The United States National Climate Assessment

NCA Report Series, Volume 4

Planning Regional and Sectoral Assessments for the National Climate Assessment

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National Climate Assessment

U.S. Global Change Research Program

NCA Report Series, Volume 4: Planning Regional and Sectoral Assessments for the National Climate Assessment

The National Climate Assessment (NCA) Report Series summarizes regional, sectoral, and process-related workshops and discussions being held as part of the Third NCA process.

The workshop on planning regional and sectoral assessments as a part of the 2013 NCA was held in Reston, Virginia on November 15-17, 2010. Volume 4 of the NCA Report Series summarizes the discussions and outcomes of this workshop. A list of completed and planned reports in the NCA Report Series can be found online at http://assessment.globalchange.gov.

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I. Executive Summary

On November 15-17, 2010, the U.S. Interagency National Climate Assessment (INCA) Task Force held a workshop on Planning Regional and Sectoral Assessments for the National Climate Assessment. This workshop was planned by the INCA Task Force to aid in the design of the methodology for conducting the climate change assessments that are required every four years by the U.S Global Change Research Act of 1990. A second goal of the workshop was to obtain input and suggestions on how to more effectively sustain climate assessment efforts among U.S. regions and sectors. The approximately 140 participants in the workshop represented a broad spectrum of regional and sectoral users and producers of assessments, including federal scientists and program managers, academics, and representatives from non-governmental organizations (NGOs), state and local governments, utilities, and resource management agencies. The majority of the workshop was spent in breakout sessions that allowed the participants to meet in small groups to discuss the design of the regional and sectoral elements of the NCA and ways to develop sustained assessment capacity at local to national scales.

Regional working groups were asked to discuss the following aspects of the regional assessments supporting the NCA:

- Approaches to delineating geographic regions and critical interregional issues within the United States for regional assessment activities
- Guidance regarding possible structures and elements of regional-assessment reports
- Approaches to organizing assessments of the various regions, necessary information inputs to regional assessments, and possible approaches to the short- and long-term NCA timelines

Sectoral working groups were asked to address questions relating to the following aspects of sectoral assessments:

- Determining sectors to be included in the NCA and the basic outline of sectoral assessment reports
- Process for conducting sectoral assessments
- Process and selection of cross-cutting regional and sectoral topics

For the sessions on the sustained assessment process, workshop participants rotated through stations related to the following topics:

- Definition and goals for a sustained assessment process, including attributes of success
- Roles and responsibilities for participants at national, regional, and local levels
- Obstacles and challenges that the process may encounter
- Ways to foster a sustained process
- Desired products from a sustained process
- Engagement with and communications to various audiences

Key inputs and suggestions that arose during these breakout sessions are summarized below.

Regions

Delineating regions. Regional reporting in the National Climate Assessment (NCA) is essential because it provides information at the scales where decisions are made, for the places that people live, and integrates vulnerabilities and solutions across various sectors. Many participants supported using a hybrid approach of regional boundaries drawn along state lines, which will facilitate states' participation in the NCA, while also allowing for flexibility in dealing with biophysical and socioeconomic systems that cross these geopolitical boundaries (including international boundaries), including watersheds, estuaries and coasts, arid/semi-arid areas, and high elevation areas. This flexibility will enable systems that cross geopolitical boundaries to be assessed effectively.

Geopolitical regions might be the following:

- Northeast
- Southeast and Caribbean
- Midwest
- Great Plains
- Northwest
- Southwest
- Alaska and Arctic
- Hawaii and Pacific Islands

A map of these delineations is shown in the report. In addition, the report includes further discussion of alternative approaches and other methods for delineating regions.

Elements of regional assessment reports. Creating a consistent structure for regional reports provides ready and authoritative references, sets clear expectations for the products of the Assessment, and provides easy access to the report for readers. Participants suggested that the following elements be included in regional assessment reports:

A. Key findings for the region
   1. Key social, economic, and ecological impacts
   2. Major vulnerabilities
   3. Major opportunities
B. Issues-focused introduction to the region's physical, biological, socioeconomic, and institutional setting
C. Environmental and societal issues that intersect with climate change and potential scenarios or visions for future socioeconomic conditions
D. Summary of regional climate and projected climate changes
E. Potential climate impacts within the region for key sectors
F. Cross-boundary and international issues related to climate (with particular attention to biophysical and socioeconomic systems that cross boundaries, including watersheds, estuaries and coasts, arid/semi-arid areas, and high elevation areas – see "Integrated, Cross-Cutting Topics" for more detail on suggestions to address these issues)
G. Current or planned adaptation/mitigation options
H. Discussion of future research and information needs

Sectors

Selecting sectors. The Global Change Research Act requires that certain sectors be included in the NCA (natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity). Participants expanded on these sectors and suggested additional sectors that might be considered for inclusion in the report. Sectors might be the following:

- Natural environment (ecosystems)
- Biological diversity
- Agriculture and forestry
- Land resources
- Water resources
- Marine resources
- Energy production and use (including renewables)
- Transportation
- Human health and welfare
- Human social systems (including impacts on cultures and cultural resources)

Within the report are several alternatives for selecting sectors, including moving toward a more topical web-based encyclopedia approach.

Elements of sectoral assessment reports. Creating a consistent structure for sectoral reports sets clear expectations for the products of the Assessment. Participants suggested that sectoral assessments address societal and economic impacts and connect the natural environment to human uses of that environment, focus on impacts and implications of climate change, review adaptation and mitigation efforts, and highlight the effects of climate change on vulnerable people and ecosystems in the sector. The following elements might be included in sectoral assessment reports:

A. Key findings for the sector
   1. Key social, economic, and ecological impacts
   2. Major vulnerabilities
   3. Major opportunities
B. Introduction - description/definition of the sector
   1. Geographic scope of sector
   2. Recent trends in the sector
   3. Significant climate-related features of the sectors
   4. Socioeconomic characteristics of sector that are relevant to understanding impacts, adaptation and vulnerability
   5. International linkages and implications
C. Climate context for the sector
   1. Observed impacts of climate variability and change on the sector
   2. Projected impacts of climate on the sector (linked to scenarios for NCA)
D. Environmental and societal stressors/drivers that intersect with climate change
   1. Socioeconomic drivers
   2. Technology and policy drivers
   3. Non-climate environmental drivers
   4. Interactive effects between climate and other drivers (link to cross-sectoral analyses)
E. Key sectoral issues (vulnerabilities and opportunities)

F. Current or planned adaptation and mitigation options; state of understanding of effectiveness of these options
G. Critical unknowns and research needs
H. Conclusions/findings

Cross-Cutting Topics

Participants suggested a number of topics that cross sectoral and regional boundaries. Critical interactions spanning multiple sectors and regions may ameliorate or magnify climate impacts through their interactions with other operative stresses. Inclusion of such cross-cutting topics may enhance the usefulness of the National Climate Assessment.

Selecting cross-cutting topics. There are several factors that may be useful in deciding which cross-cutting topics are to include in the National Climate Assessment. The ability to use existing work and examples as case studies is critical for the 2013 NCA report given the short timeframe for completion, and criteria are needed to select among potential topics and illustrative case studies. Suggested criteria include:

- **Integration** – Topics included need to have strong cross-sectoral and cross-regional interactions and to integrate across multiple factors beyond climate. The focus should be on elucidating new connections and understanding.
- **Timeliness** – Issues covered should be urgent, connected to real consequences, and relevant to current policy development.
- **Relevance** – Issues selected should have broad interest, be related to important constituencies beyond those working primarily on climate change, and spur engagement across such groups.
- **Capacity/Readiness** – Due to the short timeframe available for accomplishing the Third National Assessment Report, topics can usefully be divided into those ready for inclusion in the near-term report and those that require longer-term attention. Identifying the latter topics can help to stimulate needed research and development. The information for the topics in the near-term Assessment Report should be actionable for users.
- **New Understanding** – Emerging work is highlighting the need for new approaches to complex challenges that link changing climate conditions with many other economic, social, and ecological trends. Bringing forward new understanding of ways to address these multiple and interacting challenges across time and place could be an important goal of the NCA. A focus on of such topics will set the stage for future assessments, as well as provide relevance for the near-term report.

Based on these criteria, participants also suggested several potential high-priority cross-cutting topics for the 2013 NCA report, including:

- Water, energy, and land
- Ecosystems, agriculture, and carbon / nitrogen cycles
- Coastal areas – ecosystems, development, and communities
- Urban areas, infrastructure, and health
- Rural environments
- Environmental justice
- Native American and Alaska Native populations
- Disasters, risk management, and community resilience
- National security – trade, food security, and preparedness

Elements of cross-cutting topics reports. While some of these topics may be covered in short case studies included in regional or sectoral chapters within the report, others may require longer sections or even chapters within the NCA report. Participants did not suggest which treatment topics would require, but did suggest a structure for what should be covered within each cross-cutting topic and suggested that the cross-cutting topics be framed using a systems approach that illustrates both the synergies and trade-offs involved in coupled human and natural systems. Descriptions of each cross-cutting topic might include:

A. Description of the system and clarification of key issues
B. Possible thresholds and tipping points, including the role of extreme events
C. Pathways for solutions, including potential unintended consequences
D. Case studies

Conducting Assessments

Participants in many of the groups suggested that the assessment process be organized to promote relevance (the extent to which the NCA addresses requirements of decision makers), legitimacy (the

extent to which the process is inclusive, accessible, and has authority), and credibility (scientific integrity) of the NCA process and products. Suggestions for how this might be achieved included creation of a tripartite structure of separate teams for leadership and advisory capacities (relevance), communications and engagement (legitimacy), and writing and peer review (credibility). Each of these teams would include representatives from a variety of entities, including federal, state, local, and tribal government; academia; non-governmental organizations; and private business and industry. Important qualities for individual authors and author teams as a whole include technical expertise, credibility, objectivity, diversity of opinions, ability to meet deadlines, communications expertise, ability to sustain assessment programs after the report, access to adequate funding, and establishment in existing networks.

Participants highlighted the importance of standards for data quality and review of materials used in NCA reports that have not been peer reviewed via other channels.

Finally, participants suggested that a variety of methods will be needed to engage a broad range of stakeholders in each sector, paying particular attention to ensuring that the NCA process is accessible to people with varying levels of technical expertise and access to in-person or online meetings and seminars.

A Sustained Assessment Process

A primary goal of the NCA is to establish a permanent assessment capacity that involves networks of participants in regions and sectors across the country. The NCA will be a sustained and integrated process that is responsive to the nation's climate assessment needs and meets the requirement of the Global Change Research Act to produce a national assessment report at least once every four years.

Defining a sustained assessment process. Participants suggested a number of ways to define a sustained assessment process and what the attributes of such a process might be. Combining these suggestions and inputs, a definition might be:

> *A **sustained assessment process** is an evolving framework that connects institutions and activities in regions and sectors through a network of academia, government, private sector, tribal communities, and decision makers, to define climate-related problems and inform solutions over time, at national, regional, or local levels, and builds sustained capacity for decision makers to use this information. The sustained assessment process incorporates ongoing evaluation which facilitates adaptive management and decision making, supports adaptation actions across time scales, stimulates civic interest and engagement, and enhances national capacity to characterize risks, find solutions, and to produce periodic assessment reports as required by law.*

Roles and responsibilities of governments and other organizations. Participants suggested that the assessment process must have clearly-defined roles for federal, state, local, and tribal government; academia; non-governmental organizations; and private business and industry. Each of these entities brings particular strengths to the process, and it will be important to ensure communication across all of these participants. While the federal government serves as the catalyst and overall leader for the NCA, the co-production of information and products of the NCA will help foster ownership of and engagement in the process at all levels and ultimately lead toward a sustainable process that will be able to catalyze change and support decision making.

Obstacles and challenges. Participants discussed a number of obstacles and challenges to creating a sustained assessment process and suggested ways for overcoming them. Particularly important sets of challenges are related to the following five categories:

- Logistics
- Communication
- Stakeholders
- Support and political environment
- Science

Linking the 2013 NCA report with the sustained process. Building the NCA into a sustained and ongoing process will enable decision makers to make decisions based on the best-available science, will ensure the timely delivery of future reports, and can enable the NCA to act as a platform for

civic engagement in America. In order to do this, participants suggested the following steps leading up to the 2013 NCA report:

- Focus on the process in the report rather than just the state of knowledge
- Create a business plan that outlines the objectives, timeline, roles and responsibilities, and standards for the report
- Listen, acknowledge, and respond to engaged stakeholders
- Partner with other organizations and utilize existing networks and assessments
- Create a sustained funding structure

NCA products. The establishment and implementation of a sustained assessment process may well be one of the most important products of the NCA in the near-term. In addition to the quadrennial report required by the Global Change Research Act, other NCA products that participants suggested would be useful include:

- Research-based and supported products, especially those that contain downscaled information, improved data sets on climate vulnerabilities, and methods for valuing ecosystem services.
- Assessment-related products, including a framework for producing assessments, a clearinghouse of activities and case studies, and a plan for evaluating the assessment process and usefulness of products.
- Products to support engagement, education, communication, and outreach efforts, especially products that will help people understand how climate change will impact them in the places they live and work. Such products include:
    - Case studies, narratives, and stories
    - Information packaged for specific target audiences
    - Mapping and geospatial tools
    - Materials for science translators and to support informal science education
    - Mechanisms to support and include citizen science

Engaging and communicating with stakeholders. An important part of developing an engagement strategy for the NCA is determining who the NCA's stakeholders are. As the list of stakeholders could potentially extend to the entire population of the United States (or beyond), participants suggested targeting specific groups who would then be able to help with outreach to a broader community. The list of potential partners built from these suggestions is long, ranging from community-based organizations to international business and nonprofit entities, and includes the public, private, and academic sectors. When engaging with stakeholders, many participants suggested that discussions focus on topics such as sustainability, resources and commodities, relevance of climate to stakeholders, and risks and opportunities. Participants also discussed various approaches to engagement and communications, focusing on the need to establish a two-way dialogue that can foster exchanges about what stakeholders need and what the science community can provide, the need to use technologies such as social media and other web-based methods to get messages out and collect inputs, and the need to evaluate and adjust approaches in response to the changing needs of stakeholders and abilities of the NCA.

II. Introduction

On November 15-17, 2010, the U.S. Interagency National Climate Assessment (INCA) Task Force held a workshop on *Planning Regional and Sectoral Assessments*. This workshop was planned by the INCA Task Force to aid in the design of the methodology for conducting the climate change assessments that are required every four years by the U.S Global Change Research Act of 1990. A second goal of the workshop was to obtain input and suggestions on how to more effectively sustain climate assessment efforts among U.S. regions and sectors. The workshop was hosted by the U.S. Geological Survey (USGS) at their headquarters in Reston, VA.

The approximately 140 participants in the workshop (Appendix C) represented a broad spectrum of regional and sectoral users and producers of assessments, including federal scientists and program managers, academics, and representatives from non-governmental organizations (NGOs), state and local governments, utilities, and resource management agencies. One month prior to the workshop, the participants were provided with three "strawman white papers" that were prepared by the Workshop Steering Committee of the INCA Task Force:

- Options for Regional Assessments for the National Climate Assessment

- Content of Sectoral Analyses/Chapters of the National Climate Assessment
- Developing a Sustained Assessment Capacity

These white papers were intended to stimulate discussion at the workshop by providing some initial concepts and planning options for the regional and sectoral aspects of the National Climate Assessment (NCA) and are available from the workshop planning website (https://sites.google.com/a/usgcrp.gov/nca-regional-and-sectoral-planning/).

