



STRATUS CONSULTING

Report on the U.S. EPA Southeast Climate Change Adaptation Planning Workshop

Prepared for:

U.S. Environmental Protection Agency

Region 4
Office of Air and Radiation, Climate Change Division
Office of Water, Water Policy Staff
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Acronyms and Abbreviations

CEQ	Council on Environmental Quality
CZM	Coastal Zone Management
DOI	U.S. Department of the Interior
ECOS	Environmental Council of the States
EIS	Environmental Impact Statements
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
IPCC	Intergovernmental Panel on Climate Change
LCC	Landscape Conservation Cooperative
LIDAR	Light Detection and Ranging
MARCO	Mid-Atlantic Regional Council on the Ocean
NBII	National Biological Information Infrastructure
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGO	non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
OSTP	Office of Science and Technology Policy
RISA	Regional Integrated Sciences and Assessments
SENRLG	Southeast Natural Resource Leaders Group
SERPPAS	Southeast Regional Partnership for Planning and Sustainability
SGA	Southern Governors' Association
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

Executive Summary

The U.S. Environmental Protection Agency convened the Southeast Climate Change Adaptation Planning Workshop in Atlanta, Georgia on February 2–3, 2010. The goals of the workshop were to foster adaptation planning in the Southeast and to serve as a potential model for other regions. Emphasis was placed on exploring, understanding, and overcoming barriers to adaptation planning and action. The workshop was attended by over 200 representatives from the federal government; state, tribal, and local governments; academia; the private sector; and non-governmental organizations (NGOs). Participants came from around the country, although mostly from the Southeast. This report summarizes the discussions at the workshop.

After a plenary session dedicated to presentations on vulnerabilities of the Southeast to climate change and describing current initiatives inside and outside the region on adaptation, the workshop broke into smaller sessions to first identify impediments to adaptation and then propose possible solutions. Discussions focused on adaptation issues concerning coastal and water resources, but many of the findings could also be applied beyond these two sectors. In addition, many of the findings are likely to be applicable outside the region.

Impediments to adaptation

Workshop participants identified a number of impediments and barriers to adaptation surrounding the following topics:

- ▶ **Availability and usefulness of information.** Participants noted that information on current risks associated with climate often were not available, not comprehensive, or not consistent. In addition, decision-makers and the public are presented with uncertainties about future climate change, including the amount and for key variables such as precipitation, direction of change. Furthermore, existing vulnerability assessments typically have not projected changes for localities.
- ▶ **Level of understanding of risks from climate change.** The potential impacts of climate change are widespread and are estimated across many sectors. As a result, it is difficult to compare impacts because different metrics may be used to estimate consequences. In addition, there is limited information on the economic benefits and costs of adaptation.
- ▶ **Status of a mandate on adaptation.** The federal government has not issued a directive for states and municipalities to develop adaptation plans.
- ▶ **Degree of public engagement.** Participants noted that the public does not seem to be engaged in the need for adaptation.

- ▶ **Level of guidance and coordination on adaptation from the federal government.** The federal government, although starting to champion adaptation, has not issued guidance on the subject. Participants were also concerned about a seeming lack of coordination on adaptation among federal agencies.
- ▶ **Funding availability.** Participants mentioned that targeted funding is generally not available for states, tribes, or municipalities to address adaptation.
- ▶ **Legal and institutional barriers.** The workshop participants mentioned a number of legal and institutional barriers at all levels of government that they said can serve to impede or discourage adaptation to climate change. These ranged from insurance programs and subsidies which may not adequately discourage risky behavior or waste, to an inflexible regulatory system, to a system of property rights that may complicate adaptation efforts.
- ▶ **Resistance to some adaptations.** Finally, it was pointed out that there may be public resistance to some potential adaptation measures, such as injection of treated water into coastal aquifers to impede saltwater intrusion.

Possible solutions

Having first identified potential impediments to adaptation, participants then proposed possible solutions. The participants did not rank the potential solutions or assign them priorities, and this summary report does not endorse any possible solution.

The solutions proposed at the workshop included:

- ▶ **Develop an education and outreach role on climate change.** An education and outreach strategy should be developed to reach out to adaptation practitioners, decision-makers, and the public to help them understand vulnerabilities to climate change and adaptation. The information must be clear and understandable and the strategy should include providing experts with the right information and tools to use in outreach.
- ▶ **Create a climate change information clearinghouse for the Southeast.** A clearinghouse would contain information to help those making decisions on adaptation to understand vulnerability to climate change and develop appropriate responses. Information in the clearinghouse would include data, climate model output, results of vulnerability studies, tools to aid in analysis, training materials, descriptions of best practices, and identification of funding opportunities.
- ▶ **Conduct coordinated vulnerability assessments.** Participants called for vulnerability assessments to be carried out by sector, but also at the levels of the Southeast region,

states, and localities. Participants proposed the federal government could provide guidance and standards, while the states and regional organizations carry out the studies.

- ▶ **Define priorities.** Tools and mechanisms, such as ones that enable users to conduct benefit-cost analyses or set priorities based on risks, are needed to aid federal agencies, states, regional authorities, and municipalities to set adaptation priorities.
- ▶ **Develop adaptation policies.** Government policies should create incentives for adaptation. This may mean removing policies that encourage risky behavior, such as policies which do not adequately discourage building in floodplains or consuming water resources, and putting in place policies that encourage appropriate change in behavior to adapt to climate change. Specific activities, such as Environmental Impact Statements, that could incorporate climate change were identified. Participants said legislation and regulations should also account for climate change adaptation. Model climate change adaptation policies, such as model zoning ordinances, should be developed.

Implementation

Workshop participants also discussed who should implement these possible solutions. One implementation principle that was elucidated in a number of breakout and plenary sessions was that information, technical support, and funding should flow from the top-down (from the federal government down to states and municipalities), but that decisions should be made at the local and state levels. However, another view was that direction should come from the top (lack of guidance from the federal government was cited as a barrier to adaptation), because without leadership from the top, things would not get done.

Attendees also felt that adaptation requires collaboration and coordination within and across different levels of government and with stakeholders. The federal government, states, municipalities, tribes, the private sector, NGOs, and citizens need to be brought together to identify and discuss adaptation needs and solutions.

Participants also considered which entities should coordinate development of adaptation policies in the region. Two main options were identified: regional organizations and regional offices of the federal government. Among the possible regional organizations who participants thought could provide a coordinating role are the Southern Governors' Association, the Environmental Council of the States, the Southeast Natural Leaders Resources Group, the Southeast Regional Partnership for Planning and Sustainability, and the South Atlantic Alliance.

