

Engineering, Adaptation and the National Climate Assessment

Kathy Jacobs
Office of Science and Technology Policy

Climate Change and America's
Infrastructure
Arizona State University
January 28, 2013







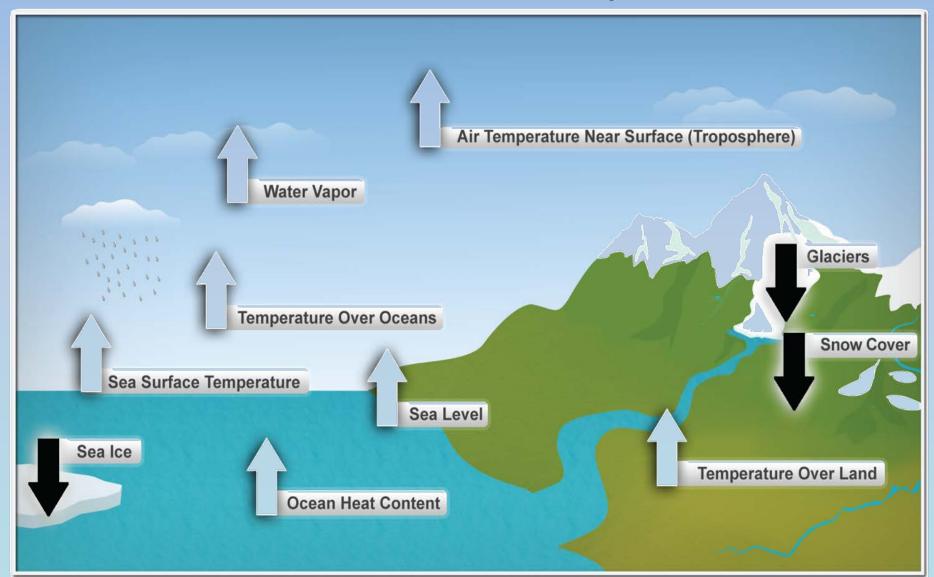
Main themes

- 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



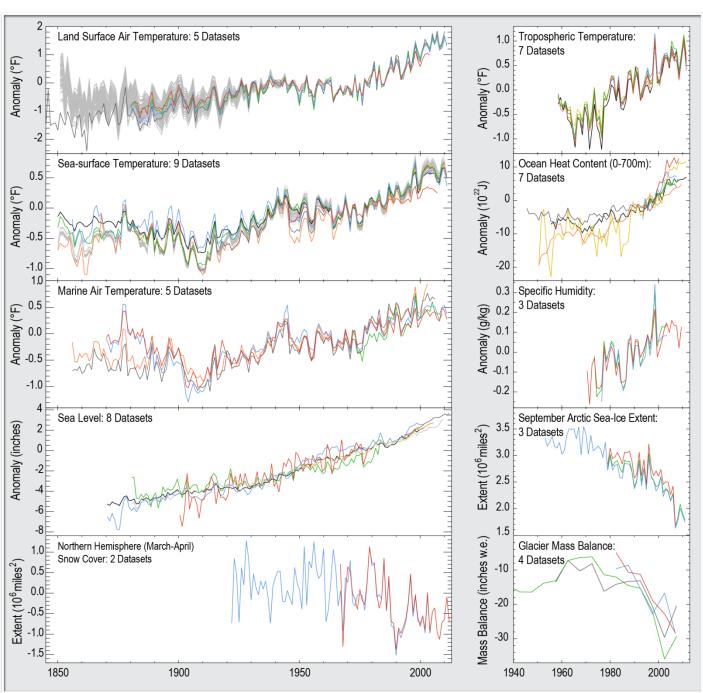
Global Climate is Changing

Ten Indicators of a Warming World



Global Climate is Changing

Ten Indicators of a Warming World

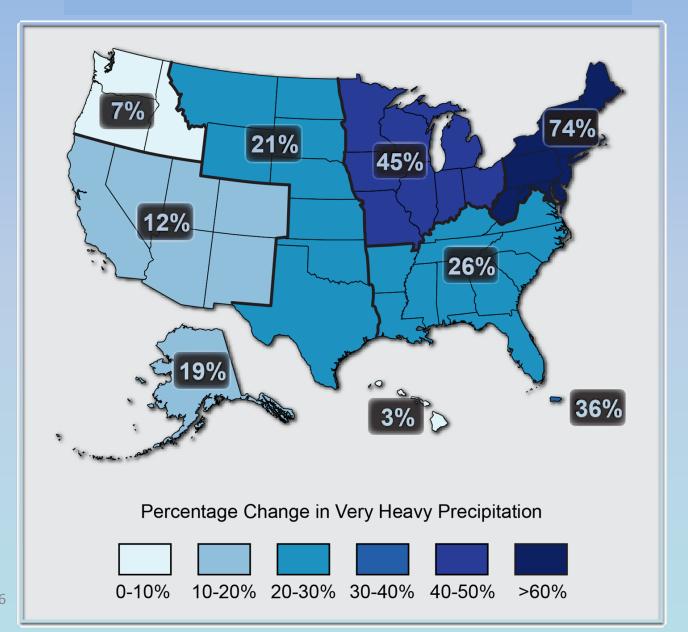


NCA Climate Science News

- 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 CO₂, increasing acidity
- Human contributions to global change; attribution of some extreme events (heavy precipitation, heat waves) to human contributions



