

Appendix 1. Report Development Process

Assessments are essential tools for linking science and decision-making. The Global Change Research Act (GCRA) of 1990¹ charged the U.S. Global Change Research Program (USGCRP) with a legal mandate to conduct a scientific assessment on the effects of global change not less frequently than every four years; the third and most recent National Climate Assessment (NCA) was released in May 2014.²

NCA Goal and Vision

In fulfillment of this mandate and in support of its Strategic Plan,^{3,4} USGCRP coordinated this Fourth National Climate Assessment (NCA4), which focuses on advancing our collective understanding of how climate change poses risks to things of value to society. Much of the NCA4 process builds on the Third National Climate Assessment (NCA3),² and thus much of this process description is derived from that of NCA3. However, several changes have been made in light of lessons learned through an external evaluation of NCA3 (see “What Has Happened Since the Last National Climate Assessment?” in Ch. 1: Overview).⁶ Some of those changes are discussed in greater detail in this appendix.

The vision for the NCA is to continue advancing an inclusive, broad-based, and sustained process for assessing and communicating scientific knowledge of the impacts, risks, and vulnerabilities associated with a changing global climate and to support informed decision-making across the United States.

Legislative Foundations

U.S. Global Change Research Program

Founded by Presidential Initiative in 1989, the U.S. Global Change Research Program aims to build a knowledge base that informs human responses to climate and global change through coordinated and integrated federal programs of research, education, communication, and decision support.

The Global Change Research Act of 1990 cemented into law what was started by President Ronald Reagan. USGCRP is mandated to develop and coordinate “a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict and respond to human-induced and natural processes of global change.”¹

National Climate Assessment

Section 106 of the GCRA requires a report to the President and the Congress not less frequently than every four years that 1) integrates, evaluates, and interprets the findings of the USGCRP; 2) 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; and 3) analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.

Institutional Foundations

U.S. Global Change Research Program

USGCRP is a confederation of 13 federal departments and agencies (Figure A1.1) that supports the largest investment in climate and global change research in the world. USGCRP coordinates research activities across agencies, produces the congressionally mandated products, and provides data and products to inform decisions. USGCRP's Strategic Plan, released in 2012 and updated in 2017, focuses on four major goals: advance science, inform decisions, conduct sustained assessments, and communicate and educate.^{3,4} The USGCRP agencies maintain and develop observations, monitoring assets, data management, analysis of data products, and modeling capabilities that support the Nation's response to global change. The agencies that make up USGCRP are:

Department of Agriculture (USDA)

Department of Commerce (DOC)

Department of Defense (DOD)

Department of Energy (DOE)

Department of Health and
Human Services (HHS)

Department of the Interior (DOI)

Department of State (DOS)

Department of Transportation (DOT)

Environmental Protection Agency (EPA)

National Aeronautics and Space Administration (NASA)

National Science Foundation (NSF)

The Smithsonian Institution (SI)

U.S. Agency for International
Development (USAID)

The Subcommittee on Global Change Research (SGCR) oversees USGCRP's activities. The SGCR operates under the direction of the National Science and Technology Council's Committee on the Environment (CoE) and is overseen by the White House Office of Science and Technology Policy (OSTP). The SGCR coordinates interagency activities through the USGCRP National Coordination Office (NCO) and informal interagency working groups (IWGs).

National Climate Assessment Components

The **NCA4 Federal Steering Committee (NCA4 SC)** consists of representatives of the USGCRP member agencies, listed above. In consultation with the SGCR, the NCA4 SC was responsible for the development, production, and content of NCA4 (Figures A1.2, A1.3). The NCA4 SC was charged with overseeing development of technical content and with conducting high-level scoping of the report to ensure coherence, relevance, and responsiveness to the Global Change Research Act and the USGCRP Strategic Plan. The NCA4 SC was also responsible for ensuring that the report development process was robust and that it adhered to the principles of engagement and transparency that are crucial to the process



Figure A1.1: Logos of the 13 agencies that make up USGCRP.

of conducting sustained assessments. In some ways, the NCA4 SC served in a similar capacity to the National Climate Assessment and Development Advisory Committee (NCADAC) during the course of NCA3 development. The NCA4 SC met weekly during the early stages of the report’s development before moving towards a more quasi-monthly meeting schedule once writing began in earnest.

The **Administrative Agency** of NCA4 was the National Oceanic and Atmospheric Administration (NOAA). In this role, NOAA was responsible for providing oversight and access to federal resources for the NCA, including (but not limited to) leadership on the NCA4 SC, management of Federal Register Notices, and dedicated funding of external engagement activities, among other supportive activities.

Agency Chapter Leads (ACLs) oversaw the production of national-level topic or response chapters and were in charge administratively of their chapter’s development.

Federal Coordinating Lead Authors (CLAs) were selected for each chapter—some chapters had two—by the NCA4 SC, in consultation with the SGCR. A key role of the CLAs was to serve as “horizontal integrators” for NCA4—working with one another to ensure that crosscutting issues were addressed consistently, accurately, and adequately. They also ensured that the chapter draft ultimately delivered to them adhered to their Agency’s criteria for a Highly Influential Scientific Assessment.

Chapter Leads (CLs; both federal and non-federal) served as “vertical integrators” for NCA4, selecting and directing their respective author team and then providing a draft of their chapter to the CLA(s). National Chapter Leads (NCLs), for the topic and response chapters, were selected by the ACL for the chapter, while the Regional Chapter Leads (RCLs) were

selected from experts nominated during a public open call by the NCA4 SC.

Chapter Authors (CAs) constituted the bulk of the chapter author team and were the main authors of the individual chapters. The CLs directed the CAs to contribute to the writing and editing of the chapters. The CLs chose the CAs based on the specific needs of the chapter. CLs were provided guidance to convene a diverse group of experts along with the full slate of nominees received during the public call for authors.

Review Editors (REs) were selected by the NCA4 SC after a public call for nominees. They were responsible for ensuring that all substantive comments—submitted during the Public Comment Period and via a National Academies of Sciences, Engineering, and Medicine (NASEM) expert review panel—were appropriately addressed and documented. REs advised CLs on how to handle contentious issues and to ensure that significant scientific uncertainties were reflected adequately in the text of NCA4.

