Natural Hazard Risk and Uncertainty Communication Practical Guide and Pilot Project

Final Report

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Performance, Risk, and Social Science Office

Submitted by:
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NATURAL HAZARD RISK COMMUNICATION
EXECUTIVE SUMMARY

Communicating natural hazard risk and uncertainty is critical to delivering on a central tenet of NOAA's mission: *to share knowledge and information with others*. Across the nation, organizations, businesses, communities, and individuals use NOAA's research, data, and knowledge every day. These entities depend on NOAA's climate predictions, weather forecasts and warnings, navigational information, Earth observations, and other data to plan and inform their activities and to make critical decisions.

PURPOSE AND METHODS

In June 2016, NOAA published the "Risk Communication and Behavior: Best Practices and Research Findings" report. This report presents a summary of risk communication and behavior literature related to hazards relevant to NOAA's mission, and provides recommendations for implementation and future research. In 2017, the NOAA Social Science Committee identified the need to take an in-depth look at NOAA risk and uncertainty communication practices and propose a simple and practical framework that all line offices can use.

As a result, NOAA's Performance, Risk, and Social Science Office (PRSSO) contracted with Eastern Research Group, Inc. (ERG) in 2017 to conduct the "Natural Hazard Risk and Uncertainty Communication Practical Guide and Pilot Project." The goals of this project were to:

- Identify natural hazard risk and uncertainty communication needs, capabilities, and current practices at NOAA.
- Identify existing risk and uncertainty communication work at other federal agencies to benchmark NOAA's efforts and help strengthen NOAA's capabilities.
- Develop a natural hazard risk communication framework to help guide and institutionalize risk communication at NOAA.
- Develop recommendations to improve natural hazard risk and uncertainty communication NOAA-wide.

To help NOAA achieve these goals, ERG interviewed 32 individuals from NOAA line offices and external stakeholders, researched risk communication at other federal agencies, and created and pilot-tested a practical guide for risk and uncertainty communication at NOAA.

KEY FINDINGS

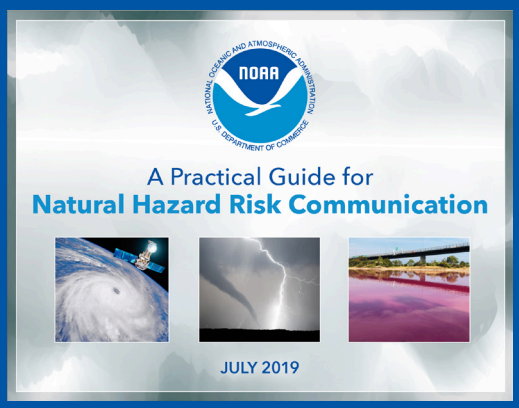
NOAA's work is diverse, spanning from space to sea. This means that NOAA must address and communicate about multiple, interconnected risks, involving harm to people, ecosystems, and the economy.

In describing NOAA's natural hazard risk communication capabilties, interviewees within NOAA and in other organizations noted the following strengths:

- **NOAA is a trusted, credible source of natural hazard risk information.** External interviewees universally praised the quality of NOAA's data and the professionalism, responsiveness, and accessibility of its staff.
- **NOAA staff are highly engaged with stakeholders.** External interviewees noted that robust engagement and outreach has allowed NOAA to effectively get information into the hands of decision-makers and the public.
- **NOAA's risk communication benefits from the interconnected nature of its work.** The foundational research, data, and infrastructure provided by one line office can often help other offices assess and characterize risk and uncertainty, transfer this knowledge internally and externally, and promote informed decision-making.
- **NOAA partnerships are an asset to risk communication.** Line office staff have established positive, productive partnerships, and are working on new ones, to help translate and amplify NOAA risk messaging and connect NOAA with its diverse audience base.
- **NOAA is evolving its natural hazard risk communication.** Many of the line offices are working with social scientists to better understand their customers' information needs and decision processes, as well as to improve their products and services and strengthen their risk communication capabilities.

In addition to identifying strengths, the research for this project also revealed challenges to integrating effective natural hazard risk and uncertainty communication at NOAA. Some challenges stem from communicating science or data, which may be inherently uncertain, dynamic, or complex. Other challenges are cultural, organizational, or operational, relating to NOAA's structure, management, or workforce. Still others are connected to technological or political constraints. Key challenges include the following:

- Lack of a common, consistent language for communicating natural hazard risk.
- Aspects of natural hazard risk that are difficult to communicate (e.g., the relevance of long-term risks to people's lives, lack of data at a local scale).
- Communicating uncertainty, especially to non-technical audiences.
- Where responsibility for risk communication lies within in a given line office.
- Lack of risk communication experience or resources to build capacity.
- Lack of awareness about existing NOAA risk communication resources.
- Inconsistent or missing protocols and procedures for risk communication.
- Limited understanding of who target audiences are or how to reach them effectively.
- Lack of information about how risk messages and information are perceived or used.



Practical Guidance for External Risk and Uncertainty Communication

As part of this project, we have created a step-by-step, proactive, and systematic guide that all NOAA staff can employ in their risk communication efforts. This guide was designed to complement other NOAA risk communication resources and add value by providing guidance on communicating uncertainty to external stakeholders as part of risk communication. A draft guide was pilot-tested by staff from each line office and revised to reflect their input.

RECOMMENDATIONS

To build on NOAA's natural hazard risk communication strengths and address challenges, we have developed six recommendations to improve and integrate risk and uncertainty communication across all NOAA line offices. The full report describes specific opportunities and best practices for implementing these recommendations.

- **Recommendation 1: Secure and maintain leadership support for risk communication activities.** Leadership must be committed to the idea that risk communication is a worthwhile activity and provide resources to support this activity.
- **Recommendation 2: Enhance planning and measurement for risk communication.** Consider developing an agency-wide strategic plan or line office-specific plans with concrete goals, activities, and performance metrics.
- **Recommendation 3: Look for opportunities to collaborate internally.** NOAA can leverage the interconnectedness of its work to build collaboration among line offices and share resources and best practices.
- **Recommendation 4: Build capacity for communication around uncertainty.** Better guidance around communicating uncertainty, including a common lexicon, could help prevent misunderstanding and better serve the risk information needs of NOAA's diverse audiences.
- **Recommendation 5: Help staff who have risk communication responsibilities become more confident and consistent communicators.** NOAA can take steps to establish internal processes for sharing resources, building capacity, and enabling staff to measure their impacts—and be rewarded for their achievements and performance.
- **Recommendation 6: Evaluate training needs and consider incentives.** Training on risk communication fundamentals, incorporating relevant scenarios and hands-on exercises, can enhance specific skills and help incorporate risk communication and outreach into job responsibilities at NOAA.

1. INTRODUCTION

1.1 Background

Communicating risk and uncertainty is integral to carrying out NOAA's broad mission of science, service, and stewardship. In particular, successful risk communication is critical to delivering on a central tenet of NOAA's mission: *to share knowledge and information with others*. Across the nation, organizations, businesses, communities, and individuals use NOAA's research, data, and knowledge every day. These entities depend on NOAA's climate predictions, weather forecasts and warnings, navigational information, Earth observations, and other data to plan and inform their activities and to make critical decisions.

Communicating risk, along with uncertainty and probabilities, helps NOAA achieve its mission (Figure 1) by:

- **Protecting lives, human health, ecosystems, and property from extreme events and emergencies.** For example, the National Weather Service (NWS) aims to ensure that high-quality forecasts are communicated effectively to empower emergency managers and the public to take protective action.
- **Empowering people to make informed choices**. For example, the National Ocean Service's (NOS's) Inundation Dashboard helps communities understand and respond to local vulnerabilities to coastal inundation.
- **Informing decision-making and policy processes.** For example, NOAA Research's Climate Resilience Toolkit helps decision-makers across the country prepare for—and adapt to—hazards that will be exacerbated by a changing climate.
- **Helping to build trust in the information NOAA provides.** For example, NWS's severe weather decision support briefings create an open and honest venue for emergency managers to receive information and ask questions, thereby building trusted relationships.

Purpose of This Report

This report provides documentation for all stages of a project that NOAA undertook from 2017 to 2019 to improve understanding of risk and uncertainty communication capacity across the agency and to strengthen the integration of risk communication into day-to-day operations. The marquee product resulting from this project is a concise interactive workbook entitled "A Practical Guide for Natural Hazard Risk Communication."

This report is a companion to the practical guide, designed for readers who seek more detailed information about the data collection efforts that informed the practical guide. This report also provides recommendations to enhance risk communication activities within NOAA.

What Is Risk Communication?

Risk communication can be broadly understood as an iterative exchange of information among individuals, groups, and institutions related to the assessment, characterization, and management of risk. Inherent to the understanding of risk, and the practice of risk communication, is an awareness that risk encompasses both objective and subjective qualities. (See Table 1 for additional definitions.)

The ultimate goal of risk communication is to help people make informed decisions about risks.

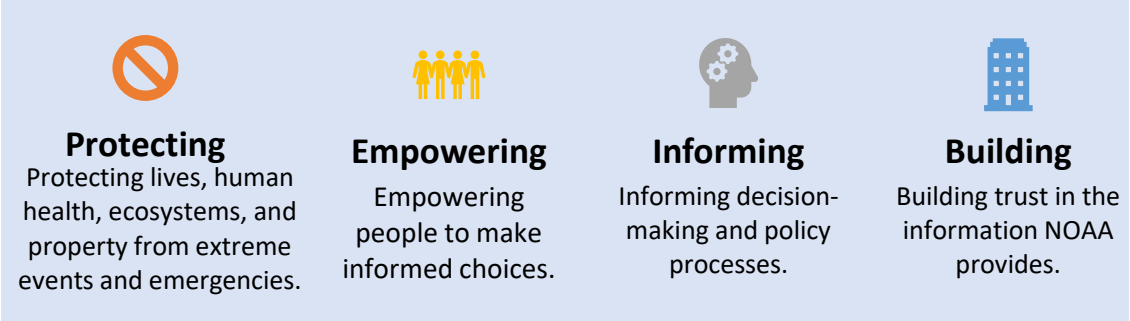


Figure 1. How Risk Communication Supports NOAA's Mission

Thus, effective risk communication educates constituents, helps decision-makers and members of the public make informed decisions, and generates trust and credibility. Risk communication can help reduce the vulnerability of communities and ecological systems in the short term, while helping our society adapt to potential environmental, social, and economic changes in the long term.

Table 1. Key Terms Used in This Report

Term	Example: Lightning
Hazard: a potential source of harm to people, the environment, society, or the economy.	Lightning is a hazard to human health, potentially causing death or permanent disability in people who are struck.
Risk: the likelihood that harm will occur if exposure to a hazard occurs. *Risk = Hazard x Exposure x Probability*	Each year in the United States, there are about 25 million cloud-to-ground lightning flashes and about 300 people struck by lightning. Of those struck, about 47 people are killed and others suffer severe injuries. The risk increases with certain behaviors, such as being the tallest object in an open area.
Uncertainty: the range of possible values for a particular quantity or phenomenon.[1] Uncertainty arises whenever the state of a system cannot be known unambiguously.[2] Uncertainty can be framed through three questions: What are we uncertain about? How uncertain are we? Due to what are we uncertain?[3]	Lightning warning or detection systems can provide advance warning of lightning hazards. However, no systems can detect the "first strike," detect all lightning, or predict when or where lightning will strike. Because of the unpredictability of lightning strikes, there is no safe place outside in a thunderstorm.

[1] Adapted from: Carleton College, Science Education Resource Center: https://serc.carleton.edu/sp/library/uncertainty/what.html, and the National Institute of Standards and Technology: https://physics.nist.gov/cuu/Uncertainty/glossary.html.

[2] National Research Council 2006. Completing the Forecast: Characterizing and Communicating Uncertainty for Better Decisions Using Weather and Climate Forecasts. Washington, DC: The National Academies Press. https://doi.org/10.17226/11699.

[3] Walker, W.E., P. Harremoës, J. Rotmans, J.P. van der Sluijs, M.B.A. van Asselt, P. Janssen, and M.P. Krayer von Krauss. 2003. Defining Uncertainty: A Conceptual Basis for Uncertainty Management in Model-Based Decision Support. Integrated Assessment 4(1):5–17.

Term	Example: Lightning
Risk communication: an iterative exchange of information among individuals, groups, and institutions related to the assessment, characterization, and management of risk. Inherent to the understanding of risk, and the practice of risk communication, is an awareness that risk encompasses both objective and subjective qualities.	NWS provides resources to help people avoid lightning strikes: https://www.weather.gov/safety/lightning. "When thunder roars, go indoors!"

1.2 Project Goals

NOAA contracted with Eastern Research Group, Inc. (ERG) in 2017 to conduct the "Natural Hazard Risk and Uncertainty Communication Practical Guide and Pilot Project." This project was designed to improve understanding of NOAA's risk and uncertainty communication capacity across all six line offices (LOs) and to strengthen and integrate risk communication into LOs' day-to-day operations. It involved four main tasks:

1. Identify risk and uncertainty communication needs, capabilities, and current practices at NOAA.
2. Identify existing risk and uncertainty communication work at other federal agencies to benchmark NOAA's efforts and help strengthen NOAA's capabilities.
3. Develop a risk communication framework and associated pilot project to help guide and institutionalize risk communication at NOAA.
4. Develop recommendations to improve the effectiveness and consistency of risk and uncertainty communication NOAA-wide.

NOAA Line Offices

- National Environmental Satellite, Data, and Information Service (NESDIS)
- National Marine Fisheries Service (NMFS)
- National Ocean Service (NOS)
- National Weather Service (NWS)
- Office of Marine and Aviation Operations (OMAO)
- Office of Oceanic and Atmospheric Research (NOAA Research)

The results of the project are intended to build on and complement the extensive collection of risk communication resources already available across NOAA, including the NOAA Social Science Committee's July 2016 Risk Communication and Behavior: Best Practices and Research Findings. Section 6 of this report presents a compilation of these resources along with a brief description of their purpose.

1.3 About This Report

This report presents:

- **Methods** used to develop recommendations and produce risk communication guidance (Section 2).
- **Findings** from research on risk communication at NOAA and best practices from other agencies (Section 3).
- **Recommendations** for strengthening NOAA's capabilities (Section 4).

- **Conclusion and next steps** (Section 5).
- **Resources** available from NOAA and other organizations (Section 6).

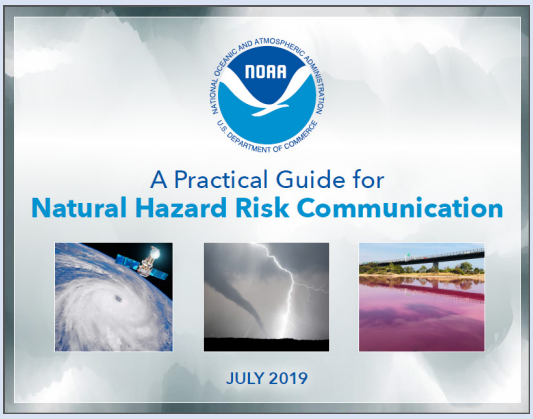
Appendices to the report include detailed summaries of interviews, research findings, and recommended practices.

This report was largely derived from interviews with 20 professionals within NOAA's six LOs, 10 individuals outside of NOAA who use the agency's risk information and/or communicate risk information themselves, and risk communicators from two other federal agencies. It was also informed by NOAA resources on risk communication and guidance developed by other organizations.

The interviews and research provided useful insights into how risk and risk communication is viewed at NOAA and identified challenges and best practices for risk communication. They also provided an opportunity for people to share their thoughts on how NOAA can strengthen and institutionalize its risk communication practices. While several recurring themes emerged, it should be noted that these interviews were exploratory in nature; because of the small sample, the findings presented here cannot be inferred to be representative of an entire LO or NOAA as a whole.

Practical Guidance for External Risk and Uncertainty Communication

As part of this project, ERG produced a step-by-step strategic, proactive, and systematic guide that line offices can employ in their external risk communication efforts. This guide was designed to complement other NOAA risk communication resources, while being unique in providing guidance on communicating uncertainty as part of risk communication.



2. METHODS

This section describes methods used to characterize risk communication at NOAA, produce a guide for external risk communication, and develop recommendations to strengthen and institutionalize risk and uncertainty communication across NOAA. These methods included interviews of individuals from LOs and external stakeholders (Section 2.1), research into risk communication at other federal agencies (Section 2.2), and development and pilot testing of a practical guide for external risk and uncertainty communication by NOAA LOs (Section 2.3).

2.1 Interviews

To investigate NOAA's risk communication capabilities and needs, ERG interviewed professionals within NOAA's six LOs as well as individuals external to NOAA who use the agency's risk information and/or communicate risk information themselves.

2.1.1 Internal Interviews

NOAA's six LOs manage the delivery of products and services to meet the needs of the agency's customers and stakeholders. During January and February of 2018, ERG interviewed 20 people across NOAA's six LOs, either in person or via webinar. They ranged from one-on-one sessions to group discussions with two or three people. NOAA selected the interviewees, who included public affairs/communications specialists, managers/directors, and scientists.

The purpose of the interviews was to glean information on each LO's mission and characterize relevant risks/hazards, risk messaging approaches, stakeholders and partners, communication channels, risk communication protocols/trainings/tools, messaging successes and challenges, verification methods, and relevant research. Appendix A summarizes three major areas explored during the interviews: 1) how LOs approach risk characterization and communication, 2) key challenges and solutions, and 3) ideas for enhancing risk communication. Appendix A also presents the script used to conduct these interviews.

2.1.2 External Interviews

In April and May of 2018, ERG conducted semi-structured interviews with individuals external to NOAA who use the agency's risk information and/or communicate risk information themselves. These included federal, state, and local officials, as well as individuals from independent organizations (governmental and nongovernmental), academia, and the private sector (see Table 2).

ERG interviewed these individuals to better understand how they use NOAA risk and uncertainty information/services and engage with NOAA staff. These interviews were informed by information from the internal interviewees, who also helped to identify external interviewee candidates.

Appendix B summarizes three key areas explored during the external interviews: 1) how interviewees engage with NOAA and/or use NOAA risk/uncertainty information, 2) how they perceive the strengths and weaknesses of NOAA's risk information and services, and 3) their recommendations for improving risk communication. Appendix B also includes the script used for the external interviews.

Table 2. External Respondents by Title and Organization

Organization	Title	Organization Type	Key Audiences
University of Minnesota, Sea Grant	Coastal Communities and Land Use Planning Extension Educator	Academia in partnership with NOAA	Coastal planners and other state/local officials; members of the public
NBC Universal	Director of Weather Operations	Private sector	Members of the public, including many Spanish-speaking viewers
Climate Central	Manager and Research Associate for Sea Level Rise Program	Nonprofit	Other nongovernmental organizations, advocacy groups, planners, members of the public, the media
The Ocean Foundation (TOF)	Project Manager of Global Tuna Conservation Project	Nonprofit	Members of the public and other conservation groups
Marine Mammal Commission (MMC)	Energy Policy Analyst and Liaison on Alaska Native Issues	Independent government agency	Agencies MMC oversees, as well as Congress, White House, OMB, members of the public
Federal Emergency Management Administration (FEMA)	FEMA Liaison to National Weather Service Storm Prediction Center	Federal government	Members of the public; all FEMA offices that need and use weather information; and nonprofit, tribal, and private organizations
South Carolina Department of Health and Environmental Control (SCDHEC)	Coastal Services Project Manager, Planning	State government	Coastal communities, state and local government officials, elected officials
Florida Fish and Wildlife Conservation Commission (FWCC)	Research Scientist	State government	State/local officials, members of the public
Monroe County, Florida, Emergency Management (EM)	Deputy Director of Emergency Management	Local government	Members of the public; also works with businesses, law enforcement, utilities, local/state officials, school boards, the military
City of Myrtle Beach, South Carolina	City Land Use Planner	Local government	Community residents, other planners, developers

2.2 Organizational Research

ERG conducted online research and one-on-one interviews with staff in various organizations and agencies to learn about their risk communication tools and frameworks that might serve as models for NOAA or provide valuable insights and lessons learned.

The two most robust risk communication programs that ERG examined were those of the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA). ERG interviewed Dr.

Barbara Reynolds, who spearheaded the development of the Crisis and Emergency Risk Communication (CERC) program at CDC, and Dr. Lee Zwanziger, who leads FDA's strategic planning for risk communications and health literacy.

ERG also reviewed risk communication guidance, fact sheets, training, and other materials developed and used by other agencies and organizations. In particular, ERG examined two risk communication lexicons—one developed by the Department of Homeland Security (DHS) and the other by the Intergovernmental Panel on Climate Change (IPCC). In addition, ERG looked at tools developed by the Federal Emergency Management Agency (FEMA) (Table 3).

Table 3. Tools and Resources Examined From Other Agencies

Agency	Tools and Resources
CDC	Manual, templates, training, and other tools
DHS	Lexicon, manuals
IPCC	Lexicon; communication manuals and a visual library developed by other organizations for IPCC
FEMA	Training course, fact sheet
FDA	Strategic plan, advisory committee, manual, training

Appendix C presents findings from this research, including other agencies' tools and practices and their potential applicability to NOAA. Appendix D presents a crosswalk of the findings across the internal and external interviews and the organizational research, while Appendix E provides a summary of risk-related challenges at NOAA, potential solutions, and best practices identified through ERG's research.

2.3 Development of Risk/Uncertainty Communication Practical Guide and Pilot Program

Drawing on the interviews and research findings, NOAA risk communication materials, and best practices in the field of risk communication, ERG drafted *A Practical Guide for Natural Hazard Risk Communication* for NOAA LOs. The guide walks the user through a step-by-step process for developing an informed plan for risk communication, and for preparing to implement, evaluate, and refine the plan (Figure 2).

After revising the guide in response to review comments, ERG conducted pilot testing of the draft guide with representatives from the LOs, and revised the guide to incorporate pilot testing results. Appendix F presents the pilot testing instrument along with a summary of the results. The final guide will be posted on a website for download.

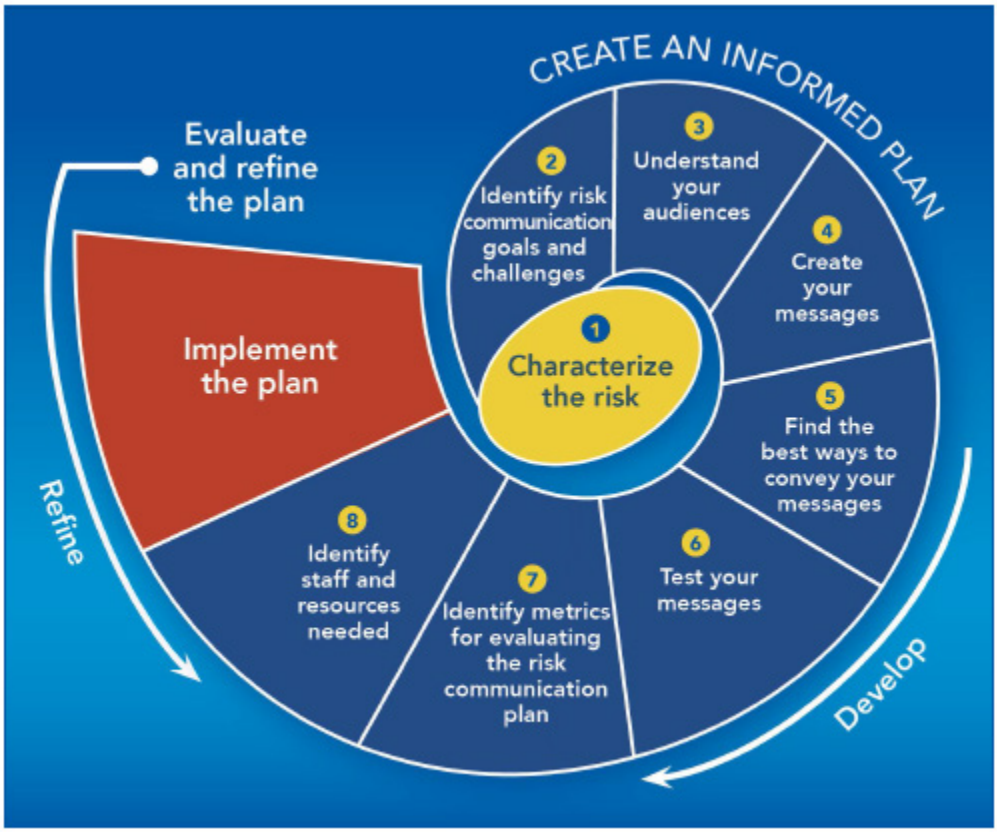


Figure 2. Steps of Risk Communication

3. FINDINGS

This section synthesizes and summarizes findings from ERG's interviews and organizational research (presented in more detail in Appendices A through E). These findings form the basis for the recommendations presented in Section 4.

3.1 Overview of Risk Communication at NOAA

3.1.1 Types of Risks

NOAA's work is diverse, spanning from space to sea. It involves gathering and delivering environmental data, maintaining assets and infrastructure, interfacing with stakeholders, and developing tools and resources to help the nation prepare for, manage, and respond to a wide array of hazards.

This diversity of work means that NOAA must address and communicate about a wide range of risks to external stakeholders and within the agency. Risks requiring communication to external stakeholders and the public include:

- **Environmental risks**—threats to the environment, ecosystems, or living organisms. Example: risks to ecosystems from oil spills.
- **Societal risks—**harm or injury to individuals or populations, people's well-being, or quality of life. Example: risks to people's health and well-being from harmful algal blooms.
- **Economic risks—**loss or disruption in businesses or industries, reducing economic stability or viability in a region or the nation. Example: risk to the fishing and tourism industries from ocean acidification.

In addition to addressing risks to people, ecosystems, and society, NOAA must consider **reputational risks—** harm to NOAA's reputation or credibility. Examples include a failed weather forecast, uncertain or changing climate change projections, or perceived slow response to an event such as a stranded whale.

A hazard may give rise to risks spanning multiple categories. For example, an aging NOAA ship could lose some surveying capability, affecting NOAA's ability to complete a fish stock assessment and posing reputational risks to the agency. Incomplete or inaccurate stock assessments could lead to poor decisions that, in turn, could affect fish stocks and people's livelihoods.

