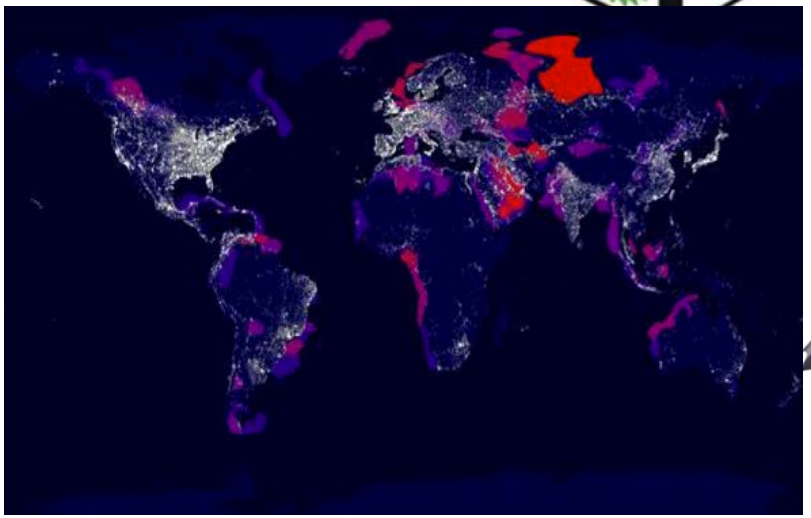
Fostering Resilience:
From Theory to Operation

Resilience of What?



Resilient to What?

What is Resilience

- The engineering field defines resilience as the “ability of a system to return to a pre-disturbed state after a temporary disturbance.”

  Holling, 1996

- Ecosystem resilience is viewed as ”the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. Resilience…has three defining characteristics:
  - The amount of change the system can undergo and still retain the same controls on function and structure
  - The degree to which the system is capable of self-organization
  - The ability to build and increase the capacity for learning and adaptation”

    The Resilience Alliance Website

What is Resilience

- New York City defines resilience (in PlaNYC) as “our ability to withstand and recover from extreme events and environmental changes.” (PlaNYC)

Different Components of Resilience

- Ability to “bounce-back” or “recreate the familiar”
- Evolution to “new state”
- Absorb external shocks and stresses
- Maintaining function, state, and/or structure
  - Maintaining purpose and integrity
- Transition over time to new state
- Transformation over time or rapidly to new state
- Building adaptive capacity and adaptive management

Characteristics of Resilience

- Tight feedback loops with capacity for learning and innovation
- Decoupled systems
- Diversity
- Modularity
- Simplicity
- Flexibility
- Adaptive governance
- High adaptive capacity
- Inclusive
- Transparent
- Less Consistency: redundancy or back-ups, and robustness
- Accessibility to information and resources
- Forward looking

Examples of Resilience-Building Activities

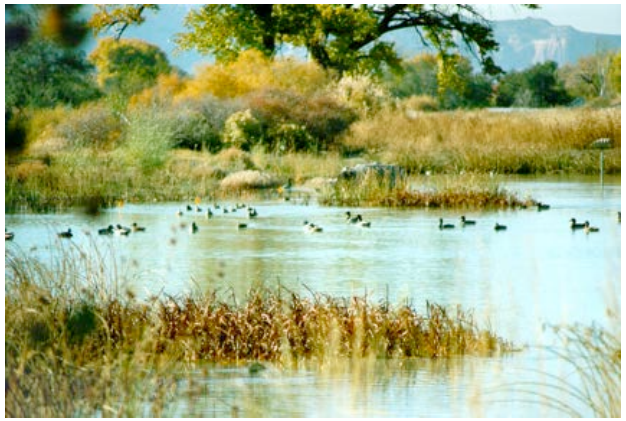
Baltimore:

- Real Food Farm – an urban agriculture project that's improving neighborhood access to healthy food and encourage local agriculture. In 2011, 8,000 lbs of produce was grown

Riverside:

- Renewable energy and energy efficiency are reducing energy demand and decentralizing energy supplies
- Applying urban planning principles that encourage high density, mixed used, walkable neighborhoods and open space preservation
- Increasing the use of recycled water from the wastewater treatment plant to recover 15,000 acre feet or 30% of plant effluent by 2020

Examples of Resilience-Building Activities



Bedford:

- Promoting landscape alternatives such as the use of native plants and drought resistant grasses, planting trees to shade buildings and reduce runoff, and the use of rain water collection systems such as rain barrels to divert water from the sewer system

New York and Philadelphia:

- Using green help manage storm water and protect water quality
- NYC is restoring 127 acres of wetlands to serve as a natural barrier against storms; have expanded the Staten Island Blue Belt which is a natural drainage system

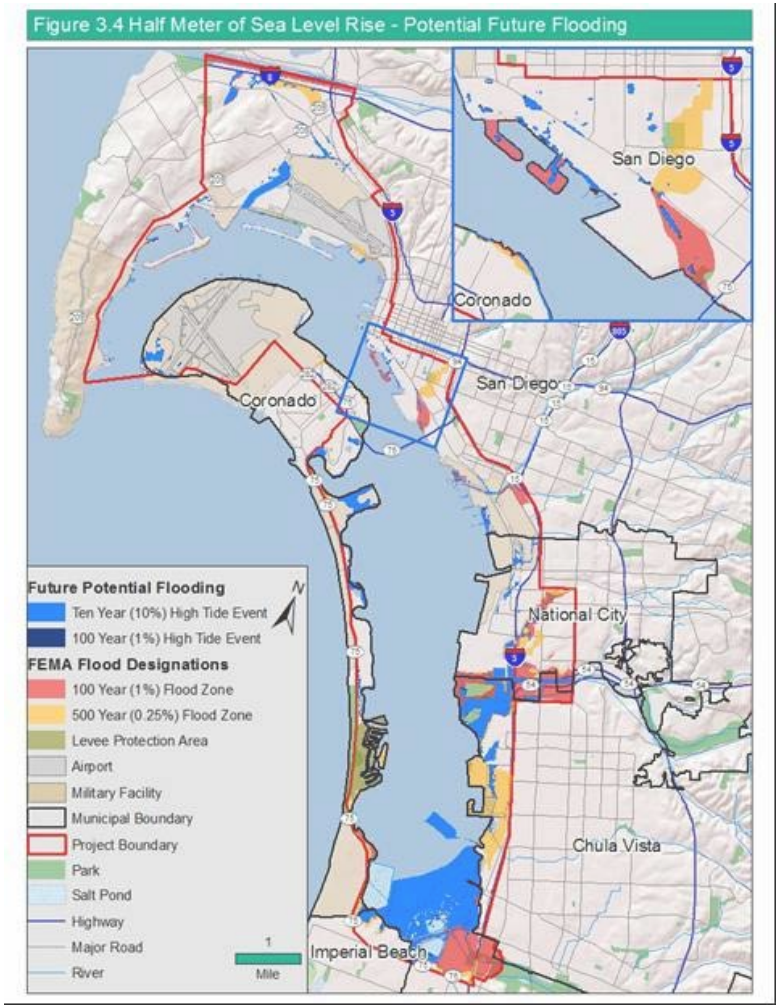
Dayton:

- Tree Canopy reduces run-off 7%

Addressing Existing Stressors

- ✓ Updating zoning in Cambridge, MA – no new basement apartments?
- ✓ Local pollution abatement in Bakersfield, CA
- ✓ Urban heat island mitigation in Chicago via cool roofs
- ✓ Reducing fire risk in Flagstaff
- ✓ Sea level rise preparedness in Miami-Dade County
- ✓ Preparing for heat in Phoenix – partnering with National Weather Service
- ✓ Water conservation in Santa Clara, CA
- ✓ Increasing storm pipe diameter in Keene, NH
- ✓ Integration of climate change impacts into design, construction, operations, and maintenance of near-cost city infrastructure in King County

