

# CLIMATE CHANGE ADAPTATION: WHAT FEDERAL AGENCIES ARE DOING



February 2012 Update

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## ■ INTRODUCTION

There is a growing consensus that regardless of our efforts to reduce greenhouse gas emissions, significant climate change is unavoidable. Although climate mitigation remains critical, we must also be thinking about and planning for ways to limit the adverse impacts from unavoidable changes in our climate. By taking steps now to adapt to climate change, we will be better able to limit future damages and their associated costs.

In March 2010, the Center released the report, *Adapting to Climate Change: A Call for Federal Leadership*.<sup>1</sup> The Center's report was developed with the understanding that while many efforts to adapt to climate change will occur at the state and local level, the federal government is a critical player in an effective and coordinated approach to climate change adaptation in the United States. In this report, the authors called for a National Adaptation Program and recommended new institutional mechanisms and roles for federal agencies to mainstream the consideration of climate change across agency operations, programs, and services. Also released in 2010 was the National Academies' report, *Adapting to the Impacts of Climate Change*, which emphasized that the federal government should not only serve as a "role model", but also play a significant role as a "catalyst and coordinator" in identifying vulnerabilities to climate change impacts and the adaptation options that could increase our resilience to these changes.<sup>2</sup>

Under the requirements of Executive Order 13514, federal agencies are stepping forward to meet this challenge and are beginning to "mainstream" consideration of climate change adaptation across their operations, programs and policies. All federal agencies drafted a policy statement on climate change adaptation that commits the agency to adaptation planning, including identifying an agency point of contact, completing an analysis of climate change impacts on its mission and operations, and preparing a climate adaptation plan by June 2012. Some agencies are also taking a leadership role in enabling others—state, local and tribal governments, businesses, and

communities—in their adaptation planning and projects. These federal actions are still in their early stages and as such, this report attempts to capture and highlight these efforts to facilitate communication and collaboration across federal agencies as well as with numerous non-federal stakeholders focused on domestic adaptation policy. Where a federal department or agency has implemented institutional mechanisms specifically for climate change adaptation, developed an agency-wide adaptation plan or set of policies, or provides adaptation resources or tools, it is our intent to represent it within this report. The authors are continuously working to expand on the information included here, and sincerely hope this report will serve as a resource for collaboration and information sharing among the growing adaptation community.

The report content is organized by major Department within the federal government (e.g., the Department of Agriculture, Department of Commerce, etc.) with the exception of the adaptation efforts led by the Executive Office of the President and related interagency initiatives, which are listed separately at the beginning of the report. For each Department, the report highlights specific adaptation initiatives (such as a program office or strategic plan) that are in place at the Department level. These are followed by an overview of each agency or bureau within that Department and relevant adaptation activities, which are typically divided into: (1) initiatives and strategies, (2) programs and institutional mechanisms, and (3) tools and resources. This January 2012 update also includes several examples of federal projects that incorporate the impacts of climate change and adaptive actions into the planning, design, and implementation process. These projects further highlight the leadership role federal departments and agencies are taking to promote a more climate resilient economy, society, and environment. The Figure on the following page provides some examples of adaptation activities within the Departments that are included in this report.

**Figure 1: Examples of Adaptation Activities at Selected Federal Agencies**



### Department of Agriculture (USDA)

- USDA Climate Change Program Office coordinates climate change programs and will develop a USDA adaptation plan
- U.S. Forest Service Climate Change Advisor's Office implements actions in the Roadmap for Responding to Climate Change



### Department of Commerce (DOC)

- NOAA provides planning guidance and training to communities to build their capacity to prepare for climate change
- NOAA launched the Climate Services Portal to provide climate data, products, and services for all users



### Department of Defense (DoD)

- DoD Quadrennial Defense Review includes climate change impacts
- DoD Strategic Environmental Research and Development Program explores infrastructure vulnerability to climate change



### Department of Energy (DOE)

- DOE Office of Climate Change Policy and Technology is a focal point for collaboration on clean energy and adaptation
- DOE Sustainability Performance Office oversees department sustainability efforts, including the adaptation policy



### Department of Health and Human Services (HHS)

- CDC Climate and Health Program helps to ensure that the health impacts of climate change are understood, considered and acted upon in public health operations and in the broader community



### Department of Homeland Security (DHS)

- DHS Climate Change Adaptation Task Force is examining climate change implications for missions and operations
- FEMA is developing a Risk MAP to provide data, increase awareness, and reduce risk to life and property



### Department of Housing and Urban Development (HUD)

- HUD Partnership for Sustainable Communities is improving planning efforts, land use, and zoning
- Long-term Disaster Recovery Working Group (w/DHS) is helping communities protect against effects of climate change



### Department of the Interior (DOI)

- DOI Energy and Climate Change Task Force is responsible for overseeing climate change adaptation planning efforts
- DOI is identifying resources vulnerable to climate change and implementing adaptive actions for 50 percent of the nation



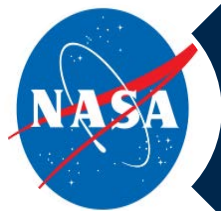
### Department of Transportation (DOT)

- Center for Climate Change and Environmental Forecasting (CCCEF) is focal point for climate change
- CCCEF Strategic Plan includes actions to prepare for the impacts of climate change



### Environmental Protection Agency (EPA)

- Cross-EPA Work Group on Climate Change Adaptation Planning coordinates adaptation policy and the adaptation plan
- National Water Program Strategy identifies water impacts and goals and objectives to respond to these impacts



### National Aeronautics and Space Administration (NASA)

- Climate Adaptation Science Investigators Workgroup develops adaptation strategies for NASA and its Research Centers
- NASA's Applied Sciences Program uses Earth science information to support planning and response to climate change

## ■ EXECUTIVE OFFICE OF THE PRESIDENT AND INTERAGENCY INITIATIVES

### INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE

In the spring of 2009, the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA) initiated the Interagency Climate Change Adaptation Task Force (ICCATF), which includes representatives from more than 20 federal Agencies.<sup>3</sup> When the President signed the Executive Order on Federal Leadership in Environmental, Energy, and Economic Performance (E.O. 13514) on October 5, 2009, he called on the ICCATF to develop, within one year, recommendations on how the policies and practices of federal agencies can be made compatible with and reinforce a national climate change adaptation strategy. The Task Force formed multiple workgroups to consider the capabilities of the federal Government to respond to the impacts of climate change on select sectors, institutions, and agency responsibilities, and conducted numerous listening sessions and public outreach events with a wide range of stakeholders. The ICCATF released an Interim Progress Report in March 2010.<sup>4</sup> In October 2010, the Task Force released its Progress Report to the President, which included the Task Force's recommendations to advance a national approach to adaptation.<sup>5</sup> A further progress report was released in October 2011, detailing actions in key areas set forth by the Task Force in 2010.

### EXECUTIVE ORDER 13514 - FEDERAL LEADERSHIP IN ENVIRONMENTAL, ENERGY, AND ECONOMIC PERFORMANCE

On October 5, 2009, President Obama signed the Federal Leadership in Environmental, Energy, and Economic Performance Executive Order (E.O.) requiring each federal agency to develop, implement, and annually update an integrated Strategic Sustainability Performance Plan (SSPP).<sup>6</sup> Each plan includes a discussion of the climate change risks and vulnerabilities on the agency's operations and mission.<sup>7</sup> The E.O. also requires agencies to actively participate

in the Interagency Climate Change Adaptation Task Force and "develop approaches through which the policies and practices of the agencies can be made compatible with and reinforce that strategy." By June 2012, each SSPP is required to include an agency climate adaptation plan for implementation in FY 2013. The climate adaptation plan must be consistent with the guidance outlined in *Implementing Instructions for Agency Climate Change Adaptation Planning* released by CEQ in March 2011.<sup>8</sup>

### COUNCIL ON ENVIRONMENTAL QUALITY

#### Overview

The Council on Environmental Quality (CEQ) was established by Congress in the Executive Office of the President by the National Environmental Policy Act (NEPA) of 1969 to provide oversight to federal agency activities affecting the environment, including agency implementation of the environmental impact assessment process.

#### Selected Initiatives and Strategies

In addition to co-chairing the Interagency Climate Change Adaptation Task Force, CEQ is engaged in a number of initiatives connected to climate adaptation. This section is divided into: initiatives and strategies related to E.O. 13514 and other initiatives.

#### SELECTED INITIATIVES AND STRATEGIES RELATED TO E.O. 13514

*Implementing Instructions for Agency Climate Change Adaptation Planning.* At the recommendation of the ICCATF, CEQ released a set of *Implementing Instructions* for federal agency adaptation planning on March 4, 2011.<sup>9</sup> The instructions advise agencies on how to integrate climate change adaptation into their planning, operations, policies, and programs. The instructions require that individual agencies shall do the following:

- Identify a senior official to carry out the climate change adaptation planning actions by April 15, 2011;

- By June 3, 2011, submit to CEQ an agency-wide adaptation policy, concurrent with the submission of the Strategic Sustainability Performance Plan (SSPP);
- Respond to a set of guiding questions that allow agencies to begin the process of assessing how climate change will affect the agency and to prepare the agency to conduct a vulnerability assessment by June 3, 2011;
- By September 30, 2011, submit to CEQ a preliminary high-level assessment of agency vulnerability to climate change and complete a final version of the high-level vulnerability assessment by March 2012;
- By September 30, 2011, identify and submit to CEQ three to five priority climate change adaptation actions that the agency will implement in FY2012;
- As part of the SSPP, submit to CEQ and OMB the agency climate adaptation plan for implementation in FY2013 by June 4, 2012. The final adaptation plan will be made publically available for review and comment; and
- During 2011, participate in interagency workshops sponsored by CEQ, sharing lessons with other agencies.

CEQ also provided supporting information to assist agencies with meeting the *Implementing Instructions* requirements.<sup>10</sup>

In preparation for submission of the final adaptation plans in June 2012, CEQ is preparing more detailed guidance on the critical elements of each plan, as well as templates. This guidance is expected to be released in early 2012.

***National Action Plan for Freshwater Resources.*** In October 2011, CEQ, as one of the co-chairs of the water working group of the ICCATF, released the National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate. The plan summarizes the latest science on the risks of climate change to freshwater resources, establishes a national goal to manage freshwater resources, and provides six recommendations and twenty-four actions for federal agencies to take over the next several years. The six recommendations include: establishing a planning process to adapt water resources to a changing climate,

improving water resources and climate change information for decision-making, strengthening assessment of vulnerability of water resources to climate, expanding water efficiency, supporting integrated water resource management, and supporting training and outreach to build response capabilities.<sup>11</sup>

***National Fish, Wildlife and Plants Climate Adaptation Strategy.*** Congress called for this Strategy in 2010, and this call was subsequently endorsed by the Task Force in its 2010 Progress Report to the President. The U.S. Fish and Wildlife Service (USFWS), NOAA, CEQ, state wildlife agencies, and Tribes are co-leading the development of the Strategy using best available science. The draft Strategy is scheduled for public release and comment in winter 2012, with a final report planned for summer 2012.

## OTHER INITIATIVES AND STRATEGIES

***Clean Water Framework (April 2011).*** The Obama Administration released *Clean Water: Foundation of Healthy Communities and a Healthy Environment*, which highlights ongoing initiatives at the EPA, USACE, USDA, and DOI to protect water resources. The framework document recognizes climate change as an emerging issue and describes efforts to use new scientific data and analytical tools to anticipate the impacts of climate change on water resource management.<sup>12</sup>

***America's Great Outdoors Initiative (February 2011).*** In April 2010, President Obama charged the DOI, USDA, EPA, and CEQ with developing a conservation and recreation agenda for the 21st century. The federal agencies released *America's Great Outdoors: A Promise to Future Generations* in February 2011, which utilizes a grassroots approach to protecting natural lands and waters and connecting Americans to our natural and cultural heritage. Specifically, Recommendation 8.2: Manage Federal Lands and Waters to Increase Their Resilience to Climate Change calls for improved science to support decisions made by land managers to implement adaptation actions and foster resilience to climate change in land, water, and wildlife.<sup>13</sup>

***NEPA Guidance (Feb 2010).*** CEQ has undertaken a broad effort to modernize and reinvigorate how



agencies implement NEPA, with the goal of enhancing the quality of public involvement in governmental decisions relating to the environment, increasing transparency, and easing implementation. In February 2010, CEQ issued draft guidance for federal agencies on when and how they should consider greenhouse gas (GHG) emissions and climate change impacts in their NEPA reviews. In the draft guidance, CEQ advises federal agencies to consider: 1) opportunities to reduce GHG emissions caused by proposed and alternative actions, and 2) the effects of climate change impacts to their proposed actions, “including the relationship to proposal design, environmental impacts, mitigation and adaptation measures.” The draft guidance excludes federal land and resource management actions.<sup>14</sup>

***Interagency Oceans Policy Task Force (June 2009).***

Established by the President in June 2009, and chaired by CEQ, the Interagency Oceans Policy Task Force (OPTF) was charged with developing a national policy that “ensures the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhances the sustainability of ocean and coastal economies, preserves our maritime heritage, provides for adaptive management to enhance our understanding of and capacity to respond to climate change, and is coordinated with our national security and foreign policy interests.” The OPTF was also charged with developing a national framework for policy coordination with other levels of government involved (state, local, etc.) and developing an implementation strategy.<sup>15</sup> On July 19, 2010, President Obama signed an Executive Order establishing a National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes (National Policy) and a National Ocean Council (NOC) to strengthen ocean governance and coordination.<sup>16</sup> This Executive Order adopts the *Final Recommendations of the Interagency Ocean Policy Task Force* and directs federal agencies to take the appropriate steps to implement them. One of the nine national priority objectives outlined in the *Final Recommendations* is “resiliency and adaptation to climate change and ocean acidification.” The National Ocean Council’s draft Implementation Plan, including a chapter on addressing adaptation, is scheduled to be released for public comment in winter 2012, with a

final report due out by summer 2012.

***Revised Principles and Guidelines for Water and Related Resources Implementation Studies.*** Since 2009, CEQ has been engaged in an interagency process to modernize the Principles and Requirements for Federal Investments in Water Resources. Moving beyond the original four agencies to which the 1983 principles and guidelines applied, this updated document will apply to water resource projects, programs, and activities undertaken by seven federal agencies: the Army Corps of Engineers, the Environmental Protection Agency, the Tennessee Valley Authority, and the Departments of Agriculture, Commerce, Interior, and Homeland Security (Federal Emergency Management Agency). In keeping with the federal objective laid out in the Water Resources Development Act of 2007, the new document focuses on a three-pronged approach to making water investment decisions that considers economic, environmental, and social goals. Released in draft form in December 2009, the revisions promote comparability and transparency for water resource projects across the country, allow consideration of non-monetary benefits in the calculation of net benefits for project justification, and take into consideration non-structural approaches to reduce flooding impacts.<sup>17</sup> Among many specific requirements, the modernized principles and guidelines also establish consideration of the risk and uncertainty related to climate change as a key factor in the decision-making process. The document has undergone interagency and public review, as well as a review by the National Academy of Sciences, and is expected to be released in early 2012.<sup>18</sup>

***Selected Projects***

***Louisiana-Mississippi Gulf Coast Ecosystem Restoration Working Group Roadmap for Restoring Ecosystem Resiliency and Sustainability (March 2010).*** Launched by President Obama in October 2009, the Louisiana-Mississippi Gulf Coast Ecosystem Restoration Working Group was asked to improve federal coordination of restoration activities within the Louisiana and Mississippi coastal regions. Co-led by the CEQ, the Working Group released the *Roadmap for Restoring Ecosystem Resiliency and Sustainability* in March 2010, providing guidance for near- and long-term restoration and protection activities. The Roadmap recognizes that addressing the potential impacts of climate

change, particularly sea level rise, is necessary in order to protect communities and infrastructure and restore ecosystems.<sup>19</sup>

**California Bay-Delta Restoration.** In September 2009, the DOI, DOC, USDA, Department of the Army, EPA, and CEQ signed the California Bay-Delta Memorandum of Understanding, establishing a Federal Leadership Committee (co-chaired by the CEQ) to coordinate a federal response to the California water crisis, facilitate a partnership with the State of California, and develop an interim action plan for federal agencies.<sup>20</sup> Published in December 2009, the *Interim Federal Action Plan for the California Bay-Delta* organizes the set of federal actions into four priority areas: work in concert with California and local authorities, encourage the smarter supply and use of Bay-Delta water, ensure healthy Bay-Delta ecosystems and improve water quality, and help deliver drought relief services and ensure integrated flood risk management.<sup>21</sup> The *Interim Federal Action Plan* calls for federal agencies to expand the analysis of projected climate change impacts on Bay-Delta ecosystem restoration efforts, outlining key actions to enable adaptation across water resources, ecosystem health, endangered species, agriculture, recreation, and flood risk management.

## OFFICE OF SCIENCE AND TECHNOLOGY POLICY

### Overview

The Office of Science and Technology Policy (OSTP) was established to “advise the President and others within the Executive Office of the President on the effects of science and technology on domestic and international affairs.” OSTP oversees the National Science and Technology Council (NSTC) and its Committees and Subcommittees, which are the primary mechanism for interagency coordination on science and technology policy issues.

### Selected Initiatives and Strategies

In addition to co-chairing the Interagency Climate Change Adaptation Task Force, OSTP is engaged in a number of initiatives related to climate change adaptation through the NSTC.

**U.S. Global Change Research Program.** OSTP provides

oversight for the U.S. Global Change Research Program (USGCRP), consisting of 13 federal agencies, to prioritize and provide climate change research, and to conduct climate impact assessments every four years. The program is governed by the NSTC’s Subcommittee on Global Change Research and its activities on adaptation are described in more detail below.

**Interagency Climate Services Coordination.** OSTP is working with NOAA and other federal agencies to define a process for improved coordination and collaboration on climate services across the federal government. This process would most likely be established under the Committee on Environment and Natural Resources, which is in the process of being re-chartered as the Committee on Environment, Natural Resources, and Sustainability.

## UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM

### Overview

The Global Change Research Act (GCRA) of 1990 established the interagency U.S. Global Change Research Program (USGCRP) “to understand, assess, predict, and respond to human-induced and natural processes of global change.”

### Selected Initiatives and Strategies

**Strategic Plan.** The USGCRP is developing a new strategic plan that will restructure the program to better address the needs of decision makers. The strategic plan will build on the technical strengths of the USGCRP, working to communicate relevant science and technical research to support decision-making. The new strategic plan goals include: advance science, inform decisions, sustained assessment, and communicate and educate. The final version is expected to be released in winter 2012.<sup>22</sup>

**Interagency Coordination.** The U.S. Global Change Research Program coordinates and integrates federal research among the 13 participating agencies to build a knowledge base that informs human responses to climate and global change. The program is undergoing a strategic realignment that will maintain its traditional strengths in observations, modeling, and



basic research. The realignment also serves to increase its capabilities to support a more sustained assessment process, provide the science to support decision-making for both adaptation and mitigation activities, strengthen communication and education efforts to increase climate literacy, and foster and sustain engagement with key stakeholders to increase the effectiveness of the program overall. As part of this realignment, a new leadership structure has been put in place that includes a new Vice-Chair for Adaptation Science who will shepherd this process.<sup>23</sup>

**Interagency Adaptation Science Workgroup.** In 2009, the Obama Administration convened the Interagency Climate Change Adaptation Task Force<sup>24</sup> (ICCATF), co-chaired by the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA), along with representatives from more than 20 federal agencies. The ICCATF activities initially included multiple Workgroups, including Adaptation Science, which was initiated in fall 2009 under CEQ. In summer 2010, the Adaptation Science Workgroup was transferred to USGCRP as a new program to improve the federal government's capacity to provide and translate science in support of adaptation decision-making at all scales.<sup>25</sup>

**Interagency Crosscutting Group on Climate Change and Human Health.** This group was chartered under the USGCRP in December 2009, as a pilot effort to improve the coordination, implementation, and reporting on federal research and related scientific activities on the human health impacts of global environmental change. The group is co-chaired by NIEHS, CDC, and NOAA, and is focused on six key workstreams, including adaptation; assessment; communications, education, and engagement; data integration; joint research and applications planning; and international activities. This group was called upon to serve as the Health Workgroup for the Adaptation Task Force and provided inputs and recommendations for the Task Force's report to the President. It will spearhead any additional health-related adaptation activities that follow from that report, including co-hosting a recent workshop with OSTP that aimed to enhance the ability of federal decision makers to incorporate health considerations

into adaptation planning.<sup>26</sup>

**National Climate Assessment.** Also required by the GCRA is a full National Climate Assessment of the impacts of global change in the United States every four years. The First National Climate Assessment (2000) identified key vulnerabilities of United States regions and sectors to climate change and variability in the 21st century.<sup>27</sup> In 2009, the USGCRP released the Global Climate Change Impacts in the United States Report, which summarized 21 Synthesis and Assessment Products and served as the Second National Climate Assessment and a current state of the knowledge report. The USGCRP is currently preparing for the next National Climate Assessment, which is scheduled to be completed in 2013.<sup>28</sup> Similar to previous assessments, the next National Climate Assessment will evaluate the state of scientific knowledge relative to trends in climate variability and change and their impact on society. However, unlike previous assessments, the 2013 National Climate Assessment will transition from a periodic report-writing activity to an ongoing process, including an evaluation of the America's progress in adaptation and mitigation efforts; building long-term partnerships with non-government entities; creating new approaches for assessing climate change-related risks and opportunities, including a national set of indicators; developing the capacity for regional and sectoral assessments; and providing relevant information to decision makers.<sup>29</sup>

### **Tools and Resources**

**Global Change Research Program Website.** The site contains general information about and links to USGCRP publications such as the latest regional and sectoral impact assessments, and reports on extreme weather and abrupt climate change. Other recent news and events are also maintained on this site.<sup>30</sup>

**Synthesis and Assessment Products.** Between 2001 and 2008, 21 reports known as Synthesis and Assessment Products (SAPs) were completed under what was called the U.S. Climate Change Science Program (CCSP). Of these 21 reports, the following were related to climate change adaptation:

- SAP 4.1 - Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region (Jan 2009) –

Lead Agency: EPA.<sup>31</sup>

- SAP 4.2 – Thresholds of Climate Change in Ecosystems (Jan 2009) – Lead Agency: USGS.<sup>32</sup>
- SAP 4.3 - The Effects of Climate Change on Agriculture, Land Resources, Water Resources and Biodiversity (May 2008) - Lead Agency: USDA.<sup>33</sup>
- SAP 4.4 – Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources (June 2008) – Lead Agency: EPA.<sup>34</sup>
- SAP 4.5 – Effects of Climate Change on Energy Production and Use in the United States (Oct 2007) – Lead Agency: DOE.<sup>35</sup>
- SAP 4.6 - Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems (July 2008) – Lead Author: EPA.<sup>36</sup>
- SAP 4.7 – Impacts of Climate Variability and Change on Transportation Systems and Infrastructure (Mar 2008) – Lead Agency: DOT.<sup>37</sup>

**Global Climate Change Impacts in the United States (June 2009).** The latest assessment report from the USGCRP summarizes the most up-to-date research on current and projected impacts to the United States. In order to facilitate use by decision makers, the report is organized into separate sections by U.S. regions as well as by sectors such as agriculture, health and water.<sup>38</sup>

**Our Changing Planet.** The USGCRP submits *Our Changing Planet* to Congress each year. The resource serves as an annual report and provides information

on near-term plans, progress in implementing long-term goals, key science accomplishments, an overview of recent expenditures, and requests for funding.<sup>39</sup>

**Image Gallery.** The USGCRP website includes a user-friendly image gallery of charts, diagrams, and visuals.

## NATIONAL CLIMATE ADAPTATION SUMMIT

The National Adaptation Summit brought together a community of users and providers of climate adaptation information from diverse climatological regions and economic sectors to provide insights into what is needed for effective climate adaptation and vulnerability assessments in the United States and to provide input into federal adaptation planning, policy and research programs. Convened by the University Corporation for Atmospheric Research (UCAR), and largely funded by USGCRP, the Summit took place in May 2010 and was co-chaired by Jack Fellows (UCAR), Rosina Bierbaum (University of Michigan), and Shere Abbott (OSTP). Using the best available information about projected climate change and impacts, participants were asked to examine the needs, knowledge, and roles that must be addressed at all levels of government and in the private sector, in both the near-term and long-term, to enable climate adaptation and vulnerability assessments.<sup>40</sup> A report based on the summit recommends that decision makers at all levels of government develop and coordinate climate change adaptation measures.<sup>41</sup>

## ■ UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)

### Department-wide Initiatives

**Policy Statement on Climate Change Adaptation.** On June 3, 2011, the USDA released a policy statement on climate change adaptation issued in response to E.O. 13514 and guidance from CEQ. The policy establishes a department-wide directive to integrate adaptation planning and actions into USDA programs, policies, and operations. The policy requires each USDA agency to analyze how climate change may affect existing programs, operations, policies, and authorities; identify budget areas affected by the policy; identify

areas where legal analysis needs to be conducted; and coordinates actions with the USDA's Global Change Task Force. The USDA Climate Change Program Office is responsible for developing a climate change adaptation plan by June 2012.<sup>42</sup>

**USDA Strategic Plan for 2010-2015.** The USDA strategic plan includes a number of goals related to climate change. For example, the Plan sets a departmental goal to "Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources."<sup>43</sup>

**Climate Change Program Office.** The Climate Change Program Office (CCPO) operates within the Office of the Chief Economist and functions as the Department-wide coordinator of agriculture, rural and forestry-related global change programs and policy issues facing USDA. The Office ensures that USDA is a source of objective, analytical assessments of the effects of climate change and proposed response strategies. The Office also serves as USDA's focal point for climate change issues and is responsible for coordinating activities with other federal agencies, interacting with the legislative branch on climate change issues affecting agriculture and forestry, and representing USDA on U.S. delegations to international climate change discussions. Adaptation-focused efforts include coordinating inquiries specific to the economic impacts of climate change and potential costs of adaptation; serving as the lead agency in the production of Synthesis and Assessment Product 4.3, *The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity*; and collaborations with CEQ, DOE, EPA and others on policy and practice issues related to adaptation in the agriculture and forestry sectors.<sup>44</sup>

**Climate Change Science Plan (November 2010).** The USDA Global Change Task Force released the *Climate Change Science Plan* in November 2010. The report provides a guide for the Department to incorporate climate change challenges and opportunities into the scientific missions of the USDA and offers a framework for assessing priorities to ensure consistency with the USGCRP. The USDA identified the following four priority research elements: 1) understanding the direct and indirect effects of climate change on natural and managed ecosystems; 2) develop knowledge, institutional models, and tools to enable adaptation to climate change and improve resiliency; 3) develop knowledge and tools to enhance the contribution of agriculture, forestry, grasslands, wetlands, and other land management practices to mitigate atmospheric greenhouse gas emissions; and 4) provide science-based decision support information and tools to USDA agencies, stakeholders and collaborators.<sup>45</sup>

## ANIMAL AND PLANT HEALTH INSPECTION SERVICE

### Overview

The USDA Animal and Plant Health Inspection Service (APHIS) regulates trade consistent with rules of the World Trade Organization (WTO) and United Nations Food and Agriculture Organization (FAO), and requires that commodities are free of quarantine pests, disease and noxious weeds. These unwanted organisms are central to effective trade policy, and impact the ability of the United States to import and export live plants, commodities, animals, and animal products. Animal diseases have a direct link to human health. Agricultural pests and diseases significantly affect our trade and trading partners. Pests, diseases and weeds show early, and in some cases, marked response to climate change. Examples include Avian Flu, West Nile Virus, Swine Flu, and Bovine Spongiform Encephalopathy.

### Selected Initiatives and Strategies

**Climate Change Research and Regulatory Initiative** (April 2010). An APHIS-wide review identified 94 issues/concerns on how climate change would impact the APHIS mission of safe-guarding U.S. agriculture and natural resources. These issues now form the basis for a plan to address key needs as pests respond to shifts in climate. APHIS has developed a Climate Change Adaptation Plan that anticipates changes to our environment.

**University Collaboration, International Cooperation.** Cooperation with universities is important in fulfilling the Agency's mission. APHIS has worked with North Carolina State University (NCSU) on a Five-Year Proposal - System to Integrate Climate Change Scenarios into Response Programs for Invasive Plant Pests (June 2010). The goal of this work is to incorporate climate change models into plant pest forecasting systems and response programs for invasive plant pests in the United States; it focuses on wheat diseases, but tools developed will be applied to other invasive species. Risk assessment, risk management and pathway analysis for invasive alien species are also adjusted to consider climate change.

International cooperation is also important for

research programs on pest response to climate change (July 2010). APHIS has engaged major trading partners (Canada, Australia, and New Zealand) in a cooperative exchange of data and research on pest response to climate change.