Technical Contributors (TCs) were invited to contribute to the chapter author team for discrete, specific issues on an as-needed basis, as identified by the CL.

The USGCRP **National Coordination Office (NCO)** in Washington, DC, provided support for the development of NCA4 through a team of contracted staff and federal detailees with expertise in planning, writing, and coordinating collaborative climate and environmental science activities. NCO staff provided monthly updates on NCA4 progress and activities to the SGCR Principals, while also—beginning in February 2017—posting similar content at <http://www.globalchange.gov/news> so the public could track progress.

The **NCA Technical Support Unit (TSU)** is funded by NOAA and is located at NOAA's National Centers for Environmental Information in Asheville, North Carolina; its

professional staff supports the Assessment's climate science findings, data management and web design, graphics and publications, editing, and other production activities.

NCA4 Authorship Models

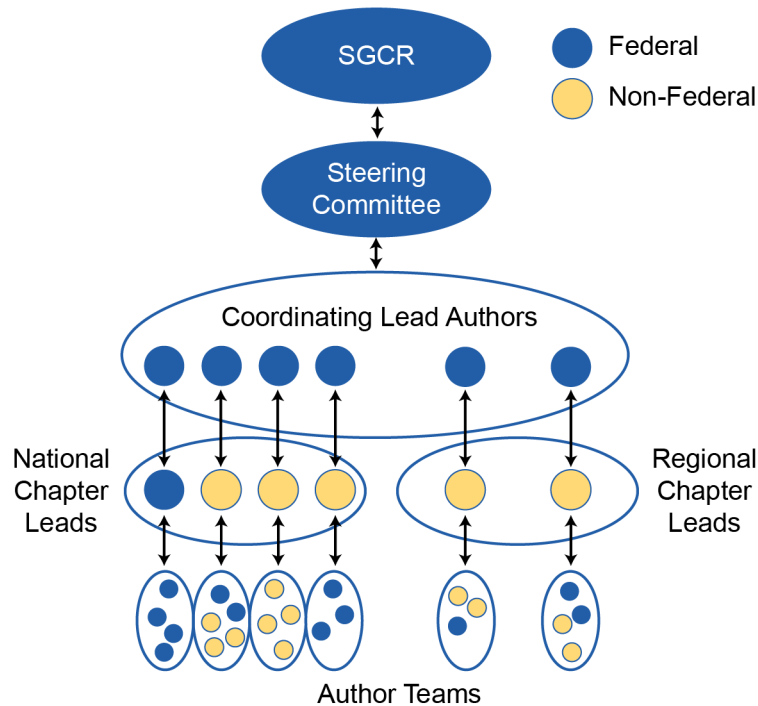


Figure A1.2: In consultation with the Subcommittee on Global Change Research (SGCR), the NCA4 Federal Steering Committee (NCA4 SC) selected Coordinating Lead Authors (CLAs) for each chapter of the NCA. CLAs worked one-on-one with either National or Regional Chapter Leads (CLs), who in turn directed Chapter Authors (CAs). A mix of authorship models including both federal and nonfederal participants was used for NCA4. Source: USGCRP.

Organization of the National Climate Assessment Participants

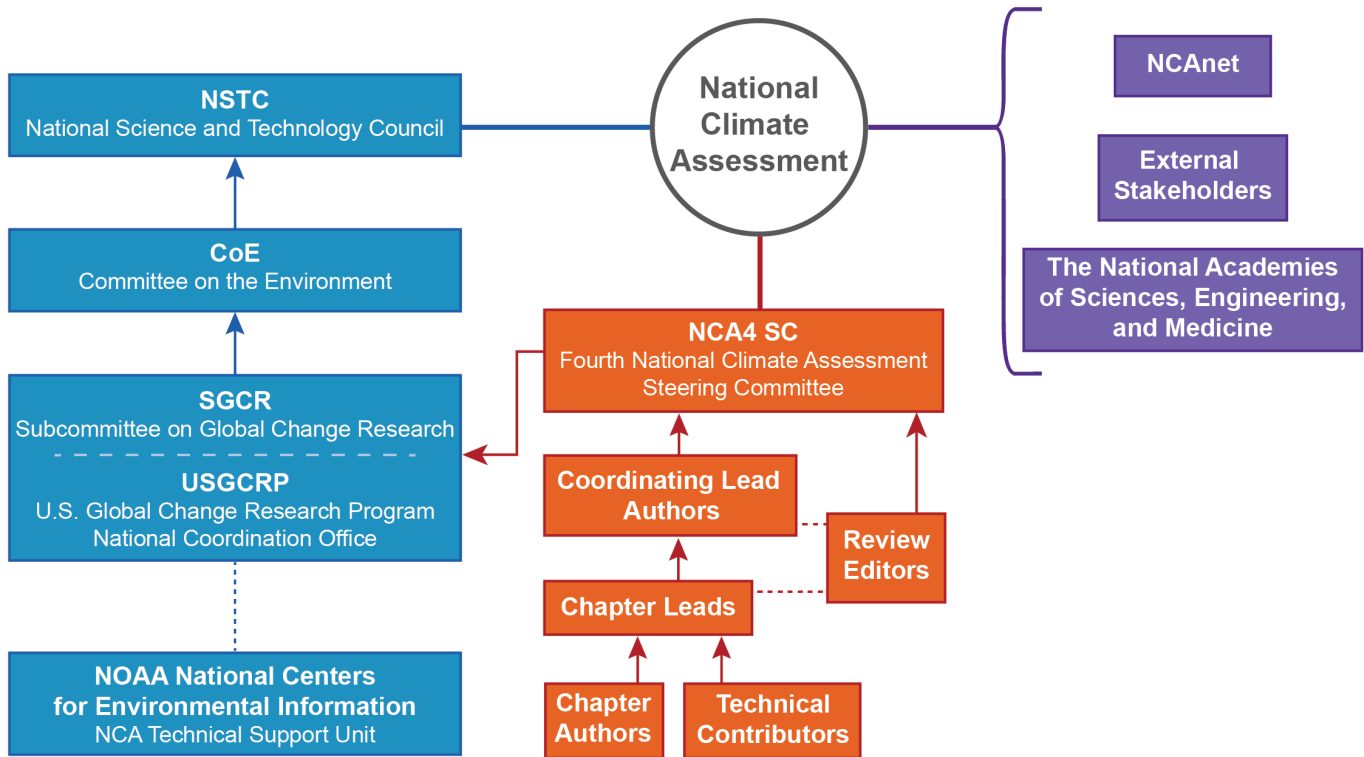


Figure A1.3: Participants in the NCA process can be divided into three broad categories: 1) federal agencies and offices, including the USGCRP (blue boxes); 2) external partners and relevant stakeholders (purple boxes); and 3) NCA4 contributors, including the Federal Steering Committee and report authors (orange boxes). Source: USGCRP.

