

## Building a sustained climate assessment process

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**Abstract** The leaders and authors of the Third US National Climate Assessment (NCA3) developed new modes of engaging academia, the private sector, government agencies and civil society to support their needs for usable, rigorous, and timely information and better connect science and decision-making. A strategic vision for assessment activities into the future was built during the NCA3 process, including recommendations on how to establish a sustained assessment process that would integrate evolving scientific understanding into decision making to manage the risks of climate change over time. This vision includes a collaborative assessment process that involves partnerships across a diverse and widely distributed set of non-governmental and governmental entities. The new approach to assessments would produce timely, scientifically sound climate information products and processes, rather than

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focusing on the production of single quadrennial synthesis reports. If properly implemented, a sustained assessment would be more efficient and cost-effective, avoiding the painful and time-consuming process of beginning the assessment process anew every 4 years. This ongoing assessment would also encourage scientific and social innovations and explore new insights and opportunities, building the capacity to advance the development and delivery of climate information to meet societal requirements and benefit from scientific opportunities.

## 1 Introduction

As communities across the nation find themselves coping with evolving climate change impacts, decision-makers are increasingly focused on adapting to both familiar and unexpected challenges. The US federal government has conducted a series of climate assessments to synthesize the state of knowledge about physical climate science and impacts. Historically, the assessments have often been more valuable to the scientific community than decision makers; delivering usable, rigorous and timely information has been difficult. The Third National Climate Assessment (Melillo et al. 2014) developed new modes of engagement between the government, academia, the private sector, and civil society for connecting science and decision-making. The experience of the NCA3 suggests that assessments of both scientific progress and the implications for managing risk, when undertaken on an ongoing and strategic basis, can improve the connections between research agendas and practical applications.

In the initial organizational stages of the NCA3 there was extensive discussion throughout the US climate assessment community about how to improve the overall outcomes of assessment activities. Many in this community had volunteered to participate in past assessments and had reached a broad conclusion that a longer-term, more sustained approach to conducting assessments over time would be more efficient and generate multiple benefits. The vision of building a sustained climate assessment process, now reflected in the Strategic Plan (National Science Technology Council 2012 for the US Global Change Research Program (USGCRP), is aimed at increasing the program's ability to effectively and efficiently support the expanding needs for decision-relevant information.

This vision of a sustained assessment process centers on empowering civil society, the business community, and multiple levels of government with knowledge needed to more effectively manage the risks of climate change. It includes sustained dialogue with users to better understand decision contexts and information needs (and hence novel ways for users to interact with Federal agencies), preparation of a wider range of products, continued innovation in communication of information about climate change risks and opportunities, and additional efforts to build capacity to decentralize assessment across a diverse and widely distributed set of non-governmental entities and multiple levels of government. This assessment process would produce timely, scientifically sound climate information products, systems, and processes to support decision-making across the nation, building the capacity to *advance* the development and delivery of climate information to meet societal requirements and benefit from scientific opportunities.

This article provides background on historical approaches to US National Climate Assessments, lessons learned from them, and the rationale for a sustained assessment process. It concludes with discussion of the challenges involved in building and evaluating a sustained assessment, including suggested metrics of success. The discussion also considers the recommendations of the National Climate Assessment Development and Advisory Committee

(NCADAC) in its Special Report, *Preparing the Nation for Change: Building a Sustained National Climate Assessment* (Buizer et al. 2013). The authors of this article all contributed to that Special Report, and are not disinterested parties.

## 2 Previous US national climate assessments

The Global Change Research Act of 1990 (GCRA) requires a scientific assessment, including projections of future climate conditions and evaluations of remaining uncertainties, to be completed at least every 4 years by the US Global Change Research Program (USGCRP). However, only three NCA synthesis reports have been completed in the intervening years between 1990 and 2014. There are a number of explanations for why the quadrennial reporting requirements have not been met, including the fact that comprehensive, multi-sector assessments are difficult to conduct; the politics of climate change and funding issues within federal agencies are also factors. Despite earlier efforts to establish an ongoing assessment program, there has been limited institutional support to plan and implement these assessments in an ongoing and strategic manner. The experiences of initiating and conducting the first (NCA1) and second (NCA2) national assessment processes provided valuable lessons that informed the development of NCA3.

### 2.1 First and second NCAs

The first two NCAs resulted in reports released in 2000–2001 and 2009; they followed different paths in their development and dissemination compared to the NCA3 and to one another. The perspectives of the participants in previous national climate assessments were important in the design of the NCA3 approach, and the lessons learned in the first and second NCA are worth reviewing here.