#### ***Pest Detection Surveys and Collaborative Efforts.***

Cooperative Agricultural Pest Surveys (CAPS), Emergency and Domestic Programs (EDP), and Interceptions Beyond Ports (IBP) enhance preparedness to chance pest introductions through domestic detection surveys; these programs will be a critical mechanism to ensure early detection of new pests as they respond to shifts in climate. Offshore Pest Information System (OPIS) works collaboratively with International Services to provide early warning of new pest outbreaks in other countries that pose a threat to U.S. agriculture, including those responding to climate changes. APHIS works cooperatively with DHS Customs and Border Protection on inspection of commodities in international trade; it maintains PestID, an archive of intercepted quarantine pests used widely as a source of updated information on origins of and commodities of infested products.

***Plant Protection and Quarantine.*** This program within APHIS has incorporated climate change forecasts into the "climatic suitability" portion of fruit and vegetable pest risk evaluations. 'Suitability' now includes climate change scenarios; development of international guidelines is underway to supplement existing standards to accommodate climate change scenarios.

#### ***Tools and Resources.***

***Plant Pest Forecasting System (NAPPEFAST)*** is now operational. The APHIS - NCSU system uses a web-based graphical user interface that links global to national climatic and geographic databases with interactive templates for biological modeling. NAPPEFAST has been used to develop high resolution global risk maps for 2010 to 2090 derived from the IPCC SRB1 and SRAB1 scenarios. This system helps APHIS identify areas of high-risk pests likely to arrive on commodities or with passengers, as well as domestic locales suitable to establishment and spread should any exotic pest get beyond ports-of-entry.

#### ***Exotic Pest Information Collection and Analysis***

***(EPICA).*** EPICA uses continuous, open-source data mining (e.g., journals, newspapers) for early detection of vectors and diseases (e.g., new virus on tomatoes) that pose a risk to US agriculture.

### **AGRICULTURAL RESEARCH SERVICE**

#### ***Overview***

The Agricultural Research Service (ARS) is the principal in-house research agency of the USDA. ARS has approximately 1,000 research projects being conducted by scientists across the country. ARS conducts research to develop and transfer solutions to agricultural problems of high national priority through 22 National Programs in 4 areas: Nutrition Food Safety and Quality, Animal Production and Protection, Natural Resources and Sustainable Agriculture Systems, Crop Production and Protection.<sup>46</sup> ARS conducts climate change adaptation research to 1) understand the impact of climate change on agricultural systems including crops, animal systems, ecosystem services, and soil, water and air resources; 2) develop genetic resources for crop and animal varieties for increased production quantity and quality under changing climate conditions; 3) develop sustainable production systems to maintain, and where possible improve, soil, water and air quality; 4) develop risk management tools for countering climate-driven threats from pathogens, insects, weeds and invasive species; and 5) improve the efficiency of water management and use.

#### ***Selected Initiatives and Strategies***

***ARS Strategic Plan.*** The *ARS Strategic Plan for 2006-2011* includes climate change as a major factor in the Service's goals and objectives throughout the Plan.<sup>47</sup> Adaptation is mentioned specifically in Objective 6.2: Improve Soil and Air Quality to Enhance Crop Production and Environmental Quality which calls for the Service to: "Measure and predict the impact of atmospheric composition and climate variation on agricultural systems, and develop technologies to enable agricultural systems to adapt to change." Additional objectives and goals in the Plan, while not mentioning adaptation, are consistent with adaptation goals, such as water conservation strategies, to support both water quantity and quality for agricultural

purposes.

### ***Programs and Institutional Mechanisms***

**Networked Research Facilities.** ARS maintains a network of research facilities at approximately 100 locations across the nation, engaged in research directed toward problem solving and decision support of crops, animals, product safety and quality, and natural resources; much of this research directly addresses or is highly relevant to mitigation of greenhouse gas emissions from agriculture and adaptation of agricultural systems to climate variability and weather extremes.

In addition, ARS' four overseas biological control laboratories conduct research projects to search for, identify, evaluate, and prioritize potential biological control agents for use against invasive species, with emphasis on species that are invasive to U.S. biological control.

ARS programs in Natural Resources and Sustainable Agricultural Systems engage researchers at 70 locations developing the technologies and strategies needed to help farmers, ranchers, and other managers effectively steward the diverse agricultural mosaic spread across the nation, even as climate continues to change. Emphasis is given to developing technologies that are economical to use and systems that support profitable production and enhance the Nation's vast renewable natural resource base. Among several National Programs is the National Program 212: Climate Change, Soils, and Emissions. The mission of this program is to improve the quality of atmosphere and soil resources affected by, and having an effect on, agriculture, and to understand the effects of, and prepare agriculture for, adaptation to climate change.<sup>48</sup>

ARS research on Plant Production and Protection includes research on plant genetic resources, genomics and genetic improvement, plant diseases and crop protection, and basic research on plant biological and molecular processes. Research in these areas is augmented by the National Plant Germplasm System, one of the world's largest collectors and distributors of germplasm and a source of traits for breeding crops that are resilient to climate and weather stresses, as well as resistant to pests and pathogens.

ARS' animal production and protection research improves the health, well-being, and efficiency of livestock, poultry, and aquatic food animals to ensure a productive and safe food supply. Emphasis is placed on germplasm characterization, improvement, and conservation; understanding the mechanisms of disease resistance, and the development of tools to prevent, control, or eradicate diseases that threaten our food supply or public health; and identifying and developing sustainable systems for animal production in diverse environments.

ARS research on Nutrition, Food Safety and Quality includes developing tests and processes that keep the food supply safe, and reduce and control pathogens and toxins in agricultural products. Climate and weather have major influences on the persistence, movement, and biological activities of microbes and microbial products in the environment.

ARS also conducts research to develop remote sensing technologies that provide information needed for adapting agriculture to changing climate. Other research activities includes the development of models that provide research tools for scientists studying impact and adaptation processes, and serve as the basis for the development of risk management tools for day-to-day production and resource management decisions, and policy development pertinent to climate change adaptation strategies. Some model examples are plant growth and yield models, soil-plant-atmosphere models, environmental process models such as wind and water soil erosion models, fate and transport models for chemical, biological and physical compound movements through agricultural systems, and hydrologic models.

## **FARM SERVICES AGENCY**

### ***Overview***

The Farm Service Agency (FSA) provides market-oriented programs dedicated to developing economically and environmentally sound American agriculture; delivering an abundant, safe, and affordable food and fiber supply; and sustaining quality agricultural communities. FSA manages the Nation's largest private lands conservation program.

### ***Selected Initiatives and Strategies***

#### ***Conservation Reserve Enhancement Program Partnerships.***

Since 2005, FSA has negotiated four Conservation Reserve Enhancement Program (CREP) agreements whose main objective is conserving agricultural irrigation water. The agreements with the governors of Kansas, Colorado, Idaho, and Nebraska, respectively, would remove a total of 255,000 acres from irrigated crop production. Incentives contributed by state and local water usage authorities pay to retire the water from agricultural irrigation in three states for the duration of the CREP contract and permanently in the other<sup>49</sup>.

### ***Programs and Institutional Mechanisms***

#### ***State and county FSA offices and county FSA committees.***

FSA administers voluntary programs impacting agricultural land through nearly 2,350 county offices supported by 50 state offices and headquarters. Local county offices perform many administrative duties, including determining land and producer eligibility for programs, maintaining records, and providing the opportunity for face-to-face interaction with agricultural producers as they consider program participation. Farmer-elected county committees are charged with fairly and equitably resolving local issues and making certain program decisions, such as recommending when two crops planted in succession in a crop year and carried to maturity under normal growing conditions should be deemed “double cropped” and made eligible for program benefits.

## **FOREST SERVICE**

### ***Overview***

The Forest Service is responsible for the health, diversity and productivity of publicly managed forests and grasslands within 193 million acres across the United States. It also partners with states, tribes and private landowners to support an additional 430 million acres of privately owned lands.

### ***Selected Initiatives and Strategies***

#### ***Climate Change Performance Scorecard (September 2011).***

The Scorecard<sup>50</sup> is a way for the Forest Service to improve its organizational capacity and readiness to

respond to climate change. Each National Forest and Grassland measures its progress by describing accomplishments and/or plans for improvement toward a “yes” answer to ten questions in four dimensions – organizational capacity, engagement, adaptation, and mitigation. By 2015, each Unit is expected to answer yes to at least seven of the scorecard questions, with at least one yes in each dimension. The replies to the scorecard questions are supported by narratives describing accomplishments and/or plans for improvement toward a “yes” answer.

***Southern Forest Futures Project (May 2011).*** The Southern Forest Futures Project (SFFP) analyzes and forecasts probable changes in forests of the 13 southern states between 2010 and 2060. It builds from the Southern Forest Resource Assessment completed in 2002. SFFP presents a range of plausible futures or scenarios of the South’s forests based on a variety of influences such as urbanization, bioenergy, climate change, land ownership changes, and invasive species. Forecasts provide a foundation for examining several broad “meta-issues” affecting southern forests, including fire, bioenergy, water supply, and wildlife. The overall goal of SFFP is to inform land management strategies, policy discussions, and program decisions with the clearest understanding of the potential long-term implications of changes in southern forests. The research project was chartered by the U.S. Forest Service Southern Region and Southern Research Station and the Southern Group of State Foresters.

***Roadmap for Responding to Climate Change (July 2010).*** In order to guide the Forest Service in achieving its goal of making the nation’s national forests and private working lands more resilient to climate change, the agency developed a Roadmap<sup>51</sup> that integrates land management, science, outreach, and sustainable operations. The focus is on three types of initiatives: (1) assessing current risks, vulnerabilities, policies, and gaps in knowledge; (2) engaging partners in seeking solutions and learning from as well as educating the public and employees on climate change issues; and (3) managing for resilience, in ecosystems as well as in human communities, through adaptation, mitigation, and sustainable consumption strategies.

***A new vision for the U.S. Forest Service (August 2009).*** In August 2009 Secretary Vilsack outlined a new vision



for the Forest Service based on restoration to combat the threats of fire, drought, pests, and disease.<sup>52</sup> Through ecological restoration, the key functions and processes of healthy ecosystems are repaired to make them better adapted to the stresses exacerbated by climate change. This vision includes an “all lands” approach that does not stop at the boundary of a national forest or grassland, but calls for the integration of forest restoration efforts across property boundaries. The Forest Service and other USDA agencies will continue to expand efforts to work with partners to sustain the entire matrix of federal, state, tribal, county, municipal, and private forests and grasslands.

***Forest Service Global Change Research Strategy (2009).***

In 2009, Forest Service Research and Development released its 2009-2019 Global Change Research Strategy. The fundamental research focus of the Strategy is to increase understanding of forest, woodland, and grassland ecosystems so that they can be managed in a way that sustains and provides ecosystem services for future generations. The Strategy balances research across a range of management, science, and science delivery actions aimed at developing adaptation and mitigation approaches to sustain healthy ecosystems. The Strategy focuses on four elements: research to enhance ecosystem sustainability (adaptation); research to increase carbon sequestration (mitigation); research to provide decision support; and shared research needs for infrastructure, scientific collaboration, and science delivery.<sup>53</sup>

***Climate Change Strategic Framework (2008).*** In 2008, the Forest Service produced “A Strategic Framework for Responding to Climate Change” which is the basis for its subsequent climate change Roadmap, Scorecard, and agency initiatives. Given impacts to forests and grasslands such as increased wildfires, pest infestations, drought, water supply issues and sea-level rise, the Framework calls for the consideration of climate change across agency planning and actions. Additionally, the Framework calls for facilitated adaptation measures to help forests and grasslands adapt to environmental stresses and to help maintain ecosystem services. Major adaptation components of the Framework include Ecological Restoration and

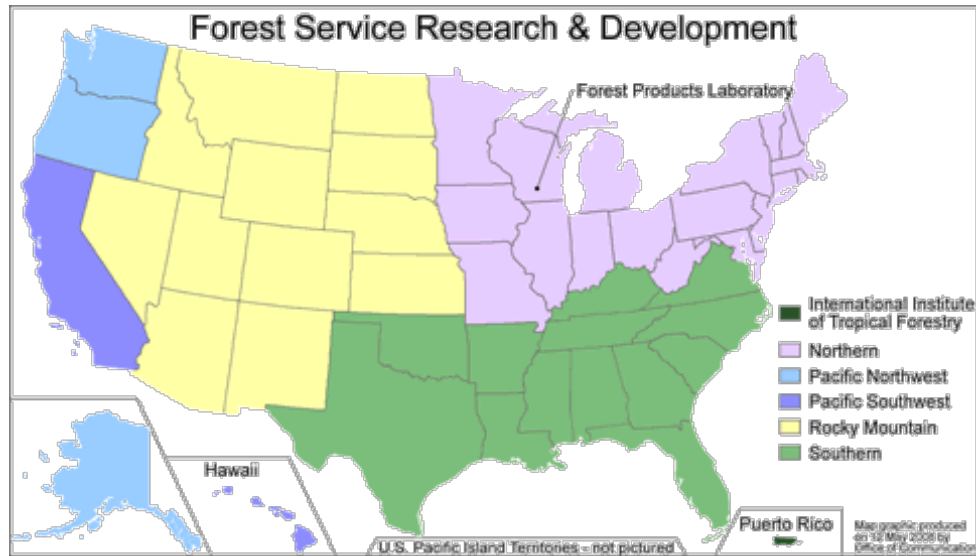
Research and Development.<sup>54</sup>

***Programs and Institutional Mechanisms***

***Climate Change Advisor’s Office.*** The Climate Change Advisor was appointed to lead Forest Service efforts to manage forests and watersheds in the face of climate change, represent the agency in climate change matters with partners, and coordinate climate change activities and communication within the agency. The Climate Change Advisor’s Office is working to bring climate change knowledge into agency planning and actions, and improve the agency’s response to climate change through existing national programs and not to create a separate program. The Climate Change Advisor’s Office oversees the development and implementation of the National Roadmap and Scorecard. *Engaging a Climate Ready Agency* is an internal newsletter published by the Office monthly.<sup>55</sup>

***Research Stations.*** U.S. Forest Service Research Stations provide national coverage for regional research, scientific information and tools that can be used by managers and policymakers to address climate change impacts to forests and rangelands. Research on the possible impacts of climate change on forests in the United States and the development of adaptation strategies has been carried out at the U.S. Forest Service for the last 20 years. Since then, assessments of climate change, its impacts and subsequent consequences to natural resource management have been the focus of continuous research efforts. Considerable effort is being put into understanding how vegetation, water, fish, and wildlife are expected to respond to a changing climate so that adaptive management strategies can be developed. Forest Service Research also contributes to the research goals of the U.S. Global Change Research Program.

***Environmental Threat Assessment Centers.*** Two centers were created to predict, detect, and assess existing and potential environmental threats to forests across the United States and to develop and share information and tools to support policy and management decisions: the Western Wildlands Environmental Threat Assessment Center (WWETAC) and the Eastern Forest Environmental Threat Assessment Center (EFETAC).<sup>56</sup>



Source: U.S. Forest Service, <http://www.fs.fed.us/research/climate/>

***The Northern Institute of Applied Climate Science (NIACS).*** NIACS is a collaborative effort among the U.S. Forest Service Northern Research Station, U.S. Forest Service Eastern Region, U.S. Forest Service Northeastern Area State and Private Forestry, the Trust for Public Land, universities, and the forest industry to provide ecological, economic and social information that can be used to facilitate the development and implementation of forest carbon management and climate adaptation. Adaptation-related projects conducted by NIACS include climate change training programs for forest managers and the development of a Climate Change Response Framework being applied across several landscapes in the Midwest and Northeast.<sup>57</sup>

### ***Tools and Resources***

***Climate Change Resource Center (CCRC).*** A joint project of the Forest Service Research Stations and the Environmental Threat Assessment Centers, the CCRC was developed to provide Forest Service resource managers and decision makers with a credible, relevant set of information and tools to address climate change adaptation and mitigation in planning and project implementation.<sup>58</sup> The site provides original syntheses written by scientists on climate change impacts and adaptation management options as well as

an extensive set of video presentations featuring management case studies and current research. The Tools section provides access to USFS tools such as the Forest Vegetation Simulator, Stream Temperature Modeling, and the Climate Change Tree and Bird Atlases, as well as other non-agency climate projection and climate impact tools. There is also an extensive bibliography of publications on global climate change, climate variability, climate models, and climate effects.

***Template for Assessing Climate Change Impacts and Management Options (TACCIMO).*** TACCIMO is a web-based assessment and reporting tool designed to integrate the most current climate change science with forest planning to meet the needs of a variety of users.<sup>59</sup> TACCIMO is a collaborative effort between the U.S. Forest Service EFETAC/WWETAC researchers and Southern and Pacific Southwest Regional planners and resource managers. TACCIMO supports the Forest Service strategic plan for addressing climate change, including science-management integration goals being implemented through the National Roadmap and Performance Scorecard. TACCIMO supports planners and managers with access to current and creditable science on climate change, which complements requirements within the National Environmental Policy Act (NEPA) and National Forest Management Act (NFMA) processes and can be used in land management plan revision, environmental

assessments, environmental impact statements, and reasonable scientifically-based alternatives.

***National Report on Sustainable Forests-2010*** This report<sup>60</sup> uses the Montreal Process Criteria and Indicators (MPC&I) for Forest Sustainability to organize and present data relevant to U.S. forests and their sustainability across ecological, social, and economic dimensions. It presents data reports addressing each of the 7 criteria and 64 indicators of the MPC&I, and discusses implications of the data.

***Resources Planning Act (RPA) Assessment (February 2012)***.<sup>61</sup> Forest Service Research and Development is finalizing the next RPA Assessment in accordance with requirements of the Forest and Rangelands Renewable Resources Planning Act of 1974 to evaluate past, present, and future trends for U.S. forests and rangelands. Alternative future scenarios were used to analyze the effects and interactions of population growth, economic growth, land use change, and climate change on forests and rangelands. The national level analysis documents recent trends in land-use patterns for different sectors (e.g., urban, agriculture, and forests) and how they are affected by demographic and economic factors. The RPA Assessment provides stakeholders and decision-makers with information on which to base adaptation options for sustainable management of forests; forest products; urban and community forests; carbon in forest resources and products; rangelands; wildlife, fish and aquatic resources; outdoor recreation; and water resources.

***MAPSS Global Vegetation Model***. The MAPSS model is a landscape- to global-scale vegetation distribution model providing simulations under both stable and changing climates.<sup>62</sup> Model output from MAPSS has been used in the Intergovernmental Panel on Climate Change's (IPCC) regional and global assessments of climate change impacts on vegetation.

***Climate Change Tree Atlas***. The Tree Atlas is an online spatial database providing an assessment of the current status and potential future suitable habitat of 134 tree species in the eastern United States.<sup>63</sup> Based on U.S. Forest Service inventory data with 38 environmental variables to generate models of current suitable habitat for each species, the Atlas uses three climate models (HADCM3, PCM & GFDL) and two emission scenarios (A1FI and B1) to model potential

future habitat distributions.

***Climate Change Bird Atlas***. The Bird Atlas is an online spatial database providing an assessment of the current and projected future status of 147 bird species in the eastern United States.<sup>64</sup> The Bird Atlas uses the same climate models and emission scenarios as the Climate Change Tree Atlas to model potential future habitat.

***Adapting to Climate Change – A Short Course for Land Managers***. This course is available on the web through the CCRC with video lectures, quizzes, literature citations, and more information regarding the impacts of climate change on forests and grasslands.<sup>65</sup>

***Responding to Climate Change on National Forests: A Guidebook for Developing Adaptation Options***.

Responding to Climate Change on National Forests contains the science-based principles, processes, and tools necessary to assist with the development of adaptation options on federal lands. The report also includes case studies of adaptation in national forests and national parks that integrate climate change into resource management and planning.<sup>66</sup>

***Seedlot Selection Tool***. The seedlot selection tool (SST) is a GIS mapping program designed to help forest managers match seedlots with planting sites based on climatic information. The tool can be used to map current climates, or future climates based on selected climate change scenarios. Although it is tailored for matching seedlots and planting sites, it can be used by anyone interested in mapping present or future climates defined by temperature and precipitation.<sup>67</sup>

## NATIONAL INSTITUTE OF FOOD AND AGRICULTURE

### Overview

The National Institute of Food and Agriculture (NIFA) is the agency within the U.S. Department of Agriculture (USDA) which administers funding that supports extramural research, education, and extension activities. Congress created NIFA through the Food, Conservation, and Energy Act of 2008. NIFA replaced the former Cooperative State Research, Education, and Extension Service (CSREES), which had been in existence since 1994. NIFA's mission is to

advance knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education, and extension programs in the Land-Grant University System and other partner organizations.<sup>68</sup>

NIFA-funded projects generate knowledge to develop agriculture and forest systems that maintain sustainable productivity in response to climate variables such as flood, drought, and temperature change. This will help producers plan for and make decisions to adapt to changing environments, sustain economic vitality, and take advantage of emerging economic opportunities offered by climate change mitigation technologies. Agriculture and natural resource science at NIFA integrates research, education and extension to ensure that ground breaking research discoveries go beyond the laboratory and make their way into the classroom and to people who can put the knowledge into practice and improve lives.

### ***Selected Initiatives and Strategies***

***Climate Research Initiative: Earth System Modeling.*** The National Science Foundation (NSF), Department of Agriculture (USDA), and Department of Energy (DOE), have agreed to align resources to create a joint research program to develop climate system models to provide insights into climate variability and impacts on ecosystems. Under NIFA, grants are being provided beginning in 2010 that are focused on developing models that can be linked to existing crop, forestry, aquaculture and livestock models to assess the adequacy of potential outcomes of risk management strategies and support reliable yield and production forecasting.

***Agriculture and Food Research Initiative: Climate Change.*** The NIFA awards grants through its Agriculture and Food Research Initiative (AFRI) program. This AFRI Climate Change Challenge Area focuses on the priority to mitigate and adapt to climate change. It supports activities that reduce greenhouse gas emissions, increase carbon sequestration in agricultural and forest production systems, and prepare the nation's agriculture and forests producers to adapt to changing climate related factors such as floods, drought, weather extremes, and temperature variation. In FY2011 the program allocated \$60 million

to three projects, which represents a major investment in studying the effects of climate change on agriculture and forest production.<sup>69</sup>

## **NATURAL RESOURCES CONSERVATION SERVICE**

### ***Overview***

The Natural Resources Conservation Service (NRCS) is a mission-oriented agency whose primary role it is to provide technical and financial assistance to help private land owners to care for their land through the application of conservation systems. NRCS provides products and services that enable people to be better stewards of the air, soil, water, and related natural resources on private agricultural lands. Climate change is an important and an overarching theme that cuts across Agency programs and activities.<sup>70</sup>

### ***Selected Initiatives and Strategies***

***Climate Change Literacy and Improving Awareness.*** NRCS has designed a climate change curriculum built around a basic introductory course integrating three inherently linked topics: air quality, energy, and climate change. This basic course is online and available to the public and for credit through AgLearn, the Department of Agriculture's online training system.<sup>71</sup> The curriculum of advanced discipline-specific courses within each of the three areas of air quality, energy concerns, and climate change are also available online, including a course entitled "Greenhouse Gases and Carbon Sequestration," and new relevant courses will be added in the coming months.<sup>72</sup>

### ***Programs and Institutional Mechanisms***

***Conservation Programs.*** NRCS's natural resources conservation programs provide incentives to help people reduce soil erosion, enhance water supplies, improve air and water quality, reduce net greenhouse gas emissions and sequester carbon, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. Programs such as the Environmental Improvement Programs, Conservation Stewardship Program, Water Resource Programs, and Easement Programs are working to help states and localities address the impacts that are now exacerbated by climate change.<sup>73</sup> Examples include:

- *Conservation Stewardship Program (CSP)* - The program, authorized in the 2008 Farm Bill, offers payments to producers who maintain a high level of conservation on their land and who agree to adopt higher levels of stewardship. Eligible lands include cropland, pastureland, rangeland and nonindustrial forestland. The program provides many conservation benefits including improvement of water and soil quality, wildlife habitat enhancement and adoption of conservation activities that address the effects of climate change.
- *Emergency Watershed Protection* - The purpose of the Emergency Watershed Protection (EWP) program is to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed.<sup>74</sup>
- *Wildlife Habitat Incentive Program (WHIP)* - The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land. The Natural Resources Conservation Service administers WHIP to provide both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat.<sup>75</sup>

- *Inventory Observations and Monitoring Networks.* NRCS has responsibility for a number of surveys and monitoring networks all of which are integral to climate change activities: National Resources Inventory (NRI), a statistical survey of land use and natural resource conditions and trends on U.S. non-federal lands; Web Soil Survey, soil maps and data produced by the NRCS and its National Cooperative Soil Survey for the United States; and SNOwpack TELemetry (SNOTEL). NRCS installs, operates, and maintains an extensive, automated system designed to collect snowpack and related climatic data in the Western United States and Alaska.<sup>76,77,78</sup> These products are used for forecasting and management of water supplies. The Soil Climate Analysis Network (SCAN) consists of automated remote sites which collect soil moisture and soil temperature data along with precipitation, wind, and solar radiation data. This data is used for the management and prediction of climatic issues affecting our natural resources.

### **Tools and Resources**

***Practice Standards for Greenhouse Gas Emission Reduction and Carbon Sequestration.*** The NRCS developed a qualitative ranking of conservation practices that can be applied to greenhouse gas and carbon sequestration. The ranking system allows conservation planners to assess how a given practice performs in reducing emissions or capturing carbon.<sup>79</sup>

## **■ DEPARTMENT OF COMMERCE (DOC)**

### ***Department-wide Initiatives***

***Addressing Climate Change Impacts at the Department of Commerce in Operations and Programs.*** Issued in response to E.O. 13514 and guidance from CEQ, DOC released a climate change adaptation policy memorandum on June 1, 2011. The policy establishes a Coordinating Committee to develop and implement a department-wide climate adaptation plan that responds to potential impacts of climate change on the

Department's operations and programs. The climate adaptation plan will analyze DOC's vulnerability to climate change and identify actions to make the Department's programs and trust resources, and the U.S. as a whole, more resilient to climate change. The policy specifies that the climate adaptation plan will recognize DOC's important roles in developing and delivering information, tools, and services that help federal and non-federal partners plan for climate change. The climate adaptation plan will also establish

a mechanism to track progress and evaluate the Department's ability to effectively adapt to a changing climate.<sup>80</sup>

**Strategic Plan 2007-2012.** The DOC Strategic Plan 2007-2012 identifies promotion of environmental stewardship, including advancing our nation's understanding about climate variability and change, as one of the primary strategic goals for the Department of Commerce (DOC). While the strategic plan does not specifically discuss the need for adaptation, an important underpinning is the translation of climate science into services, tools, and products to provide decision makers with the information that they need to help the economy and ecosystems adapt to climate variability and change. The strategic plan identifies NOAA and NIST as the primary organizations within DOC that contribute to the USGCRP.<sup>81</sup>

**Energy and Climate Working Group.** DOC has established an Energy and Climate Working Group that is responsible for facilitating the integration of climate-related activities across all of its bureaus, with the goal of providing the principal actors in the United States economy with environmental data and information on climate change to make informed decisions. DOC seeks to leverage the stakeholder networks and service offerings of economics-based bureaus, as well as the National Institute of Standards and Technology (NIST) resiliency programs, to amplify the provision of climate services from the National Oceanic and Atmospheric Administration (NOAA). Over time, this will help the private, public, and not-for-profit sectors to:

- Anticipate and adapt their operations to the effects of climate change
- Decrease climate-related risks (financial, operational, reputational, and environmental)
- Set research priorities and strategies to deal with climate change
- Create new businesses, services, and products, where applicable, to meet the needs of a nation and world experiencing climate change.

**Memorandum of Understanding (MOU) between DOI and DOC to Coordinate and Cooperate on Climate Related Activities Involving Science, Services, Mitigation, Adaptation, Education, and Communication (August 2010).** DOI Secretary Salazar and DOC Secretary Locke

signed this MOU in August 2010. The MOU provides a framework to build upon existing partnerships that bring together the Departments' best available climate science and services to inform adaptation strategies and response decisions to manage America's oceans, coasts, Great Lakes, and public lands. This agreement will also draw on national and regional programs and partnerships of each Department, including DOI's emerging Climate Science Centers and Landscape Conservation Cooperatives and DOC/NOAA's climate science and services, Regional Integrated Sciences and Assessments program, and Regional Climate Centers.<sup>82</sup>

**Addressing Climate Change in the Department of Commerce Environmental Justice Strategy.** On August 4, 2011, the Secretary of Commerce and the heads of 16 other federal agencies took an important step in the Administration's effort to support environmental justice by signing the Memorandum of Understanding on Environmental Justice and Executive Order 12898 (EJ MOU). The EJ MOU identifies "impacts from climate change" as one of four focus areas that agencies should consider as they identify and address environmental justice issues in agency programs, policies and activities. Under the EJ MOU, each agency is responsible for finalizing and publicizing an environmental justice strategy. The DOC environmental justice strategy has been available for public comment since September 30, 2011. DOC will post its final Environmental Justice Strategy by February 11, 2012.

