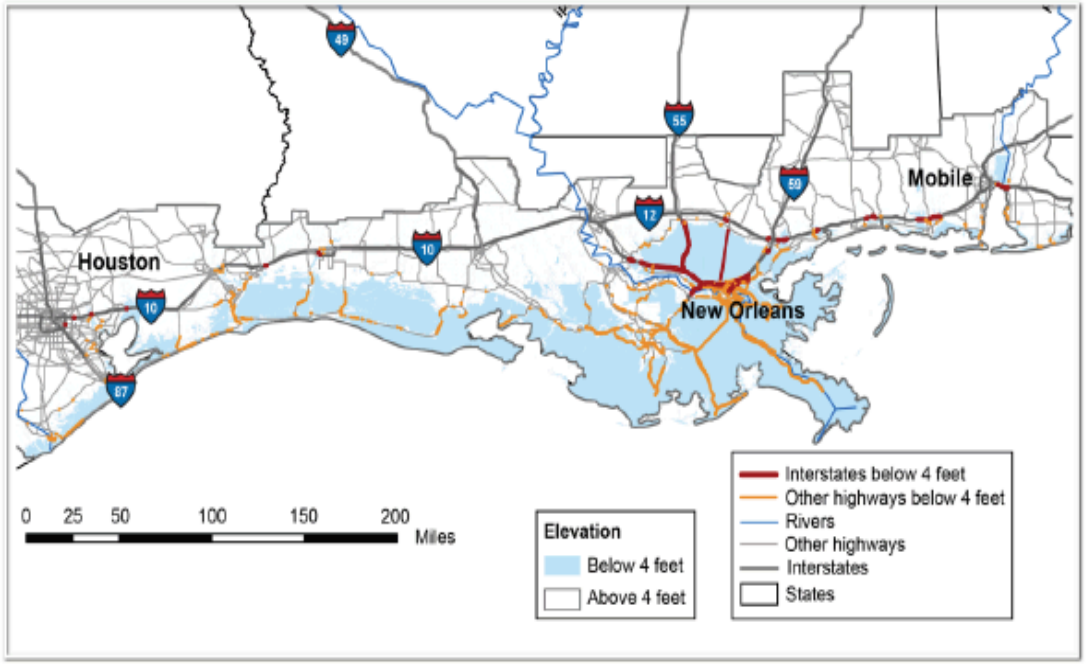
Infrastructure affected by multiple factors