The first NCA report, “*Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*” (National Assessment Synthesis Team 2000), was a landmark report on climate change for the US, and consisted of a shorter overview (154 pages, published in 2000) and a large ‘foundational’ document (612 pages, published in 2001). It was the first effort of its kind in the US, and engaged over a thousand contributors and reviewers from academia, government, and public and private sectors. The assessment was developed under the leadership of a National Assessment Synthesis Team (NAST), which was a 14-member committee of experts drawn from academia, government, non-governmental organizations and the private sector. This and all subsequent NCA report development efforts were chartered under the Federal Advisory Committee Act (FACA).

In the development phase of the foundational report (the NCA1 synthesis report), a series of regional and sectoral workshops were conducted, funded by several federal agencies, resulting in reports from 20 regional teams and five sectoral teams and representing an even wider array of contributors. Their reports were reviewed and synthesized by the NAST, and supplemented by additional peer-reviewed material in preparing the foundational document. The synthesis reports were then reviewed by the public and hundreds of experts, including an independent panel formed as a subcommittee of the President’s Council on Science and Technology (PCAST). The development and coordination of this effort was undertaken by staff at the National Coordination Office of the USGCRP, under the direction of the Office of Science and Technology Policy (OSTP) in the White House.

The NCA1 synthesis report drew primarily on literature review and input from national and regional assessment meetings. It included a wide array of contributors, and being the first effort of its kind, significant lead-time was required. Process initiation to completion of the overview reports took approximately 6 years; following the publication of the reports in 2000–2001 no further regional or sectoral engagement or outreach strategy was implemented and the infrastructure that was established to provide input to and coordination of the NCA was disbanded. The federal government did not distribute the reports widely. The inability to sustain the assessment effort after the reports were completed has been generally attributed to the transition from the Clinton administration to the Bush administration, which re-organized and reoriented the USGCRP into the Climate Change Science Program (CCSP) and a related program, the Climate Change Technology Program.

Although this first NCA was developed by well-established experts following well-vetted internal guidelines for quality assurance and was extensively and independently reviewed, the Competitive Enterprise Institute sued the government over the NCA1 report in 2003. Their legal challenge was based on the supposition that the NCA1 did not adhere to the recently adopted Data Quality Act (also known as the Information Quality Act). The case was later dismissed.

For the NCA2, a wholly different approach was employed. The strategic plan of the USGCRP (then known as the CCSP; USGCRP 2003) identified five research goals, ranging from extending knowledge of the Earth's past and present climate (emphasizing climate variability), to better characterizing uncertainty, to promoting decision support within the limits of knowledge. A series of 21 topically focused Synthesis and Assessment Products (SAPs), grouped under these strategic goals, were produced between 2006 and 2009 according to guidance criteria provided by the CCSP Coordination Office. These criteria were consistent in some instances with NCA1 (e.g., public review was required), but stakeholder engagement was not required in the development of the SAP reports themselves. It took 6 years to produce all of the individual SAPs, following long discussions about which agencies would be responsible for facilitating which report, how each would be conducted and funded, and when to form FACA committees. The CCSP website documented the progress of each report and made them available for public comments.

The SAPs were scientifically rigorous and wide-ranging in their topical coverage. They were designed to fill important knowledge gaps and answer specific science questions, most of which were priorities for federal agencies and administration policy makers. The SAP reports were written by experts and subjected to relatively transparent review processes, but were not intended to provide a comprehensive national evaluation of impacts. A 2007 lawsuit brought against CCSP seized on this issue and resulted in a judgment that the SAPs did not meet GCRA legal mandates. This led to preparation of a synthesis NCA report (Karl et al. 2009) which was developed within a year by a 31-member committee of federal and academic authors. The process included review by an expert panel and an open review process but limited stakeholder engagement. The Obama administration accepted the report and released the 188-page document, *Global Climate Change Impacts in the United States*, in 2009. The report release was followed by very limited outreach and communication efforts, resulting in the NCA2 not being widely known.

The first two NCA synthesis reports were both of high scientific quality, provided information that filled knowledge gaps, and made information accessible to non-experts. Both assessments emphasized regional findings. The major differences between the two were the degree to which stakeholders were involved in the process and the design of information flow

from the underlying reports to the synthesis report. For example, because the NCA2 SAPs did not cover all US regions or even all of the sectors required by the GCRA, the committee placed the SAP findings into a more cohesive regional and sectoral structure. Neither NCA1 nor NCA2 assessment development infrastructure was maintained beyond the release of the synthesis reports.