## ECONOMIC DEVELOPMENT ADMINISTRATION

### Overview

The Economic Development Administration (EDA) was established under the Public Works and Economic Development Act of 1965 to lead the federal economic development agenda. EDA's mission is to advance the economic revitalization of communities and regions suffering from economic distress by making grant-based investments to attract private capital investment and create higher-skill, higher-wage jobs.

### Selected Initiatives and Strategies

**Global Climate Change Mitigation Incentive Fund (GCCMIF).** The GCCMIF was established to strengthen the linkages between economic development and



environmental quality. The mission of the GCCMIF is to finance projects that foster economic development by advancing the green economy in distressed communities. The GCCMIF supports projects that create jobs through, and increase private capital investment in, efforts to limit the nation's dependence on fossil fuels, enhance energy efficiency, curb greenhouse gas emissions, and protect natural systems (i.e., build adaptive capacity).

## **NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY**

### **Overview**

NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

### ***Selected Initiatives and Strategies***

***NIST-NOAA Resilient Communities.*** This collaboration addresses wildland fires, wind, storm surges, tsunamis, and earthquakes. Understanding and reducing the vulnerability of buildings and infrastructure systems to extreme events also improves adaptive capabilities for a changing climate.

## **NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**

### **Overview**

The National Oceanic and Atmospheric Administration (NOAA) supports activities that advance our understanding of and ability to anticipate changes in Earth's environment, improve society's ability to make scientifically-informed decisions, and conserve and manage ocean and coastal resources. From daily weather forecasts, severe storm warnings, and climate monitoring to fisheries management, integrated coastal restoration and management, and supporting marine commerce, NOAA's products, operations, and services play an important role in protecting life and property and in conserving and restoring ecosystems.

### ***Selected Initiatives and Strategies***

***NOAA Next Generation Strategic Plan (NGSP).*** In December 2010, NOAA published the NGSP, which establishes a vision of the agency's future, long-term goals, specific objectives for the next five years, and measures to assess progress towards those objectives. The NOAA's Vision for the Future calls for "healthy ecosystems, communities, and economies that are resilient in the face of change", and the NGSP includes four long-term goals to help achieve this vision: Climate Adaptation and Mitigation, Resilient Coastal Communities and Economies, Healthy Oceans, and Weather-Ready Nation. These goals and their underlying objectives will be achieved by strengthening and integrating three cross-cutting, enterprise-wide capabilities of NOAA, including science and technology, stronger partnerships and stakeholder engagement, and effective organizational and administrative functions. These areas demonstrate NOAA's emphasis on informing decisions, assessing vulnerabilities, and building resilience to climate change and other stressors.<sup>83</sup>

***Climate Services.*** NOAA has long been a trusted source of weather and climate information and services that help institutions and communities better understand and prepare for risks and opportunities associated with varying environmental conditions. The agency recognizes the relevance that such information has for adaptation decision making at all scales to better help communities prepare for climate change impacts, such as future heat waves, drought, forest fires, and coastal inundation, with the aid of products such as inundation maps, heat projections, climate and precipitation models, and vulnerability and risk assessments for climate-sensitive sectors and regions of the United States. Through the combined efforts of our National Climatic Data Center, national laboratories, Coastal Services Center, National Weather Service, and Climate Program Office, NOAA will continue to meet the growing public demand for critical information so that families, businesses and communities can make informed choices to prepare for and become more resilient to our changing environment. NOAA's Regional Climate Service Directors (RCSDs) are building upon a broad range of NOAA climate products and services and leverage the expertise of widely diverse partners to better assess,

refine, and deliver climate science and information to address specific regional needs. Above all, NOAA is committed to strengthening our relationships with our academic, private sector, government, and nonprofit partners, who play a critical role in improving the many products and services the nation relies upon.

***Incorporating climate change into NOAA's stewardship responsibilities.*** NOAA is working to assess the impacts of climate change on its stewardship responsibilities and to incorporate climate change into planning, prioritization, and management strategies.<sup>84</sup> In May 2010, NOAA's Office of Habitat Conservation (OHC) and Office of Ocean and Coastal Resource Management (OCRM) released a programmatic framework for considering climate change impacts in coastal habitat restoration, land acquisition, and facility-development investments. Per recommendations outlined in the framework document, OCRM is in the process of developing technical guidance for incorporating information on climate change into Coastal Zone Management Act (CZMA) programs e.g., the Coastal and Estuarine Land Conservation Program and the National Estuarine Research Reserve System, that conduct land acquisition and facilities development. In September 2010, OCRM also released a new guide to help state and territorial coastal managers develop and implement adaptation plans to reduce the risks of climate change impacts on their coasts.<sup>85</sup> In October, 2011, NOAA's Coastal Services Center, in conjunction with The Nature Conservancy, released "Marshes on the Move: A Manager's Guide to Understanding and Using Model Results Depicting Potential Impacts of Sea Level Rise on Coastal Wetlands."<sup>86</sup> In 2010, NOAA launched an assessment of science needs and best practices for consideration of climate change in its activities under the Endangered Species Act. In 2011, NOAA launched development of methods for assessing the vulnerability of marine fisheries in a changing climate to help inform observations, research and management efforts.

***Providing information and training on climate change for coastal and ocean decision makers.*** Decision makers need access to the best-available scientific information and user-friendly tools to effectively reduce vulnerabilities of communities and ecosystems. NOAA provides foundational climate change information

through observations, monitoring, research, assessment, and modeling to increase understanding of current and future impacts of climate change and variability on coastal and marine ecosystems and coastal communities. In addition, NOAA makes this information accessible through user-friendly tools, services, and training to support and inform decision-making.<sup>87</sup> For example, in January 2011 NOAA and partners released a guide to help decision makers assess the vulnerability of natural resources in a changing climate entitled "Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment"<sup>88</sup>. Since then, NOAA and partners have developed and provided training on assessing vulnerability to climate change for hundreds of natural resource decision makers nation-wide. Since 2010, NOAA has also provided regional workshops on incorporating climate change into coastal habitat conservation efforts involving hundreds of government and non-governmental participants. NOAA Sea Grant extension agents, National Estuarine Research Reserve staff, and National Marine Sanctuary staff regularly interact with the public and other resource managers in coastal states to directly connect science and users.

***Working with global partners to adapt to climate impacts.*** NOAA works with foreign governments through both bilateral and multilateral channels to apply its technical and applied capabilities and provide end-to-end support for climate adaptation and resilience planning and activities to address climate adaptation around the globe. NOAA's scientific contributions to international observing, data stewardship and access, research, and assessment programs ensure that high-quality climate information is consistently available to decision makers in the international adaptation community. NOAA supports the U.S. involvement in the development and coordination of international climate adaptation policy through initiatives such as the World Meteorological Organization's (WMO) Global Framework for Climate Services and the United Nations' Framework Convention on Climate Change (UNFCCC). NOAA also contributes to building the scientific capacity of other nations to analyze and respond to climate change by training foreign scientists, meteorologists, adaptation practitioners, and other stakeholders to produce, analyze, interpret, and use climate

information, products, and services to manage risks and support practical decision-making (e.g., bilateral agreements, NOAA's Africa Desk, and Pacific Climate Information System-PaCIS). NOAA is a partner in a variety of international efforts to better understand, prepare for, and address impacts of climate change on water, coastal and marine resources and the communities that depend on them including the development of climate information products, forecasts, early warning systems, and adaptation tools and strategies that help integrate climate adaptation into larger sustainability and development initiatives.

***Memorandum of Understanding (MOU) between NOAA and EPA (April 2011).*** NOAA and EPA signed a MOU to strengthen coordination and communication efforts to assist regional, state, tribal, and local governments in becoming more sustainable and resilient communities, protect healthy ecosystems, restore degraded ecosystems, and adapt to climate change. While specific activities will be defined through a work plan each year, the MOU identified the following areas for collaboration with respect to climate change adaptation: produce guidelines, tools, case studies, and other products to help coastal and waterfront communities adapt to climate change; develop and implement climate change adaptation tools and strategies through existing networks such as the Regional Ocean Governance groups; create outreach materials for coastal communities describing the results of existing programs such as Climate Ready Estuary projects; and support place-based projects focused on equitable development and climate change adaptation in coastal urban watersheds.<sup>89</sup>

***National Fish, Wildlife and Plants Climate Adaptation Strategy.*** NOAA and USFWS are co-leading development of the first National Fish, Wildlife and Plants Climate Adaptation Strategy to provide a nationwide blueprint for coordinated action among federal, state tribal and nongovernmental entities to safeguard the nation's valuable natural resources in a changing climate.<sup>90</sup>

### ***Programs and Institutional Mechanisms***

***NOAA Climate Adaptation Team (NCAT).*** The NCAT was established in February 2011 to help coordinate NOAA's climate adaptation assets distributed throughout the agency. By taking an integrated

approach, the NCAT seeks to facilitate the establishment of federal and non-federal partnerships and allow for more effective communication about the agency's adaptation programs and efforts. The NCAT bridges climate adaptation efforts across the agency, fosters intra- and inter-agency partnerships, tracks implementation of the Interagency Climate Change Adaptation Task Force (ICCATF) recommendations, and ensures consistent messaging about climate adaptation.

***Climate and Societal Interactions (CSI) Program.*** CSI provides national leadership in developing interdisciplinary science, services, and assessments for application in climate-sensitive sectors and regions. The Regional Integrated Sciences and Assessments (RISA) teams are regional, university-based research groups that analyze the impacts of climate variability and change on resource management, planning, and policy decisions in key sectors.<sup>91</sup> CSI supports research to understand and address vulnerability to climate change and to inform decision-making related to water (through the Sectoral Applications Research Program) and coasts (through the Coastal and Ocean Climate Applications Program). The NOAA-sponsored International Research Applications Project (IRAP) will focus on advancing climate risk management in particular regions around the world where vulnerabilities to a changing climate have the most immediate and lasting effect on human welfare.<sup>92</sup>

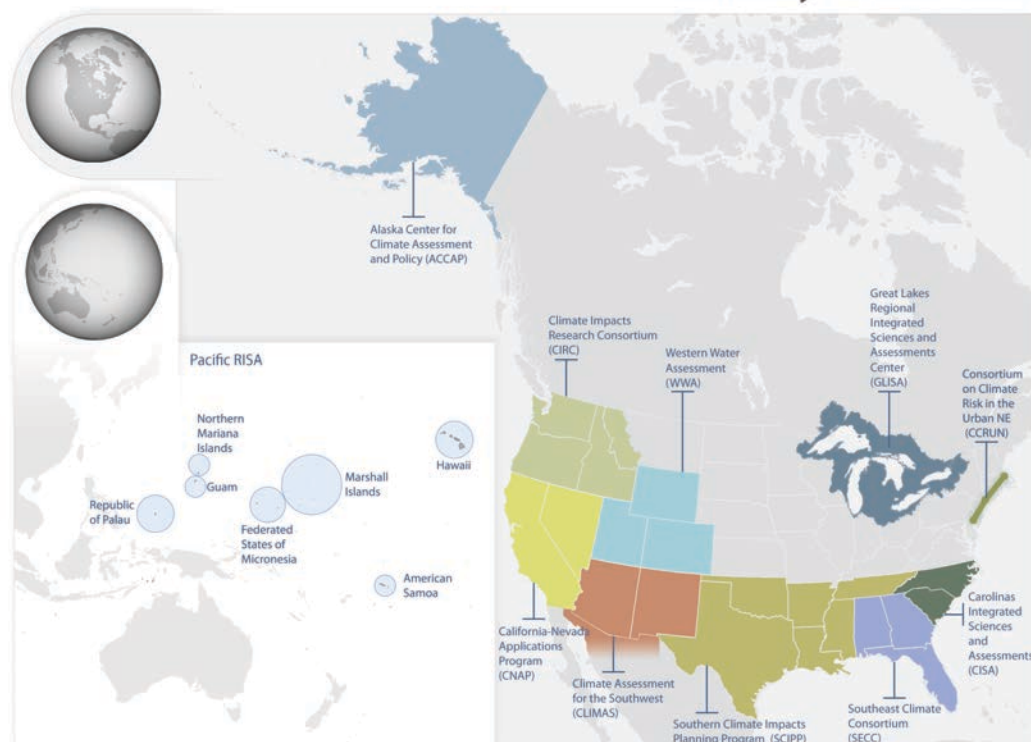
***Coastal Services Center (CSC).*** CSC was created to bring information, technology and services to coastal resource managers across the United States. CSC's efforts include understanding needs and providing the data, tools, and training to make coastal information useful to end users through communication, visualization, and ongoing dialogue. To foster collaboration and interaction at all scales, CSC has a strong local-to-regional presence, based in the Southeast and including staff in the Northeast, Mid-Atlantic, Gulf of Mexico, West Coast, Great Lakes, and Hawaii.<sup>93</sup>

***National Weather Service (NWS).*** Although NWS Climate Prediction Center (CPC) has primary operational responsibilities at short climate timescales (weeks, months, seasons) in support of the NWS preparedness and response mission, the CPC also has capabilities to provide climate information for the

intermediate timescales (e.g., seasons, years, decades) at which preparedness and adaptation meet or overlap. This includes activities to link seasonal and decadal modeling and prediction (e.g., frequency and intensity of droughts and floods) and efforts to develop prediction techniques for regional climate information across timescales.<sup>94</sup>

**National Integrated Drought Information System (NIDIS).** NIDIS is an interagency effort led by NOAA to: integrate and foster drought coping strategies through research and education; integrate drought data and predictions; and develop prototype programs for design and implementation of drought early-warning systems.<sup>95</sup>

## Currently Funded RISAs



Source: National Oceanic and Atmospheric Administration at [http://www.climate.noaa.gov/cpo\\_pa/risa](http://www.climate.noaa.gov/cpo_pa/risa)

**Regional Climate Centers (RCCs).** Currently, there are 6 Regional Climate Centers (RCCs) managed by the National Climatic Data Center (NCDC). These centers are a federal-state cooperative effort to produce and deliver timely climate products and services to users at local, state, regional and national levels.<sup>96</sup>

**National Estuarine Research Reserves System (NERRS, or Reserve System).** The Reserve System is a network of 28 biogeographic regions within the United States that are protected for long-term research, water-quality monitoring, education, and coastal stewardship. Reserve staff work with local communities to address resource management issues, offering educational opportunities and professional development programs.

There is currently an effort underway to conduct a NERRS-wide climate sensitivity analysis, as well as anticipated support from NOAA's Climate Program Office for comprehensive vulnerability assessments and adaptation planning at selected NERRS sites to inform sustainable ecosystem management in a changing climate. Information gained from these projects will help to strengthen NOAA's climate and coastal ecosystem adaptation efforts.

**Sentinel Sites.** NOAA has formed a Sentinel Site Program, and is developing the infrastructure, tools and guidelines to support networks of sentinel sites will be developed to coordinate assets and efforts with those of other federal agencies to increase

understanding of, and better respond to, sea level change impacts on coastal ecosystems and surrounding communities. This effort will leverage existing capabilities and resources from science to stewardship to support resilient coastal communities.

***Ocean Climate Center.*** In October 2010, NOAA opened the Ocean Climate Center to facilitate the exchange of technical, scientific, policy and education information, and ideas. The Ocean Climate Center serves as an ocean and climate change communication center for the San Francisco Bay Area, leading the Ocean Climate Initiative to address climate change impacts along the California coast.<sup>97</sup>

***Fisheries and the Environment Program (FATE).*** The FATE Program supports research, projections and assessment on the impacts of climate change and variability on living marine resources and ecosystems. One of its core focus areas is the development, evaluation, and distribution of indicators of climate and other environmental impacts on fisheries.<sup>98</sup>

***Climate Regimes and Ecosystem Productivity Program (CREP).*** The CREP Program<sup>99</sup> provides federal, state, tribal and private-sector decision-makers with information on how climate variability and change is impacting U.S. marine ecosystems and the communities and economies that depend on them. This information is critical to fulfilling NOAA's core management responsibilities for marine-related fisheries, protected species and habitats in a rapidly changing world. CREP is currently limited to providing information, assessments and projections of climate-related impacts on living marine resources of the Bering Sea and Gulf of Alaska (North Pacific Climate Regimes and Ecosystem Productivity project (NPCREP)). This area is home to some of our nation's richest commercial fishing grounds – almost 50% of the U.S. landings, by weight, occur in Alaska. To provide information and projections of climate-related impacts on valuable fisheries and other marine resources, CREP works with many partners to collect data on climate, ocean and living marine resource conditions through a highly efficient, leveraged network of in situ and remote observing systems. Information from the observing systems is then used to:

- Improve fishery recruitment predictions and stock assessments used in fishery management

decisions;

- Track climate-related impacts on fisheries and other living marine resources; and
- Anticipate and reduce the impacts of climate-related changes on living marine resources (fisheries, protected species, habitats) and the communities that depend on them.

***Ocean Acidification Program.*** The goals of the NOAA Ocean Acidification Program are to plan and oversee a long-term coastal and open ocean monitoring program and to lead research on the impacts of ocean acidification on marine ecosystems and the socioeconomic implications of these impacts. It will also provide educational opportunities to learn about this threat through national public outreach and coordinate activities with other agencies, nongovernmental groups and the international community.<sup>100</sup>

### ***Tools and Resources***

The NOAA Climate Services portal is currently in its prototype phase, with the goal of becoming the “go-to” website for climate data, products, and services for all users. The portal will enhance access to climate data and services, timely articles and information, educational resources, and tools. In addition to fostering inter- and intra-agency collaboration, the site is intended to better support decision making at all scales.<sup>101</sup>

***Coastal Climate Adaptation Resources Website.*** A database of adaptation resources is available by category, such as adaptation plans, case studies, and vulnerability assessments, or by state. Visitors have the opportunity to share resources and dialog on these issues.<sup>102</sup>

***Digital Coast.*** The Digital Coast is used to address timely coastal issues, including land use, coastal conservation, hazards, marine spatial planning, and climate change. This partnership network is not only a website, but also a strong collaboration of coastal professionals intent on addressing coastal resource management needs. Website content is provided by numerous organizations and includes data, tools, training and assistance opportunities, and success stories. Partners include: NOAA Coastal Services Center<sup>103</sup>, American Planning Association<sup>104</sup>,

Association of State Floodplain Managers<sup>105</sup>, Coastal States Organization<sup>106</sup>, National Association of Counties<sup>107</sup>, National States Geographic Information Council<sup>108</sup>, and The Nature Conservancy<sup>109</sup>.

**Drought Portal.** NIDIS maintains a web-based U.S. Drought Portal, providing information on U.S. drought conditions, forecasts, effects of drought on local communities, and mitigation measures.<sup>110</sup>

**Legislative Atlas.** The Legislative Atlas is an online, GIS-based tool that enables users to display coastal and ocean laws by jurisdictional boundaries. The database can be searched by region or state, as well as by state or federal agency.<sup>111</sup>

**Sea Grant Climate Network.** This website includes informational resources, a discussion forum, links to upcoming events, and social networking opportunities for the broader Sea Grant community, including extension agents.<sup>112</sup>

**State of the Climate.** NOAA's National Climatic Data

Center (NCDC) publishes the *State of the Climate* report each year in the *Bulletin of the American Meteorological Society*. The report collects climate observations from around the globe and presents a series of climate indicators. The report records temperature of the lower and upper atmosphere, precipitation, sea ice, greenhouse gases, humidity, cloud cover and type, glaciers, temperature and saltness of the ocean, snow cover, and extraordinary weather and climatic events.<sup>113</sup>

**Global Climate Change Indicators.** The NOAA National Climatic Data Center maintains a compilation of the latest information from measures of observed climate change.<sup>114</sup>

**Climate Literacy: The Essential Principles of Climate Science.** The guide provides information to individuals and communities to help understand the impacts of climate change and approaches to adapting to and mitigating climate change.<sup>115</sup>

## ■ DEPARTMENT OF DEFENSE (DOD)

### **Department-wide Initiatives**

Climate change will require the Department of Defense (DoD) to examine issues related to climate change adaptation with respect to both its installations and missions. DoD's built and natural infrastructure serves as the basis for sustaining military readiness. Maintaining this infrastructure in the face of climate change impacts is of critical importance to DoD. Likewise, climate change will shape the operating environment, roles, and missions that DoD undertakes.

**Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP).** SERDP is DoD's environmental science and technology program, planned and executed in partnership with DOE and EPA, with participation by numerous other federal and non-federal organizations.<sup>116</sup> ESTCP is DoD's environmental technology demonstration and validation program. The Program's goal is to identify and demonstrate cost-effective technologies that address DoD's highest priority environmental requirements. SERDP and ESTCP's Resource

Conservation and Climate Change program area supports the development of the science, technologies, and methods needed to manage DoD's installation infrastructure in a sustainable way. One the program's areas of investment is developing the models and tools necessary to understand infrastructure vulnerabilities to and the impacts from climate change.

**Defense Environmental International Cooperation (DEIC) Program.** The DEIC Program supports DoD dialogue with foreign defense force counterparts regarding environmental issues that have implications for infrastructure, training space, or operations. The desired outcomes included: building strategic partnerships; reducing regional tensions; and the sustainment of mission capability. Priorities include collaborating to build resilience in the face of climate change. In particular, issues being examined include vulnerabilities to built infrastructure, stressed ecosystems, training and testing lands, equipment limitations, health protection, logistic challenges, and changing (expanding) mission requirements.

**Readiness and Training Policy and Programs Office.** The DoD Readiness and Training Policy and Programs



Office is exploring adaptive approaches to climate change to help better prepare for future risks to the training environment and ensure continued military readiness.

***Legacy Resource Management Program (Legacy).*** The Legacy Program provides financial assistance to DoD efforts to preserve and protect natural and cultural resources on DoD lands, while supporting military readiness. The Legacy Program supports research into ecosystem management initiatives, habitat preservation efforts, archaeological investigations, invasive species control, Native American consultations, and/or monitoring and predicting migratory patterns of birds and animals. Legacy projects include guidelines for assessing vulnerability of species and habitats to climate change and sea level rise assessments of DoD facilities.<sup>117</sup>

### ***Tools and Resources***

***Quadrennial Defense Review.*** In February 2010, the Pentagon released its Quadrennial Defense Review, and noted that climate change will affect the DoD in two broad ways. First, it will shape the operating environment and missions by acting as “an accelerant of instability or conflict, placing a burden to respond on civilian institutions and militaries around the world.” And second, the military will need to adjust to the impacts of climate change on its facilities and capabilities.<sup>118</sup>

***Strategic Sustainability Performance Plan.*** The Strategic Sustainability Performance Plan lays out DoD’s sustainability goals and performance expectations. The Department’s vision of sustainability is to maintain the ability to operate into the future without decline—either in the mission or in the natural and manufactured systems that support it. Sustainable practices, to the extent they can be shared with partner nations, support climate change adaptation through the building of resilience. This resilience can contribute to the Department’s goal of conflict prevention as outlined in the 2010 Quadrennial Defense Review.

***Guidelines for Assessing the Vulnerability of Species and Habitats to Climate Change.*** In January 2011, the DoD Legacy Program partnered with other federal agencies and the National Wildlife Federation to produce

*Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment.* The document describes how vulnerability assessments can be used to manage natural resources in changing climatic conditions and provides guidance for agencies and organizations to consider in conducting vulnerability analysis for an adaptation strategy.<sup>119</sup>

***Climate Change Tools for Adapting Management Strategies.*** The DoD Natural Resources Conservation Program hosted a workshop at the 2010 National Military Fish and Wildlife Association (NMFWA) Annual Meeting. The workshop educated DoD personnel about climate change tools and resources.<sup>120</sup>

## **ARMY CORPS OF ENGINEERS**

### ***Overview***

The U.S. Army Corps of Engineers (USACE) is charged with missions to protect more than 12 million acres of public lands, more than 900 ports and harbors, nearly 14,000 miles of levees and 12,000 miles of commercial inland waterways, and more than 400 miles of coastal shoreline. In addition, USACE is the nation’s largest provider of hydroelectric power, producing roughly 3% of the nation’s electrical power from hydroelectric plants at its dams. And USACE has a key, first-responder role in times of national emergencies. Nearly all of these missions are at some risk from potential effects of future climate change.<sup>121</sup>

Over the last several years, and in active cooperation with other federal agencies having water or land resource management responsibilities, USACE has been surveying the vulnerability and resilience of its installed infrastructure, and of the water and land resources it manages to potential effects from future climate change. The ultimate goal of this assessment work is to inform the USACE policies and decisions for taking practical, nationally consistent and regionally tailored, cost-effective actions that will reduce climate change vulnerability and enhance the resilience of water resource infrastructure to enable continued achievement of USACE objectives and missions.

### ***Selected Initiatives and Strategies***

***USACE Climate Change Adaptation Policy Statement (June 2011).*** This policy statement, signed by the Assistant

Secretary of the Army for Civil Works, Ms Joellen Darcy, establishes that USACE has long been adapting its policy, plans, programs, and projects to the climates in which they operate and to global changes around them to ensure that mission objectives are met. The statement also makes clear that the policy of USACE is “to integrate climate change adaptation planning and actions into our Agency’s missions, operations, programs, and projects,” meaning that climate change adaptation “will be considered at every step in the project life cycle for all USACE projects, both existing and planned, through a logical, rational, legally justifiable process that develops practical, nationally consistent, and cost-effective adaptation measures, both structural and nonstructural, to reduce vulnerabilities and enhance the resilience of our water-resource infrastructure.”

***USACE Climate Change Adaptation Plan and Report (September 2011).*** This plan and report establishes that USACE considers climate change and other global change to be among the major challenges of the 21<sup>st</sup> century and demonstrates how climate change adaptation will help USACE meet its missions and obligations under its own and the US Army Campaign Plans. The 2011 report describes the five areas currently of highest concern to USACE, as identified in its high-level climate change vulnerability analysis. Those five areas are: navigation, flood and coastal storm damage reduction, environment, hydropower, and water supply. The 2011 report also establishes that USACE will continue its very close collaboration with others – federal, state, local, and tribal partners, as well as non-governmental organizations with interests in USACE climate change adaptation issues and actions as it plans and executes its integrated water resources management missions under changing global conditions.

***National Action Plan to Manage Freshwater Resources in a Changing Climate (August 2011).*** This plan, released by CEQ as a product of the Federal Interagency Climate Change Adaptation Task Force working group on freshwater resources, listed six major recommendations and assigned federal agency leads to them where they could be identified. USACE was a key representative in the working group and had a central role producing the plan. Recommendation 5, Support Integrated Water Resources Management, and several

actions stemming from that, will be led by USACE.

***Guidance on Incorporating Future Sea-Level Change Projections into Planning and Design.*** The USACE has developed new guidance together with other agencies, including USGS and NOAA, to institute a nationwide, consistent vertical datum. USACE is now completing its comprehensive evaluations of all relevant USACE project elevations to ensure that heights of projects (levees, dams, jetties, etc.) are known accurately and precisely against current sea levels and for tracking sea level changes. An Engineering Circular (1165-2-211) was produced and a USACE Civil Works Technical Letter is under development now to guide USACE operations on responses to sea-level change at vulnerable projects. A multi-year, comprehensive evaluation of all relevant USACE projects with regard to sea-level change is scheduled to begin in 2012, if federal budgets allow.

***Adaptation Pilot Projects.*** Multi-year adaptation pilot projects are continuing at USACE under a series of authorities and programs (see below). These pilots are designed to support agency planning and operations within the context of climate change by covering a large range of the different missions, objectives, and operating environments relevant to USACE operations. The pilot projects include both creating new engineering knowledge about specific projects – Garrison Dam and Sakakawea Reservoir, for example – and developing information that can be the basis of more general policies, technologies, and other management options. Different project types are being selected, such as reservoir resiliency, back bay flooding protection, and shoreline protection feasibility, as a way to extract results that can be deployed across the agency. By way of example, the Apalachicola-Chattahoochee-Flint interagency project led by NOAA intends to develop a drought information system for “better informed and more timely drought-related decisions.” For this project, USACE is tasked with developing tools to meet the identified needs of the pilot district and its stakeholders to enable agreement on drought conditions before they begin developing adaptation strategies.