The **National Climate Assessment Network (NCAnet)** consists of more than 200 organizations that work with the NCO, report authors, and USGCRP agencies to engage producers and users of assessment information.⁷ Partners extend and amplify the NCA process and products to a broad audience through the development of assessment-related capacities and products, such as collecting and synthesizing data or other technical and scientific information relevant to the NCA, disseminating NCA report findings to a wide range of users, engaging producers and users of assessment information, supporting NCA events, and producing communications materials related to the NCA and NCA report findings.

Creating the Fourth NCA Report

Process Development

In May 2015, a Federal Register Notice⁸ requested information to help inform the structure and content of USGCRP’s sustained National Climate Assessment process, which NCA4 is a part of. In early 2016, the SGCR Principals designated the NCA4 SC to lead NCA4 development, and the NCA4 SC began its work, building on prior work from the Interagency National Climate Assessment (INCA) Working Group, the NCADAC, experiences of TSU and NCO staff, and feedback from the aforementioned public call for information (Figure A1.4).

In July 2016, a Federal Register Notice⁹ was published, seeking input on the draft outline for NCA4. Subsequently, a Federal Register Notice¹⁰ was published in late August 2016,

serving as both a call for regional Chapter Leads and other authors (open call for 30 days) and a call for technical inputs (this part of the call was open for a longer time period, until mid-January 2017).

Concurrent with these public calls for nominations and technical inputs, the NCA4 SC, NCO staff, and TSU staff developed guidance documents for use during the development

of NCA4, ranging from chapter and Traceable Accounts templates to style guides and a literature resource database. Risk-based framing was integrated into the chapter templates and other drafting guidance. Authors had access throughout the process to scientific resources and writing guidance materials on a password-protected Resources website, hosted by the TSU, that also served as a collaboration space for authors.

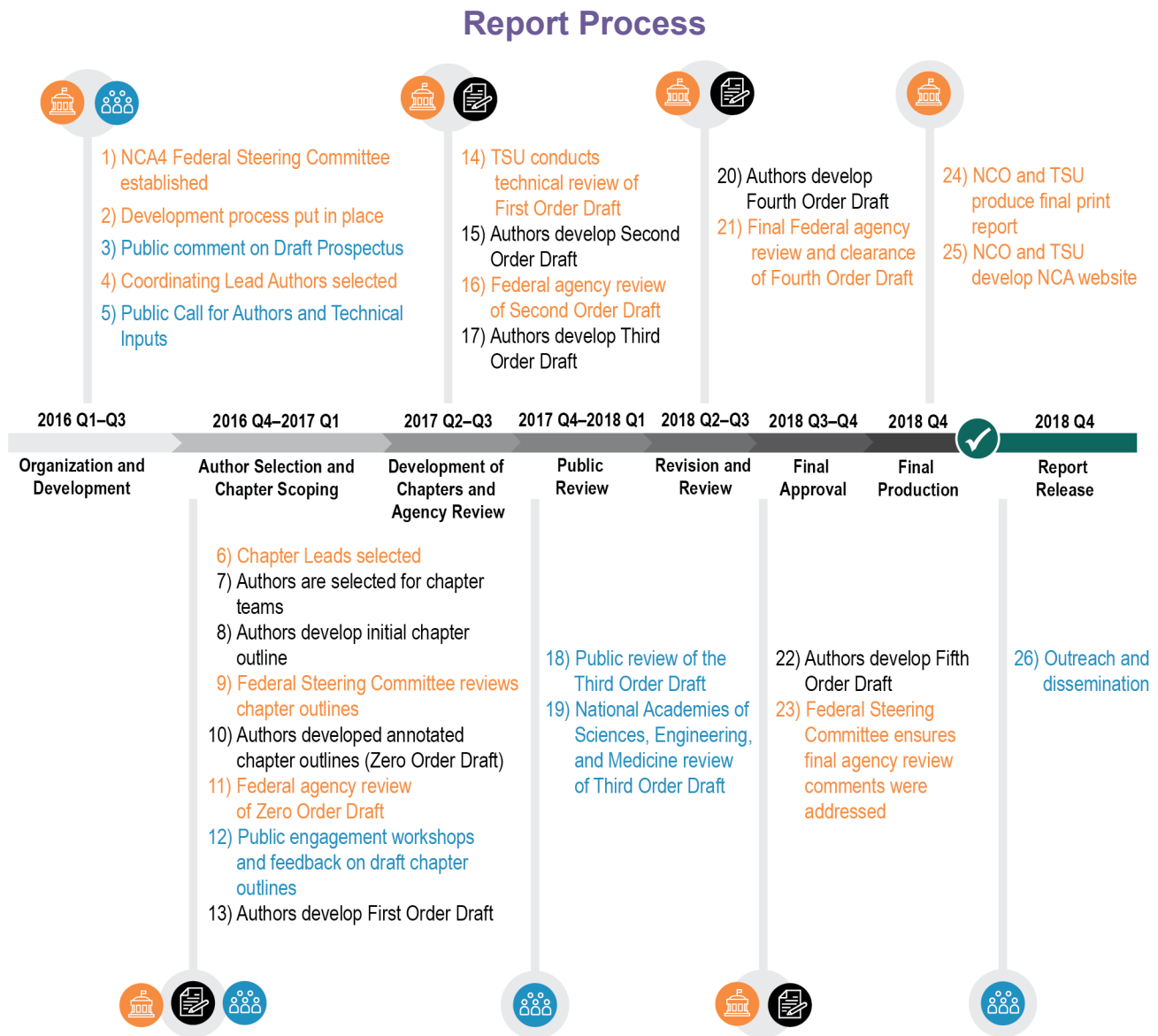


Figure A1.4: This is a graphic illustration of the NCA4 development process. Multiple points of federal review and decision (orange icons) were present throughout the process. In addition, public engagement (blue icons) was a cornerstone of the NCA development process. Authors used these feedback mechanisms to inform the development and execution of their chapters (black icons). Source: USGCRP.