Should the federal government provide the coordination, there was no consensus on which agency should take the lead. There was, however, a widespread feeling that federal agencies need to better coordinate adaptation measures. Participants also mentioned that such mechanisms

as the National Environmental Policy Act could be used to promote adaptation, and organizations such as the Coastal Zone Management Program, the National Estuaries Program, and Landscape Conservation Cooperatives could serve as models for federal coordinating bodies.

Workshop participants suggested that the dialogue started at this workshop continue to enhance regional adaptation planning.

1. Introduction

The southeastern United States may be one of the regions most vulnerable to climate change in the United States (Smith, 2004; Karl et al., 2009). It faces risks from climate change because it has a long and low-lying coastline [41% of the coterminous U.S. coastline (NOAA, 1975)] that is exposed to sea level rise and hurricanes; it is already relatively warm and thus will not, for the most part, benefit from more heat; it will be exposed to more risks of disease; and it has rich biodiversity. In addition to being home to almost 60 million people, the Southeast has over 400,000 farms on almost 80 million acres (USDA, 2008), over 127 million acres of timberland (USFS, 2010), 33% of U.S. coterminous estuaries (NOAA, 1990), and nearly 30% of all U.S. wetlands (Dahl, 1990). For these and other reasons, the region faces many risks from climate change.

Planning for adaptation has already begun in a few states and municipalities in the Southeast. However, efforts to plan and coordinate across the entire region have been limited. With climate change likely to affect multiple municipalities and states, a coordinated planning effort will improve the ability of stakeholders to adapt to the risks from climate change.

With this in mind, U.S. Environmental Protection Agency (EPA) Region 4 (headquartered in Atlanta and containing the states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee), partnered with the EPA's Office of Air and Radiation (Climate Change Division) and Office of Water to organize a workshop held in Atlanta on February 2–3, 2010. The goals of the workshop were to foster adaptation planning in the Southeast and to serve as a potential model for other regions. Emphasis was placed on exploring, understanding, and overcoming barriers to adaptation planning and action.

More than 200 representatives from the federal government; state, tribal, and local governments inside and outside the region; academia; the private sector; and non-governmental organizations (NGOs) attended the workshop. The workshop included plenary presentations on regional climate change impacts and on adaptation efforts at the federal, state, and local levels inside and outside the region, followed by breakout sessions. On the first day, breakout sessions had participants explore impediments to adaptation, and then on the second day, they identified possible solutions. On the first day, the breakout groups were organized by the following sub-sections:

- ▶ Water Resources
 - Supply
 - Quality

- Inland flooding
- Instream flows

- ▶ Coastal Resources
 - Inundation
 - Coastal flooding
 - Saltwater intrusion.

On the second day, breakout groups focused on either water resources or coastal resources and discussed common solutions within the sector, although many of the solutions are likely applicable across other sectors (e.g., forestry).

Section 2 of this report briefly discusses the potential impacts on the Southeast, adaptation concepts, and current adaptation activities. Section 3 summarizes the workshop discussions on impediments to adaptation and possible solutions and implementation mechanisms.

2. Southeast Impacts and Adaptation

This section summarizes some observed and projected impacts of climate change on the Southeast, relying on existing scientific assessment literature, and briefly overviews adaptation and adaptation activities in and outside the region.

2.1 Summary of Climate Change Impacts on the Southeast

The impacts of climate change will affect many sectors across the Southeast. Key impacts are summarized below.

The average annual temperature in the Southeast has risen by about 2°F since 1970, with the greatest seasonal increase occurring in the winter. Climate models project continued warming in the Southeast, with the greatest temperature increases occurring in the summer. Average temperatures are projected to rise by about 4.5°F by the 2080s under a lower emissions scenario, and about 9°F under a higher emissions scenario (Karl et al., 2009).

Current precipitation trends indicate an increase in autumn precipitation in much of the Southeast. Heavy downpours have increased in parts of the region, while the percentage of the region experiencing moderate to severe drought has increased over the last three decades. Climate models project a decline during this century in spring and summer rainfall in South Florida. Results are not as clear for the remainder of the Southeast, but models project that the

Gulf Coast states will tend to have less winter and spring rainfall, compared to the more northern states in the region (Karl et al., 2009).

The future frequency, duration, and intensity of droughts in the region are likely to increase (Karl et al., 2009). By the end of the century for the United States, heat wave events that now occur once every 20 years are projected to occur about every other year (under a higher emissions scenario), and very hot days are projected to be about 10°F hotter than they are today (Karl et al., 2009).

Atlantic hurricane intensity is likely to increase during this century. Such an increase is very likely to increase inland and coastal flooding, coastal erosion rates, wind damage to coastal forests, and wetland loss. Average sea level may rise by up to 2 feet or more for the greater Southeast region including the U.S. Gulf Coast, causing shoreline retreat. More frequent storm surge flooding and permanent inundation of coastal ecosystems and communities is likely in some low-lying areas. Sea level rise and associated impacts are likely to increase the salinity of estuaries, coastal wetlands, and tidal rivers, thereby displacing coastal ecosystems farther inland assuming that no migration barriers exist. Higher water temperatures and ocean acidification due to increasing atmospheric carbon dioxide will present major additional stresses to coral reefs (Karl et al., 2009).

Decreased water availability, due to increased temperature and longer periods of time between rainfall events, coupled with increased societal demand is very likely to affect the region's economy and natural systems. Higher temperatures leading to reduced dissolved oxygen in streams, lakes, and shallow aquatic habitats could lead to fish kills and loss of aquatic species biodiversity (Karl et al., 2009).

Ecosystem impacts from projected temperature increases may include altered distributions of native plants and animals, local loss of many threatened and endangered species, displacement of native species by invasive species, more frequent and intense wildfires, forest pest outbreaks (such as the southern pine beetle), and drying of lakes, ponds, and wetlands from intense droughts. Projected increased temperatures would also contribute to heat-related stress for agricultural crops, trees, and livestock (Karl et al., 2009).

Climate changes and projected impacts in the Southeast, including increases in water scarcity, sea level rise, extreme weather events, and heat stress, have implications for health and quality of life. Heat stress and related deaths in the summer months are likely to increase, and a likely reduction in cold-related deaths is not expected to offset this increase (Karl et al., 2009).