The first day of the workshop featured plenary talks about previous Assessment efforts, the new vision for a sustained assessment process, the role of climate assessments within the U.S. Global Change Research Program (USGCRP), and the approach to developing scenarios of the future that integrate climate, socioeconomic and environmental conditions (see Appendix A for the workshop agenda). Presentations on Canadian, Australian, and United Kingdom assessments and possible approaches to state and tribal assessment efforts helped frame future discussions on international and indigenous connections. Participants also discussed ways to build capacity and enhance the ability to conduct vulnerability assessments and plan for and implement adaptation within regions and sectors. Days two and three of the workshop featured 12 facilitated breakout sessions during which individuals discussed and provided input on how to structure and define the regional, sectoral and cross-cutting aspects of the Assessment, how to engage with various audiences and users of the Assessment, and how to define and structure the long-term assessment process. Each breakout session was organized around a set of questions and a consensus answer was not sought among the participants. Individual responses and suggestions from workshop participants were recorded by note takers during each of the 12 breakout sessions.

On November 18, 2010, a team of Federal climate scientists, program leaders from the USGCRP agencies, and USGCRP and Assessment staff (Appendix B) met to review the breakout session notes and develop an initial synthesis of the suggestions obtained at the workshop. The team worked together during the weeks following the workshop to collate suggestions, eliminate redundancies, and identify the common themes and messages that emerged from each breakout session. This report is the product of those efforts.

This workshop report, coupled with the three white papers prepared by Workshop Steering Committee prior to the workshop, should be useful in the design of the regional, sectoral, and cross-cutting themes for the NCA. The importance of a sustained assessment capacity was underscored in many comments during the third day of the workshop – to improve continuity and accuracy, to more effectively engage stakeholders, and to increase the efficiency of producing Federally-sponsored climate assessment reports.

III. Plenary Presentations

The plenary presentations at the workshop provided an overview of the NCA and its connections with a variety of partners in the assessment effort (listed below). Many of the inputs and discussions arising from these presentations are included in the subsequent sections of this report. The workshop agenda and the PowerPoint slides from most of these presentations are available from the workshop website (https://sites.google.com/a/usgcrp.gov/nca-regional-and-sectoral-planning/).

- **National Climate Assessment Overview and Background**
  - National Climate Assessment Overview and Outline for the 2013 Report - Kathy Jacobs
  - Lessons Learned from Previous Assessments - Tom Karl and Jerry Melillo
  - Structure, Timeline, Products, and Stakeholder Engagement from the First Two Assessments - Tony Janetos
  - Structure, Operation, and Engagement in the First National Climate Assessment: The View from the Bottom Up - Tom Wilbanks
  - Critical Connections with Other NCA Methodological Workshops - Bob Vallario
  - Necessary Scenarios to Support the Regional and Sectoral Analyses for the NCA - Richard Moss and Linda Mearns
- **International and Indigenous Connections**
  - National-Scale Climate Change Assessment Activities in Canada - Don Lemmen
  - Connections with IPCC - Chris Field
  - American Indians and Alaskan Natives: Complexities in Climate Change Adaptation - John Vitello
- **Selected Stakeholder and Decision Maker Perspectives**
  - Urban Areas - Jim Lopez
  - Perspectives on the Water Sector - Heather Cooley and Peter Gleick

- The Energy Sector in California - Guido Franco
- **Examples of Sustained National Assessments**
  - Australia Climate Adaptation Flagship - Mark Howden
  - United Kingdom Climate Impacts Program - Cynthia Rosenzweig and Richenda Connell

IV. Report from Day 2 of the Workshop: Regional, Sectoral, and Cross-Cutting Assessments

The second day of the workshop focused on the design of the regional and sectoral elements of the NCA. Workshop participants were asked to choose from one of the six parallel working groups (three regional and three sectoral working groups) that met on Day 2 of the workshop.

Three regional working groups were asked to discuss the following aspects of the regional assessments supporting the NCA:

- Approaches to delineating geographic regions and critical interregional issues within the United States for regional assessment activities.
- Guidance regarding possible structures and elements of regional-assessment reports.
- Approaches to organizing assessments of the various regions, necessary information inputs to regional assessments, and possible approaches to the short- and long-term NCA timelines.

The three sectoral working groups were asked to address questions relating to the following aspects of sectoral assessments:

- Determining sectors to be included in the NCA and the basic outline of sectoral assessment reports.
- Process for conducting sectoral assessments.
- Process and selection of cross-cutting regional and sectoral topics.

Summaries of the resulting discussions by the six working groups follow.

1. Delineating Regions

a) Charge to the working group

Three questions were asked of the working group that was assigned with characterizing options for the delineation of regions:

1. What are other ways to think about delineating regions for the assessment?
2. How might we coordinate with regions adjacent to the United States?
3. How might we develop a more dynamic regional structure that allows the assessment to have a regional character but might vary for sectors and societal issues?

As the working group discussed options, questions 1 and 3 were often addressed simultaneously since it was generally felt that dynamic approaches to delineating or characterizing "regions" could also be a useful approach. Such approaches are addressed in subsection C) below.

Several participants stressed the need to briefly review the previous two national assessment efforts to assess the successes or failures of prior regional approaches and how these might be modified in the current assessment period. Therefore this section of the workshop report is comprised of a critical evaluation of approaches used in previous assessments followed by examination of alternative options and discussion of dynamic solutions or options that many of the participants offered to improve the treatment of regionalized information in the NCA.

b) The need for regional information in an assessment context

Working group participants discussed a wide range of options for regionalization of information in the assessment context, including whether there was any value in dissecting information by region or in considering higher than regional resolution (state-by-state) analysis. Many participants in this working group suggested that regionalized information (i.e., geographically-specific synthesis of information) will be essential to the NCA for a variety of reasons, including:

- People resonate with the regions in which they live and therefore tend to be more invested in understanding changes therein;
- Sectoral impacts are frequently expressed, and can be integrated, regionally, so that regionally-distinct sensitivities, vulnerabilities, and solutions arise; and
- Decisions often are made and implemented at regional and sub-regional scales, as, for example, in the cases of state transportation plans and regional water management strategies.

c) Regional approaches

Previous assessments
Regionalization approaches from the first two National Climate Assessments were reviewed and successes and failures of those approaches examined by the group. The regional delineations used by the second National Assessment followed very closely the first National Assessment, with consideration of approximately nine 'mega-regions' spanning the U.S. The regions were largely defined along state boundaries, with some exceptions in the Gulf Coast and the foothills of the Rockies, where boundaries followed topographic or climatic divisions.

Participants expressed concerns that these earlier regional approaches were inadequate because the earlier assessments used only one static regional structure and therefore tried to use a single 'map' to serve multiple, and perhaps too many, purposes. As a result, the prior delineation neither served the needs of decision units (for example, state governments) nor did it fully allow analysis of impacts, which tend to follow biophysically-defined landscapes and boundaries.

There was also some discussion about obtaining feedback from audiences/users of previous assessments. Participants reported that audiences of previous assessments have indicated difficulties in "locating themselves on the map," especially in those areas where boundaries did not follow state lines. There was uncertainty as to which region might contain information that people in such areas were interested in finding. In addition, some audiences have indicated that there was not enough focus on states as components of regions in previous assessments. Individual states were not always mentioned or identified within the regional chapters and this was mentioned as a difficulty for some audiences.

Finally, given that in previous assessments the regions were static and largely based on state boundaries, some important topics and features were difficult to address, such as the western mountain corridor and other biophysically-based regions.

A plethora of options
Participants discussed several possible approaches to delineating regions, including:

- A decision making focus. Boundaries could be based primarily on geopolitical divisions (e.g., state boundaries). Regions organized by state boundaries may be particularly useful for Congress. However, it was recognized that not all decision units follow simple geopolitical boundaries, with important exceptions including interstate river basin commissions.

  Assuming that the Assessment is intended primarily to inform adaptation decisions, regions might specifically be designed in ways that serve the demand for adaptation resources. Regional boundaries could build off existing governmental structures (such as regional governors associations), again recognizing and facilitating connections to the issues of most importance to regional decision making. Common regional issues may naturally lead to new modes of cooperation among existing organizations and to new mechanisms for collaboration among regional institutions; regions might be delineated with such possibilities in mind. This delineation approach would facilitate engagement with states and local government and could be based on the issues most likely to require interstate cooperation.

- A "high-resolution, state by state" approach, wherein 50 or more state-based regions would be developed and assessment results mapped into each, using modern data management and graphical methods. Such an approach could specifically list the major climate-related challenges in each state so that state governments would be able to directly identify the range of issues in their state. In such an approach, state representatives could be recruited to pull together state-relevant climate information for submission into the online system.

- A biophysical focus, with divisions based on landscape, climate, or ecozone distinctions. A delineation based on physical characteristics allows the most direct mapping of climate science and areas of rapid climate change onto the impacts landscape. This scheme would also allow refugia and landscape corridors to be better accounted for. However, the matter of temporal consistency of such boundaries was also discussed and in particular, the idea that, since ecoregions will change with climate,

today's biophysically-based region delineations may become less and less appropriate as the climate and biophysical regions themselves change. By contrast, topographically based regions will remain consistent, as will state geopolitical boundaries, as the climate changes. Furthermore, the precise choices and locations of biophysical boundaries may depend on the ecological or natural resources under consideration, potentially posing challenges to use of biophysical boundaries in a regional assessment.

- A climatic focus. Several participants noted that the areas of most immediate interest in terms of climate assessments and impacts may be along boundaries following steep climatic gradients where changes may develop soonest and where impacts may be most extreme.

- A communications focus, where divisions are defined specifically to ease the telling of stories regarding regional climate and its impacts by reporting that uses geographic divisions that are most recognizable and understandable by the broader public. This would allow for a greater connection to the significance of the assessment findings, especially by those who are not climate or science professionals. A related option suggested by the working group is a regional culture focus, where divisions take into account the distinct cultural identities within the nation, with southern Appalachia mentioned as an example of a cultural region.

d) A hybrid and dynamic approach

As criteria and options were discussed among participants, there was considerable support for an approach that improved upon the 'one-size-fits-all' static map that comprised the regional approach in previous assessments. Thus, participants spent considerable time outlining a possible dynamic and hybrid approach.

This approach would involve combining a basic delineation of regions, focused on geopolitical boundaries (i.e., state lines) as shown in Figure 1, with a supplemental, flexible second layer that could be used to highlight biophysical and socioeconomic systems that cut across geopolitical boundaries. Systems of particular interest identified by participants included watersheds, estuaries and coasts, arid/semi-arid areas, and high elevation areas. This regional and cross-regional approach would be analogous to the sectoral and cross-sectoral approach being considered by other working groups and discussed separately in this report. Such an approach could help to ensure that important biophysical or culturally distinct and sensitive regions and issues were not 'lost' when they crossed geopolitical boundaries. This approach

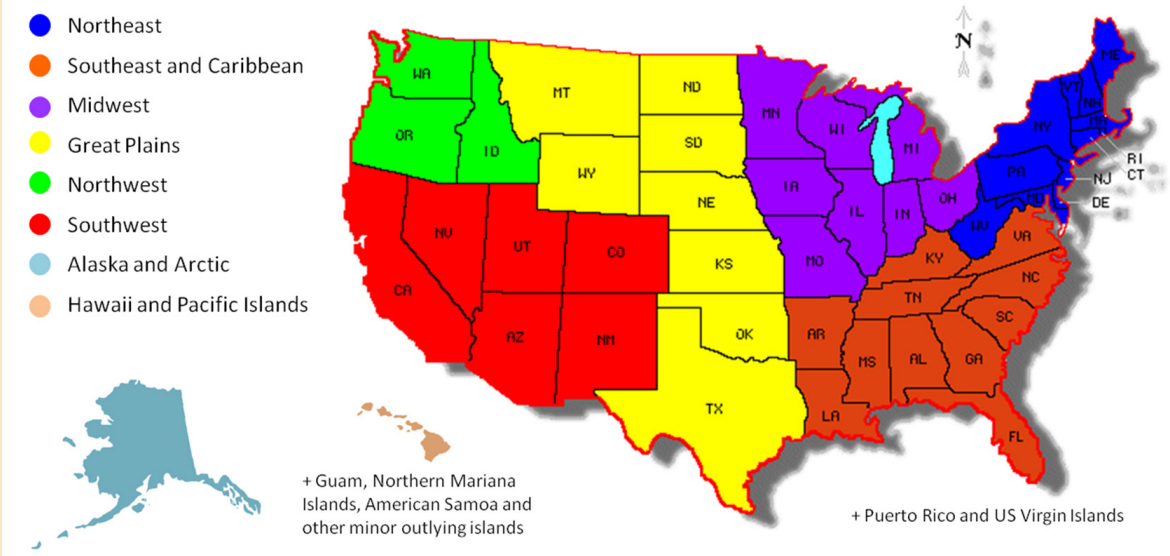

Figure 1. Possible breakdown of regions by geopolitical boundaries

also could ensure that anyone looking for impacts in their region would be able to clearly locate their area of interest. Finally, a significant advantage is that the cross-cutting regional layer could be flexible and phased so that not all cross-regional areas would have to receive comprehensive treatment in every assessment. Rather 'special reports' on cross-regional issues could be produced 'out of cycle,' with only select issues highlighted in each full National Assessment.

Several items of particular importance for creating a dynamic regional treatment in the Assessment context were identified. In any regional delineation scheme, a focus on geo-referenced data sets was considered critical. Greater reliance on geo-referenced information resources and data would promote greater ability for the Assessment results to be used in a flexible regional format.

Delivery of regional information from within a web-based infrastructure would allow for searchability that is also an important, though perhaps long-term, component of a sustainable assessment process. For example, even if state information is not explicitly broken down in the Assessment itself, if information were searchable by state, decision makers would still be able to retrieve any and all information pertinent to their state.

This dynamic approach offers the several advantages discussed above, but those advantages have their costs. In order to implement such an approach, sufficient resources (including time) will need to be invested for planning, development and implementation of the more geographically-complete databases and more flexible reporting mechanisms. Too firm a commitment to this strategy at the national scale could reduce, or be perceived to reduce, options for regions to define their own assessment approaches and products. Unless great care is taken, this approach could also increase the potential for NCA regional reports and results to become unnecessarily complex and confusing to many audiences.

Finally, several participants stated that, whatever options for regional delineation were exercised, it is important to add an overview section to the National Assessment, explaining the importance of assessing climate science, impacts, and solutions regionally, highlighting the value and challenges of regional information, and discussing many of the same tradeoffs listed above.

e) International boundaries

Many participants in this workshop made comments about the importance of addressing climate change issues and impacts that cross U.S. borders, including those with Canada, Mexico and the Arctic, as special and unique cases. The criteria and prioritization used to assess appropriate cross-cutting topics (discussed in summary from Working Group 6) should also help to identify and prioritize issues that crossed international borders. Clear opportunities and reasons for international connections exist in contexts of the Great Lakes, High Western Mountains, the Arctic, arid/semi-arid regions in the Southwest U.S., and with international river systems such as the Rio Grande, Colorado, and Red Rivers.

Participants felt that it would be important to leverage existing international partnerships and structures including treaties, such as the migratory bird treaty, drought monitoring agreements, and others. This point is so important to success of the international linkages that some participants felt that inventory of existing relationships should be developed as part of the follow-up to the workshop summarized here. In addition, it was noted that a clear point of contact will be necessary for each nation if consistent coordination is to occur.