### ***Programs and Institutional Mechanisms***

***Memorandum of Understanding (MOU) between USACE, USGS, and NOAA to support Collaborative Science,***

***Services and Tools to Support Integrated and Adaptive Water Resources Management (May 2011).*** The MOU forms a partnership between USACE, USGS, and NOAA to address water resource challenges by providing new and more integrated water-resource information and services to these federal agencies and regional, tribal, state, and local partners. Part of this effort addresses how integrated water resource management agencies can best adapt future climate and global changes, including land-use changes, an aging water delivery infrastructure, and limited water resources.<sup>122</sup> Building on these agencies' complementary missions in water science, observation, prediction and management, USACE is helping lead the partners in developing plans for implementation and outreach to other potential partners in the MOU, and is leading development of plans for a cross-agency Federal Support Toolbox for integrated water resource management.<sup>123</sup>

***Climate Change and Water Working Group (CCAWWG).*** Together with Reclamation, USGS, and NOAA, USACE formed an interagency workgroup on climate change and water resources to evaluate how climate change considerations can be incorporated into activities related to the Nation's water resources<sup>124</sup>. CCAWWG has been expanded to include USEPA, NASA, and FEMA, and has released a number of reports since 2008, most recently, "Addressing Climate Change in Long-term Water Resources Planning and Management: User Needs for Improving Tools and Information" (January 2011). This report builds on the earlier CCAWWG product published (January 2009) as USGS Circular 1331 on the federal perspective on climate change and water resources management and describes some of the needs that water resource management agencies have for climate information in their long-term decision-making. A responding report, led by the CCAWWG federal water science agencies, NOAA and USGS, is now being written to describe the state of current science with respect to those management needs and the prospects for future climate information that can help close gaps between user needs and climate science to use as the basis for action. Following that, a companion series of reports on short-term user needs and science agency responses, is planned.

***Western States Federal Agency Support Team***

***(WestFAST).*** The USACE, Bureau of Reclamation, USGS, EPA, NOAA, NRCS, USFS, USFWS, and BLM provide support to the Western States Water Council to implement the Western Governors' Association report *Water Needs and Strategies for a Sustainable Future: Next Steps*. The WestFAST team has released an inventory of federal climate change programs for water managers in the west.<sup>125</sup>

***International Climate Change Adaptation Efforts.*** The USACE works internationally on climate change adaptation issues through the International Center for Integrated Water Resource Management (ICIWaRM) at USACE Institute for Water Resources. This work involves a wide range of projects extending from extensive hydrology and hydrodynamics work with Canada on the Great Lakes and Columbia River under changed future conditions; with Peru on water availability and means for potential conflict resolution under future increased drought strain; and with Mexico on its first baseline national wetlands inventory and potential climate change effects.

## ***Tools and Resources***

***Federal Facilities Environmental Stewardship and Compliance Assistance Center (FedCenter).*** The FedCenter is a joint initiative of the Army Corps of Engineers' Construction Engineering Research Laboratory, EPA's Office of Enforcement and Compliance Assurance, and the Office of the Federal Environmental Executive. The website provides technical and compliance assistance information to federal agencies and environmental officials. The site maintains a program area for climate change adaptation that houses information on federal regulations, guidance, and policy; supporting information and tools; lessons learned; trainings, presentations, and briefings; and conferences and events.<sup>126</sup>

***Responses to Climate Change Program.*** Building on existing science and knowledge, the Responses to Climate Change (RCC) Program continues developing methods, policies, and processes for effective adaptation of USACE projects, systems, and programs to climate change. USACE is also planning to develop methods, policies, and processes to assess the effectiveness of climate change adaptation, and anticipates that assessment will include an evaluation

of how well alternative adaptation measures improve system flexibility to perform over a wide range of future scenarios. The RCC will also identify knowledge and technology gaps to guide research and development activities, and will transfer knowledge and technology to other USACE programs.<sup>127</sup> For example, the Program will provide immediate knowledge transfer to USACE projects and programs already facing the impacts of climate change. As interim results from these pilots are completed, tools developed under the RCC program are being made available publically.<sup>128</sup>

***Global Change Sustainability (GCS) Program.*** The GCS Program at USACE began in 2011 as a series of new and connected elements under the RCC and the IPET-HPDC Lessons-Learned Implementation Team, continuing work begun as a response to lessons learned from Hurricane Katrina to improve USACE capability to incorporate new and changing information. GCS work in 2011 focused on the effects of global change on USACE programs and implementing adaptation measures. GCS activities will include updating drought contingency plans, evaluating reservoir needs, conducting a Sustainable Rivers demonstration project with The Nature Conservancy, revising frequency analysis for floods and coastal storms, developing guidance for ecosystem restoration planning, evaluating all projects with respect to sea-level change, and integrating climate change mitigation measures with adaptation actions. The multi-year work under GCS has begun, and as products are completed, they will be available on the Corps website.<sup>129</sup>

## NAVY

### ***Overview***

Climate change is a national security challenge with strategic implications for the Navy. While climate change alone is not likely to lead to future conflict, it may be a contributing factor. Climate change is affecting, and will continue to affect, U.S. military installations and access to natural resources worldwide. It will affect the type, scope, and location of future Navy missions.

### ***Programs and Institutional Mechanisms***

***Task Force Climate Change.*** The Chief of Naval Operations established Task Force Climate Change (TFCC) in May 2009 to address the implication of climate change for national security and naval operations, to answer the question “when” in terms of Navy decisions regarding climate change, and to ensure the Navy is ready and capable to meet all mission requirements in the 21<sup>st</sup> century.

### ***Selected Initiatives and Strategies***

***Navy Arctic Roadmap (November 2009).*** TFCC developed this 5-year strategic plan to respond to changing climatic and landscape conditions in the region which affect maritime security, naval readiness, and resource management policies, strategies and investments and contribute to a safe, stable, and secure Arctic region.<sup>130</sup>

***Navy Arctic Strategic Objectives.*** Taking into account federal and DoD guidance, the Navy Arctic Strategic Objectives were signed by the Chief of Naval Operations in May 2010. This document outlines the desired end-state and strategic objectives for the Navy in the changing Arctic region.

***U.S. Navy Climate Change Roadmap (May 2010).*** This second roadmap released by TFCC examines the broader issues associated with climate change impacts on Navy missions, force structure and infrastructure, with an emphasis on collaborative partnerships within DoD, the federal government, academia, and NGOs.<sup>131</sup>

***National Security Implications of Climate Change for U.S. Naval Forces.*** In March 2011, the National Research Council under the Naval Studies Board published a study to examine the national security implications of climate change for U.S. naval forces. While it is not a Navy initiative, the research committee found that even modest climatic changes presented new security challenges to the U.S. Navy, Marine Corps, and Coast Guard. The report organizes its findings and recommendations into six discussion and action areas for naval leadership. These areas include: disputes of boundaries and exclusive economic zones; strains on naval capabilities; vulnerabilities to naval coastal installations; demands for establishing greater U.S., allied, and/or international maritime partnerships; impacts on the technical underpinnings

that enable naval force capabilities, particularly those in the Arctic; and investments for additional research and development that have implications for future naval operations and capabilities.<sup>132</sup>

***Table-top Exercises, and Limited Objective Experiments.***

Navy conducted a July 2010 game at the Naval War College that examined climate change as an Irregular Warfare dimension shaping security environments in different regions of the world. The Navy has also participated in table-top exercises and limited objective experiments related to the changing Arctic including a September 2011 Fleet Arctic Operations Game 2011, sponsored by the Norfolk, Va.-based U.S. Fleet Forces Command (USFF). This game explored many factors that impact the U.S. Navy's ability to operate in the Arctic and participants identified gaps that limit sustained maritime operations in the region and explore possible mitigation strategies and long-term solutions needed to address these gaps

***Arctic Mission Analysis / Capabilities Based Assessment.***

In accordance with Action Items laid out in the Arctic Roadmap, the Navy is currently looking at what its

missions and roles will be in a changing Arctic, as well as what capabilities will be required to conduct those missions.

***Educational Curriculum*** – Recognizing that today's students are tomorrow's naval leaders, U.S. Navy educational institutions are incorporating global climate change into coursework and research. The U.S. Naval Academy has a Global Climate Change course offered in its Oceanography Department. The U.S. Naval War College and U.S. Naval Postgraduate School also conduct research on different scientific and strategic aspects of global climate change.

***ICEX/SCICEX*** – In March 2011 Navy conducted its Biennial Ice Exercise (ICEX) which focused on submarine technologies and tactics with other Navy technology and science also present. Collaborations with other navies, military services, and government agencies took place. At the same time, the Navy conducted its Science Ice Exercise (SCICEX), which allows science data collection on otherwise classified submarine cruises.

## ■ DEPARTMENT OF EDUCATION (ED)

### ***Department-wide Initiatives***

***Policy Statement on Climate Change Adaptation.*** Issued in response to E.O. 13514 and guidance from CEQ, ED released a policy statement on climate change adaptation in June 2011. The policy affirms that the ED will develop and publish an adaptation plan by June 2012 and meet other deadlines specified by

CEQ's *Implementing Instructions*. The department-wide Climate Change Adaptation Work Group, which is chaired by the Senior Sustainability Officer and includes representatives from each Principal Office, will coordinate climate change adaptation planning and implementation.<sup>133</sup>

## ■ DEPARTMENT OF ENERGY (DOE)

### ***Department-wide Initiatives***

***Climate Change Adaptation Policy Statement.*** Issued in response to E.O. 13514 and guidance from CEQ, DOE released a policy statement on climate change adaptation in June 2011. The policy adopts the guidance and framework provided by the ICCATF and establishes a department-wide Climate Change

Adaptation Planning Working Group that includes representatives from all DOE Departmental Elements. The working group will assess the Department's climate change vulnerabilities and create a DOE climate change adaptation plan. The Associate Deputy Secretary of Energy is responsible for adaptation and is supported by the DOE Sustainability Performance Office.<sup>134</sup>

**Office of Climate Change Policy and Technology (CCP&T).** The DOE Office of Policy and International Affairs is the Department's focal point for the analysis of policy and technology options to address global climate change. CCP&T delivers timely analysis of domestic and international climate change developments, and serves as the Department's lead representative in interagency, intergovernmental, and international activities related to climate change and energy. In this capacity, the Office provides analytical and technical support for Cabinet and sub-Cabinet-level committees that provide strategic direction for participating federal agencies on climate change related policy, science, technology, and other change on the energy sector, and collaboration on issues related to adaptation and the transition to a clean energy economy.

**Climate Change and Potential Impact on Energy Security.** DOE's Office of Policy and International Affairs and Office of Science [Office of Biological and Environmental Research (BER)] are examining, on a national and regional basis, the energy-water interdependences and the systems implications of the full portfolio of energy technologies as it evolves under various energy and climate policy scenarios in order to inform policy development and future research and development planning.

**Impacts, Adaptation and Vulnerability Science.** Oak Ridge National Laboratory's (ORNL) Climate Change Science Institute is examining the societal and ecological consequences of climate change through its Impacts, Adaptation, and Vulnerability Science research theme.<sup>135</sup> ORNL is developing a comprehensive database on climate change impacts, adaptation, and vulnerability research and science.<sup>136</sup> ORNL's research also includes the following project areas: incorporation of impacts and adaptation into integrated assessment models; integrated science and computing support for a National Climate Service; and development of a regional integrated assessment model framework.<sup>4</sup>

**Impact of Climate Change on DOE facilities.** DOE's Office of Fossil Energy is assessing the impact of climate change, including sea level rise, subsidence and increased frequency and severity of hurricanes on oil storage and delivery infrastructure and operations, including current and future response capabilities of

the Nation's Strategic Petroleum Reserve along the Gulf Coast.<sup>137</sup>

**Research and Collaborations in Support of Climate Science Objectives.** DOE's BER, USDA and the National Science Foundation (NSF) are working together to develop climate system models (as part of the Decadal and Regional Climate Prediction Using Earth System Models) more powerful than existing models to provide insights into climate variability and resulting impacts.<sup>138</sup> BER also represents DOE as a principal to the U.S. Global Change Research Program.

**Research and Development Activities.** DOE Program Offices support a broad range of research and development activities at DOE National Laboratories, universities, and with the private sector. DOE, as the landlord of the Nation's largest civilian National Laboratory system, supports climate change prediction, mitigation, and adaptation research and development activities ranging from the most basic to the most applied at various sites across the United States. For example, DOE supports integrated assessment modeling of climate change impacts and adaptation to better inform regional integrated planning, including the development of different measures of impacts, techniques for accommodating thresholds and tipping points, concepts and approaches to addressing probabilities and uncertainties, and methods for addressing data limitations.

**Water Efficient Power Plants.** The Office of Fossil Energy and the National Energy Technology Laboratory (NETL) is developing advanced water management technologies applicable to fossil and other power plants in three specific areas: non-traditional sources of process and cooling water to demonstrate the effectiveness of utilizing lower-quality water for power plant cooling and processing needs; innovative water reuse and recovery research explores advanced technologies for the recovery and reuse of water from power plants; and advanced cooling technology research examines advanced wet, dry, and hybrid cooling technologies.

**Building Technologies and ENERGY STAR®.** DOE's Office of Renewable Energy and Energy Efficiency supports building technologies, including technologies that reduce energy and water consumption, and works with the U.S. EPA on the ENERGY STAR program.



The ENERGY STAR label appears on products that have met strict requirements for energy efficiency, thus reducing GHG emissions (i.e., mitigation), and in some cases direct water savings (i.e., adaptation). DOE is responsible for all ENERGY STAR test procedures including commercial and residential ENERGY STAR clothes washers and residential dishwashers.

### ***Program and Institutional mechanisms***

***Sustainability Performance Office (SPO).*** The SPO oversees DOE sustainability efforts required by E.O. 13514, E.O. 13423, and other federal regulations. DOE established the SPO to manage its sustainability efforts, including the long-term implementation of the Strategic Sustainability Performance Plan and the DOE climate change adaptation policy.<sup>139</sup>

***Earth System Modeling Program.*** The DOE ESM Program supports research to improve the temporal and spatial resolution of climate projections, with a continuous goal to reduce uncertainty of projected climate variables. The ESM contributes to the climate predictability goals of the USGCRP.

***The Regional Climate Modeling Program.*** The DOE RCM Program supports research that develops numerical methods that assure high resolution projections in the Arctic, tropics, and other regions

that are climate sensitive. The program also supports climate analysis and diagnostics and intercomparison of all 23 of the world's leading climate models, including those of DOE, NOAA, and NASA.

***The Atmospheric Systems Research Program.*** The DOE ASR Program supports research dedicated to advancing cloud, aerosol, and precipitation parameterizations, in regions that are sources of significant climate uncertainty.

***The Atmospheric Radiation Monitoring (ARM) Climate Research Facility.*** The DOE ARM facility provides suites of clouds, aerosol, radiative transfer, and supporting meteorological measurements to both the ASR program and to other agency programs across the federal government.

***The Terrestrial Ecosystem Research (TES) Program.*** The DOE TES program supports research on unmanaged ecosystems that are both climate sensitive and provide significant feedbacks on the climate system, both regionally and globally.

***The Integrated Assessment (IA) Program.*** The DOE IA program supports the analysis of climate-energy interdependencies, including interfaces with regional, national, and global economic and policy questions supported by CCP&T.<sup>140</sup>

## **■ DEPARTMENT OF HEALTH AND HUMAN SERVICES (HHS)**

### ***Department-wide Initiatives***

***Sustainability and Climate Change Adaptation Policy Statement.*** On June 3, 2011, the HHS released a climate change adaptation policy issued in response to E.O. 13514 and guidance from CEQ. The policy statement discusses the potential effects of climate change on human health, adopts the guidance and framework provided by the ICCATF, and states that the agency will develop a climate change adaptation plan.<sup>141</sup>

### **CENTERS FOR DISEASE CONTROL AND PREVENTION**

#### ***Overview***

The Centers for Disease Control and Prevention (CDC) is responsible for protecting health and promoting quality of life through health promotion, prevention of disease, injury and disability, and preparedness for new health threats. As it pertains to climate change, CDC leads efforts to anticipate the health effects of climate change, to assure that systems are in place to detect and track them, and to take steps to prepare for, respond to, and manage associated risks.

## ***Selected Initiatives and Strategies***

***CDC Policy on Climate Change and Public Health.*** This document provides a list of priority actions for health and climate change.<sup>142</sup>

***Climate-Ready States and Cities Initiative.*** CDC is using its prevention expertise to help state and city health departments investigate, prepare for, and respond to the health effects that climate change may have on people. Through their first climate change cooperative agreements in 2010, CDC awarded \$5.25 million to ten state and local health departments to assess risks, make plans and develop programs to address challenges over the next three years. CDC will help states and cities partner with local and national climate scientists to understand the potential climate changes in their areas. CDC will assist states and cities in developing and using models to predict health impacts, to monitor health effects, and to identify the areas that are most vulnerable to these effects.<sup>143</sup>

## ***Programs and Institutional Mechanisms***

***Climate and Health Program.*** CDC has created a Climate and Health Program within the Division of Environmental Hazards and Health Effects of the National Center for Environmental Health. CDC's expertise and programs in environmental health, infectious disease and global health form the foundation of public health efforts in climate change. CDC's work addresses five broad areas: building climate change capacity at state and local health departments; developing partnerships; promoting workforce development; developing tools and applications through applied research and development; and communicating health-related aspects of climate change.

## ***Tools and Resources***

***CDC Climate and Health website.*** The website provides information on major health effects from climate change with additional resources and publications related to each.<sup>144</sup> Funding opportunities (e.g., for state and local public health offices), links to partnering organizations, and workforce development opportunities and educational materials are also available.

## ***Climate Change and Public Health Webinar series.***

CDC, along with the American Public Health Association (APHA), National Association of County and City Health Officials (NACCHO), Association of State and Territorial Health Officials (ASTHO), and the Society for Public Health Education (SOPHE), co-sponsor and host a series of webinars titled "Climate Change: Mastering the Public Health Role." The series focuses on effectively communicating the health-related aspects of climate change, promoting workforce development, and ensuring capacity building at local levels. Archived webinars are available on-line for viewing.<sup>145</sup>

***Preparing for Heat Waves.*** CDC scientists have developed tools for local emergency planners and decision makers to use in preparing for and responding to the threats posed by heat waves in urban areas. With FEMA and NOAA, CDC helped develop the *Excessive Heat Events Guidebook* released by the EPA in 2006.<sup>146</sup> Sample related publications include *Evaluating Models of Heat Vulnerability & Heat Island Impact in NYC* and *Developing a Modular Web-based Preparedness Modeling Tool for Heat Waves*.<sup>147</sup>

***National Environmental Public Health Tracking Network.*** The CDC's National Environmental Public Health Tracking Network combines data about health and environmental problems from a variety of national, state, and city sources to better monitor public health, exposure, and hazard information. New data will soon be added related to climate change.<sup>148</sup>

## **NATIONAL INSTITUTES OF HEALTH**

### ***Overview***

The National Institute of Environmental Health Sciences (NIEHS) within the National Institutes of Health (NIH) conducts basic, applied, and clinical research on the health effects of environmental exposures. The NIEHS is engaged in multiple activities with other federal agencies, international research and policy organizations, academia, and nongovernmental organization stakeholders to better understand the links between climate change and adverse human health impacts, and to communicate findings, and work with decision makers to incorporate this information into sound health policy and actions.

### ***Selected Initiatives and Strategies***

***Interagency Working Group on Climate Change and Health (IWGCCH).*** In January 2009, the NIEHS formed the IWGCCH, an ad hoc group of federal agencies and organizations, to identify gaps in knowledge about the consequences of climate change on human health and propose research to address those gaps. The NIEHS released *A Human Health Perspective on Climate Change* in April 2010, which highlights the Working Group's findings.<sup>149</sup>

***Trans-NIH Working Group on Global Health and Climate Change.*** The NIH Working Group focuses on current and future climate change research and supports a variety of research projects. Led by NIEHS, this group has developed an ongoing funding opportunity announcement to support research studies to assess and model population vulnerability to climate change.<sup>150</sup> In addition, the working group strives to connect researchers to other grant opportunities within the NIH. For an example, see NIH Guide Notice NOT-TW-10-008 led by the NIH Fogarty International Center.<sup>151</sup>

### ***Tools and Resources***

***NIEHS Climate Change and Human Health website.*** This site provides information on NIEHS activities and events, as well as links to other useful organizations for both mitigation and adaptation.<sup>152</sup>

***Human Health Impacts of Climate Change (HHICC) Research Program.*** The HHICC research program coordinates NIEHS sponsored research to better understand the effects of climate change on human health and coordinate research initiatives across the NIEHS, NIH, and with other federal agencies.<sup>153</sup>

***NIH Challenge Grants.*** The NIH has increased support for research on the health effects of climate change through NIH Challenge Grants in Health and Science Research. Grants support research to quantify the impact of climate change on disease burden and health outcomes, project the health impacts of different climate scenarios, and evaluate the effectiveness of proposed adaptation strategies on human health and well being

## **■ DEPARTMENT OF HOMELAND SECURITY (DHS)**

### ***Department-wide Initiatives***

***Climate Change Adaptation Task Force.*** In response to Executive Order 13514, and in coordination with CEQ, DHS established the Climate Change Adaptation Task Force (Task Force) in January, 2010, as a pilot activity to assess how climate change could affect DHS missions, policy, and programs. The Task Force analyzed program areas that could be affected by climate change, including human migration, workforce health, and infrastructure protection. The task force developed case studies for the Southeast and Southwest regions to understand the cross-border impacts of climate change such as migration, infrastructure, and human health and identify areas of action for DHS. The report concluded that climate change represents a complex challenge for homeland security with strategic implications for the Department and the Nation.

DHS is in the process of developing a Climate

Change Adaptation Roadmap (CCA Roadmap) to fulfill the EO 13514 requirement for all Federal Agencies to reinforce and comply with the U.S. Government's efforts to develop a national climate change adaptation strategy, and as such, is the Department's supporting adaptation plan. The DHS CCA Roadmap identifies planning tasks and activities to guide the Department's near-, medium-, and long-term actions regarding climate change adaptation into 2018 and beyond. As with all homeland security activities, these actions seek to ensure security and resilience across all core homeland security mission areas.

### ***Sustainability and Efficiency Task Force***

***Recommendations (Feb 2010).*** The Sustainability and Efficiency Task Force recommendations recognize the impacts climate change, specifically extreme weather events, can have on national security and stability. The report makes general operational and organizational recommendations to support sustainability as well as

specific recommendations pertaining to water and energy, transportation, procurement and waste management.<sup>154</sup>

## FEDERAL EMERGENCY MANAGEMENT AGENCY

### Overview

The Federal Emergency Management Agency (FEMA) has a stated mission to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards. FEMA leads and supports the nation in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery and mitigation.

### Selected Initiatives and Strategies

**FEMA Strategic Plan (FY 2011 – 2014).** In January 2011, FEMA released their strategic plan for FY 2011 – 2014. The strategic plan provides the foundation for FEMA to promote community participation, build the nation's ability to stabilize and recover from a disaster event, establish a unified and common understanding among the emergency management team, and learn from the past and innovate as an organization. The strategic plan recognizes that climate change, coupled with deteriorating infrastructure, has the potential to alter the types and magnitudes of hazards faced by communities.<sup>155</sup>

**Strategic Foresight Initiative (SFI).** FEMA facilitates the SFI as a collaborative effort to help emergency managers understand how the world is changing. The SFI released a summary of their findings in May 2011, which identified climate change as one of the nine drivers likely to affect the field of emergency management over the next 15 years. The SFI recommended that emergency management community consider these drivers as it updates long-term plans.<sup>156</sup>

**NFIP Reform Working Group.** FEMA established the National Flood Insurance Program Reform Working Group to identify and analyze options for the future of the program. This internal work group includes a cross-section of the Federal Insurance and Mitigation Administration. Phase I began with the NFIP Listening

Session. The analysis of comments culminated in a report entitled *Content Analysis of Breakout Session Comments* and Phase I concluded with release of a final report entitled *NFIP Stakeholder Listening Session: Findings and Next Steps*. Phase II began in March 2010 with the formation of the NFIP Reform Working Group. The Working Group identified guiding principles for the reform effort and crafted evaluation criteria to steer policy analysis, incorporating comments from the listening sessions and the internet. The Working Group also reviewed prior evaluations of the NFIP program. FEMA released the *NFIP Reform: Phase II Report* in 2010.<sup>157</sup> Phase III began in June 2010, and it will identify and develop a set of policy alternatives to consider in the reform effort. This phase will result in a comprehensive NFIP reform package that will be delivered to Congress.<sup>158</sup>

**Risk MAP (Mapping, Assessment, and Planning) Multi Year Plan (March 2009).** FEMA is initiating Risk MAP and has developed a multiyear plan spanning FY10-FY14. The vision for Risk MAP is to deliver quality data that increases public awareness and leads to action that reduces risk to life and property. Risk MAP builds on flood hazard data and maps produced during the Flood Map Modernization program, recognizing that the dynamic nature of floodplains will require updated analysis of flood hazards based on climatic conditions such as changing rainfall data as well as hurricane patterns and intensities. Risk Mapping, Assessment, and Planning (Risk MAP) Multi-Year Plan: Fiscal Years 2010 - 2014 was approved on March 16, 2009.<sup>159</sup>

**Coastal Construction Manual.** In 2008, FEMA published a Coastal Construction Manual (FEMA 55) that documents state-of-the-art and best practices in coastal construction in accordance with information and recommendations contained in several pertinent publications. Currently FEMA's Mitigation Directorate is in the preliminary stages of substantially revising the Coastal Construction Manual. This revision will include a new section (or subsection) that addresses climate change.<sup>160</sup>

**Community Rating System.** FEMA has a program component of the NFIP, called the Community Rating System (CRS), which provides financial incentives for implementing practices aimed at mitigating future losses beyond the minimum NFIP floodplain management standards. It is likely that the next

revision of the CRS manual (which will probably be issued in 2011) will contain new climate change-

specific language describing certain CRS activity credits.<sup>161</sup>

## ■ DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

### *Department-wide Initiatives*

***Policy Statement for Climate Change Adaptation.*** Issued in response to E.O. 13514 and guidance from CEQ, HUD released a policy statement for climate change adaptation on June 3, 2011. The policy establishes an agency Climate Change Adaptation Steering Committee/Work Group to oversee and coordinate department-wide adaptation planning and implementation. HUD will publish a department-wide climate adaptation plan by June 2012, apply the guiding principles and planning framework outlined by ICCATF, and coordinate activities with other agency and interagency efforts. The policy recommends directing resources towards a set of ongoing efforts at HUD related to climate change adaptation.<sup>162</sup>

***Partnership for Sustainable Communities.*** In June 2009, HUD, the Department of Transportation and the Environmental Protection Agency formed a partnership focused on ensuring that housing and transportation goals are met while simultaneously protecting the environment, promoting equitable development, and helping to address the challenges of climate change.<sup>163</sup> HUD's 2010 appropriations included \$150 million for their Sustainable Communities Initiative to improve regional planning efforts that integrate housing and transportation decisions and increase the capacity to improve land use and zoning.<sup>164</sup>

***Consolidated Planning Enhancement Initiative.*** The Office of Community Planning and Development is leading an effort to improve climate change adaptation planning at the state and local government levels through the Consolidated Planning Enhancement Initiative. The initiative will encourage communities to incorporate climate change adaptation into needs assessments and funding priorities.<sup>165</sup>

***Long-Term Disaster Recovery Working Group.*** At the President's request, the Secretaries of Homeland Security and Housing and Urban Development are co-chairing a Long-Term Disaster Recovery Working Group composed of the Secretaries and Administrators of more than 20 departments, agencies and offices.<sup>166</sup> This high-level, strategic initiative will provide operational guidance for recovery organizations as well as make suggestions for future improvement. As a part of this effort, Secretary Donovan indicated in a Feb 2010 speech:

“With the Long-term Disaster Recovery Working Group I co-chair with Secretary Napolitano, we are working with communities to protect against the effects of climate change by strengthening building codes, considering new approaches to land use, and incentivizing economic development in more climate-resilient places. And we expect to deliver our report to the President in April – and then get to work implementing it.”

## ■ DEPARTMENT OF THE INTERIOR (DOI)

### *Department-Wide Initiatives*

The U.S. Department of Interior (DOI) is responsible for managing and sustaining U.S. public lands, water, wildlife, and energy resources representing one-fifth of the land in the country, 35,000 miles of coastline, 1.76 billion acres of the Outer Continental Shelf and water

supplies for more than 30 million people. It also manages the federal government's trust responsibilities to 565 Indian tribes. Bureaus and offices in the DOI include: Bureau of Indian Affairs, Bureau of Indian Education, Bureau of Land Management (BLM), Bureau of Ocean Energy Management, Regulation and Enforcement, Bureau of Reclamation (BOR), National

Park Service (NPS), Office of Surface Mining, Reclamation and Enforcement, U.S. Fish and Wildlife Service (FWS), and U.S. Geological Survey (USGS), most of which have a role to play in climate change adaptation. Through efforts described below, the Department is developing a framework to be able to make a difference in the resiliency of natural, cultural, and historic resources by bringing existing expertise and capacity together in a more strategic manner to make better decisions.