Author Selection, Role, and Preliminary Work (Autumn 2016)

In the fall of 2016, the NCA4 SC selected one or two federal **Coordinating Lead Authors** (CLAs) for each chapter, based on criteria that included expertise and experience and that ensured a variety of perspectives. As the author teams were being assembled (described below), the CLAs and many of the CLs began scoping their chapters. In addition, in October 2016, a CLA meeting was held in Washington, DC, to provide context and guidance for the CLAs moving forward with the NCA4 process.

National Chapter Leads (NCLs), for the topic and response chapters, were selected by the Agency Chapter Lead for each national chapter. The NCA4 SC selected the **Regional Chapter Leads** (RCLs) from a pool of nominated authors derived from a call for nominations in the Federal Register Notice,¹⁰ described above. These NCLs and RCLs, with input and guidance from the NCA4 SC, selected federal and nonfederal **Chapter Authors** (CAs) to establish chapter author teams. CAs were identified based not only on the expertise and experience they would bring to the chapter, but also a commitment to ensuring that a diverse range of perspectives would be reflected in the drafting process. In addition, **Technical Contributors** (TCs) were enlisted at the discretion of the CL to provide specific technical input to the chapter as needed. Each chapter had a primary and backup NCO **Point of Contact** (POC) who supported the chapter team, provided clarity on drafting guidance, facilitated conversations, and assisted the CLA in identifying crosscutting issues.

Initial Chapter Outlines (December 2016 – January 2017)

Authors developed initial chapter outlines in December 2016. The NCA4 SC provided comments on these, which resulted in more complete chapter outlines in January 2017. An interagency review led by the SGCR provided a higher-level review of these more detailed outlines to further inform the development of each chapter.

Regional Engagement Workshops, Author Meetings, and Other Chapter Engagement (Spring 2017)

During late winter and early spring 2017, a series of **Regional Engagement Workshops** (REW; Figure A1.5) and National Chapter Engagement Webinars provided stakeholders with the opportunity to learn about the NCA4 process and provide additional input to author teams as they worked to deliver a First Order Draft of their chapters in June 2017. The hub-and-satellite model (a central hub with various additional sites around the region joining virtually) employed for the REWs resulted in participation in 44 cities and towns across the United States, reaching thousands of stakeholders. Workshop summary reports were shared with all NCA4 author teams to provide a consistent foundation for all report authors. These summary reports are available online at <http://www.globalchange.gov/content/nca4-engagement-activities>.

In addition, NCA4 authors, staff, and NCAnet affiliates organized, spoke at, and participated in a number of sessions at professional society meetings, web-based seminars, community meetings, and other events designed to provide a two-way exchange of information between NCA users and contributors.

Regional Engagement Around NCA4

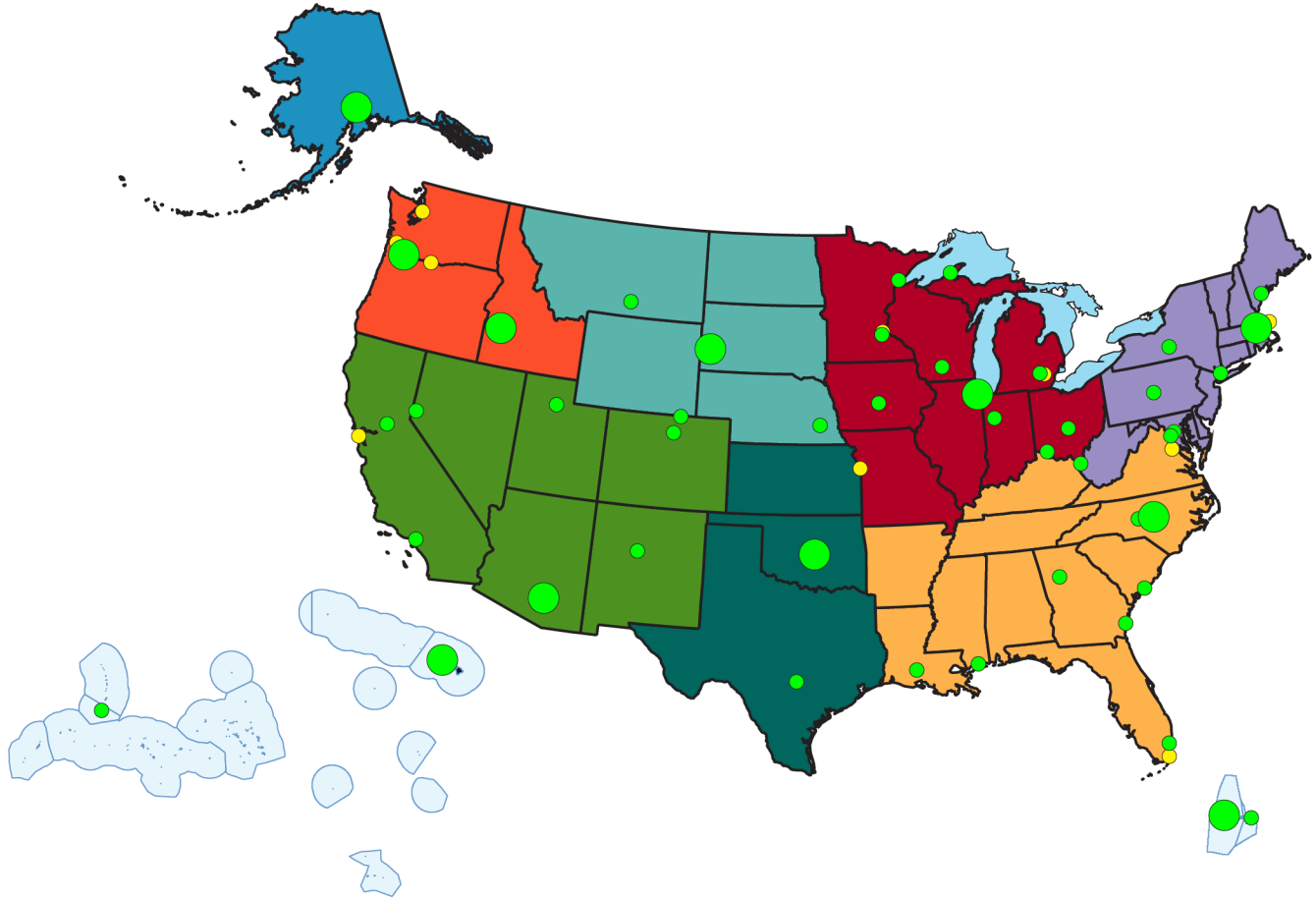


Figure A1.5: The large green dots illustrate the hub locations for the 11 Regional Engagement Workshops held across the country in February to March of 2017. The small green dots indicate satellite locations for those workshops, and the small yellow dots show the locations of some additional engagement activities, such as presentations or listening sessions at professional society meetings. Source: USGCRP.