Finally, there was strong agreement on the need to link international components of the U.S. National Climate Assessment to international assessment efforts such as the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Using structures and activities from the international assessment activities that will produce the North American chapter of the IPCC will help to coordinate across U.S. borders and facilitate our own NCA.

f) Importance of flexibility

The comments and inputs received from the first regional working group suggest that, to the extent possible and beyond the immediate choice of any particular regional delineation strategy, the delineation should not hamper assessment of sub-regional and cross-regional impacts and options. Criteria for defining and prioritizing cross regional elements as well as suggested cross-regional topics are discussed later in this report (see summary from Working Group 6).

2. Elements of Regional Assessment Reports

a) Charge to the working group

The second regional working group responded to questions regarding the need for, and feasibility of, preparing climate assessment summaries for individual regions, e.g., somewhat as in the first national climate assessment. With or without such a goal, the group also discussed elements that would support defensible, actionable regional assessments.

The initial set of seven questions for this WG was designed to stimulate consideration of the essential components of a regional assessment report are listed below; however, the discussion ranged further afield and is organized somewhat differently.

1. Is the outline clear? (Does it flow well, anything missing?)
2. Is the outline too restrictive or not enough guidance? If so, how should it be adjusted?
3. Are there elements to add that might differ among sectors?
4. What are the necessary inputs for each outline element? What data about current conditions in your region would you use if it were provided (e.g., census data, economic data, land use data, etc.)? Please be specific.
5. If scenarios of future conditions (e.g., population density, land use, climate conditions, national policies on climate or other issues, etc.) were made available would you use them? Which, specifically?
6. What uncertainties about future conditions are of greatest concern?
7. Are there specific data sets or scenarios that should be used consistently across regional assessments? Which, specifically?

b) Should there be regional reports?

As with the first working group (reported on in "Delineating Regions" section above), this working group felt that regional assessment activities have important roles to play in the NCA. This working group also considered the question of whether such regional assessment activities warranted separate region-specific reports (or chapters). There was a strong sense within the group that regions are important as political, climatological, ecological, and historical contexts for climate change impacts and adaptations and that regional assessment reports should be valued in their own right and thus targeted as important outcomes of the overall NCA. Having separate, but similarly-structured reports for each region would have many advantages, including:

- Providing ready and authoritative references for national, regional, and local resource managers, decision makers, and the public as they address climate change locally,
- Drawing together climate change issues and information across sectors in ways that might not rise to the level of the new "integrated" assessment activities, and
- Improving recruitment of local to regional participation by providing recruits with clearly visible products from their NCA contributions.

Assessment reports for a region could be structured to present the entire assessment: context setting, climate changes, climate change impacts, and plausible policy responses and options at the scale of, and largely within the bounds of, each region. Alternatively, reporting from regional assessments could be structured to focus only on context setting, climate changes, and potential impacts, with policy options and responses addressed elsewhere in a single, national-scale policy discussion. In either case, such regional reports would presumably be addressed to multiple audiences including the authors of the national assessment report, decision makers at national to local scales, and the broader public. The fact that regional assessments will have multiple audiences, however, suggested to the working group that special attention ought to be paid to the varying and differing socio-cultural perspectives across and among the regions, especially as applies to the most vulnerable populations.

Although regional assessment activities and reports were undertaken as part of the first NCA, and although regional summaries were constructed for the second NCA, developing a new generation of complete regional assessment reports will likely require new organization, resources, and studies, demands that will need to be weighed against immediate deadlines for the current and near-term NCAs. That is, although there are clear advantages to producing regional reports, the costs of doing so will also need to be weighed in decisions as to when and how they might be produced.

c) What elements would contribute to a successful regional assessment report?

At the most basic level, the working group recognized that regional assessment reports could not be policy prescriptive in view of NCA mandates, goals and limitations; nonetheless, presentation of policy options in regional contexts will be valuable to all of the various audiences of the reports. Beyond that, the resulting regional assessment reports might usefully include certain standard elements, in roughly the same order (for consistency and comparability from region to region), unless the special conditions of the region or of the regional assessment dictate otherwise. A basic outline, providing available information, could be structured around some very general elements:

A. Key findings for the region
    1. Key social (including health), economic, and ecological (including ecosystem services) impacts
    2. Major vulnerabilities
    3. Major opportunities
B. Introduction to the region's physical, biological, socioeconomic, and institutional setting
C. Environmental and societal issues that intersect with climate change and potential scenarios or visions for future socioeconomic conditions
D. Summary of regional climate and projected climate changes
E. Potential climate impacts within the region for key sectors
F. Cross-boundary and international issues related to climate (with particular attention to biophysical and socioeconomic systems that cross boundaries, including watersheds, estuaries and coasts, arid/semi-arid areas, and high elevation areas – see "Integrated, Cross-Cutting Topics" for more detail on suggestions to address these issues)
G. Current or planned adaptation / mitigation options
H. Discussion of future research and information needs

Some in the group expressed reservations about the extent to which discussions of mitigation options and policies were appropriate in regional reports, given that many mitigation policies will be established and implemented at the national scale; nonetheless, regional mitigation markets and efforts are clearly developing and the most productive mitigation options are likely to differ in implementation from region to region.

As an alternative to this outline, which parallels most previous regional assessment reports, and depending on results of regional discussions, workshops and NCA needs, the overall structure of regional reports could instead lead off with issues rather than scientific background, or focus on and reflect the actual organizational and institutional elements at work in each region's assessment activities rather than on the standard process-based outline (that is, tell the "story" of the assessment and adaptation processes in the region).

Among several group members, there was a desire to avoid too much focus in the regional reports on national-level background and even many elements of the climate science background for global and regional climate changes. This suggests approaches that would handle much of the detailed climate information though other outlets (e.g., a separate online or published atlas of climate change scenarios referenced by all of the regional reports) and that could provide most national-level background in appendices to the regional reports. Within the individual regional reports, these larger scale background issues might be handled as simply as possible to maintain a strong focus on the specific region and the challenges and options that it faces.

Other non-climatic stressors and issues face each region. Thus, in organizing the regional reports, even before turning to those climate issues, these other stressors are basic to setting the stage properly for a climate assessment. There was a strong recognition within the group that climate impacts are often dictated by the multi-stressor context within which climate change will be only one (new) stressor to be addressed. The range of possible societal responses to projections of climate changes also is strongly influenced by this multi-stressor context.

Thus a suggestion from the group was to consider the possibility of explicitly including development of several regional socioeconomic "scenarios" or "visions." Such scenarios will be most useful and successful if they are bottom-up results arising from NCA-motivated engagement of the regional communities. These scenarios would ideally comprise the region's visions of plausible futures.

The resulting scenarios could play much the same role in terms of multi-stressor contexts that the climate model-based scenarios have played in past assessments. The scenarios would ideally identify several, illustrative possible future contexts within which climate change impacts might play out (e.g., considering the possible climate change impacts as they would be felt in "high development, large tax base" vs. "urban densification with economic diversification" futures). Such scenarios also would help to crystallize the variety of climate adaptation responses that might be realistically considered. Such regional scenarios would ideally be somewhat interconnected, and thus consistent, from region to region (e.g., so that not everyone envisions becoming the economic hub of the nation simultaneously), but nonetheless would ideally be products mostly of local-to-regional consideration and design. Such scenarios could be presented, in regional reports, as crystallizations of some of the discussions of the multiple stressors confronting a region, following the multi-stressor discussion, but prior to the summary and discussions of projected climate changes and impacts.

As indicated previously, one option for organizing and streamlining the regional reports might be to present much of the climate science background separately (perhaps in national scale summaries or atlases) with much simpler, summary results and projections presented only insofar as necessary to illuminate individual regional challenges and options. Some of the space and complexity reduced in this way could be dedicated instead to discussions of whether historical indicators of current or ongoing climate change can be identified in each region. Such discussion might properly focus on scientific "attribution" studies regarding possible climate change forced changes in several key or suspect indicators in each region.[1] Such attribution studies have been designed and undertaken in recent years by various federal agencies and several academic research centers, but providing region-by-region efforts to ascertain causes of some apparent trends would mark a new effort and demand on the NCA. However, given natural and usually justifiable tendencies to trust observed changes and problems more than predicted changes and problems, regional reports that directly address the question of whether climate is changing and demonstrating climate change impacts in a region will be much more convincing to several of the audiences that these reports hope to inform and engage.

A given region is likely to contain elements and influences of many different sectors, but separate sectoral assessments will also be undertaken as part of the NCA. Thus, one approach to reporting on sectoral issues within a given region could be to address, within the regional reports, a relatively few (3-5) sectors that are (a) of particular economic importance to the region, (b) particularly vulnerable to climate change impacts in the region, or (c) relatively unique to, or uniquely constructed in, the region. Where possible, the selection of sectors to be highlighted in each region's report would parallel bottom-up expressions of concern from within the region, e.g., as voiced in regional workshops. This approach would avoid some redundancies between regional and sectoral reports. However, at the risk of allowing redundancy between sector and regional reports, another approach voiced in the group was to stress consistency between the regional reports by addressing all legislatively required sectors in each regional report, even if the sectoral segment in a given region report is no more than "This sector is not relevant or vulnerable in this region." Sectoral impact discussions will ideally include focuses on biological issues as well as socioeconomic impacts and plausible adaptation and mitigation responses.

Sections on adaptation issues and options in the regional reports will be most useful and actionable if they include discussion of barriers to adaptation, the socioeconomics of adaptation, case studies relevant to the particular region, and recognition of and feedback to the socioeconomic "scenarios" discussed earlier, in addition to the most basic presentation of identification of key indicators and information needed to plan and track adaptation. Discussion of mitigation options and policies should be careful to avoid redundant presentation of national-scale mitigation efforts and policies, but should—where relevant and where the information exists—describe region-specific mitigation efforts and plans, as well as region-specific implications of national mitigation policies.

[1] The NCA is undertaking consideration of such indicators via a series of linked workshops on ecological, physical climate, and societal indicators of the impacts of and responses to climate change. The first of these workshops took place on November 30-December 1, 2010 in Washington, DC. More information about this effort is available from the National Climate Assessment website, http://assessments.globalchange.gov.

d) Information needs

Important climate resource and information needs for regional assessments were discussed by both the second ("Elements of Regional Assessments") and third ("Conducting Regional Assessments", to follow) regional working groups. The two discussions of this topic are presented here together, to avoid some redundancies.

Much new information will be needed to conduct the NCA, but many existing products can be leveraged to facilitate and enhance the regional assessments. Much leveraging will be needed if the NCA is to become an efficient and productive effort. Both working groups noted that many of the most important climate resource and information needs can be identified as results of regional- and national-scale gap analyses of climate data and scenarios, climate impacts, and socioeconomic stressors and data, or—given time limitations confronting the NCA—through the summary and extension of existing gap analyses. The third working group listed desirable characteristics of new, and existing, information for regional assessments, as follows:

- Information that is comparable and consistent from region to region will facilitate national-scale summaries
- Information that is scalable or that can be spatially combined or disaggregated will facilitate regionalization, reflecting both (a) current scientific capacities for modeling and downscaling, and (b) needs for spatial resolutions suitable for evaluations of regional to intraregional processes, impacts and human responses
- Information must be temporally resolved at appropriate time scales to be useful
- Information will be most useful in the NCA if it is focused, to the extent possible and available, to allow good physical characterization of specific and necessary climatic processes and problems in the regions
- Information about the particular climatic variables needed in the regional and sectoral assessments will be required, including but **not** limited to temperature and precipitation changes
- For credibility, information will need to have a traceable provenance and appropriate metadata (e.g., from published sources)

An incomplete list of existing information resources (developed by the third working group) includes:

- Past regional and national climate assessments and synthesis reports
- State and local climate assessments
- Agency and institutional databases on both climatic issues and "other stressors"
- Assessments and studies of "other stressors" that may interact with climate change, and their expected impacts and mechanisms with or without climate change
- Legal and institutional constraints that constrain or affect climate change impacts and responses
- Physical, biological, engineering, and socioeconomic models and depictions of current and historical conditions in the regions
- Private sector data

Monitoring data (to make the NCA process sustainable, continuing inputs of climate, biophysical, and socioeconomic data from existing long-term monitoring programs will be necessary, and it would be desirable to engage monitoring 'partners' from the very start)

A key area—recognized by two regional working groups—where significant new information and understanding will be required is the development of socioeconomic information and scenarios describing the multi-stressor environment within which climate changes and their impacts will develop and be addressed. Such information would characterize histories, projections, and aspirations regarding population growth, land uses, and social and economic developments and options. The development and use of such information might occur in the form of multiple socioeconomic scenarios or visions as a basis for many assessment activities, but also as the most complete context for understanding and addressing climate impacts (as outlined in greater detail, in subsection 2c above). Development of these socioeconomic scenarios will likely require deep discussions with important parties and institutions within the regions regarding their aspirations, fears, and plans for the future of the region, to form useful and plausible socioeconomic scenarios within which to embed the climate-change scenarios and impacts. It will be particularly important to identify and engage the most vulnerable communities and communities least able to undertake assessment activities on their own in the design of scenarios, of assessment activities, and of resulting regional reports.

The working group was confident that climate change scenarios will be used by regional assessments and regional agencies if provided. The working group appeared much less confident that organizational frameworks and interests exist to make immediate use of socioeconomic scenarios if provided; some in the group recounted surveys from the past NCAs indicating that little use had been made of such inputs framing prior assessments. Mutual design of socioeconomic scenarios by regional stakeholders may be required to ensure and motivate the use of multi-stressor scenarios by the regions. Perhaps the two most important and difficult information needs for regional assessments will be (a) immediate surveys and gap analyses of existing information resources, including the many resources hidden within regional, state, and local agencies and NGOs, and (b) fundamental data to support characterization of possible social, economic and ecosystem impacts, e.g., with respect to historical climate influences on hazards management, wildfires, human health, and power- and water use, within and between regions.

Finally, the working group discussed ways to elicit and include information on adaptation and mitigation, including:

- Include these topics in every NCA workshop.
- Harvest this information from others that are cataloguing it, such as the Pew Center (for coastal adaptation plans) and EcoAdapt.
- Along with cataloging successes, it will be important to note where there is lack of progress. Case studies at various scales may help.
- Adaptation options can only evolve and improve if time and resources are allocated to evaluate ongoing adaptation actions. This does not mean necessarily evaluating the actions of one particular region or stakeholder but rather broader scale considerations of what's working and what's not.
- One participant noted that considerable action on adaptation is underway in the Pacific Islands. Climate groups there have come together to find out what the Federal government is doing right now on climate, looking at various aspects of climate. (Indeed, a concern was expressed that issues of the Pacific islands are completely missing from Assessment thinking.) Efforts in the continental US may be more focused on climate impacts and not how to work with the communities, whereas the Pacific islands needs further understanding of change but are already working with stakeholders. More generally, active engagement of "nontraditional" US entities (tribes, Pacific Islands) was viewed as a critical need of the NCA.

Large differences exist between and amongst states as to how to respond to projections of climate change. Obtaining information on adaptation and mitigation lends itself to telling the story about how individuals, communities, tribes, businesses, and others are applying practices, from simple to complex, to adapt to current or impending climate changes. It is important to tie these stories to the underpinning information. For example, storytelling is *the* traditional media for information sharing by Native Americans and offers considerable advantages to the NCA as it works to educate and engage the nation.