**Climate Change Adaptation Policy Statement.** Issued in response to E.O. 13514 and implementation guidance from CEQ, DOI released a policy statement for climate change adaptation on June 3, 2011. The policy memorandum reaffirms DOI's commitment to planning for climate change adaptation and publishing a department-wide adaptation plan by June 2012. The DOI Climate Change Working Group will be responsible for developing the adaptation plan as well as producing interim products required by CEQ such as a high-level vulnerability assessment and priority actions for the department. The adaptation plan and interim products complement existing DOI planning efforts, including implementation of the Climate Change High Priority Performance Goal described in the *Strategic Plan for Fiscal Years 2011-2016*. The DOI will combine its adaptation and mitigation policies into a new Departmental Manual chapter to guide current and future climate change planning efforts.<sup>167</sup>

**Strategic Plan for Fiscal Years 2011 – 2016.** The DOI released a Department-wide strategic plan in January 2011. The strategic plan provides a framework for the programs and activities for the DOI's bureaus and offices, facilitating the integration of programs, enabling the allocation and alignment of resources to achieve key goals, and aiding collaboration with key stakeholders. The plan includes mission goals, strategies, and measures to gauge the Department's performance. The mission goals address renewable energy, sustainable water management and conservation, climate change adaptation, youth in natural resources, and efforts to improve the safety of Indian communities. As an example, by the end of 2012, the DOI's Climate Change High Priority Performance Goal states that the department will "identify resources that are particularly vulnerable to

climate change and implement coordinated adaptation response actions" for 50 percent of the nation.<sup>168</sup>

**Secretarial Order 3226 - Evaluating Climate Change Impacts in Management Planning.** Signed on January 19, 2001 by former Secretary Babbitt, this order established policy for the Department and bureaus to consider climate change impacts when making major decisions, undertaking planning, setting priorities, and committing resources.

**Secretarial Order 3226 Amendment No. 1 – Climate Change and the Department of Interior.** This order was signed on January 16 2009, by former Secretary Kempthorne, replacing the original order from January 2001.<sup>169</sup> This amended order lists a number of directives intended to mainstream the consideration of climate change projections and impacts across the Department's operations and responsibilities, including requiring bureaus and offices to:

- "Consider and analyze potential climate change impacts when undertaking long-range planning exercises, setting priorities for scientific research and investigations, and/or when making major decisions affecting DOI resources;
- "Review all existing programs, facilities, boundaries, policies, and authorities under the respective bureau or office to identify potential impacts of climate change on the bureau's or office's areas of responsibility and to recommend a set of response actions; and
- Promote flexible decision making that can be modified in the face of uncertain conditions by using "*Adaptive Management: The U.S. Department of the Interior Technical Guide*" as a framework for managing natural resources."

**Secretarial Order 3289 - Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources.** Secretarial Order 3289 was signed September 14, 2009 and amended February 22, 2010, replacing Secretarial Order 3226 Amendment No. 1 from January 2009, and reinstating the original order from January 2001.<sup>170</sup> The Order established a Climate Change Response Council, renamed Energy and Climate Change Council, within the Office of the Secretary to coordinate the development of an integrated strategy across

Department agencies and bureaus to respond to the impacts of climate change on tribes and on the land, water, ocean, fish and wildlife, and cultural heritage resources that the Department manages. The order identifies Climate Science Centers and Landscape Conservation Cooperatives (described below) as central components of the Department's effort to understand and address the impacts of climate change on the resources for which it is responsible.

***Memorandum of Understanding (MOU) between DOI and DOC to Coordinate and Cooperate on Climate Related Activities Involving Science, Services, Mitigation, Adaptation, Education, and Communication.*** DOI Secretary Salazar and DOC Secretary Locke signed this MOU in August 2010. The MOU provides a framework to build upon existing partnerships that bring together the Departments' best available climate science and services to inform adaptation strategies and response decisions to manage America's oceans, coasts, Great Lakes, and public lands. This agreement will also draw on national and regional programs and partnerships of each Department, including DOI's emerging Climate Science Centers and Landscape Conservation Cooperatives and DOC/NOAA's climate science and services, Regional Integrated Sciences and Assessments program, and Regional Climate Centers.<sup>171</sup>

***DOI and USDA Conduct Joint Climate Change Research Projects.*** In September 2010, the DOI and USDA announced that they would conduct joint climate change research on Southeast and Northwest freshwater systems. The multi-year project will be carried out by the USGS and USFS to better understand the effects of climate change on aquatic ecosystems and guide long-term planning for climate change adaptation.

### ***Programs and Institutional Mechanisms***

***Energy and Climate Change Council.*** Established by Secretarial Order 3289, the Council, chaired by the Secretary, will implement "a coordinated Department-wide strategy to address renewable energy efforts and to increase scientific understanding of and development of effective adaptive management tools to address the impacts of climate change on our natural and cultural resources." The Council will coordinate energy and climate change activities among the DOI's agencies and bureaus and with other federal

departments and agencies. The Council is tasked with developing and implementing an integrated strategy for renewable energy and climate change impacts for resources managed by the Department.<sup>172</sup>

***Energy and Climate Change Task Force.*** Secretarial Order 3285 was signed in January 2010, and it established an Energy and Climate Change Task Force.<sup>173</sup> The task force, which is co-chaired by the Deputy Secretary and the Counselor to the Secretary and comprised of all Assistant Secretaries and Bureau Directors, reports directly to the Energy and Climate Change Council and is responsible for designing a strategy to increase the development and transmission of renewable energy from public lands. In 2011, the Energy and Climate Change Task Force created the Climate Change Working Group to aid in overseeing the DOI's climate change adaptation planning efforts.

***WaterSMART.*** In February 2010, the Secretary of the Interior signed Secretarial Order 3297 establishing a water sustainability strategy for the United States.<sup>174</sup> The WaterSMART Program focuses on water conservation and helping resource managers make decisions about future water use. The program acknowledges the impact of climate change on future water demand and identifies adaptive measures to address those challenges. The program maintains a clearinghouse that distributes best practices and cost-effective technologies for water information collection, analysis, and delivery.<sup>175</sup> The WaterSMART Program also coordinates activities and research with the DOI Energy and Climate Change Response Council, Climate Science Centers, and Landscape Conservation Cooperatives.

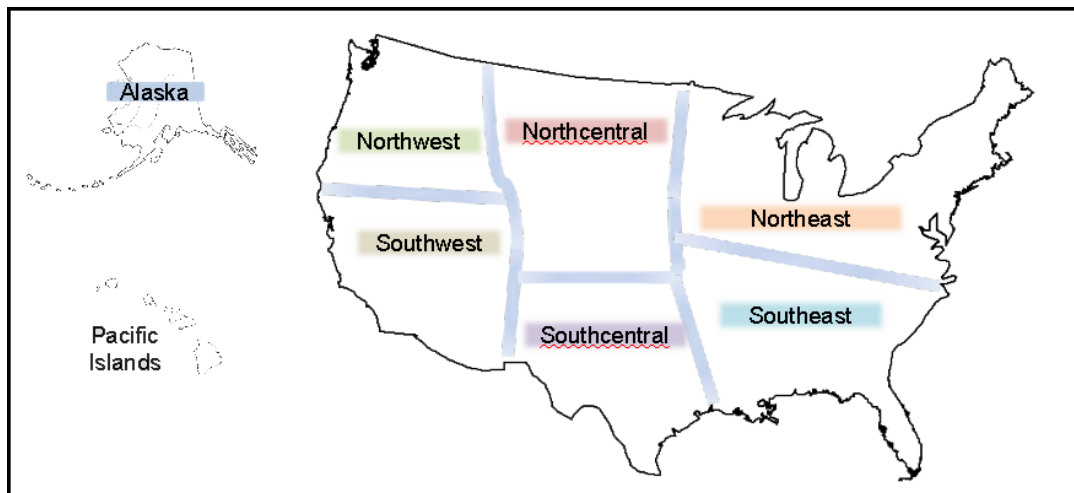
***DOI Climate Science Centers.*** DOI is working with USGS to expand the current USGS National Climate Change and Wildlife Science Center (NCCWSC) to include a suite of 8 regional DOI Climate Science Centers (CSCs). Five CSCs have been established and funded as joint ventures with major universities or consortia, and the final three host institutions will be selected during fall 2011. These centers have begun providing climate change impact data and tools to support Department managers and other partners responsible for managing the Department's land, water, fish and wildlife, and cultural heritage resources. Basic climate change impact science will be provided by the CSCs to the Landscape Conservation



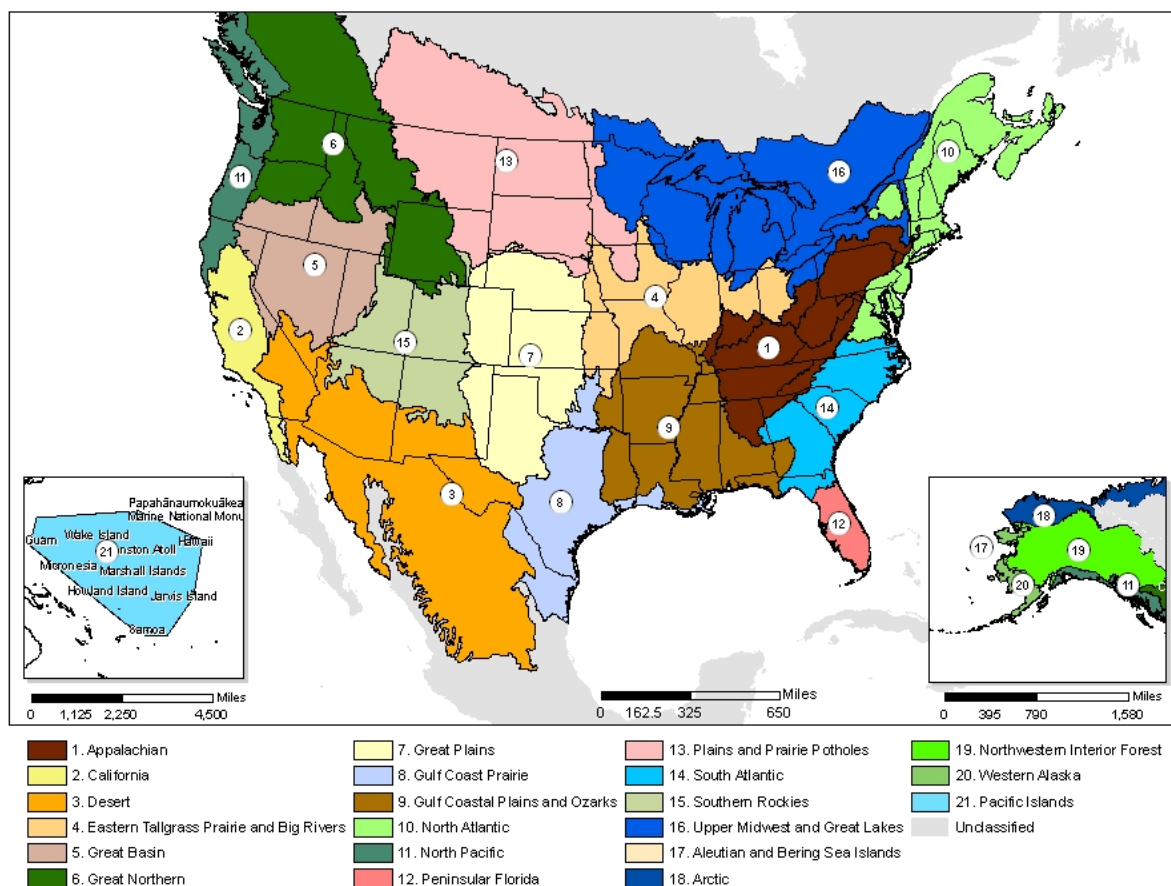
Cooperatives (LCCs) and other natural and cultural resource managers within their respective regions, based primarily on the priorities defined by the LCCs and managers, including physical and biological research, ecological forecasting, and multi-scale modeling.<sup>176</sup> The DOI released draft implementation guidance for CSCs and LCCs that describes their role within the DOI climate response strategy, the relationship between CSCs and LCCs, and standards for consistency.<sup>177</sup> USGS also has an initial five-year strategic plan for NCCWSC and the CSCs.<sup>178</sup>

***Landscape Conservation Cooperatives (LCCs).*** LCCs are a network of public-private partnerships seeking to better understand landscape-scale conservation challenges, including the potential impacts associated

with climate change, and identify adaptive strategies to ensure that the resources found within those landscapes remain resilient. LCCs are intended to complement and build upon existing science and conservation efforts – such as fish habitat partnerships and migratory bird joint ventures – as well as water resources, land, and cultural partnerships. Each LCC operates within specific ecosystem-based landscapes – currently 21 in total. Collectively, LCCs form a nationwide network of land, water, wildlife and cultural resource managers, scientists, and interested public and private organizations – within the U.S. and across our international borders – that share a common need for scientific information and interest in conservation.<sup>179</sup>



Source: Department of Interior Climate Science Centers at <http://www.doi.gov/csc/index.cfm>



Source: Department of Interior Landscape Conservation Cooperatives at <http://www.doi.gov/lcc/index.cfm>

## Tools and Resources

**Climate Change Website.** The site provides a summary of department level climate change actions, both mitigation and adaptation, and access to updates on key initiatives such as the Landscape Conservation Cooperatives and Climate Science Centers.<sup>180</sup>

**DOI Adaptive Management Technical Guide.** This guide was issued in March 2007 and provides guidance for using adaptive management in decision-making. The guide includes case studies, such as the Bureau of Reclamation's management of Glen Canyon Dam and the FWS' determination of annual waterfowl harvests, to demonstrate how adaptive management can be applied.<sup>181</sup>

**Reading List - Climate Change.** The DOI maintains an extensive, categorized list of recently published books

on climate change.<sup>182</sup>

## BUREAU OF LAND MANAGEMENT

### Overview

The Bureau of Land Management (BLM) manages more federal land than any other agency – 245 million surface acres of public lands found primarily in the Western United States, as well as 700 million sub-surface acres of mineral estate located throughout the country. Responsibilities include program areas such as wildland fire management, land use planning, landscape conservation, and invasive species.<sup>183</sup>

### Selected Initiatives and Strategies

**Landscape Approach.** The BLM's proposed landscape approach looks across large, connected geographic

areas to better understand the factors that affect resource management. The approach “provides a framework for integrating science with management; for coordinating management efforts and directing resources where they are most needed; and for adapting management strategies and actions to changing conditions and new information.” The landscape approach includes the following five interconnected components: rapid ecoregional assessments; ecoregional direction; on-the-ground implementation; monitoring for adaptive management; and science integration.<sup>184</sup>

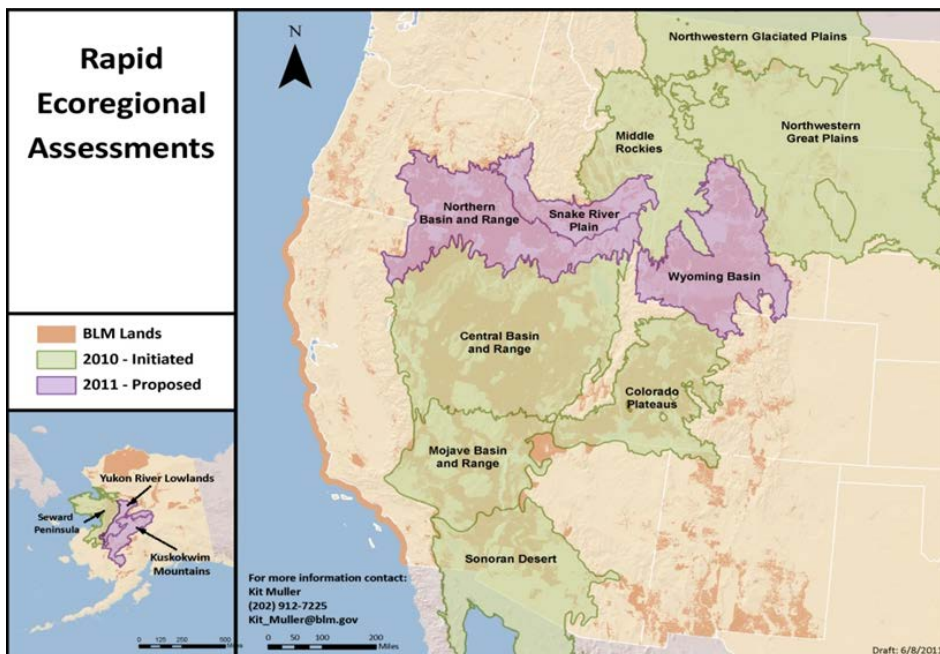
**Rapid Ecoregional Assessments (REAs).** The BLM launched the REAs to consolidate existing information about resource conditions and trends within seven ecoregions by the end of 2012.<sup>185</sup> The REAs identify areas of high ecological value and assess the potential risks from climate change, wildfires, invasive species, energy development, and urban growth and gauge the effectiveness of future management actions. Seven REAs are underway.<sup>186</sup> Three additional assessments are starting in 2011, scheduled for completion in 2013.

**Ecoregional Direction.** Building on the REAs and with input from stakeholders, the BLM will develop landscape-level management strategies for Bureau-managed lands that coordinate efforts across field offices. Management strategies will focus on conserving wildlife habitats and migration corridors and identifying focal areas for potential energy development and urban growth.<sup>187</sup>

**Regional Strategic Plans.** BLM is organized into 11 regions comprised of 18 western states, not including eastern states for mining and minerals management. The Oregon-Washington region has a strategic plan that incorporates climate change mitigation and adaptation.<sup>188</sup> The Arizona region has also developed a strategic plan that incorporates the landscape approach.<sup>189</sup>

### Tools and Resources

**Climate Change Website.** The site includes the BLM’s activities related to climate change and key resources.<sup>190</sup>



Source: Bureau of Land Management

## BUREAU OF RECLAMATION

### Overview

The Bureau of Reclamation is the largest wholesaler of water in the country, bringing water to more than 31 million people, and providing one out of five Western farmers (140,000) with irrigation water for 10 million acres of farmland that produce 60% of the nation's vegetables and 25% of its fruits and nuts. Reclamation is also the second largest producer of hydroelectric power in the western United States.

### Selected Initiatives and Strategies

#### *Climate Change and Water Working Group (CCAWWG).*

The CCAWWG is a long-term, coordinated federal interagency working group to identify water user requirements to address climate change and develop new technology, tools, research and development, and science. Principal partners are the Bureau of Reclamation, USGS, NOAA, and USACE.<sup>191</sup> CCAWWG sponsored three workshops in 2010. The Working Group also published *Addressing Climate Change in Long-Term Water Resources Planning and Management: User Needs for Improving Tools and Information* in January 2011.<sup>192</sup> The report identifies the needs of local, state, and federal water management agencies for climate change information and tools to support long-term planning. CCAWWG is also currently working on a short-term user needs document.

**Basin Study Program.** Through the Basin Study Program, Reclamation is partnering with basin stakeholders to conduct comprehensive water supply and demand studies to define options for meeting future water demands in river basins in the West. The Basin Studies will incorporate the latest science, engineering technology, climate models and water management innovations. The desired outcomes are basin-specific plans recommending collaboratively developed solutions that will help meet water demands and foster sustainable development.

**SECURE Water Act Section 9503(c) - Reclamation Climate Change and Water 2011.** Reclamation released the report in April 2011, highlighting the impacts of climate change on Western water resources. The report discusses climate change risks and how those

risks could impact water operations, hydropower, flood control, and aquatic and terrestrial ecosystem in the Colorado, Rio Grande, San Joaquin, Columbia, Missouri, Sacramento, Klamath, and Truckee rivers basins.<sup>193</sup>

### Tools and Resources

#### *West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections.*

Reclamation has produced consistent and complete projections of future water supply based on the Coupled Model Intercomparison Project 3 climate projections.

**Literature Synthesis on Climate Change Implications for Water and Environmental Resources.** Reclamation published this literature review in January 2011.<sup>194</sup>

**Climate Change Website.** Reclamation maintains a site devoted to climate change and water management that includes climate change adaptation research.<sup>195</sup>

## FISH AND WILDLIFE SERVICE

### Overview

The U.S. Fish and Wildlife Service (FWS) is the principal federal agency responsible for conserving, protecting, and enhancing fish, wildlife, and plants and their habitats for the continuing benefit of the American people. The vast majority of fish and wildlife habitat is on lands not owned by the federal government, thereby making partnerships with Native American tribes, state and local governments, nongovernment organizations and private citizens a crucial element to the Service fulfilling their mission. The Service also manages the 150 million acre National Wildlife Refuge System that consists of 553 National Wildlife Refuges and thousands of small wetlands and other special management areas. Approximately 7,300 people are employed by the Service across the United States, with eight regional offices, and over 700 field units including 81 ecological services field stations, 70 national fish hatcheries, and 65 fish and wildlife management offices.

### Selected Initiatives and Strategies

**National Fish, Wildlife and Plants Climate Adaptation Strategy (In-Progress).** The Service is co-chairing the

development of a national adaptation strategy with NOAA and the New York Department of Environmental Conservation.<sup>196</sup> Working with a broad range of conservation interests, including local governments, states, tribes, conservation organizations, federal agencies, industry and private landowners, the strategy will identify and define the “principles and methods to maintain key terrestrial, freshwater and marine ecosystems and functions needed to sustain fish, wildlife and plant resources in the face of accelerating climate change.”<sup>197</sup> The strategy will be a blueprint for action, and it will include scientific support, policy and legal frameworks, best management practices, processes for integration and communication, and a framework for implementation. Strategy development was initiated from Conservation Leadership Forums that occurred in June 2009 and January 2010.<sup>198</sup> The strategy is expected to be complete in May 2012.

***Fish and Wildlife Service Climate Change Strategic Plan (September 2010).*** The U.S. Fish and Wildlife Service's *Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change* identifies key goals and objectives for the agency centered around three areas: adaptation, mitigation, and engagement.<sup>199</sup> Key adaptation goals and objectives include not only efforts to create the CSCs and LCCs described above (which are broader than FWS efforts), but also to develop a National Fish and Wildlife Adaptation Strategy over a 5 year period (see above), conduct species and habitat vulnerability assessments, and incorporate climate change into agency activities and decisions. A draft supplemental, “Appendix: 5-Year Action Plan for Implementing the Climate Change Strategic Plan,” details the specific actions the Service will take through 2013 to achieve each of the goals and objectives.<sup>200</sup> FWS has created a National Climate Team (NCT) to provide coordination and guidance to implement the Service's Strategic Plan for Climate Change. As part of these responsibilities, the NCT annually recommends Climate Change Action Priorities (CCAPs) that advance the long-term vision of the FWS Strategic Plan.

### ***Programs and Institutional Mechanisms***

***Inventory and Monitoring.*** The Inventory and Monitoring Initiative is being designed to address the

National Wildlife Refuge System's mission critical information needs, and to help plan and evaluate the effectiveness of conservation strategies in the face of accelerating climate change and other environmental stressors. Inventory and monitoring have long been a vital part of the biological program of the National Wildlife Refuge System and have been used to inform local management actions, but the need to inform adaptation strategies at multiple geographic scales necessitates that information be easily accessible, standardized and managed in accordance with data standards of the federal government and the Department of the Interior.

### ***Tools and Resources***

***National and Regional Climate Change Websites.*** The Service maintains a Climate Change website with access to six regional climate change sites, resources and information, as well as updates on the Service's climate change and adaptation strategies, and links to other Service and non-Service resources.<sup>201</sup> Regional sites include: Alaska, Midwest, Northeast, Pacific, Southeast and Southwest covering 40 states; providing regional impacts, resources and FWS related updates and activities.

***Climate Change Learning Center (CCLC).*** The agency's National Conservation Training Center (NCTC) is in the process of modifying training opportunities for FWS staff to increase their knowledge of climate science and climate change as it relates to resource management; providing new landscape-scale approaches to planning, design, delivery, monitoring and research, as well as new tools for managers. A Climate Change Learning Center webpage provides information on upcoming and archived webinars, courses, workshops and other training opportunities offered through the NCTC.<sup>202</sup>

***Sea Level Affecting Marshes Model (SLAMM).*** SLAMM-View is a browser-based application that allows the public to view simulations of sea level rise from the SLAMM model output, and helps people understand the potential impacts of climate change on sea level.<sup>203</sup> The Service is able to determine potential effects of sea level rise on coastal National Wildlife Refuges and use results to help develop refuge and landscape scale adaptation strategies and revising refuge conservation plans.

***Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment.*** This document was prepared by a collaborative expert workgroup on vulnerability assessment co-chaired by the Service. The Guide is designed to help implement the Service's Climate Change Strategic Plan and draft 5-year Action Plan (see above) and to support the States (see below) and others in efforts to integrate climate change vulnerability information into adaptation planning and management activities. It was published in January 2011 and is available on-line.<sup>204</sup> A related interagency course has been developed on climate change vulnerability assessment of species and habitat, with a focus on how the information can guide climate change adaptation planning; the course is being offered through the Service's National Conservation Training Center.

***Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans & Other Management Plans.*** The Service participated in the development of the voluntary guidance for state agencies to better incorporate the impacts of climate change on wildlife and their habitats into Wildlife Action Plans. The guidance was released by the Association of Fish and Wildlife Agencies in November 2009.<sup>205</sup>

***Climate Change Toolkit.*** This online toolkit contains resources to assist in communicating about climate change impacts and the Service's strategic response. The materials can be modified or augmented to include region-specific information for different target audiences.<sup>206</sup>

## U.S. GEOLOGICAL SURVEY

### Overview

As the Nation's largest water, earth, and biological science and civilian mapping agency, the U.S. Geological Survey (USGS) collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. With approximately 10,000 scientists, researchers and staff in 400 locations across the United States the USGS conducts large-scale, multi-disciplinary investigations and provides impartial scientific information to resource managers, planners, and other customers. On-the-ground scientific information is provided from

observation and monitoring networks and research activities. These observations and related research support efforts to build climate models, especially those that deal with the impacts of climate change to terrestrial, freshwater, and marine ecosystems. USGS is recognized for its research and monitoring efforts in the fields of hydrology, climate history, land-use and land-cover changes, wildlife health, ecosystem science, and carbon and other geochemical and nutrient cycles.

### Selected Initiatives and Strategies

***USGS 10-Year Strategy.*** The 2007-2017 Strategy sets the direction for the agency in six areas including: Ecosystems, Climate, Natural Hazards, Environment and Human Health, Water, and Energy and Minerals.<sup>207</sup>

***Global Change Science Strategy.*** The draft *USGS Global Change Science Strategy* was open for public comment through April 8, 2011.<sup>208</sup> Building on the *USGS 10-Year Strategy*, the science strategy defines six programmatic goals over the short- and long-term. Progress towards these goals will improve understanding in the following areas: the rates, causes, and impacts of past global changes; global carbon cycle; land-use and land-cover change rates, causes, and consequences; droughts, floods, and water availability under changing land use and climate; coastal response to sea-level rise, climatic hazards, and human development; and biological responses to global change.

***Carbon Sequestration Assessments.*** As directed by the Energy Independence and Security Act of 2007, the USGS is conducting two national assessments: 1) geological carbon sequestration, and 2) biological carbon sequestration and greenhouse gas fluxes. The assessments evaluate both the potential capacities and the potential limitations of the various forms of carbon sequestration as well as evaluate their geologic, hydrologic, and ecological consequences. Findings, products, and tools of the assessments will allow users to formulate management and policy options related to climate change adaptation and mitigation.<sup>209</sup>

### Programs and Institutional Mechanisms

***USGS Climate and Land Use Change Research Program.*** The USGS Climate and Land Use Change Research

Program supports fundamental scientific research on topics related to climate and land-cover change and their impacts. USGS basic research serves federal, state, tribal and local agencies by providing a scientific basis for decision-making and adaptive management of natural ecosystems, lands, and infrastructure. In addition, it supports national and international efforts to address climate change, such as the US National Assessment of Climate Change and the Intergovernmental Panel on Climate Change. Priority research areas include the global carbon cycle, sea-level rise and coastal processes, global warmth, precipitation and drought, abrupt climate change, polar climate, glaciers, ice caps and ice sheets, sea ice, wetlands and permafrost, vegetation and ecosystems, feedback processes, climate change and ocean circulation, land-cover impacts, and natural climate variability. USGS Climate and Land Use Change R&D integrates research on paleoclimate, earth surface processes, hydrology, ecology, modeling, and land-use/land-cover trends to provide objective, state-of-the-art information for land managers and policymakers confronted with changing global climate.

**National Climate Change and Wildlife Science Center (NCCWSC).** USGS established a National Climate Change and Wildlife Science Center to understand fish and wildlife responses to changing climate and to test and validate related adaptation decisions by land managers and other stakeholders.<sup>210</sup> As part of the new DOI Climate Change strategy, USGS is taking the lead for the Department on the selection of host institutions for the DOI Regional Climate Science Centers.<sup>211</sup> The National Climate Change and Wildlife Science Center (NCCWSC) will provide the initial staffing and startup capabilities to these centers. The NCCWSC science agenda will focus on the linkage of global climate information with fundamental ecological knowledge, and the application of this understanding to the particular species, habitats, and ecosystems present in each region.<sup>212</sup>

### **Tools and Resources**

**GAP Analysis Program.** The Gap Analysis Program (GAP) national land cover viewer displays data on the vegetation and land use patterns of the continental United States.<sup>213</sup> The map depicts the extent of forests, grasslands, wetlands and other habitats from coast to

coast. The national map contains 551 Ecological Systems containing 39 land use classes and is searchable by state and region at three different levels of detail using eight, 43 or 590 classification categories. The map can be used to support large-scale planning at federal and state agencies, helping them to see where large tracts of diverse ecosystems still exist so they can work to preserve whole habitats, rather than just single species.