Mobile, Alabama

Leeville Bridge, Coastal Louisiana

Gulf Coast Transportation Hubs at Risk



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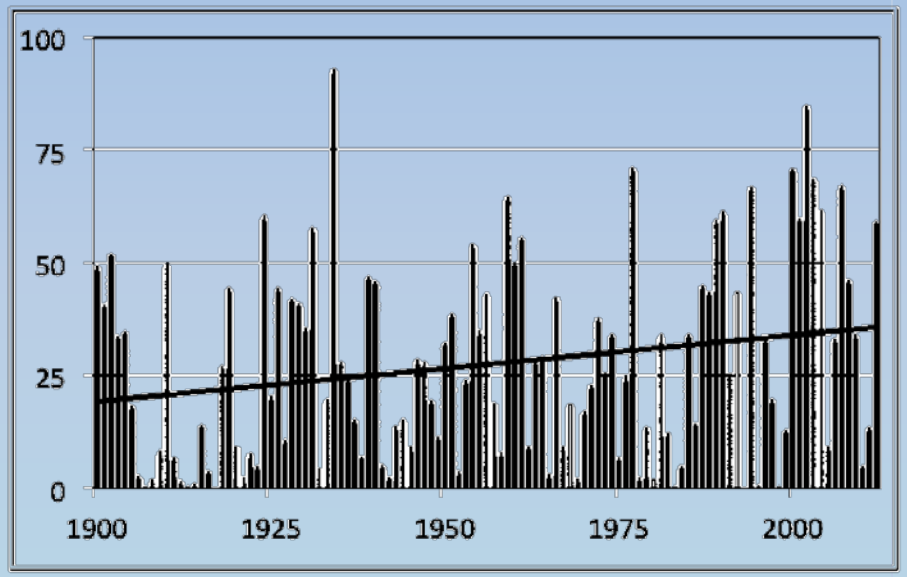
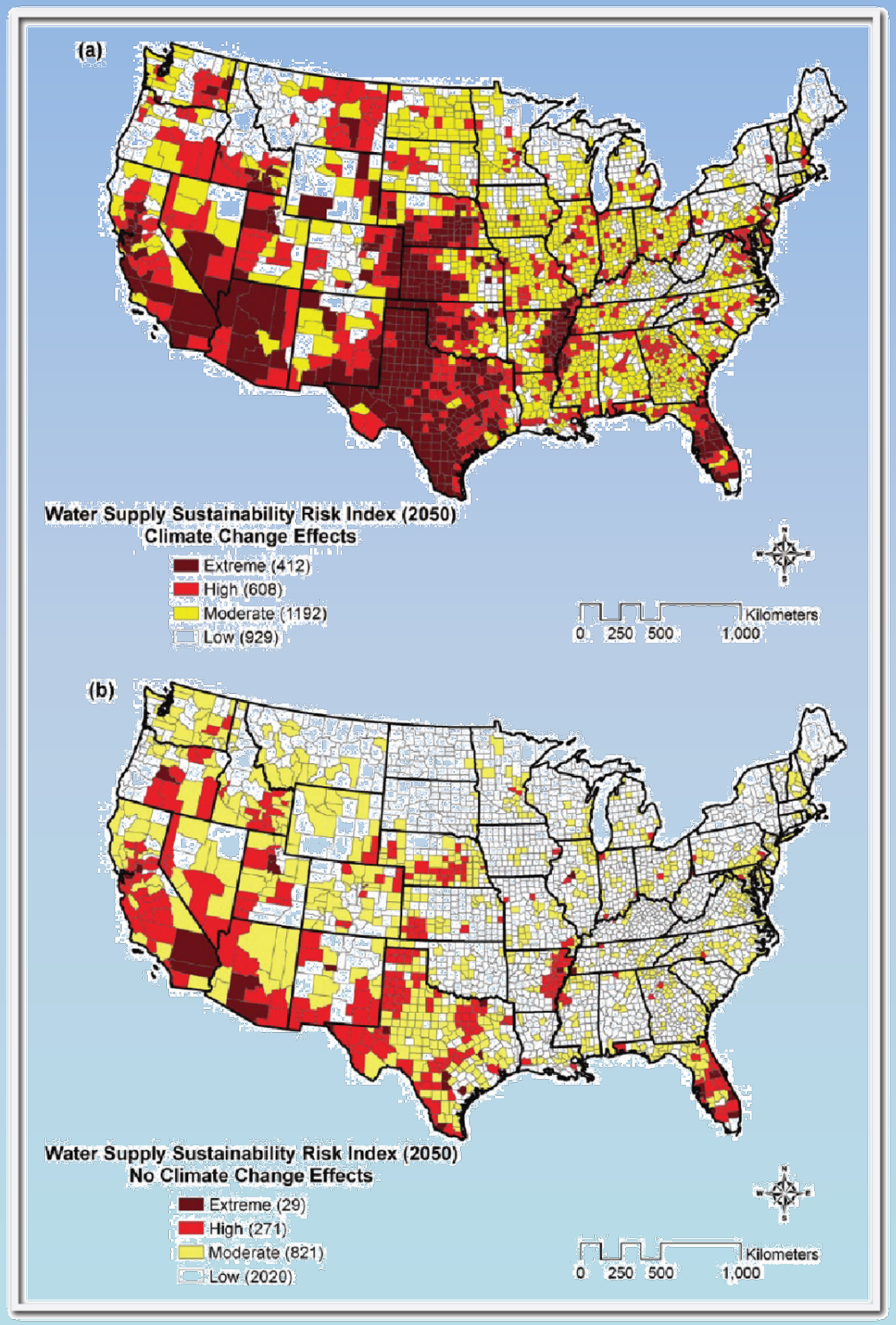
Water Supply Reliability



