



Reflections on preparing regional chapters for NCA5

Abby G. Frazier¹ · Allyza R. Lustig² · Michael Chang³ · Emile H. Elias⁴ ·
Renee A. McPherson⁵ · Victoria W. Keener^{6,7} · Zena N. Grecni⁶ · Henry
P. Huntington⁸ · Ellen L. Mecray⁹ · Kimberly M. Wood¹⁰ · Kathie D. Dello¹¹ ·
Patricia Chardón-Maldonado¹² · Dave D. White⁶

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Abstract

Regional chapters in the National Climate Assessment (NCA) report provide a comprehensive synthesis of how climate change is impacting United States regions and are extensively used to support climate change decision-making by local communities and policymakers. The regional chapter author teams are tasked with assessing the climate trends, risks, and responses across a range of sectors and across a vast and diverse geography, while making content locally relevant. Regional chapters have evolved in many ways since the third NCA (NCA3), often shifting from focusing on climate stressors and hazards to addressing more diverse human-centric impacts (e.g., human health), inequities, and other barriers to action. The fifth NCA (NCA5) author teams were constructed to be intentionally diverse, including more social scientists and cultural practitioners. Here, regional chapter authors provide reflections on the assessment process and identify some best practices for developing an effective regional chapter. These include building a diverse and complementary author team, utilizing technical contributors to enhance the technical and geographical expertise of the team, and conducting extensive public engagement with local communities and policymakers throughout the process. To improve future regional NCA chapters, we identify several recommendations: (1) thoughtful analysis and possible revision of regional boundaries, (2) inclusion of authors from underrepresented regions on national-scale topic chapters, (3) structured cross-chapter engagement among regional chapters, (4) a holistic communications plan for the post-release period, and (5) better coordination with sub-national climate assessments.

Keywords Regional climate change · Equity · Climate assessment · Climate impacts · Actionable science

1 Introduction

Scientific assessments—such as the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports and the National Climate Assessment (NCA)—are trusted, authoritative sources of scientific information intended to inform decision-making processes across sectors (Moss et al. 2019). While the impacts of climate change are global in nature, impacts are most directly experienced at the regional, local, and community scales, and people are the most engaged when information and adaptations are personally relevant (Scannell and Gifford 2013). Whereas the IPCC reports provide information most relevant at the continental and global scales, the NCA plays an important role in providing decision-relevant information for a wide range of stakeholders across the United States, at national and regional scales (Avery et al. 2025). Place-based and sub-national climate information supports local decision makers as they develop plans and projects to address the rapidly emerging impacts of climate change in their communities (Keener et al. 2022). Additionally, sustained interaction among national science agencies, regional scientists, resource managers, and communities through the quadrennial NCA process can build trust in climate products and accelerate the use of relevant information in local decision-making (Dilling and Lemos 2011; Keener et al. 2022). The objectives of this paper are to highlight the importance of, and advancements in, NCA chapters that focus on specific geographical regions (hereafter, “regional chapters”), reflect on best practices for developing a regional chapter, and describe lessons learned and advice to inform future scientific assessments.

The Fifth National Climate Assessment (NCA5; USGCRP 2023) has four distinct chapter types: (1) chapters devoted to the physical science of climate change; (2) national-scale topic chapters that cover climate change effects on various sectors (e.g., water, energy, transportation, and health); (3) regional chapters that highlight the relevant climate risks, impacts, and responses across different geographic regions in the U.S. (Fig. 1); and (4) national-level response chapters that detail advancements in adaptation and mitigation research and implementation. The report also includes five cross-cutting boxes on topics that broadly apply across multiple chapters (wildfires, compound events, blue carbon, supply chains, and COVID-19) and several appendices (development process, information quality, climate scenarios and datasets, indicators, and glossary).

Regions have been included in the NCA since the 2014 NCA3 (USGCRP 2014), which featured eight regional chapters: Northeast, Southeast and the US Caribbean, Midwest, Great Plains (GP), Southwest, Northwest, Alaska, and Hawai‘i and US-Affiliated Pacific Islands (HI-USAPI). In response to public feedback requesting more regional information and specificity on how key sectors were impacted at regional and local levels, NCA4 (USGCRP 2018) expanded the length of regional chapters to twice the length of national topic chapters and featured 10 regions: Northeast, Southeast, US Caribbean, Midwest, Northern Great Plains, Southern Great Plains, Northwest, Southwest, Alaska, and HI-USAPI. NCA5 maintained the NCA4 regions (Fig. 1). The regional boundaries have evolved over time with consideration of several key factors, including geography, climatic zones, and existing federal assets (e.g., regional climate programs); all have maintained political boundaries (i.e., state boundaries). However, no regional outline is perfect, and the boundaries are an ever-evolving topic of consideration.

The NCA regional chapters are important resources used by many local governments and practitioners to understand climate impacts within their own regions, as they provide

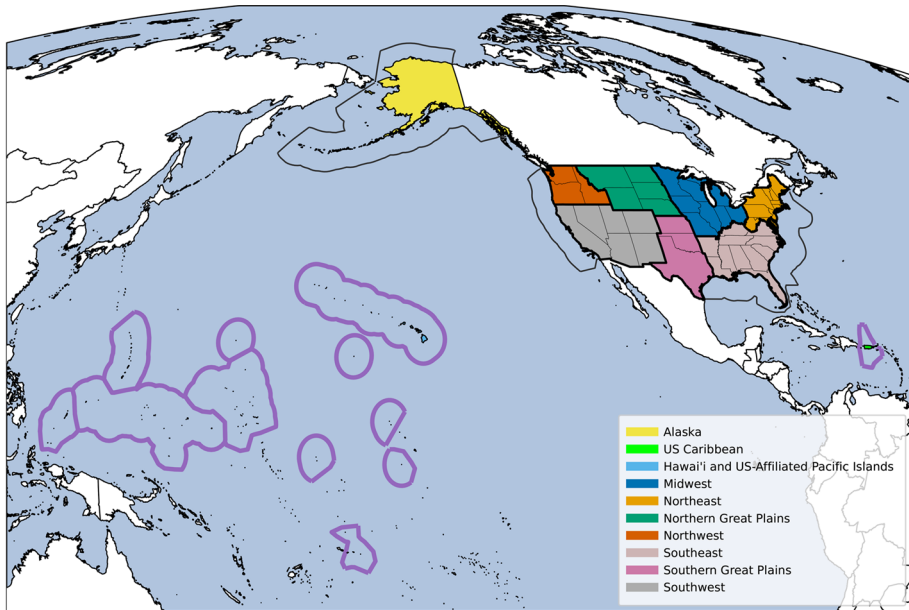


Fig. 1 Regions as defined by NCA5 (USGCRP 2023). Exclusive economic zones are shown around the contiguous US and Alaska in dark grey and around U.S. Pacific and Caribbean islands in purple