**National Assessment of Coastal Vulnerability to Sea-Level Rise.** This project, within the USGS Coastal and Marine Geology Program's National Assessment, seeks to objectively determine the relative risks due to future sea-level rise for the U.S. Atlantic, Pacific, and Gulf of Mexico coasts.<sup>214</sup>

**USGS Office of Global Change Website.** The Survey maintains a website with links to climate change research and activities.<sup>215</sup>

### **Selected Projects**

**Southeast Regional Assessment Project (SERAP).** SERAP is the first regional assessment project to be funded by the USGS NCCWSC.<sup>216</sup> Working with DOI LCCs and other partners, the USGS is leading a pilot project to convert global models into regional climate projections for the Southeast and develop landscape change datasets to project the potential impacts on the region's climate and ecosystems. Assessment tools will be developed to help resource managers and decision makers determine the best approaches for ecosystem management and assess change along coasts where inundation, land loss, and habitat change is expected to occur.

## **NATIONAL PARK SERVICE**

### **Overview**

Since 1916, the American people have entrusted the National Park Service with the care of their most treasured landscapes and rich cultural history. With the help of volunteers and park partners, the NPS is proud to safeguard 395 national parks, monuments, recreation and historic areas spanning over 84 million acres of land, 4.5 million acres of oceans, lakes, reservoirs and 43,000 miles of shoreline in order to share their stories with more than 275 million visitors

every year. The NPS maintains 909 visitor centers and contact stations and engages with over 120 million people annually in hundreds of thousands of special events and ranger-led programs. It is the mission of the National Park Service to preserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations.

### ***Selected Initiatives and Strategies***

***Climate Change Response Strategy.*** The NPS released its Climate Change Response Strategy in September 2010.<sup>217</sup> The Strategy provides direction to NPS leadership and employees in four major areas: science, mitigation, adaptation, and communication. To foster integration of climate change response in all aspects of NPS operations, the NPS Director established a Climate Change Coordinating Group consisting of Associate Directors in Natural Resource Stewardship and Science, Cultural Resource Stewardship and Science, Interpretation and Education, and Park Planning, Facilities, and Lands. This leadership group addresses policy issues and identifies key goals and strategic actions for implementation at all levels of the agency. The NPS has held a series of regional and interagency workshops to explore climate change impacts and coping strategies and to develop action plans.

***Adaptation and Scenario Planning.*** Incorporating climate change into all levels of planning is one of four goals within the Adaptation component of the service-wide Climate Change Response Strategy and is a critical part of the NPS adaptation framework. The NPS is working with parks and partners in developing an innovative application of scenario planning to help manage uncertainty around existing and future climate impacts to the nation's parks.<sup>218</sup> Since 2007, NPS has held numerous workshops to explore the use of scenario planning in the park system and build the technical capacity of employees to apply scenarios within the context of adaptation planning and implementation.<sup>219</sup>

***Climate Change Communication.*** The NPS is ideally positioned to raise public understanding of climate change and its effects on parks. By providing information about the many actions the NPS is taking to understand climate science, ensure the resiliency of

park resources, and mitigate the agency's carbon footprint, the NPS fosters public support and expands partnership opportunities. Specific communication goals and objectives were developed in the NPS Climate Change Response Strategy for NPS staff. Four key messages were also established to serve as a foundation for interpretation and education products and provide all employees guidance when engaging in communication about climate change. These four key messages are:

- Climate change is happening and human activities are contributing to and accelerating it.
- Changing climate has consequences for parks, people, and the planet.
- The NPS is responding with practices that address climate change.
- The choices we make now may help to avoid catastrophic impacts in the future.

### ***Programs and Institutional Mechanisms***

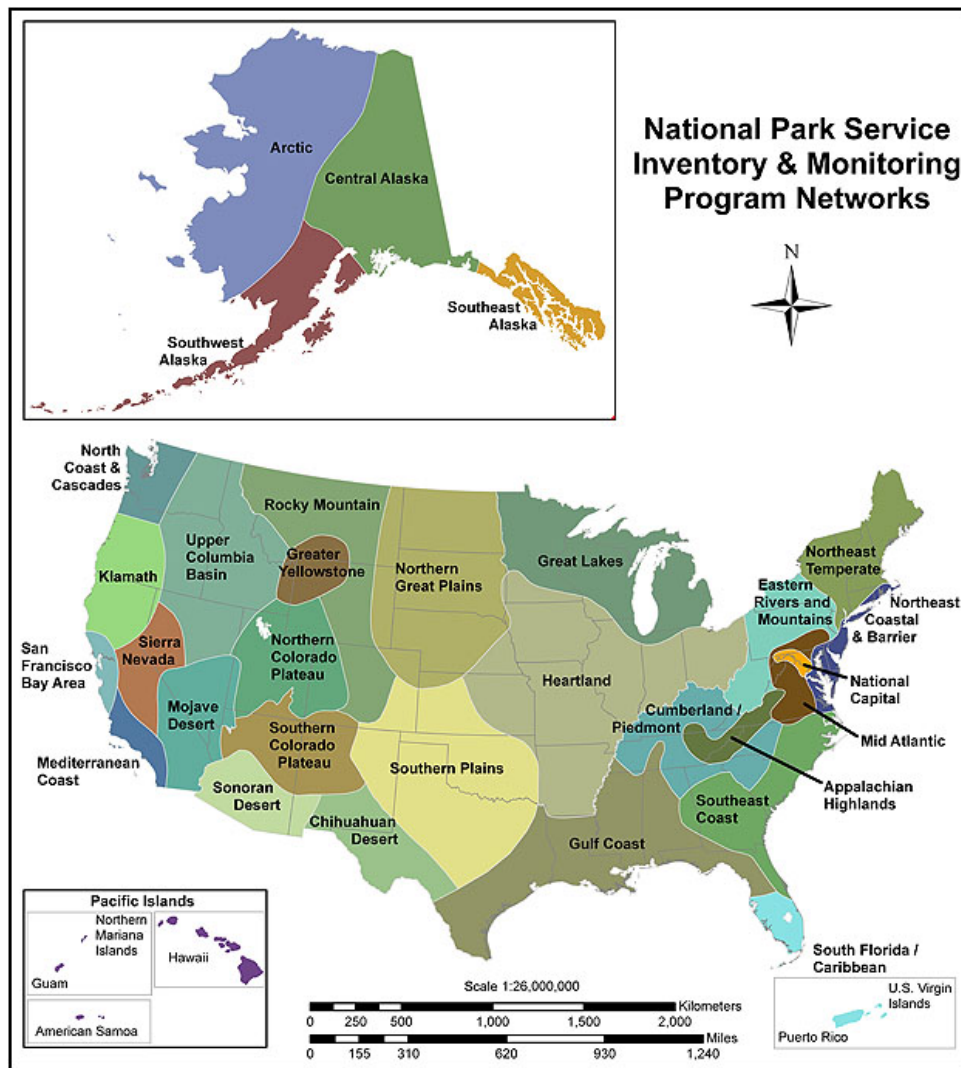
***Climate Change Response Program.*** To preserve the future health of parks in the face of global climate change, the National Park Service (NPS) established the Climate Change Response Program (CCRP) in 2010. The program is responsible for working with parks, regions, national program offices, and partners to develop a cross-cutting, interdisciplinary approach that embraces four major components: Science, Adaptation, Mitigation, and Communication. Specifically, the NPS acknowledges the need to move to a systems-based management approach that places a greater emphasis on partnerships and cross-jurisdictional collaboration, promotes an increased use of interdisciplinary teams, and sets high standards for scientific analysis and communication of results.<sup>220</sup>

***Vital Signs and Monitoring Program.*** To enhance capacity for monitoring and responding to climate change impacts, NPS is leveraging its existing science programs. More than 270 parks with significant natural resources are organized into 32 eco-regional networks to conduct expanded inventory and monitoring activities.<sup>221</sup> Two primary goals of the program are to 1) inventory the natural resources under National Park Service stewardship to determine their nature and status and 2) to monitor park ecosystems to better understand their dynamic nature and condition and



provide reference points for comparisons with other, altered environments. The program makes data collected into usable information through analysis,

synthesis, and modeling, and each of the 32 Networks have produced briefs that identify ways in which NPS meets climate change needs for park management.<sup>222</sup>



Source: National Park Service Inventory and Monitoring Networks, at <http://science.nature.nps.gov/im/networks.cfm>

## BUREAU OF INDIAN AFFAIRS

### Overview

The Bureau of Indian Affairs (BIA) is responsible for the administration and management of 55 million surface acres and 57 million acres of subsurface

mineral estates held in trust by the United States for American Indian, Indian tribes, and Alaska Natives. The BIA provides services (directly or through contracts, grants, or compacts) to approximately 1.9 million American Indians and Alaska Natives who are members of 562 federally recognized tribes. Services provided by BIA include human services; justice and

law enforcement services; energy and economic development; housing; irrigation and power systems; road maintenance; realty, probate, land, and heirship records; forestry, agriculture, and range lands development; wildland fire management; water resources; and fish and wildlife management.

### ***Selected Initiatives***

**2011 Tribal Climate Change Grant Program.** The BIA, in fulfilling its Trust Responsibilities to Tribes and Alaska Natives, is providing financial resources through a competitive grant program to help Tribes address the challenges associated with climate change and its impacts. The funding will help Tribes participate and be represented in the many climate change related activities occurring around the country. The funds will also help Tribes develop and implement climate change adaptation/mitigation projects and strategies to benefit Tribal resources and communities. Tribal staff can become more knowledgeable about climate change, which will enable them to provide direct input into the planning process and ensure that Tribal concerns are addressed and incorporated into project plans for climate change adaptation and mitigation.<sup>223</sup>

**Climate Change Tribal Engagement and Communication Action Plan.** To address the threats from climate change, the BIA implemented this Action Plan to create the infrastructure needed to engage American Indian and Alaska Native communities in policy development and other climate change related activities. Broad engagement is one effective way to bring traditional tribal land management knowledge

and capacity to the table and create implementation or mitigation strategies that fit local threats and address local values. Realizing that cooperation, collaboration, coordination, and consultation are keys to success, this action plan addresses communication strategies, implementation mechanisms, and administrative support.<sup>224</sup>

#### ***Traditional Ecological Knowledge Workshop.***

Traditional Ecological Knowledge (TEK) is important in the culture and resource stewardship of Indigenous people. As North America's first stewards, Native Americans and Alaska Natives enjoy a unique relationship with the land and its resources. These qualities and the place-based nature of traditional knowledge provide an invaluable record of frequent observations and adaptation to change, which is information of high value in contributing to solutions and responses to climate change. Moreover, Native people are frequently affected by the early impacts of climate change and in many cases find themselves in highly vulnerable situations and often without clear remedies. In September 2011, a workshop was held to bring together Tribal leaders and their senior natural resource and cultural staff, representatives of state and federal agencies, members of NGO's and academia to explore opportunities for linking TEK and western science in the development of a tribal and native climate change response and adaptation framework. The workshop was hosted by the Affiliated Tribes of Northwest Indians with sponsorship and support from the BIA, FWS, EPA, USGS, and Pacific Northwest Climate Change Collaboration.

## **■ DEPARTMENT OF LABOR (DOL)**

### ***Department-wide Initiatives***

**Agency Climate Change Adaptation Policy Statement.** Issued in response to E.O. 13514 and guidance from CEQ, DOL released a policy statement on climate change adaptation in June 2011. The policy affirms that the DOL will assess how climate change will affect the mission, operations, and programs of the

department. The Office of the Assistant Secretary for Administration and Management, in conjunction with the Employment Training Administration's Job Corps National Office and the Mine Health and Safety Administration, is responsible for coordinating the Department's climate change adaptation planning process.<sup>225</sup>

## ■ DEPARTMENT OF TRANSPORTATION (DOT)

### *Department-wide Initiatives*

***Policy Statement on Climate Change Adaptation.*** Issued in response to E.O. 13514 and implementation guidance from CEQ, DOT released a policy statement on climate change adaptation during June 2011. The policy requires DOT modal administrations (e.g., Federal Highway Administration, the Federal Aviation Administration, and Federal Transit Administration) to incorporate climate change adaptation into their planning processes and investment decisions, while encouraging state, regional, and local transportation agencies to consider climate change impacts in their decision-making. The Counselor to the Secretary, as the DOT's Senior Sustainability Officer, and designated modal executives are responsible for implementing the policy, with support from the Assistant Secretary for Transportation Policy and the DOT Center for Climate Change and Environmental Forecasting. The policy also describes eight guiding principles for climate change.<sup>226</sup>

***Center for Climate Change and Environmental Forecasting (CCCEF) Strategic Plan 2006-2010.*** The DOT established the Center for Climate Change and Environmental Forecasting (CCCEF) in 1999. The Center has become the focal point within USDOT for information and technical expertise on transportation and climate change, working with its component organizations to coordinate related research, policies, and actions. This plan focused on both greenhouse gas emission reductions as well as preparing for the impacts of climate change, and it included both short- and long-term actions in areas such as research and planning. Long-term actions included completing Phase II of the Gulf Coast Study, and conducting research to “understand how more extreme temperatures may affect transportation operations and infrastructure, and what steps should be taken to avoid or mitigate those potential affects. Short-term actions included the development of the Transportation Climate Change Clearinghouse, which is now available.”<sup>227</sup>

***DOT Transportation and Climate Change Clearinghouse.*** The new DOT Transportation and

Climate Change Clearinghouse website replaced the Center for Climate Change and Environmental Forecasting website.<sup>228</sup> While the current content is largely mitigation-focused, the site provides resources that identify potential impacts of climate change on transportation infrastructure, as well as state and local planning efforts and approaches for integrating climate change considerations into transportation decision-making, of which some address adaptation.

***Gulf Coast Study, Phase 1 (2008) and Phase 2 (expected 2013).*** Phase 1 of the Gulf Coast Study analyzed how changes in climate over the next 50 to 100 years could affect transportation systems in the U.S. central Gulf Coast region and discussed how to account for potential impacts in transportation planning.<sup>229</sup> Phase 2 of the Gulf Coast study is underway and seeks to develop more definitive information about multimodal impacts at the local level in a single metropolitan planning organization (the Mobile, AL area MPO) as well as to develop risk management tools and guides to help transportation system planners, owners, and operators determine which systems and assets to protect and how to do so. The methods and tools developed under Phase 2 are intended to be replicable to other regions throughout the country. Note that the first task, identification of critical infrastructure, has been completed and is posted on the FHWA web site. (FHWA manages the study for the DOT Climate Center).

## FEDERAL HIGHWAY ADMINISTRATION

### *Overview*

Climate change and related effects are complex—there is no single, 'one-size-fits-all' approach to addressing these issues. Acknowledging this complexity, the Federal Highway Administration (FHWA) focuses its resources on supporting transportation and climate change research and disseminating the results, providing technical assistance to stakeholders, and coordinating its activities within DOT and with other federal agencies.

## ***Selected Initiatives and Strategies***

***FHWA Strategy to Address Adaptation to Climate Change Effects.*** The Strategy is being developed by the FHWA Adaptation Working Group. The Strategy will include the relevance of impacts/adaptation to FHWA program areas, identify program vulnerabilities, and discuss ongoing and planned activities by FHWA.

## ***Programs and Institutional Mechanisms***

***FHWA Adaptation Working Group.*** FHWA formed a multi-disciplinary internal working group in the fall of 2008, to coordinate policy and program activities to address climate change impacts to transportation infrastructure. Climate change is an interdisciplinary issue, cutting across many programs in FHWA. Many offices are represented in the Adaptation Working Group, including: Environment, Planning, and Realty; Infrastructure (Asset Management, Bridge, Design, and Emergency Response); Operations; and Safety. The primary activity to date has been focused on developing FHWA's Adaptation Strategy.

## ***Tools and Resources***

***FHWA Climate Change website.*** This web site provides information on FHWA research, publications, and resources related to climate change science, policies, and actions. It also includes some current state and local practices in adapting to climate change and reducing greenhouse gas (GHG) emissions.<sup>230</sup>

***Regional Climate Change Effects: Useful Information for Transportation Agencies (May 2010).*** This document provides basic information on projected future changes in climate change (in temperature, precipitation, storm activity and sea level rise) over the near term, mid-century and end-of-century. The report includes two appendices: maps for some of the climate changes, and a "typology" of projected climate change information gleaned from recent reports.<sup>231</sup>

***Atlantic Coast Study - The Potential Impacts of Global Sea Level Rise on Transportation Infrastructure (2008).***

The study uses GIS tools to conduct a first look at the potential impacts of sea level rise on land and transportation infrastructure along the Atlantic coast, from Florida to New York.<sup>232</sup>

***Vulnerability and Risk Assessment Framework and Pilots.*** This project is supporting five pilots involving

State DOTs and MPOs to implement a vulnerability and risk assessment conceptual model to better understand the potential impact of climate change on transportation infrastructure.<sup>233</sup> The purpose of the pilots is twofold: 1) to assist State DOTs and MPOs in more quickly advancing existing vulnerability assessment activities and 2) to assist FHWA in "test-driving" the model. Based on the feedback received through the pilots, FHWA will revise and finalize the model for national application. The pilot projects are scheduled to be completed in December 2011.<sup>234</sup>

***Integrating Climate Change into the Transportation Planning Process (June 2008).*** The final report summarizes a review of the state-of-the-practice in State DOTs and Metropolitan Planning Organizations (MPOs), including statutes and regulations, and interviews with several planning agencies. The report includes information on both mitigation and adaptation.<sup>235</sup>

***Transportation and Climate Change News.*** The FHWA Office of Planning, Environment and Realty publishes a regular newsletter that provides transportation stakeholders with climate change and transportation information.<sup>236</sup>

***Climate Change Adaptation Peer Exchanges*** In partnership with the American Association of State Highway and Transportation Officials (AASHTO), FHWA convened a peer exchange of state transportation officials about climate change adaptation activities and strategic needs in June 2010.<sup>237</sup> FHWA is also convening a series of adaptation peer exchanges with state DOTs and MPOs during 2011-2012. The first of these workshops was held in Indiana in May 2011, and brought together representatives from several Midwestern states and MPOs to discuss the potential impacts of climate variability and change on transportation systems.<sup>238</sup>

## **FEDERAL TRANSIT ADMINISTRATION**

### ***Overview***

Subway tunnels, busways, rail tracks, and maintenance facilities are vulnerable to increased flooding from more frequent and intense rain storms, rising sea level, and storm surges. Extreme heat can deform rail tracks, stress materials, reduce asset life, and jeopardize customer and worker health and safety. In fact,

recorded weather data already shows increases in heat waves and heavy precipitation, which are affecting transit now. While transit and other sectors can and must play a role in reducing greenhouse gas emissions to lower the severity of impacts, because of the level of emissions already in the atmosphere, some climate changes are already in the pipeline and responsible risk management calls for adaptive responses to reduce vulnerability. FTA seeks to be a partner with the transit industry in responding to this challenge and has a number of resources and opportunities available.

### ***Selected Initiatives and Strategies***

***Policy Statement and Dear Colleague Letter.*** FTA issued a policy statement in May 2011 explaining the impacts of climate change on key FTA goals such as safety and state of good repair. The policy statement reiterates FTA's commitment to addressing climate change impacts in its policies, programs, and procedures. It also explains that the broad eligibility of FTA's grant programs allows for projects that further adaptation goals. This statement supplements the department-wide policy statement. FTA publicized the statement and FTA's adaptation initiative with a dear colleague letter sent to public transportation agency grantees.

***Pilots.*** FTA is funding several transit agencies and partnerships with transit agencies to assess the vulnerability of transit agency assets and services to

climate change hazards such as heat waves and flooding. The pilots will also assess initial adaptation strategies and link these strategies to transit agency organizational structures and activities. One of the pilots will focus on demonstrating the integration of adaptation assessment within an asset management system. Each pilot will submit to FTA a final report on the activities conducted, main findings, and applicability to other transit agencies.

### ***Tools and Resources***

***Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation.*** This FTA report examines projected climate impacts on U.S. transit, climate change adaptation efforts by domestic and foreign transit agencies, transit adaptation strategies, risk management tools, and incorporation of adaptation into transit agency organizational structures and processes.<sup>239</sup>

***Workshops and Webinars.*** FTA is holding a series of workshops and webinars to engage the transit industry in adaptation assessment and planning. FTA held its first workshop in Los Angeles on August 3, 2011 and its second on October 5, 2011 in New Orleans. The third workshop is tentatively scheduled for 2012 in Washington, DC. Recordings of FTA webinars are available on the FTA website.<sup>240</sup>

## **■ ENVIRONMENTAL PROTECTION AGENCY (EPA)**

### ***Overview***

The Environmental Protection Agency (EPA) has responsibility for programs and policies to protect human health and safeguard the environment through programs spanning air and water quality, pesticides and chemicals, and solid waste and emergency response.

### ***Selected Initiatives and Strategies***

***Policy Statement on Climate Change Adaptation.*** Issued in response to E.O. 13514 and implementation guidance from CEQ, EPA released a policy statement on climate change adaptation on June 2, 2011. The policy affirms

that the EPA will develop and publish an adaptation plan by June 2012 and meet other deadlines specified by CEQ's *Implementing Instructions*. The Cross-EPA Work Group on Climate-Change Adaptation, chaired by the EPA's senior climate change adaptation official, will develop and oversee the implementation of the climate change adaptation plan. It also directs each national program and regional office to create a plan that describes how it will implement the actions within the agency-wide adaptation plan. As part of the adaptation plan, EPA will focus on understanding the environmental justice implications of climate change and incorporate those considerations into adaptation strategies.<sup>241</sup>

**Fiscal Year 2011 – 2015 Strategic Plan.** The strategic plan sets the course for the EPA to advance its mission to protect human health and the environment. The plan identifies measurable health and environmental outcomes through five strategic goals to guide the agency's work: taking action on climate change and improving air quality, protecting America's waters, cleaning up communities and advancing sustainable development, ensuring the safety of chemicals and preventing pollution, and enforcing environmental laws. The plan calls for EPA to collaborate with state, local, and tribal governments on regulatory and policy initiatives, technical assistance, and voluntary programs related to climate change adaptation and incorporate climate change into its programs and rules.<sup>242</sup>

**National Water Program (NWP) Strategy: Response to Climate Change.** The NWP will soon finalize its second climate change strategy. The first strategy was published in 2008, and identified impacts of concern to water programs in the United States, defined goals and objectives to respond to such impacts, and provided specific actions in the areas of mitigation, adaptation, research, education, and program management.<sup>243</sup> The 2012 strategy builds on the lessons learned and momentum gained since then, lays out a long term vision and goals, and identifies mid-term building blocks (strategic actions) to move towards those long term goals. The new strategic actions are aligned with five key areas: Water infrastructure; Watersheds and wetlands; Coastal and ocean waters; Water quality; and Working with tribes. Annual Implementation Progress Reports and related adaptation products are posted as they become available. Key programs for adaptation include Climate Ready Water Utilities and Climate Ready Estuaries (described below), WaterSense, and Green Infrastructure. Examples of two recent reports include: *Climate Change Vulnerability Assessments: A Review of Water Utility Practices*<sup>244</sup> and *Climate Change Vulnerability Assessments: Four Case Studies of Water Utility Practices*.<sup>245</sup>

**Climate Change Impacts on Water Quality and Aquatic Ecosystems.** In collaboration with EPA's Office of Water, EPA's Office of Research and Development is conducting an assessment of the sensitivity of goals articulated in the Clean Water Act and the Safe Drinking Water Act to climate change, and opportunities for adaptation to the anticipated

impacts. This assessment will be completed in 2013.

**HUD-DOT-EPA Interagency Partnership for Sustainable Communities.** Part of EPA's Smart Growth Program, EPA formed a partnership with HUD and DOT in 2009 focused on ensuring housing and transportation goals are met while simultaneously protecting the environment, promoting equitable development, and helping to address the challenges of climate change.<sup>246</sup>

### **Programs and Institutional Mechanisms**

**Cross-EPA Work Group on Climate Change Adaptation Planning.** Led by the EPA Office of Policy, the cross-EPA Work Group on Climate Change Adaptation Planning provides coordination and leadership on climate change adaptation. The work group has been tasked with developing the agency-wide climate change adaptation plan, participates in the Interagency Climate Change Adaptation Task Force, works to integrate climate change into EPA's programs and rules, communicates information about climate change to EPA personnel, and seeks to understand and address environmental justice implications of climate change.<sup>247</sup>

**Climate Ready Estuaries Program.** The Climate Ready Estuaries (CRE) program is a partnership between EPA and the National Estuary Programs (NEPs) to address climate change in coastal areas.<sup>248</sup> Climate Ready Estuaries is supporting NEPs and coastal communities in becoming "climate ready" by developing tools and assistance to: assess climate change vulnerabilities, engage and educate stakeholders, develop and implement adaptation strategies, and share lessons learned with other coastal managers. For example, the Climate Ready Estuaries Coastal Toolkit provides resources for estuaries and coastal programs about climate change impacts and adaptation.<sup>249</sup> The program also publishes annual progress reports.<sup>250</sup>

**Climate Ready Water Utilities (CRWU).** The CRWU program provides technical resources and tools for the water sector to develop and implement long-range plans that account for climate change impacts.<sup>251</sup> In 2009, the EPA National Drinking Water Advisory Council established a CRWU Working Group to provide findings and recommendations on the development of the program to help water and

wastewater utilities prepare long-term plans that incorporate climate change. Completed in January 2011, the Working Group report includes 11 findings and 12 recommendations, an adaptive response framework, and the identification of needed resources and possible incentives to support and encourage utility climate readiness.<sup>252</sup> EPA's CRWU program continues to work with a range of stakeholders to develop tools such as the *Climate Resilience Education and Awareness Tool* (CREAT), software that helps water utilities assess climate 'threats' to their infrastructure and operations and to develop adaptation plans.

**Planning for Heat Health-Related Climate Change Impacts in American Cities.** EPA is developing a program to assist American cities with understanding and planning for the public health impacts of climate change, focusing mainly on extreme heat events.<sup>253</sup> EPA's OAR produced the *Excessive Heat Events Guidebook* (2006) with NOAA, CDC, and the Department of Homeland Security (DHS).<sup>254</sup> Designed to help community officials, emergency managers, meteorologists, and others plan for and respond to excessive heat events, the guidebook highlights best practices that have been employed to save lives during excessive heat events in different urban areas and provides a menu of options that officials can use to respond to these events in their communities. To help reduce temperature increases in urban areas, the EPA also published *Reducing Urban Heat Islands: Compendium of Strategies*. Also applicable to helping reduce heat islands is EPA's Low Impact Development and Green Infrastructure program.<sup>255</sup>

**Global Change Impacts and Adaptation Research.** In the EPA's Office of Research and Development (ORD), global change research is stakeholder oriented and focused on increasing our understanding and assessment of the potential consequences of climate variability and change on air and water quality, aquatic ecosystems, human health, and socioeconomic systems in the United States. EPA uses the results of these studies to investigate adaptation options to improve society's ability to effectively respond to the risks and opportunities presented by global change, and to develop decision support tools for resource managers coping with a changing climate.

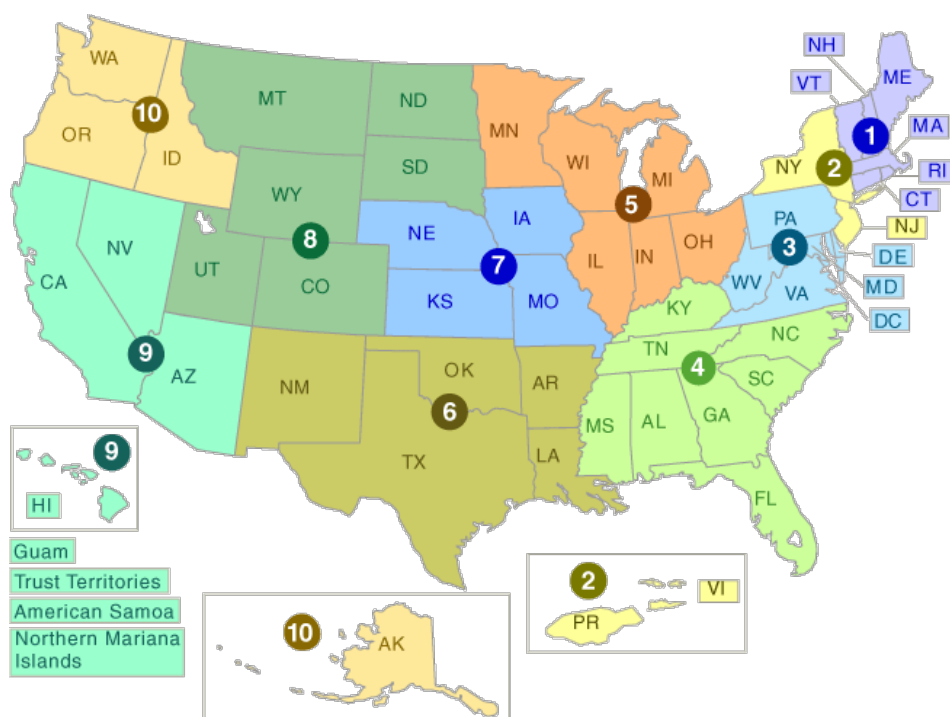
ORD has recently restructured its historic research

programs. Climate research, broadly, is incorporated in the Air, Climate and Energy (ACE) Research Program. In addition, ORD views climate variability and change as an additional, overarching stressor impacting all aspects of the research program. Therefore, climate as a stressor is incorporated throughout the current the research portfolio. For example, drinking water and water quality are now combined into a single research program, Safe and Sustainable Water Research Program (SSWR), that focuses on developing integrated, system solutions to the nation's water problems.