Examples of Risks Addressed by NOAA Line Offices

The hazards and associated risks that NOAA LOs address are wide-ranging and diverse—from life-threatening weather events, to hazards to ecosystems, to long-term threats to communities and the economy. In many cases, multiple LOs, or all of them, have a role in characterizing and communicating a particular risk. For example, all LOs have a role with respect to oil spills. Additional examples include:

- Marine debris
- Coastal inundation
- Ocean acidification
- Extreme weather
- Overfishing
- Fish diseases
- Harmful algal blooms
- Lightning
- Dangerous waves and currents
- Invasive species
- Wildfires
- Aviation hazards from volcanoes
- Drought
- Arctic sea ice loss
- Navigation hazards
- Aging NOAA research vessels and aircraft

NOAA LOs, therefore, often must address multiple interconnected risks. All such risks are important to address and require thoughtful communication, whether to external stakeholders or within the agency. The *Practical Guide* developed under this project focuses on external risk communication, drawing on social science research to guide the interaction between NOAA and its external stakeholders and the public.

Risk Communication in Action at NOAA

National Marine Fisheries Service:
Mitigating a Reputational Risk Through Better Crisis Communication

THE CHALLENGE

Seeing a wild animal in distress can be a heart-wrenching experience. A person's first impulse may be to rescue the animal—but that may not always be the best choice, for either the animal or the person. NOAA Fisheries, which coordinates emergency responses to distressed marine mammals, must communicate quickly and effectively during these crises—no easy feat when an animal's life is in danger and people's emotions run high.

In 2016, a large humpback whale was stranded on Long Island, New York. A local foundation tried to move the whale, but was unsuccessful and the whale could not be saved. Some community members were extremely distressed over the situation and felt NOAA did not respond quickly enough.

NOAA works with a local veterinary team to assist a humpback whale stranded on a Long Island beach.

THE SOLUTION

NOAA Fisheries took a number of steps to address the situation. The Regional Administrator apologized for a lack of communication between NOAA and the community about the decisions being made. A town hall meeting was held to hear the community's concerns and rebuild trust. Measures were also put in place to avoid such events in the future, including a clear incident command structure. These lessons learned have all been captured in a crisis communications guidance manual for NOAA.

3.1.2 Aspects of Risk

Interviewees from the NOAA LOs cited the following aspects of risk that influence their risk communication activities:

- **Temporal scale.** Some risks, such as those arising from storms or equipment breakdowns, are immediate or short-term, while others, such as pollution and climate change, are more long-term. Communicating imminent versus non-imminent risks requires different messaging, approaches, and even channels.

- **Spatial scale.** Risk information is relevant to different stakeholders at different geographic scales—from the local or community level to state and national levels.
- **Static versus dynamic risks.** Certain risks remain relatively constant over time (e.g., all machines break down eventually; invasive species transfer is an ongoing risk), while others are constantly changing (e.g., wildfire risk, which is tied to precursor conditions and specific weather events, and also changes over longer climatic time scales).
- **Severity.** Some hazards entail especially dangerous or even life-threatening risks, while others present more moderate risks.
- **Predictability.** Some risks are predictable; others are less so. For example, a predictable risk for OMAO is an aircraft's particular useful life, while an unpredictable risk is an unexpected malfunction in a system.
- **Controlled versus uncontrolled risks**. Some risks can be planned for; others cannot. For example, NESDIS can control for the planned obsolescence of a satellite series, whereas no one can control the weather.

3.1.3 Framing Considerations

Internal and external interviewees cited the following as key considerations influencing how they frame their risk communication:

- **Uncertainty.** Interviewees expressed the need for NOAA to be transparent in its communication of uncertainty, while acknowledging the challenge of that communication. Many interviewees stated they express uncertainty differently depending on the audience, and some mentioned they struggled most with how best to communicate uncertainty to less sophisticated users.
- **Impacts.** Many internal and external interviewees discussed the need for NOAA to communicate impacts, or "what's at risk." NWS acknowledged the importance of communicating impacts on a continuum before, during, and after an event and of communicating *changing* impacts.
- **Tradeoffs.** NMFS interviewees described the need to communicate and frame risk tradeoffs (e.g., allowing fishing while fish stocks are low while also communicating the risks of overfishing); such communication is relevant across all LOs. For example, NESDIS might need to communicate the risk tradeoffs of delaying a spacecraft launch, while NWS might communicate the risk tradeoffs of not evacuating a community in the face of a hurricane.

3.1.4 Audiences

Internal interviewees described the audiences, customers, partners, and stakeholders for risk communication activities at their respective LOs as follows:

- **NWS.** Provides direct support to government decision-makers and safety officials for hazardous weather and non-weather events. NWS reaches locally into communities by providing consistent impact-based decision support services to these partners. In addition, NWS's local, regional, and national centers and offices work with local emergency managers to communicate weather impacts for major events that have an impact on public safety. Based on the nature of information-sharing activities, NWS defines three audience levels: deep relationship core partners, core partners, and general partners/public.
- **NMFS.** Defines its primary customer as Congress. Defines partners as fisheries management councils and state agencies, environmental nongovernmental organizations (NGOs), internal

regional offices, federal and international agencies, and other LOs. NMFS is also undertaking an effort to increase engagement with the recreational fishing community.

- **NOS.** Defines partners as collaborators, including NOAA offices; external partners such as the Coast Guard, EPA, and U.S. Army Corps of Engineers; and non-federal partners such as commercial entities, the maritime community, universities, and NGOs such as The Nature Conservancy. NOS is attempting to find partners within coastal recreational communities with a conduit to public and community. Customers include sanctuary programs, coastal managers, floodplain managers, state environmental agencies, municipalities, and maritime communities. For NOS's Office for Coastal Management (OCM), the key focus is on external customers—states, NGOs, the coastal management community, and floodplain managers.
- **NESDIS.** Defines **s**takeholders as those that "influence our ability to work or depend on us to function" (e.g., Congress, the media). Defines partners as "collaborators who do not directly affect our existence or operations (they do same kind of work we do to accomplish mutually beneficial goals)." Partners include meteorological organizations in the United States and internationally; the Navy and Air Force; NASA, FEMA, USGS, and DOI; and state and regional climate centers (NESDIS disseminates data through these public-facing agencies). Internal partners include the National Centers for Environmental Information (NCEI) and NOS.
- **NOAA Research.** Defines internal partners as NWS, NMFS, and NOS. Defines external partners as EPA, the military, and emergency managers at national, state, and local levels. External partners also include international organizations for technology transfer and support (e.g., Taiwan). NOAA Research also supports several international agreements related to such issues as acidification and marine observations. NOAA Research laboratories also work with universities, think tanks, and academia. Congress is another audience, as NOAA Research promotes high-visibility projects to appropriations committees.
- **OMAO.** Identifies primary stakeholders as internal NOAA scientists, with NMFS as its largest customer. External partners include FEMA and NASA**.**

Risk Communication in Action at NOAA

National Environmental Satellite, Data, and Information Service: Keeping a Key Stakeholder Informed

THE CHALLENGE

NESDIS transforms satellite data and other data into information products that help users protect the nation's environment, economy, and way of life. Given its mission, NESDIS faces intense scrutiny by many stakeholder groups, including Congress, where staffing turnover is frequent and influence over NESDIS's budget and mission is strong.

THE SOLUTION

NESDIS proactively reaches out to Congressional staff and comes to briefings prepared to explain program risks and uncertainties. To inform this process, NESDIS frames uncertainties and develops flyover scenarios, which illustrate operational satellites and planned mission lives.

Risk Communication in Action at NOAA

Office of Marine and Aviation Operations: Building Trust With Stakeholder Communities

THE CHALLENGE

OMAO fleets routinely assist in national emergencies, and OMAO personnel face personal safety risks whenever they are in the air or at sea. OMAO must also contend with a reputational risks, such as when it considers relocating a base of operations. These situations can be highly charged with much at stake—both for the community that is losing the base as well as for the new community where the operations must be integrated.

In 2009, OMAO decided to relocate a portion of its Pacific Marine Operations Center from Seattle, Washington, to Newport, Oregon. The relocation had been under consideration for years after a fire destroyed portions of the facility in 2006. However, Seattle and Bellingham protested the move, and some media also criticized the decision.

Pacific Marine Operations Center in Newport, Oregon.

THE SOLUTION

OMAO extensively detailed for the community the rationale behind its decision to relocate. It also applied the lessons learned from this experience when it relocated another portion of its fleet in Florida. This time, OMAO was proactive in its media and community relations. OMAO hosted press events, as well as an opening ceremony and open house in the new location. To further build relationships in the new community, OMAO provided guest speakers at local institutions and schools. This communication was instrumental in making the relocation a success.

3.2 Risk and Uncertainty Communication Strengths and Capabilities at NOAA

As an agency, NOAA has many strengths and capabilities, recognized by both internal and external interviewees. These include the following:

NOAA is a trusted, credible source of risk information. All external interviewees found NOAA to be a trusted, high-quality, and credible risk information source. They universally praised the quality of NOAA data and the professionalism, responsiveness, and accessibility of NOAA staff.

NOAA staff are highly engaged. Many external interviewees cited the good access and strong working relationships they have with NOAA staff. Interviewees reacted positively to liaison positions, such as those with NWS/FEMA and with the NOAA Great Lakes Environmental Research Laboratory/Sea Grant.

NOAA's work is interconnected. Even though different LOs contend with different risks, their work is often highly interconnected, presenting opportunities for collaboration and synergies. The foundational research, data, and infrastructure provided by one office can help other offices assess and characterize risk and uncertainty, transfer this knowledge internally and externally, and promote informed decision-making. LOs also share a common need to understand their stakeholders' risk communication needs and their own capacity for meeting these needs.

NOAA has positive and productive partnerships. Generally, external interviewees were very appreciative of their positive and productive working relationships with NOAA staff. Several interviewees stated that NOAA has taken steps in recent years to strengthen its stakeholder and partner engagement. The Weather-Ready Nation Ambassadors initiative (see box) is just one example of how NOAA is working with partners to help translate and amplify NOAA risk messaging as well as connect NOAA with its diverse audience base.

External interviewees found NOAA to be most effective when it:

- Tailors its risk information to audience needs and delivery preferences.
- Communicates information that is digestible by multiple audiences, from citizens to scientists.
- Redesigns websites to make them easy to use and helpful. OCM's website and Digital Coast tools, NOAA Fisheries' website, and the Harmful Algal Blooms (HABs) website all received favorable comments.
- Provides timely information and keeps information updated.
- Develops graphics that are easy to use and customize.
- Is transparent in information exchange and clearly communicates uncertainty.
- Makes tools and resources available to stakeholders and promotes these resources.

Weather-Ready Nation Ambassadors

The NWS Weather-Ready Nation (WRN) Ambassador initiative fosters collaborations across many partner groups to strengthen national resilience to hazardous weather. Organizations that commit to becoming WRN Ambassadors are leaders in their communities, working to keep others informed and prepared to minimize or prevent impacts from extreme weather events.

NOAA LOs are also recognizing that their partnership base is growing and they need to diversify and grow to meet these new partners' needs. Several internal interviewees said they are actively meeting with new partners to learn about their risk communication needs. For example, NESDIS spoke of recent meetings

with the insurance and reinsurance sector, while NWS described partnering with new technology and data analytics companies that are becoming part of the weather enterprise. NMFS mentioned an effort to increase engagement with partners in the marine recreational fishing community.

Risk Communication in Action at NOAA

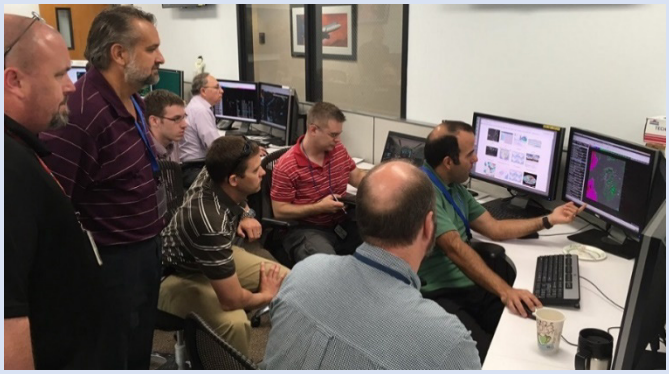
Office of Oceanic and Atmospheric Research: Collaboration to Test Models and Systems

THE CHALLENGE

NOAA Research provides the foundational knowledge to support NOAA LOs, as well as partners around the globe. While NOAA researchers are always working to develop the best possible models and systems from a science and technology perspective, they know that even the most state-of-the-art product may not function as expected in an operational situation.

THE SOLUTION

NOAA scientists have learned from experience that the best possible products and services are those developed in collaboration with NWS forecasters—*before* a product becomes operational. Through rigorous testbeds and other experiments, NOAA researchers and forecasters now get a chance to try new methods and systems in an operations-like setting. These collaborations allow NOAA to effectively to pave the way for transitioning research to operations—whether that means identifying training needs, workflow adjustments, or changes to the product or service itself.



NOAA and partners test models and systems for an aviation weather experiment.

NOAA is evolving its risk communication. Many LOs are working with social scientists to better understand their customers' information needs and decision processes, as well as to improve their products and services and strengthen their own risk communication capabilities. For example:

> *Our role has changed from just providing the data to adding value to the data and communicating the risk beyond the data.*
>
> —Internal NOAA interviewee

- NWS, NMFS, and NOS have funded many social, behavioral, and economic studies and research efforts.
- A group of NESDIS scientists in Boulder, Colorado, are working with social scientists to study aviation sector decision-making processes for winter weather.
- NOS's OCM has been a leader in helping to integrate social science into physical science at the agency. It manages a contract to fund social science efforts in NOAA and offers a host of risk

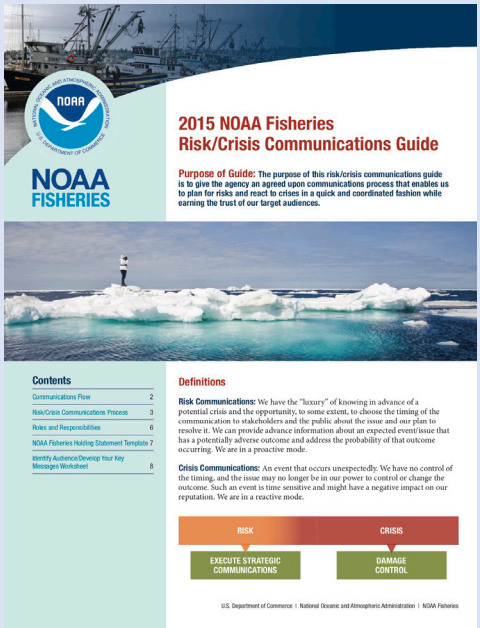
communication trainings and tools. It also sponsors the Social Coast conference to share research and best practices.

- NWS is actively moving toward impact-based decision support services and communicating impacts on a continuum before, during, and after an event. External interviewees embrace these efforts. One NWS partner stated that having NWS staff embed with them during an emergency is "huge," while another commended the local NWS Weather Forecast Office for its high level of engagement with stakeholders.
- An external interviewee commended NMFS for investing in outreach over the past 10 to 15 years, stating that the office is now effectively getting risk information into the hands of regulators and the public.

Risk Communication Best Practices at NOAA

Internal interviewees identified best practices from their risk communication activities, including:

- **Integrating social science into physical science.** OCM manages a contract to fund social science efforts in NOAA and offers a host of risk communication trainings and tools. It also sponsors the Social Coast conference to share research and best practices. NWS, NOS, NMFS, NESDIS, and NOAA Research are all working with social scientists to better understand their customers' information needs and decision processes, as well as to improve their own risk communication capabilities and products.
- **Communicating the potential impacts associated with risks**. NWS is moving toward providing impact-based decision support services and communicating impacts on a continuum before, during, and after an event. NWS is also focusing communication on changing impacts—and how they affect preparation decisions, rather than just the meteorological information.
- **Collaborating internally**. An NWS interviewee cited the recent internal collaboration between field offices and the National Hurricane Center during Hurricane Harvey as a best practice.
- **Developing protocols for messaging**. NMFS, for example, has developed crisis communications guidance.
- **Developing and engaging external partnerships.** NWS described effective work with external partners, including nontraditional ones like faith-based organizations, to broaden its risk communication.



2015 NOAA Fisheries
Risk/Crisis Communications Guide

NOAA FISHERIES

Purpose of Guide: The purpose of this risk/crisis communications guide is to give the agency an agreed upon communications process that enables us to plan for risks and react to crises in a quick and coordinated fashion while earning the trust of our target audiences.

Contents

Communications Flow 2
Risk/Crisis Communications Process 3
Roles and Responsibilities 6
NOAA Fisheries Holding Statement Template 7
Identify Audience/Develop Your Key Messages Worksheet 8

Definitions

Risk Communications: We have the "luxury" of knowing in advance of a potential crisis and the opportunity, to some extent, to choose the timing of the communication to stakeholders and the public about the issue and our plan to resolve it. We can provide advance information about an expected event/issue that has a potentially adverse outcome and address the probability of that outcome occurring. We are in a proactive mode.

Crisis Communications: An event that occurs unexpectedly. We have no control of the timing, and the issue may no longer be in our power to control or change the outcome. Such an event is time sensitive and might have a negative impact on our reputation. We are in a reactive mode.

RISK — EXECUTE STRATEGIC COMMUNICATIONS
CRISIS — DAMAGE CONTROL

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries

Clear protocols for messaging, particularly in emergency or crisis situations, are a best practice in risk communication. The 2015 NMFS Risk/Crisis Communications Guide provides an agreed-upon communications process that facilitates planning for risks and reacting to crises in a quick and coordinated fashion, while earning the trust of target audiences.

Risk Communication in Action at NOAA

National Weather Service:
Ensuring Consistent Messaging to Protect Lives

THE CHALLENGE

Many diverse stakeholders rely on NWS information to make critical decisions before, during, and after a weather event. NWS's ability to provide timely, accurate impact-based decision support services is crucial during these events.

In 2017, Hurricane Harvey made landfall in Texas as a Category 4 hurricane, bringing high winds, tornadoes, storm surge, and heavy rainfall. Many areas experienced catastrophic flooding. Multiple NWS Weather Forecast Offices needed to communicate information about the hurricane and its potential impacts to external stakeholders, while also coordinating internally at local, regional, and national scales.

THE SOLUTION

To coordinate internally during Harvey and ensure consistent external messaging, all affected Weather Forecast Office managers communicated with one another via group text messaging, while forecasters used a coordination software tool to talk with one another. Weather Forecast Offices were also in constant communication with the Storm Prediction Center and the National Hurricane Center.

Weather Forecast Offices pioneered new approaches to further enhance impact-based decision support services: NWS Houston teamed up with the West Gulf River Forecast Center for a series of flood-focused webinars, while NWS Lake Charles used Facebook Live to provide up-to-the-minute updates to partners and the public.

3.3 Risk and Uncertainty Communication Challenges at NOAA

In addition to identifying key strengths, the research for this project also revealed challenges to integrating effective risk and uncertainty communication at NOAA. Some challenges stem from communicating science or data, which may be inherently uncertain, dynamic, or complex. Other challenges are cultural, organizational, or operational, relating to NOAA's structure, management, or workforce. Still others are connected to technological or political constraints. Key challenges include the following:

NOAA LOs lack a common, consistent language for communicating risk. NOAA LOs are concerned with many different kinds of risks and uncertainties—both internal and external to the agency—and the terms themselves mean different things to different people. For example, when asked to define *risk*, internal and external interviewees provided responses ranging from weather and environmental hazards, to reliability of ships and aircraft, to lack of information for effective decision-making, and more. Even when terms are defined (e.g., NWS Storm Prediction Center's severe thunderstorm scale/words), there is no

guarantee that they are being used consistently across NOAA, or that external partners accept or use these definitions.

Certain aspects of risk are particularly problematic to communicate. Communicating long-term risks versus short-term risks is difficult because people tend to perceive immediate threats as more urgent and relevant than future problems. Compounding this challenge is the fact that while some long-term risks may not be relevant for years, NOAA's customers need information on short horizons to make decisions. In addition, the spatial scale of NOAA's risk information may not line up with customers' needs. For example, national sea level rise data are not necessarily applicable at the local level; more granularity is needed for a local planner to even begin to assess the potential risks and convey these to the community. Conversely, much weather information is geared toward a local scale, but that information is less useful for federal and state planning and risk communication.

All LOs struggle with communicating uncertainty, especially to nontechnical audiences. Internal NOAA interviews revealed that explaining uncertainty without losing credibility can be a challenge for NOAA scientists and leaders alike. One interviewee commented that "acknowledging uncertainty doesn't mean you [as a staff member] don't know what you are doing." Yet, leadership does not always recognize this, and instead wants to convey a more unequivocal message.

> *Scientists can overcommunicate the uncertainty, while leadership can be reluctant to acknowledge uncertainty*.
>
> —Internal NOAA interviewee

Different LOs take different approaches to expressing uncertainty; there is no universal language for talking about uncertainty across NOAA. Some use numbers (percentages, ranges); others use verbal expressions (likely, most likely) or a combination of numbers and words to express probabilistic information. While a standardized terminology would be helpful, research has found that people can interpret phrases such as "likely" and "very likely" differently,[4] and any NOAA lexicon would need to reflect the way people intuitively interpret words. Even if terms were used uniformly internally, there is no guarantee that they would be interpreted consistently outside of the agency.

Responsibility for risk communication is sometimes unclear. Some internal interviewees expressed ambiguity about whose role it is to deliver risk information; some LOs consider risk communication part of their work, while others do not. A mindset exists among some scientists that it is not their job to communicate their science—or that it is a job for "translators." One NOAA interviewee stated, "Explaining the science takes time away from doing the science."

While some offices may not embrace an explicit role in risk communication, they *do* engage in it, whether at a press conference about the relocation of a base of operations, a Congressional briefing on a satellite mission, or a presentation by a scientist to a group of partners. An external interviewee commented, "Communication should not be left to an outreach specialist; they don't understand the intricacies of your work."

[4] Ho, E.H., Budescu, D.V., Dhami, M.K., and Mandel, D.R. 2015. Improving the communication of uncertainty in climate science and intelligence analysis. Behavioral Science and Policy 1(2):43–55.

Many LOs lack risk communication experience and do not have the resources to build their capacity. While some LOs have incorporated social and behavioral science research into their product development and risk communication, others have not. Every LO has limited funding and resources to develop risk communication strategies and guidelines.

Resource constraints also affect LOs' ability to provide timely data and information to their audiences. Data may not get updated as frequently as partners would prefer. While external interviewees cited NWS for its timely risk information, others suggested that some NOAA information (e.g., glider information for HABs, LIDAR data, publications or tables on NOAA Fisheries website) was not updated as frequently or as rapidly as needed.

In addition, technology is not always as modernized as desirable; IT resources can be scarce or not timely. Lacking the best technology can mean that the agency does not have the best information from which to interpret and communicate risk, while clunky data tools can frustrate audiences—so that even if risk information is available, users might not access it.

Resources available for website development are limited. As a result, it can be difficult to find information on some NOAA websites, even for sophisticated users. Some NOAA website interfaces look dated, which makes NOAA look less authoritative, especially when NOAA spokespersons show their data along with other partners, who have more sophisticated visualizations.

Existing NOAA risk communication resources are underutilized. Some LOs have developed evidence-based risk communication tools, guides, and training, but these resources are not gathered in one place, and many staff are not aware they exist. Some external interviewees stated that potential end users are not aware of certain NOAA tools or expertise. One person noted that her organization needed "re-education" about newer NOAA tools. Several people mentioned OCM's Digital Coast website (several specifically citing the "Topics" or county snapshots) as resources that are not publicized enough. Several internal interviewees stated that they do not have a good sense of what risk communication resources are available or being developed. Some stakeholders also do not know what resources NOAA offers, or they would like to be regularly informed about what is new or available. Several individuals suggested that NOAA could better market or promote its resources, including its people. A contributing factor, cited by NOAA Research, is hesitancy on the part of some scientists to publicize their ongoing work.

Protocols and procedures for risk communication and messaging can be inconsistent or missing. Some internal interviewees said it is unclear "who owns the message." Also, LOs' protocols for crisis communication depend on the high-level administrative staffing in place and the political climate. Some NOAA LOs struggle with ensuring consistent messaging in their risk communication, particularly when different offices are involved and working at different levels (such as national centers and local field offices).

NOAA's risk communication also exists within the context of a broader communications landscape populated with many voices, particularly given the rise of social media. Some offices are more comfortable than others with engaging in social media, and NOAA maintains hundreds of social media accounts, contributing to challenges in internal coordination and consistent communication. There is a need for more standardization in the development and dissemination of risk communication products, which are not always branded or tested with stakeholders before release.

Not everyone knows who their audiences are or how to effectively target those audiences. Some external interviewees expressed that certain LOs did not have a good definition of who their audience is; others felt that some LOs could be customizing their messaging more to different audiences. Some also

wanted more local engagement. All agreed it is important for NOAA to communicate in a way that resonates with audiences.

> *The best work with NOAA has been when they have been engaged with the data needs of the communities… not "here's the data, now go away."*
>
> —External interviewee

Internal and external interviewees also acknowledged that NOAA's audience base has grown over the past decade, encompassing more members of the public than in the past. Many questioned whether LOs were effectively serving this expanded audience, noting that scientists generally tend to be "in the weeds," using language that is too dense with too many technical terms and jargon. Because of the way the information is written, some interviewees have to put additional time into repackaging and tailoring the information for the appropriate audience. One interviewee pointed out that sometimes NOAA presents information in a way that is easy to use, but other times she gets "a spreadsheet with thousands of data points." Interviewees noted that some NWS graphics were easy to use and customize, but others were poorly designed or hard to use.

In addition, there are no guidelines for ensuring that risk messaging and materials are culturally competent, and there is limited translation of messaging and materials into other languages. One external interviewee suggested that more bilingual information is needed from NOAA, not just during severe weather events, but every day. He said, "The Telemundo station in Miami has the highest rating of any station, including English-speaking stations. Using this information, the NWS Weather Forecast Office in Miami should put out information in both Spanish and English proactively."