Percent of West in Summer Drought

Water Supplies Projected to Decline



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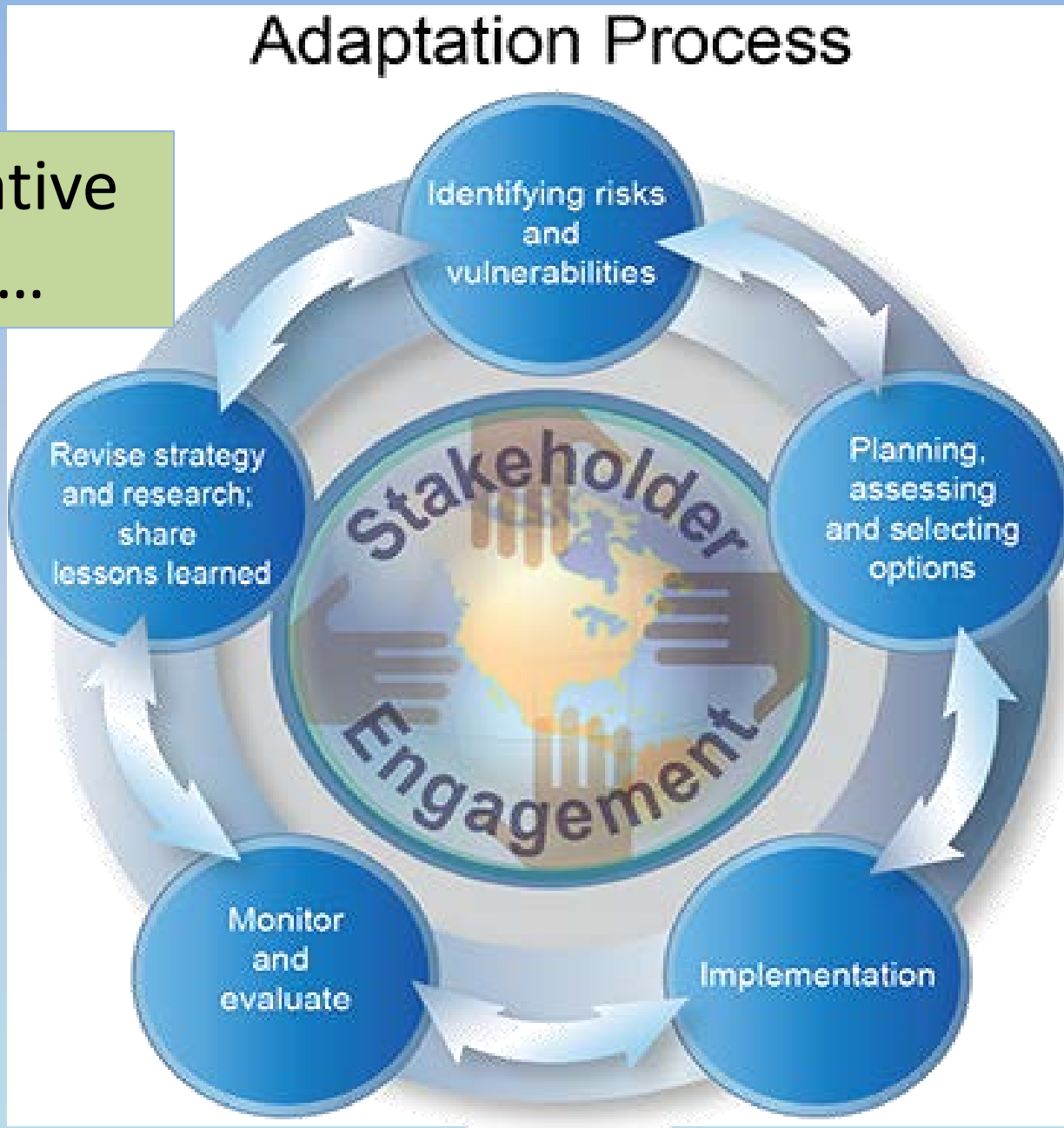
Adaptation is Iterative Risk Management…



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Challenges of Climate Change for Engineered Systems

- Non-stationarity is a new paradigm
- Trends vs abrupt change/extreme events
- Knowing “what to adapt to” especially if outside the envelope of prior experience
- Cascading effects
- Institutional and regulatory issues
- Incorporating “ecosystem-based approaches” into engineered systems