Percentage Change in Heavy Precipitation

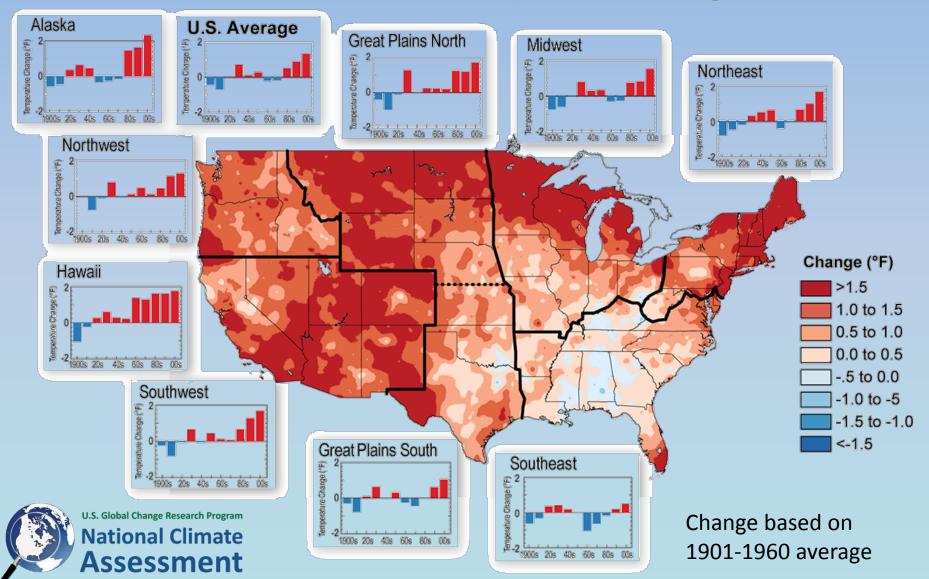


Change based on 1901 – 1960 average, top 1% of all daily events



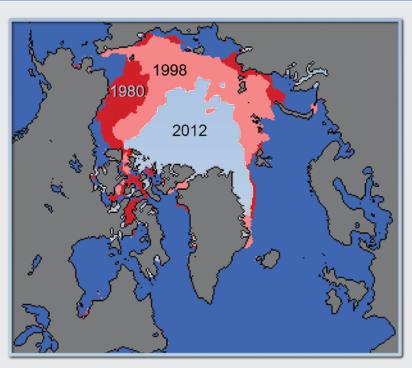
Change is Apparent Across the Nation

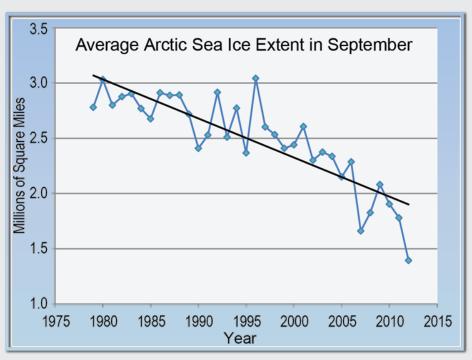
Observed U.S. Temperature Change



Change is also Apparent Across the Arctic

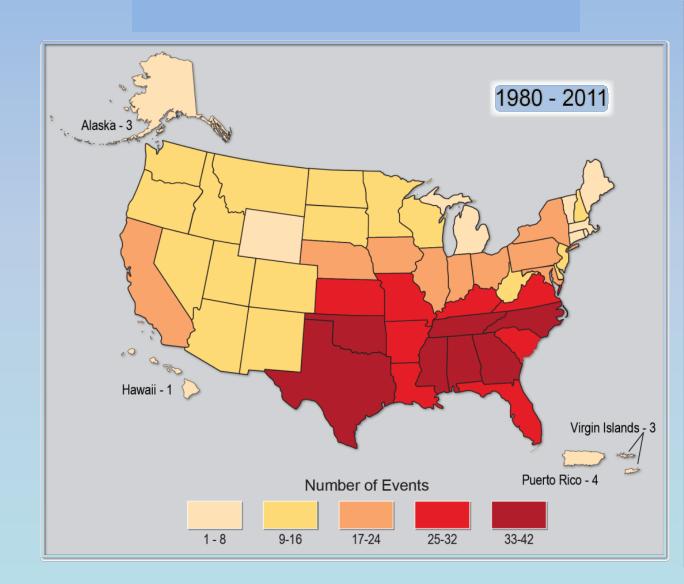
Arctic Sea Ice Decline





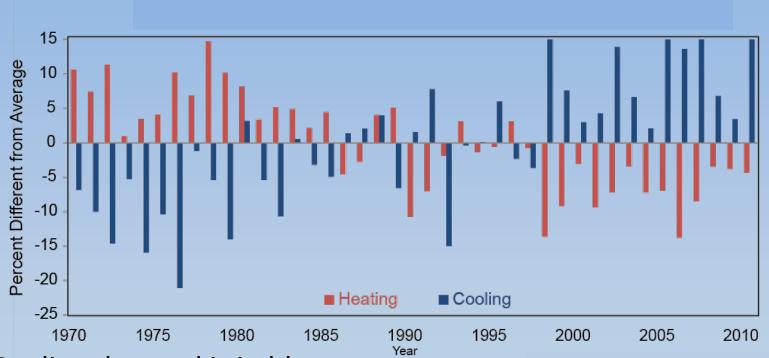


Billion Dollar Weather/Climate Disasters in last 30 years





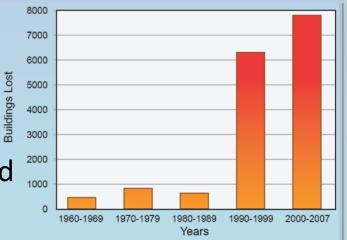
Infrastructure Affected