locally-relevant scientific context for decision makers (Holmes et al. 2020). Although studies evaluating the overall impact and use of NCA products and reports over time are limited (Cloyd et al. 2016), regional chapters in both NCA4 and NCA5 have been used as place-based educational tools and to inform planning or catalyze action around climate resilience at local and state levels (see use cases in the caption of Fig. 2). The uses of regional NCA chapters can be broadly categorized across four types (see Lustig et al. [In Review](#)), and regional examples are shown in Fig. 2. Additionally, regional chapters can provide structure and support for sub-national climate assessments, which play an important role in connecting decision-makers to information on local climate impacts (Galford et al. 2016). In the Pacific Islands region, the NCA4 regional chapter (Keener et al. 2018) was a springboard for a new phase of a decade-long regional assessment effort, the Pacific Islands Regional Climate Assessment, which originated as a regional technical input to NCA3 (Keener et al. 2022). The NCA4 assessment products (USGCRP 2017, 2018; Sweet et al. 2017), and especially the regional chapter key messages (KMs), were a guiding framework and set of references for ongoing deep-dive assessments for each USAPI jurisdiction (Miles et al. 2020; Grecni et al. 2020, 2021, 2023; Keener et al. 2021). The Pacific Islands Regional Climate Assessment case demonstrates how local, state, and regional sustained assessments can accelerate the uptake and application of climate information contained in large-scale assessments in local decision-making processes. Local, state, and regional assessments also play a critical role in making fine-grained, place-based information on climate risks and adaptation available to the NCA, IPCC, and other regional and international assessments (Keener et al. 2022).

Regional chapters differ from national-scale topic chapters because they synthesize assessments of climate trends, risks, and responses for their specific region, across a diver-

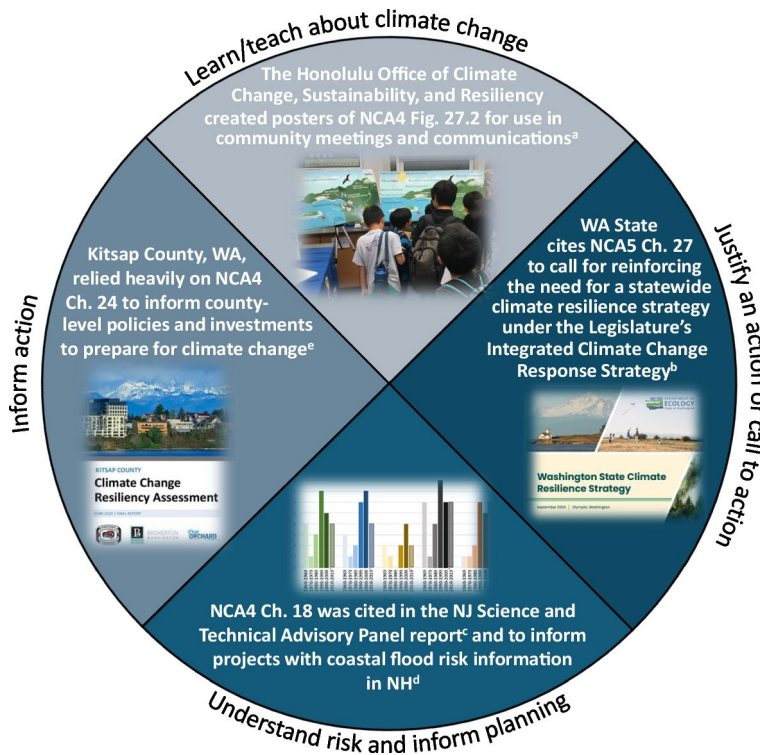


Fig. 2 The uses of regional chapters can be categorized into four types: (1) Learn/teach about climate change, (2) justify an action or call to action, (3) understand risk and inform planning, and (4) inform action (see Lustig et al. *In Review*) This figure highlights a documented use case of regional NCA chapters for each type. To see or contribute to a more comprehensive list of use cases, please visit: <https://www.pacificrisesa.org/education-outreach/us-national-climate-assessment/>. ^aImage courtesy of the Honolulu Resiliency Office (https://www.instagram.com/resilientoahu/p/B2ILtjFD-jS/?img_index=1). ^bWashington State Department of Ecology 2024. ^cKopp et al. 2019. ^dWake et al. 2019. ^eKitsap County 2020

sity of sectors and topics, and through the lens of local impacts, values, and needs. For example, in NCA5, the Southern GP chapter included sectors ranging across agriculture, transportation, energy production, and more, as well as topics highlighting equity, Indigenous Knowledges, and sports/recreation—all from perspectives of those living, working, and playing in the region. Regional chapters also enhance equitable access to geographically specific climate information by enabling all states, Tribes, communities, and businesses to access current science, regardless of whether they have the resources, capacity, mandate, and/or willingness to develop their own localized assessments (Maxwell et al. 2025). For example, in the Southeast region, well-resourced states like North Carolina have official climate assessment reports and resilience officers at the state level (e.g., Kunkel et al. 2020), while other states and localities lag in both assessments and resilience efforts. A regional chapter helps to level the playing field and give all states and territories in the region a sound scientific basis and assessment as they develop solutions for their communities. Importantly, regional chapters highlight tangible examples of local, proactive efforts for resilience that others can use to visualize success in similar geographic, demographic, and political

environments with comparable climate stressors. For NCA3–NCA5, people learned about regional content via public engagement efforts (e.g., webinars, workshops, Tribal consultations, youth dialogues, and conference presentations), ensuring that the assessment meets the needs of its broad user community (e.g., Cloyd et al. 2016).

2 Regional chapters in NCA5

2.1 Evolution of regional chapters since NCA3

Regional chapters in NCA3 primarily focused on summaries of available climate science and projections for each region, place-based impacts of climate change, and specific examples of adaptation and mitigation efforts in the region. This focus on climate stressors and hazards continued in NCA4 regional chapters but with more response and planning examples that had become available. In NCA5, human-centric topics (e.g., human health, livelihoods, and infrastructure) drove many of the KMs in the regional chapters. The shift underscored the understanding that climate change is not solely a scientific topic, but rather a human issue affecting all realms of society and lived experiences (Maxwell et al. 2025). It also reflects a continued shift towards a risk-based approach to climate communication, which seeks to frame climate change in ways that make it more resonant and connected to the issues people care about (Weaver et al. 2017). Finally, the shift reflects an evolution in society's response to climate change, which has allowed the assessment to move from focusing solely on physical impacts to also putting emphasis on adaptation and mitigation efforts. For instance, the Midwest chapter in NCA3 reported on how climate change will impact the Great Lakes, including fish species and the navigation season (Pryor et al. 2014), while in NCA5, the Midwest chapter highlighted experimental port management initiatives in the Great Lakes and the ways in which ports are reimagining how they can enhance the social and ecological health of surrounding communities (Wilson et al. 2023). This evolution from NCA3 to NCA5 may be significant for motivating adaptation and mitigation actions among individuals and communities, as climate change communications that highlight solutions close to home can help audiences envision a desirable future involving preferred interventions, gain a sense of personal and collective ability to effect change, and stay engaged with the issue (Kahan et al. 2007; Roser-Renouf et al. 2014; Markowitz and Guckian 2018). Examples of community and government responses can enable audiences to connect climate change issues to experiences in their daily lives, increasing likelihood of behavioral changes (Wiest et al. 2015).