While engagement and outreach opportunities exist, some could be more fruitful. One person said there is "not always enough trust in the information exchange." Another suggested that NOAA could be more connected to the needs of the end user. Even external interviewees who were highly satisfied with their engagements with NOAA staff noted there were "always opportunities to improve." One person noted that the communication process should be a two-way street, whereby end-users are also doing their part to bring NOAA staff to the table via working groups and other mechanisms.

NOAA LOs generally do not have a good sense of how their risk messages and information are perceived or used. Many interviewees said they rely on anecdotal information to verify their communication. Some LOs deem their communication as successful when they *do not* hear any feedback. At the same time, LOs may lack the capacity, resources, and knowledge to measure their impact. Often, they have qualitative data, but are unsure how to mine this information or apply it to their programs. Testing of messaging and products before, during, and after implementation is limited. There is no agency-wide risk communication plan or performance metrics to measure success. Not all LOs know how to establish a baseline for measurement.

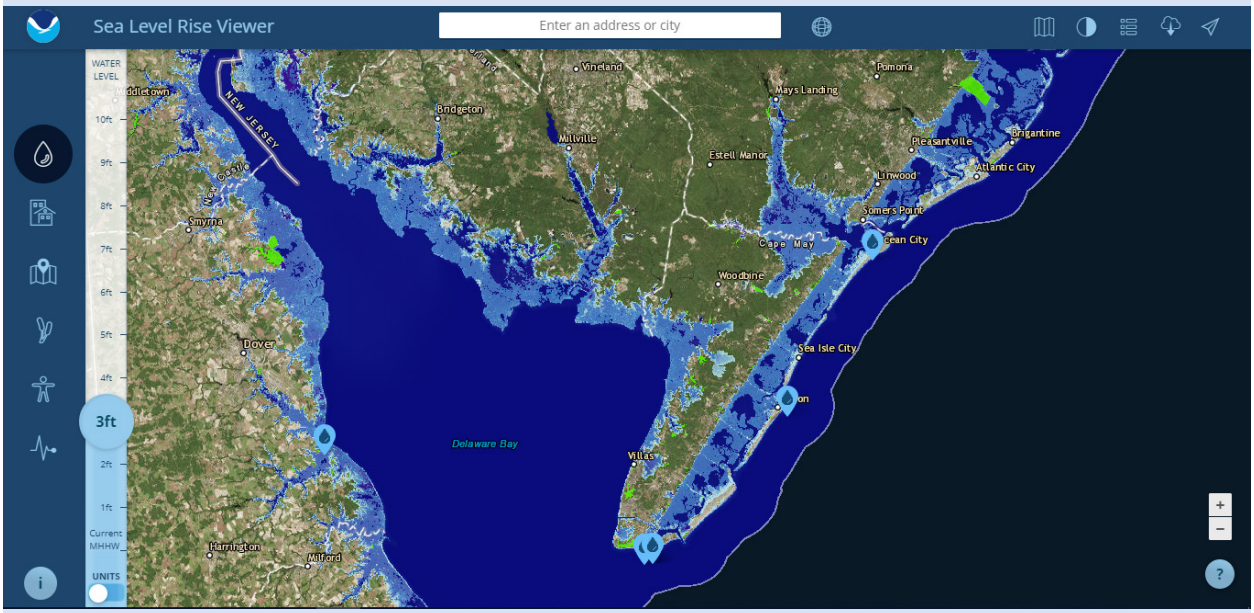
Risk Communication in Action at NOAA

National Ocean Service:
Giving Communities Data They Need

THE CHALLENGE

Coastal communities face many risks, from high-tide flooding to sea level rise to hurricanes. NOS provides science-based solutions to alleviate these and other pressures on U.S. coasts. Meeting the precise requirements of stakeholders with varying needs is not always easy, especially when data are collected at a national level and based on projections many years into the future.

Many communities are struggling to understand their potential risks from coastal flooding and sea level rise. NOS created the interactive Sea Level Rise Viewer to help communities assess their vulnerability under different sea level projection scenarios. However, the tool's national scale means that its spatial resolution may be too coarse to provide the precision that local communities desire for long-term planning.



THE SOLUTION

NOS has worked directly with different communities to help them get the best data possible for their needs. For example, NOS worked with New Jersey to provide the code behind the tool so they could see projected water levels at a 1-meter rather than 30-meter scale. NOS also has partnered with Climate Central, which has developed a complementary tool, Surging Seas. The Surging Seas tool uses NOAA data, including elevations, tide gauge data, and meteorological information, to depict how sea level rise affects U.S. neighborhoods.

4. RECOMMENDATIONS

This section presents six overarching recommendations for strengthening and institutionalizing risk and uncertainty communication at NOAA, along with relevant best practices from other organizations.

Recommendation 1: Secure and maintain leadership support for risk communication activities.

Leadership must be committed to the idea that risk communication is a legitimate activity and also provide resources to support these activities. Additionally, this commitment must be conveyed to all staff who may have a role in risk communication. As one NWS interviewee expressed it: "We need to recognize there is a need in the first place and then get people internally to buy into the need." Not all scientists or people with technical backgrounds feel comfortable communicating risk information or see it as their responsibility, but having leadership support can go a long way toward building a culture that embraces and engages in effective risk communication.

> *Risk communication should become a standard operating procedure, like a seatbelt that you use and don't think about.*
>
> —Dr. Lee Zwanziger, Designated Federal Official for FDA's Risk Communication Advisory Committee

BEST PRACTICES FROM OTHER ORGANIZATIONS

- **Make risk communication a priority for senior and middle managers**. When FDA leadership made risk communication a priority for senior and middle managers, these managers, in turn, were able to engage their professional staff in integrating risk communication into their everyday activities.
- **Enlist champions to launch and sustain efforts**. Both FDA and CDC cited the importance of agency "grassroots" champions who can help get risk communication programs off the ground and provide ongoing support and motivation. FDA found that for its program to be successful, risk communication activities need sustained support and networks of communications specialists committed to gathering and sharing information across the agency.

OPPORTUNITIES AT NOAA

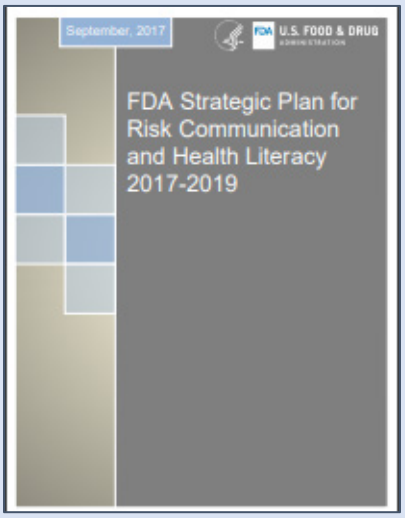
- **Identify existing champions**. NOAA already has some risk communication champions, such as those individuals on the Social Science Committee. Consider ways these individuals could be embedded as "risk ambassadors" into LO initiatives and programs to strengthen risk communication.
- **Formalize risk communication functions.** Consider building risk communication functions into job descriptions and performance reviews.

Recommendation 2: Enhance strategic planning and measurement for risk communication.

Consider developing an agency-wide strategic plan or LO-specific plans with concrete goals, activities, and performance metrics. This recommendation mirrors recommendations from the 2018 National Academy of Sciences study *Integrating Social and Behavioral Sciences with the Weather Enterprise*. While an agency-wide strategic plan can formalize NOAA's risk communication, objectives, players, and promote greater consistency, keeping the plan current and tracking activity across the agency will require dedicated resources and committed people. It might be more effective for each LO to develop its own plan (or refine a plan if they have one) around its own specific objectives and resources, as LOs might feel that an agency-wide program cannot serve their unique needs adequately.

FDA's Strategic Plan

FDA's strategic plan for risk communication was first developed in 2009. The new plan came about because FDA had learned lessons from prior strategic planning, such as to focus more on concrete tasks. FDA uses the plan internally to make clear communication ideals a reality.



BEST PRACTICES FROM OTHER ORGANIZATIONS

- **Establish outcomes first.** FDA developed its plan using a strategic process starting with desired outcomes, then working backwards to determine what activities would bring about these outcomes and what performance indicators would be needed to measure progress.
- **Establish a mechanism and the necessary staff support to collect the data needed to measure progress.** FDA has a large internal workgroup that helps to monitor and track risk communication efforts across the agency. FDA also has an advisory committee that helps to guide, facilitate, and monitor risk communication efforts.
- **Ensure there is leadership support and resources to develop and maintain sustained strategic planning and measurement.** FDA's leadership directed agency staff to develop its Strategic Plan for Risk Communication and Health Literacy, which updates a prior plan that had become out of date. With this leadership support, staff across the agency contributed to the plan and help to maintain it.

OPPORTUNITIES AT NOAA

- **Build on the Social Science Vision and Strategy** already developed by the Social Science Committee, adding specific risk communication goals, activities, and performance measures.
- **Build risk communication planning into each LO** with the help of communications managers, public affairs specialists, or the Social Science Committee. As part of this planning, establish protocols and systems to guide new products and tools, building in appropriate testing and stakeholder collaboration.
- **Have offices that have developed performance metrics, logic models, or other tools share their processes and lessons learned.**

Recommendation 3: Look for opportunities to collaborate internally.

NOAA can take advantage of the interconnectedness of its work to build collaboration among LOs and share resources and best practices. Some NOAA LOs have the benefit of having professionals on staff with specialized knowledge in social and behavioral sciences, communications, graphics, and other fields. Even if a program or office does not have in-house staff with some of these specialties, they can take advantage of existing NOAA tools and training to build staff skills to strengthen risk communication. NOAA already has developed a considerable number of guidance products, tools, and success stories on risk and crisis communication. While these resources tend to be LO-specific and not gathered in any kind of central repository, many have broad application across the agency. They can provide a foundation as NOAA connects and cultivates relationships among individuals with complementary skills (e.g., technical knowledge, digital, social science, and communications) who together can design, disseminate, and evaluate risk communication strategies and messaging.

BEST PRACTICES FROM OTHER ORGANIZATIONS

- **Enlist volunteers for testing.** FDA has addressed its need for message testing by setting up an internal database of volunteers. When a center needs to test a message, it can find eight to 12 people internally, whom it will interview. Volunteers are chosen from outside of the particular center where the work is being done. FDA is large enough that it can apply some desired screening criteria (e.g., people who do not have a college degree, people who speak Spanish) to establish a diversified database.
- **Develop and execute internal campaigns to create awareness of risk communication best practices**. FDA, for example, offers awards to individuals or teams for their efforts in employing plain-language principles to make their websites and documents easier to read.

OPPORTUNITIES AT NOAA

- **Assess risk communication expertise and ancillary skills** (graphics, social media, etc.) within LOs or across the agency, and consider strategies to build capacity by using available talent or by outsourcing these skills.
- **Actively share existing resources** with codified communication protocols and strategies, such as those developed by NMFS.
- **Look across the agency at all the different processes, products, and messages being developed**—particularly across the many NWS Weather Forecast Offices. Assign someone the task of finding and monitoring emerging resources/tools being used across the agency (or LO), then test and implement the best ideas.
- **Work with partners to promote tools;** use their channels and members (e.g., Sea Grant, mentioned by several interviewees) to help promote NOAA risk information and stories.
- **Send out a monthly calendar of events, news, and actionable information** to keep key partners and stakeholders informed of NOAA's activities and resources.
- **Collect and share strategies for building trust and credibility** with partners and stakeholders.
- **Set up collaborative tools to share skill sets.**

Recommendation 4: Build capacity for communication around uncertainty.

As described in Section 3, the LOs face challenges with communicating uncertainty, especially to non-technical audiences, and different offices take different approaches to expressing uncertainty. Better guidance around communicating uncertainty, including a common lexicon, could help prevent misunderstanding and better serve the risk information needs of NOAA's diverse audiences.

Homeland Security Risk and Uncertainty Lexicon

DHS developed a risk lexicon to reduce the possibility of misunderstandings when communicating across DHS and within the homeland security community. Terms and definitions are developed through a collaborative process within DHS. Definitions are then validated against glossaries used by other countries and professional associations and standardized grammatically.

BEST PRACTICES FROM OTHER ORGANIZATIONS

- **Be transparent**. Be upfront about what is known and unknown.
- **Customize messaging and expressions of uncertainty to the end user.** For example, use analogies for less technical audiences.
- **Focus on impacts,** or "what is at risk," rather than probabilities.
- **Develop a validated dictionary or lexicon of terms.**

OPPORTUNITIES AT NOAA

- **Collect strategies and best practices for explaining uncertainty** using proven techniques by NOAA spokespersons, especially for anticipated or recurring situations.
- **Assess how risk and uncertainty terms are used by different LOs** (or within LOs), consider if more consistency is needed, and explore possible solutions, such as a lexicon. Create visualizations, videos, and analogies to help frame and explain risk and uncertainty.
- **Continue to improve methods for visualizing uncertainty**, such as the much-discussed "cone of uncertainty." Use social science methods to develop and test improvements.

Suggestions from NOAA's LOs: Expressing Probabilities and Uncertainty

- Use a **range of values** to communicate possibilities (NWS, NOS, NESDIS, NMFS).
- Focus on **impacts**, especially for audiences that need this information for decision-making (NWS, NESDIS, NMFS). Recognize that some users also need probabilities.
- Use **descriptive words** such as "knee-high" or "waist-high," rather than just numbers, to convey risk information to members of the public (NWS).
- Use terms like "likely" or "highly likely" to frame uncertainty for **long-range phenomena** (NMFS).
- Relate risks to similar or **familiar events** (NWS).
- Use **heightened language** (e.g., catastrophic, life-threatening) when warranted (NWS).
- Don't **overcomplicate** the messaging with a lot of numbers when communicating with public audiences (NESDIS).

Recommendation 5: Help staff who have risk communication responsibilities become more confident and consistent communicators.

NOAA already has the advantage of being viewed positively by partner organizations and stakeholders. The agency can build on this credible reputation for sound science and high-quality data by developing user-centric risk communication strategies that better serve its stakeholders and partners. At the same time, NOAA can take steps to establish internal processes for sharing resources, building capacity, and enabling staff to measure their impacts—and be rewarded for their achievements and performance. NOAA's LOs need strategies for communicating risk on longer-term, evolving scales as well as in short-term, event-driven, crisis situations.

BEST PRACTICES FROM OTHER ORGANIZATIONS

- **Create a plain-language committee or writing center**. Identify high-priority resources to convert to plain language.
- **Develop a library of images.** NASA has created a Conceptual Image Lab where artists work hand-in-hand with scientists to produce engaging visualizations.
- **Use visualizations and storytelling to connect with audiences.** IPCC authors have developed practical guidance on communication and engagement, which includes guidance on both data visualization and storytelling, while the Tyndall Centre for Climate Change Research has drafted guidance specifically on enhancing the accessibility of data visuals.
- **A growing body of guidance on climate change risk communication** is available:
  - A report from Columbia University's Center for Research on Environmental Decisions emphasizes the need to know your audience, tap into their social identities and networks, and tell compelling stories.
  - The Yale Program on Climate Change Communication has created effective messaging around climate change based on an analysis of six distinct audience segments with differing beliefs and characteristics.
  - Yale also has developed a separate report on Latinos' perspectives on climate change, recognizing the need to understand a growing and critical U.S. population group and its differing perspectives and beliefs.

OPPORTUNITIES AT NOAA

- **Develop a consistent visual identity for the agency.**
- **Develop branding guidelines and templates** to ensure consistency and increase development efficiency.
- **Ensure that websites are easy to use, up to date, and mobile-friendly.**
- **Ensure that risk communication materials and messaging are culturally competent and available in different languages.**
- **Develop case studies** of successful, tailored risk messaging within NOAA.
- **Develop different strategies and messaging** for short-term versus longer-term risks.
- **For NOAA briefings, develop best practices, training, and templates.**
- **Publicize what NOAA does, particularly at a local level.** One person suggested NOAA frame social media campaigns around OCM's topics.

- **Draw on the skills of accomplished communicators within NOAA** to help frame and customize risk messaging. Many interviewees internal and external to NOAA provided names of good communicators within NOAA.
- **Incorporate agile development and usability testing into website development.** For example, use cross-functional teams of stakeholders, subject matter experts, and operational staff to provide guidance to development teams.

Table 4 describes several of these opportunities in more detail, and it notes that many of these suggestions arose from multiple sources.

Table 4. Suggested Improvements in Risk Communication Tools and Tactics

Tool/Tactic	Source of Recommendation		
	Internal Interviews	External Interviews	Organizational Research
Briefings: Need to be less dense and better designed • Best practices for presentations • Standard templates • Branding guidelines	X	X	
Graphics/data visualization: Need more/better visualization • Guidance on effective visualization • Hire/train staff to support LOs, centers, etc. • Before/after examples • Story maps	X	X	
Storytelling/messaging: Need to better engage, relate, personalize • Bite-sized science videos and other videos, testimonials, case studies, explainers, podcasts, etc. • Message development training and testing	X	X	X
Plain-language content: Need to reduce technical terms, jargon • Before/after examples • Establish centers/staff who can help • Conduct workshops/courses or tap into external sources • Employee recognition awards	X	X	X
Websites: Need to be intuitive, modern, and mobile- and user-friendly • Incorporate agile development and usability testing • Standardize sites/pages • Establish procedures for timely updates	X	X	
Protocols/governance: Need consistency in messaging, procedures • Develop protocols for crisis management at all applicable levels • Use or improve existing technology tools for coordination (software, text message, phone) • Develop case studies of successful collaborations • Develop or enhance tools that can be easily customized	X	X	X

Recommendation 6: Evaluate training needs and consider incentives.

Internal interviewees expressed a strong desire for more training (see "Training Needs" box below). They also want training geared to their work with relevant scenarios and hands-on exercises. External interviewees want to see risk communication and outreach more thoroughly integrated with everyone's job responsibility at NOAA; they see training as helpful to achieving this integration.

BEST PRACTICES FROM OTHER ORGANIZATIONS

- **Provide training in risk communication fundamentals and make it mandatory for certain staff.** Some agencies require that all personnel who may be involved in conducting risk communication be trained in risk communication fundamentals. To this end, many organizations (including CDC, FDA, and FEMA) provide foundational training to ensure staff have the skills they need to be effective communicators.
- **Provide specialized training targeted to unique groups, and use groups' own materials in the training.** FDA offers risk communication training specific to a group, working with that group's own materials to make the training more relevant and useful.
- **Integrate training concepts into workflows.** FDA and CDC caution that developing risk communication training and guidance is not enough. Such guidance must be integrated into an organization's workflows and become part of relevant staff's everyday activities.
- **Provide incentives for training.** At CDC, certain training modules satisfy supervisory training requirements, and this approach has been popular among employees. CDC also collaborates with national and international partner organizations to provide emergency preparedness and response webinars that can be taken to receive free continuing education credits.

Training Needs Identified by NOAA Staff

- Formal training on how to translate complex scientific information into plain, concise, and conversational language.
- Media training (including mock interviews) for scientists and spokespersons.
- Training on creating better visuals/graphics.
- Social media training and guidelines.
- Training on storytelling/personalizing and customizing communication.
- Training for staff on separating personal opinion and biases from professional messaging.
- Training on crisis communication procedures and protocols.
- Intensive "boot camp" training on risk communication.

OPPORTUNITIES AT NOAA

- **Use existing institutional mechanisms for developing training;** for example, consider integrating risk communications training into NWS forecast training.
- **Customize existing training resources** for LO-specific needs.
- **Engage NOAA's social scientists and communicators** who have already conducted risk communication or media training to help design and deliver training modules.

5. CONCLUSION AND NEXT STEPS

Looking ahead, it will be important for NOAA to consider the challenges identified by internal and external interviewees as part of the research that informed this framework. NOAA can also look to how other organizations have approached risk communication to learn from their experiences.

Based on the research presented in this report, possible next steps for NOAA include the following:

- **Define risk communications objectives for the agency as a whole and for specific LOs, as well as how these objectives will be measured.** As part of this effort, determine what performance metrics can be established and how data will be gathered to track these metrics. Ensuring a sustained effort will require leadership commitment, resources, and a network of champions.
- **Determine how structured and centralized the agency's risk communication efforts should be.** Any kind of risk communication model, plan, or training must be integrated into current organizational cultures and workflows. The advantages of a centralized system are that it provides a more accountable way to guide and monitor the agency's risk communication efforts. Conversely, LOs may feel that an agency-wide program cannot serve their needs adequately, and they may not endorse the effort. Many parts of NOAA operate with some degree of local autonomy; for example, NWS interviewees noted that they have many centers and local offices, which require organizational flexibility.
- **Understand what resources (people, funding, time) are needed and what level of leadership endorsement can be anticipated.** Interviewees suggested that resources are already stretched thin, and LOs may not have the support staff needed to develop, implement, and maintain risk communication plans and strategies. As mentioned by external federal agencies, leadership support is critical. What support can be expected, and how will this commitment be conveyed to senior and middle managers and professional staff?
- **Consider what kinds of training, guidance, and tools are needed—and who needs them.** Training, guidance, and tools must be practical and relate to LOs' processes, audiences, and missions. As evidenced by FDA's experience, using actual LO products in any kind of training or guidance would make the experience more relevant and useful. Also, as demonstrated by the experience of FDA and CDC, it is not enough to simply develop risk communication guidance; rather, such guidance must be integrated into an organization's workflows and become part of relevant staff's everyday activities.

NOAA already has the advantage of being viewed positively by partner organizations and stakeholders. The agency can build on this credible reputation for sound science and high-quality data by developing user-centric risk communication strategies that better serve its stakeholders and partners. At the same time, NOAA can take steps to establish internal processes for sharing resources, building capacity, and enabling staff to measure their impacts—and be rewarded for their achievements and performance.

6. RESOURCES

This section presents resources identified over the course of this project that can assist in implementing the recommendations for strengthening risk communication at NOAA. Table 4 presents resources NOAA has developed; Table 5 presents resources from other agencies and organizations.

Table 4. Internal Resources

Office	Resource	Type	Description
NOAA	Vision and Strategy: Supporting NOAA's Mission with Social Science	Report	Helps NOAA meet its mission and advance its priorities through effective use of social science in and across LOs. One of its goals is to "use social science methods to assess and communicate risk while reducing vulnerability to changing environmental conditions."
NOAA	NOAA Social Science Basics	Training (online, self-guided)	This course focuses on social sciences (e.g., psychology, economics, geography, sociology) that support NOAA's mission and help the agency decide how to communicate effectively, prepare necessary support services, determine where services are needed, and consider other crucial details.
NOAA Social Science Committee	Risk Communication and Behavior: Best Practices and Research Findings	Report	This report reviews risk communication and public response research literature within the context of key episodic hazards relevant to NOAA's mission. It covers three weather hazards (tornado/severe wind, flood, and tropical cyclone), findings for general weather, and three other environmental hazards (tsunami, volcano, and wildfire). These specific hazards were chosen for their relevance to NOAA's mission, priorities, and vision for the future.
NOS	Inundation Dashboard	Visualization tool	Provides real-time and historical inundation information at select NOS stations. The product is available in three regions: New York City/Long Island Sound, Chesapeake Bay, and coastal North Carolina, with additional regions to follow.

Office	Resource	Type	Description
NWS	How to Avoid Getting Caught in a Rip Current	Website	Website that provides a variety of information about rip currents. Topics include rip current safety, surf forecasts, things to know before going to the beach, protective actions to take at the beach, and tips for how to survive a rip current.
NWS	#SafePlaceSelfie	Social media campaign	Social media campaign to raise awareness about extreme weather preparedness activities. Encourages members of the public to spend a few minutes going to their safe place, taking a selfie, and sharing it over social media using the #SafePlaceSelfie hashtag.
NOAA Research	Bite-Sized Science	Videos	A series of short videos that focus on specific activities and projects from the NOAA Weather Partners in Norman, Oklahoma.
OCM	Sea Level Rise Viewer	Visualization tool	Visualizes community-level impacts from coastal flooding or sea level rise (up to 10 feet above average high tides). Provides photo simulations of how future flooding might impact local landmarks, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence.
OCM	Coastal Flood Exposure Mapper	Visualization tool	Supports communities that are assessing their coastal hazard risks and vulnerabilities. The tool creates a collection of user-defined maps that show the people, places, and natural resources exposed to coastal flooding. The maps can be saved, downloaded, or shared to communicate flood exposure and potential impacts.
OCM	Coastal County Snapshots	Visualization tool	Provides managers and citizens with easy-to-understand charts and graphs that describe complex coastal data. Users select a county of interest and the website does the rest, creating a helpful educational tool for governing bodies and citizen groups. Current snapshot topics include flood exposure, wetland benefits, and ocean and Great Lakes jobs.
OCM Digital Cost	Needs Assessment Guide	Self-guided training	An online guide for those with some understanding and experience with conducting needs assessments. The guide provides easy-to-use instruction, along with coastal issue-based case studies and sample reports.

Office	Resource	Type	Description
OCM Digital Cost	How to Write a Strategic Plan	Guidelines, worksheets, and templates	Detailed guidance on how to write a strategic plan, including how to assess the target population, perform a self-assessment, develop a niche, develop program outcomes, and develop a shared vision.
OCM Digital Coast	What Is Storm Surge?	Video	This easy-to-understand video (available in both English and Spanish) describes storm surge and its impacts and why individuals should evacuate.
OCM Digital Coast	Tsunamis: Be Prepared and Stay Safe!	Video	This easy-to-understand video (available in English, Spanish, and Samoan) describes tsunami threats and impacts, as well as how to prepare for and respond to a tsunami.
OCM Digital Coast	Tidal Flooding	Explainer animation (self-guided)	Describes how tidal flooding affects low-lying coastal communities and how sea level rise, coastal storms, and wind and rain greatly increase flood levels and frequency. Also explains how communities can prepare for these events.
OCM Digital Coast	Flooding Resilience Meeting Template	PPT template	Customizable template for local officials and those conducting public outreach in coastal communities. Officials/presenters should add as much local context as possible so it will resonate with a local audience. Includes tips and suggestions for how to apply risk communication and stakeholder engagement techniques, as well as ideas for how to create interactive graphics and illustrations to keep the audience engaged and allow them to be heard.
OCM Digital Coast	Are You Flood Ready?	Infographic	Concise, visual infographic that describes flood risks for houses in flood zones and how to prepare.
OCM Digital Coast	Coastal Inundation Toolkit	Training (online, self-guided)	This toolkit shows how data, tools, and other information within Digital Coast can help communities tackle coastal inundation. It provides steps for identifying inundation risk and guidance for visualizing and communicating those risks to community members. The toolkit also includes examples of what other communities are doing to address inundation impacts.