Collaborating Regionally



Some Supporting Boundary Organizations

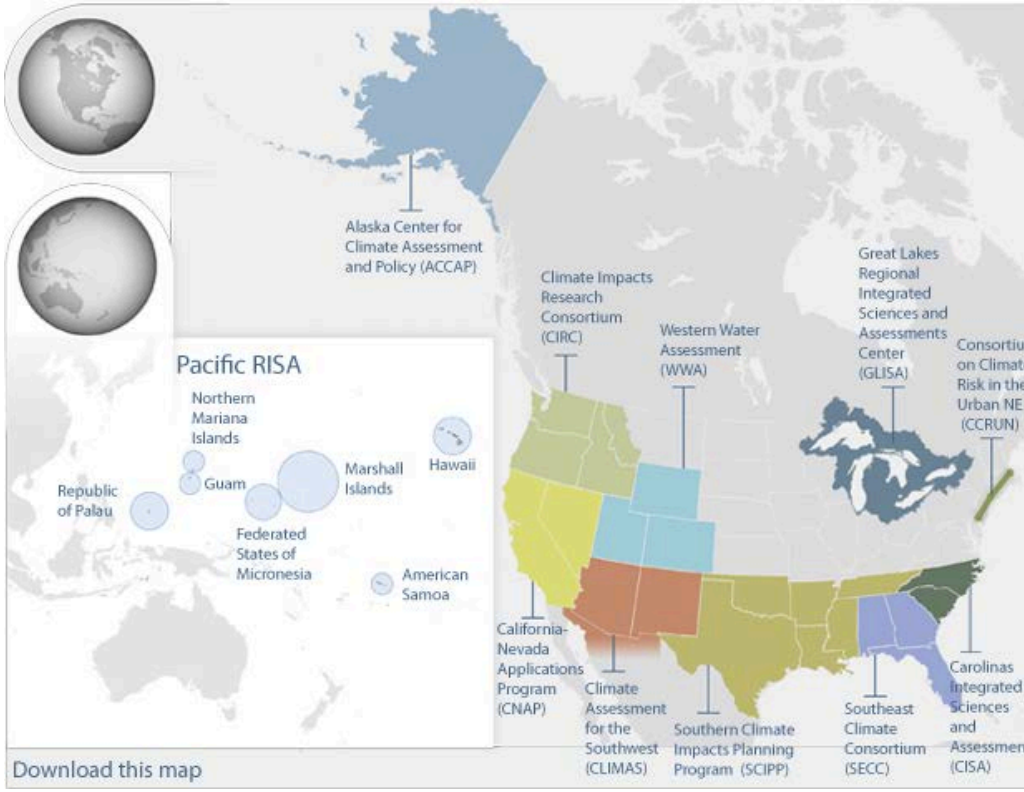
- **Community and Regional Resilience Institute (CARRI)**
  - Created the Community Resilience System (CRS) which guides communities through a process to identify practical, implementable community actions to increase resilience to all types of disasters (economic, natural, human, etc.)
  - Assesses the capacity of a community to withstand and recover from significant disturbances
  - Helps communities create a vision for the future and identify actions to achieve that vision
  - Brings together: people, processes, and technology
  - Currently being piloted in 7 communities

Some Supporting Boundary Organizations

- ICLEI-Local Governments for Sustainability's Climate Resilient Communities Program
  - Process-based program for municipalities
  - ADAPT: Adaptation Database and Planning Tool to guide climate adaptation planning and action
  - Collaboration with science entities to make science more accessible
  - Technical guidance, case studies, training, and peer networking

Some Supporting Boundary Organizations

- NOAA's Regional Integrated Science and Assessments (RISAs)
  - Research teams that are tasked to work with stakeholders to expand and build the nation's capacity to prepare for and adapt to climate variability and change
  - Focus on advancing understanding of impacts, vulnerabilities and response options
  - Creation of innovative tools that enhance the use of science in decision-making
  - Create knowledge tailored to suit specific user needs



Final Thoughts

- The importance of positive framing and creating a vision
- The definition of terms doesn't matter as much as their operationalization
- Climate change is but one of a multitude of stressors; resilient systems are those that can tolerate an array of perturbations

“Resilience is, like life itself, messy, imperfect, and inefficient. But it survives”

~Andrew Zolli

NCA Adaptation Chapter: Key Finding One

Substantial adaptation planning is occurring in the public and private sectors and at all levels of government, however, few measures have been implemented and those that have appear to be incremental changes.