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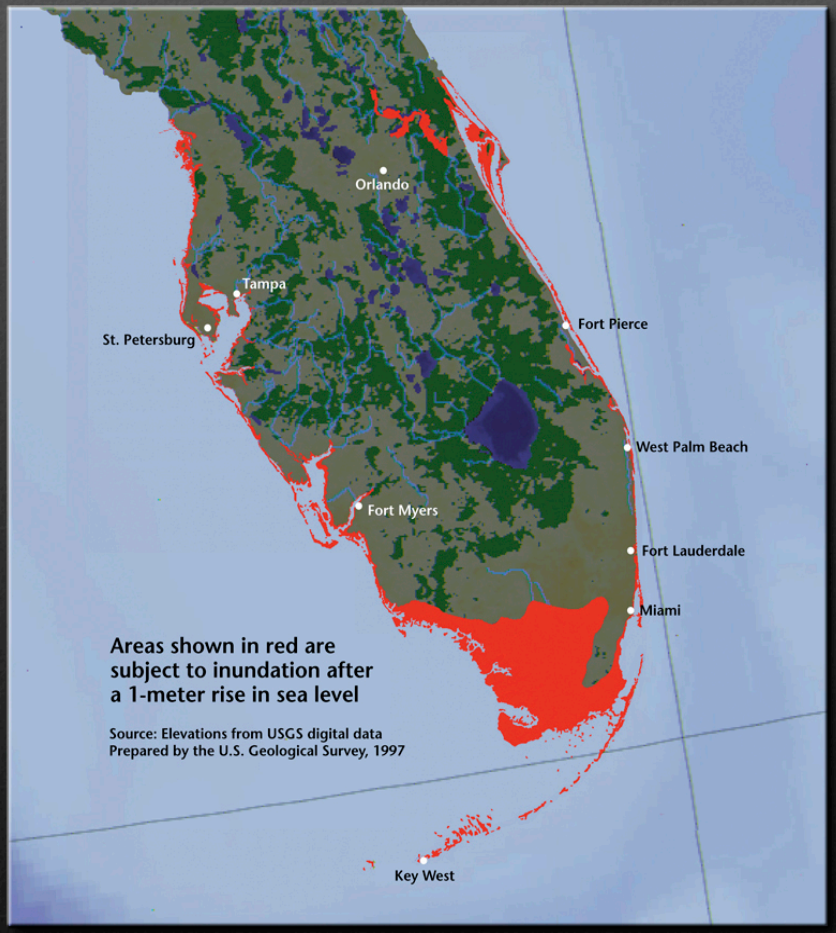
The Limits of Engineering Solutions

Red Areas Show Inundation with 1-meter Sea Level Rise



Adaptation and Mitigation

Effectiveness of Fuel Treatments

Adaptation Possibilities for Coastal Infrastructure

Ecosystem Restoration

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NCA Risk & Decision-Support Framing

- Importance of underlying vulnerabilities
- Assessments of the state of Adaptation, Mitigation and Decision Support
- Inter-sectoral links and cascading effects
  - Water, Energy & Land
  - Biogeochemical Cycles
  - Tribal Resources
  - Land Use & Land Cover
  - Rural Communities
  - Urban Systems, Infrastruc
  - Coastal Zones, Developm
  - Oceans and Marine Reso

Intersecting systems can either increase resilience or result in catastrophic failure - cascading effects through systems

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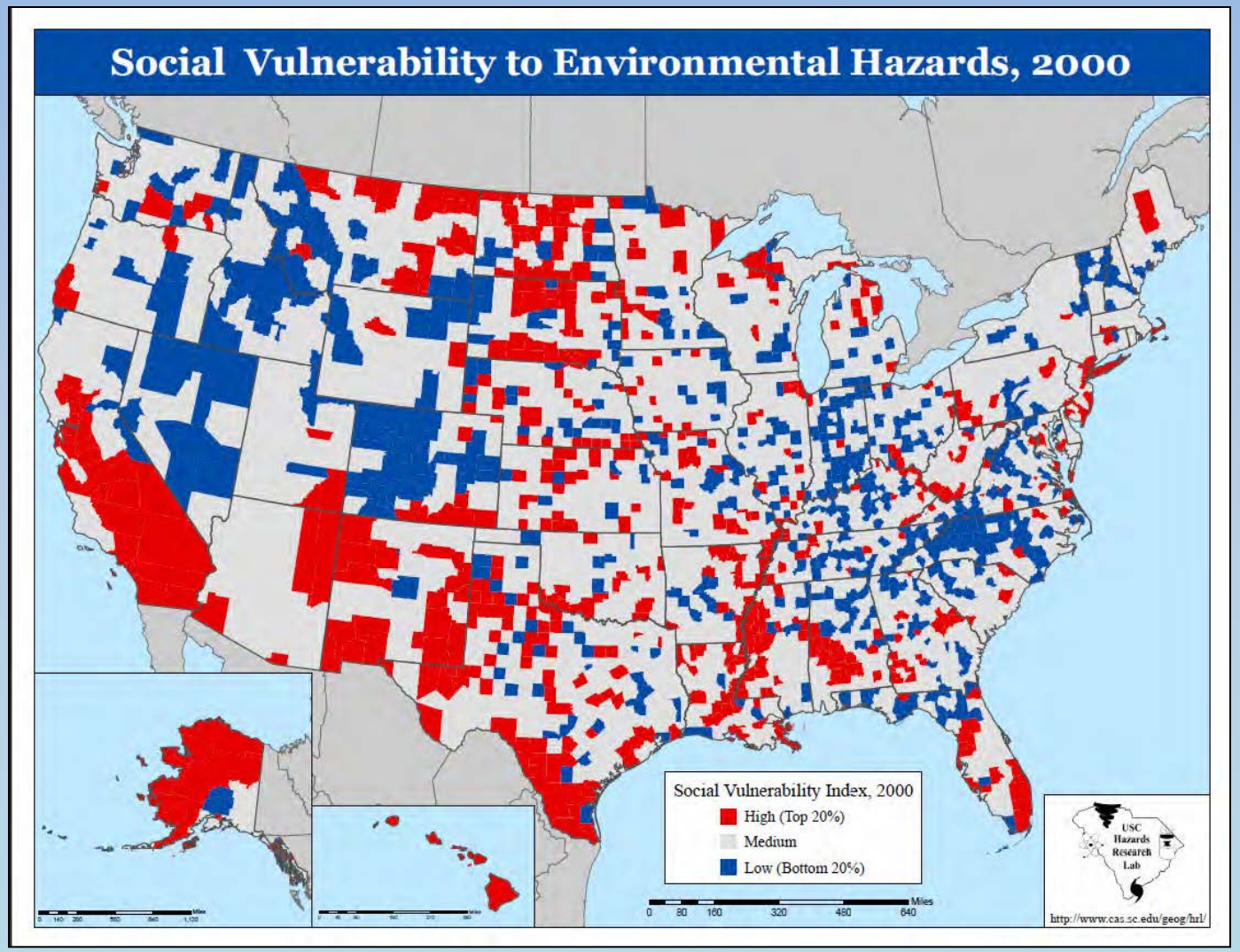
Vulnerability of Human Systems