Office	Resource	Type	Description
OCM Digital Coast	Risk Communication Best Practices	Tip sheet/quick reference	Brief PDF tip sheet that provides seven best practices and techniques that can be applied to all risk communication conversations and produces.
OCM Digital Coast	Seven Best Practices for Risk Communication	Training (online, instructor-led)	An instructor-led, interactive webinar that introduces participants to seven best practices, numerous techniques, and examples for communicating about coastal hazards. Participants will learn how to apply the best practices/techniques, use the fundamentals of behavior change to improve communication, and adapt strategies from successful case studies.
OCM Digital Coast	Risk Communication Basics	Guidebook	Helps community leaders understand and connect with stakeholders and inspire risk-wise behavior through improved communication. Shares insights into why people respond to risk the way they do, and provides examples and tips for working with residents to explore solutions and make decisions to improve the resilience of coastal communities.
OCM Digital Coast	Understanding Risk Behavior: The Fundamental Challenges	Tip sheet/quick reference	Identifies suggestions and best practices to communicate risks and change public behavior.
OCM Digital Coast	Risk Behavior and Risk Communication: Synthesis and Expert Interviews	Report	Shows local decision-makers how they can help the public understand the linkages among hazard impacts, community vulnerabilities, and policy alternatives. Describes the processes involved in risk perception, how perceptions are influenced by experience, and what strategies might be effective in promoting better citizen understanding of coastal hazards and more effective mitigation and response. Synthesizes existing social science research on risk behavior and risk communication, and describes interviews with people active in the risk analysis and communication arena for hands-on examples of effective ways to promote behavior that reduces risk to lives and property.

Office	Resource	Type	Description
OCM Digital Coast	Building Risk Communication Skills	Training (classroom, instructor-led)	In-classroom, instructor-led training that provides insights into how and why people respond to risk and helps participants develop new skills to better connect with a variety of audiences. Students learn how to recognize differing values and identify how and why people perceive and respond to risks the way they do, apply social science and risk communication principles when faced with challenging questions, respond to difficult questions with more confidence, and develop an effective risk communication strategy that incorporates relevant and proven principles.
OCM Digital Coast	Introduction to Stakeholder Participation	Report	Describes approaches and key process elements for gathering stakeholder input and incorporating that information into decision-making.
OCM Digital Coast	Great Lakes Beach Hazards: Developing a Risk Communication Strategy for Dangerous Waves and Currents	Report	Presents findings from a research project that identified how beachgoers perceive the risk of dangerous currents and waves in the Great Lakes; evaluated existing messages and delivery mechanisms; translated complex beach conditions into understandable, actionable messages for specific beachgoer audiences; and identified effective delivery mechanisms for specific audiences.
OCM Digital Coast	Storm Surge Marketing	Strategic plan	Guides outreach efforts to communicate the availability of the Potential Storm Surge Flooding Map to its audiences, ensure correct understanding and interpretation of the map, and strive for consistent messaging about the map among NWS partners.
OCM Digital Coast	Summary of Hurricane Local Statement Social Science Projects	Report	Social science research report that provides recommendations to NWS to improve the timing, readability, and usefulness of the hurricane local statements issued by Weather Forecast Offices when an area is under tropical cyclone threat.
OCM Digital Coast	Incorporating Sea Level Change Scenarios at the Local Level	Report	Outlines eight steps to guide local decision makers in developing site-appropriate sea level change scenarios for coastal community planning.

Office	Resource	Type	Description
OCM Digital Coast	Sharing Stories and Improving Discussions About Floodplain Buyouts	Case study	Case study about Jennifer McCulloch, a flood mitigation program coordinator with Morris County, New Jersey, who was tasked with developing a flood acquisition program after Tropical Storm Irene caused record flooding. By using good risk communication techniques, including sharing stories and tailoring the conversation to meet her audience's needs, McCulloch helped local officials see the importance of flood acquisition, and the majority ultimately chose to participate in the program.
OCM Digital Coast	Stories from the Field	Case studies	A collection of stories showing how different organizations use OCM Digital Coast resources to address coastal issues.

Table 5. External Resources

Agency	Resource	Type	Description
CDC	CERC Manual	Guidebook	Describes core emergency and crisis communication principles and provides guidance to leaders and other communicators on how those principles apply to each phase of an emergency. Also discusses key communication challenges during a crisis. Serves as the basis for all other CERC materials and training.
CDC	CERC Templates and Tools	Templates and tools	A collection of quick fact sheets, templates, worksheets, checklists, and assessment materials adapted from the comprehensive CERC manual. People can use these tools during a crisis when they do not have time to read the full manual.
CDC	CERC Resources	Tip sheets/quick reference	Additional resources that supplement and build on the CERC manual. These include: • Quick-reference wallet cards for communicators. • A leadership-specific CERC manual. • Hazard-specific (hurricanes, infectious disease, and Zika virus) CERC guidance. • CDC RiskSmart™ system.

Agency	Resource	Type	Description
CDC	CDC Clear Communication Index: A Tool for Developing and Assessing CDC Public Communication Products User Guide	Guidebook	Provides a set of research-based criteria to develop and assess public communication products. Identifies the most important communication characteristics that enhance clarity and aid understanding of public messages and materials. Provides a research-based tool for staff to develop and assess communication products for CDC's audiences, no matter the format or distribution channel.
Climate Central	Surging Seas: Sea Level Rise Analysis	Visualization tool	Interactive tool that allows users to see maps of areas below different amounts of sea level rise and flooding, down to a neighborhood scale, matched with area timelines of risk. The tool also provides statistics of population, homes, and land affected by city, county, and state, plus links to fact sheets, data downloads, action plans, embeddable widgets, and more.
Climate Outreach	Climate Visuals Project	Visualization tool	Developed by the nonprofit Climate Outreach, this library of visuals is available for communicators to use and is based on seven core principles for effective communication. The principles were developed based on research conducted internationally with the public.
Columbia Center for Research on Environmental Decisions	The Psychology of Climate Change Communication	Guidance	Guidance for anyone who communicates about climate change, from scientists, journalists, educators, clerics, and political aides to concerned citizens. The guide is designed to assist communicators in reaching two key audiences—the general public and decision makers from government and business—more effectively.
DHS	DHS Risk Lexicon	Lexicon	Defines more than 120 terms, encompassing data and statistical concepts such as "likelihood," "joint probability," "marginal probability," and "frequency"; economic concepts ("willingness to pay"); hazard concepts ("mitigation," "hazards"); and risk-focused terminology ("risk," "risk analysis," "residual risk"). The lexicon defines risk communication as "the exchange of information with the goal of improving risk understanding, affecting risk perception, and/or equipping people or groups to take appropriate actions in response to an identified risk."

Agency	Resource	Type	Description
DHS START	Understanding Risk Communication Best Practices: A Guide for Emergency Managers and Communicators	Guidebook	Examines social and behavior science about how people understand risk messages across the preparedness, response, and recovery phases of an event. Distills theoretical understandings of human response into practical implications for officials, on topics such as public trust and emotional response, as well as other factors (proximity to risk, severity of risk, prior relationships with risk and risk communicators).
DHS START	Training in Risk and Crisis Communication (TRACC)	Training (online, in person, or blended)	An interactive training accredited by FEMA that covers four modules to help organizations plan effective communication before, during, and after a crisis: 1) risk and crisis planning, 2) audience analysis and engagement, 3) media relations, and 4) crisis communication simulation.
FDA	Strategic Plan for Risk Communication and Health Literacy (SPRCHL)	Strategic plan	Goals, strategies, and actions for improving the agency's communication of regulated products.
FDA	Communicating Risks and Benefits: An Evidence-Based User's Guide	Guidebook	A scientific foundation for effective communication that grew out of a 2009 meeting.
FDA	Risk Communication Advisory Committee	Website	Reviews and evaluates strategies and research to communicate the risks and benefits of FDA-regulated products. Minutes and presentations from the committee are available on the FDA website.
FEMA	Risk Mapping, Assessment and Planning (Risk MAP) Community Engagement Fact Sheet	Fact sheet/quick references	FEMA develops flood insurance studies and rate maps and provides non-regulatory tools and planning support to communities. A fact sheet entitled "Community Engagement" provides guiding principles for engaging with the community, including guidance on topics such as use of language when communicating with the public, frequency and timing of engagement, and coordination with partners and other organizations for reinforcement of messaging.

Agency	Resource	Type	Description
FEMA	Crisis and Risk Communication Course	Academic course	FEMA's Crisis and Risk Communication is designed as a complete academic course with more than 20 planned course sessions. Its defined purpose is "to present the different forms of communication proficiencies that are likely to be expected of a practicing emergency manager or department/office of emergency management employee during the course of their duties."
IPCC	Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties	Guidebook	Designed to assist lead authors of the Fifth Assessment Report (AR5) in the consistent treatment of uncertainties. The guidance provides definitions of "likelihood" (based on probability of an outcome) and "confidence" (based on agreement and evidence, but not interpreted probabilistically). The guidance assigns numerical values to phrases; for example, the guidance defines "virtually certain" as 99–100% probability, "about as likely as not" to a 33–66% probability and "very unlikely" to a 0–10% probability.
IPCC	Principles for Effective Communication and Public Engagement on Climate Change: A Handbook for IPCC Authors	Guidebook	Distills essential principles for effective communication and engagement with practical tips, including 1) be a confident communicator, 2) talk about the real world, not abstract ideas, 3) connect with what matters to your audience, 4) tell a human story, 5) lead with what you know, and 6) use effective visualizations.
IPCC	Enhancing the Accessibility of Climate Change Visuals: Recommendations to the IPCC and Guidance for Researchers	Guidebook	Provides guidance for researchers on enhancing the accessibility of data visuals while also maintaining scientific rigor using the following principles: 1) does the visual communicate a clear message? 2) is the visual appropriate for the intended audiences? 3) does the visual use evidence-based design principles? and 4) has the visual been tested with the audiences?
Tyndall Centre for Climate Change Research	Enhancing the Accessibility of Climate Change Data Visuals	Guidance	Focuses on 12 evidence-based guidelines for enhancing the accessibility of data visuals while maintaining scientific accuracy. While the guidance is directed at IPCC, the guidance has broad applicability beyond just IPCC data visuals.

Agency	Resource	Type	Description
Yale Program on Climate Change Communication	Engaging Diverse Audiences with Climate Change: Message Strategies for Global Warning's Six Americas	Report	Designed to help communicators understand the sources of diverse perspectives on climate change in the United States and develop messaging content to effectively communicate with these different audiences.
Yale Program on Climate Change Communication	Climate Change in the Latino Mind	Report	Based on two surveys of Latinos' engagement and viewpoints on climate change in the United States. The report summarizes Latinos' beliefs and attitudes, policy and politics, and actions and behaviors around climate change.

APPENDIX A. SUMMARY OF INTERNAL NOAA INTERVIEWS

Background

NOAA's six LOs manage the delivery of products and services to meet the needs of the agency's customers and stakeholders. During January and February of 2018, ERG interviewed 20 people across NOAA's six LOs. These interviews were conducted either in person or via webinar. They ranged from one-on-one sessions to group discussions with two or three people. NOAA identified the interviewees for each LO, and they included individuals who focus on external functions, internal functions, and strategy of internal functions. The interviewees included public affairs/communications specialists, managers/directors, and scientists.

The purpose of the interviews was to glean information on each LO's mission and characterization of relevant risks/hazards, risk messaging approaches, stakeholders and partners, communication channels, risk communication protocols/trainings/tools, messaging successes and challenges, verification methods, and relevant research to operations applications. This appendix summarizes three major areas explored during the interviews: 1) how LOs characterize risks and risk communication, 2) key challenges and solutions, and 3) ideas for enhancing risk communication. A Google spreadsheet provides more details: https://docs.google.com/spreadsheets/d/16r7oHeAxLBDI0UChsHlmsHIMkFWQwf4kY3c4GweFC18/edit?usp=sharing.

Characterizing Risks and Risk Communication Across NOAA

NOAA's work is diverse, spanning from space to sea. It involves gathering and delivering environmental data, maintaining assets and infrastructure, interfacing with a wide variety of agencies, organizations, and members of the public, and developing tools and resources. Of all the line offices, NWS and NMFS are both the most public-facing. NWS predicts, monitors, and communicates risks—sometimes imminent and life-threatening ones—associated with weather, water, and climate. NMFS deals with both short-term risks/crisis situations (e.g., a stranded whale on a beach) and longer-term, non-life-threatening risks (e.g., impacts of climate change on the marine environment). NMFS interviewees also mentioned they must communicate and frame tradeoffs (e.g., allowing fishing while fish stocks are low while also communicating the risks of overfishing) and the risks of *not* managing the marine environment.

NOS provides data, tools, and resources to support other LOs, coastal communities, and a variety of external partners. Messaging focuses on recognizing, planning, and adapting to marine-related hazards, such as flooding, rip tides, inundation, chemical and oil spills, and harmful algal blooms (HABs). It also deals with long-range risks, such as sea level rise. A good deal of work and messaging focuses on resiliency. NOAA Research supports other NOAA line offices, particularly NWS and NMFS, so it also is concerned with weather-related risks, a dynamic environment, and a changing climate, as well as fish populations. Weather-related and environmental risks are also relevant to both OMAO and NESDIS, in their roles overseeing NOAA's assets and infrastructure (e.g., satellites, ships, buoys, aircraft).

For OMAO, key risks include recapitalization, as well as personnel safety and ship/aircraft security and reliability. For NESDIS, there are both service delivery and programmatic risks. One NESDIS interviewee stated, "Risk is something that hasn't happened yet, but could." For example, if NESDIS is relying on weather data for a project, it must consider the risks (in terms of monetary value, impact on the project or other projects) if the data do not arrive on time. Social and economic risks, mentioned only specifically

by NMFS, are also relevant to other LOs, as well. For example, NOS research supports navigation and commerce, while NWS's mission involves protecting life and property.

Roles in Risk/Uncertainty Communication

Different LOs have different views on their role in risk/uncertainty communication, which depends, on part, on their missions, programs, partners, and customers. Some offices, such as NESDIS, NOAA Research, and OMAO, see themselves as largely supporting other NOAA LOs with data, tools, models, systems, and infrastructure. They view risks in association with delivering services and bringing on capability when needed. They view uncertainties in terms of the useful life of a satellite, the performance of a ship, or the reliability and sufficiency of funding mechanisms. However, NCEI, within NESDIS, is somewhat different, since it is collecting, analyzing, and interpreting weather and climate data for a wide variety of customers.

Scientists' Roles in Risk Communication

NOAA is a science agency, and some internal interviewees reflected that there are different opinions about the role of scientists in risk communication. Some offices expressed that scientists are not well-equipped to speak on behalf of NOAA as they are "too into the weeds," don't speak in plain English, and/or use language differently (e.g., bias means something different to a scientist than a member of the public). One NOS interviewee stated that among some scientists, there is a perception that engaging in communication takes time away from doing the science. This raises a "division of labor" question as to whether NOAA scientists should be the ones communicating the science, or does NOAA simply need more "translators" to explain the science? One NOAA Research interviewee stated that "we have trained media spokespersons to speak on behalf of NOAA; that is our way of communicating risks."

Stewardship and Service Functions

In addition to science, NOAA's mission encompasses stewardship and service. One interviewee characterized his office (NOAA Research) as being at the "intersection of science and service." LOs often must balance the fine line between communicating science versus recommending or influencing policies. This fine line may also be a reason why NOAA Research has seen that some NWS and NMFS experts are reticent to publicize their work, even when it has been peer reviewed and published.

Evolving Risk Communication

Some LOs do see risk communication as part of their mission and are actively evolving their capabilities. One NOS interviewee observed that "Our role has changed from just providing the data to adding value to the data and communicating the risk beyond the data; this is a new role for NOS." OCM within NOS sees its role as "bringing people together to talk about what is happening, how they can learn from one another, and share best practices." A session in its biannual Social Coast forum focuses specifically on exploring "failures" and lessons learned.

An NWS interviewee said the LO is moving toward impact-based decision support services and communicating impacts on a continuum before, during, and after an event. NWS is also focusing communication on changing impacts—and how they affect preparation decisions, rather than just the meteorological information.

The Role of Social Science

NWS, NOS, NMFS, and NOAA Research are all working in some capacity with social scientists to better understand their customers' information needs and decision processes, as well as to improve their

products and services and strengthen their own risk communication capabilities. NWS and NOS have funded many social, behavioral, and economic studies and research efforts. NWS pointed to the implementation of storm surge inundation products as a key project that followed years of social science research and testing, while NOS referenced a successful rip current campaign informed by social science research.

Economic studies have long been a part of NMFS's work, and it is also expanding its use of social science to assess social vulnerability and resilience of communities engaged in commercial or recreational fishing. A group of NESDIS scientists in Boulder, Colorado, are currently working with social scientists to study aviation sector decision-making processes for winter weather. NOS/OCM noted that it has played a leadership role for the agency over the past two decades in helping to integrate social science into physical science. NOS/OCM manages a contract to fund social science efforts in NOAA and offers a host of risk communication trainings and tools. It also sponsors the Social Coast conference, mentioned above, to share research and best practices.

Challenges/Solutions

The NOAA LOs shared many risk communication challenges, along with some of the solutions they have implemented. Some challenges stem from the science or data itself—which may be inherently uncertain, dynamic, or complex. Others appear to be more organizational or institutional, relating to NOAA's structure, management, or workforce. Still others stem from administrative, resource, or political constraints.

Communicating Uncertainty

All the LOs struggle with communicating uncertainty or recognize that it is can be a challenge for NOAA. Several internal interviewees (across different LOs) stated that NOAA is inconsistent in the way it defines and communicates probabilistic information. As one interviewee stated: "What does a 'slight' chance mean? The Storm Prediction Center defines it, but terms mean different things to different forecasters–if these terms are not used uniformly internally, they can't be externally." In general, there is no common language for risk and uncertainty communication across NOAA. One person asked: "What do we mean by 'risk,' 'hazard,' 'adaptation,' 'risk reduction'? It is very inconsistent across NOAA. We must have everyone on same page talking about risk."

Interviewees also pondered whether it was better to use numbers (percentages, ranges) or words (likely, most likely) or a combination of numbers and words to express probabilistic information. NOS stated that for sea-level rise projections, it uses a "range of values," which is similar to their partners' characterizations. NMFS will use terms such as "likely" of "highly likely" to frame uncertainty for long-range phenomenon, particularly for members of the public who may not understand that the science is "not 100 percent certain."

In fact, several internal interviewees observed that the expression of confidence or certainty depends on the audience. One interviewee commented that NESDIS often communicates confidence by binding data within numerical ranges, but that with some audiences, it's better to "not overcomplicate the message with complicated numbers." Another interviewee observed that NOAA scientists can overcommunicate the uncertainty, while leadership is not nuanced enough in talking about uncertainty. NOS interviewees noted that they struggle with communicating uncertainty, whether it's rip currents or sea level rise projections, particularly when communicating with the public. They mostly use common vernacular to communicate probabilistic information to members of the public, but also acknowledged shying away from this communication, likening the challenge to a "lightning rod that is difficult to touch."

Providing data sources associated with risk information can also be challenging. A public affairs specialist stated that the number one question he is asked in relation to climate data is "what the data source is." But the information he is providing may be based on "millions of sources of data, some of which gets thrown out…some of which is in the weeds of statistics and probability." An additional challenge is providing raw data that could be subject to bias from people who are interpreting it without a scientific background.

SOLUTION: PARTNER EDUCATION

Some LOs are finding that partner/customer education over time can reduce the difficulties of trying to explain uncertainty. NCEI has observed a large increase in the people looking at uncertainty with weather and climate, including new sectors like the insurance/reinsurance industry, who are trained to use the data. With these customers, "we don't need to explain all of our uncertainty away. That makes the communication a little easier, but the science a little harder." NOS and NMFS have also found that building trust with partners over time helps boost their confidence in the NOAA spokesperson providing the data and the uncertainties being conveyed. NOS has also found that there can be a "shock value" with long-term projections, so it uses strategies such as starting a presentation with shorter-term projections (e.g., 40 years rather than 100 years).

Inconsistent Messaging/Protocols

Some offices, such as OMAO, have rigorous protocols in place for emergency response, diving safety, etc. One internal interviewee suggested that for many LOs, however, there is very little "top-down" communication in NOAA. This can be a "plus" in that it provides flexibility to LOs, field offices, and centers. But it also means that different LOs can have different protocols for risk communication, particularly during crises, and that there can be a lack of clarity around "who owns the message." One interviewee observed that because NOAA is under Department of Commerce, different LOs' protocols for crisis communication depend on the high-level administrative staffing in place and the political climate.

Both NMFS and NWS have struggled with ensuring consistent messaging in their risk communication. NMFS has applied lessons learned from crises to make its internal messaging consistent and has developed detailed guidance to guide messaging in such situations. NWS stated that it has been focusing on ensuring messaging is consistent from its national offices. While acknowledging there are differences in messaging from at a local (field office level) versus a national center or office level, NWS is also working to help NWS field offices not only in *what* they communicate, but with *whom* they communicate. For example, one interviewee pointed out that not all Weather Forecast Offices recognize or prioritize the need to identify vulnerable populations or to engage certain, less traditional partners, such as churches. One NWS interviewee noted that the field offices are all "doing what they want" to some degree when it comes to risk communications. There also are not standard templates for communication across Weather Forecast Offices, though a goal is to gather and share tools and best practices.

NWS also operates within the context of a broader weather enterprise with many voices, particularly with the rise of social media. One internal interviewee characterized the social media landscape as the "wild west," with NWS trying to assume a role as the "honest broker in the room." At the local level, one NOAA interviewee observed that "some field offices do better" than others in using social media effectively.

SOLUTION: TRAINING

A couple of years ago, NWS brought all of its Warning Coordination Meteorologists to the Silver Spring campus for training, including risk communication. Some centers also conduct trainings and boot camps (a component of which is risk communication and safety messaging). NWS also is planning a training for

messaging do's and don'ts and a blog for communicating everything from frequent grammar errors to how to hold a meeting to how to make a better presentation.

SOLUTION: CLEAR PLANS AND PROTOCOLS

NMFS has developed a detailed crisis communication guide (see Figure A-1) with established protocols, communication flows, and notification procedures, while NWS has established a rapid response team with standard operating procedures. Additionally, one NWS region (Eastern) has a crisis plan. NMFS also conducts hot washes after each event to apply lessons learned. It has taken steps to be proactive and get its narrative communicated (such as by placing calls to the media), as well as by engaging and listening to the local community. NMFS reflected that when an agency is silent, other voices, often noncredible ones, step in to fill the silence.

Updated August, 2017

NOAA FISHERIES

2017 NOAA Fisheries Risk/Crisis Communications Guide

Purpose of Guide: The purpose of this risk/communications guide is to give the agency an agreed upon communications process led by communications staff that enables us to plan for risks and react to crises in a quick and coordinated way, using a proven approach with the goal of earning the trust of our target audiences.

Contents

Communications Flow 2
Risk/Crisis Communications Process 3
Roles and Responsibilities 6
NOAA Fisheries Holding Statement Template 7
Identify Audiences/Develop Your Key Messages Worksheet 8

Definitions

Risk Communications: We have the "luxury" of knowing in advance of a potential crisis and the opportunity, to some extent, to choose the timing of the communication to stakeholders and the public about the issue and our plan to resolve it. We can provide advance information about an expected event/issue that has a potentially adverse outcome and address the probability of that outcome occurring. We are in a proactive mode.

Crisis Communications: An event that occurs unexpectedly. We have no control of the timing, and the issue may no longer be in our power to control or change the outcome. Such an event is time sensitive and might have a negative impact on the reputation of the agency. We are in a reactive mode.

RISK → EXECUTE STRATEGIC COMMUNICATIONS

CRISIS → DAMAGE CONTROL

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries

Figure A-1. NMFS Crisis Communications Guide

Explaining the Science

Most of the LOs face challenges in "explaining the science" to customers, the media, and/or Congress. Compounding the challenge for some of the LOs, such as NOS, NMFS, and NCEI/NESDIS, is that that they are dealing with long-term risks that may not be relevant for years, but their customers need information on the short horizon to make decisions. Another challenge for some LOs is the nature and distribution of data. For example, NOS may be dealing with national-level sea-level rise data when their customers need more granularity to apply the information at a local level. A NOS interviewee also pointed out that not only has its customer base expanded and changed over time, but the LO also has more products, so more interpretation is needed.

SOLUTION: VISUALIZATIONS

Many LOs pointed to the value of visualizations for all kinds of audiences to help communicate data, along with risks, probabilities, and uncertainties. NOS has created tools to show more spatial representations of data via its Inundation Dashboard and Sea Level Rise Viewer. NOAA Research has developed "bite-sized science" videos in collaboration with ESRI scientists and public affairs specialists. NESDIS develops "flyout charts" to explain to the Congress when satellites will be at the end of their useful lives.

SOLUTION: ACTIONABLE INFORMATION

Both NWS and NOS mentioned the value of providing actionable information. A NOS interviewee referenced a rip current video the LO posted on Facebook that garnered 20 million views; he attributed this success to the useful tips and information the video provided.

SOLUTIONS: PROVIDING CONTEXT AND NOT JUST NUMBERS

Some LOs have found that it is sometimes preferable to use words such as "knee-high" or "waist-high," rather than just numbers to convey risk information. Other tactics have included relating risks to similar or familiar events and using heightened language (e.g., "catastrophic," "life-threatening") when warranted.

SOLUTIONS: PERSONALIZED AND PERSONABLE

NWS has found value in personalizing risk information, such as through its preparedness campaign SafePlaceSelfie, which asked people to take a selfie photo showing their safe place during a hazardous

weather event. NWS also has found that people relate to messaging when NOAA itself is personable, citing the use of videos it produced during Hurricane Harvey that featured Dr. Louis Uccellini.