Table 3: Examples of Local and Regional Adaptation Activities

Local or Regional Government	Adaptation Action
Satellite Beach, FL	Collaboration with the Indian River Lagoon National Estuary Program led to the incorporation of sea level rise projections and policies into the city's comprehensive growth management plan (Gregg 2011).
Portland, OR	Updated the city code to require on-site stormwater management for new development, and re-development and provides a downspout disconnection program to help promote onsite stormwater management(EPA 2010a) .
Lewes, DE	In partnership with Delaware Sea Grant, ICLEI-Local Governments for Sustainability, the University of Delaware, and state and regional partners, the City of Lewes undertook a stakeholder-driven process to understand how climate adaptation could be integrated into the hazard mitigation planning process. Recommendations for integration and operational changes were adopted by the City Council and are currently being implemented (City of Lewes, 2011).
Groton, CT	Partnered with Federal, state, regional, local, nongovernmental, and academic partners through the EPA's Climate Ready Estuaries program to assess vulnerability to and devise solutions for sea level rise (Stults 2011).
San Diego Bay, CA	Five municipalities partnered with the port, the airport, and more than 30 organizations with direct interests in the future of the Bay to develop the San Diego Bay Sea Level Rise Adaptation Strategy. The strategy identified key vulnerabilities for the Bay and adaptation actions that can be taken by individual agencies, as well as through regional collaboration (Solecki; Rosenzweig 2012).
Chicago, IL	Through a number of development projects, the city has added 55 acres of permeable surfaces since 2008 and has more than four million square feet of green roofs planned or completed (City of Chicago 2008).
King County, WA	Created King County Flood Control District in 2007 to address increased impacts from flooding through activities such as maintaining and repairing levees and revetments, acquiring repetitive loss properties, and improving countywide flood warnings (Wolf, 2009).
New York City, NY	Through a partnership with the Federal Emergency Management Agency (FEMA), the city is updating FEMA Flood Insurance Rate Maps based on more precise elevation data. The new maps will help stakeholders better understand their current and future flood risks and allow the city to more effectively plan for climate change (City of New York, 2012).
Southeast Florida Climate Compact	Joint commitment among Broward, Miami-Dade, Palm Beach and Monroe Counties to partner in reducing greenhouse gas emissions and adapting to climate impacts (Southeast Florida Compact Counties 2011).

NCA Adaptation Chapter: Key Finding Two

Barriers to implementation of adaptation action include lack of funding, policy and legal impediments, and difficulty in anticipating climate-related changes at local scales.

Table 7: Summary of Adaptation Barriers

Barrier	Specific Examples
Climate Change Information and Decision Making	• Uncertainty about future climate impacts • Disconnect between information providers and information users • Fragmented, complex, and often confusing information • Lack of climate education for professionals and the public • Lack of usability and accessibility of existing information
Lack of Resources to Begin and Sustain Adaptation Efforts	• Lack of financial resources / no dedicated funding • Limited staffing capacity • Less than 5% of USGCRP budget dedicated to adaptation (?) • Underinvestment in human dimensions research
Fragmentation of Decision Making	• Lack of coordination within and across agencies, private companies, and non-governmental organizations • Uncoordinated and fragmented research efforts • Disjointed climate related information • Fragmented ecosystem and jurisdictional boundaries
Institutional Constraints	• Lack of institutional flexibility • Rigid laws and regulations • No legal mandate to act • Use of historical data to inform future decisions • Restrictive management procedures • Lack of operational control or influence
Lack of Leadership	• Lack of political leadership • Rigid and entrenched political structures • Polarization
Divergent Risk Perceptions, Cultures, and Values	• Conflicting values/risk perceptions • Little integration of local knowledge, context, and needs with traditional scientific information • Cultural taboos and conflict with cultural beliefs • Resistance to change due to issues such as risk perception

NCA Adaptation Chapter: Key Finding Three

There is no "one-size fits all" adaptation, but there are similarities in approaches across regions and sectors. Sharing best practices, learning by doing, and iterative and collaborative processes including stakeholder involvement, can help support progress.

NCA Adaptation Chapter: Key Finding Four and Five

Vulnerability to climate change is exacerbated by other stresses such as pollution and habitat fragmentation. Adaptation to multiple stresses requires assessment of the composite threats as well as tradeoffs amongst costs, benefits, and risks of available options.

Climate change adaptation actions often fulfill other societal goals, such as sustainable development, disaster risk reduction, or improvements in quality of life, and can therefore be incorporated into existing decision-making processes.

Key Finding Six and Next Steps

The effectiveness of climate change adaptation has seldom been evaluated, because actions have only recently been initiated, and comprehensive evaluation metrics do not yet exist.

Next Steps:

- Enabling research and development to advance adaptation across scales, sectors, and disciplines.
- Research on the kinds of information users desire as well as how to deliver that information in contextually appropriate ways
- Research on decision-making in light of uncertainty about climate change and other considerations will be equally important
- Research on costs and benefits of adaptation; adaptation and mitigation interactions; critical adaptation thresholds; and adaptation to extremes