## 2.2 The third national climate assessment

From the beginning of the NCA3 process, the USGCRP agencies and the broader science community (through the National Research Council and other venues) were interested in building an efficient, ongoing enterprise of learning and engagement. However, engaging stakeholders, understanding evolving information needs, building on previous regional or topical analysis, and tracking outcomes (and needed improvements) from the previous NCA processes were initially difficult because the staff and support infrastructure were no longer in place. As a result, the NCA3 process was kicked off with a series of “listening sessions” to help shape a strategic plan for the NCA3 and initiate discussions of a sustained assessment process. Public meetings in Chicago in February 2010 included a “Midwest Regional Workshop” and a “Strategic Planning Workshop” (USGCRP 2010a, b).

The Chicago discussions included conversations about the audiences for the assessment, its mission, goals, and principles, and identifying what (limited) assessment activities were already underway within agencies and across the US. Some of the key insights that emerged from the Strategic Planning workshop were: 1) the need for the NCA to support both adaptation and mitigation decisions; 2) the importance of seeing the NCA as both a process and a set of products; 3) the need to do a significantly better job identifying regional issues and engaging with stakeholders than previous assessments had done; 4) the need to support science translation and “boundary-spanning” activities; 5) the importance of establishing metrics that relate to informing policy and supporting decisions; 6) the need to balance “scholarly” contributions with decision relevance; 7) the importance of a phased, sustained approach to ensure timeliness of future products; 8) concerns about finances and how that might constrain the process; 9) the importance of an inclusive vision (reaching outside of the federal agencies); and 10) the need for co-ownership of the assessment activity with external partners. Improving the accessibility of findings and the need to coordinate with the needs and assets of federal agencies were also topics of significant discussion.

Importantly, the Strategic Planning Workshop report (USGCRP 2010b) contained a significant section on “Building an Enduring Assessment Structure,” including the following priorities (paraphrased from the workshop report):

- Identify and engage stakeholders from the beginning
- Identify and prioritize stakeholders’ needs
- Map existing capacity and capabilities
- Move from a focus on vulnerability assessment to building resilience
- Develop data, observations, and trusted sources
- Develop a strategy for communication early in the process

The discussions at this early workshop, the development of the actual NCA3 process, and the final recommendations of the federal advisory committee (NCADAC) in the Special

Report on how to sustain the assessment process (Buizer et al. 2013) are remarkably consistent, with a strong focus on the value of building a sustained assessment process.

### 3 Benefits of a sustained assessment process

The changes underway in climate and weather systems are driven by a range of complex processes and feedbacks. Managing the increasing pace of change and the associated consequences requires actionable, up-to-date information. Although scientific understanding of the climate system is improving, resource managers, businesses and private citizens often do not have the information they need to support decisions about managing greenhouse gas emissions and managing the risks associated with changes that are already occurring, let alone those projected for the future. There is demand for data at the scale of decisions – often this means at the community scale – and for more timely access to credible and actionable scientific information.

The primary benefit of a sustained assessment process is the establishment and maintenance of ongoing dialog among potential users and producers of scientific information needed to support national and global efforts to manage risks to both people and planetary life support systems. An ongoing, distributed assessment process can leverage improvements in both scientific rigor and the salience of findings. It can provide pathways for moving the science produced under the auspices of the USGCRP to civil society, the private sector, state/local governments, and regional entities who can apply this information to evaluate the potential implications of global change for their own interests. Without the establishment of a sustained process that harvests information from multiple knowledge systems and channels, information would need to flow through a centralized, government-driven process, which is less likely to be able to meet these diverse information needs.

### 4 Building a sustained assessment process

From its formation, the NCADAC was tasked with both developing the NCA3 synthesis report and providing advice to the government on how to build a sustained assessment process. According to its charter, “The committee’s mission is to synthesize and summarize the science and information pertaining to current and future impacts of climate change upon the United States; *and to provide advice and recommendations toward the development of an ongoing, sustainable national assessment of global change impacts and adaptation and mitigation strategies for the Nation*” (emphasis added). Accordingly, the NCADAC decided to include a discussion of the rationale for a sustained assessment process as a chapter of the final NCA3 synthesis report and also to prepare a Special Report advising the government on how and why such a process should be established.

#### 4.1 A new vision and process for climate change assessments: special report on the sustained assessment

Preparation of the special report was assigned to an interdisciplinary subcommittee of NCADAC members. The authors drew on a number of National Research Council reports, reviews of prior assessments, and their own experiences interacting with users, Federal officials, and members of the research community.

The recommended vision for the sustained assessment is creating.