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

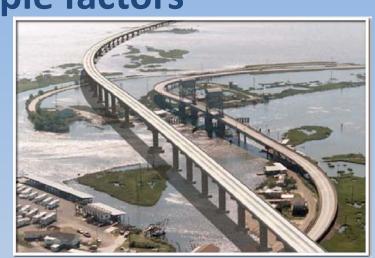


Building loss from fires in CA in wildland –urban interface

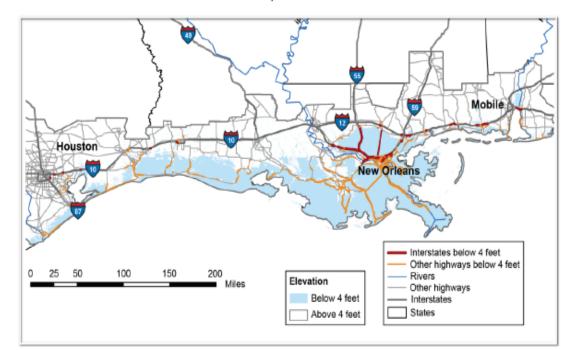


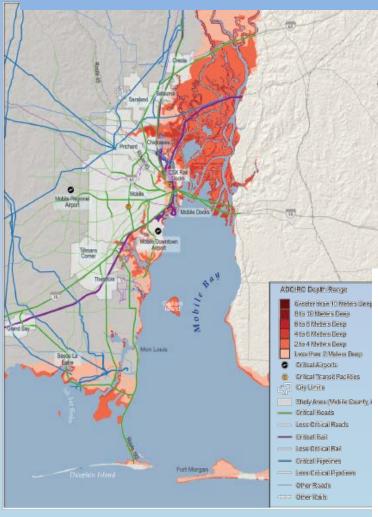
Infrastructure affected by multiple factors

Leeville Bridge, Coastal Louisiana



Gulf Coast Transportation Hubs at Risk

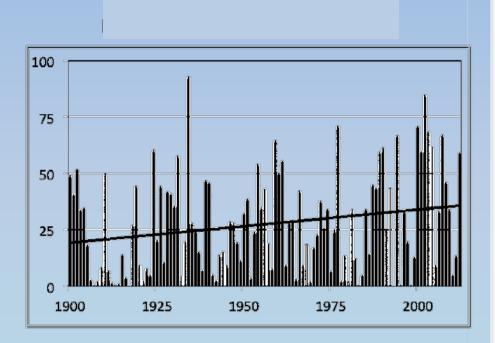




Mobile, Alabama



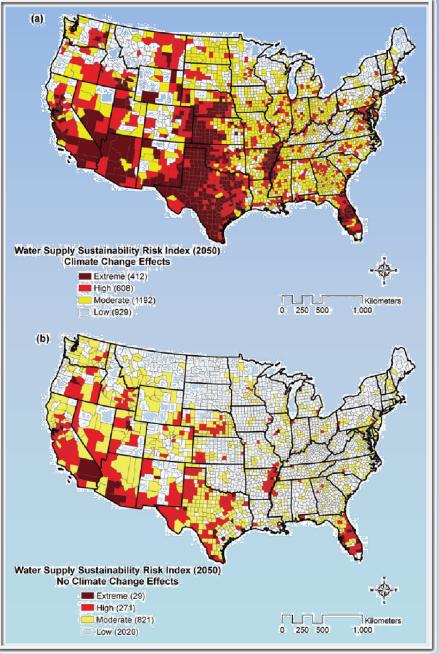
Water Supply Reliability



Percent of West in Summer Drought



Water Supplies Projected to Decline



Adaptation Process

Adaptation is Iterative Risk Management...