3. Conducting Regional Assessments

a) Charge to the working group

Regions include diverse communities of people, infrastructure, and resources. The most useful regional assessments will reflect these diversities as well as the great diversity of issues that must be integrated to meet place-based needs. Regional components in the 2000 NCA were led by university researchers who built trust and credibility with stakeholders by understanding and communicating the impacts of climate variability and change. By interacting with stakeholders, scientists increased the relevance and utility of climate research and assessment for decision makers by providing real-world, multi-stressor contexts for this information. The expected emphasis on the process of assessment (rather than just the products) in the 2013 NCA report builds on these breakthroughs in providing support to decision makers and presents an opportunity to empower regional communities to participate in leadership of assessments and to take action for building resilience.

This working group was asked to address several questions relating to the involvement of stakeholder groups in NCA regional assessments:

1. Who could/should lead and who should prepare regional assessments?

2. How could/should regional stakeholder groups (e.g., citizens, local/state governments, business associations, NGOs, etc.) be engaged in the process?
3. Do regional assessments need to be stand alone documents? Can the same prefatory information be used in all regional reports?
4. How can we obtain the adaptation and mitigation components from regions?
5. Develop a timeline for producing regional reports that would meet the timeframe of the NCA.

The working group discussed issues of leadership of the regional assessments, how to foster engagement in the process, and development of timelines for development of regional assessment reports. The group discussed ways to increase the sense of ownership of the assessment process by regional communities,[2] including arrangements for regional interests to directly lead regional assessments, having regional leaders write or vet assessment products, or establishing and relying on two-way communication mechanisms for interaction with scientists who provide trusted information.

b) Goals for regional assessments

In all of these discussions, participants identified three organizing principles that could guide organization of the regional assessment process: relevance, legitimacy, and credibility. Relevance was roughly defined as the extent to which the current and future NCAs address requirements of decision makers who plan for or manage resources affected by climate variability and change. Legitimacy refers to the inclusiveness of the process, whether participants felt that they had adequate access to the process, and whether the process is seen as having authority. Credibility refers to the need to maintain scientific integrity throughout the process, including avoiding the influence of politics, so that impartial and trusted information serves as the foundation for assessment.

The diversity of backgrounds, values, and positions of communities in each region presents both opportunities for the long-term goals of the NCA and challenges for producing its short-term, 2013 report. Participants acknowledged the time and resource constraints on the 2013 NCA, but also recognized that regional assessments in particular may be essential in reaching the longer-term NCA objectives of establishing a sustainable and participatory assessment process.

NCA Regional Assessment Structure

As an alternative to the past NCA organizational approach, with leadership by one entity responsible for maintaining all three guiding principles, working group participants explored a regional assessment structure that might include separate teams for leadership and advisory capacities (relevance), communications and engagement (legitimacy), and writing and peer review (credibility)

Leadership and Advisory Teams – Enhancing Relevance

To enhance relevance over the long-term, working group participants recognized that the leadership for regional assessments could either include or be validated by stakeholders at the regional, state, and local levels. Participants felt that regional representatives would also help establish trust, since there are recognized leaders who support and even represent planning and implementation efforts in each region. This strategy represents a shift away from leadership by universities who are still trusted sources of information (see Communication and Writing below) but lack the ability to implement mitigation and adaptation options to address vulnerabilities identified in the NCA and who do not always symbolize real-world decision making and leadership to the broader communities.

A leadership team could include representatives from trusted institutions that comprehend short-term and longer-term opportunities for an assessment process, the needs of decision makers and communities within the region, the socioeconomic implications of climate variability and change, and the institutional capacities within regions. Regional communities would, by involvement here, increase their investment in the process, and working group participants pointed out that many states already have climate adaptation plans. A few examples of groups poised to lead regional assessments, or to contribute to leadership, include:

- State governments
- City governments
- US Council of Mayors
- Regional Governors Associations
- Regional Greenhouse Gas Initiative (RGGI)
- Local Governments for Sustainability (ICLEI)

[2] "Communities" was a proposed alternative to the word "stakeholder" in this context, emphasizing increased investment in the outcome of the process as opposed to partial investment.

Groups and representatives would likely differ from region to region, although the working group recognized the importance of including federal agencies in terms of the national scope of the US Global Change Research Act, the resources of the federal government, and the ability to provide consistency across the nation. A combined leadership group comprised of representatives from federal agencies in each region and representatives from regional, state, or local institutions could achieve dual goals of increased ownership by the community and sustained investment in the process over the long term, thereby balancing top-down and bottom-up aspects of the NCA.

Participants recognized that not all groups could be represented on the leadership teams. Regional, state, and local representation would be a significant step in increasing the incentive and investment for regional communities, but alone it would not legitimize the process. One method for legitimizing the process would be to establish a separate advisory committee that includes representatives from the regional community that do not serve on the leadership team. Such advisory committees could be based on the organizational structure for the overall NCA, but the working group did not flesh out the details of advisory committee compositions.

Communications and Engagement – Enhancing Legitimacy

To maintain legitimacy, working group participants emphasized the importance of establishing strong foundations of communication with regional communities. The NCA process would ideally constitute an ongoing discussion amongst regional communities that facilitates two-way feedback between decision makers who use the assessment and the scientists who develop content. Participants called upon NCA leadership, at national and regional levels, to communicate the vision and objectives for the process, emphasizing to communities that their participation in ongoing discussions influences how assessment information is developed and put into context.

This type of facilitated discussion requires social science expertise for many reasons, including ensuring equitable consideration of all vulnerable populations, ensuring the integration of socioeconomic information with climate science, evaluating interactions between leaders of the NCA, scientists, and decision makers, and revealing how regional communities have shaped the process over time. The working group felt that significant expertise is available through a variety of existing networks and boundary organizations, including:

- Sea Grant Program
- State geospatial extension specialists
- Cooperative Extensions
- NOAA's Regional Integrated Science and Assessment (RISA) teams

Other groups that have trusted relationships with regional communities and, with expertise from boundary organizations or social scientists, that could help to connect people to the NCA process over time include (but are not limited to):

- State Chambers of Commerce
- Councils of State Governments
- American Bar Association
- Attorneys General
- American Association of State Climatologists
- NOAA Regional Climate Centers (RCC)
- NOAA National Climatic Data Center (NCDC)
- NOAA Ocean and Human Health centers
- DOI Landscape Conservation Cooperatives (LCC)
- Non-governmental organizations (NGOs)
- Local, state, and tribal nations
- National Integrated Drought Information System (NIDIS) and its partners
- Private sector representatives
- Professional societies (e.g. Association of State Floodplain Managers)

Members of this working group also suggested that communications from the NCA can be designed to educate regional communities. Decision makers, planners, and policy makers need assistance in formulating questions for researchers to address. To re-formulate these questions, there is often a period of communication during which decision makers and scientists work together to establish a common knowledge base that spans both arenas.

An important goal of communications and engagement teams could be identification and improvement of mechanisms by which assessment activities and results are communicated to, and from, the regional communities. Working group participants noted an increasing use of open, web-based technologies to reach different groups across a region. For example, the State of Washington is gathering feedback via blogs on how to fund its water program. Consideration of these mechanisms

is particularly important for engaging communities that have been traditionally ignored. Tribal communities have not always been recognized or invited to participate in the assessment process, and need to be recognized as groups that are neither above or below states and local entities, but rather as equally important.

Writing and Peer Review – Enhancing Credibility
To enhance NCA credibility in the regions, the working group discussed ways that regional writing teams could draw upon trusted information sources in both academia and the federal government (see below for more on information sources). One advantage of using federal employees is that some funding exists within the federal agencies for support of the NCA, although there are uncertainties concerning the amounts and timing of funding (see Timeline below). Many academic partners have high status within the regions, have experience from previous assessments, existing relationships with decision makers, and are presumed to draw from unbiased research agendas. Academics thus may be natural leads for regional writing teams. Writing teams could also include representatives from NGOs, and state, local, and tribal groups. Contributions from federal and regional representatives might help contextualize the regional assessments nationally while sustaining regional relevance and community participation.

A peer review team will be important for maintaining the credibility of the science and ensuring that politics do not influence assessment results. Participants thus recognized an important role for peer review teams as part of the regional assessment structure, but they did not make specific suggestions about who would be included on the peer review team.

c) Timeline for regional assessments

The third National Climate Assessment is being planned for completion in 2013, as required by the 1990 U.S. Global Change Research Act (GCRA), which is within four years of the release of the last assessment in June 2009. To establish a timeline and consider approaches consistent with short- and long-term NCA objectives, the group discussed the limited time between the delivery of final guidance from the NCA's Federal Advisory Committee and the due date for a draft NCA (June 2012), the need to begin regional and sectoral assessments contemporaneously, and the need to identify and distribute resources for those involved with implementing the NCA.

Given the tight constraints of the 2013 NCA, it may not be possible to have many regional community representatives involved in the leadership of the current NCA effort. However, regional communities may begin articulating how they would like to see the assessment process structured in the future. One alternative is that the 2013 regional assessment products focus more on an articulation of the needed, long-term process rather than on a rapid-fire update of the 2009 NCA.

A variation on this alternative could have a regional writing team that begins writing an update of the 2009 NCA regional elements by March 2011. The writing process could extend to early 2012. The product would be similar to a white paper and could be used as a starting point to engage regional communities at the beginning of the discussion. This approach would provide incentive for the engagement of regional decision makers, planners, and policy makers by giving them a knowledge base and allowing them time to participate in creating the long-term NCA context.

In early 2012 (January), NCA leadership could engage regional communities at a workshop delivering the report. The time freed by this approach could allow NCA leadership to think broadly about which groups from various regions need to be engaged for the long term. For those groups new to the process, the engagement could start with a summary of the vision, objectives, and anticipated outcomes of the process prior to the workshop. The 2012 workshop could be a mechanism to begin to add a strategy for long-term engagement to the 2013 regional report(s). That strategy would afford opportunities for regional communities to define and commit to long-term NCA roles and responsibilities.

4. Selection of Sectors and Basic Sectoral Report Outline

a) Charge to the working group

This Working Group was asked to provide input on the sectors that should be included in the NCA and to provide input about the basic outline for a sectoral assessment report. The 1990 Global Change Research Act (GCRA), Section 106 provides guidance on the sectors that the NCA should cover:

the periodic national climate assessment … "analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity."

The working group considered the following questions:

1. What criteria are important when considering sectors that should be assessed but are not required by the GCRA?
2. What specific additional sectors should be considered?
3. Is the outline clear? (Does it flow well, anything missing?)
4. Is the outline too restrictive or not enough guidance? If so, how should it be adjusted?
5. Are there elements to add that might differ among sectors?
6. What are the necessary inputs for this element? In other words, what do we need to do and have available to do this analysis?

b) How to delineate sectors?

The list of topics in the GCRA blends areas that are well defined as economic sectors, such as energy and agriculture, with topics that are considered important for assessing impacts of climate change, such as natural environments. Since the "sector" designation has been used in previous assessments for this wide range of topics, workshop participants maintained this designation.

There was extensive discussion about the seeming overlap between the sectors listed in the GCRA, particularly the potential overlap between natural environments, biological diversity, land and water resources, and agriculture. Natural environments and agriculture occupy land and water, so the distinction between these topics is not clear. The general logic seems to be that the land and water resources topic focuses on human uses of land and water. Following this logic, the natural environment sector would focus on the ecological attributes affected by climate change. The water resources sectors would focus on human uses of water, including water withdrawals, consumptive uses, recreational uses, commercial fisheries, and in-stream flow needs. The land sector is harder to differentiate, especially since one of the major human land uses is agriculture, which is addressed in a separate sector. This dilemma points to the need to better define how the categories overlap. For example, agriculture can also be defined to include aquaculture, rangelands, or forests, which might overlap with marine resources and ecosystems.

The difference between the human health and welfare sector and social systems sector was also discussed at length. The result of the discussion was the group defining the human health and welfare sector as the sector focused on assessing impacts on individuals. The social systems sector (potentially re-named "culture and society") was defined to focus on impacts of climate change on communities and other collective social units. For example, analysis of the human health and welfare sector would include attributes such as mortality from heat waves, while the culture and society sector would include attributes about a community's capacity to cope with climate change impacts, such as health care facilities per thousand residents. Both sectors could be further broken into analyses of rural and urban subsectors to compare and contrast differences in individual and social attributes. The legal and institutional uniqueness of tribes was seen as sufficient justification for a separate treatment of "Native Peoples" under all proposed options. Many participants also suggested that consideration be given to U.S. insular and protected territories. Since many of these territories are islands, they tend to be highly vulnerable to climate change. While islands have been treated as a region in previous assessments, these territories have some of the unique characteristics common to tribal cultures, and may be a topic for more in-depth exploration in future assessments.

The working group participants also discussed criteria for adding sectors beyond those required in the GCRA. But the criteria could equally apply to prioritizing coverage of the legally required sectors as well, since each NCA is constrained by time, resources, and data available to assess climate impacts.

There was general agreement among participants that the focus of analyses in the NCA should be on the health of ecosystems and human uses of resources. This focus seems consistent with the intent of GCRA. The anticipated magnitude of impacts is a potential criterion that could be used to identify missing sectors, as well as prioritizing work among sectors. The group also discussed the need to connect with users and potential partners. If the

INCA Task Force wants to engage external groups in the NCA process, then these external groups will need to see their interests reflected in the list of sectors and other portions of the NCA outline.

Options for NCA Sectors

Previous NCAs have generally followed the sector list in the GCRA. Table 1 provides a list of sectors that were covered in the 2000 NCA, 2009 NCA, the 2013 NCA proposed list of sectors, and two new options for sectors suggested at the workshop. The sectors are organized within Table 1 to cross-walk with the list of sectors in GCRA to the extent possible.

The 2000 NCA was the first attempt to meet the requirements of the GCRA. While some of the sections of the report mirrored the list of topics in the GCRA, some topics were not covered (e.g., transportation and energy). Other topics were covered partially – e.g., forest and coastal and marine resources were analyzed, but not all natural environments.

The 2009 NCA was based primarily on a series of Synthesis and Assessment Products (SAPs) published between 2006-2009, but included some other relevant research as well. In Table 1 the topics of the SAPs relevant to sector analyses are shown in parentheses in the column for the 2009 NCA. In

Table 1. Options for Delineation of Sectors for the National Climate Sector

GCRA	2000 NCA	2009 NCA (SAPs)	Proposed in FRN (9/2010) for 2013 NCA	Integrating Human and Natural Systems	Audience Focus
Natural Environment	1) Coastal and Marine Resources 2) Forests	Ecosystems	Natural Environment	Terrestrial Ecosystems and Land Use	Ecosystem Integrity and Biodiversity
Agriculture	Agriculture	Agriculture	Agriculture		Agriculture
Energy Production & Use		Energy Supply and Use	Energy Production and Use	Energy	Energy
Land and Water Resources	Water Resources	Water Resources (including Forests and Arid Lands)	Land Resources Water Resources	Aquatic Ecosystems and Use Marine Resources	Land Resources Water Supply, Demand, and Use Marine Resources
Transportation		Transportation	Transportation	Transportation	Transportation
Human health and welfare	Human Health	Human Health (Human welfare)	Human health and Welfare	Health and Welfare	Health and Welfare
Human social systems	Native Peoples and Homelands (treated as a region in the document)	Society (Human settlements)	Human social systems	Culture and Society Native Peoples	Culture & Society Native People and Homelands
Biological Diversity		Biodiversity	Biological Diversity		
			Marine Resources		Forestry Urban Etc…
			Air Quality		

some cases, a SAP may have been done for which there was no corresponding section in the 2009 NCA (e.g. biodiversity). The SAPs addressed many of the topics in the GCRA, although the topics were "redefined" in some cases to both clarify the focus of the analyses and match the GCRA topics with current science and analytical capacity

A Federal Register Notice (FRN) was published in September 2010 to elicit public comments on proposed topics for the 2013 NCA.[3] The sector list was based on the GCRA sectors, with a few new sectors suggested. Starting from the historic and proposed 2013 NCA list, the workshop participants devised two additional options for the list of sectors, although there is considerable overlap among the historic and suggested lists of sectors.