Increases in intense precipitation may increase short-term flooding, stressing the capacity of existing drainage systems and potentially disrupting traffic management, increasing highway incidents, and affecting airline schedules. Additionally, increases in mean and extreme high

temperatures may require changes in materials, maintenance, and operations of transportation infrastructure and vehicles (CCSP, 2008a).

Climate change is also expected to have impacts on the energy sector, the economy (e.g., tourism and recreation), and environmental justice issues. Overall, the adverse impacts of climate change in the Southeast may be felt most acutely by certain especially vulnerable parts of the population. These include the poor, the elderly, those already in poor health, the disabled, those living alone, and/or indigenous populations dependent on one or a few resources (CCSP, 2008b).

2.2 Overview of Adaptation and Activities

The Intergovernmental Panel on Climate Change (IPCC) defined adaptation to climate change as follows:

Adaptation to climate change takes place through adjustments to reduce vulnerability or enhance resilience in response to observed or expected changes in climate and associated extreme weather events (Adger et al., 2007, p. 720).

Some adaptations will be “anticipatory,” that is, undertaken to avoid future impacts of climate change. Most, however, are likely to be “reactive,” that is, done as changes in climate and impacts are observed.

There are two basic types of anticipatory adaptation:

1. Those that can be justified because of climate change (“climate change justified adaptations”)
2. Those that can be justified even without the consideration of climate change (“no regrets adaptations”).

Adaptation to climate change is being addressed at many levels of government within the Southeast and across the United States. The efforts so far are nascent and in many respects not comprehensive. Florida has completed a Climate Action Plan and a State Adaptation Plan, while several other states have initiated adaptation efforts or developed other plans; such as drought management plans consistent with adapting to climate change. In addition, some municipalities in Florida and North Carolina have begun examining adaptations. A number of states and municipalities outside the Southeast have adaptation efforts underway. For example, California published a state adaptation plan; while King County, Washington, built a water treatment system in anticipation of climate change; and New York City issued a comprehensive adaptation plan.

The federal government has also begun to address adaptation. EPA's Office of Water issued an adaptation strategy (U.S. EPA, 2008), and the U.S. Department of the Interior (DOI) created Landscape Conservation Cooperatives for applied adaptation research. The National Oceanic and Atmospheric Administration (NOAA) recently announced formation of a NOAA Climate Service to make climate information available for various end-uses. President Obama signed an Executive Order in October 2009 that requires federal agencies to examine and manage their vulnerabilities to climate change (Executive Office of the President, 2009). The Council on Environmental Quality (CEQ) is working with the Office of Science and Technology Policy (OSTP) and NOAA to coordinate a process on adaptation which includes providing science to support adaptation, coordinating activities, setting priorities, and evaluating adaptations (CEQ et al., 2010). CEQ recently issued draft guidance that outlined changes for preparation of Environmental Assessments and Environmental Impact Statements (EIS) under the National Environmental Policy Act (NEPA) which would include consideration of climate change impacts on a proposed project.

3. Workshop Summary

This section summarizes discussions from the workshop on adaptation issues in the Southeast. The discussions on impediments to adaptation are presented first, followed by possible solutions and mechanisms for implementing the solutions.

The summary is based on notes taken during all of the breakout and plenary sessions. While note-takers diligently worked to record everything that was stated, it is possible that some statements were not recorded or may have been misunderstood. The authors of this report attempted to be thorough in summarizing the notes, but do not claim to have presented everything that was in the notes. Additionally, the authors report what participants stated at the workshop and have, in some cases, added clarifying comments in footnotes.

3.1 Impediments to Adaptation

Many impediments to adaptation in the Southeast were identified by participants. These impediments included:

- ▶ Concerns about the availability and usefulness of climate change information
- ▶ Level of understanding and clarity of risks
- ▶ Status of a mandate on adaptation
- ▶ Degree of public engagement

- ▶ Level of guidance and coordination on adaptation from the federal government (and other levels of government)
- ▶ Funding availability
- ▶ Legal and institutional barriers to adaptation
- ▶ Resistance to some adaptations.

Each of these impediments are discussed in detail below. Note that although the breakout groups focused on coastal and water resources management in light of climate change, many of the impediments identified during the discussions are also relevant to other sectors affected by climate change. In addition, many if not all of these impediments are not unique to the Southeast or even to the United States.

3.1.1 Concerns about availability and usefulness of climate change information

Two general concerns about climate change information were raised by participants. The first was on the quality of information on risks from observed climate. This included concerns about the comprehensive nature and consistency of climate change data, as well as access to data on current climate conditions and associated vulnerabilities. The second concern was with the access to, and difficulty of understanding and using information on climate change.

Information on current conditions

Information on risk from the present climate was considered by participants to often be unavailable or inconsistent. Information on some risks has not been collected uniformly. For example, participants in the workshop reported that data on saltwater intrusion into coastal aquifers is gathered by local water utilities, counties, water management districts, the state, and the U.S. Geological Survey (USGS). According to the participants, these data are not combined in a common dataset. Similar concerns were raised about the inconsistency of data collection for other sub-sectors, such as coastal flooding. In addition, Light Detection and Ranging (LIDAR) has not been used to develop more detailed elevation data on all coastlines in the region. Another issue raised by participants was the lack of sufficient information to understand impacts of climate change on federal trust species (which includes federally designated threatened and endangered species as well as migratory birds).

One reason cited by participants for the inconsistent and incomplete datasets is the reduction in federal funding for monitoring. One participant noted that the USGS has reduced its share of

financial support for monitoring.¹ The remaining monitoring must be supported by other entities such as states and municipalities, and this contributes to the collection of incomplete data on, for example, saltwater intrusion into coastal aquifers. Participants also pointed out that monitoring networks on streams have been degraded as a result of decreased federal funding. So, in general, some participants felt that a lack of federal support is producing a decreased capacity to monitor and thereby detect changes in the environment.

Information on climate change

The concerns on availability and quality of information on climate change mentioned by participants included the inconsistency of projections, the multiplicity of studies, but also the lack of comprehensive projections of climate change particularly at a smaller geographic scale.

One critical issue mentioned by many participants was the wide range of projections from climate change models. These result from the use of different greenhouse gas emissions scenarios as well as the use of multiple climate models. This wide range of projections makes it difficult to plan for future changes with confidence.²

Some participants suggested the large number of studies on climate change vulnerabilities leads to confusion. Different studies can produce different results and it may not be clear which results are appropriate for use in planning for adaptation.