Developed using 42 indicators of social vulnerability

Role of Ecosystem Services in Engineering

- **Natural ecosystems are being directly affected by climate change, including changes in biodiversity and location of species. As a result, the capacity of ecosystems to moderate the consequences of disturbances such as droughts, floods, and severe storms is being diminished.**

  - Droughts, floods, wildfires, and pest outbreaks associated with climate changes are already disruption ecosystem structures and functions in a variety of direct and indirect ways.

  - These changes affect the capacity of forests, barriers beaches, coastal- and freshwater-wetlands to adapt and continue to play roles in reducing the effects of extreme events on infrastructure, human communities, and other valued resources.

What is the role of engineering in responding to climate impacts in different sectors and regions?

- Water Supply
- Coastal protection
- Floodplain management
- Transportation
- Public Health
- Land Use Planning
- Energy Systems
- Adaptation and Mitigation

Progress in Adaptation in the Federal Government

Climate Change Preparedness and Adaptation Science

- National Climate Assessment / activities of U.S. Global Change Research Program

Interagency Climate Change Adaptation Task Force

- Chaired by CEQ, OSTP and NOAA with participation of 20 agencies.
- Coordinates and guides interagency adaptation work, including national cross-cutting strategies (Freshwater Resources; Fish, Wildlife and Plants: National Ocean Policy Implementation)

EO 13514

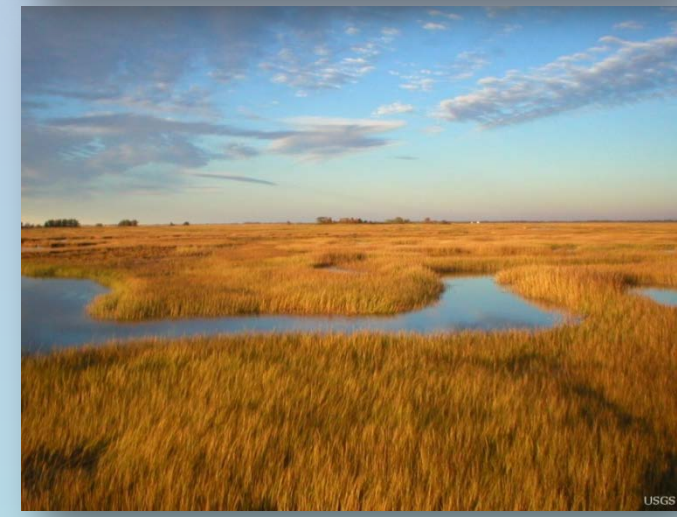
- Required all Federal agencies to evaluate agency climate-change risks and vulnerabilities and manage the effects of climate change on the agency's operations and mission