The first option is described as "Integrating Human and Natural Systems." This option focused on merging the natural ecosystems and land and water resource sectors, based on the assumption that the land and water resource sector differs primarily from natural environment by focusing on the human uses of those resources. The logic to this approach was that there is no natural division between the condition of the natural system and the human uses of those systems. All environments are managed to some extent in the US, even if that management is a deliberate decision to allow natural processes to dominate. Therefore, a more integrated approach would explore the interactions between ecological conditions and human uses. The group suggested dividing "sectors" into terrestrial ecosystems and uses and aquatic ecosystems and uses. Terrestrial ecosystems could be further divided by land cover/land use (e.g. forest, grasslands, wetlands) and aquatic ecosystems could be further divided into freshwater and marine. Biodiversity was also subsumed into this new structure, because biodiversity was seen as too narrow a frame for the issues facing plant and animal species. Agriculture was also subsumed under the terrestrial ecosystem and use category, although there was considerable debate about treating agriculture as an "ecosystem."

This option maintains some of the GCRA sectors, including energy and transportation. The human health and welfare sector and culture and society sectors are defined as described earlier, with a separate consideration of native peoples. This approach collapses the total number of sectors, although the subcategories could easily expand. The group noted several concerns about this approach. Some users would not see their area of interest as easily within the integrated topics, and may be frustrated at having to search extensively. This was a particular concern for the water sector, which has strong constituents in many topic areas. The integrated approach results in large and complex topic areas that will require larger teams of writers. Defining subtopics with the larger ecosystems may address this problem. However, it was thought that the approach would force integration across ecologists, resource managers, and social scientists.

The second option focused on defining sectors to appeal to audiences for the NCA. This option generally follows the list of topics found in the GCRA, since the group assumed that the original list was based on needs perceived by Congress. This option combines natural environments and biodiversity into a single topic "ecosystem integrity and biodiversity," using the same logic as the previous option.

A focus on audience also links to potential partners for undertaking assessments. Priority could be placed on vulnerable systems and people, and on sectors most strongly affected by climate change. This approach provides a comprehensive coverage of sectors, although the ability to conduct assessments in each category will continue to depend on the state of the science and underlying data. While this approach also allows for the inclusion of new topics (or isolating topics from more comprehensive topics), there was a concern that criteria would need to be developed to limit the potential size of the list. The group began to list items that might be likely to have an audience, but recognized the list could expand rapidly. However, this option also allows the list to evolve with societal needs.

While the previous two options focused on a list of sectors, the working group also developed an option that suggested a different approach to conducting NCAs that could work within any definition of sectors. The group called this "option NCA 3.0+." The basic concept is to use a web-based encyclopedia approach that would provide a comprehensive and ongoing assessment process. Special topics and case studies could be included that are easily targeted to a range of audiences.

[3] http://www.globalchange.gov/what-we-do/assessment/notices

A web approach can be extremely flexible and modular, and be responsive to changing science. Specific topics could be developed in less depth, but with links to more detailed information and data sources. This type of layered approach may be more in tune with how people are retrieving information. A topical approach may allow the creation of smaller writing teams focused on narrowly defined subjects. Peer review may be easier to obtain on more focused products, but integration may suffer.

This type of approach may be most supportive of a sustained assessment process. It would provide significant challenges for coordination, particularly in maintaining consistency across analyses and completing the assessment in short time frames. Further thought is needed about whether this approach would provide sufficient information to support adaptation options.

Comments on Additional Sectors

The workshop participants had an opportunity to comment on the need for additional sectors. There was no support expressed for air quality as a separate sector. The participants in this working group seemed to agree that air quality could be treated within other sectoral analyses, such as human health or ecosystem condition.

There was considerable support for including a marine sector in the 2013 NCA. Some would interpret the original list of sectors as including marine-related topics in the natural environment sector. The 2000 NCA included a section and report devoted to coastal and marine resources. So, whether it's a new sector or a further refinement of the existing list, many participants agreed that the potential impacts of climate change on oceans and marine environment make it an important sector to include. There was also a suggestion that coasts should be treated as a sector instead of as a region.

Economics was mentioned as a potential sector, especially for its use as a tool to communicate with the public. A focus on economics has been used effectively in the Australian climate change report, and in the UK Stern report. Economics is not usually defined as a separate sector in climate assessments, but rather as a component within a sector. Economic assessments of climate change impacts, such as that conducted by United Kingdom Treasurer Sir Nicholas Stern[4], generally use economic concepts and analyses to compare the potential costs of adopting (or not adopting) policies that address climate impacts. This type of approach can be used at various scales, but requires information about potential climate change impacts, potential benefits and costs of policy options, and their probability of effectiveness. While there appeared to be general agreement that economics was an important aspect to consider, the group did not have sufficient time to discuss the potential uses of economics in the NCA. For example, economics could serve as a lens to summarize impacts across sectors and/or regions, to evaluate the costs and benefits of policy options at different geographic scales, continue to provide information about individual sectors, and/or provide some other synthesizing function.

National security was mentioned in almost all working groups, either as a sector or as a cross-cutting topic. It is considered an important aspect of any treatment of international effects of climate change. One linkage that was mentioned repeatedly was the effect of climate change on the stability of countries and potential ancillary effects on immigration and emigration and human security.

Several other "sectors" were mentioned for consideration. The built environment tends to overlap with several existing sectors, but is not necessarily treated in its entirety in the current list of sectors. A focus on urban areas may capture some of the interaction across sectors, but not completely. Recreation and tourism was suggested, either as a separate sector, or to ensure it is included in relevant sectors. Finally, the general topic of natural hazards was suggested, although that topic is also a potential "cross-cutting" topic.

c) What should the core elements of sectoral chapters/analyses be?

The workshop participants did not address the core elements of the sectoral analyses or chapters in any depth. However, several guiding principles were offered for consideration. First, all sector chapters need to address societal and economic impacts and interactions and connect the natural environment to the human use of that environment. Second, impacts and implications should be the focus of all chapters. Third, chapters should address the set of adaptation and mitigation options being pursued or envisioned. Fourth, the potential effects on vulnerable people and ecosystems needs to highlighted. One simple modification of the chapter

[4] Stern, N., 2007: *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge, 692 pp.

outline in the strawman draft would be to replace the chapter summary with a section on key findings that would not attempt to summarize all of the chapter's content, and instead focus on the impacts for that sector.

A. Key findings for the sector
    1. Key social (including health), economic, and ecological (including ecosystem services) impacts
    2. Major vulnerabilities
    3. Major opportunities
B. Introduction - description/definition of the sector
    1. Geographic scope of sector
    2. Recent trends in the sector
    3. Significant climate-related features of the sectors
    4. Socioeconomic characteristics of sector that are relevant to understanding impacts, adaptation and vulnerability
    5. International linkages and implications
C. Climate context for the sector
    1. Observed impacts of climate variability and change on the sector
    2. Projected impacts of climate on the sector (linked to scenarios for NCA)
D. Environmental and societal stressors / drivers that intersect with climate change
    1. Socioeconomic drivers
    2. Technology and policy drivers
    3. Non-climate environmental drivers
    4. Interactive effects between climate and other drivers (link to cross-sectoral analyses)
E. Key sectoral issues (vulnerabilities and opportunities)
F. Current or planned adaptation and mitigation options; state of understanding of effectiveness of these options
G. Critical unknowns and research needs
H. Conclusions/findings

5. Conducting Sectoral Assessments

a) Charge to the working group

This working group was presented with the following questions, although not all of the questions were explicitly addressed in the discussion:

1. Who could/should lead and who should prepare sectoral assessments?
2. How could/should sectoral stakeholder groups (e.g., associations, NGOs, labor groups, etc.) be engaged in the process? Any examples?
3. What are the necessary inputs for sectoral assessments?
    a. What data about current conditions relevant to each sector is needed (e.g., census data, economic data, trade statistics, land use data, etc.)?
    b. If scenarios of future conditions (e.g., population density, land use, climate conditions, national policies on climate or other issues, etc) were made available would you use them? Which, specifically?
    c. What uncertainties about future conditions are of greatest concern?
    d. Are there specific data sets or scenarios that should be used consistently across sectoral assessments? Which, specifically?
4. Do sectoral assessments need to be stand alone documents? Can the same prefatory information be used in all sectoral reports?
5. How can we obtain the adaptation and mitigation components from sectors?
6. What is a good timeline for producing sectoral reports that would meet the timeframe of the NCA?

b) Leading and writing sectoral assessments

Participants identified many important qualities for NCA sectoral author teams: technical expertise, credibility, objectivity, diversity of opinions, ability to meet deadlines, communications expertise, ability to sustain assessment programs after the report, access to adequate funding, and establishment in existing networks. Working group participants noted that these qualities rarely reside in a single person, and workshop participants found particularly valuable the model of author leadership started in the 2000 National Assessment, namely, two coordinating lead authors, one federal government and one non-federal government. This approach recognizes both the inherent responsibility of the federal government to lead the assessment and the vital capabilities of specialists outside the federal government. The coordinating lead authors would direct a team of authors with technical expertise required to complete each sector chapter, subject to decisions on which sectors to include in the 2013 National Climate Assessment. Working group participants suggested that it would be useful to issue each sectoral assessment as a separate report after publication of the main report because smaller sectoral reports may be more accepted, read, and used. Working group participants also suggested ideas for increasing federal employee

involvement in the NCA. These included identifying work on the Assessment as an objective on employee performance plans, making Assessment efforts budget priorities, and connecting federal agency adaptation plans to the Assessment.

c) Engaging stakeholder groups

The NCA draft Strategic Plan particularly focuses on decision makers – those individuals with the responsibility and authority to take action. The Assessment seeks to provide scientific information on observed and potential impacts so that decision makers integrate climate change science into their management responsibilities. Workshop participants emphasized that decision makers' questions would form an effective starting point for the Assessment.

Participants in this working group suggested that stakeholder engagement will build and reinforce the understanding and use of climate change information. Outreach to organizations representing groups of stakeholders with similar characteristics, needs, and interests will be an important activity of the NCA. Stakeholder groups potentially interested in Assessment activities include among others:

- Neighborhood and civic organizations
- Public interest groups
- Charities
- Environmental groups
- Labor organizations
- Trade organizations
- Professional societies
- Small businesses
- Large corporations
- Chambers of commerce
- Business coalitions
- Schools and universities
- Research institutes
- Government agencies
- Native American and Alaska Native tribes

The continual engagement of stakeholder groups is necessary to ensure the usefulness of the Assessment. Stakeholders with key expertise in a sector can participate as authors, contributors of material for case studies or vignettes, and reviewers of drafts during scheduled periods of public review and comment.

Any previously unreviewed material from stakeholders proposed as formal contributions to the assessment, such as informal reports, observations, and compilations of local knowledge and experience, should go through a special peer review process that USGCRP proposes to establish for the Assessment. Some workshop participants proposed that the Assessment teams develop a standard format and solicit new reports from stakeholder groups in which the groups explicitly express their needs for specific answers from the Assessment. This would avoid surprising or disappointing stakeholders if their inputs are not used because they do not meet Assessment data standards.

Meetings, workshops, and conferences can bring author teams and stakeholders together in person. Electronic means of engagement include videoconferences, teleconferences, webinars, web sites, e-mail, and social media. An active web-based portal could promote continued and direct exchange among NCA staff, authors, and stakeholders. This portal could become a permanent means, after the 2013 report, for maintaining networks among NCA staff, authors, and stakeholders.

Workshop participants pointed out that lower income and other groups, who comprise parts of society that may be more vulnerable to impacts of climate change, may be less able to engage in the process. It will be necessary for USGCRP and the authors to establish the means to reach out to these groups in ways that will assure their comfort and interaction.

d) What are the critical information needs for sectoral assessments?

General Considerations

Participants discussed critical information needs at some length. To prepare for potential changes in sectors due to climate change, decision makers need at a minimum:

- Information on changes already observed and attributed to climate change,
- Changes projected under a range of plausible future scenarios,
- Vulnerabilities of key parts of each sector, and
- Quantified uncertainties in observed changes, projected changes, and vulnerability.

Working group participants emphasized that quantification of uncertainties would provide decision makers with explicit information to assess confidence in different data sets. Calibration and

validation of any model output against observed data are essential for assessing the accuracy and uncertainties of models. To produce results consistent across the National Climate Assessment, participants agreed that teams should select specific data sets that all authors will use for specific variables. Harmonization of observed baseline and future projected time periods can improve consistency across data sets. Spatial data in the form of Geographic Information System (GIS) data layers is the most useful format. Where GIS data are in the form of grids (rasters), justification of the spatial resolution is essential, as participants raised concerns over the spatial and/or temporal resolution of the data. For example, although it is mathematically possible to downscale some raster data layers to very fine resolution, the sparse density of the point data used to generate them may only justify downscaling to medium or coarse resolution.

Observed Changes and Uncertainties
Information on observed 20th century changes in fundamental climate variables is essential. Working group participants said that attribution of the causes of specific changes to anthropogenic greenhouse gas emissions or to other factors would allow decision makers to properly target management actions. In addition to measures of central tendency (e.g., mean, median values), workshop participants emphasized the need for measures of variability, marginal effects, the ends of distributions of values, and thresholds. The quantification of uncertainties in observed data derived from measurement errors, statistical variation, modeling factors, and the propagation of error through combinations of the different sources would be useful. Because past observations are less subjective than future scenarios, uncertainties in observed data may be lower. Continued monitoring of the state of sectors over time is important to track the impacts of climate change and possible improvements in resilience due to adaptation measures.

Working group participants did not exhaustively catalogue all possible data sets because of the relatively short time of the session and because they felt that author teams and stakeholders for each sector would be the best people to select exact data sets. The series of NCA workshops on indicators will also serve this purpose. Nevertheless, participants identified certain essential types of data, in addition to the fundamental climate variables. Data sets (and sources) include population (U.S. Bureau of the Census), land cover and land use (U.S. Geological Survey National Land Cover Data), forest characteristics including forest carbon (USDA Forest Service Forest Inventory and Analysis), agricultural production (USDA National Agricultural Statistics Service), sea and lake levels (National Oceanic and Atmospheric Administration), snow (National Oceanic and Atmospheric Administration), water flows (U.S. Geological Survey), baseline geography (U.S. Geological Survey National Map and National Atlas), health data such as heat-related morbidity (state health departments), beach closures and other indicators of coastal change (local governments). Some U.S. Government data may not include Indian lands, so close work with the Bureau of Indian Affairs in data collection will help ensure inclusion of Indian communities and lands.