Regional Engagement Workshops



Figure A1.6: Regional engagement workshops were held around the country in every NCA4 region to facilitate feedback from interested stakeholders on the outlines of the regional chapters. Workshops in San Juan, Puerto Rico, Norman, Oklahoma, Portland, Oregon, and Rapid City, South Dakota, are highlighted. Photo credits: (San Juan, PR photos) Gary Potts, USFS; (all others) USGCRP.

First Chapter Leadership Meeting (CLA-CL1)

On April 4–5, 2017, chapter leadership (CLAs and CLs) convened in Washington, DC, to work on cross-chapter coordination and to discuss additional guidance on chapter drafting, especially on Key Message and Traceable Account formulation. A particularly successful component of this

two-day meeting was an extended “speed-dating” session, where CLAs and CLs from a given chapter would meet with their counterparts from another chapter for 30 minutes to discuss how crosscutting issues would be addressed in their respective chapters to ensure consistent, non-duplicative coverage of key issues.

First Chapter Leadership Meeting



Figure A1.7: Chapter leadership gathered in Washington, DC, for a two-day meeting intended to facilitate individual National Climate Assessment chapter development, inform leadership on process and logistical needs, and facilitate cross-chapter collaboration and information sharing. Photo credits: USGCRP.

Author Training and Drafting

Each of the author teams met multiple times by phone, web, and in person and produced multiple iterations of their chapters since beginning work in October 2016. Traceable Accounts developed for the chapters provide transparent information about the authors' deliberations to arrive at their expert judgment regarding the level of certainty related to the Key Messages of their chapter.

Monthly calls/webinars were generally held with all authors in order to provide them with updates and to address a variety of topics in an effort to ensure consistency across the report and to keep the Assessment progressing in a timely manner. In addition, USGCRP coordinated 14 author training webinars on the following topics:

- Available scenarios products and how to use them
- The EPA's Climate Change Impacts and Risk Analysis (CIRA) project¹¹
- Lessons learned through previous assessments
- Key Message and Traceable Account development
- A walkthrough of the website for scenario products¹²
- Available regional- and local-scale climate variables, through the Localized Constructed Analogs (LOCA) system (see App. 3: Data & Scenarios for more information)
- Metadata requirements and the Global Change Information System (GCIS)
- Climate change indicators

- A report from the National Academies of Sciences, Engineering, and Medicine (NASEM) on *Characterizing Risk in Climate Assessments*¹³
- Risk-based framing
- *Climate Change and Indigenous Peoples: A Synthesis of Current Impacts and Experiences* report¹⁴
- NCA4 Volume I: *Climate Science Special Report* (CSSR)
- NOAA's State Climate Summaries¹⁶
- External, expert peer-review of the draft report by an ad hoc panel of NASEM¹⁷

All author training webinars were recorded and archived on the password-protected Resources portal for authors to access at their convenience throughout the process.

Cross-Chapter Coordination

A key component of success in any broad assessment effort is a means of facilitating cross-chapter coordination. During NCA4, this was done throughout the drafting and review processes. The CLA-CL1 meeting facilitated high-level information sharing among chapter leadership, especially through the aforementioned speed-dating meetings between chapters. The Resources website also provided a forum for interim drafts to be posted and viewed by all author teams.

Specific author teams employed many other techniques. For example, the regional authors working on tribal and Indigenous topics began having regular phone meetings in the winter of 2017 and then began meeting with the authors of the national-level "Tribes and Indigenous Peoples" chapter to discuss consistent terminology and language framing around these topics. Authors of another national-scale

chapter (Ch. 10: Ag & Rural) set up phone calls with authors from each of the regional chapters to ensure appropriate coverage of topical issues throughout the regions and to facilitate the roll-up of regional issues related to agriculture and rural communities to the higher-level synthesis chapter.

Review Editor Selection and Role

The NCA4 Federal Steering Committee selected Review Editors (REs) from a slate of candidates nominated through a public open call in the summer of 2017.¹⁸ For their assigned chapter(s), REs ensured that all substantive comments submitted during the Public Comment Period and via an expert review panel of NASEM were appropriately addressed and documented. REs advised CLs on how to handle contentious issues and ensured that significant scientific uncertainties were reflected adequately in the text of NCA4. REs did not provide additional comments on assigned draft chapters but instead focused on the materials derived from the Public Comment Period and NASEM review. REs ensured that each and every comment had been considered by the author team and that the “annotation” (the written response to the comment) was responsive to the comment and indicated any revision made to the chapter(s), including the scientific or logical rationale for said action. REs helped the CLs ensure that the response to each review comment matched the final text of the revised, post-public/NASEM review draft.

All-Author Meeting

On March 26–28, 2018, all chapter authors and review editors were invited to participate in a 2.5-day all-author workshop in Bethesda, Maryland. The workshop gave authors the opportunity to finalize cross-chapter references and finish edits in response to both public and NASEM reviews of the Third Order Draft.

Review Processes

To begin the writing process, author teams were instructed to develop high-level chapter outlines late in 2016 in light of comments received on the draft prospectus⁹ and guidance provided to authors. The NCA4 Federal Steering Committee reviewed and provided comments on these high-level chapter outlines, which resulted in annotated outlines (Zero Order Drafts) provided to the SGCR for interagency review in January 2017. Comments from this interagency review, alongside input from the suite of public engagement events held throughout the spring of 2017, informed the development of a full First Order Draft.