Agency Adaptation Plans

- Adaptation policies, vulnerabilities and risks, and adaptation actions

Principles to Guide Adaptation

1. Integrate into ongoing planning
2. Prioritize protection of the most vulnerable
3. Use Best-available Science
4. Build Strong Partnerships
5. Use a Risk Management Approach
6. Protect Ecosystem Services
7. Ensure Multiple Benefits
8. Evaluate Performance



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Reframing the Role of Engineering? Some Suggestions

- Make sure you are solving the right problem
- Engage a broad range of stakeholders and decision makers in collaborative, participatory processes to focus on solutions
- Leverage existing systems, institutions, partnerships and networks to build on existing capacity
- Understand regional culture and its influence in decision making. Identify and engage trusted intermediaries who can assist with coordination
- Advance coordination and evaluation processes based on shared learning and joint problem-solving.

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Current Sustained Assessment Activities:

NCAnet: Partners in Assessment

- A network of organizations that extend the NCA process and products
- Building long-term capacity to conduct and use assessments
- Cultivating partnerships with organizations that will participate in the sustained assessment process

More than 60 organizations so far
https://sites.google.com/a/usgcrp.gov/nca-net

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Current Activities of the Sustained Assessment Process

- **Design of GCIS**: Data archiving, management, retrieval, tools
- **Communications and engagement**: NCAnet; NCA Communications and Engagement Workgroup;
- **Regional coordination**: maintenance and building of regional and sectoral networks
- **Indicators**: NCA Indicators Workgroup, multiple funded interagency activities; proposed NCADAC products
- **Scenarios**: NCA scenarios workgroup; SBE Task Force; several proposed NCADAC products

Please comment on the NCA!

Comments due April 12 at 5 pm Eastern

ncadac@globalchange.gov

(or google National Climate Assessment)

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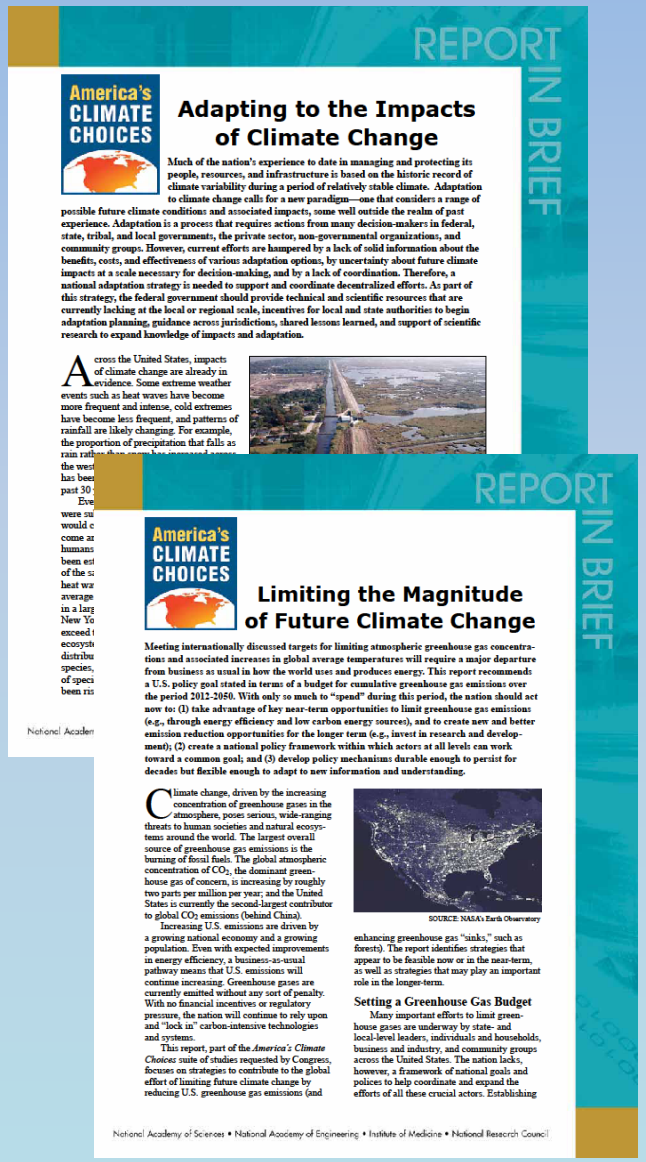
America's Climate Choice: Adaptation and Mitigation

- 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?

We will adapt – but at what cost?



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