Finally, while some vulnerability studies have been undertaken, participants felt they are neither comprehensive, nor have they produced information on potential climate change impacts on a scale that facilitates decision-making. For example, the Southeast lacks a comprehensive assessment of risks to the built and natural environments. Assessments that have been done tend to look across the region and have not generally made projections at the local level.

1. USGS relies on state/local agency funds to leverage federal dollars to support monitoring. Due to level federal funding for many years and recent decreases in state and local partner spending, over time the funding available to support USGS monitoring programs has been eroded. The amount of support for monitoring varies by state, as each cooperative program is unique to each state. USGS has implemented programs to maintain a core set of federally funded monitoring stations that support national data needs and are not subject to the availability of cooperator funds (W. Brian Hughes, USGS, personal communication, May 4, 2010).

2. The IPCC, among others, use multiple model simulations of change in regional climate to represent uncertainty about such changes (e.g., Christensen et al., 2007). Many studies of climate change impacts use multiple scenarios to capture some of the uncertainty about regional climate change.

3.1.2 Level of understanding and clarity of risks

Participants stated that the communication of information on risks from climate change was not conducive to supporting adaptation. Climate change affects many different sectors and potential impacts and risks are not expressed in common metrics, which makes it difficult to compare risks and set priorities.

In addition, participants noted that information on economic consequences of climate change was either lacking or inadequate. Neither the costs of climate change impacts nor the benefits of adaptation are well known. Participants cited this as being a particular problem at the local scale. It was also pointed out that not knowing the costs associated with climate change is an impediment to public understanding of climate change risks.

3.1.3 Status of a mandate on adaptation

The lack of a mandate on adaptation was raised as an issue in several breakout sessions. While, as noted above, several states in the region have begun exploring adaptation, none have made adaptation a requirement and there is no mandate from the federal government on the need to adapt to climate change.

3.1.4 Degree of public engagement

Participants pointed out that the public appears not to be engaged in adaptation, while some suggested the public does not understand the breadth and complexity of climate change risks. People tend to focus more on short-term issues, not issues such as long-term risks from climate change.

3.1.5 Level of guidance and coordination on adaptation from the federal government

The lack of federal guidance on adaptation, as well as a lack of coordination, was mentioned as an impediment to adaptation in several breakout groups. As noted above, the federal government is in the early stages of preparation to address adaptation. Participants stated that there has been no guidance on how federal agencies as well as other levels of government can or should address adaptation, although they noted that the federal government has issued draft guidance on climate change and NEPA. Just recently, the U.S. Army Corps of Engineers (USACE) issued guidance on sea level rise.

Participants also mentioned the lack of coordination on adaptation among federal agencies. Agencies with jurisdictions in the same sector are not working together to address the issue. For

example, participants mentioned that NOAA, the Federal Emergency Management Agency (FEMA), and EPA, among others, do not share common goals on resource management. Participants pointed to what appears to them to be a competition among federal agencies for a position of leadership on adaptation. Participants also noted that the same lack of coordination is evident among state agencies.

A similar concern was the apparent lack of coordination across different levels of government. For example, the water supply breakout group identified dozens of federal, state, and local agencies and other bodies that influence management of water resources in the Southeast. However, these organizations do not appear to be coordinating on regional adaptation, although participants pointed out that there has been coordination on matters such as management of the Everglades.

3.1.6 Funding availability

The lack of funding for adaptation was mentioned in a number of breakout sessions as an impediment to adaptation. Participants said that targeted funding is not available from the federal or state governments to support planning for adaptation at lower levels of government. With the recent economic recession, availability of funds for planning at the state level is limited as well. Tribes also lack financial resources to study climate change risks and adaptation.

3.1.7 Legal and institutional barriers to adaptation

The existence of legal and institutional barriers to adaptation, particularly but not exclusively in the federal government, was mentioned in many breakout groups as an impediment to adaptation. Many laws and programs do not provide the right incentives to promote adaptation. Participants said that the National Flood Insurance Program (NFIP) is an example of a program that does not discourage development in low-lying areas prone to flooding.³ With sea level rise

3. Mark Crowell of FEMA stated that aspects of the NFIP create a disincentive to building in the flood zone. Mapping of flood zones provides flood risk information to communities, developers, prospective homeowners, and others. Structures built in floodplains must comply with the community's 100-year floodplain-specific building standards (based upon FEMA minimum requirements that must be adopted by a community before the community can join the NFIP). In addition, those who build in a 100-year flood hazard area must buy flood insurance. With a few exceptions, the NFIP does not generally consider changes in conditions in the future (Blais et al., 2006). Changes such as sea level rise and more intense hurricanes are currently being investigated by FEMA in response to a Government Accountability Office recommended study entitled "Impact of Climate Change on the NFIP." The study should be completed in summer 2010 (Mark Crowell, FEMA, personal communication, May 4, 2010).

and more intense hurricanes and storms, flooding may increase, making those areas even more vulnerable to flooding.

Specific barriers mentioned were:

- ▶ **Flood zone mapping.** Mapping of flood zones can serve as a barrier to adaptation by creating the impression for those with property outside the designated flood zone (typically based on the 100-year flood) that their property is “safe” from flooding.⁴
- ▶ **Non-federal barriers.** Barriers can exist outside of the federal level as well. For example, subsidies for water consumption and not charging consumers for the true replacement costs of water can create incentives to consume too much water. With the potential for an increase in drought and salination of coastal aquifers, overconsumption of water can increase vulnerability to climate change.
- ▶ **Contradictory policies.** Some participants stated that some government policies contradict each other and noted these contradictions can impede adaptation. For example, government agencies involved in water supply and instream flow management have competing priorities, including providing water supplies, protecting against floods, and maintaining instream flows at a sufficient level to protect aquatic ecosystems and, in particular, endangered species.
- ▶ **Administration of regulations.** In a number of respects, the regulatory system itself and how it is managed can impede adaptation. Participants noted the lack of flexibility in laws, regulations, and permits. Some participants said that the Clean Water Act itself is too inflexible to allow for a nimble response to climate change. Regulations can be difficult to change and the regulatory system may not be responsive to changing conditions resulting from climate change.
- ▶ **Short planning horizons.** Short planning horizons that may not allow for consideration of climate change over many decades, was also mentioned as a barrier.
- ▶ **Property rights.** Another possible legal impediment to adaptation identified by participants was property rights. This is of particular concern along the coast where changes in the seaward boundary of private property are governed typically by state law. Issues can include whether private property is lost as shorelines erode, what rights private property owners have to protect their property (particularly if measures such as armoring

4. According to CCSP (2009), many studies have evaluated the impact of flood insurance on coastal development, and it has not been shown that the NFIP has increased development in coastal areas outside the 100-year floodplain.

can cause other problems such as beach erosion and blocking of inland migration of wetlands), and whether the littoral owner or the state owns coastal land that is reclaimed from the sea or replenished, e.g., through beach nourishment.