With the receipt of the full First Order Draft in mid-June 2017, the TSU began an iterative technical editing process with the authors of each chapter to ensure that content was scientifically accurate, that topics were addressed consistently across chapters, and that the text and figures were accessible to the target audience. This process resulted in a Second Order Draft (SOD). A second round of interagency, SGCR-led review of this SOD occurred in the summer of 2017. Consequently, authors revised their chapters in response to these interagency comments, resulting in a Third Order Draft (TOD). This TOD was then released on November 3, 2017, for review by the public.¹⁹ The three-month public review period allowed individuals and groups to examine the draft and provide comments to ensure that the report 1) presented the science accurately, 2) responded to user needs, and 3) relayed its findings in a clear and consistent manner. By the time the Public Comment Period closed on January 31, 2018, the online comment system had received 3,416 comments representing diverse perspectives from over 1,100 registrants (although a smaller number of individual registrants actually submitted comments). Concurrent to this public review period, NASEM convened an expert ad hoc committee to review the TOD and provided the authors with a formal, peer-reviewed external expert review.¹⁷

All-Author Meeting



Figure A1.8: Author teams gathered in Bethesda, Maryland, in March 2018 to finalize revisions in response to public and NASEM reviews (c, f) and to collaborate across chapters to ensure coherency across the report (a, d, e). More than 200 authors attended the meeting (b). Photo credits: USGCRP.

Chapter author teams amended the TOD in response to these public and NASEM comments; they were required to respond to each and every comment. Review Editors evaluated the adequacy of the responses to the comments on each chapter. The public

comments and the chapter authors' responses to those comments are available online with the final report (<https://nca2018.globalchange.gov/downloads/>).

The Fourth Order Draft (4OD) that resulted from the revisions made in response to the public and NASEM comments was then circulated to the interagency again for final federal review and clearance in late April 2018. Any comments that were submitted by the early June 2018 deadline were addressed by the authors during the summer of 2018, resulting in a Fifth Order Draft. In late summer 2018, each Agency's Federal Steering Committee member reviewed this final draft of the report to ensure that any agency comments submitted by the June deadline were adequately addressed.

NCA Final Report

After a production and layout phase in the autumn of 2018, a final public version of the report was published as a downloadable PDF in December 2018; an accompanying website (nca2018.globalchange.gov) was unveiled at the same time. A number of derivative products, including a "Report-in-Brief" document, were produced in addition to the full report.

Resources Available for Authors

The **Resources website** served as the primary compendium of guidance documents, recordings of training webinars, drafts in progress, and many other resources for authors. In addition, the Resources site contained forms to submit figure requests and the associated, required metadata.

Technical Inputs

A public call for technical inputs¹⁰ resulted in the submission of more than 400 peer-reviewed journal articles, reports, and other contributions authored by hundreds of individuals from academia, industry, various levels of government, and nongovernmental organizations. Alongside this public set of technical inputs, the USGCRP NCO conducted a survey of high-impact scientific journals and other peer-reviewed sources to develop a searchable-by-chapter database of over 1,200 articles

and reports for NCA4 authors to consider in their assessment.

In addition, the TSU climate science team developed 51 state climate summaries (one for each state, with a 51st summary on Puerto Rico and the U.S. Virgin Islands) to meet a demand for state-level information in the wake of NCA3.¹⁶ The summaries cover assessment topics directly related to NOAA's mission, specifically historical climate variations and trends, future climate model projections of climate conditions during the 21st century, and past and future conditions of sea level and coastal flooding. Furthermore, EPA produced 50 state climate summaries plus one each for Guam, Puerto Rico, and the U.S. Virgin Islands, looking at historical climate impacts.²⁰

The *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment (CIRA2.0)* was produced as a technical input to NCA4 and informs many chapters.¹¹ This report estimates the physical and monetary benefits to the United States of reducing global greenhouse gas emissions in 2050 and 2090 for more than 20 sectors of the American economy. Other technical reports produced since NCA3 and used as technical inputs to NCA4 include the U.S. Forest Service's *Effects of Drought on Forests and Rangelands in the United States: A Comprehensive Science Synthesis*²¹ and *Climate Change and Indigenous Peoples: A Synthesis of Current Impacts and Experiences*.¹⁴

Special Assessment Reports

A number of federally produced scientific assessment reports provide a robust foundation from which NCA4 authors drew. An illustrative list of such USGCRP-sustained assessment products include:

The *Climate Science Special Report (CSSR)*,¹⁵ released in November 2017, is Volume I of NCA4. It provides the scientific underpinnings for NCA4 and serves as an update of the physical science as presented in NCA3.² Topics include detection and attribution; precipitation change; droughts, floods, and wildfire; extreme storms; sea level rise; ocean acidification; mitigation; potential surprises; and more.

The *Second State of the Carbon Cycle (SOC-CR2)*²² was released in December 2018 and provides an update on carbon cycle science across North America that informs several NCA4 chapters.

The *Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (referred to as the “Climate and Health Assessment”) was released in April 2016 and strengthens our understanding of the linkages between climate change and health. It serves as an important input to NCA4,²³ covering such issues as temperature-related death and illness; air quality impacts; extreme events; vector-borne diseases; waterborne illness; food safety, nutrition, and distribution; mental health and well-being; and populations of concern.

The *Climate Change, Global Food Security, and the U.S. Food System* assessment was released in December 2015 and identifies climate change impacts on global food security. It provides input to many chapters,²⁴ covering such issues as non-climate drivers of food systems and security; models, scenarios, and projections of socioeconomic change; integrated assessment models of agricultural and food systems; food availability and stability; food access and stability; food utilization and stability; and global food security and the United States.

The *Third National Climate Assessment (NCA3)* was released in 2014 and covered many of the

same sectors and geographical regions of the United States, providing a foundation for the sectors and regions in NCA4.² NCA4 includes several new national topic chapters and regions as a result of feedback from the public for such information.

Engagement Activities

The NCA Engagement Strategy,²⁵ developed for NCA3 and expanded for NCA4, provides a vision for participation, outreach, communications, and education processes that help make the NCA process and products more accessible and useful to many audiences. The overall goal of engagement is to create a more effective and successful NCA that is informed by and responsive to user needs—improving the processes and products of the effort so that they are credible and salient and build the capacity of participants to engage in the creation and use of these processes and products for decision-making.²⁵ The strategy describes a number of mechanisms through which scientific and technical experts, decision-makers, and members of the general public might learn about and participate in the NCA process.