SOLUTION: PARTNER EDUCATION/COLLABORATION AND INTERNAL EDUCATION

NESDIS hosts monthly climate call for media and stakeholders (from agriculture, insurance, etc.) and a similar call for an annual global climate report it produces in partnership with NASA. NOS has worked with both NWS and media, such as The Weather Channel, to develop talking points on coastal hazards to ensure the "messaging is right." NESDIS has provided media training to help NOAA scientists feel comfortable on television and webinars, and a climate communication training for its scientists in Asheville.

SOLUTION: CUSTOMIZING INFORMATION AND MESSAGING

As discussed earlier, many LOs customize their messaging to their audience. NCEI also develops stories that are targeted toward their stakeholders based on seasonal needs.

Organizational Challenges

As described earlier, several LOs stated that their roles and customers have expanded and changed over time. With these changes have also come changes in the way they communicate data, risks, and uncertainties. Organizational change can be difficult, and people can be resistant to change. As one NWS interviewee expressed it: "We need to recognize there is a need in the first place and then get people internally to buy into the need." Also, as detailed earlier, not all scientists or people with technical backgrounds feel comfortable communicating risk information or see it as their responsibility.

While some NOAA LOs have staff with risk communication experience, others do not or have lost these resources. Not having enough IT support can also be a barrier. One interviewee stated that IT resources can be a "big bottleneck" and turnover is high. One interviewee expressed a desire to have help with graphic design, risk communication, and media training, noting "we need people that are not operationally essential but that are essential for communicating our operations." A NOAA Research interviewee suggested that NOAA is "far behind in forecasting and modelling" by European standards. This means more spokespersons (both internal and external to NOAA) often reference different models, which confuses the messaging to NWS partners and end users. Another NOAA interviewee noted that in showing all the different models, an interpretation step is often missing.

One internal interviewee suggested that integrating the new workforce is an additional obstacle, as it comes with a need to pass on institutional knowledge and ways of working and communicating. At the same time, another person cited a benefit to a new (and often younger) staff that is more comfortable with current modes of communication, particularly social media.

Finally, every LO mentioned that resources were a challenge and that they lack funding and resources to develop risk communication strategies and guidelines. One internal interviewee said that because limited resources are available for website development, some NOAA website interfaces look "dated and clunky," which makes NOAA look less authoritative. This is especially true when NOAA spokespersons show their data along with other partners, who have more sophisticated visualizations.

MEASUREMENT, APPLICATION, AND RESEARCH TO OPERATIONS

Measuring the impact or "success" of risk communication is a stumbling block for most LOs. One NWS interviewee stated he had an abundance of qualitative data and success stories, but no way to quantify it or use it systematically. Many LOs cited feedback from partners and other parties as a key way they

measure success. NOS/OCM conducts interviews to learn how end users are using its coastal tools and resources. It has developed more than 140 stories from the field.

Some LOs also monitor media stories to see if they are accurately portraying the issues and information provided by NOAA. Nearly all LOs reported tracking communication outputs, such as through Google Analytics or surveys. Some track media stories and publications as well. Many measure success through partner or media feedback, or whether their messaging is picked up or amplified by others. In some cases, a *lack* of communication (e.g., being called upon to do a briefing for Congress) can mean communication efforts are successful. For the past two years, NESDIS has been tracking all inquiries it receives as well as well all interactions at conferences through a database. The information in the database is used for project management operations and strategic decisions in every annual cycle.

One internal interviewee said his biggest challenge is transitioning research to operations and communicating the science in a way that is accessible. He noted that his LO doesn't have risk communication input *during* product development, and that there is a need for "translators who are equipped with good visuals and resources to help with transition instead of having to reinvent the wheel on our own." NOAA Research and NWS discussed how they use testbeds to transition products to operations. NWS also has worked on developing guidelines for conducting testbeds to ensure they are rigorous.

Several LOs, including NMFS, NWS, NOS, and OMAO, discussed ways they utilize lessons learned from situations and crises to improve procedures and communication. NOS/OCM conducts risk communication trainings with up to "Level 3" evaluations (see box), which incorporate a basic training evaluation, learning boosters, and interviews to learn how participants applied the training to their situation.

Training Evaluation Levels

Level 1: Reaction—The degree to which participants find the training favorable, engaging and relevant to their jobs.
Level 2: Learning—The degree to which participants acquire the intended knowledge, skills, attitude, confidence and commitment based on their participation in the training.
Level 3: Behavior—The degree to which participants apply what they learned during training when they are back on the job.

Source: https://www.kirkpatrickpartners.com/Our-Philosophy/The-Kirkpatrick-Model

Enhancing Risk Communication

Internal interviewees had many ideas for enhancing communication generally across NOAA, and risk communication, specifically.

Develop a Common Language

A NESDIS public affairs specialist reflected on the difficulties of communicating risk and uncertainty information and the necessity of having everyone at NOAA on a "similar page." NWS and NOAA Research echoed the need for a common language for expressing probabilities. One suggestion was for NOAA to systematically assess how each LO communicates uncertainty and probabilistic information and also to look at other organizations and agencies that may use more rigor in their language, such as FEMA and the Intergovernmental Panel on Climate Change (IPCC). One model may be the most recent authors' guidance for the IPCC Fifth Assessment Report, which provides definitions of "likelihood" (based on probability of an outcome, see Figure A-2) and "confidence" (based on agreement and evidence, but not interpreted probabilistically, see Figure A-3). The National Academy of Sciences has also published a proceedings on uncertainty that may provide some insights.

Table 1. Likelihood Scale

Term*	Likelihood of the Outcome
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33 to 66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

Figure A-2. IPCC Likelihood Scale

Source: Mastrandea, C., et al. Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties. IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties Jasper Ridge, CA, USA 6-7 July 2010.

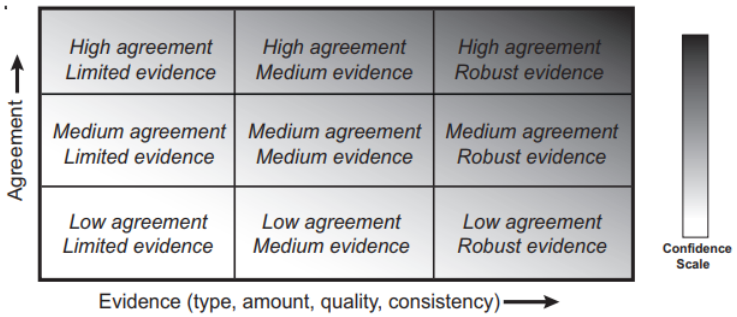


Figure A-3. IPCC Depiction of Evidence and Agreement Statements and Relationship to Confidence

Source: Mastrandea, C., et al. Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties. IPCC Cross-Working Group Meeting on Consistent Treatment of Uncertainties Jasper Ridge, CA, USA 6-7 July 2010.

Training

The LO interviewees had many ideas on training:

- Formal training on how to translate scientific information into concise and conversational plain English.
- Media training for scientists and spokespersons.
- More training on communicating uncertainty.
- Week-long, intensive training (boot camp) on risk communication. Make it very interactive with case studies, scenarios.

- Training on how to bring complex issues into the foreground without losing the audience or credibility.
- Training for staff on separating personal opinion and biases from the science and not editorializing with personal opinions.
- Better and more transparent crisis communication procedures and protocols (along with training on these procedures), particularly for things that can be anticipated (such as the "bust" forecast).

One internal interviewee noted that there is an institutional mechanism in place for developing training modules or a communication strategy since each line office has a communications office and NOAA has an office of public affairs; also, NWS forecasters are required to go through a number of trainings to do forecasting, so it may be possible to integrate communications training into these existing mechanisms.

Other Ideas

Other ideas that came out of the interviews include:

- **Measurement.** While most offices measure outputs (e.g., website hits, video views), it would be useful to have a practical way to measure the impact of risk communication, particularly for big events.
- **Social media.** A number of LOs struggle with social media. Guidelines and training for using social media platforms, engagement, and monitoring would be helpful.
- **Design templates.** Standardized branding and well-designed, common templates (for presentations, briefings, etc.) can help to bring consistency to NOAA's risk communication. Having a common look and feel and templates will also could reduce staff time to develop these items while bringing more professionalism and consistency to NOAA communication.

Interview Guide for NOAA Line Offices

Introduction

- ERG is conducting this interview under contract with NOAA's Office for Coastal Management, and we are working with NOAA's Performance, Risk, and Social Science Office on this work.
- We will be talking with you today to learn more about how each of you, as well as your line office, engages in communicating with your stakeholders and partners about environmental hazards and their associated risks and uncertainties.
- The information you share with us today will help us better understand the communication needs and capabilities of NOAA's different line offices. We'll use this information, along with other research, to develop guidance and recommendations to enhance current efforts.
- We anticipate the interview will take about an hour.

General Background Information

Let's start by talking a little about yourselves.

- Could each of you tell us what you do?
- What are your responsibilities? What's a typical day like?

1. We're also interested in learning about your line office more broadly.
    - What is the mission of your line office?

- What services does your office provide?
- Who does your line office consider to be your primary constituents [or audiences/stakeholders—the people the office serves]? [Probe for internal and external]
- Who are your core partners? [Probe for internal and external]

Risk Communication

2. I want to share a statement with you that was drafted by NOAA's Social Science Committee: "NOAA spends billions of dollars each year monitoring and predicting risk from environmental hazards to help people, communities, businesses, and governments find and use the right information to understand risk and make smart decisions."
    - I am wondering how this statement might relate to your line office. First, what kinds of environmental hazards are relevant to your line office and the services it provides?

    - Can you describe how your office communicates about these hazards to others?
        - What are you trying to "message" or say in your communications?
            - To whom?
    - Do you message or say different things to different stakeholders?
    - Are there any common themes in your communication with all stakeholders?
    - What are you hoping to achieve through this communication?
    - How would you describe the main challenges your office faces in communicating about these hazards to your different stakeholders?
        - What kinds of strategies have you found to be effective in addressing these challenges?

- How do you [or your office] address uncertainty related to specific hazards of concern in your communications?
    - What kinds of challenges do you face in communicating these uncertainties?
    - What kinds of strategies have you found to be effective in addressing these challenges?

Tools and Strategies

3. What channels do you use to communicate information to your stakeholders?
    - Which ones have you found to be most effective?
    - Why?
4. Can you describe the strategies or tools that you [or your office uses] in your communicating about hazards and uncertainty? [Probe for best practices or guiding principles]
    - If so, where did you learn these? [Probe for training, on-the-job experience, prior job experience, etc.]
    - How effective do you think these are? [Probe for mechanisms for feedback, verification, etc.]
    - Do you see any ways they might be improved or where something might be done differently?
5. Are there any efforts or tools that should be discontinued?
    - Why?

6. Can you describe a time where you [or your office] was successful in your messaging/communication?
    - What worked well?
    - How do you know your efforts were successful? [Probe for mechanisms for feedback, verification, etc.]
7. Now, can you recall a time when you [or your office's] communication/messaging did not achieve results?
    - What were some of the barriers that you have encountered?
    - Was there anything you [or your office] could have done differently?
    - Did this experience change anything in the way you [or your office] communicates or works?
8. Are there any challenges that you [or your office] face in communicating hazard, risk, and uncertainty information that we haven't already discussed? [Probe for issues such as institutional barriers, resource constraints, time, training, knowledge, etc.]

Resources, R2O, and Referrals

9. Are you aware of any risk communication research at NOAA, or within your LO? Are you aware if this research has influenced or been incorporated into operations in any way?
10. [If not already addressed by Q5…] Can you describe any training that you (or staff within your line office) have received for communicating hazards as part of your jobs? Has this training influenced or been incorporated into operations?
11. Can you share with us any tools, trainings, protocols, etc., that you [or your office] uses? [If they have good success stories, i.e., #9, we should get any copies of briefings etc. used]
12. Are you aware of any other useful tools or best practices, either within NOAA or external to NOAA, that might be useful as we consider developing guidance?
13. Who would you recommend we speak to externally, among your stakeholders and partners, to explore their communication needs and get a better sense of how they interface with your office?

APPENDIX B. SUMMARY OF EXTERNAL INTERVIEWS

In April and May of 2018, ERG conducted semi-structured interviews with individuals external to NOAA who use the agency's risk information and/or communicate risk information themselves. These individuals included federal, state, and local officials, as well as people from independent organizations (governmental and nongovernmental), academia, and the private sector (see Table B-1).

ERG interviewed these individuals to better understand how they use NOAA risk and uncertainty information/services and engage with NOAA staff. The interviews with these external stakeholders were informed by a similar set of interviews conducted internally with NOAA staff in all six line offices (see text box) in January and February of 2018. The internal NOAA interviewees also helped to identify external interviewee candidates. Appendix A includes the script used for the external interviews.

This memo summarizes three key areas explored during the external interviews: 1) how interviewees engage with NOAA and/or use NOAA risk/uncertainty information, 2) the strengths and weaknesses they perceived in NOAA's risk information and services, and 3) their recommendations for enhancing risk communication. For more details on each interview, see https://docs.google.com/spreadsheets/d/1CT6PUc3_3VHudOVi73Pu20HLORAkPYJahHJ6zyrhGrs/edit#gid=0

Table B-1. Respondents by Title and Organization

Organization	Title	Organization Type	Key Audiences
University of Minnesota, Sea Grant (Recommended by NOS)	Coastal Communities and Land Use Planning Extension Educator	Academia in Partnership with NOAA	Coastal planners and other state/local officials, members of the public
NBC Universal (Recommended by NOAA Research)	Director of Weather Operations	Private Sector	Members of the public, including many Spanish-speaking viewers
Climate Central (Recommended by NESDIS)	Manager and Research Associate for Sea Level Rise Program	Nonprofit	Other nongovernmental organizations, advocacy groups, planners, members of the public, the media
The Ocean Foundation (TOF) (Recommended by PRSSO)	Project Manager of Global Tuna Conservation Project	Nonprofit	Members of the public and other conservation groups
Marine Mammal Commission (MMC) (Recommended by NMFS)	Energy Policy Analyst and Liaison on Alaska Native Issues	Independent Government Agency	Agencies MMC oversees, as well as Congress, White House, OMB, members of the public
Federal Emergency Management Administration (FEMA) (Recommended by NWS)	FEMA Liaison to National Weather Service Storm Prediction Center	Federal Government	Members of the public, all FEMA offices that need and use weather information, and nonprofit, tribal, and private organizations
South Carolina Department of Health and Environmental Control (SCDHEC)	Coastal Services Project Manager, Planning	State Government	Coastal communities, state and local government officials, elected officials

Organization	Title	Organization Type	Key Audiences
Florida Fish and Wildlife Conservation Commission (FWCC) (Recommended by NOS)	Research Scientist	State Government	State/local officials, members of the public
Monroe County, Florida, Emergency Management (EM) (Recommended by NWS)	Deputy Director of Emergency Management	Local Government	Members of the public; also work with businesses, law enforcement, utilities, local/state officials, school boards, the military
City of Myrtle Beach, South Carolina (Recommended by DCDHEC)	City Land Use Planner	Local Government	Community residents, other planners, developers

Engaging with NOAA and Using Risk and Uncertainty Information

External interviewees use NOAA risk/uncertainty information and tools in various ways, such as to inform policy, planning, or research or to help protect people, animals, economies, and the environment. The types of risk and uncertainty information that interviewees use range from meteorological/weather forecast information to coastal/beach hazard information to harmful algal bloom cell counts to fisheries stock assessments and marine mammal takes. They use NOAA information at local, state, and national scales. In certain situations, some organizations use certain NOAA information or products (e.g., NWS graphics) directly; others customize the information to suit a specific geographic scale, delivery channel, or target audience. Still others ingest the information as part of an entirely new application, such is the case with Climate Central, which has built its own digital tool on sea level rise (see Figure B-1).

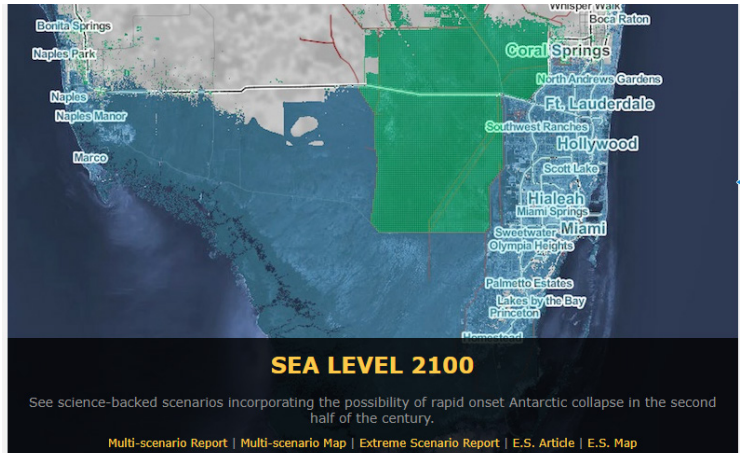


Figure B-3. Climate Central's Sea Level Rise Tool

Characterizing Risk and Uncertainty

The external interviewees discussed a variety of environmental risks related to their organizational missions, around which they communicate with their stakeholders and partners. These included severe weather, climate change, harmful algal blooms, seal level rise, flooding, rip currents, erosion, land use/development, oil/gas exploration, noise, marine pollution, marine mammal takes,[5] and fishing bycatch.[6] Economics play a vital role as well; there is an economic value associated with marine mammals,

[5] The Marine Mammal Protection Act established a moratorium (with a few certain exceptions) on the taking of marine mammals in U.S. waters. The act defines a "take" as hunting, capturing, killing, or harassing marine mammals.

[6] Bycatch refers to animals that fishermen catch but do not want, cannot sell, or are not allowed to keep.

fish stocks, coastal real estate, beaches and shorelines, for example. Threats to these animals and assets pose economic risks to communities and industries.

All external interviewees acknowledged there are uncertainties with the risk information—whether it be weather forecasts, climate change projections, or stock/bycatch assessments. These are attributable both to inherent uncertainty (one interviewee commented that "nothing is certain in a coastal environment" and another said that "in severe weather, most of the forecast is probabilistic") as well as uncertainties or limitations with the models or methods used to derive the information. In addition, interviewees noted uncertainties with the *delivery or exchange* of information as well (see Table B-2 and Figure B-2). These uncertainties contribute to a different kind of risk—the risk of making bad decisions or poor policies.

Table B-2. Uncertainties Related to NOAA Information Delivery and Exchange

Not knowing that NOAA has certain types of information
Not having enough explanation about the information NOAA is providing
Not having information or complete information because of a fear on NOAA's part of being sued
Not having enough trust in the information exchange process
Not having the best science available
Not knowing where the uncertainty is
Not having enough detail or context about the uncertainty provided
Not being able to find information, such as on NOAA websites or via mobile devices
Not having access to information that NOAA has, such as GIS tools and mapping
Not being able to understand the information that NOAA is providing
Not being able to relate or connect with the information that NOAA is providing
Not having as much communication or collaborations as desired (or as in the past) due to resource constraints

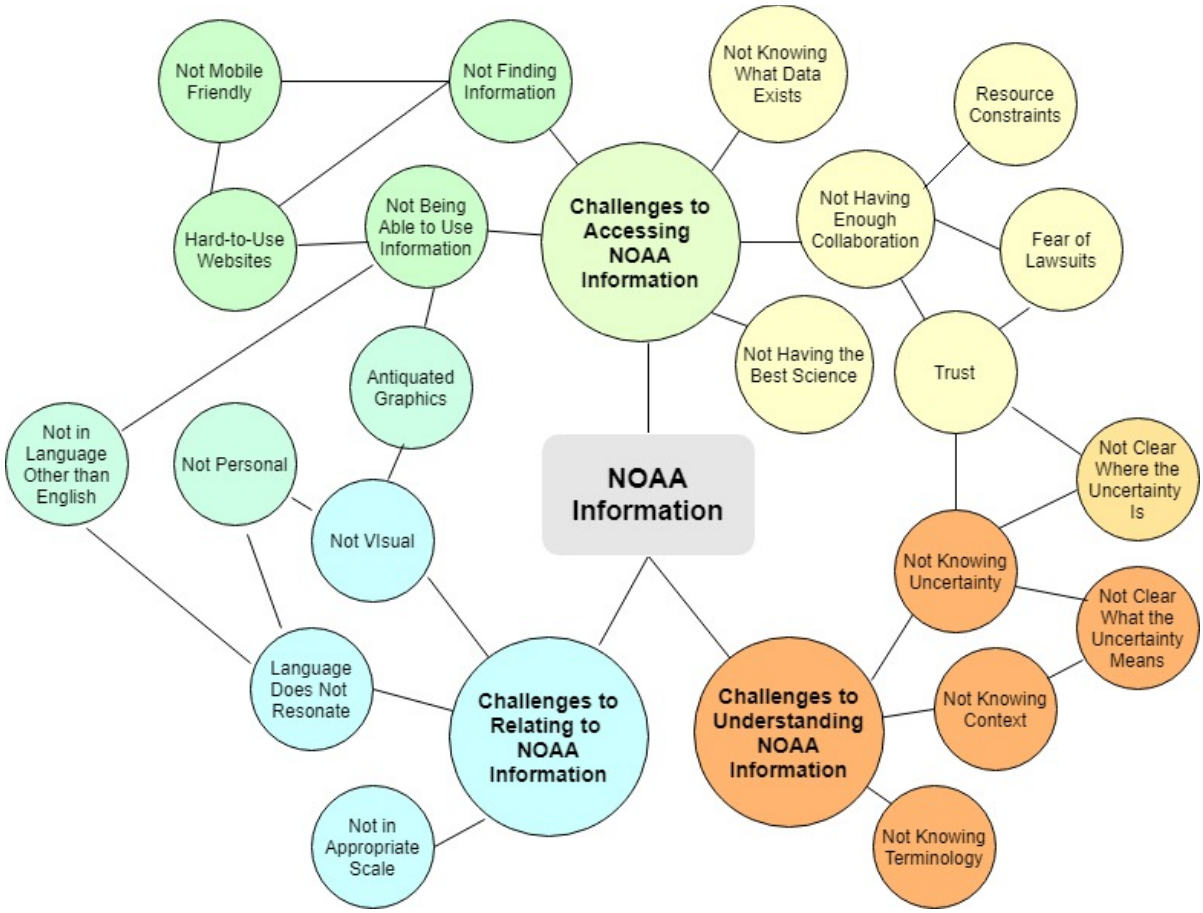


Figure B-2. Challenges to Using NOAA Risk/Uncertainty Information Cited by External Interviewees

Channels and Engagement

External interviewees access NOAA information through the agency's websites and social media accounts, as well as through briefings, chats, telephone conversations, text messages, *Federal Register* notices, advisory committees, workshops, meetings, trainings, and other collaborations.

HIGH-QUALITY, TRUSTED DATA

NOAA is a trusted, high-quality, credible risk information source for every external interviewee. One federal government interviewee said she uses only NOAA meteorological information and does not seek information from any other source. Many interviewees on the "wet" side were regular users of the Office for Coastal Management's (OCM's) Digital Coast, which one interviewee praised as "fantastic." Interviewees specifically cited OCM's Sea Level Rise Viewer, Coastal Flood Exposure Mapper and Coastal County Snapshots as tools they use regularly. Some interviewees on the "dry" side praised NWS impact-based decision support services, NWSChat, forecast discussions, and briefings. A few interviewees also commended NOAA for sending information via email or list servs (more convenient than having to fetch information from a website) and for providing data resources and updates via email.

STAFF ENGAGEMENT

Many external interviewees cited the good access and strong working relationships they have with NOAA staff. Interviewees reacted positively to liaison positions, such as those with NWS/FEMA and with the NOAA Great Lakes Environmental Research Lab/Sea Grant. One interviewee stated that during an

emergency weather situation, having NWS staff embed with them is "huge," while another commended the local NWS Weather Forecast Office for its high level of engagement with stakeholders. One interviewee on the "wet" side said it was "amazing" to have a NOAA staff person available on a weekly call, and another person commended NOAA for investing in outreach over the past 10 to 15 years, stating that outreach is now a component of what NWFS does, and the office is effectively getting information into the hands of regulators and the public.

Strengths and Weaknesses

External interviewees were asked to identify the strengths and weaknesses of engaging with NOAA and of seeking/getting risk information, as well as their assessments of the quality, timeliness, ease of use, and utility of these engagements and information.

Strengths

As mentioned above, external interviewees universally praised the quality of NOAA data and the professionalism, responsiveness, and accessibility of NOAA staff.

Strength or Weakness

In some cases, external interviewees had differing opinions about certain factors—whether they perceived them as a strength or weakness depended on their viewpoint and that of their organization. These factors are listed below (in no particular order).

TARGETING AUDIENCES APPROPRIATELY

On the "wet" side, some external interviewees felt that NOAA does a good job generating information that is digestible for multiple audiences, from citizens to research scientists. One interviewee commented that NOAA staff with technical or scientific backgrounds are still able "to customize their messaging to an audience group." On the "dry" side, some interviewees observed that the NWS does not seem to know who its audience is and that it puts out information that is mostly geared to high-end users rather than the public. Another noted that NWS information is often dense, technical, and contains too much jargon—again suggesting the information is more suitable to higher-end users. Also, because of the way the information is written, some interviewees have to put additional time into repackaging and tailoring the information to the appropriate audience.

EASE OF USE OF RISK INFORMATION

NOAA websites are an important information source for the external interviewees. Several lauded OCM's website and Digital Coast tools, and one individual praised a recent redesign of the NOAA Fisheries website, stating that it was easy to use and helpful. One interviewee commented on the NOAA HAB website, saying that NOAA has continued to improve it to make it more user-friendly. Some interviewees were critical of NWS websites, finding the user experience "very outdated" and not mobile-responsive. Interviewees also said that across the NWS, website design is not intuitive or standardized. While Weather Forecast Offices are trying to standardize their websites, they noted there still are inconsistencies from one Weather Forecast Office site to another. In addition, the websites for the national-level programs all look different.