NCA5 also emphasized environmental injustices and inequities more than prior NCAs. This evolution emerged from a growing literature base on the subjects, an increased representation of social scientists across the report authorship (Maxwell et al. 2025), federal agency priorities, and the shift in the national discourse around racism, legacies of colonialism, and injustice. For example, in the HI-USAPI NCA4 chapter (Keener et al. 2018), the Chapter Lead Author spent several months corresponding with a federal agency regarding the concepts of “sovereignty” and “equity” in terms of how climate impacts are experienced in the greater Pacific Islands versus an island's relative contribution to global greenhouse gas emissions. In NCA5's HI-USAPI chapter, authors were encouraged to address and inte-

grate issues of equity on frontline and Indigenous communities across all KMs (Frazier et al. 2023).

Compared to previous NCAs, NCA5 made considerable improvements in geographic representation in national map figures. Regional chapter teams representing areas outside the contiguous U.S. (OCONUS) worked closely with U.S. Global Change Research Program (USGCRP) leadership to improve representation in maps across the report (Basile et al. 2024). Any time a chapter showed a national map that did not include all areas of the U.S. (including islands and territories), chapter authors were asked to reach out to those regions to see if data existed, and if they were not able to include these OCONUS regions, they were asked to acknowledge the lack of data and reference the missing region's chapter. This practice acknowledges the reality of U.S. policy, governance, and influence over OCONUS areas, and it represents a preliminary step for the scientific community and federal entities toward more equitable data and resourcing, as well as grappling with impactful nuclear, World War II, and colonial histories (Frazier et al. 2023; Basile et al. 2024). The decision to feature two boxes on the ongoing data inequities for OCONUS areas (US Caribbean Box 23.2, and Pacific Islands Box 30.1; Frazier et al. 2023; Méndez-Lazaro et al. 2023) further underscored the need for attention to this issue.

2.2 Comparison of NCA5 regional chapters

Most regional chapters in NCA5 included five KMs, though the number ranged from four (Southeast) to seven (Alaska) (Table 1). Introductory text comprised 5% to 12% of chapter text for most regions; only OCONUS regions had longer introductions: 18% in Alaska, 25% in US Caribbean, and 28% in HI-USAPI. Chapters included text “Boxes” to describe case studies or special topics, and these ranged from one (Midwest and Southwest) to seven (Alaska). Regional chapters in NCA5 included anywhere from nine (Southwest) to 23 (Southern GP) figures, usually a mixture of photos, data visualizations, and conceptual diagrams. Only the US Caribbean and HI-USAPI regional chapters included dedicated region maps to improve public awareness of the entire areas covered by these regions, which are typically omitted from U.S. maps. Six regional chapters also included tables that served different purposes; the Northeast chapter cataloged state and Tribal climate action plans (Table 21.1; Whitehead et al. 2023) and the HI-USAPI chapter highlighted climate impacts across each of its jurisdictions (Table 30.1; Frazier et al. 2023). The number of references varied widely across regional chapters, from 268 (Southern GP) to 486 (HI-USAPI).

Across chapters, KMs highlighted the most pressing climate change issues and impacted sectors affecting the diverse communities in each region. Of the 10 regional chapters, nine included KMs regarding ecosystems (Table 2). Nine chapters also included a human health-related KM; the 10th chapter (Northeast) included a substantial health discussion in its disproportionate impacts KM. Seven chapters had an infrastructure-related KM, and six chapters had a KM focused on economy and livelihoods. Five chapters featured KMs on agriculture and food security, and five chapters had KMs focused on water security (US Caribbean and HI-USAPI combined these topics in “Water and Food” KMs). Some chapters covered unique KMs: Northeast included a KM on climate finance; Southern GP discussed sports and recreation; and Alaska highlighted national, state, and community security. These regionally-specific KMs reflect the priorities of the region and feedback received through various rounds of public comment.

Table 1 Comparison of regional chapters. Columns correspond to the number of: Authors (excluding chapter leads), Technical Contributors (TCs), Key Messages (KMs), References, Boxes, Tables, Figures, Public Engagement Workshop Attendees, Public Comments Received on the Zero Order Draft (ZOD) and Third Order Draft (3OD), Percent of Chapter Word Count Used in Introduction, and the Average Percent of Word Count used for KMs

Regional Chapters	Authors	TCs	KMs	Refs	Boxes	Figs	Public Workshop Attendees	ZOD Public Comments	3OD Public Comments	Introduction Pet Word Count	KM Avg Pet Word Count
21. NE	13	4	5	290	2	1	10	110	18	70	18.8%
22. SE	11	10	4	410	3	0	20	141	13	76	23.7%
23. Caribbean	21	3	5	305	2	2	12	102	23	23	15.1%
24. Midwest	13	4	5	301	1	1	13	140	26	41	18.6%
25. NGP	16	11	5	301	3	0	12	52	2	39	18.6%
26. SGP	14	7	5	268	4	0	23	64	5	57	17.7%
27. NW	14	3	6	419	3	2	11	72	19	83	14.7%
28. SW	11	6	5	441	1	0	9	93	17	85	18.1%
29. AK	13	9	7	324	7	1	17	94	6	223	11.8%
30. HI-USAPI	14	41	5	486	6	1	16	90	1	10	14.4%
AVERAGE	14	9.8	5.2	354.5	3.2	0.8	14.3	95.8	13	70.7	17.1%
All: 12.9%; CONUS: 8.3%; OCONUS: 23.7%											

CONUS=Contiguous US; OCONUS=Outside the Contiguous US (Caribbean, Alaska, HI-USAPI). Regional abbreviations: NE=Northeast; SE=Southeast; NGP=Northern Great Plains; SGP=Southern Great Plains; NW=Northwest; SW=Southwest; AK=Alaska; and HI-USAPI=Hawaii and US-Affiliated Pacific Islands

2.3 Connecting regional and topical chapters across NCA5

To improve cohesion across the entire NCA5 report, individual chapters include references to other chapters in NCA5. Regional chapters made cross-chapter references ranging widely in number from 17 in Northern GP to 111 in HI-USAPI (Table 3), mainly citing the national topic chapters (75% of total cross-chapter references) but also the physical science chapters (10.7%), the adaptation chapter (4.6%), and the mitigation chapter (1.5%). However, regional chapters rarely included references to other regional chapters. Of the total 523 cross-chapter references made in regional chapters, only 13 of them (2.5%) were to other regional chapters, with 10 of those between the US Caribbean and HI-USAPI chapters. The limited connections among regional chapters may indicate the need for more communication across chapters, an opportunity for future NCAs. More intentional collaboration and learning across regional chapters may improve assessment of cross-boundary regions (e.g., mid-Atlantic or intermountain West).

