Introduction
The Fourth National Climate Assessment (NCA4), currently in development, will assess the science of climate change and its impacts across the United States. It will document climate change-related impacts and responses for various sectors and regions, with the goal of better informing public and private decision-making at all levels.

To ensure that the assessment is informed by and useful to stakeholders, engagement activities were planned for many of the 17 National Chapters. These activities provided stakeholders an opportunity to provide input to and exchange ideas with the chapter author team on key message formulation, share relevant resources, and give individual feedback on issues of importance to the chapter topic.

Webinar Structure
National Chapter webinars were organized and hosted by the coordinating lead authors (CLA) and chapter leads (CL) with help from NCA4 staff from the U.S. Global Change Research Program (USGCRP). Invitations to the webinars were distributed by the hosts, author team, and USGCRP staff to their stakeholder networks.

Ocean and Marine Resources Webinar and Session
Hosted by NOAA’s National Marine Fisheries Service, the NCA4 Ocean and Marine Resources chapter team held its engagement webinar on March 20, 2017 to gather input from stakeholders, including authors of the regional chapters, to help inform the writing and development of NCA4, and to raise awareness of the process and timeline for NCA4. Stakeholder participation was broadly solicited, and the webinar attracted approximately 85 participants from across the country.

In addition, an in-person event was held March 2, 2017 during the weeklong Association for the Sciences of Limnology and Oceanography (ASLO) conference in Honolulu, HI. The ASLO event attracted about 30 scientists and students attending the conference. In addition to these events, two-page flyers (Appendix B) describing the Oceans and Marine Resources chapter of NCA4 were distributed at the conference.
Overview and Topics of Discussion
Dr. Taylor Armstrong opened the webinar and introduced the presenters. Dr. Fred Lipschultz, NCA Regional Coordinator, presented an overview of the NCA process, including the Key Messages on Oceans and Marine Resources from NCA3. Chapter Lead Dr. Andrew Pershing (GMRI) then described the draft focal areas for the NCA4 chapter. The speakers took questions about the presentation before posing a series of questions to the audience.

At ASLO, Dr. Fred Lipschultz presented the overview of the NCA process and described the NCA4 draft focal areas. He then took questions about the presentation before posing a series of questions to the audience. Dr. Erica Ombres (NOAA) facilitated the discussion.

Key Takeaways
Participants expressed concerns about whether or how specific issues would be included in the chapter, while also offering some suggestions about strategies for communication. Key takeaways include:

Coverage
- Aspects of the physical climate system (e.g., El Niño and hurricanes, or deep ocean downwelling changes due to climate change that affect large-scale currents and nutrient availability) will be covered in the Climate Science Special Report (CSSR), rather than the chapter. The Oceans and Marine Resources chapter will refer to the CSSR for those drivers of impacts and will highlight the impacts arising from those changes. Another example was consideration of how the reduction in sea ice in the Arctic, covered in the CSSR, will affect fishing and transportation.
- It was suggested that the NCA4 chapter should cover the many cross-cutting issues that relate to the ocean, Great Lakes, estuaries and bays (warming, stratification, hypoxia, acidification), as well as important intersections of climate change with eutrophication (nutrient pollution).
- Shifts in species distribution and phenology was one of the key messages in the NCA3 report, but the NCA4 chapter should note that interpreting the biological implications is difficult since they can either represent an adaptation to changing climate that can help populations survive or represent a sign that organisms are being adversely impacted by climate change. For instance, changing fish distributions due to climate change and working with fisheries to improve their fishing effort is important to highlight. This should be carefully contrasted to discussion of invasive species that are not currently in the draft. There will be winners and losers, as well as biodiversity loss and genetic issues (trait/fitness loss) in the ocean with climate change that should be discussed.
• Several participants highlighted the severe and increasing coral bleaching events that have affected both the Pacific Islands and U.S. Caribbean coral reef systems, which is a dramatic climate impact to a valued ecosystem and interacts with coral disease to devastate coral populations.
• Offshore energy generation is increasingly likely but could be affected by climate change as offshore wind patterns or currents may change.
• In addition to natural resource issues, it was suggested that cultural resources that are tied to the ocean be addressed in this chapter.

Strategies
• Other than global mitigation of greenhouse gas emissions, the chapter should emphasize what marine management strategies could be used to address ocean acidification.
• Emphasis should clearly highlight scientific uncertainties and corresponding risk management strategies available to ocean communities.
• Opportunities for collaborations and leveraging resources should be discussed.
• Strategies for coping with additive and antagonist interactions of multiple stressors, as well as additional unknowns that may be coming should be communicated. At the same time, letting people know that some things might be worse than currently projected is worthwhile to highlight.