3.1.8 Resistance to some adaptations

Finally, a category of impediments to adaptation identified by the participants involved resistance on the part of the public to accept some adaptations. For example, injection of highly treated groundwater can serve as a hydraulic barrier to block or limit salination of coastal aquifers, but, coastal residents may not approve of having treated water put into their public water supply.

3.2 Possible Solutions

Once workshop participants had articulated potential impediments to adaptation, they then attempted to identify possible solutions. This report briefly describes the suggested solutions, but no attempt was made during the workshop to rank them or set priorities. Furthermore, endorsement of all or any of the possible solutions by EPA should not be inferred from this report. The section following identification of possible solutions discusses what levels of government and organizations within those levels could implement the solutions.

The workshop participants identified several categories of solutions that could address the impediments identified above:

- ▶ Develop an education and outreach role on climate change
- ▶ Create a climate change clearinghouse for the Southeast
- ▶ Coordinate vulnerability studies
- ▶ Set priorities for adaptation
- ▶ Develop adaptation policies.

Each category is discussed in more detail below, followed by overall implementation options.

3.2.1 Develop an education and outreach role on climate change

Several breakout groups noted that a key impediment to engaging in adaptation was the lack of understanding of climate change and the risks posed to the region. These breakout groups felt that this lack of understanding crosses several different levels. First, the public may not understand risks from climate change and may be skeptical about whether climate is changing or what is causing the changes. Some of the reasons for this lack of understanding were discussed

in the impediments section above. Second, decision-makers lack clarity on adapting to climate change. Finally, workshop participants identified a lack of experts who can provide guidance to decision-makers on climate change as one reason for the lack of understanding, and noted that more experts are needed to advise decision-makers and others about managing resources.

The participants concluded that an education and outreach strategy needed to be carefully targeted to decision-makers and the public to overcome the impediments to adapting to climate change. To be successful the strategy needs to utilize messages that are not abstract and that people can understand. Among the ideas put forth by the participants were:

- ▶ Understand people's priorities and inclinations. Public education may not be a matter of one size fits all and messages may need to be tailored for different groups. This principle also applies to decision-makers, as those in different fields and sectors may require different outreach and communication strategies.
- ▶ Express climate change in terms people will relate to. Economics was offered as one consideration that would be widely understood. Expressing the benefits and costs of adaptation would help, as would the use of concepts such as ecosystem services.
- ▶ Put climate change in relevant time scales. Impacts and adaptation will need to be stated in shorter time horizons than is typically done, for it to be meaningful to most people.
- ▶ Work with information providers. There should be a more concerted effort to work with universities, climatologists, extension agents, NGOs, consultants, and others who are in a position to explain climate change and adaptation to the public or to decision-makers. Workshop participants mentioned that Sea Grant and Land Grant institutions could provide outreach on climate change. Strategies should be developed for supporting these groups in their quest to improve their understanding of climate change and to help them develop tools and techniques to use to reach out to the public and decision-makers.

3.2.2 Create a climate change information clearinghouse for the Southeast

Participants suggested creation of a clearinghouse on climate change information for the Southeast.⁵ The discussion centered on what would be included in such a clearinghouse, and also on how it would be managed and maintained.

5. The breakout groups were not asked to consider whether it is most efficient to have a single national clearinghouse, one specifically for the Southeast, or a set of regional clearinghouses.

Clearinghouse contents

Participants proposed the clearinghouse contain a variety of information to help those addressing adaptation understand vulnerability to climate change and develop appropriate responses. Information in the clearinghouse would include data, climate model output, results of vulnerability studies, tools to aid in analysis, training materials, best practices, and funding opportunities.

Data

Having the clearinghouse be a reliable source of data was an important consideration raised in a number of breakout sessions and during the plenary review of the breakout sessions. The data should include information needed to understand vulnerability. It should be comprehensive and on a common platform. It should also adhere to standards to make it useful. Participants pointed out that a repository of raw data and shape files from different agencies may be appropriate. The clearinghouse should also contain data metrics and cross-referencing to make different datasets more compatible and useful. Maps as jpegs and a graphics library should be included in the clearinghouse. Participants identified several examples of datasets which the clearinghouse could have links to, including USGS' National Biological Information Infrastructure (NBII) and South Florida Information Access (SOFIA, 2010) datasets. The portal www.data.gov was also mentioned as an example and good source of data.

Models and scenarios

Participants agreed that a climate change clearinghouse should provide data from models and information on how to develop climate change scenarios. The clearinghouse should not be limited to just supplying model projections for the Southeast, but should also provide guidance on how to choose the best models to use in vulnerability analysis. Participants suggested that, if possible, the guidance should consider the needs of different sectors and regions in the Southeast and describe the usefulness of various climate models for different needs. For example, the U.S. Forest Service (USFS) provides a web-based set of models that can be used to estimate changes in stream temperature (USFS, 2010).

Participants said that guidance on the development and use of climate change scenarios is needed. Some stated that a consistent set of scenarios in the clearinghouse would be helpful. However, participants noted the danger of having a common set of scenarios because it might stifle creativity. One solution mentioned would be for the clearinghouse to offer a default set of scenarios, but allow and enable users to apply whatever scenarios they deem appropriate. Finally, participants called for creation of probabilities of climate change at the regional scale.

Assessment tools

Modeling and other software tools that can be used by vulnerable communities, states, tribes, and others to assess their vulnerability to climate change should also be made available through the clearinghouse. One breakout session identified the need for tools to estimate the effects of sea level rise on saltwater intrusion. This session also identified the need for provision of flood simulation tools that could account for the interactions of surface and groundwater.

Other sessions called for the clearinghouse to include tools to aid decision-making. Participants identified the need for tools to help decision-makers estimate the benefits and costs of adaptations.

Training

A number of participants said the clearinghouse should include training materials and presentations on assessing vulnerability and addressing adaptation. Participants suggested the need for cultural training on beliefs, values, and attitudes on climate change provided perhaps by the American Anthropological Association.

Other clearinghouse components

Participants suggested the clearinghouse should also include best practices on adaptation. In addition, participants suggested the clearinghouse could identify funding opportunities for adaptation planning.