Successful and strategic coordination with other chapters relied on strong leadership and consistent and open communication between the Federal Coordinating Lead Authors (CLAs) assigned to each chapter. One effective pathway of collaboration among the Federal CLAs of both regional and topical chapters was through individual meetings with specific chapters. For example, the US Caribbean chapter Federal CLA and authors worked with the HI-USAPI chapter team to write a box about data inequities in both regions. However, it was easier for regional chapters to connect with topical chapters than other regional chapters because of the clear link with specific content; often, cross-chapter meetings centered around KMs. For example, the Southwest chapter met with the leadership for national topic chapters that aligned with Southwest chapter KMs: Water (Ch. 4), Coasts (Ch. 9), Oceans (Ch. 10), Forests (Ch. 7), Human Health (Ch. 15), and Agriculture (Ch. 11). These meetings, held early in the NCA5 process, were helpful in discussing intended scope and content (including regional examples). Since the regional chapters were twice the length of the topical chapters, some discussions resulted in regional chapters including content that would not otherwise fit in the topical chapters. For example, the Water chapter did not have space to include information about megadrought or the Rio Grande Basin, so their authors requested those themes be mentioned in the Southwest chapter. Often these interactions with regional chapters were critical for ensuring that the topical chapters were including the most important issues in all corners of the U.S. (e.g., after discussion with the Southwest Federal CLA, the Agriculture chapter added new content on extreme heat impacts on outdoor workers). However, many regions (e.g., OCONUS areas) are still underrepresented in the topical chapters (Basile et al. 2024), which undermines timely policy decisions and underestimates national estimates of climate risks. Addressing this issue in future NCAs will likely require more inclusion of experts from OCONUS and other underrepresented regions on national topic chapter author teams.

Table 2 Key Message (KM) topics by regional chapter. The KM number is given for each chapter

KM Topic	21. NE	22. SE	23. Caribbean	24. Midwest	25. NGP	26. SGP	27. NW	28. SW	29. AK	30. HI- USAPI
Ecosystems	KM2	–	KM2	KM2	KM2	KM1	KM2	KM2, KM5	KM5	KM4
Health	–	KM2	KM1	KM3	KM2	KM1	KM5	KM4	KM1	KM2
Infrastructure	–	–	KM4	KM4	–	KM5	KM4	KM2	KM4	KM3
Economy / Livelihoods	–	KM3	–	–	KM3	KM2	KM3	–	KM3	KM3
Action / Adaptation / Governance	KM4	–	KM5	–	KM4, KM5	–	–	–	KM7	–
Agriculture / Food Security	–	KM4	KM3	KM1	–	–	–	KM3	–	KM1
Water Security	–	–	KM3	KM5	–	KM1	–	KM1	–	KM1
Extremes / Impacts	KM1	KM1	–	–	KM1	–	–	–	KM2	–
Disproportion- ate Impacts	KM3	–	–	–	–	KM4	KM1	–	–	–
Culture	–	–	–	–	–	KM1	KM6	–	–	KM5
Climate Finance	KM5	–	–	–	–	–	–	–	–	–
Recreation	–	–	–	–	–	KM3	–	–	–	–
Security	–	–	–	–	–	–	–	–	KM6	–

Table 3 Counts of cross-chapter references in regional chapters

Regional Chapters	Physical Science (Chs. 2–3)	National Topics (Chs. 4–20)	Regions (Chs. 21–30)	Adapta- tion (Ch. 31)	Miti- gation (Ch. 32)	Focus Boxes	Appendices	Total
21. NE	6	18	0	2	1	1	1	29
22. SE	6	35	0	3	1	0	2	47
23. Caribbean	3	25	5	2	0	0	0	35
24. Midwest	10	29	2	0	0	1	0	42
25. NGP	1	13	0	1	0	2	0	17
26. SGP	7	35	0	1	1	3	0	47
27. NW	0	25	0	1	0	2	1	29
28. SW	8	67	0	3	4	5	1	88
29. AK	5	55	1	7	0	7	3	78
30. HI-USAPI	10	88	5	4	1	2	1	111
Total	56	390	13	24	8	23	9	523
Percentage	10.71%	74.57%	2.49%	4.59%	1.53%	4.40%	1.72%	

3 Assessment development process

3.1 Timeline

Public calls for author nominations and technical input encouraged experts to volunteer their service to NCA5 and, in spring 2021, Federal CLAs and Chapter Lead Authors were

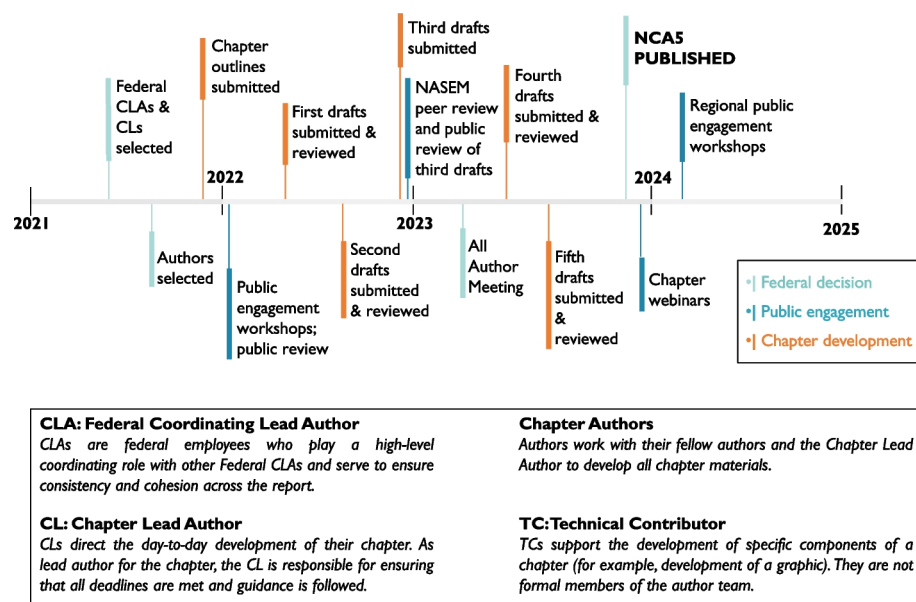


Fig. 3 NCA5 timeline from 2021 to 2024, with description of roles below. NASEM=The National Academies of Sciences, Engineering, and Medicine

selected (Fig. 3). Regional leads collaborated to finalize their author team and, with the team, outlined the chapter topics by the end of 2021. During early 2022, each chapter team held public engagement workshops. Thereafter, teams developed successive chapter drafts and addressed reviews by federal agencies and the public, until finalization in fall 2023. Extensive post-release outreach and engagement took place from late 2023 through mid-2024, including regional workshops. The lengthy timeline meant that a small percentage of authors resigned from their chapter teams during the process, usually due to job changes or other commitments. When replacing authors became difficult, regional teams added Technical Contributors to address specific gaps.