Results
The feedback provided during these two public engagement events serves as valuable input to the development of not only the Ocean and Marine Resources chapter of NCA4, but is also being shared with all NCA4 authors to inform the development of their chapters. All of these engagement summary reports will be made publicly available on the NCA4 website (www.globalchange.gov/nca4). The more than 100 stakeholders who participated in the events provided authors with a great deal of useful feedback – from concerns they face, to resources they use and specific case studies where communities are working to address the risks they face as a result of climate change. Responses from both authors and participants indicated that the activities were not only positively received in and of themselves, but served to cultivate new relationships, research ideas and, hopefully, future collaborations.

About the NCA
The National Climate Assessment is the U.S. Government’s premier resource for articulating the risks posed to the Nation by climate change, as well as what is being and can be done to minimize those risks. It is an inter-agency effort, bringing together experts from the 13 Federal agencies of USGCRP, the broader Federal government, as well as hundreds of experts in the academic, non-profit, and private sectors.
Appendix A: List of Ocean Regional Chapter Authors

**Coordinating Lead Authors**
Libby Jewett, National Oceanic and Atmospheric Administration
Roger Griffis, National Oceanic and Atmospheric Administration

**Regional Chapter Lead**
Andy Pershing, Gulf of Marine Research Institute

**USGCRP Points of Contact**
Fred Lipschultz
Apurva Dave

**Chapter Authors**
Alan Haynie (National Oceanic and Atmospheric Administration)
John Bruno (University of North Carolina)
Shallin Busch (National Oceanic and Atmospheric Administration)
Samantha Siedlecki (University of Washington)
Desiree Tommasi (University of California)
Appendix B: Ocean Flyer

Fourth National Climate Assessment
Addressing Regional and Local Needs
Oceans and Marine Resources

What is the National Climate Assessment?
Global Change Research Act (1990), Section 106:

...Not less frequently than every 4 years, the Council... shall prepare... an assessment which...
- integrates, evaluates, and interprets the findings of the Program (U.S. Global Change Research Program) and discusses the scientific uncertainties associated with such findings;
- 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
- analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.

Our most recent National Climate Assessment was released in May 2014. Visit: nca2014.globalchange.gov

Federal Coordinating Lead Authors & Regional Chapter Leads
Federal Coordinating Lead Authors (CLA) were nominated and selected through the Federal Steering Committee. CLAs coordinate with each other to ensure consistent treatment of their chapter issues throughout the assessment and liaise one-on-one with Chapter Leads.

Regional Chapter Leads (RCL) are non-Federal employees, selected by the Federal Steering Committee. RCLs select and direct regional authorship teams and are responsible for the development of each regional chapter.

Regional Chapter Leads:
- Gulf of Mexico Regional Chapter Lead
  Fred Lipschultz (flipschultz@usgcrp.gov)
- USGCRP Points of Contact
  Apurva Dave (adave@usgcrp.gov)

Oceans and Marine Resources in NCA3

Key Messages
1: Rising Ocean Temperatures. The rise in ocean temperature over the last century will persist into the future, with continued large impacts on climate, ocean circulation, chemistry, and ecosystems.
2: Ocean Acidification Alters Marine Ecosystems. The ocean currently absorbs about a quarter of human-caused carbon dioxide emissions to the atmosphere, leading to ocean acidification that will alter marine ecosystems in dramatic yet uncertain ways.
3: Habitat Loss Affects Marine Life. Significant habitat loss will continue to occur due to climate change for many species and areas, including Arctic and coral reef ecosystems, while habitat in other areas and for other species will expand. These changes will consequently alter the distribution, abundance, and productivity of many marine species.
4: Rising Temperatures Linked to Diseases. Rising sea surface temperatures have been linked with increasing levels and ranges of diseases in humans and in marine life, including corals, abalones, oysters, fishes, and marine mammals.
5: Economic Impacts of Marine-related Climate Change. Climate changes that result in conditions substantially different from recent history may significantly increase costs to businesses as well as disrupt public access and enjoyment of ocean areas.
6. Initiatives Serve as a Model. In response to observed and projected climate impacts, some existing ocean policies, practices, and management efforts are incorporating climate change impacts. These initiatives can serve as models for other efforts and ultimately enable people and communities to adapt to changing ocean conditions.

Oceans and Marine Resources in NCA4

Draft Key Messages
1: Climate change and climate variability are acting together to produce extreme events in the ocean (marine heatwaves, tropical cyclones) with impacts on land (changes in weather patterns, droughts, floods, hurricanes) and clear impacts on people, businesses, and communities.
2: Climate-driven stressors (increasing disease rates, rising ocean temperature, hypoxia, ocean acidification, harmful algal blooms) adversely impact the health and productivity of marine ecosystems and fishing and aquaculture industries.
3: The distribution and abundance of species are changing, both in space and within a season, altering ecosystem function, affecting people, communities and economies and challenging management of fisheries and protected species.
NCA4 Chapters

I: Overview
II: Our Changing Climate
III: National Analyses
   - Water
   - Energy
   - Land Cover and Land Use Change
   - Forests
   - Ecosystems, Ecosystem Services, and Biodiversity
   - Coastal Effects
   - Oceans and Marine Resources
   - Agriculture and Rural Communities
   - Built Environment, Urban Systems, and Cities
   - Transportation
   - Air Quality
   - Human Health
   - Tribal and Indigenous Communities
   - Climate Effects on U.S. International Interests
   - Sectoral Interdependencies and Compounding Stressors: The Science of Complex Systems

IV: Regional Analyses
   - Northeast
   - Southeast
   - US Caribbean
   - Midwest
   - Northern Great Plains
   - Southern Great Plains
   - Northwest
   - Southwest
   - Alaska
   - Hawaii and Pacific Islands

V: Response
   - Near-term Adaptation Needs and Increased Resilience
   - Mitigation: Avoiding and Reducing Long-term Risks

NCA4 Milestones

All dates are tentative.