Management of a Southeast climate change clearinghouse

A number of options were offered with regard to which organizations should manage a clearinghouse. The most common suggestion was to have the federal government develop the clearinghouse, but that others would manage the data and be able to provide information to be included in the clearinghouse. For example, inclusion of information from states and other sources was mentioned. Some participants also proposed the Regional Integrated Sciences and Assessments (RISA) organizations funded by NOAA could manage the clearinghouse.⁶ Another possible model is the Southern Appalachian Information Node, which is part of the NBII, managed by the USGS. Participants also suggested that the clearinghouse be run by state climatologists.

One of the breakout groups identified a process for a clearinghouse to engage stakeholders. Once a clearinghouse was created to consolidate information to support adaptation, interactive forums

6. RISAs typically exist at universities or other research centers.

with stakeholders could be held to share information and identify information needs. The forum could also be used to identify lessons learned and impediments to adaptation.

3.2.3 Coordinate vulnerability studies

As noted in the impediments discussion, there are inconsistencies in how studies on vulnerability to climate change are done as well as the coverage of such studies. Participants called for vulnerability assessments to be carried out by resource (e.g., water resources, coastal resources), but also at the levels of the Southeast region, states, and localities. Several breakout groups called for leadership to be provided by the federal government (see discussion below on roles), with the national government providing guidance and a minimum set of standards on how vulnerability assessments should be carried out. The assessments, however, would be conducted by states and regional agencies.

3.2.4 Set priorities for adaptation

One of the impediments to adaptation identified was the difficulty in setting priorities for adaptation. Tools and mechanisms are needed to aid federal agencies, states, regional authorities, and municipalities set priorities for adaptation. Breakout sessions included discussion of helping set risk-based priorities. The use of benefit-cost analysis was also frequently mentioned as a way to help in decision-making.

3.2.5 Develop adaptation policies

The discussion on developing adaptation policy fell into two categories: identification of specific changes in policy that would help enable adaptation and development of example policies for governments to adopt. The discussion at this workshop was focused on coastal and water resources policies. Yet, many of the findings are applicable to other sectors affected by climate change.

Changes needed to enhance adaptation

The major theme expressed about changing policies regarding management of climate sensitive resources was to introduce incentives that would reduce risks. Participants identified two forms of policies. The first concerns policies that would discourage risky behavior such as building in vulnerable coastal areas which could be threatened by sea level rise inundation or flooding from

coastal storms.⁷ The second form is development of policies that encourage retreat from vulnerable areas. In other words, the first focuses on preventing an increase in vulnerability from new development, whereas the second focuses on reducing risks as they emerge, e.g., through relocation.

Participants identified a number of federal policies that could incorporate adaptation to climate change, including:

- ▶ Federal guidance on adaptation. The President's Executive Order issued October 2009 (Executive Office of the President, 2009) requires federal agencies to consider climate change impacts. Participants suggested that CEQ be engaged when agencies issue draft guidance on adaptation.
- ▶ EIS should incorporate adaptation. Participants noted that the CEQ has proposed that impacts of climate change on a proposed action (along with effects on climate) be considered in the review of federal actions under NEPA (Sutley, 2010).
- ▶ Reforming the NFIP to create additional incentives to limit development in flood-prone areas and accurately transmit risks of flooding through insurance rates was raised in several sessions.⁸ Participants questioned the appropriateness of offering government insurance for development in floodplains.
- ▶ Another idea that might create a better incentive for wise water resource management is that instead of governments issuing "water rights," they define "water responsibilities."⁹
- ▶ Grant programs such as community development block grants should require a portion of the funding be spent on adaptation planning. Participants noted that the State Revolving Fund sets aside a portion of funds for green activities, so such requirements are not without precedent. Some participants said there should be a requirement for green infrastructure programs to be incorporated into traditional core programs.

7. Although not mentioned during the workshop, the same sentiment may apply to building in areas that may face increased inland floods or droughts.

8. Mark Crowell of FEMA said that FEMA's insurance rates for post-FIRM (Flood Insurance Rate Map) and pre-FIRM actuarial-based policies are based on actuarial data that consider the probabilities of the full range of possible losses, including catastrophic levels. Currently, 78% of FEMA's policies are considered actuarially-based (Hayes and Neal, 2009); however, FEMA does not generally consider future conditions in the NFIP (Mark Crowell, FEMA, personal communication, May 4, 2010).

9. How "responsibilities" would differ from "rights" was not in summary notes and so may not have been discussed in the breakout session.

- ▶ The USACE authorizations for shoreline management should be neutral with regard to whether coastal areas are protected (e.g., with structures) or encouraged to retreat in the face of sea level rise. Participants expressed the view that current policy is biased toward protection or hardening the shoreline.

In addition to suggesting policy changes, participants identified a number of policy changes to promote adaptation that would require federal legislation. These included:

- ▶ Incorporate a requirement to plan for climate change impacts in relevant legislation up for reauthorization.
- ▶ Require that all permits for activities that would be affected by climate change consider climate change impacts. Participants felt such a change would require legislation. Participants also mentioned specific activities or outcomes that are likely to be affected by climate change. These included:
 - **Instream flows.** Participants felt that state and federal authorities were inadequate to protect in-stream flows under climate change. They further stated that where authorities exist, they were not adequately employed.
 - **Stormwater permits.** Participants mentioned that this outcome is likely to be affected by climate change.
- ▶ Some participants thought that legislation was needed to create a national conversation on adaptation and start planning around a set of climate change scenarios.
- ▶ Participants noted that it would be important for states to play a role in development of federal regulations. Such a change in policy would, according to participants, require legislation.
- ▶ Some participants felt that draft legislation in Congress on adaptation is focused on federal agencies' roles in adaptation. Since states and municipalities will be on the front lines of adapting to climate change, participants recommended that the federal legislation consider the needs of such governments and define how the federal government would support and facilitate adaptation at the lower government levels.

Development of model or example policies

Workshop participants also suggested the development of model policies on adaptation that could be adopted by states, municipalities, or tribes. No agent for developing such model policies was proposed. The policies would include draft state legislation and municipal zoning ordinances. One specific idea that was mentioned was developing a model zoning ordinance or a

model comprehensive plan that would incorporate climate change, particularly, sea level rise. Some participants suggested that the Sea Grant and Land Grant programs take the lead with NOAA and EPA funding. Others suggested that states provide such guidance. In addition, some participants said that guidance was needed on how to plan for changes in extreme climate events. Such guidance could be developed in collaboration between the USACE and municipal governments. Finally, although it was mentioned as an impediment to adaptation, there was an implicit call for the development of a standard set of sea level rise planning scenarios.