3.2 Author selection

Author selection is important for ensuring that the assessment is responsive to regional needs and priorities and that individual chapters are seen as authoritative in their regional context (Bremer and Meisch 2017; Maxwell et al. 2022). Regional chapter authors are often based at in-region institutions, are keenly aware of local context and sub-regional impacts and efforts, and are trusted messengers for the public. Author teams included experts from federal agencies, non-profit and climate-services boundary organizations, Tribal and municipal governments, academia, the private sector, and, for some chapters, cultural practitioners and other local experts with lived experiences in the region. The number of authors on regional chapters ranged from 11 (Southeast and Southwest) to 21 (US Caribbean).

Author diversity was crucial for representing the highly variable needs, interests, populations, climates, and climate impacts among and within regions (Chu et al. 2025). To begin author selection, each chapter leadership team identified a set of critical issues for the

region and compiled a list of potential candidates with relevant experience, starting with the publicly-nominated experts. Chapter Lead Authors sought to improve the diversity of their author teams compared to NCA4, working to ensure the representation of diverse voices across gender, ethnicity, discipline, career stage, previous NCA experience, institutions, and geography (both geography of expertise as well as where authors were from). For example, the US Caribbean team made a substantial effort to ensure better author representation from the U.S. Virgin Islands (USVI), not just Puerto Rico. The HI-USAPI chapter prioritized people who had expertise in multiple fields and worked broadly across the entire region. To help increase the salience of the chapter for potential users, the Southern GP Chapter Lead Author selected an author team that included several adaptation specialists and practitioners who had applied prior NCA content in their professional work.

Chapter Lead Authors employed several strategies for successfully recruiting authors. For example, as potential authors were approached to join the Southwest author team, the Chapter Lead Author clarified that authors would not write individual sections in isolation; rather, the team would focus on consensus, deliberation, participation, and accountability to one another with the expectation that authors work closely as a coordinated group and be committed to the team's process and core values. The Northwest Chapter Lead Author employed an informal "rule of two" (e.g., two Tribal climate experts) so that no single author was tasked with assessing and synthesizing all information for a KM, topic, or affected population for the region. The Alaska and Southern GP Chapter Lead Authors each communicated to potential authors that they as Chapter Lead Author would perform most of the routine work (e.g., compiling metadata and citations) so that authors could spend their limited time on substantive work, such as drafting specific sections or responding to relevant comments during the various review phases. These approaches seemed to work well, both in practice and in recruiting authors.

Despite these efforts, many author teams struggled with missing perspectives and geographic biases (e.g., Appalachia and parts of the USAPI remain underrepresented). The short timeline for author selection was challenging for some Chapter Lead Authors who identified that urgency and inclusion were incompatible, especially for seeking authors beyond their own networks. Another challenge was that NCA authors serve as volunteers, limiting the pool of candidates willing to invest the necessary time. The Alaska chapter was fortunate to have a commercial fisherman and a community organizer join their author team, and the Chapter Lead Author was largely able to schedule meetings so that both authors could make strong contributions despite fishing seasons and election cycles. Efforts like these to increase inclusivity on chapter teams can allow for broader participation and enrich chapter content (Chu et al. 2025).

Technical Contributors also helped to fill "gaps" in representation and expertise. Unlike Chapter Lead Authors and authors, the Technical Contributors were responsible only for targeted, predetermined chapter contributions (e.g., a case study or figure). They were not responsible for the whole chapter, could not edit the chapter directly, and were not involved in author team discussions or the formulation of the KMs. Technical Contributors are not listed in the suggested citation for the chapter, which may diminish the appeal of the task to some, but the role does provide recognition of their expertise and a way to be involved without the level of commitment required of authors. The Technical Contributor role helps bring in additional voices and forms of knowledge to improve regional representation (Chu et al. 2025). The average number of Technical Contributors (not including HI-USAPI) was

6, ranging from 3 (US Caribbean and Northwest) to 11 (Northern GP). The HI-USAPI chapter included 41 Technical Contributors, many of whom participated in a series of five invited technical workshops held in early 2022 (Fig. 3). Using a virtual collaborative writing process, these regional experts brainstormed ideas and references, contributing directly to the chapter outline. Their inclusion was important not only for the scientific substance of the chapter, but also for building trust in the report process across a broader network of regional collaborators.

3.3 Regional chapter content

The chief responsibility of the author teams was to provide the narrative and content for the chapter, including figures, boxes, and local stories about impacts and adaptation or mitigation. Author teams selected the KM topics, wrote their supporting narratives and Traceable Accounts, and provided context through a chapter introduction. Each chapter followed a different path to narrative development through various methods for author collaboration, including regular video calls (ranging from weekly to monthly), small group assignments, and co-writing. Increased competency with online collaboration tools, spurred by the COVID-19 pandemic, formed a bedrock for the collective writing process across each region's geography. Still, some authors utilized these tools more than others, suggesting the potential for further improvement in the collaborative process. Here we provide some descriptions of the writing process, including KM, narrative, and figure development.

3.3.1 Key message themes

Author teams were asked to develop chapter KMs by consensus to ensure a robust, deliberative, and defensible assessment of the primary conclusions and messages of each chapter. Scientific consensus processes can be challenging when navigating a diversity of expertise and epistemologies (Montana 2017; Roesch-McNally et al. 2020); however, when employed successfully, these processes can support the translation of technical scientific information into applicable knowledge for decisionmakers (Fletcher et al. 2014; Kowarsch et al. 2016). Deliberations and consensus-building occurred during regular author meetings to promote efficiency and inclusion. The Northwest team finalized key findings—such as KMs—using an online survey that allowed for a spectrum of consensus, allowing authors to raise concerns without disrupting or destabilizing the narrative development process.