As for other delivery mechanisms, one external interviewee pointed out that sometimes NOAA presents information in a way that is easy to use, but other times she gets "a spreadsheet with thousands of data points." Some interviewees noted that some NWS graphics were as easy to use and customize; others were viewed as badly designed or hard to use.

Another aspect of usability is scalability. For climate and coastal information, external interviewees observed that much of NOAA's data is at a national scale, and they also want to see data layers and fine-tuning for more localized scales. Conversely, one interviewee suggested that most NWS products are geared toward local EMs or the media, and that it would be helpful to consider federal and state planning considerations as well.

TIMELINESS OF INFORMATION

On the "dry" side, external interviewees cited NWS for its timely risk information while interviewees on the "wet" suggested that some NOAA information (e.g., glider information for HABs, LIDAR data, publications or tables on NOAA Fisheries website) was not updated as frequently or as rapidly as an interviewee would like. Interviewees recognized the challenge of maintaining information, but also said they realized the value of keeping it up to date.

INFORMATION EXCHANGE

Generally, external interviewees were very appreciative of their positive and productive working relationships with NOAA staff. A couple of interviewees stated that NOAA has taken steps in recent years to strengthen its stakeholder and partner engagement: one mentioned that NMFS has integrated outreach into NOAA staff responsibilities so that outreach is no longer a reaction or side thought, but rather "a component of what they do." Another interviewee said her organization is in "constant communication" with their local Weather Forecast Office.

While engagement and outreach opportunities exist, they could sometime be more fruitful. One external interviewee said there is "not always enough trust in the information exchange." Another suggested that NOAA could be more connected to the needs of the end user. Even interviewees who were very satisfied with their engagements with NOAA staff noted there were "are always opportunities to improve." One person noted the communication process is a two-way street whereby NOAA end users are also doing their part to bring NOAA staff to the table via working groups and other mechanisms.

GIS

The two local officials interviewed stressed their need for mapping capabilities and GIS. One person said she is getting what she needs by either using NOAA tools or working with NOAA staff to tailor the information appropriately. "It's like having a GIS expert at my fingertips," she said. Another external interviewee mentioned that NOAA (NWS) has GIS tools that would be helpful to her organization both before and after a major storm. She stated that she knew that the NWS has GIS people and tools, but did not have access to the information, which "could help us be working with electric company where we have outages or to see where there was surge for post-storm damage assessments."

Areas for Improvement/Solutions

The external interviewees also identified some areas where there was room for improvement to enhance NOAA's communication of risk and uncertainty.

Awareness and Utilization of NOAA People and Tools

Some external interviewees stated that potential end users are not aware of certain NOAA tools or expertise. One person noted her organization needed a "re-education" of newer NOAA tools. Some also thought that NOAA staff are great resources, but underutilized. Several people mentioned OCM's Digital Coast website (several specifically citing the "Topics" or county snapshots) as resources that are not publicized enough (see Figure B-3).

SOLUTION: USE SOCIAL MEDIA

External interviewees suggested that NOAA should publicize what it does, particularly at a local level. One person suggested NOAA frame social media campaigns around OCM's Topics.

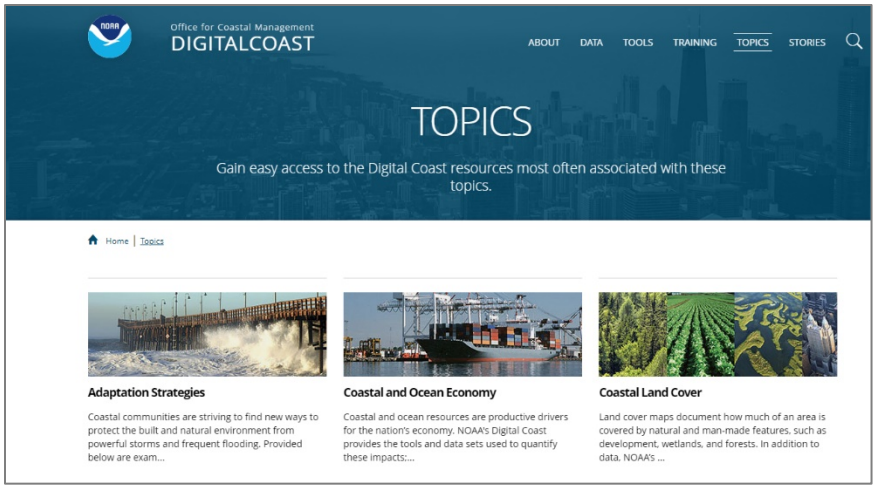


Figure B-3. OCM's Topics on Digital Coast

SOLUTION: ENLIST PARTNERS TO PROMOTE RESOURCES

Several external interviewees suggested NOAA work more with other organizations and partners to promote its tools, such as the Coastal State Organization (CSO) in each state, the National League of Cities, or the National Association of Counties. NOAA could then make use of partners' channels and members to help promote its information and stories.

SOLUTION: PROVIDE TRAINING TO MEET CERTIFICATION REQUIREMENTS

External interviewees thought highly of OCM's risk communication training and webinars. One interviewee pointed out that government officials frequently need training for certification, and if the training is provided for credit, many people would become aware of the training and take it.

SOLUTION: PROVIDE CALENDAR OF ALL EVENTS

NOAA currently sends an email about the trainings and webinars available; NOAA could consider developing a calendar of all training and send to people that need training hours.

Uncertainty

External interviewees noted there is always room for improvement in communicating uncertainties. They want to know what's behind a number that NOAA provides, even when it means acknowledging that there is information NOAA doesn't *know.* They also shared limitations with communicating uncertainty. For example, one interviewee noted that a problem with percentages is that while people might pay attention to a high number, they may disregard a low number that has potential impacts (e.g., a 2% chance for a tornado might sound low, but it is something to pay attention to).

SOLUTION: TAILOR UNCERTAINTY INFORMATION

Several external interviewees stated that the level of uncertainty that needs to be conveyed depends on the end user, noting they customize their messaging accordingly (by, for example, using analogies for less sophisticated audiences).

SOLUTION: FOCUS LESS ON UNCERTAINTY AND MORE ON IMPACTS

Some external interviewees also suggested that it is more important for NOAA to focus on impacts, or "what's at risk," rather than probabilities.

More Visuals

Many external interviewees shared their own success at using visual imagery to engage audiences and wanted to see more visuals from NOAA. One interviewee recounted how she shows a picture of a seemingly vast ocean and asks people to try counting all the fish in the ocean. Then she shows a picture of lions in the Serengeti, where it is possible to count every lion. Those images have helped her communicate the difficulty and uncertainty associated with stock assessments.

SOLUTION: PROVIDE MORE IMAGES THAT PEOPLE CAN RELATE TO

As many external interviewees noted, people can be complacent about weather and apathetic about climate change. It is helpful to use visuals that people can relate to, such as those that show a local connection and/or have an emotional resonance. Specific suggestions included more photos on NOAA's Sea Level Rise Viewer of iconic places, as well as flooding animations, and side-by-side maps that show different flooding scenarios.

Enhancing Risk Communication

In addition to the specific suggestions that external interviewees provided to address particular areas for improvement, they reflected more generally on ways that NOAA could strengthen its risk communication and engagement, as discussed below.

Understand Audiences and Their Needs

External interviewees stated that it is important for NOAA to communicate in a way that resonates with audiences. One individual said that the "best work with NOAA has been when they have been engaged with the data needs of the communities…not 'here's the data, now go away.'" As discussed earlier, some interviewees questioned whether the NWS was effectively serving "lower-end users," such as members of the public, and suggested that the NWS consider just focusing on the high-end/sophisticated user or better define the audience for its products. Interviewees also acknowledged that NOAA's audience base has probably grown over the past decade, thanks in part to the "democracy of the web," as one interviewee put it—encompassing more members of the public than in the past.

Another external interviewee suggested that more bilingual information is needed from NOAA, not just during severe weather events, but every day. He said, "the Telemundo station in Miami has the highest rating of any station, including English-speaking stations. Using this information, the NWS Weather Forecast Office in Miami should put out information in both Spanish and English proactively."

Use Partners

Partners can be instrumental in translating and amplifying NOAA risk messaging as well as helping to connect NOAA to its diverse audience base and even untapped partners. External interviewees cited the success of liaison positions and using people who have a technical background but also are able to customize their messaging to an audience group. Several interviewees noted that Sea Grant does this well.

Embrace Technology

While external interviewees understand the need to maintain the legacy products (like weather radio, old website templates, etc.), they also encourage NOAA to keep up with the rapidly changing world of technology, especially in the field of artificial intelligence. One interviewee noted that if NWS's information were not so valuable, he would not visit NWS websites given how antiquated they look and how difficult it is to find information. Conversely, several interviewees commented favorably on NOAA

websites that have recently been redesigned, citing better user experiences and an ability to find information more readily.

Use Storytelling

Many external interviewees cited the value of storytelling—presenting information in a narrative format. More and more science communicators are embracing the concept of storytelling, discovering that not only do narratives help people understand complex issues, but they also remember the information better. As interviewees also pointed out, communicating science through stories is also most effective when those narratives use language that reflects the concerns of the audience.

Enhance Coordination

There is an opportunity across NOAA line offices for the agency to be more coordinated in its risk communication protocols, products, and messaging. This coordination should not occur in a top-down way that would be antithetical to current organizational structures and workflows, however. One external interviewee cited the advantage of not having protocols that are too prescriptive: "In a time sensitive situation, one could get too caught up in the protocol and steps; sometimes it's just more efficient to pick up the phone and call a trusted contact instead of following steps from a manual." However, interviewees also suggested that it could be useful for NOAA to look across the agency at the all the different processes, products, and messages that people are putting out (particularly across the many NWS Weather Forecast Offices). One person suggested that "then, some of the ideas could be beta-tested so they are based on solid research."

Provide Training

As echoed by some of the internal interviewees, there is a desire among some of the external interviewees to see risk communication and outreach more thoroughly integrated with everyone's job responsibility at NOAA. One external interviewee reflected that NOAA Fisheries has taken significant steps in recent years to integrate outreach into people's positions. However, this person also noted there is still a tendency in NOAA to "see outreach as the responsibility of an outreach expert, rather than a manager or scientist."

However, external interviewees felt that everyone in NOAA can benefit from better communication training—how information is being communicated to the outside. One researcher said, "communications should not be left to an outreach specialist; they don't know intricacies of your work." Another interviewee suggested that communications training should be focused on what people can connect with—again, the concept of storytelling came up. "People can have trouble with abstract examples, but if you can relay information in more personal and relatable ways, people remember better. We try to incorporate storytelling information when we talk to Congress or the general public—or news media—try to lead with a story."

External NOAA Interview Guide

Introduction

- ERG is conducting this interview under contract with NOAA, and the purpose of this interview is to help us characterize NOAA's risk communication. Part of this work involves talking to people like you who use or are familiar with NOAA risk information.

- We will be talking with you today to learn more about how you engage with NOAA, what kind of information you get or seek from NOAA, and how satisfied you are with this information and your engagement with NOAA.
- The information you share with us today will help us better understand the communication needs and capabilities of NOAA's different line offices. We'll use this information, along with other research, to develop guidance and recommendations to enhance current efforts.
- We will not identify you by name in any write-up that is shared with NOAA.
- We anticipate the interview will take about an hour.

Organizational Information

1. Let's start by talking a little about you.
   - Can you describe your job responsibilities?
   - What is the mission of your organization?
   - Who are your audiences or stakeholders?
   - Who are your partners?
   - How do you interface with NOAA?
2. Let's focus for a minute on your communication or experience around risk communication.
   - What kind of information are you [or your organization] communicating?
   - What kinds of challenges do you face in your communications?
   - What kinds of strategies have you found to be effective in addressing these challenges?
   - How do you [or your organization] address uncertainty related to risks (or specific hazards of concern) in your communications?
3. What channels do you use to communicate information to your customers/stakeholders?
   - Which ones have you found to be most effective?
   - Why?

NOAA Engagement

4. Now, let's talk about how you interface or engage with NOAA.
   - Who do you interface with?
   - What are you looking for from NOAA? [PROBE for risk information, etc.]
   - When do you get/seek this information, or when do these engagements occur?
   - [If relevant] How do these engagements typically occur (by phone, email, etc.)?
5. Do you tailor the information you receive/seek to enhance its usability for *your* customers or stakeholders?
   - If so, how do you do this?
   - What challenges, if any, do you face?
6. Thinking back on the last time you received/sought risk information from NOAA, can you share your thoughts about its effectiveness and usefulness?
   - How timely is it? How accurate? How reliable? How easy is it to use?
7. How well do you think NOAA addresses uncertainty related to risks (or specific hazards of concern) in its communications?
8. What is your "level of satisfaction" with the *way* you get/seek information?
   - Would you prefer to get or be able to access the information in a different way?

- In more ways?

9. If not already covered, what are the strengths of the information you receive/seek or the engagements you have with NOAA staff?
10. Again, if not covered, what are the weaknesses of the information you receive/seek or the engagements you have with NOAA staff?
11. Do you have any recommendations to enhance the effectiveness or usefulness of this information?
12. Is there anything else you'd like to share today that could be useful to NOAA as it considers its risk communication efforts and looks for ways to strengthen these efforts?

APPENDIX C. SUMMARY OF OTHER AGENCIES' TOOLS AND PRACTICES

Overview

ERG conducted online research and one-on-one interviews with staff in various organizations and agencies to learn about their risk communication tools and frameworks that might serve as models for NOAA or provide valuable insights and lessons learned.

The two most robust programs that ERG examined were with the Centers for Disease Control and Prevention (CDC) and Food and Drug Administration (FDA). ERG conducted an interview with Dr. Barbara Reynolds, who spearheaded the development of the Crisis and Emergency Risk Communication (CERC) program at CDC, and with Dr. Lee Zwanziger, who heads up FDA's strategic planning for risk communications and health literacy.

ERG also reviewed risk communication guidance, fact sheets, training, and other materials developed and used by other agencies and organizations. In particular, ERG examined two risk communication lexicons—one developed by the Department of Homeland Security (DHS) and the other by the Intergovernmental Panel on Climate Change (IPCC). In addition, ERG looked at tools developed by the Federal Emergency Management Agency (FEMA), DHS, and other climate change organizations. (See table below for list of tools and resources.)

Agency	Tools and Resources
CDC	Manual, templates, training, and other tools
DHS	Lexicon, manuals
IPCC	Lexicon, as well as communication manuals and a visual library developed by other organizations for IPCC
FEMA	Training course, fact sheet
FDA	Strategic plan, committee, manual, training

Key Findings

The following are some key findings of the research and their potential applicability to NOAA.

Strategic Plan and Organizational Considerations

- **Strategic Plan:** Only one agency (FDA) that ERG looked at had a strategic plan for risk communication. FDA is also the only agency with a formal risk communication advisory committee (established by Congress).
- **Leadership Support:** Both CDC and FDA emphasized that it is critical to have leadership support for any agency risk communication effort. For CDC, that leadership commitment (and resources devoted to maintaining and expanding the CERC program) fluctuated over time, depending on the leadership in charge.
- **Champion and Grassroots Support:** Successful internal programs benefitted from an internal champion (such as Dr. Reynolds in CDC) and networks of communications specialists (FDA) committed to sharing information across the agency.

APPLICABILITY TO NOAA

- **Defining Objectives and Resource Commitments:** It will be important for NOAA to define its risk communications objectives for the agency as a whole and/or for specific line offices. It is also essential to understand what level of resources (people, funding, time) can be devoted to such an effort—and what level of leadership endorsement can be anticipated.
- **Structure:** NOAA also must determine how structured and centralized its efforts should be based on NOAA's culture and leadership. For example, interviewees (both internal and external to NOAA) have noted that NWS (with all its centers and local offices) operate with a fair amount of organizational flexibility. Any kind of risk communication model, plan, training, etc., must be integrated into the current organizational culture and workflows.
- **Strategic Plan**: A strategic plan could be a useful tool to document NOAA's risk communication, objectives, players, and outcomes, but as witnessed by the FDA plan, keeping a plan current and tracking activity across a large agency in support of such a plan takes dedicated resources and committed people.

Training

- **Staff Training:** Several agencies (FDA, CDC, and FEMA) offer training in risk communication. FDA conducts both general risk communication training and more targeted workshops for its different centers, using those centers' existing tools and processes as part of the training to increase the relevancy of the training for participants.

APPLICABILITY TO NOAA

- **Internal Staff Training**: A central, consistent method for risk communication training could help develop staff skill and advance consistency in risk communication, inclusive of a range of topics (social media, lexicon, community engagement strategies, etc.).
- **Validated Principles:** A key takeaway for NOAA in developing any risk communication guidance or training is to ensure that communicators stay true to tested/validated risk communication principles, as suggested by Dr. Reynolds of CDC.
- **Build on Existing Capacity:** NOAA already has in-house capacity for training and various NOAA offices have undertaken risk communication training efforts. The Office of Response and Restoration (ORR) held a series of three regional risk communication trainings in 2015, for instance (https://response.restoration.noaa.gov/about/media/risk-communication-training-held-noaa-gulf-mexico-disaster-response-center.html), and in 2017 the Office of Coastal Management's (OCM's) Digital Coastal Academy launched the "Building Risk Communications Skills" course, which aims to use training about human response to risk and methods for communication in order to build a "higher level of community engagement and increase the number of people and organizations motivated to reduce risk." Many external interviewees referenced this training and other OCM risk communication tools and felt they were underutilized.

Risk Communication Language and Lexicons

- **IPCC Controversial Uncertainty Lexicon:** Communicating uncertainty is a common challenge for agencies. IPCC has developed a lexicon for uncertainty/weight of evidence that was used in its Fifth Assessment Report (AR5). The lexicon was developed in response to criticism that IPCC was

not defining certainty with enough rigor or explanation in prior reports. However, this lexicon, too, has been met with criticism, and a recent study has shown alternative approaches rooted in the way people naturally and intuitively think about uncertainty may be more effective than the current IPCC approach.

- **DHS Risk Communication Lexicon:** DHS also has developed a risk communication lexicon that is more inclusive than just uncertainty. It is also less laden with people's value systems, politics, and policy.

APPLICABILITY TO NOAA

- **Recognized Need for a Common Language:** Several of the internal NOAA interviewees reflected on the difficulties of communicating risk and uncertainty information and the necessity of having everyone at NOAA on a "similar page," particularly when it comes to having a common language for expressing probabilities.
- **Recognized Need for Strategies:** The external interviewees also did not have a silver bullet for communicating uncertainty. Their suggestions focused on tailoring the expression of uncertainty to the end user, with greater or less detail, and by using a combination of ranges/words and/or analogies for less sophisticated audiences. Some also suggested it was more important for NOAA to focus on impacts, or "what's at risk," rather than probabilities.
- **Obstacles to Developing a Lexicon**: A key takeaway for NOAA in considering if an uncertainty lexicon could function for the agency is that while words are perceived as more intuitive than numbers, people can interpret phrases, such as "likely" and "very likely" differently, and any NOAA lexicon would need to reflect people's not only scientists' assessments/definitions of probability, but also the way people intuitively interpret words. It would likely take significant resources, time, and commitment to develop a common lexicon at NOAA. Additionally, any lexicon that would be developed also would need to be thoroughly tested with the scientific community and other end users.

Best Practices

- **Theory Versus Practice:** Several agencies have published "best practices" manuals or other tools that provide background, principles, and research related to risk communication. Some of these are lengthy and dated, and may be more theoretical than practical for NOAA staff. Dr. Reynolds conveyed that at one point, CDC decided to frame the CERC materials in a more academic than practical way, which did not work for users. The manual still has not been "updated in a smart way," she says.
- **Need to Acknowledge Short-Term and Longer-Term Risks:** Existing agency resources (such as those developed by DHS), however, are useful for NOAA to consider as looks at possible tools and training, particularly in framing the conversation toward longer-term understanding and education about risks, rather than "crisis communication," which would occur during an acute event. NOAA's LOs have a need to communicate risk at both the longer-term, evolving scale and the short-term, event-driven, crisis level; the distinction between these is important to note and understand.
- **Consider Recent Practical Tools Referencing Storytelling and Visuals:** Recent practical guidance developed for IPCC authors on effective communication and engagement and enhancing the accessibility of data visuals might be a useful model for NOAA as it considers possible guidance,

especially since so many internal and external interviewees cited the importance of storytelling, visualizations, and user-centric messaging in effective risk communication.

Organizational Synopses

A summary of organizational tools and models is provided on the following pages, along with details about their development and applicability to NOAA.

Centers for Disease Control and Prevention (CDC)

- Interviewee: Dr. Barbara Reynolds, Senior Advisor, Crisis and Risk Communication, Office of the Associate Director for Communication.
- CERC = crisis and emergency risk communication. Distinct from overall risk communication, which often has long lead times in terms of threat. CERC = risk communication for immediate crisis/emergency.

The CDC's CERC website includes the CERC Manual—the basis for all CERC trainings and materials—and complementary CERC tools and resources, which are described in the table below.

Resource	**Description**
CERC Manual	Describes core emergency and crisis communication principles and provides guidance to leaders and other communicators on how those principles apply to each phase of an emergency. Also discusses key communication challenges during a crisis. Serves as the basis for all other CERC materials and training.
CERC Templates and Tools	A collection of quick fact sheets, templates, worksheets, checklists, and assessment materials adapted from the comprehensive CERC manual. People can use these tools during a crisis when they do not have time to read the full manual.
CERC Resources	Additional resources that supplement and build on the CERC manual. These include: • Quick-reference wallet cards for communicators • A leadership-specific CERC manual • Hazard-specific (hurricanes, infectious disease, and Zika virus) CERC guidance • CDC RiskSmart™ system

AUDIENCES

External

- Originally written for public health communication professionals. Then expanded to leaders.
- Target is anyone who must communicate to the public during an emergency—primarily those involved in emergency response and public health response.
- CERC has been taught internationally to diverse audiences—hospitals, utilities, public health, emergency management, elected officials, etc.
- Every major health organization across the world has taken CERC up as their mantra.
- External parties can email/go to website to request in-person training; in addition to Dr. Reynolds, a few other people at CDC do trainings (but no cadre of trainers). Dr. Reynolds used to do many more trainings in the past.

Internal

- Didn't focus inward to agency early on. Instead focused on state and public health departments. After a few years, CDC started paying attention. Has now been taught consistently at CDC for 15 years.
- Periodically teach it to CDC leadership.
- At CDC, anyone who is possibly going to be incident commander or manager within public health emergency response is expected to take the training, as well as anyone who is going to be high-level spokesperson.
- CERC training can be used to satisfy supervisory training requirements. Very popular at CDC.

DEVELOPMENT TIMELINE

- Dr. Reynolds was part of CDC's epidemiologic team in Hong Kong during bird flu outbreak in 1997. Had to figure out how to talk to the world and Americans specifically about what the risks were, what could be done, what was being done, and how to manage the emotions. What do you communicate in a situation where you can't plan for everything? This experience was the foundation for CERC development.
- After anthrax letters in 2001 (after 9/11), DHHS funded the first CERC course. Dr. Reynolds then wrote the first book in 2002 for public health communication professionals.
- DHHS then gave Dr. Reynolds the feed money to develop CERC for leaders. Eliminated the how-to stuff for communicators and encapsulated best practices into smaller training.

HOW PRODUCTS ARE USED/UPDATED

- Helps communicators prepare and respond to public emergencies.
- Helps people make good decisions during an *immediate* crisis—when someone's life has been turned upside down/the unthinkable has happened
- Taught as part of CERC trainings—both by CDC and private-sector organizations.
- Some public health university programs teach CERC.
- Updated in 2006—DHHS asked for pandemic version, which required additional concepts.

- At some point, CDC decided to compile CERC in a different way. Contractor turned it into an academic book instead of practical one. Didn't work. Got updated again. Have not updated it in a smart way.
- CDC uploads new modules when it can.

CHALLENGES/LESSONS LEARNED/APPLICABILITY TO NOAA

- CDC started backwards with communicators instead of leaders. Get leadership on board quickly—demonstrate training to them early. Leadership doesn't understand what their role would be in a crisis. They're so focused on functional, operational side of preparing, they don't recognize that they'll spend most of their time organizing and managing communications around the event itself.
- Dr. Reynolds took science-based rigor approach to CERC. It has been recognized in the field as a theory of communication. Has its own identity—has been tested and validated. If someone teaches CERC and gives opinions instead of true content backed by research and evidence, they could damage the brand very quickly and lose credibility.
- Resources devoted to CERC have changed over time along with leadership commitment; securing NOAA leadership support is crucial to sustaining any kind of long-term risk communication guidance or training.
- CERC has benefitted and evolved because it had champion behind the effort from the start.

Food and Drug Administration (FDA)

- Interviewee: Dr. Lee Zwanziger, Designated Federal Official for FDA's Risk Communication Advisory Committee

TYPES OF PRODUCTS AND ACTIVITIES

The goal of FDA risk communication is to help people make informed decisions about FDA-regulated products. Doing this means conveying both the risks and the benefits of these products. To assist the agency in this effort, a formal advisory committee provides agency-wide and center-specific advice. FDA also has a strategic plan to guide the agency's communication. See table below for more details.

Resource	Description
Strategic Plan for Risk Communication and Health Literacy (SPRCHL)	Goals, strategies, and actions for improving the agency's communication of regulated products.
Communicating Risks and Benefits: An Evidence-Based User's Guide	A scientific foundation for effective communication that grew out of a 2009 meeting.
Risk Communication Advisory Committee	Reviews and evaluates strategies and research to communicate the risks and benefits of FDA-regulated products. Minutes and presentations from the committee are available on the FDA website.

AUDIENCES

- FDA staff members
- Members of the public can also access all committee meetings' materials and minutes

DEVELOPMENT TIMELINE

- FDA has long been involved in risk communication given the agency's role in product labeling.
- In 2005, the National Academy of Sciences (NAS) did report on the future of drug safety and recommended that Congress establish an advisory committee on risk communication for FDA. In 2007, the committee was formed[7] to serve the whole agency.
- The committee does center-specific work on certain issues; it also provides advice to the agency as a whole.
- FDA has communications specialists in each center; some larger centers have offices of communications. FDA also has an office of external affairs that handles all media queries and interactions.