3.2.6 Implementation options

There was much discussion during the workshop on general principles for implementation and whether government or other entities should take the lead and participate in coordinating adaptation efforts. Most of the discussion focused on the coordination of adaptation rather than on identifying particular organizations to carry out specific adaptations.

Principles for implementation

One implementation principle that was elucidated in a number of breakout and plenary sessions was that information, technical support, and funding should flow from the top-down (from the federal government down to states and municipalities), but that decisions should be made at the local and state levels. However, another view was that direction should come from the top (lack of guidance from the federal government was cited as a barrier to adaptation), because without leadership from the top, things would not get done. In this view, direction would flow from the federal government to the states and from states to municipalities. Feedback would come from municipalities and states back up to the top.

A number of views were given on the role of the federal government in supporting adaptation in the region. Some participants said the Southeast is not looking for direction to come from the federal government, but instead the role of the federal government should mainly be one of providing support to enable the region to adapt to climate change. Other participants felt the role of the federal government would need to be more than just providing technical support. Changes in legislation and regulations will be needed to remove barriers to adaptation and enhance opportunities for adaptation.

A second principle that was also widely discussed was that adaptation would require collaboration across different levels of government. Various stakeholders, including the federal government, states, municipalities, tribes, the private sector, NGOs, and citizens need to be brought together to identify and discuss adaptation needs and solutions. The inclusion of stakeholders needs to encompass the grassroots level.

One breakout session suggested the following process:

1. Develop a regional adaptation strategy that defines government priorities and responsibilities
2. Consider potential roles and responsibilities for NGOs (e.g., businesses, nonprofits, charities, religious organizations)
3. Review existing programs to identify and modify policies and practices that hinder adaptation efforts
4. Develop guidance policies and procedures on how to incorporate adaptation into existing policy and management processes
5. Develop a clearinghouse on available adaptation funding opportunities.

Adaptation coordination

A number of different ideas were offered on how coordination across different levels of government and with stakeholders outside the government should be done. The process should identify requirements, roles, and responsibilities, and then develop an action plan to carry this out. Participants also suggested creation of a process for helping municipalities develop climate change action plans. Existing planning processes should be considered. One proposed option was for states to develop a planning toolbox and distribute it throughout counties.

There was also discussion about what forums should be used to provide such coordination. One idea offered was to have an annual meeting like the present workshop. However, it would not necessarily need to be coordinated each year by EPA. Other federal agencies could take or rotate the lead. Others suggested there be regular stakeholder forums to develop coordinated adaptation strategies. An additional thought offered was to use existing forums for regional policy coordination, but to add climate change adaptation as an additional topic for consideration.

Two options were identified for coordinating adaptation in the Southeast. One was for a regional organization to do so. The second was for the federal government to play the role. There was no clear consensus as to which option was preferred although many participants saw a role for the federal government to provide technical and financial support no matter which agency was chosen to coordinate the effort. Both options are discussed below.

Options for coordination by regional organizations

Some of the regional organizations discussed here are run by the states. In others, the federal government has a more significant role. Among the regional organizations that workshop

participants proposed could coordinate adaptation in the Southeast are the Southern Governors' Association (SGA), the Environmental Council of the States (ECOS), the Southeast Natural Resource Leaders Group (SENRLG), the Southeast Regional Partnership for Planning and Sustainability (SERPPAS), and the South Atlantic Alliance (Alliance). With the exception of ECOS, all of these organizations focus on all or part of the Southeast. Each organization is briefly described below. The first two, SGA and ECOS, are organizations led by states. The latter organizations are partnerships between states and the federal government.

Southern Governors' Association. The SGA, which includes 16 southern states, is the oldest and historically the largest of the regional governors' associations, having been founded in 1934. SGA recently undertook an effort to produce a regional cost-benefit analysis of state policy options on climate change. SGA has previous experience facilitating collaboration among its member states, including the recently developed Emergency Management Assistance Compact. As such, climate change adaptation could fit within the purview of the SGA.

Environmental Council of the States. ECOS is the national nonprofit, non-partisan association of state and territorial environmental agency leaders. ECOS was established in 1993 to improve the capability of state environmental agencies and their leaders to protect and improve human health and the environment. ECOS works through state government agencies to coordinate environmental protection afforded by both federal and state laws. ECOS is not a Southeast regional organization, but a national organization. However, ECOS has worked at a regional level upon the request of states. ECOS has addressed reduction of greenhouse gas emissions, but has not yet taken on adaptation.

Southeast Natural Resource Leaders Group. SENRLG is made up of a partnership of federal agencies in the Southeast¹⁰ that have natural resource conservation as part of their mission. SENRLG has three general goals: (1) to create and encourage interagency relationships in order to promote sustainable healthy ecosystems, smart economic growth, and preservation of cultural values throughout the Southeast; (2) focus on collaborative initiatives to protect natural resources and educate the public; and (3) communicate successes regarding the values and needs of the Southeast (U.S. EPA, 2010). Rather than serving as a decision-making group, SENRLG instead promotes collaboration, consistency, and efficiency among its members.

Southeast Regional Partnership for Planning and Sustainability. SERPPAS is a partnership between the U.S. Departments of Defense, Interior, and Agriculture as well as EPA with the states of Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina to promote collaboration on resource-use decisions. The objectives of SERPPAS are to "prevent

10. Federal participants are the U.S. Department of Transportation, EPA, NOAA, USFS, Tennessee Valley Authority, National Parks Service, USACE, USGS, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Army Environmental Command, and Bureau of Land Management.

encroachment around military lands, encourage compatible resource-use decisions, and improve coordination among regions, states, communities, and military services” (SERPPAS, 2010).

South Atlantic Alliance. The Alliance is a voluntary partnership among the states of North Carolina, South Carolina, Georgia, and Florida with the goal of increasing regional collaboration among South Atlantic states along with USGS, NOAA, and EPA, and other stakeholders in order to protect the coastal and marine environmental, natural resource, economic, public safety, social, and national defense missions of the member states (South Atlantic Alliance, 2010). A workshop participant noted that the Alliance is focusing on healthy ecosystems, clean ocean and coasts, working waterfronts, and disaster resilient communities and is preparing a strategic plan on these topics. NOAA is facilitating the development of this plan.