“...an **inclusive, broad-based, and sustained process** for assessing and communicating scientific knowledge of the vulnerabilities, impacts, risks, *and opportunities* associated with a changing global climate in support of decision-making across the United States.

supporting the goal to.

“Enhance the ability of *decision-makers at multiple scales throughout* the United States to **anticipate, mitigate, and adapt** to changes in the global environment.”

Clearly this vision required something more than continuous production of NCA- and IPCC-like reports. In fact, at its core, the goal and vision for the sustained assessment involved broadening the assessment process beyond the Federal government – to engage and empower decision makers throughout society to use the best available scientific information to come to terms with climate-change risks, opportunities, and uncertainties. And, as described in the report, it envisioned making a more diverse set of products available (including data sets, maps, indicators, evaluations of decision support science, and others) through various communication mechanisms involving ongoing interactions among producers and users of scientific information.

The Special Report (Buizer et al. 2013) was formally submitted to the government in October 2013, in advance of issuance of the final synthesis report. It suggests how to develop a more efficient and strategic ongoing process, as well as programmatic approaches and investments that could significantly enhance both the utility and the scientific rigor of future processes. As the Special Report notes,

“a sustained process offers the opportunity for planning and investment decisions to be more deliberate and phased in over time...(allowing)...the US government (to) more efficiently support the science and adaptation needs of federal agencies; and provide transparent access to data at a variety of scales for private businesses, local/state/regional/tribal governments, and other organizations that are planning for the future.”  
(p.7)

It also points out that “a strong federal commitment to documenting and anticipating both the positive and the negative aspects of climate and global change demonstrates leadership that can further encourage broad non-governmental engagement....and allow greater efficiency in development of assessment products” (ibid.).

The specific recommendations of the Special Report, grouped into four categories below, are discussed in detail in the report, along with criteria for prioritization of assessment efforts.

- a) *Establish mechanisms to support enduring collaborative partnerships that sustain assessment activities*: this was seen as a central challenge because it requires USGCRP and participating agencies to develop unprecedented long-term relationships between the research community and decision makers. The report describes engagement, communication, and partnership opportunities that provide ‘co-production’ capacity.
- b) *Enhance and organize the scientific foundations for managing the risks and opportunities of climate change*: this section focuses on integrating fundamental scientific knowledge with decision support processes to develop new products and tools that support



assessments and create new knowledge systems to link scientists and information users. These products and systems include:

- methods for vulnerability assessment and risk management;
  - development of indicators of change, scenario methods and products, and valuation methods;
  - ways to incorporate climate-related international influences on the US;
  - methods for assessing confidence and uncertainty;
  - adaptive learning within assessment processes;
  - identification of risk management information needs
- c) *Provide infrastructure to support a sustained assessment process*: this section describes a variety of ‘infrastructure’ needed for sustained assessment including good leadership and a strong coordination office, processes to support preparation of several different types of reports, data and information management systems, and regional institutions and networks; and
- d) *Diversify the resource base and set priorities*: this was seen as both an opportunity and necessity – establishing an opportunity to draw on a wide range of resources from the private sector and civil society; it is also viewed as a necessity in light of constrained federal resources.

## 4.2 Innovations of NCA3 that inform a sustained assessment process

The NCA3 process included a number of innovations that provide valuable ideas and insights for transitioning to a sustained assessment. These included development and promotion of guidelines to encourage ‘risk-based framing’ to identify climate-related impacts of high consequence; attempts to improve assessment and communication of levels of confidence and improve transparency of author team deliberations through preparation of ‘traceable accounts’ that explain the author’s thought process and sources for key findings; and development of scenario approaches that incorporated lower probability events (for sea-level rise) and that encouraged participatory scenario planning to explore implications of uncertainty. Several of these innovations are discussed in other chapters of this volume. We emphasize here two innovations related to expanding the information base for the assessment and improving online delivery of information and access to underlying data:

### 4.2.1 Peer-reviewed publications vs. information quality act innovations

In the effort to enhance the relevance of process and products for decision-makers, the NCA3 authors were asked to go beyond the standard academic literature where necessary or possible to illustrate impacts, provide case studies, or integrate important new insights. In many instances they found government documents and other sources of highly reviewed information that were viewed as credible by subject experts; these were relied upon to support important conclusions. In other cases, the authors found information that was extremely useful in case studies and other illustrations of climate change impacts and responses, but considered less reliable from the perspective of supporting scientific conclusions themselves.