Every region of the country is experiencing some aspect of impact from hydrologic shifts, and more than two thirds of the states are anticipating local to statewide water shortages within the next two years. Current water supply and water quality models and decisions were built on historical hydrologic experiences, which are changing. Also, better treatment strategies for treating and delivering safe water and for delivering and treating wastewater are needed to reduce the water-related energy demand while protecting human and ecosystem health. Therefore, ORD is incorporating climate into the SSWR program.<sup>256</sup>

**Regional Climate Change Efforts.** EPA maintains regional offices across the United States organized within 10 defined regions, with most regions taking action or providing adaptation-related resources and developing regional resiliency. All ten EPA regions have developed specific adaptation strategies and initiatives to address local priorities, many in collaboration with federal, state, tribal and local partners. For example, Region 6 completed the development of a *Clean Energy and Climate Change Strategy*<sup>257</sup> through internally surveying employees, researching other EPA Regions and state and local efforts, and analyzing the Region's carbon sources by state. The *Strategy* prioritizes activities across four, action-oriented categories including: conserving energy and resources; reducing GHGs; adapting to climate change impacts; and, promoting clean and renewable energy sources. Information on EPA Regional adaptation activities are summarized in a highlights document available online.<sup>258</sup>





Source: EPA regions at: <http://www.epa.gov/epahome/whereyoulive.htm>

**State and Local Climate and Energy Program.** EPA's State and Local Climate and Energy Program provides technical assistance, analytical tools, and outreach support to state, local, and tribal governments interested in both mitigation and adaptation planning efforts, specifically where a project will reduce GHGs while demonstrating economic, environmental or public health benefits such as improvements to air quality.

**State-Tribal Climate Change Council (STC3).** As part of the National Water Program Climate Strategy, the EPA established the STC3 to share information about climate change with state and tribal leaders and improve dialogue to build capacity for adaptation to climate change.<sup>259</sup>

### Tools and Resources

**Climate Change website.** The EPA developed and maintains a website synthesizing educational information and links to EPA and non-EPA publications and resources for climate change adaptation science, U.S. policy, U.S. regions, and

sectors impacted by climate change including Health, Agriculture and Food Supply, Forests, Ecosystems and Biodiversity, Coastal Zones and Sea Level Rise, Water Resources, Energy Production and Use, and Public Lands and Recreation.<sup>260</sup> The site also includes an adaptation page.

**Climate Change Indicators in the United States (April 2010).** Focused primarily on the United States, this report presents 24 indicators, each describing trends related to the causes and effects of climate change, in order to support monitoring, evaluation and policy development.<sup>261</sup> Included are indicators such as U.S. and global temperatures, precipitation, drought, heat waves, sea level, snowpack, and growing seasons. Other federal agencies contributing to this report include CDC, NOAA and USGS.

**BASINS 4.0 Climate Assessment Tool.** BASINS is an environmental analysis system that incorporates watershed data and watershed modeling tools into a single package. Released in 2007, version 4 of BASINS allows users to assess the potential implications of climate variability and change on water and watershed



systems.<sup>262</sup>

***Climate Ready Estuaries Coastal Toolkit.*** The CRE Coastal Toolkit provides resources for estuaries and coastal programs that are interested in learning more about climate change impacts and adaptation. The site provides links to websites, reports, and other resources related to assessing vulnerability and developing adaptation plans for coastal resources.<sup>263</sup>

***Climate Resilience Evaluation & Awareness Tool (CREAT).*** CREAT is a planning tool that uses traditional risk assessment and scenario-based planning to assist drinking water and wastewater utilities in evaluating the potential impacts of climate change on their utilities and in understanding the adaptation options available to them.<sup>264</sup>

***Climate Ready Water Utilities Toolbox.*** The CRWU Toolbox provides access to resources related to climate change for the water resources sector. The Toolbox is currently in its prototype phase.<sup>265</sup>

***Tabletop Exercise Tool for Water Systems: Emergency Preparedness, Response, and Climate Resiliency (TTX Tool).*** The EPA developed the TTX Tool to introduce water resource planners and decision makers to the potential impacts of climate change on the water sector within an all-hazards approach to emergency preparedness and response.<sup>266</sup>

## ***Selected Projects***

***Chesapeake Bay Protection and Restoration.*** In May 2009, President Obama issued Executive Order 13508 to “protect and restore the health, heritage, natural resources, and social and economic value of the Nation’s largest estuarine ecosystem and the natural sustainability of its watershed.”<sup>267</sup> Section 202 of the E.O. required federal agencies to assess the impacts of climate change on the Chesapeake Bay and develop an adaptation strategy for natural resources and public infrastructure. The E.O. Executive Order established a Federal Leadership Committee (FLC), which is led by the EPA and includes representatives from the USDA, DOC, DOD, DHS, DOI, and DOT. The FLC released a *Strategy for Protecting and Restoring the Chesapeake Bay Watershed* in May 2010.<sup>268</sup> The FLC identified responding to climate change as a key strategy for the protection and restoration effort, developing supporting objectives and identifying individual actions for federal agencies to take that will ensure climate change impacts and adaptive strategies are mainstreamed into future restoration and protection efforts. The FLC subsequently released the *Fiscal Year 2011 Action Plan*.<sup>269</sup> Selected climate change actions from the *FY 2011 Action Plan* include: establishing mechanisms to deliver climate change information to states and communities in support of adaptation work and contributing to small demonstration projections in the region.<sup>270</sup>

## ■ NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA advances our understanding about the global and regional integrated Earth system by sponsoring research, collecting observations from space, developing technologies, and communicating scientific information. The agency provides information on solar activity, sea level rise, the temperature of the atmosphere and the oceans, the state of the ozone layer, air pollution, and changes in sea ice and land ice.

Sea level rise, extreme heat events, changes in storm intensity and frequency, inland and coastal flooding, beach erosion, winds, storm surge, and changes in availability of electricity and water already pose risks to

NASA’S mission, operations and services. NASA manages risk proactively and in an integrated fashion. Consideration of climate variability and extremes is just one of many factors included in existing discussions and decisions regarding risk to mission, risk to operations, risk to people, and risk to the environment. A key element in managing these risks is making appropriate adaptations to institutional systems.

## ***Selected Initiatives and Strategies***

***NASA Policy Statement—Adapting to Climate Change.*** Issued in response to E.O. 13514 and implementation

guidance from CEQ, NASA released a policy statement on climate change adaptation in May 2011. The policy directs NASA to develop and publish an adaptation plan by June 2012 and meet other deadlines specified by the *Implementing Instructions* released by CEQ. The Senior Sustainability Officer will be responsible for implementing adaptive actions, working with NASA Center Sustainability Officers who will coordinate Center adaptation activities.<sup>271</sup>

**NASA Earth Science Division, Applied Sciences Program: Climate Applications Area.** The Applied Sciences Program develops innovative uses and practical benefits of NASA Earth science data, scientific knowledge, and technology, creating a bridge between the data and knowledge generated by NASA Earth Science Division and the needs of decision makers and the public. The Applied Science Program includes eight application areas, including Agriculture, Air Quality, Climate, Ecological Forecasting, Public Health, Natural Disasters, Water Resources, and Weather. The Climate Applications area concentrates on using NASA's Earth science information to support assessments, policy analyses, and implementation in planning and response to climate change. The Climate Application area has a special focus on enhancing economic and policy decision-making models and tools with Earth-science information.<sup>272</sup>



**“Resilience and Adaptation to Climate Risks Workshops”.** NASA has established a voluntary initiative for NASA Centers to identify and manage their site-specific climate risks in a workshop setting, working in collaboration with NASA climate scientists, and NASA Headquarters institutional managers. Thus far three workshops have taken place and two more are

currently scheduled in 2012. The workshops are based on an approach first utilized by NASA's Goddard Institute for Space Studies with New York City in conjunction with New York City's broader sustainability plan (PlaNYC 2030)<sup>273</sup>. NASA has refined the approach and successfully applied it to NASA Centers for their use and the use of their surrounding communities. The approach emphasizes three important aspects of seeking solutions in the “win-win-win” overlap area of disaster management, sustainability and climate adaptation (as illustrated in the following graphic) to optimize benefits.

From an infrastructure perspective, a long view of adaptation, implemented through modest changes to renewal investments rather than through adaptation-exclusive investments, helps minimize costs and negative impacts. Adaptation involves planning and management of risks related to environmental changes and variability in order to reduce negative effects and takes advantage of new opportunities to increase efficiency and build in resilience and flexibility. Adaptation planning recognizes the need to address future risks and requirements while managing the current and changing environment.

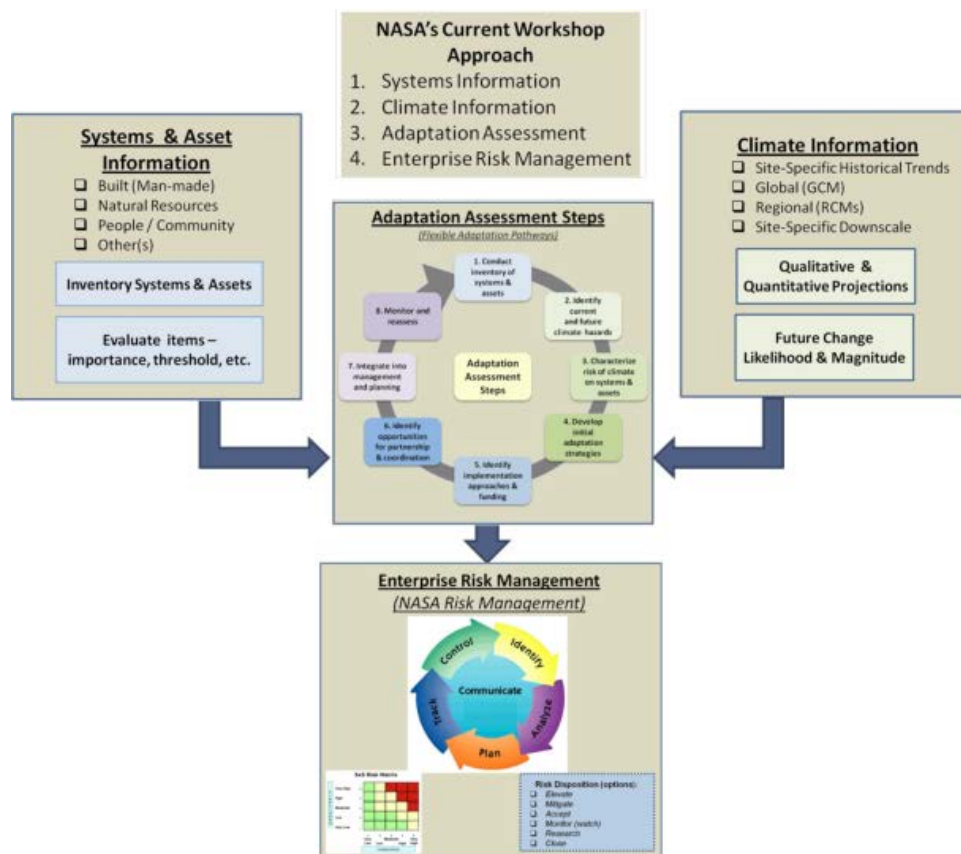
NASA's current workshop approach has matured to a process comprising four major elements depicted in the diagram below.

### ***Programs and Institutional Mechanisms***

NASA-funded researchers develop predictive climate models, heavily informed by NASA-produced observations, including downscaled regional models for use by decision-makers and adaptation planners. Science-based decision support tools that incorporate NASA data and models into frameworks for policymakers, natural resource managers, and public health officials are in use and new ones designed to meet new risk requirements are in development. For example: In collaboration with the Center for Disease Control (CDC) and Indiana University, NASA has ongoing pilot projects working with the communities of Philadelphia, PA, Dayton, OH, and Phoenix, AZ to improve their heat watch/warning systems through the development of tools that integrate NASA satellite data products with social and health data. NASA is making available information products regarding Center-specific climate, weather, and climate hazards

developed for internal risk management use with surrounding communities. By seeking and leveraging partnerships with state and local governments to protect infrastructure and communities of mutual concern, NASA is assisting the Nation in building resilience while minimizing expenditures. To develop a risk-based response to climate change grounded in the best available science, New York City Mayor

Michael Bloomberg requested NASA's assistance in understanding the risks of a changing climate on the city's critical infrastructure. NASA is sharing with other communities the lessons learned from helping New York City plan strategies for resilience. NASA is also applying the best practices learned at Stennis Space Center in the aftermath of Hurricane Katrina to its NASA Centers and their communities.



SOURCE: NASA

**NASA Climate Adaptation Science Investigators (CASI) Workgroup.** The CASI Workgroup assists in the development of climate adaptation strategies for NASA as whole and for individual Research Centers across the country.<sup>274</sup> The Workgroup has compiled historic climate and climate projections with associated uncertainties for each Center, is creating an inventory of climate and climate impact data and project activities within NASA, assessing adaptation approaches and Center-level planning strategies, recommending future research initiatives that fill gaps,

and leading thematic and region-specific workshops. Each Center faces unique climate hazards and impacts. The following list describes the major research areas and accomplishments at each Center.

- **Ames Research Center (ARC)** - Analyzed historical and projected climate and land use change for the surrounding region; linked projected changes to increased drought and flood risk, sea level rise, and to declines in ecosystem services; hosted 3-day Resilience & Adaptation to Climate Risks Workshop and half

day climate symposium.

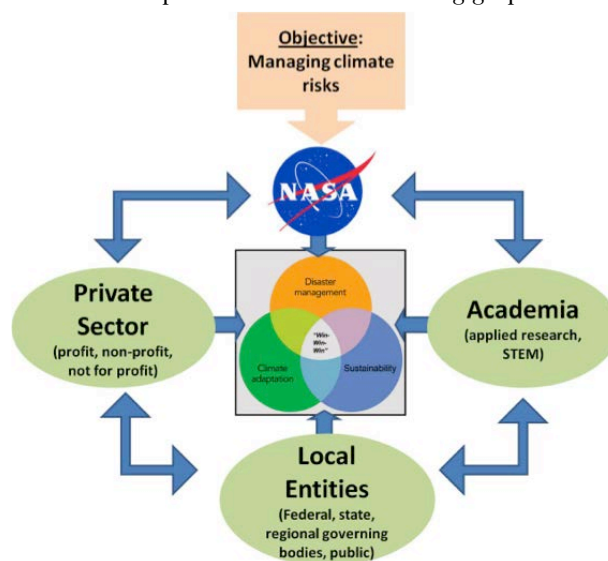
- **Dryden Flight Research Center (DFRC)** - Developed a vulnerability assessment based on an extreme precipitation scenario known as ARkStorm; hosted 1.5 day technical Workshop on Climate Change Adaptation in the Mojave Region.
- **Goddard Space Flight Center (GSFC)** - Researched impacts of climate change on forest health by merging NASA ecosystem modeling (Biome-BGC) and forest modeling (UFORE-iTree).
- **Jet Propulsion Laboratory (JPL)** - Analyzed relative importance of natural variability (including the El Niño Southern Oscillation), and long-term trends in California's long term precipitation records.
- **Kennedy Space Center (KSC)** - Completed a GIS analysis of sea level rise hazards to identify first order vulnerabilities of more than 25 different facility, infrastructure, and natural and archaeological resource categories; hosted 3-day Resilience & Adaptation to Climate Risks Workshop.
- **Langley Research Center (LaRC)** - Applied the Virginia Institute of Marine Science (VIMS) storm surge model to the geographic location of LaRC and adjacent Langley Air Force Base; hosted 3-day Resilience & Adaptation to Climate Risks Workshop.
- **Marshall Space Flight Center (MSFC)** - Assessed the impacts of climate and extreme weather on the centers buildings and infrastructure; installed local weather stations to identify and characterize extreme events at fine spatial scales.
- **Stennis Space Center (SSC)** - Developed baseline storm surge inundation scenarios and investigated available storm surge models

## TOOLS AND RESOURCES

**Global Climate Change Website.** NASA maintains a public website that contains general information about climate change, including key indicators, evidence, causes, effects, and uncertainty of climate change. Recent news and events are also collected on the site.<sup>275</sup>

**Internal Communication.** NASA has an internal electronic portal for climate impacts and adaptation and maintains a sophisticated climate risk communication approach that applies best practices identified in the literature as shown in the following Table:

**Leveraged Resources.** NASA understands that in these austere times there is a need to be creative and innovative to *get things done*. NASA seeks out partnerships, coalitions, and alliances to implement its initiatives, projects and programs to share and leverage resources. A prime example is NASA Kennedy Space Center's "Dune Vulnerability Team" which is managing the risk of eroding beach dunes that threaten NASA's launch pads' exposure to the sea. Currently, NASA is exploring several opportunities to work with community stakeholders through various kinds of relationships to manage climate risks and other mutual benefits. NASA's current framework for these relationships is shown in the following graphic:



SOURCE: NASA

## CONNECTING PRODUCERS & USERS OF CLIMATE SCIENCE: PROVEN INSTITUTIONAL ARRANGEMENTS & MECHANISMS\*

\* L DILLING & M C LEMOS (2011) "CREATING USABLE SCIENCE: OPPORTUNITIES AND CONSTRAINTS FOR CLIMATE KNOWLEDGE USE AND THEIR IMPLICATIONS FOR SCIENCE POLICY"; GLOBAL ENVIRONMENTAL; CHANGE, PAGES 680-689

<b><i>Institutional Arrangements &amp; Mechanisms</i></b>	<b>Description</b>	<b>Remarks: NASA's Approach</b>
1) <i>Information Brokers</i>	Broker is an intermediary between the user and the scientists	<i>NASA's contractor consultant is currently SAIC</i>
2) <i>Collaborative Group Processes</i>	Many groups with a vested the outcome and where decision making is highly distributed	<i>NASA "Oversight Steering Group": Directorate level stakeholders that coordinate efforts</i>
3) <i>Embedded Capacity</i>	Local climate scientists available to provide information and advice	<i>NASA Climate Adaptation Science Investigators (CASI) are NASA climate scientists at NASA Centers doing local applied research</i>
4) <i>Boundary Organizations</i>	Functions between the world of research and use of science to tailor information and produce value-added products; translation and customization of climate information to specific users	<i>NASA "Core Team" on Climate Risks &amp; Adaptation: implementation team that designs workshops and information products</i>
5) <i>Knowledge Networks</i>	Comprised of policy makers, scientists, government agencies, and non-government organizations that communicate and share information across areas of practice	<i>Interagency Forum on Climate Change Impacts &amp; Adaptations: (NASA, USACE, and others) NASA is Forum Co-Chair and uses the Forum to spin-in best practices.</i>

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The Center for Climate and Energy Solutions (C2ES) is an independent nonprofit organization working to promote practical, effective policies and actions to address the twin challenges of energy and climate change.



## ■ ENDNOTES

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- 1 For more information on the Center's report and to download a free copy, visit <http://www.c2es.org/publications/report/adapting-to-climate-change-call-for-federal-leadership>
- 2 For more information on the adaption report from the National Academies, see [http://www.nap.edu/catalog.php?record\\_id=12783](http://www.nap.edu/catalog.php?record_id=12783)
- 3 For more information on the Task Force, see <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation>
- 4 To read the Task Force's Interim Report, visit <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100315-interagency-adaptation-progress-report.pdf>
- 5 To read the Task Force's report to the President, visit <http://www.whitehouse.gov/sites/default/files/microsites/ceq/Interagency-Climate-Change-Adaptation-Progress-Report.pdf>
- 6 To read the Executive Order, visit [http://www.whitehouse.gov/the\\_press\\_office/President-Obama-signs-an-Executive-Order-Focused-on-Federal-Leadership-in-Environmental-Energy-and-Economic-Performance](http://www.whitehouse.gov/the_press_office/President-Obama-signs-an-Executive-Order-Focused-on-Federal-Leadership-in-Environmental-Energy-and-Economic-Performance)
- 7 To view a list of the Strategic Sustainability Performance Plans, visit <http://www.whitehouse.gov/administration/eop/ceq/sustainability/plans>
- 8 To read the Implementing Instructions, visit [http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation\\_final\\_implementing\\_instructions\\_3\\_3.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation_final_implementing_instructions_3_3.pdf)
- 9 To read the Implementing Instructions, visit [http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation\\_final\\_implementing\\_instructions\\_3\\_3.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation_final_implementing_instructions_3_3.pdf)
- 10 For more information on the Implementing Instructions, visit [http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation\\_support\\_document\\_3\\_3.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation_support_document_3_3.pdf)
- 11 To read the National Action Plan, visit [http://www.whitehouse.gov/sites/default/files/microsites/ceq/napdraft6\\_2\\_11\\_final.pdf](http://www.whitehouse.gov/sites/default/files/microsites/ceq/napdraft6_2_11_final.pdf)
- 12 To review the framework, visit <http://www.whitehouse.gov/administration/eop/ceq/initiatives/clean-water>
- 13 To read the America's Great Outdoors Initiative, visit <http://americasgreatoutdoors.gov/files/2011/02/AGO-Report-With-All-Appendices-3-1-11.pdf>
- 14 For more information on the Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas (GHG) Emissions, see <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf>
- 15 For more information on the Oceans Task Force, see [http://www.whitehouse.gov/sites/default/files/page/files/2009ocean\\_mem\\_rel.pdf](http://www.whitehouse.gov/sites/default/files/page/files/2009ocean_mem_rel.pdf)
- 16 For more information on the Ocean Task Force's recommendations, visit [http://www.whitehouse.gov/files/documents/OTPF\\_FinalRecs.pdf](http://www.whitehouse.gov/files/documents/OTPF_FinalRecs.pdf)
- 17 The updated Principles and Requirements for Federal Investments in Water Resources was released in draft form in 2009. See "Proposed National Objectives, Principles, and Standards for Water and Related Resources Implementation Studies" at <http://www.whitehouse.gov/sites/default/files/microsites/091203-ceq-revised-principles-guidelines-water-resources.pdf>
- 18 To read the National Academy of Sciences review, visit [http://www.nap.edu/catalog.php?record\\_id=13071](http://www.nap.edu/catalog.php?record_id=13071)

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- 19 To read the Working Group's report, visit <http://www.whitehouse.gov/sites/default/files/microsites/ceq/100303-gulf-coast-roadmap.pdf>
- 20 For more information, visit <http://www.doi.gov/documents/BayDeltaMOUSigned.pdf>
- 21 To read the Interim Federal Action Plan, visit <http://www.doi.gov/documents/CAWaterWorkPlan.pdf>
- 22 For more information on the USGCRP's strategic planning, visit <http://globalchange.gov/what-we-do/strategic-planning>
- 23 For more information on the agencies involved and their work, visit <http://www.globalchange.gov/agencies>
- 24 For more information on the Climate Change Adaptation Task Force, visit <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation>
- 25 For more information on the USGCRP Adaptation Science Workgroup efforts, visit <http://www.globalchange.gov/what-we-do/adaptation-science>
- 26 For more information on the USGCRP's Interagency Crosscutting Group on Climate Change and Human Health, visit <http://www.globalchange.gov/what-we-do/climate-change-health>
- 27 For more information on the first National Assessment, see <http://www.globalchange.gov/publications/reports/scientific-assessments/first-national-assessment>
- 28 For more information on the current National Assessment process, visit <http://www.globalchange.gov/what-we-do/assessment/nca-overview>
- 29 To review the USGCRP's National Climate Assessment Interim Strategy, visit [http://www.globalchange.gov/images/NCA/nca-summary-strategy\\_5-20-11.pdf](http://www.globalchange.gov/images/NCA/nca-summary-strategy_5-20-11.pdf)
- 30 For more information, visit <http://www.globalchange.gov>
- 31 For more information, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-1>
- 32 For more information, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-2>
- 33 For more information, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-3>
- 34 For more information, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-4>
- 35 For more information, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-5>
- 36 For more information, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-6>
- 37 For more information, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-7>
- 38 To read the report, visit <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts>
- 39 To read the Fiscal Year 2011 report, visit <http://downloads.globalchange.gov/ocp/ocp2011/ocp2011.pdf>
- 40 To read the synthesis report of the summit or to view video and presentations from the event, visit <http://www.joss.ucar.edu/events/2010/ncas/index.html>
- 41 To read the adaptation summit report, visit [http://www.joss.ucar.edu/events/2010/ncas/ncas\\_report.pdf](http://www.joss.ucar.edu/events/2010/ncas/ncas_report.pdf)
- 42 To view the policy statement on climate change adaptation, visit <http://www.ocio.usda.gov/directives/doc/DR1070-001.pdf>
- 43 To read the strategic plan, visit <http://www.ocfo.usda.gov/usdasp/sp2010/sp2010.pdf>
- 44 For more information on the CCPO, visit [http://www.usda.gov/oce/climate\\_change/index.htm](http://www.usda.gov/oce/climate_change/index.htm)
- 45 To read the USDA Climate Change Science Plan, visit [http://www.usda.gov/oce/climate\\_change/science\\_plan2010/USDA\\_CCSPlan\\_112910.pdf](http://www.usda.gov/oce/climate_change/science_plan2010/USDA_CCSPlan_112910.pdf)

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- 46 For more information, visit <http://www.ars.usda.gov/main/main.htm>
- 47 To read the strategic plan, see: <http://www.ars.usda.gov/SP2UserFiles/Place/00000000/ARSStrategicPlan2006-2011.pdf>
- 48 A map of projects by state is available at [http://www.ars.usda.gov/research/programs/programs.htm?NP\\_CODE=212](http://www.ars.usda.gov/research/programs/programs.htm?NP_CODE=212)
- 49 For more information on CREP agreements, visit: <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep>
- 50 For more information, visit <http://www.fs.fed.us/climatechange/advisor/scorecard.html>
- 51 For more information, visit <http://www.fs.fed.us/climatechange/advisor/roadmap.html>
- 52 For more on the announcement by the Secretary, see: <http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=2009/08/0382.xml>
- 53 To read the Strategy, visit: <http://www.fs.fed.us/climatechange/documents/global-change-strategy.pdf>
- 54 To read the Framework, visit: <http://www.fs.fed.us/climatechange/documents/strategic-framework-climate-change-1-0.pdf>
- 55 To read the first newsletter, see <http://www.fs.fed.us/climatechange/updates/cc-news-july7.pdf>
- 56 For more information on Environmental Threat Assessment Centers, see <http://www.fs.fed.us/wwetac/wwetac.html> and <http://www.forestthreats.org/>
- 57 For more information, see <http://www.nrs.fs.fed.us/niacs/>
- 58 For more information, visit <http://www.fs.fed.us/ccrc/>
- 59 For more information, visit <http://www.forestthreats.org/tools/taccimo>
- 60 For more information, visit <http://www.fs.fed.us/research/sustain/>
- 61 For more information, visit <http://www.fs.fed.us/research/rpa/>
- 62 For more information, visit <http://www.fs.fed.us/pnw/mdr/mapss/>
- 63 For more information, visit [http://nrs.fs.fed.us/atlas/tree/tree\\_atlas.html](http://nrs.fs.fed.us/atlas/tree/tree_atlas.html)
- 64 For more information, visit <http://nrs.fs.fed.us/atlas/bird/index.html>
- 65 To access course information, see <http://www.fs.fed.us/ccrc/hjar/>
- 66 To review the guidebook, visit <http://www.fs.fed.us/psw/publications/millar/Peterson%20et%20al.%20%28Adaptation%20Guidebook%29%20%28Feb.%202011%29.pdf>
- 67 For more information, visit <http://sst.forestry.oregonstate.edu/>
- 68 For more information on NIFA, see <http://www.nifa.usda.gov/>
- 69 To read more about the grants, visit [http://www.nifa.usda.gov/newsroom/news/2011news/02181\\_climate\\_change\\_cap.html](http://www.nifa.usda.gov/newsroom/news/2011news/02181_climate_change_cap.html)
- 70 For more information on the NRCS, visit <http://www.nrcs.usda.gov>
- 71 See <http://www.aglearn.usda.gov/> for more information.
- 72 More information on these courses including links to public sources of these courses is available at: <http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/air/?&cid=stelprdb1046159>
- 73 For more information, visit <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs>