Another possible model for regional cooperation is the Mid-Atlantic Regional Council on the Ocean (MARCO). Zoë Johnson of the Maryland Department of Natural Resources described this model in her plenary presentation. MARCO was formed in 2009 and has the states of New York, New Jersey, Delaware, Maryland, and Virginia as its members. The organization is a forum for the five states to work together on coordinating management of ocean and coastal issues (MARCO, 2010).

An alternative to having one organization coordinate all aspects of adaptation is to use or create organizations focused on a specific sector or topic. Participants suggested that the use of water basin compacts may be appropriate for the Southeast. Participants noted that there is no formal structure for resolving interstate water resource issues. Such issues have arisen across state lines in recent years in the Apalachicola-Chattahoochee-Flint and Catawba rivers, among others. Workshop participants also said that specific regional organizations could be developed to coordinate such issues as management of endangered species as well as invasive species and pest outbreaks.

Coordination by the federal government

A possible role for the federal government in facilitating and coordinating adaptation in the Southeast was mentioned in a number of breakout groups. Many participants said the federal government should not set adaptation policy for the region. An emphasis was on facilitating interactions among federal agencies, states, and others. In addition, the federal government could provide technical and financial support to states and others on adaptation.

One idea expressed by participants was that if the federal government coordinates adaptation, it should do so out of federal offices in the region, such as EPA Region 4. It was also pointed out that other federal agencies have regional offices with similar geographic coverage.

There was no consensus on whether a particular federal agency should lead the adaptation coordination effort. Some suggested coordination by EPA Region 4, while others proposed coordination could be jointly handled or rotated among agencies such as EPA, NOAA, FEMA, USACE, DOI, and others.

One need that was expressed several times was for the federal government itself to be better coordinated. There was a sense that federal agencies pursue different and sometimes contradictory objectives with no coordination of effort. Participants expressed frustration regarding the apparent confusion about roles and responsibilities relevant to adaptation among federal agencies. Indeed, some participants called on the federal government to develop a coordinated strategy on adaptation. In the first plenary session on the first day of the workshop, Jeff Peterson from the CEQ said that CEQ is working with OSTP and NOAA to, among other things, develop a coordinated federal agency planning process on adaptation.

Participants also expressed a desire for EPA Region 4 to clarify how its own role may evolve.

Options for federal coordination

The participants suggested a number of possible ways the federal government could support, encourage, or coordinate adaptation. Participants identified the following options:

- ▶ **NEPA.** As mentioned above, CEQ has proposed that NEPA reviews include consideration of the potential impacts of climate change on a proposed federal project.
- ▶ **Coastal Zone Management (CZM) program.** The CZM program provides funding to states that voluntarily develop a coastal management program. These coastal management programs help states manage and balance competing uses of and impacts to coastal resources. Sea level rise is included in the list of hazards for CZM programs to address. In the Southeast, Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina all have an approved coastal management program (Stratus Consulting, 2010).
- ▶ **National Estuary Program (NEP).** The NEP was mentioned in several breakout groups as a good model for coordination of adaptation on coastal resource issues. The federal government provides funding and technical support, while communities develop estuary programs. Participants thought this is a good model for adaptation because it can be

applied in specific locations (in this case individual estuaries) without necessitating a national program requiring all affected entities to participate.¹¹

- ▶ **Landscape Conservation Cooperatives (LCCs).** DOI is creating regional LCCs to work with other federal agencies, state, local, and tribal governments, and the private sector “to develop landscape-level strategies for understanding and responding to climate change impacts” (DOI, 2009). Participants identified the LCCs being set up in the Southeast as possible mechanisms to coordinate adaptation policies in the region. They stated that the LCCs will provide information and tools on climate change to locals in the region. Four LCCs will cover states in EPA Region 4 (and additional states). They are Peninsula Florida, South Atlantic, Appalachian, and Gulf Plains and Ozarks LCCs (DOI, 2010).

3.3 Conclusions

Although focused on coastal and water resource issues, the Southeast Climate Change Adaptation Planning Workshop, held in Atlanta in early February 2010, essentially addressed the need for adaptation, identified impediments to adaptation, and proposed possible solutions that would cover all sectors and the entire region. Indeed, the insights gained from the discussions are likely applicable across the United States.

The discussions suggest that while interest in climate change in the Southeast is growing, there are a number of important impediments to addressing the topic. Among the impediments identified were a lack of public awareness of climate change impacts, particularly at the local scale, lack of information on adaptation options, lack of uniform access to information on current risks and climate change, and a lack of guidance on what information and tools should be used and how to use them. In addition to information on impediments, the participants noted that adaptation planning in the region is also limited by a lack of funding, a lack of political will to take on the issue, and a lack of leadership by federal and state governments. The division of authority across topics within a given level of government (e.g., the number of federal agencies with responsibility over management of water resources), and the geographic boundaries across state and municipal governments, impedes development of effective adaptation policies.

Fundamentally, workshop participants said a mechanism or mechanisms are needed that will facilitate stakeholders from the federal, state, local, and tribal governments along with the private sector, NGOs, and academics to work together to analyze the region’s vulnerabilities to climate change and implement possible adaptation options. These mechanisms could include

11. EPA’s Climate Ready Estuaries Program works with NEPs and other coastal managers to assess climate change vulnerabilities, develop and implement adaptation strategies, engage and educate stakeholders, and share the lessons learned with other coastal managers (U.S. EPA, 2009).

coordination by the federal government, by regional government organizations, or a combination of government entities. One option for federal leadership includes the use of regional federal offices. One implementation principle that was elucidated in a number of breakout and plenary sessions was that information, technical support, and funding should flow from the top-down (from the federal government down to states and municipalities), but that decisions should be made at the local and state levels. However, another view was that direction should come from the top (lack of guidance from the federal government was cited as a barrier to adaptation), because without leadership from the top, things would not get done.

Support from the upper levels of government could take many forms including:

- ▶ Creating a clearinghouse containing data on current risks, climate change scenarios, best practices, contact information on experts and practitioners, and guidance materials
- ▶ Education and outreach to help decision-makers and the public better understand climate change
- ▶ Coordination of studies on the region's vulnerability to climate change
- ▶ Methods for setting priorities on adaptation
- ▶ Modifying current federal and state policies that impede adaptation
- ▶ Using or establishing a mechanism or mechanisms to facilitate development of adaptation policies for the region through discussion and cooperation across different levels of government and with non-government stakeholders.

In general, workshop participants seemed committed to a regional approach as the best option for taking on the challenges of adapting to climate variability and change. They suggested that the dialogue started at this workshop continue.

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