2017
Jan-Mar  Regional engagement workshops
Jan-Sep  Drafting and initial reviews; author responses
Sep-Jan 2018 Public and National Academies reviews

2018
Jan-Feb  Responses to public and National Academies reviews; revisions
Mar-Aug  Final reviews
Sep-Dec  Layout and final production
Dec 2018 NCA4 release

How to Contribute to NCA4

Public engagement is critical to the entire NCA process. Learn more about opportunities to get involved:

Be a Technical Contributor
Chapter teams have been assembled, but there may still be ways to contribute. If you are interested in being considered as a technical contributor, please contact our NCA4 team at globalchange.gov/about/staff.

Submit Technical Inputs
To provide feedback on the Oceans and Marine Resources Outline, contact c. taylor.armstrong@noaa.gov. If you have additional resources or technical inputs you would like to share with NCA4 authors, please visit globalchange.gov/content/nca4-outline.

Regional Workshops
We are working with our author teams and collaborators to develop a series of regional workshops. These workshops are expected to take place from January-March 2017, and are intended to gather information from local communities and stakeholders on topics of particular importance to the region. Please visit globalchange.gov/nca4 for updated information.

Be a Reviewer
A critical component of NCA4 success is a robust, inclusive, and transparent public review process. NCA4 is slated to be released for public comment in the Fall of 2017, but look for other opportunities to contribute along the way at globalchange.gov/notice.

NCA4net
We invite you to join NCA4net, a network of more than 190 organizations working with the NCA to engage producers and users of assessment information across the United States. Participants extend the NCA process and products to a broad audience through the development of assessment-related capacities and products. More information can be found at nca4net.usgcrp.gov.

Contact the NCA4 Team

Dr. David Reidmiller
Director, National Climate Assessment
dreidmiller@usgcrp.gov

Susan Angron-Long
Senior Scientist, National Climate Assessment
sangronlong@usgcrp.gov

Tessa Carter
Program Coordinator, National Climate Assessment
tcarter@usgcrp.gov

Dr. Kristin Lewis
Senior Scientist, National Climate Assessment
klewis@usgcrp.gov

Dr. Fred Lipschultz
Regional Coordinator, National Climate Assessment
flipschultz@usgcrp.gov

Katherine Weingartner
Program Assistant, National Climate Assessment
kweingartner@usgcrp.gov

More Information

globalchange.gov/nca4
contribute.globalchange.gov

U.S. Global Change Research Program
Appendix C: Questions posed in the NMFS webinar for author consideration

Q: How are cultural resources addressed in this chapter?

Q: Climate challenges: long-term measurements that measure the surface to the bottom conditions. NOAA buoys are failing with reduced budgets to repair. Many areas are not sampled.

Q: I have a role in the Midwest chapter regarding issues of the Great Lakes. Will this chapter address freshwater biology play into your chapter, given your page limit?

Q: Other than mitigation, what management strategies are available to address OA?

Q: Is there thought of focusing on severe and repeated coral bleaching events that have affected both Hawaiian/Pacific Is and Florida/US Caribbean coral reef systems in the current assessment period (2014-2016)? This is a dramatic climate impact to a valued ecosystem.

Q: Also, there is an ongoing interaction with coral disease in Florida that continues devastating coral populations?

Q: Shifts in species distribution and phenology is one of the key messages in the report, but it can be difficult to interpret the meaning of these shifts in terms of their biological implications. They can either represent an adaptation to changing climate that can help populations survive or represent a sign that organisms are being adversely impacted by climate. How will shifts in distribution be interpreted in the context of this report?

Q: As a NOAA researcher, I am curious how NCA4 relates to the EPA Climate Change Impacts and Risk Analysis (CIRA); Is CIRA ongoing, and do you recommend that NOAA researchers work directly through NCA4, or also reach out to EPA?

Q: Will there be content that explores opportunities for collaboration and leveraging of resources to make real change?

Q: Thank you for the presentation! I would emphasize the need to clearly / explicitly highlight scientific uncertainties and corresponding risk management options, throughout the NCA.

Q: Some additional ocean acidification management answers. Nutrient attribution - local nutrient loading, local emissions, and forecasts.... Some suggestions for local ocean acidification management. All currently being explored in regional forums.

Q: What about funding for observations and measurements to observe climate change?