Projected Changes and Uncertainties
Projections of fundamental climate variables under plausible future emissions scenarios are essential. The Integrated Assessment Modeling Consortium (IAMC), a global organization of scientific research organizations, including major U.S. climate research organizations, is developing a set of emissions scenarios called Representative Concentration Pathways (RCPs) for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5). IAMC members are working with USGCRP to provide scenarios for the National Climate Assessment.

For model output of future projections, workshop participants underlined the need for measures of variability, marginal effects, the ends of distributions of values, and thresholds, in addition to measures of central tendency. The quantification of uncertainties in model output, estimated through validation against observed data and other empirical methods, is important for decision makers to assess confidence in model projections. Decision makers will then need to determine how much uncertainty they are willing to accept. Workshop participants suggested surveying how decision makers currently deal with climate uncertainty. Estimation of the probabilities of different emissions scenarios could aid the quantification of uncertainties represented by the range of scenarios. Otherwise, it will be necessary to assume equal probabilities for each scenario.

As with the observed changes, working group participants did not exhaustively catalogue all possible projected data sets because of the relatively short time of the session and because they felt

that author teams and stakeholders for each sector would be the best people to identify the most important variables and most pertinent spatial and temporal scales for each sector. Workshop participants identified certain essential types of projected data in addition to the fundamental climate variables: population (including net migration), economic conditions, land use and land cover, vegetation shifts, roads and other built infrastructure, low frequency hydrologic variability, snowfall and snow cover, resource use (especially water), changes in people's behaviors and potential mass movements, expectations of environmental quality, national will to adopt emissions reductions and other policies, agricultural technology changes and adoption for yield increases. Workshop participants suggested that the experience of the State of California (including its Department of Health) in selecting data and projections for its climate change assessments could provide useful insights for the NCA.

Vulnerability and Uncertainties
Explicit analyses of vulnerability can provide decision makers with the information most useful for managing resources. Observations and projections provide data on the three components of vulnerability - exposure, sensitivity, and adaptive capacity. Working group participants pointed out that vulnerability analyses can translate complex measures of observed change, projected change, and uncertainty into indicators more easily understood by decision makers. Projections of all three components of vulnerability can supplement current analyses of exposure to risk with analyses of future exposure and risk.

Examples of key vulnerabilities to consider include mortality from heat-related conditions, changes in disease risk, destruction of infrastructure from floods, and vulnerability of ecosystems to vegetation shifts. Time lags in the response of climate variables to increases in atmospheric greenhouse gas concentrations, and in ecosystem responses to changes in climate delay the ultimate manifestation of ecological impacts of climate change.

e) Addressing adaptation and mitigation

Participants in this working group considered two issues concerning the interaction of adaptation and mitigation actions: the possibility that risks and impacts are outpacing adaptation and mitigation options and interactions (both positive and negative) between adaptation and mitigation measures. For the first issue, it will be necessary to assess or quantify existing adaptation efforts and develop quantitative methods of evaluating progress and projecting future balances between risks and impacts, on one hand, and adaptation and mitigation options, on the other hand. Estimating people's ability to pay and where to invest reveals the importance of economic scenarios. Workshop participants suggested potential sources of new ideas: the expertise of business corporations, the U.S. Securities and Exchange Commission climate risk disclosure guidance, surveys of users such as water utilities, U.S. Conference of Mayors city mitigation plans, the Carbon Disclosure Program (self-reporting of emissions), California and New York state implementation plans, cost-benefit analyses of mitigation and adaptation actions.

Some mitigation actions can produce negative impacts that will require adaptation measures. Participants pointed to examples, such as increased land use for growing feedstocks for biofuels, disruption of food security and food prices due to growing crops for biofuels, long-term radiation risks from nuclear waste, and habitat fragmentation and destruction from centralized solar plants. On the other hand, some adaptation actions can produce positive mitigation benefits. For example, prescribed burning and other forms of fire management to reduce the risk of catastrophic wildfire under climate change can also increase the density of older, large-diameter trees, removing more carbon from the atmosphere.

6. Delineation of NCA Cross-Cutting Topics

a) Charge to Working Group

This working group was originally presented with the following questions:

1. What criteria can be used to select cross-sectoral areas of focus?
2. Given those criteria, and then considering the Federal Register Notice list or other potential topics for cross-sectoral assessments, which ones present near-term opportunities and why?
3. How should these topics link to their component sectors and with the regional assessments? Are the cross-sector assessments standalone, or do they need to occur after the sectoral assessments are underway/completed?

4. What is the best way to plan and complete assessments of cross-sectoral impacts, adaptation, and vulnerability?

Members of this working group were originally asked to provide input regarding the delineation of "cross-sectoral" topics for the 2013 NCA. Many participants, however, expressed concern about the exclusion of important "cross-regional" topics, as well as those topics that involve a combination of sectors and regions. The participants in this working group preferred to call this aspect of assessments "cross-cutting topics," an approach that is commonly used by the IPCC in its assessment reports. Strong natural constituencies exist for examination of individual sectors and regions, and it remains important to understand the potential effects of climate change within these categories, and how mitigation and adaptation strategies can be developed to address climate risks within this framework. However, there are also critical interactions spanning multiple sectors and regions that may ameliorate or magnify climate impacts through their interactions with other operative stresses. Inclusion of such cross-cutting topics will enhance the usefulness of the National Climate Assessment.

In order to assess the full scope of climate change impacts and associated adaptations, the working group suggested that the NCA should adequately describe how large-scale stressors, particularly near-term phenomena such as current economic and demographic trends, can bring natural and managed ecosystems closer to thresholds. Although they are sometimes more difficult to visualize and describe, cross-sectoral and cross-regional interactions are crucial because they can influence the effectiveness of adaptation strategies in unanticipated ways. Moreover, there are key interactions that span mitigation and adaptation, and affect the success of those strategies. For example, mitigation that focuses on biofuels may create additional stressors on food security due to changes in land use and water resource requirements. Therefore, working group participants discussed the need for the NCA to include cross-cutting, integrated topics consisting of cross-sectoral and cross-regional analyses, criteria for selecting topics for inclusion, a set of possible topics to draw from, and some suggestions for framing their presentation.

b) Criteria for Inclusion of Cross-Cutting Topics

There are several factors that may be useful in deciding which cross-cutting topics are to include in the National Climate Assessment. For example, are the connections between sectors and regions sufficiently important to warrant national attention? Are they applicable to a wide range of people and places? Are they related to other stressors beyond climate? Considerations will also likely include the significance of the potential economic, social, and ecological impacts as well as data and information availability. The ability to use existing work and examples as case studies is critical for the 2013 NCA report given the short timeframe for completion. Topics included need to have strong cross-sectoral and cross-regional interactions and to integrate across multiple factors beyond climate. The focus should be on elucidating new connections and understanding. Other considerations include how well the topic can be addressed by actionable policy responses. Interactions between mitigation and adaptation are also a key focus. Finally, topics need to be easily understood by a wide range of audiences, including land managers, planners, and the layperson, including those who are not otherwise engaged in addressing climate change.

The working group members suggested several criteria as characteristics desired for inclusion of cross-cutting topics in the NCA. These include:

- Integration – Topics included need to have strong cross-sectoral and cross-regional interactions and to integrate across multiple factors beyond climate. The focus should be on elucidating new connections and understanding.
- Timeliness – Issues covered should be urgent, connected to real consequences, and relevant to current policy development.
- Relevance – Issues selected should have broad interest, be related to important constituencies beyond those working primarily on climate change, and spur engagement across such groups.
- Capacity/Readiness – Due to the short timeframe available for accomplishing the Third National Assessment Report, topics can usefully be divided into those ready for inclusion in the near-term report and those that require longer-term attention. Identifying the latter topics

can help to stimulate needed research and development. The information for the topics in the near-term Assessment Report should be actionable for users.

- New Understanding – Emerging work is highlighting the need for new approaches to complex challenges that link changing climate conditions with many other economic, social, and ecological trends. Bringing forward new understanding of ways to address these multiple and interacting challenges across time and place could be an important goal of the NCA. A focus on of such topics will set the stage for future assessments, as well as provide relevance for the near-term report.

c) Potential Cross-Cutting Topics

A wide array of potential cross-cutting topics were discussed that loosely fit the criteria above. Following are some of topics that garnered the most attention, with a brief description of each.

1) Water, Energy, and Land

Water supplies and land are required for production of energy as well as food, with vital consequences for both mitigation of and adaptation to climate change. However, these issues are also linked to water quantity and quality, and illustrate many cross-cutting ecosystem concerns, including loss of habitat and species migration.

2) Ecosystems, Agriculture, and Carbon/ Nitrogen Cycles

There is growing understanding of the linkages between the carbon and nitrogen cycles and the effects of human interventions on the combined system. For example, food production is a positive benefit of human alteration of the nitrogen cycle, but leakage of nitrogen from agricultural systems also produces negative consequences for ecosystem and human health. Adequate nitrogen is needed for carbon sequestration in agricultural soils to be effective; however, excess nitrogen released to the environment is having measurable impacts on ecosystem services, biological diversity, water quality, air quality, and human health. Both carbon and nitrogen affect the climate system through direct (e.g., carbon dioxide and nitrous oxide emissions) and indirect processes (e.g., carbon sequestration and nitrogen deposition in ecosystems).

3) Coastal Areas – Ecosystems, Development, and Communities

Sea level rise will amplify risks to coastal populations, leading to inundation of low-lying areas, more frequent flooding by storm surges, and increased beach erosion. High rates of coastal erosion are occurring in northern latitudes, threatening and destroying coastal villages in Alaska today. Loss of coastal wetlands reduces species diversity, including fish and shellfish populations. High water levels, strong winds, and heavy precipitation resulting from coastal storms already cause damage and disrupt transportation and power distribution systems. Inclusion of the potential for impacts of sea level rise and enhanced flooding is critical to coastal development planning.

4) Urban Areas, Infrastructure, and Health

Urban areas are home to over half the nation's population and are at risk to changing climate due to urban heat island effects, poor air quality, dense populations, and vulnerable locations near coasts and rivers. Cities are key hubs for transportation infrastructure, which can play a key role in mitigating greenhouse gas emissions. At the same time, potential impacts on infrastructure need to be taken into account in urban planning to avoid exacerbating risks. The health of urban populations, especially the elderly, the very young, and the poor, in regard to augmented potential for heat waves, coastal inundation, and changes in air quality, requires special attention.

5) Rural Environments

Rural areas are home to communities that live and work in close proximity to natural ecosystems, and are the regions where wildlife migration corridors still exist. Climate change is projected to have important consequences in these systems and thus for the communities who manage them. Rural areas include State and National Parks, National Forests, wilderness areas and Native lands, as well as being important regions of agricultural production. Rural areas are targeted for urgently needed sources of renewable energy, through wind and solar projects, as well as the production of biofuels. One of the current challenges in rural areas is balancing the competing interests for a rapid change in the source of energy supplies and the need to provide sufficient habitats for wildlife, including corridors for movement as an adaptation to changing

conditions. Impacts to rural areas are also important to understand from the perspective of food security and related ramifications to the national economy.

6) Environmental Justice

Climate change risks, vulnerabilities, and capacities to adapt are uneven across regions, sectors, households, individuals, and social groups. Equity issues emerge because climate change impacts and adaptation policies can worsen existing inequalities and can also create new patterns of socioeconomic conditions. This topic consists of a special examination of the interactions of climate change with vulnerable groups, including the urban poor.

7) Native American and Alaska Native Populations

Native American lands and communities are highly susceptible to climate change impacts for a number of reasons. Reservations were established in regions of the United States that are typically extreme environments, where sustainability of acceptable living conditions is a challenge under normal circumstances. Because Native lands are federal trust lands, under the care of the Dept. of the Interior, and considered sovereign rather than under state and city jurisdiction, reservation communities have never had zoning laws or flood plain delineation to help communities avoid floods and other natural hazards. In spite of these challenges, Native people have continued to practice a lifestyle with strong links to environmental conditions, because of cultural ties to the land that take the form of gathering herbal medicines, hunting and fishing, and traditional agricultural practices. The dire economic conditions on reservations combined with a lack of resources leaves tribal governments unprepared to cope with climate change impacts. Because of this combination of circumstances, many of the "unanticipated surprises" from climate change may appear on Native lands.

8) Disasters, Risk Management, and Community Resilience

There is a growing awareness that climate change increases the potential for climate-related disasters and that enhancing community resilience is a critical task. A risk-management approach is emerging as a useful paradigm for increasing resilience. This approach involves characterizing climate risks, developing and prioritizing adaptation strategies, and evaluating outcomes to enable learning through time. Understanding how risk is perceived and engagement at the community level are critical to effective risk management and increased community resilience.

9) National Security – Trade, Food Security, and Preparedness

This topic could include a range of issues including how climate change may affect US trade routes and patterns, food and energy systems, disaster preparedness, and international and trans-boundary agreements.

Other potential cross-cutting topics include Transportation, water, and wildlife; Infrastructure; and Population and consumption.

d) Presentation, Framing and Timing

The description of cross-cutting topics could include:

A. Description of the system and clarification of the key issues,
B. Possible thresholds and tipping points; role of extreme events,
C. Pathways for solutions, including the potential for unintended consequences, and
D. Case studies.

Emerging work is highlighting the need for new approaches to complex challenges that link changing climate conditions with many other economic, social, and ecological trends. Bringing forward new understanding of ways to address these multiple and interacting challenges across time and place could be an important goal of the NCA. A focus on of such topics will set the stage for future assessments, as well as provide relevance for the near-term report.

The most effective framing of the cross-cutting topics would entail a systems approach that illustrates both the synergies and trade-offs involved in coupled human and natural systems. It is important that an illustration of economic effects be conveyed, and that the effects on natural systems (positive and negative) are illustrated in a context that shows the resulting impacts on the economy. Coverage of the cross-cutting topics should not only include explanation of the related problems, opportunities, and challenges but should be solutions-oriented,

proposing a range of potential technical as well as policy responses. Cross-cutting topics can elucidate the beneficial function of ecosystems such as the provision of wildlife habitat, clean and plentiful water resources, and soils for food production.

Cross-cutting topics can be illustrated using case studies that demonstrate the need for examination of sectors and regions in an integrated framework. One approach could be that cross-cutting topic case studies could be interspersed throughout the NCA document, so that discussions of potential climate change impacts on individual sectors include illustrative examples that highlight the need for examination of impacts to sectors beyond an isolated context. Case studies can illustrate how poor understanding of cross-sectoral and cross-regional interactions, lack of planning, poor socioeconomic conditions, or other group vulnerabilities can result in greater and unanticipated impacts from climate change. Case studies are also an effective way to illustrate complex interactions among sectors, and provide examples of climate change impacts that are occurring now rather than at some time in the future. These are the "stories" of our life on earth that will help our science resonate with the public. If commonalities emerge among case studies, it may also be appropriate to review the similarities they share in a summary section on cross-sectoral and cross-regional analyses.

Strategic timing of issues released in reports is also a consideration for NCA planning. Due to the short timeframe available for producing the Third National Assessment Report in 2013, topics can usefully be divided into those ready for inclusion in the near-term report and those that require longer-term attention. Identifying the latter topics can help to stimulate needed research and development. The information for the topics in the 2013 Assessment Report will be most useful if it includes information that is "actionable" for users. Future publication of the NCA reports could potentially be scheduled prior to the IPCC Assessment, to boost the usefulness and impact of the NCA.

V. Report from Day 3 of the Workshop: Options for a Sustained Assessment Process

A primary goal of the Third NCA is to establish an ongoing, evolving, and permanent assessment capacity that involves networks of participants in regions and sectors across the country. This approach differs from the two prior assessment efforts that focused on producing the reports required by the 1990 Act and concluded once the reports were released.