The NCO organized listening sessions, symposia, webinars, and other sessions at professional society meetings to provide updates on the NCA process, solicit broad input from subject matter experts, and collect feedback on the approach, topics, and methodologies under consideration.

A series of **Regional Informational Webinars** were conducted in September 2016 to solicit technical inputs and nominations for authors and to discuss the NCA4 process. These included webinars targeted at each of the NCA4 regions (with the Southeast and U.S. Caribbean being combined), as well as one webinar focused on tribal and Indigenous communities and a final, national-level webinar intended for a general audience.

In addition, a series of **Public Comment Period Webinars** were offered from November 2017 through January 2018 to raise awareness of the opportunity for the public to review the Third Order Draft of NCA4.

NCO staff also provided substantive updates on process and development directly to NCA authors in **weekly emails** and **monthly calls**. The broader public was kept abreast of developments through **regular updates** on the USGCRP website: <http://www.global-change.gov/nca4>.

NCAnet Activities

USGCRP hosts an NCAnet (NCA network) Conversation on a roughly bimonthly basis (since January 2012). Briefly, NCAnet is a network of organizations working with the NCA to engage producers and users of assessment information across the United States. Participants (<http://ncanet.usgcrp.gov/partners>) help extend the reach of USGCRP assessment products, including the NCA and reports like the Climate and Health Assessment (<https://health2016.globalchange.gov/>), through the development of assessment-related capacities and products. These efforts have included collecting and synthesizing data or other technical and scientific information relevant to current and future assessments, disseminating findings to various users of assessment information, engaging assessment information producers and users, supporting assessment-related events, and producing communications materials related to the NCA and other assessment findings.

More information on NCAnet, including a list of NCAnet affiliates and presentations, as well as information on becoming a member, is available at <http://ncanet.usgcrp.gov>.

Regional Engagement Workshops and Subsequent Author Meetings

In order to gain feedback from the residents of the various NCA4 regions, author teams held workshops in various locations and invited members of the public and interested stakeholders to listen to presentations on the proposed chapter outlines. Attendees were then asked to provide feedback to authors to help clarify the priorities of the region, relay valuable technical inputs, and otherwise inform the development of the chapter. Reports from these workshops are available online at <https://www.globalchange.gov/content/nca4-engagement-activities>.

- Alaska Regional Engagement Workshop, Hub: Anchorage, Alaska, February 2017
- Northeast Regional Engagement Workshop, Hub: Boston, Massachusetts, with six satellite locations, February 2017
- Southwest Regional Engagement Workshop, Hub: Tucson, Arizona, with six satellite locations, February 2017
- Northern Great Plains Regional Engagement Workshop, Hub: Rapid City, South Dakota, with three satellite locations, February 2017
- Hawai'i and U.S.-Affiliated Pacific Islands Regional Engagement Workshop, Hub: Honolulu, Hawai'i, March 2017
- Midwest Regional Engagement Workshop, Hub: Chicago, Illinois, with nine satellite locations, March 2017
- Southern Great Plains Regional Engagement Workshop, Hub: Norman, Oklahoma, with one satellite location, March 2017

- U.S. Caribbean Regional Engagement Workshop, Hub: San Juan, Puerto Rico, with one satellite location, March 2017
- Southeast Regional Engagement Workshop, Hub: Raleigh, North Carolina, with seven satellite locations, March 2017
- Northwest Regional Engagement Workshop, Hubs: Portland, Oregon, and Boise, Idaho, March 2017
- Alaska Center for Climate Assessment and Policy Webinar, February 2017
- Association for the Sciences of Limnology and Oceanography, March 2017, Honolulu, Hawai'i
- National Adaptation Forum, May 2017, St. Paul, Minnesota

Listening Sessions

Listening sessions were held in a number of places where a full workshop was not appropriate or possible. Listening sessions included a brief overview presentation on the NCA, with some specifics on the chapters of interest to the given audience. Stakeholders were then encouraged to provide feedback on the content of the presentation, as well as any additional information or resources that might be useful for authors to understand.

- Great Lakes Adaptation Forum, October 2016, Ann Arbor, Michigan
- The Kresge Foundation, November 2016, Washington, DC
- American Geophysical Union Annual Meeting, December 2016, San Francisco, California
- American Meteorological Society Annual Meeting, January 2017, Seattle, Washington
- Transportation Research Board Aviation Climate Change Subcommittee, January 2017, Washington, DC
- National Council for Science and the Environment National Meeting, January 2017, Crystal City, Virginia
- North American Carbon Program Science Leadership Group–NCA4 Overview, October 2016, Crystal City, Virginia
- Resilience AmeriCorps Federal Resource Fair, October 2016, Alexandria, Virginia
- 2016 Belmont Forum Plenary Meeting, November 2016, Doha, Qatar
- 7th Annual Northwest Climate Conference, November 2016, Stevenson, Washington
- American Lung Association, December 2016, Washington, DC
- American Geophysical Union Annual Meeting (NASA and NOAA booths), December 2016, San Francisco, California
- Transportation Research Board–Climate Change and Energy Task Force, January 2017, Washington, DC
- American Meteorological Society Annual Meeting Booth, January 2017, Seattle, Washington

Presentations

Many presentations were given to relevant stakeholder audiences through the development of this report. An illustrative listing of NCA4-related presentations made by NCO staff includes:

- North American Carbon Program Science Leadership Group–NCA4 Overview, October 2016, Crystal City, Virginia
- Resilience AmeriCorps Federal Resource Fair, October 2016, Alexandria, Virginia
- 2016 Belmont Forum Plenary Meeting, November 2016, Doha, Qatar
- 7th Annual Northwest Climate Conference, November 2016, Stevenson, Washington
- American Lung Association, December 2016, Washington, DC
- American Geophysical Union Annual Meeting (NASA and NOAA booths), December 2016, San Francisco, California
- Transportation Research Board–Climate Change and Energy Task Force, January 2017, Washington, DC
- American Meteorological Society Annual Meeting Booth, January 2017, Seattle, Washington