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- 74 For more information, visit <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp>
- 75 For more information, visit <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/whip>
- 76 For more information, visit <http://www.nrcs.usda.gov/technical/NRI/>
- 77 For more information, visit <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>
- 78 For more information, visit <http://www.wcc.nrcs.usda.gov/products.html>
- 79 To view the rankings, visit <http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/air/?cid=stelprdb1044982>
- 80 To view the climate change adaptation policy, visit [http://www.commerce.gov/sites/default/files/documents/2011/june/docclimateadaptation\\_0.pdf](http://www.commerce.gov/sites/default/files/documents/2011/june/docclimateadaptation_0.pdf)
- 81 To read the strategic plan, visit <http://www.osec.doc.gov/bmi/budget/07strplan/DOC07strplan.pdf>
- 82 To read the MOU, visit <http://www.noaa.gov/climate/resources/resources/doidocclimatemoufinal.pdf>
- 83 To read the NGSP, visit [http://www.ppi.noaa.gov/NGSP3/NOAA\\_NGSP.pdf](http://www.ppi.noaa.gov/NGSP3/NOAA_NGSP.pdf)
- 84 For examples, see <http://spo.nmfs.noaa.gov/tm/spo95.pdf> and <http://spo.nmfs.noaa.gov/tm/TM%20SPO%2089.pdf>
- 85 To read the guide, visit <http://coastalmanagement.noaa.gov/climate/adaptation.html>
- 86 To read the guide, visit [www.csc.noaa.gov/publications/Marshes\\_on\\_the\\_move.pdf](http://www.csc.noaa.gov/publications/Marshes_on_the_move.pdf)
- 87 To access the Climate Services portal, visit <http://www.climate.gov/#climateWatch>
- 88 To read the guide, visit <http://www.nwf.org/News-and-Magazines/Media-Center/Reports/Archive/2011/Scanning-the-Horizon.aspx>
- 89 To read the MOU, visit <http://www.csc.noaa.gov/publications/2011-EPA-NOAA-MOA.pdf>
- 90 For more information, see [www.wildlifeadaptationstrategy.gov](http://www.wildlifeadaptationstrategy.gov)
- 91 For more information, see [http://www.climate.noaa.gov/cpo\\_pa/risa/](http://www.climate.noaa.gov/cpo_pa/risa/)
- 92 For more information, see [http://www.cpo.noaa.gov/cpo\\_pa/irap/](http://www.cpo.noaa.gov/cpo_pa/irap/)
- 93 For more information on NOAA's Coastal Services Center, see <http://www.csc.noaa.gov/>
- 94 For more information on the Climate Prediction Center, see <http://www.cpc.noaa.gov/>
- 95 For more information see [www.drought.gov](http://www.drought.gov)
- 96 For more information on NOAA's Regional Climate Centers, see <http://www.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html>
- 97 To learn more about the Ocean Climate Center, visit [http://www.noaanews.noaa.gov/stories2010/20101026\\_oceanclimatecenter.html](http://www.noaanews.noaa.gov/stories2010/20101026_oceanclimatecenter.html)
- 98 For more information see <http://fate.nmfs.noaa.gov/>
- 99 For more information see <http://www.pmel.noaa.gov/foci/NPCREP/index.shtml>
- 100 For more information, see <http://www.pmel.noaa.gov/co2/story/Ocean%2BAcidification>
- 101 To access the Climate Services portal, visit <http://www.climate.gov/#climateWatch>
- 102 For coastal state adaptation resources, see <http://collaborate.csc.noaa.gov/climateadaptation/>
- 103 For more information, see <http://www.csc.noaa.gov/>
- 104 For more information, see <http://www.planning.org/>

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- 105 For more information, see <http://www.floods.org/>
- 106 For more information, see <http://www.coastalstates.org/>
- 107 For more information, see <http://www.naco.org/Pages/default.aspx>
- 108 For more information, see <http://www.nsgic.org/>
- 109 For more information, see <http://www.nature.org/>
- 110 To access the NIDIS Drought Portal, visit [www.drought.gov](http://www.drought.gov)
- 111 To access the Legislative Atlas, see <http://www.csc.noaa.gov/digitalcoast/tools/legatlas/>
- 112 For more information, see <http://sgccnetwork.ning.com/>
- 113 To read the State of Climate reports, visit <http://www.ncdc.noaa.gov/bams-state-of-the-climate/>
- 114 To view the indicators, visit <http://www.ncdc.noaa.gov/indicators/>
- 115 To read Climate Literacy, visit. [http://climate.noaa.gov/index.jsp?pg=/education/edu\\_index.jsp&edu=literacy](http://climate.noaa.gov/index.jsp?pg=/education/edu_index.jsp&edu=literacy)
- 116 For more information, visit <http://www.serdp.org/>
- 117 For more information about the Legacy Program, visit <https://www.dodlegacy.org/legacy/index.aspx>
- 118 To read the QDR, visit [http://www.defense.gov/qdr/images/QDR\\_as\\_of\\_12Feb10\\_1000.pdf](http://www.defense.gov/qdr/images/QDR_as_of_12Feb10_1000.pdf)
- 119 To read Scanning the Conservation Horizon, visit [https://www.dodlegacy.org/Legacy/project/productdocs/NWF-Scanning%20the%20Conservation%20Horizon-FINAL-122110\\_d1dca940-b61e-4298-9a80-7731c8366ce6.pdf](https://www.dodlegacy.org/Legacy/project/productdocs/NWF-Scanning%20the%20Conservation%20Horizon-FINAL-122110_d1dca940-b61e-4298-9a80-7731c8366ce6.pdf)
- 120 For more information on the DoD workshop, visit <http://www.dodworkshops.org/files/ClimateChange/CC-Home.html>
- 121 For more information, visit <http://www.usace.army.mil/>
- 122 For more information, visit [http://www.building-collaboration-for-water.org/Documents/FederalToolboxMOU\\_051111.pdf](http://www.building-collaboration-for-water.org/Documents/FederalToolboxMOU_051111.pdf)
- 123 For more information, visit <http://www.building-collaboration-for-water.org/>
- 124 For more information, visit <http://www.esrl.noaa.gov/psd/ccawwg/>
- 125 To read the Water-Climate Change Program Inventory, go to <http://www.westgov.org/wswc/westfast/reports/climateinventory.pdf>
- 126 For more information on the FedCenter's climate change adaptation program area, visit <http://www.fedcenter.gov/programs/climate/>
- 127 For more information, visit <http://www.corpsclimate.us/index.cfm>
- 128 Pilot interim results are available at <http://corpsclimate.us>
- 129 Results are available at <http://corpsclimate.us>
- 130 To read the 2009 Arctic Roadmap, see [http://www.navy.mil/navydata/documents/USN\\_artic\\_roadmap.pdf](http://www.navy.mil/navydata/documents/USN_artic_roadmap.pdf) – also available on the TFCC website <http://greenfleet.dodlive.mil/climate-change/>
- 131 To read the Navy Climate Change Roadmap, see <http://www.navy.mil/navydata/documents/CCR.pdf> – also available on the TFCC website <http://greenfleet.dodlive.mil/climate-change/>
- 132 To read the National Security Implications of Climate Change for U.S. Naval Forces, visit [http://www.nap.edu/catalog.php?record\\_id=12914](http://www.nap.edu/catalog.php?record_id=12914)
- 133 To read the climate change adaptation policy, visit

---

<http://www2.ed.gov/about/reports/strat/sustainability/climate-change-policy.pdf>

134 To read the DOE adaptation policy, see  
[http://www1.eere.energy.gov/sustainability/pdfs/doestatement\\_ccadaptationpolicy.pdf](http://www1.eere.energy.gov/sustainability/pdfs/doestatement_ccadaptationpolicy.pdf)

135 To review the ORNL research theme, visit <http://climatechangescience.ornl.gov/content/rt4-impacts-adaptation-and-vulnerability-science>

136 For more information, see GAO, GAO-10-114SP, Climate Change Adaptation: Information On Selected Federal Efforts To Adapt To A Changing Climate, <http://www.gao.gov/new.items/d10114sp.pdf>

137 For more information, see GAO, GAO-10-114SP, Climate Change Adaptation: Information On Selected Federal Efforts To Adapt To A Changing Climate, <http://www.gao.gov/new.items/d10114sp.pdf>

138 For more information on the Joint Climate Prediction Research Program, see <http://energy.gov/articles/doe-usda-and-nsf-launch-joint-climate-change-prediction-research-program>

139 To read about the Sustainability Performance Office, see <http://www.sustainability.energy.gov>

140 For more information on the Integrated Assessments of Global Climate Change, visit  
<http://science.energy.gov/ber/research/cesd/integrated-assessment-of-global-climate-change/?p=1>

141 To review the HHS climate change adaptation policy, visit <http://www.hhs.gov/about/sustainability.html>

142 To read the CDC Policy on Climate Change and Public Health, visit  
<http://www.cdc.gov/climatechange/policy.htm>

143 To learn more about Climate-Ready States and Cities and awards, visit:  
[http://www.cdc.gov/climatechange/climate\\_ready.htm](http://www.cdc.gov/climatechange/climate_ready.htm)

144 To access the CDC Climate Change and Public Health website, visit <http://www.cdc.gov/climatechange/>

145 To view the webinars and other workforce development initiatives, visit:  
<http://www.cdc.gov/climatechange/workforce.htm>

146 For more information, visit [http://www.epa.gov/heatisland/about/pdf/EHEguide\\_final.pdf](http://www.epa.gov/heatisland/about/pdf/EHEguide_final.pdf)

147 For more information, see GAO, GAO-10-114SP, Climate Change Adaptation: Information On Selected Federal Efforts To Adapt To A Changing Climate, an E-supplement to GAO-10-113, Oct. 7, 2009,  
<http://www.gao.gov/new.items/d10114sp.pdf>

148 To use the Tracking Network, visit <http://ephtracking.cdc.gov/>

149 To read the NIEHS report, go to [http://www.niehs.nih.gov/health/assets/docs\\_a\\_e/climatereport2010.pdf](http://www.niehs.nih.gov/health/assets/docs_a_e/climatereport2010.pdf)

150 To read the NIEHS announcement, visit <http://grants.nih.gov/grants/guide/pa-files/PAR-10-235.html>

151 To review the NIH Guide Notice, go to <http://grants.nih.gov/grants/guide/notice-files/NOT-TW-10-008.html>

152 To access the NIEHS Climate Change and Human Health website, go to  
<http://www.niehs.nih.gov/about/od/programs/climatechange/index.cfm>

153 For more information about the HHICC research program, visit  
<http://www.niehs.nih.gov/research/supported/programs/climate/index.cfm>

154 For Task Force recommendations, see  
[http://www.dhs.gov/xlibrary/assets/hsac\\_sustainability\\_efficiency\\_task\\_force\\_recommendations\\_2010.pdf](http://www.dhs.gov/xlibrary/assets/hsac_sustainability_efficiency_task_force_recommendations_2010.pdf)

155 To read the strategic plan, visit [http://www.fema.gov/pdf/about/strategic\\_plan11.pdf](http://www.fema.gov/pdf/about/strategic_plan11.pdf)

156 To read the findings of the SFI, visit [http://www.fema.gov/pdf/about/programs/oppa/findings\\_051111.pdf](http://www.fema.gov/pdf/about/programs/oppa/findings_051111.pdf)

157 To read Phase II of the NFIP reform effort, visit

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[http://www.fema.gov/pdf/business/nfip/nfip\\_reform\\_phase\\_II\\_report.pdf](http://www.fema.gov/pdf/business/nfip/nfip_reform_phase_II_report.pdf)

158 For more information on NFIP reform, see [http://www.fema.gov/business/nfip/nfip\\_listening\\_session.shtm](http://www.fema.gov/business/nfip/nfip_listening_session.shtm)

159 For more information on Risk MAP, see [http://www.fema.gov/plan/prevent/fhm/rm\\_main.shtm](http://www.fema.gov/plan/prevent/fhm/rm_main.shtm)

160 For more information, visit <http://www.fema.gov/rebuild/mat/fema55.shtm>

161 For more information, visit <http://www.fema.gov/business/nfip/crs.shtm>

162 To read the climate change adaptation policy statement, visit

<http://portal.hud.gov/hudportal/documents/huddoc?id=ClimateAdptnStmnt060311.pdf>

163 For more information, visit <https://www.fhwa.dot.gov/livability/partnerships/>

164 To read NOFA describing the roles of each agency in the Partnership and HUD's FY10 Grant process, go to <http://www.hud.gov/offices/adm/grants/nofa10/scrpgsec.pdf>

165 To find out more about the Consolidate Planning Enhancement Initiative, visit

[http://portal.hud.gov/hudportal/HUD?src=/open/innovation\\_ideas\\_in\\_action/consolidated\\_plan\\_enhancements](http://portal.hud.gov/hudportal/HUD?src=/open/innovation_ideas_in_action/consolidated_plan_enhancements)

166 For more information, visit <http://www.disasterrecoveryworkinggroup.gov/>

167 To read the policy memorandum, visit <http://www.doi.gov/whatwedo/climate/strategy/upload/29237-Hayes-Memo-Final.pdf>

168 To review the strategic plan, visit [http://www.doi.gov/bpp/data/PPP/DOI\\_StrategicPlan.pdf](http://www.doi.gov/bpp/data/PPP/DOI_StrategicPlan.pdf)

169 To read Secretarial Order 3226 Amendment 1, visit

[http://www.blm.gov/pgdata/etc/medialib/blm/wy/programs/science.Par.46189.File.dat/SO\\_3226A1.pdf](http://www.blm.gov/pgdata/etc/medialib/blm/wy/programs/science.Par.46189.File.dat/SO_3226A1.pdf)

170 To read Secretarial Order 3289 visit <http://elips.doi.gov/elips/ElectronicFile.aspx?docid=155&dbid=0>

171 To read the MOU visit <http://www.noaa.gov/climateresources/resources/doidocclimatemoufinal.pdf>

172 To read Secretarial Order 3289, visit <http://elips.doi.gov/elips/ElectronicFile.aspx?docid=155&dbid=0>

173 To read Secretarial Order 3285, visit <http://elips.doi.gov/elips/ElectronicFile.aspx?docid=151&dbid=0>

174 To read Secretarial Order 3297, visit <http://elips.doi.gov/elips/ElectronicFile.aspx?docid=162&dbid=0>

175 To view the WaterSMART clearinghouse, visit <http://www.doi.gov/watersmart/html/index.php>

176 For more on DOI's Climate Science Centers, see <http://www.doi.gov/csc/index.cfm>

177 To review the Implementation Guidance, visit [http://www.nrmcs.usgs.gov/files/gnlcc/Draft\\_CSC-LCC\\_guidance\\_21JAN2011.pdf](http://www.nrmcs.usgs.gov/files/gnlcc/Draft_CSC-LCC_guidance_21JAN2011.pdf)

178 To view the USGS strategic plan, visit [http://nccwsc.usgs.gov/documents/NCCWSC\\_5\\_year\\_strategy\\_ver\\_7-13-09b.pdf](http://nccwsc.usgs.gov/documents/NCCWSC_5_year_strategy_ver_7-13-09b.pdf)

179 For more on DOI's Landscape Conservation Cooperatives, see <http://www.doi.gov/lcc/index.cfm>

180 DOI's Climate Change website is available at <http://www.doi.gov/whatwedo/climate/>

181 To view the guide, visit <http://www.doi.gov/initiatives/AdaptiveManagement/documents.html>

182 To review the DOI climate change reading list, go to <http://library.doi.gov/collections/lists/climatechange.html>.

183 For more information, visit <http://www.blm.gov/wo/st/en/prog/more/weeds.html>

184 For more information on the BLM's proposed landscape approach, visit

<http://www.blm.gov/wo/st/en/prog/more/climatechange/landscapeapproach.html>

185 To read about the BLM's REAs, visit <http://www.blm.gov/wo/st/en/prog/more/climatechange/reas.html>

- 
- 186 To view the status of REAs, visit <http://www.blm.gov/wo/st/en/prog/more/climatechange/documents.html>
- 187 For more information on Ecoregional Direction, visit <http://www.blm.gov/wo/st/en/prog/more/climatechange/direction.html>
- 188 For more information, visit [http://www.blm.gov/or/news/files/2015\\_SPOT.pdf](http://www.blm.gov/or/news/files/2015_SPOT.pdf)
- 189 Visit the BLM website at: <http://www.blm.gov/az/st/en/info/strategies.html>
- 190 To view the BLM website, visit <http://www.blm.gov/wo/st/en/prog/more/climatechange.html>
- 191 For more information, visit [http://www.esrl.noaa.gov/psd/workshops/mwwcc/docs/CCAWWG\\_Vision\\_Paper.pdf](http://www.esrl.noaa.gov/psd/workshops/mwwcc/docs/CCAWWG_Vision_Paper.pdf)
- 192 To view the report, visit <http://www.usbr.gov/climate/userneeds/>
- 193 To read the report, visit <http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf>
- 194 To review the literature synthesis, visit <http://www.usbr.gov/research/docs/climatechangelitsynthesis.pdf>
- 195 To see Reclamation's climate change site, visit <http://www.usbr.gov/climate/>
- 196 To visit the Strategy website, go to <http://www.wildlifeadaptationstrategy.gov/index.php>
- 197 For more information, see <http://www.fws.gov/nfwcas.html>
- 198 For more information, visit [http://training.fws.gov/CSP/Resources/climate\\_change/LCC\\_forum.html](http://training.fws.gov/CSP/Resources/climate_change/LCC_forum.html)
- 199 To read the strategic plan, go to <http://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf>
- 200 For more information, visit <http://www.fws.gov/home/climatechange/pdf/CCDraftActionPlan92209.pdf>
- 201 For more information, visit <http://www.fws.gov/home/climatechange/>
- 202 For more information, visit [http://training.fws.gov/CSP/Resources/climate\\_change/home.html](http://training.fws.gov/CSP/Resources/climate_change/home.html)
- 203 For more information on SLAMM, visit <http://www.fws.gov/slam/>
- 204 For more information, visit [http://www.fws.gov/pacific/Climatechange/highlights\\_archive/Feature.cfm?id=164634133](http://www.fws.gov/pacific/Climatechange/highlights_archive/Feature.cfm?id=164634133)
- 205 To review the guidance, visit [http://www.fishwildlife.org/files/AFWA-Voluntary-Guidance-Incorporating-Climate-Change\\_SWAP.pdf](http://www.fishwildlife.org/files/AFWA-Voluntary-Guidance-Incorporating-Climate-Change_SWAP.pdf)
- 206 To explore the toolkit, visit <http://www.fws.gov/home/climatechange/toolkit.html>
- 207 To read the USGS Strategy, go to <http://pubs.usgs.gov/circ/2007/1309/>
- 208 To read the Global Change Science Strategy, visit <http://pubs.usgs.gov/of/2011/1033/>
- 209 For more information, visit [http://www.usgs.gov/climate\\_landuse/carbon\\_seq/](http://www.usgs.gov/climate_landuse/carbon_seq/)
- 210 To learn more about NCCWSC and the DOI CSCs, visit <https://nccwsc.usgs.gov/>
- 211 For more information about the DOI CSCs, visit <http://www.doi.gov/csc/index.cfm>
- 212 For more information about the NCCWSC and CSCs, see <https://nccwsc.usgs.gov/?q=node/59>
- 213 To learn more about the GAP Analysis Program tool, visit <http://www.gap.uidaho.edu/landcoverviewer.html>
- 214 To read the Assessment, go to <http://woodshole.er.usgs.gov/project-pages/cvi/>
- 215 To visit the USGS Office of Global Change website, go to [http://www.usgs.gov/climate\\_landuse/](http://www.usgs.gov/climate_landuse/)
- 216 For more information on the SERAP pilot project, visit <http://serap.er.usgs.gov/>
- 217 To read the Strategy, go to [http://www.nature.nps.gov/climatechange/docs/NPS\\_CCRS.pdf](http://www.nature.nps.gov/climatechange/docs/NPS_CCRS.pdf)
- 218 For more information on scenario planning, visit

---

<http://www.nature.nps.gov/climatechange/adaptationplanning.cfm>

219 To read an NPS brief on scenario planning, visit

<http://www.nature.nps.gov/climatechange/docs/SPlanningOverview.pdf>

220 For more information on the NPS response to climate change, see

<http://www.nature.nps.gov/climatechange/docs/AdaptationBrief.pdf>

221 For more information, visit <http://science.nature.nps.gov/im/networks.cfm>

222 For more information on the Inventory and Monitoring Program, visit

<http://science.nature.nps.gov/im/index.cfm>

223 For more information, see

[http://www.fws.gov/nativeamerican/graphics/Tribal\\_Climate\\_Change\\_Grant\\_Program\\_RFP.pdf](http://www.fws.gov/nativeamerican/graphics/Tribal_Climate_Change_Grant_Program_RFP.pdf)

224 To read the action plan, see

[http://www.npaih.org/images/resources\\_docs/weeklymailout/2011/may/week3/Dear%20Tribal%20Letter%20-%20Communication\\_%20BIA.pdf](http://www.npaih.org/images/resources_docs/weeklymailout/2011/may/week3/Dear%20Tribal%20Letter%20-%20Communication_%20BIA.pdf)

225 To read the climate change adaptation policy statement, visit

<http://www.dol.gov/open/sustainability/2011SustainabilityPlanApp2.pdf>

226 To read the DOT's policy statement on climate change adaptation, visit

<http://www.dot.gov/docs/climatepolicystatement.pdf>

227 To read DOT's Climate Change Strategic Plan, go to [http://climate.dot.gov/documents/splan\\_2006.pdf](http://climate.dot.gov/documents/splan_2006.pdf)

228 To access the DOT Climate Change Clearinghouse, visit <http://climate.dot.gov/>

229 To read the Gulf Coast Study, go to <http://www.climatescience.gov/Library/sap/sap4-7/final-report/sap4-7-final-all.pdf>

230 To access the FHWA Climate Change website, visit <http://www.fhwa.dot.gov/hep/climate/index.htm>

231 To read the report, go to [http://www.fhwa.dot.gov/hep/climate/climate\\_effects/](http://www.fhwa.dot.gov/hep/climate/climate_effects/)

232 To read the report, go to <http://climate.dot.gov/impacts-adaptations/forcasts.html#potentialImpacts>

233 To view the conceptual model, visit [http://www.fhwa.dot.gov/hep/climate/conceptual\\_model62410.htm](http://www.fhwa.dot.gov/hep/climate/conceptual_model62410.htm)

234 For more information, visit: <http://www.fhwa.dot.gov/hep/climate/pilots.htm>

235 To read the report, go to <http://www.fhwa.dot.gov/hep/climatechange/index.htm>

236 To read the Transportation and Climate Newsletter, visit

<http://www.fhwa.dot.gov/hep/climatechange/newsletter/index.htm>

237 For more information on the peer exchange, visit

[http://www.fhwa.dot.gov/hep/climate/peer\\_exchange/peer00.cfm](http://www.fhwa.dot.gov/hep/climate/peer_exchange/peer00.cfm)

238 For more information on the Indiana peer exchange visit

[http://www.fhwa.dot.gov/hep/climate/midwest\\_adaptation\\_peer\\_exchange/peerreport092111.pdf](http://www.fhwa.dot.gov/hep/climate/midwest_adaptation_peer_exchange/peerreport092111.pdf)

239 For more information, see [http://fta.dot.gov/documents/FTA\\_0001\\_-\\_Flooded\\_Bus\\_Barns\\_and\\_Buckled\\_Rails.pdf](http://fta.dot.gov/documents/FTA_0001_-_Flooded_Bus_Barns_and_Buckled_Rails.pdf)

240 For more information, visit <http://www.fta.dot.gov/>

241 To read the climate change adaptation policy, go to

<http://www.epa.gov/climatechange/effects/downloads/adaptation-statement.pdf>

242 To view the strategic plan, visit <http://www.epa.gov/planandbudget/strategicplan.html>

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- 243 To read the National Water Program climate strategy and related documents, go to <http://water.epa.gov/scitech/climatechange/index.cfm>
- 244 For more information, visit <http://water.epa.gov/scitech/climatechange/upload/Climate-Change-Vulnerability-Assessments-Sept-2010.pdf>
- 245 For more information, visit <http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=233808>
- 246 For more information, visit <http://www.epa.gov/smartgrowth/partnership/>
- 247 For more information about the work group, visit <http://www.epa.gov/aboutepa/opei.html>
- 248 To learn more about the Climate Estuaries Program, visit <http://www.epa.gov/cre/>
- 249 For more information, visit <http://www.epa.gov/cre/toolkit.html>
- 250 To read the annual Progress Reports and the June 2011 Lessons Learned, go to <http://www.epa.gov/cre/>
- 251 For more information on the CRWU program, visit <http://water.epa.gov/infrastructure/watersecurity/climate>
- 252 To read the CRWU Working Group report, visit <http://water.epa.gov/drink/ndwac/climatechange/upload/CRWU-NDWAC-Final-Report-12-09-10-2.pdf>
- 253 To learn more about EPA's efforts and extreme heat events, visit <http://www.epa.gov/naturalevents/extremeheat.html>
- 254 To read the Excessive Heat Guidebook, go to <http://www.epa.gov/heatisland/about/heatguidebook.html>
- 255 To learn more about EPA's Low Impact Development and Green Infrastructure program, visit: [http://water.epa.gov/polwaste/green/test\\_lid\\_index.cfm](http://water.epa.gov/polwaste/green/test_lid_index.cfm)
- 256 For more information, see <http://www.epa.gov/ord/>
- 257 For more information, visit <http://www.epa.gov/region6/climatechange/strategy.htm>
- 258 For more information, visit <http://water.epa.gov/scitech/climatechange/>
- 259 For more information, visit [http://water.epa.gov/scitech/climatechange/upload/State\\_Tribal\\_Climate\\_Change\\_Council\\_Charter\\_100209-2.pdf](http://water.epa.gov/scitech/climatechange/upload/State_Tribal_Climate_Change_Council_Charter_100209-2.pdf)
- 260 To access EPA's Climate Change website, go to <http://www.epa.gov/climatechange/> and for additional adaptation information see <http://www.epa.gov/climatechange/effects/adaptation.html>
- 261 For more information, visit [http://www.epa.gov/climatechange/indicators/pdfs/ClimateIndicators\\_full.pdf](http://www.epa.gov/climatechange/indicators/pdfs/ClimateIndicators_full.pdf)
- 262 For more information, visit <http://water.epa.gov/scitech/datait/models/basins/index.cfm>
- 263 For more information, visit <http://www.epa.gov/cre/toolkit.html>
- 264 For more information, visit <http://water.epa.gov/infrastructure/watersecurity/climate/creat.cfm>
- 265 For more information, visit <http://www.epa.gov/safewater/watersecurity/climate/toolbox.html>
- 266 For more information, visit [http://yosemite.epa.gov/ow/SReg.nsf/description/TTX\\_Tool](http://yosemite.epa.gov/ow/SReg.nsf/description/TTX_Tool)
- 267 For more information, visit [http://www.whitehouse.gov/the\\_press\\_office/Executive-Order-Chesapeake-Bay-Protection-and-Restoration/](http://www.whitehouse.gov/the_press_office/Executive-Order-Chesapeake-Bay-Protection-and-Restoration/)
- 268 To read the Chesapeake Bay Restoration and Protection Strategy, visit <http://executiveorder.chesapeakebay.net/file.axd?file=2010%2f5%2fChesapeake+EO+Strategy%20.pdf>
- 269 For more information on the FY 2011 Action Plan, visit <http://executiveorder.chesapeakebay.net/file.axd?file=2010%2f9%2fChesapeake+EO+Action+Plan+FY2011.pdf>
- 270 For more information on the Strategy, visit the Chesapeake Bay Program Watershed Partnership website at

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<http://www.chesapeakebay.net/>

271 To read the climate change adaptation policy, go to

[http://www.nasa.gov/pdf/555942main\\_NASA%20CC%20Policy%20Statement%20May%202011.pdf](http://www.nasa.gov/pdf/555942main_NASA%20CC%20Policy%20Statement%20May%202011.pdf)

272 For more information on the Climate Applications area, visit <http://appliedsciences.nasa.gov/climate.html>

273 For more information on PlaNYC and to view NYC's sustainability and climate resilience publications, visit

<http://www.nyc.gov/html/planyc2030/html/home/home.shtml>;

274 To read about the CASI Workgroup, visit [https://c3.nasa.gov/nex/projects/1204/quick\\_view/](https://c3.nasa.gov/nex/projects/1204/quick_view/)

275 To view the NASA Global Climate Change Website, visit <http://climate.nasa.gov/>