Regional chapter teams approached KM theme development in multiple ways. Many chapters built KMs based on conclusions from NCA3 and NCA4 (e.g., NCA5, Ch. 27, Table 27.2; Chang et al. 2023) but focused on impacts and solutions rather than re-reporting climate trends and projections. For example, three KMs in the Northeast chapter enumerated regional climate actions, systemic challenges of delivering equitable climate solutions, and financial challenges of taking action at regional to local scales (Whitehead et al. 2023). The Southeast chapter used boxes to highlight resilience measures taken by frontline communities, such as Princeville, NC, a community established by formerly enslaved people who have experienced multiple catastrophic flooding events and have implemented resilience measures that celebrate their history with the land and community (Hoffman et al. 2023). Similarly, the US Caribbean chapter expanded on different climate projections by describing the ways they increase the risk of cascading impacts for human health, water,

infrastructure, and energy security while highlighting measures that support climate adaptation, sustainable development, and social transformation (Méndez-Lazaro et al. 2023). Regardless of method, author teams endeavored to write KMs that were relevant across all landscapes of their region.

To refine KMs, chapter authors also relied on public engagement workshops, held in early 2022 (Fig. 3), with community groups, government entities, regional organizations, and interested individuals. Some of these workshops helped author teams include content that was not covered by prior NCAs. For example, regional workshops helped the Southern GP chapter team focus one of their KMs on sports and recreation—a beloved part of the cultural fabric of the states in the Southern GP and a strong economic driver (McPherson et al. 2023). The Northeast chapter team developed a KM around financing climate action and adaptation plans, another new topic for the NCA, following their regional workshop (Whitehead et al. 2023).

When developing their KMs, multiple chapter teams considered whether a theme should be its own KM or woven throughout all KMs. Regional chapter teams integrated Tribal and Indigenous Knowledges or social equity and justice in different ways. For example, the Southeast U.S. has been shaped by a long history of systemic and structural racial discrimination and aggression, such as Jim Crow segregation. Its chapter team chose to integrate social equity and justice across all of its KMs (Hoffman et al. 2023). Several author teams deliberated on whether to devote a KM to Indigenous perspectives or weave them throughout the chapter. While the former provides greater visibility, it can also be seen as marginalizing Indigenous experiences by framing it as separate from other climate change impacts and actions; the latter approach is more inclusive, though at the cost of easily identifying specific Indigenous concerns. Multiple chapters—such as the Southwest, Alaska, Northern GP, Southern GP, HI-USAPI, and Northwest chapters—ultimately integrated Indigenous and Tribal research and case studies throughout each of their KMs (Chang et al. 2023; Frazier et al. 2023; Huntington et al. 2023; Knapp et al. 2023; McPherson et al. 2023; White et al. 2023). For most chapters, this practice differed from NCA4 where chapters included a separate KM for Indigenous Knowledges and peoples. The HI-USAPI chapter, while integrating Indigenous peoples and research throughout all of its KMs, also devoted a specific KM to Indigenous Knowledges because of their ubiquity across the region (Table 2; Frazier et al. 2023).

3.3.2 Narrative text

Narrative text in regional chapters is important to not only assess the state of the science, but also to tell stories of challenges, opportunities, successes, and future directions in ways that evoke understanding and connection to community. After developing the KM themes, all regional chapter teams assigned sub-groups of authors with interest and relevant expertise to lead the narrative content development. Some chapters, such as the Southwest chapter, also required authors to consistently review the entire chapter to facilitate a more cohesive narrative voice, cross-referencing other KMs and findings.

Some studies indicate that personal experience with recent extreme weather events can promote climate action (e.g., Sambrook et al. 2021). As a result, many chapter authors took the opportunity to highlight the impacts and responses from recent hazards across their narrative. For example, the US Caribbean chapter focused on the impacts in the aftermath

of Hurricanes Irma and Maria and the 2020 earthquake (Méndez-Lazaro et al. 2023); the Northwest chapter highlighted the impacts of the 2021 heat dome event (Chang et al. 2023); the Northern GP chapter described how subsequent heavy rain events and flooding in 2019 cut off a Tribal housing community from the town, which led to the creation of the White Swan Recovery Group (Knapp et al. 2023); and the Southern GP chapter showcased the electricity generation failures associated with the February 2021 extreme cold outbreak (McPherson et al. 2023). Additionally, multiple regional chapters discussed the interactions between climate risks and the COVID-19 pandemic, including Indigenous water rights and interactions with wildfire smoke (White et al. 2023), fragile supply chains and food security (Frazier et al. 2023), challenges responding to climate extremes because of public health guidance and restrictions (Chang et al. 2023), and the compounding effects with recent climate disasters (McPherson et al. 2023).

Many regional chapters contended with uneven geographical coverage of the KM topics within the peer-reviewed literature. For example, in the three-state Southern GP region, most state-level studies were about Texas, and a majority of the locally focused research only used major Texas metro areas—such as Austin, Dallas-Fort Worth, or Houston—for their case studies. The HI-USAPI chapter had more research available for Hawai‘i than for USAPI; the Northwest chapter team was challenged to find Idaho-specific studies as compared to the relative abundance of Oregon- and Washington-specific research; and the US Caribbean chapter authors found larger gaps in research, observations, warning systems, and modeling for the USVI than for Puerto Rico. Many regional teams struggled to find peer-reviewed research regarding rural communities, medium-sized towns, and Tribal communities. Chapter teams approached these geographic challenges in different ways. The Northwest chapter recruited additional Idaho-based authors to ensure that local case studies and initiatives were integrated through each of its KMs (Chang et al. 2023). The HI-USAPI chapter included a table that highlighted a local example from each of the five KMs for each jurisdiction in the region (Table 30.1; Frazier et al. 2023), allowing local practitioners and community members within the region to see themselves represented in each KM narrative. Other chapters bolstered gaps in their regional peer-reviewed literature on Indigenous peoples by relying on the Status of Tribes and Climate Change Report (STACCWG 2021), which collated and documented stories and case studies of climate action from Tribal and Indigenous communities across the country. Major uncertainties and gaps are described in each chapter’s Traceable Accounts section, which often highlight these geographic inequities in data or understudied populations.

3.3.3 Figures

Figures play a prominent role in NCAs and are likely to be used in classrooms; presentations; local, state, or Tribal governmental reports; and elsewhere long after publication. Figures can also help author teams think clearly about chapter priorities and messaging, thus bringing many chapter issues into sharper focus. Figures in regional chapters are often place-based, providing site-specific examples and information to aid in local decision-making. Figure production involves many elements, from content creation and design to metadata documentation and copyright, making the process complex. Importantly, regional author teams had significant autonomy for what figures helped convey their story and appreciable help from the National Oceanic and Atmospheric Administration (NOAA) Technical

Support Unit, which developed and managed the figures for all chapters. At times, however, the Technical Support Unit was overstretched because of the vast number of figures, copyrights, and metadata in various stages of development. To overcome this challenge, the Alaska chapter team recruited a graphic artist as a Technical Contributor and found it helpful to have a dedicated team member focused on figures.