Identifying risks and vulnerabilities Planning, Revise strategy assessing and research; and selecting share options lessons learned ?gagemen Monitor and Implementation evaluate



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



The Limits of Engineering Solutions

Red Areas Show Inundation with 1-meter Sea Level Rise





Effectiveness of Fuel Treatments



Ecosystem Restoration



Adaptation and Mitigation

Adaptation Possibilities for Coastal Infrastructure





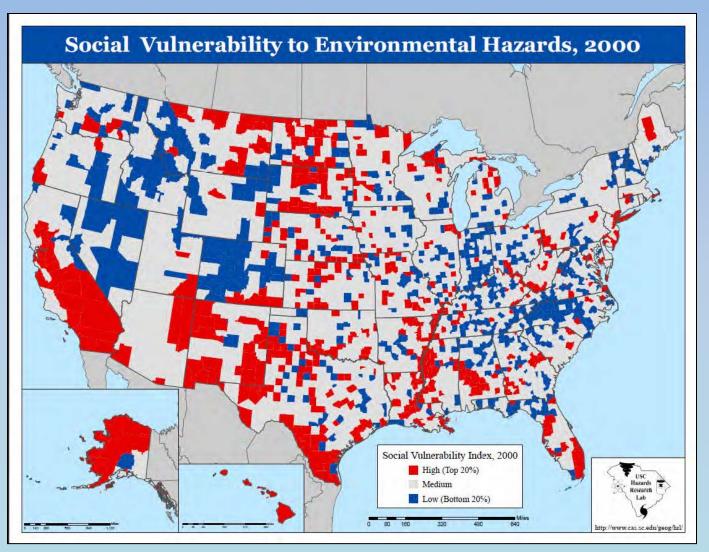
NCA Risk & Decision-Support Framing

- 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 cascading effects
 - Coastal Zones, Developm
 - Oceans and Marine Reso

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



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







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.



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

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)

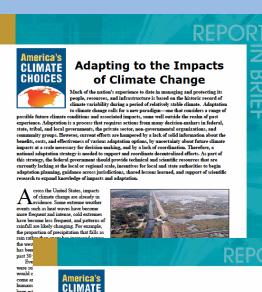


America's Climate Choice: Adaptation and Mitigation

- 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?





Limiting the Magnitude of Future Climate Change

Meeting internationally discussed targets for limiting atmospheric greenhouse gas concentrations and associated increases in global average temperatures will require a major departure from business as assual in how the world uses and produces energy. This report recommends a U.S. policy goal stated in terms of a bauget for cumulative greenhouse gas emissions over the period 2012-2050. With only so much to "spead" during this period, the aution should act now to: (1) take advantage of key master error apportunities to limit greenhouse gas emissions (e.g., through energy efficiency and low carbon energy sources), and to create new and better emission reduction opportunities for the longer term (e.g., invest in research and development), (2) create a antional policy framework within which actors at all levels can work toward a common goal, and (3) develop policy mechanism durable enough to periit for

limate change, driven by the increasing concentration of preschouse gases in the atmosphere, pose serious, wide-ranging timests to human necessits and natural ecosystems of the serious serious of a preschouse gas sensitions in the huming of front flosh. The global atmospheric concentration of CO₂, the dominant green, house gas of concern, in cureasing by rougably two parts per million per year, and the Unand-States is currently the second largest contributor. Increasing U.S. emissions are driven by

a growing national economy and a growing opposition. Even with expected improvements in energy efficiency, a business-at-usual pathway means that U.S. emissions will continue increasing. Greenhouse gases are currently emittles without any sort of penalty. With no financial incentives or regulatory pressure, the nation will continue to rely upon and "loch in" carbon-intensive technologies and "pathway and systems.

This report, part of the America's Climate Choices suite of studies requested by Congress, focuses on strategies to contribute to the global effort of limiting future climate change by reducing U.S. greenhouse gas emissions (and



SOURCE: NASA's Earth Obse

enhancing greenhouse gas "sinks," such as forests). The report identifies strategies that appear to be feasible now or in the near-term, as well as strategies that may play an important role in the longer-term.

Setting a Greenhouse Gas Budget Many important efforts to limit greenhouse gases are underway by state- and local-level leaders, individuals and households business and industry, and community groups across the United States. The nation lacks, however, a framework of national goals and policies to help coordinate and expand the efforts of all these crucial actors. Establishing

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