- National Council for Science and the Environment Annual Meeting, January 2017, Crystal City, Virginia
- American Association for the Advancement of Science Annual Meeting, February 2017, Boston, Massachusetts
- 2017 Joint NACP Ameriflux Principal Investigators Meeting, March 2017, North Bethesda, Maryland
- Southeast & Caribbean Climate Community of Practice 2017 Meeting, April 2017, Charleston, South Carolina
- Association of State Floodplain Managers Annual Conference, May 2017, Kansas City, Missouri
- National Adaptation Forum, May 2017, St. Paul, Minnesota
- Conference of Mayors Annual Meeting, June 2017, Miami Beach, Florida
- Ecological Society of America Annual Meeting, August 2017, Austin, Texas
- American Chemical Society National Meeting, August 2017, Washington, DC
- Pacific Northwest Climate Conference, October 2017, Tacoma, Washington
- Geological Society of America Annual Meeting, October 2017, Seattle, Washington
- Guest lecture at Boston University, November 2017 (virtual)
- American Geophysical Union Fall Meeting, December 2017, New Orleans, Louisiana
- American Meteorological Society Annual Meeting, January 2018, Austin, Texas
- National Council for Science and the Environment Annual Meeting, January 2018, Crystal City, Virginia
- Guest lecture at San Francisco State University, February 2018 (virtual)
- National Association of Regulatory Utility Commissioners Winter Policy Summit, February 2018, Washington, DC
- Air and Waste Management Association webinar, February 2018 (virtual)
- American Association for the Advancement of Science Annual Meeting, February 2018, Austin, Texas
- Center for Climate and Energy Solutions Business Environmental Leadership Council Spring Meeting, March 2018, Washington, DC
- Guest lecture at University of Illinois, April 2018 (virtual)
- Guest lecture at University of Arizona, April 2018 (virtual)
- Electric Power Research Institute (EPRI) Energy 7 Climate Research Seminar, May 2018, Washington, DC
- Adaptation Futures Conference, June 2018, Cape Town, South Africa
- American Association of State Climatologists Annual Meeting, June 2018, Nebraska City, Nebraska

- National Academies of Sciences, Engineering, and Medicine Committee to Advise USGCRP, July 2018, Washington, DC
- Ecological Society of America Annual Meeting, August 2018, New Orleans, Louisiana
- National Academies of Sciences, Engineering, and Medicine Workshop on Subnational Climate Assessments, August 2018, Washington, DC
- Great Lakes Adaptation Forum, September 2018, Ann Arbor, Michigan
- Sigma Xi Annual Meeting, October 2018, Burlingame, California
- American Geophysical Union Fall Meeting, December 2018, Washington, DC

Sustained Assessment: Past, Present, and Future

The concept of, motivation for, and ideas to inform a sustained assessment process were articulated in Chapter 30 of NCA3, “Sustained Assessment: A New Vision for Future U.S. Assessments,”²⁶ and the NCADAC Special Report, “Preparing the Nation for Change: Building a Sustained National Climate Assessment Process.”²⁷ In addition, the Interagency National Climate Assessment (INCA) Working Group provided thought leadership and implementation options in response to recommendations laid out in the above reports.

NCA4 was developed within a sustained assessment framework and process, drawing on these previous efforts, as well as an evaluation of the NCA3 process.⁶ As part of this sustained assessment process, NCA4 built on and utilized products, indicators, and tools developed since NCA3 (many of which are described in detail in App. 3: Data & Scenarios). In addition,

in response to gaps identified in NCA3, NCA4 is placed in a broader international context (detailed in the new chapter “Climate Effects on U.S. International Interests” and in the new appendix “Looking Abroad: How Other Nations Approach a National Climate Assessment”). The Climate Change Impacts and Risk Analysis (CIRA) project responds to a recommendation for additional work on quantifying the economic impacts of climate change across sectors of the American economy.¹¹ The CIRA report’s project leaders not only provided information tailored to each NCA4 region and most sectors but also worked with many individual chapters through webinars, conference calls, and other collaborative interactions. Guidance on uncertainty and confidence treatment was also provided early on to NCA4 authors, responding to another sustained assessment recommendation.

While the aforementioned efforts provided a useful foundation on which NCA4 could be informed through a sustained assessment lens, greater efficiency and efficacy can be realized under a sustained assessment framework. In an effort to make that a reality, two groups were constituted to further elucidate what such a process could look like.

The **Advisory Committee for the Sustained National Climate Assessment (ACSNCA)** was a 15-member federal advisory committee established by the Department of Commerce on behalf of the USGCRP to advise SGCR on the sustained assessment process and stakeholder engagement. Its primary focus was not on NCA4 but on future assessment processes and engagement work around the NCAs. The ACSNCA met in person biannually and more frequently on teleconferences, with its first in-person meeting being held in September 2016. The original two-year charter for the ACSNCA expired in 2017 and was not renewed.

The **Sustained Assessment Interagency Working Group (SAWG)** provides an interagency forum for agencies to deliberate upon ideas for the various components composing a sustained assessment process. The SAWG holds monthly meetings attended by a diverse array of interagency experts, including SGCR Principals, USGCRP Interagency Working Group co-chairs and members, NCA4 Federal Steering Committee members, representatives from regional science organizations (for example, NOAA Regional Integrated Sciences and Assessments offices, DOI Climate Adaptation Science Centers, USDA Climate Hubs, etc.), and staff at the NCA4 Technical Support Unit. The SAWG first met in early 2017, when members began by reorienting themselves with the NCADAC recommendations and the options put forward by INCA. In ensuing months, thematic issues were discussed, bringing in outside experts to suggest ideas for next steps on a range of topics, including foundational elements, data tools and scenario products, special reports, user engagement, contributor engagement, harvesting assessments for research priorities, evaluation, and a vision and process for NCA5 and beyond.

The ultimate objective is to develop a process that includes activities inside and outside the Federal Government, makes efficient use of limited federal resources, and—importantly—is informed by and responsive to evolving user needs.

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Federal Coordinating Lead Author

David Reidmiller

U.S. Global Change Research Program

Lead Author

Christopher W. Avery

U.S. Global Change Research Program

Contributing Authors

Therese (Tess) S. Carter

U.S. Global Change Research Program

Katie Reeves

U.S. Global Change Research Program

Kristin Lewis

U.S. Global Change Research Program

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