In anticipation of concerns about the use of non-traditional sources of information for the NCA3, a separate subcommittee of the NCADAC developed guidance on how to manage the requirements of the Information Quality Act while incorporating some non-traditional literature (USGCRP 2011). This guidance was crucial and helped set expectations about sources of information for all the authors and the government reviewers. There were occasions during the review process when specific sources were challenged, but in all cases a resolution was found that allowed the findings to be included appropriately. This is particularly important in light of proposed long-term partnerships with non-governmental external parties who would like to play a role in the ongoing process, and who particularly value some sources of information (such as information about the current status and success of adaptation projects) that is unlikely to be updated on a regular basis through the peer-reviewed literature.

#### *4.2.2 Online delivery and transparent access to underlying data*

A dramatic change between the NCA3 and its predecessors was its electronic delivery via an interactive (and attractive) website. This meant that all of its contents were searchable online and that all of the evidence behind the findings could be linked rather than just cited in a bibliography. The fact that the interagency Global Change Information System was built by USGCRP as a means to support and deliver the NCA3 synthesis report marks a major transition to a new era of information access that reaches far beyond the NCA because it can facilitate ongoing data-sharing and analysis across agencies and support subsequent NCA reports. Advances in information technology, information systems, author support platforms, and web-based search functions used in the NCA3 process have permanently changed the way assessments will be conducted. Sustained assessment is much more viable in the context of automated submissions, online review, electronic reports, and high-volume data-management systems (Waple, [Submitted for publication in this special issue](#)).

## **5 Such a good idea – so hard to implement!**

There are many barriers to creating a permanent, sustained assessment process; the majority of them relate to concerns about the word “sustained.” Under current federal budget constraints, it is hard to agree across multiple federal agencies to any kind of ongoing expenditures, even for a program that is congressionally mandated. Some federal agencies and program managers within the USGCRP have expressed concern about exactly what a sustained assessment might entail. The word “sustained” could be understood to mean maintaining the same level of effort required for the extremely involved NCA3 process and its very large participant list. However, the Special Report (Buizer et al. 2013) and the USGCRP Strategic Plan (National Science Technology Council 2012) note that efficiencies can be achieved through a well-planned, ongoing process, while also improving products, regardless of the size of specific assessment efforts. There are also uncertainties about the extent of the ongoing role of non-federal participants and contributors in a process that is fundamentally a government responsibility, especially given the constraints of FACA, which governs the degree to which non-federal groups can provide consensus advice to the government on an ongoing basis. Other barriers to progress include issues associated with leadership, resistance to change, and governance issues.

## 5.1 Budgetary constraints

There has never been a budget line for the USGCRP Coordination Office itself or the NCA process, even though preparation of these reports is a federal mandate for the USGCRP. At the start of the NCA3 effort (in FY 2010) funding was identified by the Office of Management and Budget within one agency (NOAA) as its contribution to the collective assessment process, but other agency contributions were not specified. In part, the need for building financial support across the agencies has a positive effect – it reinforces their “ownership” of the processes and products jointly created. However, having no explicit interagency budget line for the NCA means that existing agency programs need to be leveraged and/or “taxed” to support the assessment. The lack of sufficient ongoing funds to support the sustained assessment remains a significant challenge.

Importantly, federal program managers operate in an environment of constantly increasing expectations on a fixed (or in some cases, decreasing) budget. In this context, it would be understandable if they saw investments in the NCA as one more unfunded mandate. It is much easier to start new programs that are additive (bringing in new resources) than to engage in a zero sum game. Understandably there was some reluctance to fund NCA3 activities under highly constrained fiscal conditions. Despite this challenge, federal managers involved in the NCA3 clearly embraced the general role of assessments in the scientific process.

Based on personal communication with program managers, there are clear differences between internal assessments of agency program outcomes and broad-scale assessments that are highly vetted like the NCA3. The multiple levels of review in NCA processes add significant credibility to the outcomes. In the NCA3, the number of topics involved, the array of participants, the intersections of physical and social science, the multiple geographic scales of evaluation, and the time frames for future projections mandated by law all added cost and complexity. But the benefits of the NCA3 process were well recognized by federal leadership, particularly by those who represented their agencies in the interagency NCA working group that helped build and manage the process on a day-to-day basis.

## 5.2 Losing control

One barrier to conducting highly transparent, broad-scale assessments with significant stakeholder engagement is the potential for loss of control for the federal participants. Including on-the-ground managers and stakeholders from regions and sectors in assessment processes leads to new sources of information that may challenge conventional approaches to science and to its interpretation. For example, some federal agency representatives expressed concerns during the development of the NCA3 process that, given the political nature of climate issues, strong engagement with stakeholders could lead to a potential loss of control over the process itself. Many federal program managers have had negative experiences in public meetings with confrontational individuals, inaccurate press reports, or other consequences of poorly designed engagement strategies or unforeseen events causing unexpected outcomes. There is justifiable anxiety about government and scientific processes that are conducted in a truly public arena. It is not surprising that there could be reluctance to engage in a major way with stakeholders.