HOW PRODUCTS ARE USED/UPDATED

- FDA's strategic plan includes a strategic framework, implementation plan, and performance indicators (see Figure C-1) to track progress toward meeting the outcomes delineated in the plan.

- Strategic Framework: a hierarchical diagram of outcomes that FDA must achieve to meet our goal of better communication
- Implementation Plan: a map of potential activities to specific outcomes in the Strategic Framework, offering a foundation to help Centers and Offices plan specific action steps for the next 1-3 years
- Performance Indicators Phase I: specific indicators for outcomes in the Strategic Framework that FDA plans to monitor in the near term

Figure C-1. Components of FDA's Strategic Plan

- The strategic plan was first developed in 2009 and then retired in 2012. But people still thought planning was useful, so a new strategic plan was developed that came out in 2017.
- The new plan came about because FDA had learned lessons from prior strategic planning, such as to focus more on concrete tasks. The plan is used internally to make clear communication ideals a reality.

CHALLENGES/LESSONS LEARNED/APPLICABILITY TO NOAA

- FDA has a large internal workgroup that helps to monitor and track risk communication efforts across the agency.
- Effective communication needs to part of someone's everyday practice—a standard operating procedure. Dr. Zwanziger likened it to "a seat belt that you just use and don't think about."
- Agency leadership must support a communications effort. Leadership must make effective communication a priority for senior and middle managers.
- FDA offers both general risk communication and specific workshops. FDA has been offering general training to internal staff on clear communication practices based on the CDC Clear Communication Index. Another strategy that FDA uses is to offer risk communication training specific to a group using its own materials.
- Dr. Zwanziger urged NOAA to at a minimum find a way to test messages. FDA has set up an internal database of volunteers so when it wants to test a message, it will find 8–12 people

[7] The Risk Communication Advisory Committee was established by 21 U.S.C. 360bbb-6, as added by section 917 of the Food and Drug Administration Amendments Act of 2007.

internally, whom it will interview. Volunteers are chosen from outside the particular center where the work is being done. FDA is large enough that it can apply a limited amount of desired screening criteria (e.g., people who don't have a college degree).

Department of Homeland Security (DHS)

The DHS Risk Lexicon "promulgates a common language to ease and improve communications for the Department and its partners." See table below for more detail.

Resource	Description
Guidance Document: DHS Risk Lexicon	Defines more than 120 terms, encompassing data and statistical concepts such as "likelihood," "joint probability," "marginal probability," and "frequency"; economic concepts ("willingness to pay"); hazards concepts ("mitigation," "hazards"); and risk-focused terminology ("risk," "risk analysis," "residual risk"). The lexicon defines risk communication as "the exchange of information with the goal of improving risk understanding, affecting risk perception, and/or equipping people or groups to take appropriate actions in response to an identified risk."

AUDIENCES

- DHS staff and partners

DEVELOPMENT TIMELINE/UPDATING

- The first edition of the DHS Risk Lexicon was published in 2008 and contained more than 70 terms. A second edition, published in 2010, add 50 new terms and revises some of the original terms.
- The lexicon is periodically updated by a subset of the DHS Risk Steering Committee called the Risk Lexicon Working Group.
- Terms and definitions are developed through a collaborative process within DHS. Definitions are validated against glossaries used by other countries and professional associations and standardized grammatically.

HOW PRODUCTS ARE USED

- The DHS Lexicon is a reference tool used by DHS and in the homeland security community. By defining common terms, the DHS Lexicon is intended to reduce the possibility of misunderstandings when communicating across DHS.

CHALLENGES/LESSONS LEARNED/APPLICABILITY TO NOAA

NOAA LO staff have referenced the challenges in identifying consistent understandings of key terms. The DHS Risk Lexicon provides a model structure and product for NOAA to consider when addressing the need for uniformity and consistency in the use of key risk communication terms, including loosely defined weather terms such as "chance," "slight chance," "possible," and "probable" as well as other terms that have temporal, spatial or impact-focused implications.

DHS—National Consortium for the Study of Terrorism and Responses to Terrorism (START)

Based at the University of Maryland and supported by DHS, START publishes studies on risk communication (some specific to weather hazards) and offers training to help organizations plan for and conduct effective communication during all phases of an event (see table below for relevant tools).

Resource	Description
Understanding Risk Communication Best Practices: A Guide for Emergency Managers and Communicators	Examines social and behavior science about how people understand risk messages across the preparedness, response, and recovery phases of an event. Distills theoretical understandings of human response into practical implications for officials, on topics such as public trust and emotional response, as well as other factors (proximity to risk, severity of risk, prior relationships with risk and risk communicators).
Understanding Risk Communication Theory: A Guide for Emergency Managers and Communicators	Discusses theories and models related to risk communication applicable across the preparedness, response, and recovery phases.
Training in Risk and Crisis Communication (TRACC)	An interactive in-person training accredited by the Federal Emergency Management Agency (FEMA) that covers four modules to help organizations plan effective communication before, during, and after a crisis: 1) risk and crisis planning, 2) audience analysis and engagement, 3) media relations, and 4) crisis communication simulation.

AUDIENCES

- Federal, state, and local homeland security personnel and emergency managers

DEVELOPMENT TIMELINE/UPDATED

- Developed in 2012 and not updated.

CHALLENGES/LESSONS LEARNED/APPLICABILITY TO NOAA

- In framing the issue of risk communication, the Best Practices guide emphasizes the difference between crisis (short-term acute events that are "spontaneous and reactive) and risk (which is "more nebulous and evolves over time" and "viewed as controlled and structured").
- In distinguishing between crisis and risk, the report emphasizes that "risk communication often focuses on developing and conveying messages prior to and during an event." As such, the report provides this frame: "Risk communication tends to utilize messages from experts and scientists while crisis communication typically utilizes messages from authoritative figures."
- The manual also includes a section on special needs' populations (inclusive of elderly, children, less numerate communities, racial and ethnic minorities, white males and activists). The guide also advises on use of both traditional and social media, as well as communication during the preparedness phase, including addressing common risk communication "myths."
- In a section on communication during the response phase the report emphasizes the role of a Crisis Management Plan and, finally, provides guidance on how to communicate the path to renewal during the recovery phase.

Federal Emergency Management Agency (FEMA)

FEMA offers a detailed training course and other risk communication materials for community officials.

Resource	Description
Risk Mapping, Assessment and Planning (Risk MAP) Community Engagement Fact Sheet	FEMA develops flood insurance studies and rate maps as well as non-regulatory tools and planning support to communities. A fact sheet entitled "Community Engagement" provides guiding principles for engaging with the community, including guidance on topics such as use of language when communicating with the public, frequency and timing of engagement, and coordination with partners and other organizations for reinforcement of messaging.
FEMA Emergency Management Institute Training Crisis and Risk Communication Course	FEMA's Crisis and Risk Communication is designed as a complete academic course with more than 20 planned course sessions. Its defined purpose is "to present the different forms of communication proficiencies that are likely to be expected of a practicing emergency manager or department/office of emergency management employee during the course of their duties."

AUDIENCES

- Community officials (fact sheet)
- FEMA Emergency Management Institute students (training)

DEVELOPMENT TIMELINE

- 2011 (fact sheet)

CHALLENGES/LESSONS LEARNED/APPLICABILITY TO NOAA

- The risk communication principles infused into the Risk MAP program were process-based, rather than content-focused; that is, they provided instruction to staff on broad concepts for engaging in communication with the public, rather than providing, for instance, specific instruction on the use of terms or concepts. NOAA should consider its need for guidance for LOs relating to the *processes* by which they share risk information and engage with stakeholders (including such considerations as frequency of contact, methods for distributing content, and others).
- Interviews with LO staff revealed needs for training in use of social media, traditional media, and basic risk communication training, as well as media training.

Intergovernmental Panel on Climate Change (IPCC) and Other Organizations

Communicating climate science uncertainty has been challenging for the IPCC. After not explicitly defining expressions of uncertainty in its first reports, the IPCC developed a more prescriptive lexicon for the IPCC Fifth Assessment Report (AR5). Since the AR5, however, other research and recommendations provide additional insights for climate change communication (see table below for more detail).

Resource	Description
Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties	Designed to assist lead authors of the AR5 in the consistent treatment of uncertainties. The guidance provides definitions of "likelihood" (based on probability of an outcome) and "confidence" (based on agreement and evidence, but not interpreted probabilistically). The guidance assigns numerical values to phrases; for example, the guidance defines "virtually certain" as 99-100% probability, "about as likely as not" to a 33 to 66% probability and "very unlikely" to a 0-10% probability.
Principles for effective communication and public engagement on climate change: A Handbook for IPCC Authors	Distills essential principles for effective communication and engagement with practical tips, including 1) be a confident communicator, 2) talk about the real world, not abstract ideas, 3) connect with what matters to your audience, 4) tell a human story, 5) lead with what you know, and 6) use effective visualizations.
Enhancing the Accessibility of Climate Change Visuals: Recommendations to the IPCC and Guidance for Researchers	Provides guidance for researchers on enhancing the accessibility of data visuals while also maintaining scientific rigor using the following principles: 1) does the visual communicate a clear message? 2) is the visual appropriate for the intended audiences? 3) does the visual use evidence-based design principles? and 4) has the visual been tested with the audiences?
Climate Visuals Project	Developed by the nonprofit Climate Outreach, this library of visuals is available for communicators to use and is based on seven core principles for effective communication. The principles were developed based on research conducted internationally with the public.

AUDIENCES

- IPCC authors
- Researchers and wider scientific community who engage audiences on climate change

DEVELOPMENT TIMELINE/USE

- The guidance reflects the discussions of a 2010 IPCC working group and recommendations by the InterAcademy Council (IAC), which conducted a review of the IPCC model and processes for developing its assessment reports.
- Among the IAC's recommendations was for IPCC to apply more consistency in how its working groups characterize uncertainty. In particular, IPCC working groups should use 1) a level of understanding scale to qualify their understanding of the amount of evidence available and the degree of agreement among experts, and 2) a probability scale to quantify the likelihood of a particular event occurring, but only when there is sufficient evidence to do so.
- The principles handbook is a new publication (2018), not officially endorsed by IPCC (as it has not gone through IPCC's formal review process) and provides practical suggestions and real-world examples.
- While much has been written on the verbal communication of climate change, less research has been conducted on visual imagery even though it is a key communication mechanism (consider the iconic visualization of a polar bear on a melting ice floe). Based on research conducted in three countries and an international survey, a nonprofit has collected a library of visual images

that adhere to seven principles of effective visual communication, such as using real people, providing an emotional connection, showing a local connection, and telling new stories.

CHALLENGES/LESSONS LEARNED/APPLICABILITY TO NOAA

- Since the publishing of the AR5, some researchers have argued that people do not intuitively understand the IPCC uncertainty lexicon, and a recent research study found that two evidence-based alternative lexicons outperformed the IPCC lexicon in conveying information about uncertainty.

Interview Guide for Federal Agencies

Introduction

- ERG is conducting this interview under contract with NOAA. The purpose of the interview is to learn more about your agency's risk communication efforts.
- The information you share with us today will be shared with NOAA, which is undertaking a project to look at its own risk communication practices and needs and where there might be opportunities to strengthen these efforts.
- We anticipate the interview will take about 30 minutes.

Background/Challenges

1. Can you tell us a little bit what you do and how you are involved with these materials?
2. Can you speak generally about the kinds of risks your organization is concerned about?
3. What types of challenges do you face in communicating around and about these risks?
4. What kinds of strategies have you found to be effective in addressing these challenges?

Approaches/Tools

5. In conducting some research on federal agencies involved in risk communication, we learned that your agency had developed some resources. We're interested in learning more about the development of these materials.
    - First, how did they come about? What was the impetus?
    - Who is their intended audience? [probe for internal/external audience]
    - Did you develop them internally or involve external partners?
    - How long did it take to develop the tools and how did you decide which ones to develop?
6. What was the process like (how much time, staff, and budget did/does your organization devote to developing these materials)?
7. How often are they updated and what is that process like?
8. How are the resources being used?

Lessons Learned/Applicability to NOAA

9. Could you talk about some of the challenges and lessons learned in developing and using these materials?
10. Do you have any advice for NOAA as it considers ways to strengthen its risk communication efforts?

APPENDIX D. CROSSWALK OF KEY FINDINGS

Organizational Considerations In considering next steps, we should define what we want to achieve, how big is the scope, what is the timeframe, who should be involved, what is the leadership commitment, and what are the resources available.			
Mentioned By	**Internal**	**External**	**Agency**
Goal definition • What do we want to accomplish? • What are the priorities?			X
Scope • Agency-wide vs. LO-specific • Leadership vs. staff; scientists vs. outreach specialists • Short-term vs. long-term or one-time effort vs. sustainable program • Consideration of existing workflows and culture • Considerations of maturing workforce/retirements	X		X

Governance
• Roles of existing players
  ○ PRSS, OCM, external/public affairs, communications directors/leads,
  ○ NWS PMO/Evolve efforts
  ○ Social science committee
• Possible new entities
  ○ Advisory or other committee/groups/individuals
	X		X

Strategic plan • Pros/cons • Establishing outcomes • Monitoring progress			X
Leadership commitment • Degree of institutionalization within agency • How much of a priority for upper/middle-level managers?	X	X	X

Resources
• Internal/existing vs. new
  ○ Build on existing efforts/tools (e.g., OCM)
  ○ Tap into partners/outside tools (e.g., FEMA training)
  ○ Hire or reassign staff, consultants, etc.
	X	X	X

Challenges Identified by Research Participants			
Mentioned By	**Internal**	**External**	**Agency**
Not thinking risk communication is part of one's job	X	X	X
Not being well-equipped to communicate risk/uncertainty information	X	X	X
Not having adequate or right resources • A sense that some offices/staff are overworked and cannot respond to stakeholder inquiries • Not having staff or losing staff that are "not operational but essential to operations" (graphic artists, risk communicators, etc.) • Not having enough/timely IT support	X X		X
Lacking internal coordination in protocols and messaging, particularly around crises	X	X	X
Stakeholder lack of trust in the information NOAA provides	X	X	
Not knowing what risk communication tools/best practices already exist internally	X	X	X
Not having common terms or language for risk communication	X	X	X
Difficulty in communicating: • Dynamic information • Probabilistic information, uncertainties • Baseline (relative to what) • Short-term relevance of longer-term, non-imminent data • Locally relevant information • User-centric information	X	X	
Developing products without benefit of input, testing, social science research	X		X
Not defining/understanding audiences and/or effectively engaging partners	X	X	X
Not communicating the uncertainty and/or probability effectively	X	X	X
Lacking process for measuring communication success/improvements needed	X		X

Improve Communication Products and Tools			
Mentioned By	**Internal**	**External**	**Agency**
Briefings: criticized as dense, text heavy, poor design • Best practices/training/templates for presentations • Branding guidelines	X	X	
Graphics/data visualization: need more/better visualization • Guidance/training on effective visualization/courses • Hire/train staff to support LOs, Centers, etc. • Before/after examples • Storymaps	X	X	
Storytelling/risk framing/messaging: important to make risk information personable and relatable • Bite-sized science videos and other videos, testimonials, case studies, explainers, podcasts, etc. • Messaging development training, etc. • Message testing	X	X	X
Plain English content: need to reduce technical terms, jargon • Before/after examples • Establish centers/staff who can help • Conduct workshops, courses or tap into external sources • Employee recognition awards (see FDA example)	X	X	X
Websites: need to be intuitive, modern, user friendly • Incorporate agile development and usability testing • Standardize sites/pages • Establish procedures for timely updates	X	X	
Develop Internal Training and/or New Tools			
Mentioned By	**Internal**	**External**	**Agency**
Media training (including mock interviews)	X	X	
Social media training/guidelines	X		X
Risk communication 101 (adapt OCM training?) and 102	X	X	X
Climate change communication training/best practices	X		
Intensive risk communication boot camp	X		
Translate scientific/technical language to plain English	X	X	X
Separating personal opinion from professional messaging	X		
Crisis communication training	X	X	X
Creating better visuals/graphics: training, best practices, workshops, courses	X	X	
Developing messaging: Training, best practices, templates Testing messaging: Guidelines, system (FDA internal panels)	X	X	X
Storytelling/personalizing and/or customizing communication: Training, best practices, examples, podcasts	X	X	

Common Challenges and Solutions		
Challenges	**Possible Solution**	**Relevant Line Offices**
Culture/roles/workflows Some scientists/meteorologists may not feel risk communication is part of their job. Some scientists/meteorologists may not feel well equipped to be risk communicators.	• Build into job definitions • Integrate into workflows • Leadership commitment/prioritization • Training/courses • More internal collaborations with scientists/communications staff (e.g., media training, testbeds) • Recognition awards	• All
Risk/uncertainty lexicon NOAA lacks a consistent approach or language for communicating risk and uncertainty (words, graphics, ranges, analogies, etc.) depending on hazard, area, situation, customer. For NWS, the Storm Prediction Center scale mentioned as good example of having defined terms, but some partners refuse to use the Storm Prediction Center terms/colors/scales; also, region-specific criteria for warnings can also be limiting and may not adequately convey risks and impacts. Interviewees for NMFS want better communication and articulation about "what is known and unknown" and they want to see that upfront in a report or other messaging. NOAA needs to communicate risk and uncertainty associated both with short-term crisis situations (severe weather) and longer-term, non-imminent threats (climate change). Media and some other stakeholders want exact numbers.	• Communicating uncertainty works better when there is trust; foster open lines of communication (listening sessions, etc.) • Assess internally how the different line offices communicate uncertainty and probabilistic information • Convene NOAA-wide working group to examine issue and possible solutions • Examine literature on short vs. long-term risks for lessons learned, best practices, guidance • Some internal interviewees desire a common language; IPCC and DHS have developed standard lexicons (USGCRP National Climate Assessment also has defined terms); NOAA could review these lexicons as well as evidence-based research studies on lexicons, such as IPCC's • Consider visualizations, pictographs, etc., to describe uncertainty, changes in risk, etc.; test any prototypes before implementation • Focus more on impacts vs. probabilities; consider risk framing, storylines, etc. • Ensure collaborated messaging within NOAA for crises (media training, internal protocols) • Use LO communications offices to train the trainers or develop a communication strategy	• All to some degree • Longer-term impacts are more relevant to NOS and NESDIS • Crisis communication most relevant to NMFS and NWS

Common Challenges and Solutions		
Challenges	**Possible Solution**	**Relevant Line Offices**
Lack of knowledge about resources NOAA staff don't know what tools resources are available or being developed. In some offices, tools are developed independently/inconsistently. So, both the tools themselves and the processes for development, testing, and transitioning to operations could be enhanced. Partners also not aware of resources.	• Establish internal repository of best examples and strategies for making people aware of them • Establish protocols/system to guide new products, tools, building in appropriate testing and collaborations • Assign someone the responsibility to find and monitor resources/tools; then test and implement best ideas (R2O) • Need agile web development processes with usability testing • Develop guidance on best practices—both visual and text • Modernize graphics; improve data visualization • Develop Weather Forecast Office briefing templates (look at Southern Region examples); guidance for how to host Weather Forecast Office briefings • Strategies/protocols for publicizing tools • Partner involvement, education, and re-education about tools/resources	• IT may be NOAA-wide challenge • NWS • NMFS, NOS (timely updates)
Technology modernization Interviewees felt NWS needed to modernize and consider advances in technology, especially artificial intelligence. At the same time, with all the models, etc., interpretation is sometimes missing.	• Hire or consult with private industry/technology experts to modernize current systems, improve graphics/data visualization, and prepare for future advances • Use social science research to help frame interpretation and messaging and incorporate into operations	• NWS • NOS
Lack of coordinated messaging Lack of coordination and "who owns the message," especially in crises; sense on part of Weather Forecast Offices that HQ thinks National Centers own the message.	• Develop protocols, systems for Weather Forecast Office/National Center collaborations • Use or improve existing technology tools for coordination (software, text message, phone); Eastern Region has crisis management plan • Develop case studies (e.g., Harvey) of successful collaborations • Develop or enhance tools that can be easily customized (Southern Region has briefing template)	• NWS • NMFS has developed crisis communication protocols

Common Challenges and Solutions		
Challenges	**Possible Solution**	**Relevant Line Offices**
Lack of trust in messaging NOAA generally viewed as trusted source of information; advocacy groups lack trust about information exchange; also challenges in communicating climate science/projections, etc.	• More forums such as listening sessions, webinars, town halls, etc. • Best practices for risk framing, storytelling, personalizing information (e.g., NOS example of not leading with 100-year climate projection) • Being upfront and detailed about what is known and unknown in reports, etc. • More training and best practices on ways to communicate science behind the message ("scientists need to simplify messaging; management needs to make messaging more complex")	• NMFS • NOS
Partner engagement While NOAA was praised highly for partner engagement in interviews, there also was some room for some improvement.	• Research to understand partner needs and preferences (conduct more social science research, share findings, and incorporate into practice) • Strategies for customizing and personalizing information to particular audiences (plain English language, storytelling, visuals, scaling) • Strategies for explaining the science (data visualization, storytelling) • More publicizing and promoting of available resources and more sharing of people, tools, data, GIS • Continued work to raise awareness and engagement among NOAA staff of importance of partner engagement, including nontraditional partners • Continued work on education and re-education of partners, esp. when new tools are developed • Case studies, training, webinars, etc., of effective partner engagements • More/continued involvement in working groups, committees, etc. • Periodic or monthly calls/webinars for stakeholders • Media/other partner calls in advance for big releases, events • Message development/testing	• NOS • NWS • NMFS • NESDIS

Common Challenges and Solutions		
Challenges	**Possible Solution**	**Relevant Line Offices**
Audience definition and understanding Some interviewees felt certain line offices did not have a good definition of who their audience is; some interviewees also felt that some line offices could be customizing their messaging more to different audiences; some also wanted more local engagement.	• Definition/understanding (e.g., high vs. low); and with that a focus on service delivery • More consideration of vulnerable populations • More consideration (training, etc.) of cultural competency issues • More use of translation • More use of social science research into audiences, needs, preferences, perceptions, etc., along with sharing findings from that research and incorporating into operations • Strategies for customizing and personalizing information to particular audiences (plain English language, storytelling, visuals, scaling of data to local level) • Strategies for explaining the science (data visualization, storytelling) Develop LO-specific strategies: gauge what is already being done, lessons learned, where there are gaps (e.g., NMFS listening sessions, NWS surveys, social science research) • Establish a process/group to translate certain information/products into other languages • Cultural competency awareness training/procedures/best practices/case studies • Develop information on why it's important to understand vulnerable populations, along with guidance for engagement (see DHS Best Practices Guide); case studies of effective engagements • Workshops, guidance, etc., for tailoring products/information to different audiences—training, guidance, examples, templates • Social media guidance/training—NWS Eastern Region and some Weather Forecast Offices may have tools	• NWS • NOS

Common Challenges and Solutions		
Challenges	**Possible Solution**	**Relevant Line Offices**
Monitoring and evaluation communication Internal interviewees generally didn't have a good sense of how well they are doing—how their messages and information are perceived, used, etc. Mostly, they rely on anecdotal information to verify their communication.	• Develop guidelines/training for what to measure, how to track, how to analyze, how to incorporate • Share strategies internally (peer to peer, webinars) • Use technology for tracking (e.g., NESDIS system for tracking requests) • Training, webinars, train the trainers, etc., on Google analytics, social media monitoring, media monitoring • Build into existing communication plans or develop plans if they don't exist	• All to some degree

APPENDIX E. SUMMARY OF CHALLENGES/SOLUTIONS AND BEST PRACTICES

Challenges

Key challenges that affect all LOs to some degree are:

1. A culture/viewpoint that risk communication is the job of scientists.
2. There isn't a common language for talking about risk and uncertainty.
3. Science is hard to communicate.
4. LOs lack capacity and resources for risk communication.
5. People don't know what resources are available.
6. NOAA staff can't measure their impact.

The following challenges were mentioned in relation to specific offices, but because of the limited number of people sample, these challenges may just reflect the viewpoint of a few individuals or may not necessary be a LO-wide problem.

1. NWS: Internal operations lack some coordination.
2. NMFS, NOS: Information exchange could be more credible and transparent.
3. NWS, NOS, NESDIS: Audiences are not always effectively defined and engaged.
4. NOS, NWS, NMFS, NESDIS: Partners could be more effectively engaged.

These challenges, along with possible solutions (tactics and activities), are described in the following pages. In addition, sample metrics are provided as a starting point.

Challenges in Risk Communication Applicable to All LOs

- **"Risk communication isn't my job."** There is a mindset among some scientists that is it not their job to communicate their science—or that it is a job for "translators." One NOAA interviewee stated, "Explaining the science takes time away from doing the science." Another external interviewee said, "Communication should not be left to an outreach specialist; they don't understand the intricacies of your work."

Possible Solutions/Tactics/Activities	Resources	Sample Metrics
• Identify positions that require risk communication expertise by LO • Build risk communication responsibilities into job definitions. • Provide ongoing training on risk communication (perhaps require annual training). • Integrate risk communication best practices into existing workflows. • Incorporate risk communication metrics into performance reviews. • Conduct internal campaigns to raise awareness of importance/best practices for risk communication. • Create testimonials from scientists who embrace risk communication about their processes + success. • Establish a recognition program and give awards to good risk communicators. • Host webinar series (NOAA Social Science Committee) on importance of risk communication and success stories.	• Strategic Plan for Risk Communication and Health Literacy (SPRCHL) • English Communication for Scientists by Scitable/Nature education	**Short-term (outputs)** • # of job descriptions that include risk communication. • # of times/ways leadership messages or demonstrates the importance of risk communication. • # recognition awards. • # campaigns, # reach. • # webinars, # reach. • # testimonials. **Medium-term (outcomes)** • Risk communication training is built into NOAA workflows. • NOAA staff understand and value and risk communication. • NOAA staff are effective risk communicators. **Long-term (outcomes)** • Customers trust, value, use, and act upon NOAA risk communication.