Every regional chapter included at least one conceptual diagram. The Southern GP chapter included one for each KM to highlight examples of a climate-change driver (e.g., more days with extreme heat), its risks (e.g., poorer health outcomes, hotter facilities), and example adaptation and mitigation actions (e.g., expand health monitoring, power facilities with renewable energy) (McPherson et al. 2023). The diagrams were intended to initiate local discussions about a range of resilience actions that align with values across the region and are framed such that climate drivers, impacts, and responses can be changed easily, depending on the local context.

4 Public engagement

4.1 Pre-release public engagement

During development of NCA5, online public engagement workshops were held in early 2022 (Fig. 3). These workshops included 2,700 people from all 50 states, Puerto Rico, USVI, Guam, and Micronesia, with an average of 96 attendees in each regional workshop (ranging from 52 people in Northern GP to 141 in Southeast; Table 1). The online format was initially used because of COVID-19 but turned out to be critical for representation, especially across large regions (Avery et al. 2023). The scale of participation justifies a virtual option for engagement in the future, even if some aspect of in-person meeting resumes. When authors engaged their networks, workshops saw greater participation than when USGCRP alone conducted outreach. This begins to embody the “knowledge network” concept wherein a web of interactions enables mutual and evolving understanding among scientists, decision-makers, and boundary spanners (such as extension offices) (Bidwell et al. 2013). In essence, the NCA process functions not as a centralized keeper of all stakeholder communities, but rather as an organizing framework for many other networks to converge and communicate. Leveraging this concept in the regional space is particularly relevant because the chapters are meant for sub-national application, and local networks are particularly hard to reach for national-scale programs like USGCRP. Public review of draft chapters was solicited twice (Fig. 3), although some regions received more comments than others (Table 1). To encourage more submissions during the public review period, future regional author teams may consider additional targeted communication with their networks. When comments are minor or uneven, authors may choose to enlist expert Technical Contributors to review specific sections.

4.2 Post-release outreach and communication

After the November 2023 release of NCA5, the USGCRP conducted, supported, and encouraged broad outreach and communication of all chapters by the author teams and their networks. Without regional chapters in NCA5, it would be difficult to reach local, place-based

organizations and small- to medium-sized communities, especially in states or territories where few authors were selected for topical chapters. Because the Chapter Lead Authors and Federal CLAs of regional chapters invested time in building geographic diversity of their author team, the post-release outreach and communication had a better chance of diffusing into more places where decision-makers were seeking information.

For each chapter, USGCRP organized official webinars that took place from November 2023 to March 2024,¹ averaging 168 attendees per regional webinar. USGCRP also recommended a public workshop in each of the regions, with the content and focus determined by the individual author teams. Some teams added the NCA workshop to other climate-focused events occurring in the region (e.g., adding the Southern GP workshop to the South Central Climate Resilience Forum in Dallas, TX; adding the HI-USAPI workshops to Hawai'i Climate Week in Honolulu, HI, and the Conference on Island Sustainability in Tumon, Guam; aligning the Midwest workshop with the National Adaptation Forum in St. Paul, MN; and sharing SW content at the Southwest Adaptation Forum in Tucson, AZ); other regions held NCA-dedicated workshops (e.g., Northern GP, Northwest, and Southeast).

Many regional chapter teams have continued to take initiative and volunteer their time for public outreach events to engage communities across their regions following the report release. The Southeast chapter team designed a four-part webinar series, with each webinar focused on a different KM. For each session, they invited three practitioners to reflect on the applications of the NCA, which allowed the Southeast team to include experts from geographies not included in the author team itself (e.g., Arkansas and Alabama). The Southeast chapter team also held an in-person workshop in Raleigh, NC, with a morning session for researchers and an afternoon session for practitioners. Practitioners from four states helped to craft practice messages for representative audiences using the figures from the NCA5 Southeast and Overview chapters (Hoffman et al. 2023; Jay et al. 2023). The Southwest team partnered with a Native American-serving college to host the Four Corners Climate Summit² where six NCA5 authors shared their expertise. The HI-USAPI team responded to requests for engagement in a more ad hoc manner, including providing talks and sessions for high school and undergraduate students and briefings to the Hawai'i State Legislature and Maui County Mayor's Office and public. The US Caribbean chapter team worked with the Caribbean Climate Adaptation Network³ to deliver presentations on the assessment during their educational events and produced a series of educational segments on climate change for Radio Universidad de Puerto Rico. USGCRP translation of the report into Spanish enabled authors to connect with broader audiences.

While these examples demonstrate the ability of authors to expand the reach of the NCA, it is also the case that many authors do not have capacity or funding to take on additional volunteer duties to promote the NCA. Moving forward, further collaboration with the NCA team and the regional chapters around post-release activities, including increased guidance on supplemental activities such as the post-release workshops and sustained regional engagement strategies, could help advance wider NCA engagement and use. For example, after the release of NCA5, much of the onus for regional engagement and outreach was on the regional teams, which often had to supplement their activities through boundary-

¹ Recordings of NCA5 chapter webinars available at: <https://www.globalchange.gov/resources>

² <https://www.fortlewis.edu/climate-summit/>

³ <https://ccan-upr.org>

spanning organizations such as the NOAA Climate Adaptation Partnership / Regional Integrated Sciences and Assessments teams and State Climate Offices. While it makes sense for regional chapters to lead aspects of engagement given local networks and relationships, a broader and more effective post-release regional engagement strategy would be supported by more clearly stated goals, defined metrics for success, and increased funding. One possible approach is to embed an NCA outreach and engagement ambassador in each regional author team to ensure a sustained national launch through workshops and other efforts. Throughout the assessment development process, developing a community of communications staff based at each author's home institution could serve to amplify the report post-release and also to engage a broader community at earlier stages of the report's progress.

5 Recommendations

5.1 Regional structure

Our strongest recommendation is to maintain the regional chapters and their prominence (e.g., word count). We have highlighted examples of how important regional chapters are for informing and catalyzing place-based climate action and planning at local and state levels (e.g., Fig. 2). Key messages (KMs) and supporting narrative text in regional chapters resonate with the regional values and interests; figures and case studies provide examples that can be used as models across regions. A major topic of consideration regarding regional chapters is the definition of regional boundaries. For example, public response to the NCA5 draft prospectus called for even greater regional specificity (e.g., the Chesapeake Bay, the intermountain West). While these suggestions could not be accommodated for NCA5, further thought toward regional boundaries should be granted for future assessments. As the NCA further subdivides the country into smaller and smaller sections, there is also the opportunity to think creatively about how to present the information. For example, regional climate information might evolve from a traditional narrative presentation to something more interactive or tool-based, which could be updated more frequently than only every four years. This type of evolution could begin to shift the NCA from only the realm of climate assessment to also include that of climate services, something that has already begun with the release of the NCA5 Atlas.