However, there is also broad acknowledgement that the federal government’s conduct of comprehensive assessments can and does benefit from the input of external parties and on-the-ground knowledge. Multiple previous reports (e.g., NRC National Research Council 2007, National Research Council 2009, National Research Council 2010) have noted that

assessments benefit from more interactive, inclusive processes. The federal government simply does not have all of the kinds of expertise required to evaluate the risks and opportunities associated with climate impacts. However, broadening the assessment effort to incorporate multiple sources of knowledge, including traditional ecological knowledge and the perspectives of private and public sector managers within regions and sectors, is challenging (see Jacobs and Buizer, this issue).

Possibly the most important scientific opportunity associated with expanded participation in assessment activity is the potential change in scientific understanding that can come from sharing information across multiple scientific disciplines and practitioner perspectives, access to new data sources, and changed research agendas. The trend toward integration of multiple kinds of knowledge has led to activities such as “Integrated Assessment Modeling” that work towards predictions of future conditions while taking into account many different sources of data and knowledge. Risk-based framing, an interdisciplinary approach that considers biological, social, physical, and health impacts, helped NCA3 authors identify gaps in knowledge that need attention from the scientific community. While such approaches can challenge the views and investments of more conventional science, the resulting improvements in scientific understanding have great potential for societal benefit.

### 5.3 Partnership opportunities and complexities

As recommended in the Special Report, any ongoing assessment process will need to diversify its resource base. A shrinking domestic federal budget, along with expanding demands for services, implies that changes are required.

An ever-increasing number of foundations, private companies, and NGOs are working on climate issues and investing funds in research, education, and communication. Communities that are actively engaged in managing risks are interested in working with the federal government to ensure that assessment processes provide the kinds of data they find most useful and are willing to provide in-kind services or even financial assistance. The amount of activity focused on adaptation planning (Bierbaum et al. 2014) is also increasing. Although the NCA3 found that the level of adaptation activities occurring is not commensurate with the need or future challenges from climate change, it is clear that the interest level in more and higher quality climate information is rising. Using only the measure of the number of hits on the NCA3 website in the first two months since its release (1.5 million) by comparison to previous hits on the USGCRP website following previous report releases (orders of magnitude lower), gives an indication of the expansion of interest.

Because of resource constraints there is a need to leverage existing investments and seek opportunistic approaches that lead to win-win solutions. For example, future quadrennial NCA synthesis reports may not actually drive research agendas, but they certainly can harvest information from agency documents as it becomes available. A properly designed sustained assessment process encourages agencies and contributors to conduct activities and produce products to meet their own needs that are also useful in a subsequent synthesis report.

The Special Report (Buizer et al. 2013) recommends expanding the partnerships that were initiated in the NCA3 process, also noting that doing so might require shared governance of some aspects of the process. The federal government has reason to be cautious about this approach, given the important political and regulatory implications of climate products. In addition, the scientific community has reason to be concerned about the possibility of interference with the process or impacts on the credibility of the findings from some future

partnerships. It is imperative that the credibility of the assessment process be untarnished, yet non-federal resources are likely to be a critical component of most paths to a sustained and useful assessment. A well-designed system of shared governance and information quality assurance can support the construction of credible outcomes from distributed processes that involve both federal and non-federal resources and input, but it will require careful attention to both the appearance and the reality of avoiding potential conflicts of interest.

#### **5.4 Challenges requiring resolution in establishing a sustained assessment**

There is natural tension between the need for government support and engagement in assessment processes and the need for independence from the government, politics, FACA rules, etc. Government often moves slowly and cautiously, while the private sector and non-governmental entities can often shift direction and priorities more quickly. If true partnerships are to emerge, short-term political and economic considerations need to be less prominent than the longer-term needs of the country, the scientific community, and civil society. At some level, the federal government must support a sustained assessment process, not only because of GCRA requirements but because of its own need for accurate and integrated scientific information to support research and decision-making. Clearly the sustained assessment process must meet the needs of the federal government, its major stakeholder, in order to succeed.