The strategic plan of the INCA Task Force, which was shared with workshop participants, envisions a continuing, inclusive assessment process that: 1) synthesizes relevant science and information; 2) increases understanding of what is known and not known; 3) identifies needs for information related to preparing for climate variability and change and reducing climate impacts and vulnerability; 4) evaluates progress of adaptation and mitigation activities; 5) informs science priorities; 6) builds assessment capacity in regions and sectors; and 7) builds societal understanding and skilled use of Assessment findings. The NCA will be a sustained and integrated process that is responsive to the nation's climate assessment needs and meets the requirement of the Global Change Research Act to produce a national assessment report at least once every four years.

Workshop participants were asked to offer insights about the design of a sustained assessment capacity and to identify options for initiating sustained assessment efforts at the local to national scale. All workshop participants moved through stations where, through a facilitated discussion of six key questions, they provided their suggestions and ideas on the following topics relating to a sustained process for U.S. climate change assessments:

- Definition and goals for a sustained assessment process, including attributes of success
- Roles and responsibilities for participants at national, regional, and local levels
- Obstacles and challenges that the process may encounter
- Ways to foster a sustained process
- Desired products from a sustained process
- Engagement with and communications to various audiences

Question 1:
Is the sustained assessment properly defined in the White Paper? What are the most important attributes of a successful sustained assessment process?

Sustained Assessment Process Definition
In general, participants said that the draft Sustained

Assessment definition was on the right track and had most of the right words – with a few notable exceptions which should be addressed. Comments about the definition included:

- Need to mention an ongoing evaluation of the process and its effectiveness
- Implement adaptive management based on the evaluation of effectiveness of management options
- Move sustainability toward the front of the definition
- Reflect that the NCA process should not solve problems itself, but informs solutions and enables users to solve problems
- Reflect that the NCA process should support adaptation at multiple scales
- Add "adaptive management"
- Add "evolutionary learning"
- Include private sector

If the definition in the Sustained Assessment white paper were to reflect these suggestions, it could be edited as follows:

> *A **sustained assessment process** is an evolving framework that connects institutions and activities in regions and sectors through a network of academia, government, private sector, tribal communities, and decision makers, to define climate-related problems and inform solutions over time, at national, regional, or local levels, and builds sustained capacity for decision makers to use this information. The sustained assessment process incorporates ongoing evaluation which facilitates adaptive management and decision making, supports adaptation actions across time scales, stimulates civic interest and engagement, and enhances national capacity to characterize risks, find solutions, and to produce periodic assessment reports as required by law.*

There was also some suggestion that the definition include proposed outcomes, with products and time frame being part of the NCA time line, not the definition. Similarly, the comments about the definition and delineation of regions and sectors perhaps was seen by some as helpful but by others as maybe even limiting. There was also considerable comment on engaging stakeholders and related notions of "civic engagement," which is captured later under question 6.

Attributes of a Sustained Assessment Process
Participants indicated that the attributes of a sustained assessment process proposed in the draft white paper were a good starting point, but should be expanded. There was considerable input and wide-ranging discussion and ideas of what else should be included. By far, there were many comments addressing first and foremost the need for sustainable support including both funding and administrative/institutional support. Creative discussion ensued on how to sustain the process in a limited funding environment and what other incentives could and should be considered. Some relatively straightforward ideas included regular and meaningful 'thank you' letters to participants and their employers.

In addition to those already listed in the white paper, other key attributes included:

- Salience, legitimacy, credibility
- Integration
- Flexibility – adapting to expectations of stakeholders
- Clear, accepted leadership responsibilities
- A clear vision based on scientific evidence
- Sustainable financial support
- Continued connection with decision makers
- A lasting structure and network of workers
- Clear public relations, media, and communications targeted to different users and engagement groups throughout the process
- Clear rules of engagement that are also flexible, many institutions will participate

The attributes are intended to be a high-level framing construct for the sustained assessment process. Many of the constructive suggestions were focused on what a sustained assessment process should do and be, and are highlighted below:

- Articulate a vision of a transformed conversation: engaging the public on

climate change, connected to their cares
- Identify, track, and communicate benchmarks of success
- Foster a sense of prestige or recognition, including intangible incentives
- Assign permanent responsibilities as a backbone for future assessments
- Be relevant to broad and powerful constituencies
- Include and track socioeconomic data and connect to people's budget lines
- Acknowledge need for bottom-up engagement
- Provide credible information
- Link to broader sustainability issues
- Meet stakeholders where they are
- Reduce vulnerability and conduct ongoing vulnerability assessments

Question 2:
What should the roles and responsibilities be of state, federal, and local agencies in a sustained assessment process?

Before discussion was underway, many participants felt the framing question for the breakout session was incomplete because it disregarded entities that would, could, or should be involved in a sustained assessment process. Some participants stated that there is a need to move beyond government to include other entities that could play a role, including as businesses, tribal governments, regional organizations, and other government structures such as the Pacific Climate Cooperative. Based on this input, workshop attendees first reworded the question to state: *What are the roles of federal, state, local agencies, and other government structures, as well as tribal and regional organizations?* With this new question in mind, Table 2 summarizes the input on roles and responsibilities from the workshop participants.

In addition to identifying roles and responsibilities, participants highlighted one or more key attributes or issues to be taken into consideration at each planning level:

Federal:
- Consider creating a reward for participation (e.g., Department of Transportation links transportation awards to having climate adaptation in proposals)
- Trust of government is less in some regions than others
- Each federal agency has a different ability, view, and interest in climate
- Using assessment in own programs

Regions:
- Regional organizations can acknowledge & translate cultural differences between states

State:
- States have uneven capacity and widely varying resource levels to participate
- Not all states have the same interest and viewpoint on climate
- The state level is often the first place that local governments seek information
- Have robust monitoring efforts
- State level could be a source for creative solutions

Local:
- Shapers and users of climate information and infrastructure to support service

Tribal:
- Cannot just use the Bureau of Indian Affairs for representation, tribal governments need to be explicitly invited to represent themselves otherwise engagement will be low
- Tribal lands are a large land mass with cultural history and infrastructure which means they have to adapt to that place as they cannot move
- Subsistence and vulnerability

A few overarching messages came up during the breakout sessions on Day 3. First, there is a need for communication at all levels, particularly across agencies. Having a consistent message on the federal level and a common understanding of federal agencies' individual and collective roles will be important to the government providing leadership. Second, the co-creation of information and products with participants will help foster ownership, engagement, and sustainability of the process. Third, many regional and sectoral components are likely to have cross-scalar implications. Finally, participants expressed that the assessment should catalyze change. It will need to lead to progress – "be actionable" – in order to be sustainable.

Table 2. Summary of Roles and Responsibilities for Sustained Assessment Process

FEDERAL	• Catalyst and leadership • Long-term monitoring, data management (QA/QC) & modeling • One-stop shop for resources and standardized materials • National hub for input from regional, state, and other scales • Clearinghouse for guidance, methodology, framework, and indicators • Communicates and coordinates across all scales • Provide base funding and oversight of assessment process and its evaluation • Support structures that facilitate state, regional, and local engagement
REGIONAL	• Integrators and drivers of engagement • Policy translators • Bridge between federal and state/local, especially where States are not as engaged • Bridge to industry, which often operates at regional scale
STATE	• Integrator and boundary between local and federal • Framework for building local capacity • Grass-roots communication for outreach using materials from Federal • Provide case studies and storylines • Training function – train the trainer • Test-bed for application & innovation • Lead role in conducting assessments at a scale relevant to their needs • Can identify leaders/opinion leaders and pathways to reach out and communicate • Data providers
TRIBAL	• Provide knowledge of historical 'record' and observed impacts • Local monitoring and data provision • Identification of monitoring gaps • Provide case studies and storylines • Grass-roots communication for outreach using materials from Federal • Can identify leaders/opinion leaders and pathways to reach out and communicate
LOCAL	• Local monitoring and data provision • Tailoring/customizing information from assessment • Provide case studies and storylines • Input to regional agenda • Early warning/emerging issues identification • Grass-roots communication for outreach using materials from Federal • Can identify of leaders/opinion leaders & pathways to reach out and communicate • Translators

Question 3:
What are the main obstacles and challenges to creating a sustained process, and what are some ideas for overcoming them?

For this question, workshop participants focused on the main obstacles for a sustained assessment process and on identifying ways to overcome them. Many of the obstacles and solutions identified in this breakout session were raised in reference to or linked to other sessions, including creating and sustaining appropriately supported (human and financial), flexible, and credible networks. Those that did not appear in other sessions are identified below. They are grouped into five categories: logistics, communication, stakeholders, support and political environment, and science.

Logistics

- Deadlines that conflict with other agency priorities, IPCC report development, and scientific activities
- Building and maintaining an easily accessible website
- Funding and resources (people, line item, sustained, private-public partnerships)

Communication

- Assuring that the report is useful to the decision makers
- Structure for information exchange (need a process for information gathering and clarity on who will be doing what)
- Increasing climate literacy and reducing misinformation
- Perception and communication of scientific rigor
- Media (messaging around newsworthy creates weighting bias)

- Explain risks and opportunities associated with climate change
- Improve NCA visibility
- Spokespeople that speak to the particular culture
- Bring in communication and stakeholder experts to design the NCA from the start

Stakeholders
- Structure for the engagement process is not yet clearly defined
- Delivering on what is promised with the process – historically this can be a liability
- Willingness and capacity to participate
- Skill and leadership at regional and sectoral level for stakeholder engagement – sustainable dimensions
- Stakeholder education
- Inclusion of all important stakeholders, especially those under-represented but highly impacted

Support and Political Environment
- Agency priorities change and are not always aligned with each other
- Scientists' personal/political values can taint message
- Rise above short-term politics and issues of the day – e.g., by including climate variability in addition to climate change
- Congressional champions
- Changing political landscape poses particular challenges
- Connecting with real decisions and decision makers
- Private and civic engagement and leadership for sustained support

Science
- Leverage current scientific research and ongoing studies (e.g., IPCC)
- Opportunities for having groups write sections of the report (coordinate deadlines, take advantage of consortia)
- Linking science to decisions
- Mismatch between NCA timeline and IPCC, scientific activities, and other cycles
- Making sure that the science contained in the assessment is both relevant and accurate
- Providing access to and finding ways to make legitimate the use of agency documents and other grey literature

What can be done to foster a sustained process during the next 2 years as the 2013 NCA report is developed?

Building the NCA into a sustained and ongoing process is one of the major goals of this current round of assessment. Doing this will enable decision makers to make decisions based on the best-available science, will ensure the timely delivery of future reports, and can enable the NCA to act as a platform for civic engagement in America.

The input collected from workshop attendees fell into 5 broad themes: the need to focus the 2013 report on process, the need to create a business plan for the assessment process, the need to listen carefully and widely to people who want to engage, the need to partner with other organizations and existing networks, and the need to find mechanisms of funding. The following comments and suggestions from workshop participants highlight the importance of the process for producing the 2013 NCA report (note: these are individual comments and not a consensus view of the workshop participants):

Focus on the process
- Use the process of producing the report as a way to build partnerships and institutional structures (or networks) that function to inform decision-making beyond the NCA
- Re-focus the 2013 report on process rather than state of knowledge
- Have an explicit framework to support process, and articulate it clearly in the beginning of the process
- Be explicit about roles and responsibilities at regional and national scales
- Establish and name regional partnerships
- Making sure the report details a diversity of views

Create a business plan
- Develop a business plan for the next 2 years, outlining objectives, timeline, division of labor, and standards for carrying out sectors, regions, and other report sections; this can help diminish stakeholder fatigue
- In order to build this business plan, get input and participation from private foundations who have been engaged in climate change communication and work, such as Pew and Packard

Listen, acknowledge, and respond to engaged stakeholders

- Listen to the needs of Native American communities, who are important players that are often not engaged
- Institutionalize two-way feedback between user community and federal agencies to ensure that needs are being expressed and that the federal government and other partners are addressing those needs
- Provide people involved with a sense that they are getting return on their time/investment

Partner with other organizations and utilize existing networks and assessments

- Strengthen support for existing monitoring networks that are at risk but play a key role for assessment, such as USGS stream gages and EPA CastNet
- Coordinate with and integrate into existing planning, process, and assessment projects so the NCA isn't seen as a separate process

Funding

- Every agency should be required to fund a long-term assessment process, and to do this they should leverage existing funding systems
- The NCA should show progress on adaptation, which requires monitoring of indicators; doing this may drive funding for monitoring by creating demand for monitoring info

Other notable points

- Target outreach to the business community and help them develop new business plans for adaptation
- Enhance the emphasis of the 2013 report on the outcomes that are important to end users, and by doing this make the NCA more meaningful
- Once the Federal Advisory Committee is in place, the NCA needs to find ways to expand and/or stagger the terms of participants to establish continuity (i.e., not everyone should rotate on or off at the same time)
- Make sure to have a permanent, web-based mechanism to connect the NCA with decision makers
- Effectively manage media by creating small products continuously over time
- Carefully track how the process emerges in civic society and tell those stories

Some near-term and long-term priorities that the NCA team might pursue in order to make the Assessment a sustained process include:

Near term

- Focus on expanding the term limits of the FAC
- Develop partnerships with existing NGOs, and local and state governments
- Develop a business plan for the next two years
- Develop an explicit framework for the assessment by institutionalizing the process and naming regional and sectoral networks

Long term

- Focus on listening to stakeholders and evaluating their use of Assessment products
- Demonstrate progress on Adaptation in order to spur future demand
- Highlight the usable outcomes of the 2013 report in order to make it more valuable to end users

Question 5:
What types of products would be useful if a sustained assessment process is established and what is the desired timeframe?

There was a lot of overlap between input received for Questions 5 and 6. Answers for Question 5 focused mostly on communication and engagement products and services, not data products and services. This is still a gap for which future data needs should be identified.

Overarching Themes

User Input:
Participants were divided on the amount of input from end users, decision makers and policy makers needed to establish a clear sense of the products that would be useful. The input that has already been received through USGCRP listening sessions and other mechanisms could be collated, recognizing that each stakeholder group will likely have unique needs at different scales. This collation would also help determine if input is balanced, or if there are gaps remaining where more dialogue is needed.

National vs. International:
Given that climate change is a global issue, the NCA is expected to address international implications and provide mechanisms to collaborate more effectively with international groups and communities (e.g., Canada and Mexico on our

borders; coordination with IPCC; and helping to inform the State Department on climate science to support global negotiations).

The PROCESS may be the most important product:
The establishment and implementation of an inclusive and sustained process is likely to be the most important product from the assessment overall. This process would help to:

- Ensure the science produced and assessments conducted answer the needs of decision makers at local, regional, and national levels
- Ease the requirements the next time we need to deliver a report
- Build overall adaptive capacity across the country
- Remind people that climate change could be incorporated into everyday decisions
- Create a mechanism to support continued engagement with various audiences
- Determine what can be provided to address climate change needs of a variety of end users

Categories of Products
Three main categories of products emerged from discussion:

- Research-based and supported products
- Assessment-related products
- Products to support engagement/education/communication/outreach efforts necessary for sustained process (the majority of discussion was focused on the products to support engagement/education/communication/outreach)

Research-based and supported products
Most user communities have requested downscaled information:

- Regionally downscaled scenarios for long-term effects (specific examples were noted and can be made available)
- Improved resolution of seasonal predictions; further discussion needed regarding specific monitoring needs and effective and useful packaging
- Focus on shifts in likelihoods of seasonal and extreme events

Another gap that was identified includes the need to improve data sets on climate vulnerabilities:

- Currently, datasets do not exist on consistent, accessible basis, *but it is critical if we want to do a complete climate assessment*
- We need to look at how to expand and integrate datasets over time

Another specific recommendation was for a "climate savvy" valuation of ecosystem services.