5.2 Author participation and chapter development

For future NCAs, chapter leadership should continue to broaden and diversify participation. More time for author selection, more author support resources, and greater flexibility would help expand the pool of potential authors and further improve many aspects of author team diversity. However, the authors acknowledge that without targeted funding support to offset time and labor, author participation will likely remain limited to those at institutions and career stages that allow them to volunteer their time for NCA. Given significant data gaps and underrepresentation of OCONUS locations across the report (e.g., Basile et al. 2024), future NCAs should make efforts to include OCONUS authors on every national topic chapter where possible. Authors from these regions were largely restricted to regional chapters

in NCA5 (Chu et al. 2025), which perpetuates exclusion from climate assessments and has long-lasting implications for timely policy decisions.

A recommendation for future regional chapter authors is to recognize some of the most critical times for chapter development are in the beginning: developing the chapter outline and first draft (Fig. 3). Development of figures should also happen as early as possible, not only to offer opportunities for the public to provide feedback but also so that Technical Contributors can be brought in if needed, ensuring that figures go through all necessary edits and iterations to achieve their full potential. A helpful step to facilitating smoother figure development would be for chapters to identify relevant authors or Technical Contributors to focus on figures. Given the significant time commitment required of authors, early in the NCA process, authors should be encouraged to notify multiple members of leadership at their institutions about their involvement and the importance of these assessments, particularly at the regional level (e.g., for academics: department head, dean, perhaps even provost). Especially as the NCA continues to include more diverse participants from institutions beyond government and academia, increased awareness “up the chain” may not only open dialogue for institutional support of the author’s efforts but also ensure that communication mechanisms are in place to disseminate notices of upcoming outreach events and thus broaden participation.

5.3 Chapter integration

The challenge remains about when to integrate across chapters and what that integration entails. Is it cross-chapter references, or is it content-driven at the front end of the process to more seamlessly integrate and negotiate content and flow? The Federal CLA’s unique role needs to be clarified early, and Federal CLAs need additional guidance to maximize the integration of regional chapters within the rest of the report, including integration across other regional chapters. A regional Federal CLA meeting early in the process to share KMs and identify regional connections may help build more content-driven regional connections. The in-person “All Author Meeting” near the end of chapter development (Fig. 3) was critical for making connections between chapters, and we recommend structured cross-chapter engagement at strategic points in the process for future NCAs.

5.4 Outreach

The authors of this paper express a desire for a holistic communications plan from USGCRP. Aside from the webinar for each chapter and press kit, authors had limited guidance about post-release external communications. Post-release is perhaps the most important time to be messaging about the report and its contents, and it is currently conducted on an ad hoc basis from chapter to chapter, usually with the Chapter Lead Author and another author in a volunteer role. It would be helpful to identify and embed a communications lead in each regional chapter from the beginning of the process. This person would have a connection to USGCRP and the other regional communications leads. Additionally, this would create a conduit from USGCRP to the regional chapters that may better connect them with the people using the NCA in practice.

5.5 Sub-national assessments

Finally, future NCAs could better integrate into the broader sub-national assessment landscape. Many cities, states, Tribes, and regions have their own assessments (e.g., NWIFC 2016; Whitlock et al. 2017; Bedsworth et al. 2018; Widhalm et al. 2018; Kunkel et al. 2020; Grecni et al. 2020, 2021, 2023; Galford et al. 2021; Braneon et al. 2024; Maxwell et al. 2025), and there are opportunities to establish greater interconnectivity and coordination among them. A relatively simple way to improve coordination would be to increase the visibility of sub-national assessments in the NCA, for example, by highlighting them as additional resources in the relevant regional chapters. Encouraging cross-pollination of authors between sub-national assessments and the NCA could also help facilitate coordination and synergize efforts. More complex coordination could involve developing a common set of standards or guidance related to timing, process, and content that all sub-national assessments and the NCA would follow. Such coordination might enable the assessments to reference one another more easily and might help meet the need for increasingly granular regional information.

5.6 Final thoughts

The NCA brings together local, state, and regional policymakers around credible regional chapter findings in a way that standard academic publications generally cannot. Despite the significant time commitment and enormous endeavor regional authors are charged with, participation in the NCA process can be extremely rewarding. Not only are authors producing a high-impact product that can directly inform local, state, and regional policy (Fig. 2), but there are numerous opportunities to build a network of colleagues across a diverse range of backgrounds and disciplines and connect with different groups across the region through public engagement workshops and outreach. Because regional chapters cover such a wide range of topics, this experience often provides authors with opportunities to engage with new topics. Chapter Lead Authors should work to create inclusive and flexible environments to encourage participation from practitioners and others from non-traditional academic backgrounds. Encouraging more diverse participation at each stage of the NCA can help ensure the relevance and usefulness of the regional chapters.

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Declarations

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Authors and Affiliations

Abby G. Frazier¹  · Allyza R. Lustig²  · Michael Chang³  · Emile H. Elias⁴  ·
Renee A. McPherson⁵  · Victoria W. Keener^{6,7}  · Zena N. Grecni⁶  · Henry
P. Huntington⁸  · Ellen L. Mecray⁹  · Kimberly M. Wood¹⁰  · Kathie D. Dello¹¹  ·
Patricia Chardón-Maldonado¹²  · Dave D. White⁶ 

✉ Abby G. Frazier
afrazier@clarku.edu

¹ Graduate School of Geography, Clark University, 950 Main Street, Worcester, MA 01610, USA

² ICF, Reston, Virginia, USA

³ Cascadia Consulting Group, Seattle, WA, USA

⁴ USDA Agricultural Research Service, Southwest Climate Hub, Las Cruces, NM, USA

⁵ Department of Geography and Sustainability, and South Central Climate Adaptation Science Center, University of Oklahoma, Norman, OK, USA

⁶ Global Institute of Sustainability and Innovation, Arizona State University, Tempe, AZ, USA

⁷ East-West Center, Honolulu, HI, USA

⁸ Ocean Conservancy, Eagle River, AK, USA

⁹ NOAA/NESDIS/National Centers for Environmental Information, Norton, MA, USA

¹⁰ Department of Hydrology and Atmospheric Sciences, The University of Arizona, Tucson, AZ, USA

¹¹ North Carolina State University, Raleigh, NC, USA

¹² Caribbean Coastal Ocean Observing System Inc. (CARICOOS), Isabela, Puerto Rico