However, over more than two decades since the GCRA was passed, the federal government has demonstrated how difficult it is to move past precedent and historic ways of conducting assessments. Ending tiresome debates about process issues and focusing instead on “the art of the possible” is important. For example, the government may need to be both more strategic and more opportunistic in order to leverage work initiated for other purposes that is timely, credible, and useful to stakeholders and the sustained assessment process. It will never be possible to make all assessment process decisions in advance, but rather, a key to success is learning from ongoing efforts and collaborating to identify ways contributions will be most useful. In addition, the government should provide basic guidance to the scientific and user community that facilitates participation – e.g., by providing guidance on how an external party can contribute data or reports for consideration in a future assessment, including how to document data sources, processes, and conclusions so that the products can be more easily used.

### **6 Measuring success of a sustained assessment process**

One way to test whether a sustained assessment is successful is to evaluate progress over time based on established criteria (the Special Report includes suggestions for such criteria). We offer additional criteria here for consideration. For example, can future report processes meet the four-year deadline? This is one (admittedly limited) way to test the Special Report’s assertion that a standing advisory committee, an ongoing set of interim reports to harvest from, a well-trained staff, and well-defined external partnerships can result in a more efficient process. Second, is there a documented increase in demand for products, including the full range of electronic and hard copy products as well as the less traditional products and data that are expected to be of interest to decision-makers? Third, is the engagement enterprise widely perceived as successful? This would include a review of the expectations and performance of external partners and funders in a broadening array of partnerships, as well as internal

engagement efforts. For example, a metric could be the number and quality of partnerships, measured in terms of numbers of people engaged, types of engagement, and documented applications of the information produced. And fourth, is the process linked on an ongoing basis to federal and external partners' research agendas?

A critical component of success in the sustained assessment process is whether it is perceived to be truly owned and supported by its parent organization, the USGCRP, relevant USGCRP agencies, and the named partners in the process. Evidence could include ongoing support for developing indicators of change, development of useful and timely scenario products, or improvements in the functionality of the website and the data management system. Metrics could also include staffing levels, agency use of assessment products, and the quantity and quality of technical input documents submitted for consideration. To assess success in the eyes of external parties, evaluation by independent NCA partners and information users should become an integral component of the process.

Different measures of success may be needed over different time frames, from the short term to the long term. Metrics could focus on issues related to process, outputs/products, and outcomes. Agreeing on what success looks like in a broad, multi-party, multi-objective process is very difficult. Key considerations include:

- One measure of success would be to examine whether the NCA process is producing a more diverse set of products – data sets, maps, targeted information on extreme events, evaluations of decision support systems and processes, user forums, and others. Reports will, of course, continue to be a mainstay of the process, but as discussed above (and in Moss, this issue) the growing range of decision contexts and information needs requires an expanded product set.
- After 10 years, success could mean that multiple people and organizations across regions and sectors have used NCA products in their own assessments and data to make decisions. If the sustained assessment is successful, assessment and decision making processes associated with the NCA will be more widely distributed, and tracking this evolution will require ongoing scholarly work demonstrating that the sustained assessment has played a significant role in how decision-relevant science is developed and used in decisions. These metrics of success would require a process to be in place that allows monitoring and study of the process of conducting and building the sustained assessment.
- Measures should capture whether the ongoing process is inclusive and has a more diverse set of players over time. Metrics could include whether states or other countries are following the NCA model; whether local governments, industry and philanthropy are engaging in funding, knowledge creation, and data-sharing; whether ongoing private sector relationships are built around the NCA; and whether a self-identified and self-organized community continues to engage and be part of the assessment process.
- Measures of the degree to which USGCRP and the federal member agencies have embraced the process as a central component of its program activities could be established across agencies, including whether components of the sustained assessment process continue to show up in the strategic plans and budgets of USGCRP; and whether academic partners, private sector interests, agencies and program managers are able to get funding for projects that support “sustained assessment” activities.
- Success can also be measured in terms of engagement of the assessment community, its collective capacity, and its sense of shared accomplishment, whether the premier scientists and stakeholders continue to choose to spend their time on assessment, and whether the

science gaps noted in the Special Report and subsequent assessment activities are starting to be filled.

Ultimately, the success of a sustained assessment should be measured relative to outcomes. If a goal is a more resilient society, an important measure would be linking information in the NCA reports to use of information and, ultimately, to evidence of reduction of risks. In the short term, measures could be more rudimentary; for example, are the agencies and external partners actually using NCA information in managing risk? The US government's ongoing public commitment to an ongoing assessment process would also qualify as a success.

## 7 Conclusions

The experience from the past three national climate assessments suggests that moving toward a sustained assessment model would provide efficiency and effectiveness in responding to decision makers' information needs for climate risk management. It would also enable capacity building that supports climate adaptation and mitigation, encourages innovation, provides new interdisciplinary scientific insights and opportunities, and ensures greater utility of future NCA findings. Establishing an adaptive process designed to test new approaches and continuously evaluate them would improve both the scientific content and the utility of the information products. The NCA3 experience demonstrates that an inclusive approach to assessments can lead to more real-time participation and decision-relevance. Increased engagement, better representation of sectors and scales, political, social and geographic diversity, and a more integrated community of scientists and practitioners who can work together to solve issues of concern to society can all contribute to better risk management strategies.