Assessment-related products
An overarching theme was that to be most effective, interim products should be released between the mandated quadrennial report to help sustain the ongoing process, and these products should be more than science products, but also expand to focus on impacts and adaptation strategies. Specific assessment-related products might include:

Framework: There is a strong and immediate need to develop and convey an understanding of the overall the assessment framework. This package will be most effective if it includes a visual diagram explaining the process, a roadmap or decision tree to explain how to move through the system of the assessment, and guidance to help explain how to engage appropriately or to use specific tools. Such products could also be used to help increase understanding of institutional relationships and contacts as people wish to appropriately engage in the process. These could be tailored into informational briefing packages. A concern was voiced over the need to be smarter about how we provide guidance and training on the assessment process, as evaluation of the first assessment found that nobody was aware that guidance documents were available.

Clearinghouse: There is a need for good accounting of impacts across sectors to help pursue a risk-based approach that has been discussed that would help measure losses due to climate change (and possible benefits). It was suggested that a clearinghouse of ongoing activities at multiple scales (national, regional, local, etc.) could help increase awareness of what others are doing, which would ideally help with the coordination of activities, reducing duplication and identifying any gaps to be filled. Such a collection of information could be used in formal and informal education settings to raise awareness of changes that have occurred within communities. Such a clearinghouse could serve as a repository for the case studies discussed below (under "Products to support engagement, etc.").

Evaluation: Evaluation will be very important of the assessment process itself, and should also include evaluation of the implementation of efforts within communities to see what has been successful or not. Similar to the discussions regarding national indicators, it may be helpful to establish process indicators to facilitate comparative case studies. This new approach to the assessment was described as a set of small experiments, and it will be necessary to develop a mechanism to capture what works and what does not.

Products to support engagement/education/ communication/outreach efforts necessary for sustained process

Well-informed communication and engagement strategies are necessary and will be most effective if developed in collaboration with experts in communication of science as well as those familiar with the assessment goals and process.

NCA products will likely focus on both the potential impacts of climate change as well as solutions and options for responding to climate change. However, the presentation of options needs to be done carefully to avoid being policy prescriptive. For example, the NCA could showcase examples of what has happened elsewhere on similar challenges, the monetary and non-monetary costs of the options, and the potential loss of opportunities if there is no action.

Specific product needs are described below.

Case studies, narratives, and stories: Much discussion focused on the development and use of compelling case studies or narratives to help illustrate the impacts of climate change. Stories are also useful for scenario development and future projections. This "evidence-based" information could include case studies or narratives that would help:

- Showcase impacts that are already occurring (e.g., Alaska)
- Capture traditional knowledge that may not otherwise be used
- Help connect the dots between projections and observations
- Allow us to learn from what we're doing – either successes or failures (it is hard to publish failures)

Package information for target audiences: Prepackaged information that improves climate literacy in general could help build understanding of what new information is coming out. UKCIP could be used as a model. Several participants expressed support for the release of NCA products in "layers", e.g., from fact sheets to dense assessment reports and over time, rather than in one big event. This would be more appealing to a wide variety of audiences and the media. They also suggested that efforts should be made to convert the abstract nature of climate change into something that is more concrete that can easily be applicable across sectors and scales. Options for doing this may include:

- Building climate change aspects and information about future climate into existing tools with certain sectors will resonate more because it will be tied to commonalities in the sector and accepted among the community
- Engaging with those in the engineering community and in the regulatory community to develop a revised set of standards (e.g., ASHRAE, IDF standards for how we build, etc.)
- Making communications materials as local as possible (recognizing that this may be difficult due to increased uncertainties surrounding downscaled projections and avoiding being so dire or oblique that communities are left to inaction, despair, etc.)
- Address range of uncertainty and how to incorporate into standards for professional organizations

Mapping and geospatial tools: The development and use of visualization and mapping tools was a consistent suggestion, however, concern was expressed due to potential lawsuits and interpretation of information (observations vs. projections). Examples included:

- GIS maps pertaining to a particular sector (e.g., invasive species maps)
- Vulnerability mapping or impact mapping across time
- A potential model suggested was CalADAPT

Need for science translators: There is a need to facilitate the creation of the "next generation" of science translators. Ideas of products and ways to help support that included:

- Mechanisms for universities to incentivize staff to serve as translators
- Establishment of curriculum to build a new generation of translators

- Development of a scholarship or internship program to build the next generation (could be broadened across climate science overall, not just translators)
- Provision of examples of career paths that could result from those students wishing to build these skills

Citizen science: Several participants suggested developing mechanisms and standards to encourage the use of citizen science. For example, students at various levels could contribute to the assessment process (benefit = free labor with a deadline) by working on coordinated projects on locally or regionally relevant issues. Standardization and coordination across participating organizations would be necessary.

Informal Education: There were suggestions to improve our outreach to and partnerships with organizations that do informal education. Specific examples included development of traveling exhibits on climate change that could be transported to less resourced areas or assistance with making the science interesting to audiences.

Other: Other suggested communication/education/engagement products include:

- A marketing plan that highlights why climate change is important and what can be done
- Use of a mascot (e.g., litter bug, leaf car commercial, Smoky the Bear, etc.)
- "Train the trainer" products that could be used for network building with key environmental organizations, professional organizations, community-based organizations, extension services, etc.
- Translation of materials into different languages
- Publication of articles in the business literature (about issues, process, etc.) may spark discussion with this critical group
- Inclusion of climate change into textbooks for training (e.g., as was done for architecture in Australia)
- Targeted media releases as a trickle of reports or products rather than one big event
- Applications for handheld devices (e.g., apps.gov and GSA's ongoing competition)

Question 6:
What types of engagement and communications are needed to support and foster a sustained assessment process? Who are the stakeholders that need to be engaged in the assessment process; when and how should they be engaged?

Some participants suggested that the engagement strategy should consist of an evolutionary process, tracking the changing interests, information needs, and perspectives of stakeholders. Key to this process is identifying the stakeholders and deciding whether it is most effective to engage with everybody (i.e., the general public) or target audiences. Many participants suggested that the NCA engagement strategy should focus on people who have the ability to act and those who have demonstrated interest and want to be engaged. However, there was also a sense that it is important to reach out to those who do not necessarily see themselves as climate stakeholders, such as those in the private sector, and those who do not currently accept the scientific consensus on climate change, and engage with them in a way to shift their perspectives.

Who to engage?
The list of people to engage could potentially extend to the entire population of the United States, thus participants suggested particular groups that could help with outreach to larger groups and specific types of stakeholders that are important to engage with. These include the following:

- Professional societies (e.g., Association of American Geographers, the Association of Climate Change Officers, Council of Environmental Deans and Directors, Association for the Advancement of Sustainability in Higher Education)
- Federal counterparts, especially in the defense and intelligence communities (e.g. Army Corps of Engineers, FEMA, Homeland Security)
- NGOs and community-based organizations
- Think tanks, foundations, and other grant-making agencies or entities
- Federal, State, Local, and Tribal Governments, including through governors associations, mayors councils, and individual politicians
- Private sector/Business community, including through chambers of commerce and affected commodity groups (e.g., wine growers)
- Groups and investors that have existing projects (e.g., adaptation plans, mitigation efforts)

- Scientists, meteorologists, climatologists
- Social science and communications communities
- Arts community
- Academic community and extended networks
- Indigenous communities, including through tribal colleges
- Vulnerable populations
- International community, including other countries doing similar assessments
- Opinion leaders (e.g. military, agriculture, business, religious groups, hunters)
- The natural resource community, extension agents, outdoor groups, and hunters
- Students, youth, groups such as 4-H and student conservation groups
- New media experts, newscasters, bloggers

How to engage stakeholders?
Many participants stated that stakeholder engagement should focus on solutions, rather than using science as the central theme. The NCA could engage with people through issues that are personal to them, connecting to what they value. The NCA also will also be most effective if it measures communication effectiveness and clearly define the desired outcomes early in the process. Suggestions from the workshop participants regarding ways to engage stakeholders include:

NCA's role:
- Develop a leadership structure within the NCA to develop/implement the strategy, and make this a permanent position connected to the NCA, including expert communicators within the leadership structure
- Facilitate and define interactions and provide support
- Create partnership agreements and MOUs
- Provide training and tools for groups to communicate with their networks, including training the media about how to talk about climate change

Communication/messages about:
- Sustainability
    - Show links with climate change
    - Message about engagement beyond climate change and about a sustainable future
    - May need better definitions
- Values of resources and commodities affected by climate change
- Help people understand why climate is relevant to them (e.g. help the business sector see opportunities in climate change)
- Thinking in terms of risk management strategy, and think in terms of opportunities rather than all the negative aspects

Approaches:
- Two-way communication and engagement – moving beyond "public affairs" approaches used by many agencies toward engaging technical experts and drawing on lessons from social science; capacity building within groups
- Social media, webinars
- Two-way story-telling – provide the stories and narratives to these groups and receive information from groups about how NCA can help them build upon what they are already doing
- Track changing abilities/interests of stakeholders through time
- Map capacity and potential of professional societies and groups that already have efforts in place and reach out to the extension networks
- Systematize different degrees and levels of engagement
- Have frequent updates and announcements about NCA activities that create public anticipation

A common theme among the suggestions from the participants was that NCA could benefit in many ways from a permanent engagement process and by designating long-term positions throughout the regions and sectors. The NCA can serve as a vehicle for civil engagement; therefore, the engagement process will need to focus on listening to, and asking, stakeholders about their perspectives and ideas, building partnerships, and knowledge sharing.

VI. Conclusion

Many valuable insights were obtained from the workshop participants and several important themes and ideas emerged during the workshop about the design of regional, sectoral, and cross cutting topics for the NCA. The participants expressed a lot of interest in a "flexible" approach to setting regional boundaries, which was not the design of previous U.S. climate assessments. There was also considerable interest in having a standard approach for handling regions and sectors to promote an information base for the Assessment

that was both consistent and scalable. Many overarching, frequently repeated recommendations concerned the need for the Assessment to address cross-cutting topics, such as water, energy, and land; ecosystems, agriculture, and carbon/nitrogen cycles; coastal ecosystems and development; and urban infrastructure and health. The emphasis of the workshop comments on engaging stakeholders in the design of the NCA and at strategic points in its development cannot be overstated.

This workshop report, coupled with the three white papers prepared by INCA Task Force members prior to the workshop, should be useful in the design of the regional, sectoral, and cross-cutting themes for the NCA. The importance of a sustained assessment capacity was underscored in many comments during the third day of the workshop – to improve continuity and accuracy, to more effectively engage stakeholders, and to increase the efficiency of producing Federally-sponsored climate assessment reports.

Appendix A: Agenda

National Climate Assessment (NCA) Workshop on Planning Regional and Sectoral Assessments

November 15-17, 2010
U.S. Geological Survey Dallas Peck Auditorium
12201 Sunrise Valley Drive
Reston, Virginia

Monday, November 15 (Plenary)

8:00 am **Continental breakfast and registration** (please arrive between 8:00 am and 8:45 am to allow time to go through USGS security; a complementary shuttle is available at the Sheraton Hotel to transport you to USGS)

9:00 am **Welcome and charge to the workshop** – Matt Larsen (Associate Director for Climate and Land Use Change, USGS) and Virginia Burkett (Science Advisor for Climate and Land Use Change, USGS)

9:15 am **NCA mission, strategic plan, Federal Advisory Committee, and progress to date** – Kathy Jacobs (White House Office of Science and Technology Policy)

9:45 am Role of the NCA within USGCRP and some lessons learned from prior assessments – Tom Karl (Chair CENR Subcommittee on Global Change Research, NOAA) and Jerry Melillo (Woods Hole Marine Biological Laboratory)

10:15 am **Break**

10:45 am **Structure, timeline, products and stakeholder engagement for the first two national assessments** – Tom Wilbanks (DOE) and Tony Janetos (University of Maryland, Pacific Northwest National Laboratory)

11:15 am **Critical Connections with other NCA methodological workshops** – Bob Vallario (DOE)

11:30 am **Necessary Scenarios to Support the Regional and Sectoral Analyses for the NCA** – Richard Moss (Pacific Northwest National Laboratory) and Linda Mearns (NCAR)
Noon Lunch on your own, USGS cafeteria

1:00 pm **International and Indigenous Connections** - Don Lemmen (Natural Resources Canada); Chris Field (IPCC, via webex); John Vitello (Bureau of Indian Affairs)

2:15 pm **Selected stakeholder and decision maker perspectives on building long-term assessment capacity** – Jim Lopez (HUD), Heather Cooley (water), Guido Franco (energy)

3:00 pm **Break**

3:30 pm **Review of 3 draft white papers for this workshop** – format and expected products from the next 3 days regarding: regional assessments, sectoral and cross-sectoral assessments, and sustaining the assessment process

4:15 pm **Plans and logistics for Day 2**

4:30 pm **Public Comment Period**

5:00 pm **Adjourn**

Tuesday, November 16 (Regional and Sectoral Working Groups)

8:00 am **Continental breakfast**

8:30 am **Plenary presentations** by Kathy Jacobs (OSTP), Virginia Burkett (USGS) and Nancy Walters (USDA Forest Service) about regional and sectoral components of the assessment and plans for working groups

9:30 am **Break**

9:45 **Working Groups convene in assigned rooms**

11:40 am **Lunch on your own**, USGS cafeteria (facilitators start preparing their report out)

1:00 pm **Working Groups reconvene** in assigned rooms and complete work

2:40 pm **Break**

3:00 pm **Plenary session**, Nancy Walters (USDA Forest Service) facilitator – Highlights of Working Group results followed by facilitated feedback to the report outs, first from other breakout groups and then everyone

4:30 pm **Plan for Day 3 and Adjourn**

Wednesday, November 17 (The Sustained Assessment Process and Timeline)

8:00 am **Continental Breakfast**

8:30 am **Plenary Session in Auditorium**, Emily Cloyd (USGCRP) moderator – review of 1) the white paper on the sustained assessment process and 2) the timeline for the 2013 NCA

9:00 am **Overview of 2 examples of sustained national assessments**: Mark Howden (Australia Climate Adaptation Flagship) and Richenda Connell and Cynthia Rosenzweig (United Kingdom Climate Impacts Program)

9:30 am **Instructions for small groups**, Nancy Walters (USDA Forest Service)

9:40 am **Break** – start with coffee at each World Café location

10:00 am **Sustained Assessment Process Working Groups** (participants will divide into four groups, which will circulate through a number of stations to answer questions about developing a sustained assessment capacity and build on the answers that have come before)

Noon **Lunch on your own**, USGS cafeteria

1:00 pm **Sustained Assessment Process Working Groups continue**

2:30 pm **Closing session** - Report out from Sustained Assessment Process Working Group leaders and Next Steps

3:00 pm **Adjourn**

Synthesis Team Members – Please plan on meeting from 3:00-5:00 pm on Wednesday and 8:30 am – Noon on Thursday.

Appendix B. Members of the Workshop Synthesis Team.

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