The NCADAC Special Report recommends the following steps for building an effective sustained assessment process: 1) build mechanisms to support collaborative partnerships, 2) develop the scientific foundations for improving assessments over time, 3) provide adequate and enduring infrastructure (including leadership and staffing), and 4) develop a diversified resource base within and beyond the federal government. There are many successes from previous assessments, but making consistent progress will require trying new approaches, as recommended in these four steps. A properly designed sustained assessment process would *advance* the development and delivery of information in ways that society demands, to manage the risks of the changing climate.

USGCRP faces decisions about the structure, leadership, and scientific underpinnings of ongoing assessments in order to ensure credible outcomes that are useful for managing risk while also meeting the needs of the federal science agencies and broader user community. It is not yet clear whether the USGCRP will seize the current opportunity and use the momentum of the NCA3's success and lessons learned to ensure that its research investments continue to meet the needs of people nationally and internationally, or whether a wide range of factors will be allowed to limit progress. The lessons documented in this special issue provide a foundation for future climate assessment in the US and elsewhere.

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## References

- Buizer JL, Fleming P, Hays SL, Dow K, Field CB, Gustafson D, Luers A, Moss RH (2013) Report on preparing the nation for change: Building a sustained national climate assessment process. Committee, National Climate Assessment and Development Advisory
- Bierbaum R, Lee A, Smith J, Blair M, Carter LM, Chapin III FS, Fleming P, Ruffo S, McNeeley S, Stults M, Verduzco L, Seyller E (2014) Ch. 28: Adaptation. Climate change impacts in the United States: The third national climate assessment, Melillo JM, Richmond TC, and Yohe GW, eds., U.S. Global Change Research Program, pp. 670–706. doi:10.7930/J07H1GGT
- Global Change Research Act of 1990. Public Law 101-606 [S. 169]; November 16, 1990, 104 Stat. 3096-3104
- Karl, TR, Melillo JM, Peterson TC, eds. (2009) Global climate change impacts in the United States: 2009 Report, Cambridge University Press. 188 p. <http://nca2009.globalchange.gov/download-report>
- Melillo JM, Richmond TC, Yohe GW, eds. (2014) Climate change consequences in the United States: The third national climate assessment, U.S. Global Change Research Program, 841 pp.
- National Assessment Synthesis Team (2000) Climate change impacts on the United States: The potential consequences of climate variability and change, report for the US global change research program. Cambridge University Press, Cambridge UK, 154 pp.
- National Assessment Synthesis Team (2001) Climate change impacts on the United States: The potential consequences of climate variability and change, report for the US global change research program. Cambridge University Press, Cambridge UK, 620 pp.
- National Research Council (2007) Board on atmospheric sciences and climate. In: Analysis of global change assessments: Lessons learned. National Academies Press, Washington
- National Research Council (2009) NRC Committee on Strategic Advice on the U.S. climate change science program. Restructuring federal climate research to meet the challenges of climate change. National Academies Press, Washington
- National Research Council Council NR (2010) NRC panel on informing effective decisions and actions related to climate change, informing an effective response to climate change. National Academies Press, Washington
- National Science Technology Council (2012) National global change research plan 2012–2021: A strategic plan for the U. S. Global Change Research Program <http://downloads.globalchange.gov/strategic-plan/2012/usgcrp-strategic-plan-2012.pdf>
- USGCRP (2003) Strategic plan for the US Global Climate Change Science Program, at <http://www.globalchange.gov/about/strategic-plan-2003/2003-strategic-plan>
- USGCRP (2010a) In: The United States National Climate Assessment NCA report series, vol 1: Midwest Regional Workshop: Feb. 22-24, 2010, Chicago. Illinois, USGCRP
- USGCRP (2010b) The United States National Climate Assessment NCA report series, vol. 2: Strategic Planning Workshop. USGCRP
- USGCRP (2011) Information Quality Principles, at [http://www.globalchange.gov/sites/globalchange/files/Information-Quality-Principles-Draft\\_2011-11-16.pdf](http://www.globalchange.gov/sites/globalchange/files/Information-Quality-Principles-Draft_2011-11-16.pdf)
- Waple, A. (submitted for this issue) Innovations in Information Management and Access for Assessments. Climatic Change