- **There isn't a common language for talking about risk and uncertainty.** Several interviewees stated that NOAA is inconsistent in the way it defines and communicates risk and probabilistic information. All LOs struggle with communicating uncertainty or recognize that it is can be a challenge for NOAA. In NWS, probabilistic terms mean different things to different forecasters. However, even when NWS defines terms (e.g., the Storm Prediction Center's severe thunderstorm scale/words), external partners may not buy into those definitions or use them consistently. Some internal and external interviewees suggested that risk communication, including expressions of uncertainty, must be tailored to different audiences. An additional challenge is that NOAA needs to communicate risk and uncertainty for different types of situations and hazards. Some organizations, such as the Intergovernmental Panel on Climate Change (IPCC) and the Department of Homeland Security (DHS) have developed guidance or tools to help standardize terminology. Even with these definitions, however, research has found that people can interpret phrases, such as "likely" and "very likely" differently, and any NOAA lexicon would need to reflect the way people intuitively interpret words.

Possible Solutions/Tactics/Activities	Resources	Sample Metrics
• Convene a NOAA working group to examine the lexicon issue and possible solutions.[8] • Create a glossary of risk communication terms (perhaps tailored to each LO, audience sector). • Conduct simulations to explore content and processes (e.g., frequency of contact, distribution methods) for messaging risk/uncertainty under common situations. • Develop LO-specific templates/guidance. • Develop best practices/lessons learned/training for tailoring risk/uncertainty information to different types of audiences. • Develop case studies of successful, tailored risk messaging within NOAA. • Create visualizations, videos, analogies to help frame and explain risk and uncertainty. • Match NOAA social scientists/communicators with scientists to help frame messaging.	• Guidance Note for Lead Authors of the IPCC AR5 on Consistent Treatment of Uncertainties • Guidance Document: DHS Risk Lexicon • Risk Mapping, Assessment and Planning Community Engagement Fact Sheet • Characterizing Risk in Climate Change Assessments	**Short-term (outputs)** • Depends on tactic chosen. **Medium-term (outcomes)** • Risk communication is tailored to the audience and situation. • Expressions of risk and uncertainty are consistent to the extent desired. • NOAA is transparent about what is known and unknown. **Long-term (outcomes)** • Customers understand the risks and uncertainty associated with NOAA's communications and information.

[8] IPCC developed a lexicon for uncertainty/weight of evidence that was used in its Fifth Assessment Report (AR5). The lexicon was developed in response to criticism that IPCC was not defining certainty with enough rigor or explanation in prior reports. However, this lexicon, too, has been met with criticism, and a recent study has shown alternative approaches rooted in the way people naturally and intuitively think about uncertainty may be more effective than the current IPCC approach.

- **Science is hard to communicate.** Data can be abstract, complex, dynamic, and uncertain. Interviewees commented that scientists tend to be "in the weeds," too dense, and use too much technical jargon. Several federal agencies (FDA, CDC, and FEMA) offer training in risk communication. FDA conducts both general risk communication training and more targeted workshops for its different centers, using those centers' tools and processes to increase the relevancy of the training for participants. NOAA already has in-house capacity for training, and various LOs offices have undertaken risk communication training efforts (see best practices table at the end of this appendix). Interviewees also stressed the importance of using visualizations and storytelling in communication. NASA has even created a Conceptual Image Lab where artists work hand-in-hand with scientists to produce engaging visualizations.

Possible Solutions/Tactics/Activities	Resources	Sample Metrics
• Promote staff development in risk communication via training, courses, etc.; conduct media training (use mock interviews); develop standard Q/As. • Create an internal Risk Communication Ambassadors[9] program to foster collaborations between scientists and communicators; create best practices, testimonials, etc. • Develop general best practices/guidance/training for communication (e.g., tailored, actionable, personable, visual, tells a story, etc.). See IPCC guidance. • Develop briefing best practices/training/templates. • Develop guidance/training on effective visualizations. • Develop guidance/training on using social media. • Create plain language committee or writing center, conduct plain language LO-specific training or toolkits (using before/after examples). Identify high-priority resources to convert to plain language. • Create staff recognition awards for plain English or effective communication (see FDA example). • Create storytelling training, templates. • Create message development/testing processes, workshops, templates; create message library for crises.	Internal • OCM Risk Communication Training Resources • NWS/WCM Risk Communication Training • ORR regional risk communication trainings • NWS Comms blog (Doug Hilderbrand) External • FEMA Crisis and Risk Comm Course • CDC Clear Communication Index • FDA Plain Language Principles • Federal Plain Language Guidelines • Federal Agency Plain Language Training • Centers for Medicare and Medicaid Services Plain English Toolkit • IPCC communication guidance • IPCC guidance on effective visuals • CDC design templates and visual library (and other resources) • CERC messages and audiences	**Short-term (outputs)** • # of people trained, get awards • # of documented applications from trainings to jobs • # of resources developed, tested for, or converted into plain English, visuals, stories, etc. **Medium-term (outcomes)** • NOAA staff have the support they need to be good communicators. • NOAA staff are effective risk communicators (e.g., write in plain English, use stories, visualizations, etc.). **Long-term (outcomes)** • Customers trust, value, use, and act upon NOAA risk communication.

[9] Many interviewees internal and external to NOAA provided names of good communicators within NOAA who have skills that could be utilized to help frame and customize risk messaging (David Herring, Heidi Stiller, Doug Marcy); perhaps these individuals could be tapped as Ambassadors. Additional candidates of interviewees we talked to would be Doug Hilderbrand and Brady Phillips.

- **People don't know what resources are available.** Several internal interviewees stated they don't have a good sense of what risk communication resources are available or being developed. Some stakeholders also don't know what resources NOAA offers (or they want to be regularly re-educated what's new or available). Several individuals suggested that NOAA is underutilized and could market or promote its resources (including its people) better. A contributing factor, cited by NOAA Research, is hesitancy on the part of some scientists to publicize their work. In some LOs, products or tools are also developed independently/inconsistently. So, both the tools themselves and the processes for development, testing, and transitioning to operations could be enhanced.

Possible Solutions/Tactics/Activities	Resources	Sample Metrics
• Establish internal repository of best examples and develop strategies to market their availability. • Market resources internally and externally through channels such as email lists, social media campaigns, partner networks, etc. • Establish protocols/systems to guide new products, tools, building in appropriate testing and collaborations. • Develop and share case studies of successful product development stories (e.g., NWS storm surge products). • Assign someone to find and monitor emerging resources/tools; then test and implement best ideas. • Work with partners to promote tools; use their channels and members (e.g., Sea Grant mentioned by several interviewees) to help promote NOAA risk information and stories. • Send out monthly calendar of events, news, actionable information. • Conduct monthly partner calls/webinars.	• NOS/OCM is working with a company in Charleston to develop a learning hub for its risk communication materials. • NWS is working to gather best practices from regions and field offices. • NWS Weather Forecast Offices may have or are working on some standard briefing templates.	**Short-term (outputs)** • # social media campaigns. • # emails delivered, opened. • SEO optimization, rankings. • # case studies. • # tools identified, tested, implemented. • # webinars, partner calls, attendees. **Medium-term (outcomes)** • Protocols are put in place to guide tool/resource development, testing, implementation. **Long-term (outcomes)** • Internal tools are created, tested, and implemented. • NOAA staff and partners know what resources are available. • NOAA staff and partners use available resources.

- **NOAA staff can't measure their impact.** NOAA interviewees generally didn't have a good sense of how well they are doing—how their messages and information are perceived, used, etc. Mostly, they rely on anecdotal information to verify their communication. One NMFS interviewee said their LO communication is sometimes deemed successful when they *don't* hear any feedback. At the same time, LOs may lack the capacity and knowledge to measure their impact. NWS stated it needed a "practical way" to measure communications effectiveness and societal response. "We have a lot of qualitative data, but no way to quantify it or use it systematically."

Possible Solutions/Tactics/Activities	Resources	Sample Metrics
• Hire or find internal resource to help LOs develop guidelines/training for defining objectives, indicators, and measurement activities. • Build metrics into existing communication plans or develop plans if they don't exist. • Share strategies internally (peer to peer, webinars)—could this be a role for Risk Ambassadors? • Use technology for tracking and responding to inquiries (e.g., NESDIS system for tracking requests). • Hire experts or establish internal capacity to conduct ongoing Google analytics, social media monitoring, media monitoring. • Solicit input (qualitative, quantitative) to assess impact (e.g., interviews, customer satisfaction surveys, focus groups, etc.). • Share outcomes and tell transformational stories of measurements.	• OCM solicits input and feedback from coastal managers who use Digital Coast tools and creates stories from the field. • OCM conducts up to Level 3 evaluations on training, which incorporate a basic training evaluation, learning boosters, and interviews to learn how participants applied the training to their situation. • CDC Evaluation Planning • Selecting Measurement Indicators at CDC	**Short-term (outputs)** • # mentions/links to; #reach in social media; website analytics, including trends over time. • # webinars, trainings, people attended, etc. • # papers published, #citations, #mentions of research by others. • # presentations given. • # awards. • # interview requests. **Medium-term (outcomes)** • Measurement objectives and indicators are defined. • A system is in place to measure indicators/metrics. • Indicators/metrics are being tracked. **Long-term (outcomes)** • NOAA risk communication is having an impact on policy makers or practitioners (e.g., influencing policy, discourse). • NOAA risk communication is changing perspectives, behaviors, actions. • NOAA staff have increased capacity and effectiveness.

- **LOs lack capacity/resources for risk communication**. Internally, there is a perception that some offices are overworked and lack staff with capabilities (e.g., graphics, social science) for risk communication. Also, technology is not always as modernized as desirable, data may not get updated as frequently as partners would prefer, and IT resources can be scarce or not timely. Both internal and external interviewees noted the existence of outdated technology and clunky websites within NOAA. Internal interviewees mentioned a lack of timely IT support. Not having the best technology can mean the agency doesn't have the best information from which to interpret risk, while poor websites or clunky data tools can frustrate audiences—so even if the risk information is available, users may not access it.

Possible Solutions/Tactics/Activities	Resources	Sample Metrics
• Hire, partner, or consult with industry/technology experts to modernize current systems, improve graphics/data visualization, and prepare for future advances. • Use social science research/NOAA's Social Science Committee or Risk Communication Ambassadors to help LOs develop risk communication strategies and plans. • Incorporate agile development and usability testing into website development. For example, use cross-functional teams of stakeholders, subject matter experts, and operation staff to provide guidance to development teams. • Ensure websites are mobile friendly. • Develop branding guidelines and templates to ensure consistency and increase development efficiency. • Standardize websites/pages. • Establish procedures for timely updates of website information.	• OCM Digital Coast and NMFS websites • NWS usability testing for Hurricane Threats and Impacts website • Digital.gov, provides guidance, training, etc.	**Short-term (outputs)** • # website analytics to help guide and measure web improvements. • # usability studies. • # tools identified for modernization. • # tools modernized. • # sites/pages that are mobile-friendly. • # sites/pages that are standardized. • # of social science studies conducted to guide risk communication planning. • # IT experts, graphics experts, social scientists hired or sourced. **Medium-term (outcomes)** • LOs have the resources they need to develop risk communication strategies and plans. • LOs have developed risk communication plans and strategies. • LOs are implementing their plans and strategies. • Standard procedures are in place to guide web development, testing, and updates. • Branding guidelines/templates are developed and used. **Long-term (outcomes)** • Customers can easily find, use, and act upon NOAA's risk information. • NOAA's tools and models are modernized.

Challenges in Risk Communication Specific to Individual Line Offices

The following challenges were mentioned in relation to specific offices, but because of the limited number of people sampled, these challenges may just reflect the viewpoint of a few individuals or may not necessary be a LO-wide problem.

1. **NWS: Internal operations lack some coordination.** Some interviewees suggested there can be inconsistent messaging, a lack of clarity around who owns the messaging, and a lack of protocols. There was also a desire for more standard templates. Interviewees both internal and external to NOAA said products are often developed without testing or stakeholder input. External interviewees expressed how difficult it is to find information on NWS websites, even for sophisticated users. They also criticized some Weather Forecast Office briefings as being text-dense and poorly designed and felt there was more work for NWS to do on being coordinated and effective on social media, citing the preponderance of Twitter accounts as just one example.

   Tactics

   - Develop NWS-wide protocols for crisis management at all applicable levels (Eastern Region has crisis management plan). One Weather Forecast Office said that NWS needs a "formal huddling up" of all affected Weather Forecast Offices (noting NWS is heading in this direction, but there is still room for improvement).
   - Develop protocols, systems for Weather Forecast Office/National Center collaborations. Develop case studies (e.g., Harvey) of successful collaborations.
   - Use or improve existing technology tools for coordination (software, text message, phone). One Weather Forecast Office suggested a text messaging group so that all managers are connected with other Weather Forecast Office managers and know what everyone is going to say; National Centers also need to be part of this group.
   - Develop standard messaging/Q and A's for anticipated/recurring types of situations or where there have been lessons learned (e.g., the "bust" forecast, preparing for winter weather).
   - Develop template, branding guidelines, common look and feel for products/briefings.
   - Develop more bilingual information—and not just during events. The NWS Weather Forecast Office in Miami (and other cities with large Latino populations) should proactively put out information in English and Spanish.
   - Risk information and messaging should be culturally competent; Consider developing internal cadre of people who can check translations/cultural competency.
   - Assess national vs. regional vs. local social media functions and accounts with an eye toward leveraging resources and becoming more coordinated. Develop training/best practices for social media.

2. **NWS, NOS, NMFS, NESDIS: Audiences are not always effectively defined, understood, or engaged.** Internal and external interviewees reflected that NOAA's audience base is growing and diversifying. For example, NESDIS and NWS interviewees both said that members of insurance/reinsurance sector are new customers. One NOS interviewee remarked that not only has its customer base expanded and changed over time, so has its number of products—meaning more interpretation is needed. One NWS interviewee stated that Weather Forecast Offices need help not only in *what* they communicate, but with *whom* they communicate, citing a need to engage certain, less traditional partners, such as churches. Externally, one interviewee said NOAA works best when it is engaged

with local communities, not "here's the data, now go away." Some external interviewees also felt certain LOs did not have a good definition of who their audience is; some interviewees also felt that some LOs could be customizing their messaging more to different audiences; some also wanted more local engagement.

Tactics

- More use of social science research to identify audiences, needs, preferences, perceptions, etc., along with sharing findings from that research and incorporating into operations
- More development/use of strategies for customizing and personalizing information to particular audiences (plain English language, storytelling, visuals, scaling of data to local level)
- Strategies for explaining the science (data visualization, storytelling) Develop LO-specific strategies: gauge what is already being done, lessons learned, where there are gaps (e.g., NMFS listening sessions, NWS surveys, social science research)
- Establish a process/group to translate certain information/products into other languages
- Cultural competency awareness training/procedures/best practices/case studies
- Develop information on why it's important to understand vulnerable populations, along with guidance for engagement (see DHS Best Practices Guide); case studies of effective engagements
- Workshops, guidance, etc., for tailoring products/information to different audiences—training, guidance, examples, templates
- More forums such as listening sessions, webinars, town halls, etc.
- Best practices for risk framing, storytelling, personalizing information (e.g., NOS example of not leading with 100-year climate projection)
- Being upfront and detailed about what is known and unknown in reports, etc.
- More training and best practices on ways to communicate science behind the message ("scientists need to simplify messaging; management needs to make messaging more complex")

3. **NMFS, NOS: Information exchange needs to be more credible and transparent.** External interviewees expressed a desire for NOAA to provide more transparency about what is known and unknown in its data and communication. As an example, one individual commented that NOAA can put out a report with hundreds of pages, but only have one sentence listing—but not explaining—the uncertainties. NOAA is generally viewed as a trusted source of information; advocacy groups lack trust about information exchange; there are also challenges in communicating climate science/projections, etc.

   Tactics

   - More forums such as listening sessions, webinars, town halls, etc.
   - Best practices for risk framing, storytelling, personalizing information (e.g., NOS example of not leading with 100-year climate projection)
   - Being upfront and detailed about what is known and unknown in reports, etc.
   - More training and best practices on ways to communicate science behind the message ("scientists need to simplify messaging; management needs to make messaging more complex")

4. **NOS, NWS, NMFS, NESDIS: Partners need to be effectively used and engaged.** Generally, external interviewees were very appreciative of their positive and productive working relationships with NOAA staff. A few interviewees stated that NOAA has taken steps in recent years to strengthen its

stakeholder and partner engagement: one mentioned that NMFS has integrated outreach into NOAA staff responsibilities so that outreach is no longer a reaction or side thought, but rather "a component of what they do." Another interviewee said her organization is in "constant communication" with their local Weather Forecast Office. While engagement and outreach opportunities exist, they could sometime be more fruitful. One person said there is "not always enough trust in the information exchange." Another suggested that NOAA could be more connected to the needs of the end user. Even interviewees who were very satisfied with their engagements with NOAA staff noted there were "are always opportunities to improve." One person noted the communication process is a two-way street whereby NOAA end users are also doing their part to bring NOAA staff to the table via working groups and other mechanisms.

Tactics

- Research to understand partner needs and preferences (conduct more social science research, share findings, and implement)
- Strategies for customizing and personalizing information to particular audiences (plain English language, storytelling, visuals, scaling)
- Strategies for messaging, testing messaging, and explaining the science (data visualization, storytelling)
- More publicizing and promoting of available resources and more sharing of people, tools, data, GIS
- Continued work to raise awareness among NOAA staff of importance of partner engagement, including nontraditional partners
- Continued work on education and re-education of partners, esp. when new tools are developed
- Development of case studies, training, webinars, etc. of effective partner engagements
- More/continued involvement in working groups, committees, etc.
- Periodic or monthly calls/webinars for stakeholders
- Media/other partner calls in advance for big releases, events

Line Office Resources and Best Practices

LO	Research	Messaging	Customer-Directed Products	Internal Tools/Guidance/Strategy	Engagement
NESDIS	Not mentioned	Includes confidence and data sources when putting out probability estimates Avoids terms like "record-breaking" Collaborates with partners on messaging in advance of publication or media engagements	Develops stories targeted to customers based on seasonal needs Develops flyout charts to explain funding needs to Congress	Tracks all inquiries/responses received through a database Has provided media training to scientists	Holds monthly climate calls for the media and other stakeholders Provides technical assistance to new reporters Proactively reaches out to partner agencies and Congress Conducts weekly meetings with largest stakeholders
NMFS	Conducts economic and social science studies Currently assessing vulnerability and resilience of communities engaged in commercial or recreational fishing	Is proactive about putting out numbers and stats and explaining what they mean Has taken immediate responsibility for a situation when warranted Uses positive and measurable messaging Communicates risks and tradeoffs of	Recently revamped website and made it mobile-friendly (#1 communication platform)	Developed crisis communication guide/protocols (see attached) Conducts "hot washes" after a crisis to review and improve communication Conducts website analytics to measure outputs Have presentation and media training Suggestion: Keep training ongoing and active as new workforce comes on	Conducts listening sessions and town halls with local communities Is proactive about making calls to media when a crisis is occurring Set up a domestic fisheries advisory groups to provide a forum for input Tracks if NMFS messages are picked up/amplified by credible sources

LO	Research	Messaging	Customer-Directed Products	Internal Tools/Guidance/Strategy	Engagement
		risks and not managing risks			
NOS/OCM	Social, behavioral, and economic studies and research Working with a company in Charleston to develop a hub for risk communication materials to create effective paths for customer learning Uses third-party validation—success stories and feedback from others ("when people start sharing your content without your involvement, we consider it a success") Conducted a survey on website, collects analytics on website	Provide useful and actionable tips and guidance (rip current campaign) Relate messaging to similar or familiar events (e.g., rather than just provide a number, add context such as "it'll be like/almost like x storm") Put data in context for public audiences; e.g., have used common vernacular (knee-high, waist-deep) rather than numbers Have found it useful to provide more incremental data rather than "extreme" data (e.g., climate projections many years in the future) at the beginning of any partner	Story maps Rip current campaign informed by social science research; produced videos garnered 20 million views Digital Coast (tools, visualizations, etc.) Stories from the field (case studies of how communities used Digital Coast tools and resources to address coastal issues) Cited as a good example of a visualization produced by an external agency: https://www.windy.com (see poor NOAA example in contrast) High Tide Bulletin is most viewed content on website Inundation Dashboard collects data and tools from all over NOAA in one place	Guidance Risk Communication Basics (15 page PDF) How to Write a Strategic Plan (guidance, worksheets, and templates) Needs Assessment Guide (Self-paced online guide) Risk Communication Best Practices (tip sheet on seven best practices for risk communication) Introduction to Conducting Focus Groups (13-page PDF) Case studies (peer to peer guidance on tackling issues) Introduction to Stakeholder Participation (15-page PDF on when, why, and how to engage and identify stakeholders) Digital Coast Topics (organizes resources and tools by topic) Training Seven Best Practices for Risk Communication (webinar) Building Risk Communication Skills (one day training-see attached) Facilitation Basics for Coastal Managers (live training hosted by a partner)	Have developed talking points for the media to use when talking about coastal hazards; have partnered with The Weather Channel and NWS to make sure messaging is right NOS has a link and email on its website to handle low-less, non-urgent questions from people who use NOS data Conducts up to Level 3 assessments on training and use of resources; OCM actively solicits input and feedback from coastal managers who use Digital Coast tools and creates stories from the field OCM conducts up to Level 3 evaluations, which incorporate a basic training evaluation, learning boosters, and interviews to learn how participants applied the training to their situation Conducts Social Coast Forum, focused on the integration of social science into physical science; includes a session

LO	Research	Messaging	Customer-Directed Products	Internal Tools/Guidance/Strategy	Engagement
		interactions to build trust and credibility	OCM has given access to Sea Level Risk Viewer to enable a state to modify the tool using their data; NOAS has also partnered with Climate Central to provide data sets for their Surging Seas tool	Planning and Facilitating Collaborative Trainings (live training hosted by a partner) Social Science Basics for Coastal Managers (live training hosted by a partner) Fostering Behavior Change for Coastal Management: An Introduction to Community-Based Social Marketing (can be requested for online delivery) Other Uses management transition advisory groups to help transition research to application	about explicit failures, sharing strategies to avoid Digital coast partners get together a couple of times a year to focus on common goals, brings people together that would not otherwise come together to share different perspectives
NWS	Have conducted many social, behavioral, and economic studies and research (Jen Sprague Hilderbrand) Conducted Operations and Workforce Analysis (OWA) and developed recommendations through NWS Program Management Office (PMO)	Assumes position of "honest broker in the room" on social media; part of role is to quell rumors Working on "One NWS, One Forecast" Develops personalized messages (ex. Dr. Uccellini appeared in videos shared during 2017 hurricanes)	Storm surge products, ProbSevere Tool for hazardous weather, ATSFW—all tools transitioned or transitioning into operations informed by research and testing #SafePlaceSelfie Campaign (personalized) Infographics to explain things like inland flooding, cone of uncertainty and how they relate to impacts	Developed and implementing Evolve Strategy; collecting resources and best practices under PMO Impact-Based Decision Support Services Definition Policy in review Conducts testbeds; NWS also has worked on developing guidelines for conducting testbeds to ensure they are rigorous Weather Forecast Office best practices developed after Ike: 1) talk to other WCMs, 2) conduct	Hosts partners' meetings Have established liaison positions between NOAA and FEMA to help with coordination/translation Internal coordination between Weather Forecast Offices and the National Hurricane Center during Hurricane Harvey Weather Forecast Office impact-based decision support services and deployments, constant

LO	Research	Messaging	Customer-Directed Products	Internal Tools/Guidance/Strategy	Engagement
		Provide context in messaging (local and event-specific) Use actionable messaging; use terms like life-threatening and catastrophic when warranted Take out words like "possible" when there is certainty From Weather Forecast Office: uses science-based messaging to communicate what we know and don't know, uses words, plain vernacular to express uncertainty	Targeted materials for media and social media Intensive media outreach efforts during major events, such as Harvey (TV/radio, phone interviews, social media; in Spanish & English)	decision-support webinars; 3) create repository of templates Social media guidance/training—NWS Eastern Region and some Weather Forecast Offices may have tools and plans Eastern Region has a crisis communication plan Southern Region developing briefing templates Training (messaging?) during severe weather and fire weather (Katie Edwards) Working on a blog for comms training—basics of how to do things better	communication during crises: emails, webinars 3 x a day; send out condensed versions of briefings; post on FB, Twitter hourly; monitor and respond on social media as well One Weather Forecast Office suggests doing live webinars (hosted by NWS), also co-hosting webinars with RFO if appropriate Southern Region has a Regional Operations Center to serve as communications hub during high impact events Weather Forecast Offices send briefing packages directly to partners, so they do partners do not have to go to website to find them Weather Forecast Offices are collecting their local partner needs for impact-based decision support services (challenge is to unify these datasets across NWS)
NOAA Research	Leverage partnerships with social scientists with weather backgrounds; for	Couch risks with caveats; not our job to develop policy (e.g., "here's what	Developed 3–4 minute, bite-sized science videos	Testbeds Identify training needs from testbed observations	Hold press events for reporters to come in and see research in action

LO	Research	Messaging	Customer-Directed Products	Internal Tools/Guidance/Strategy	Engagement
	example, partnered with social scientists to improve models and uncertainty information for NWS forecasters Publishes up to 1,500 papers a year Is working with social scientists to study decision-making processes in the aviation sector	we are seeing and what could happen") Careful to balance fine line between communicating science and recommending or influencing policies	Created one-pagers of high visibility projects for Congress Created "Science on a Sphere" which is live in 86 U.S. museums		Advocate for our work with Congress, visit the Hill once a year
OMAO	Not mentioned	For media, provides context, background, and strategy layout (here's the problem and where's what we're doing and why) before doing a Q&A session Collaborates with other offices to present "one NOAA voice" to Congress Proactively reaches out to communities affected by relocations	Use traditional channels, but growing digital presence and has used website, earned media, also has regular engagement on social media	Collaborated with other offices across NOAA to put together a report for the Congress; use an independent third party to validate the strategic recommendations put forward by NOAA in that report Have Emergency Response Plans for our platforms that have a communications component; have checklists on what to do during an emergency for each platform Have training drills with aircraft operations Diving program provides training and guidelines	Have learned lessons from relocations how to communicate proactively with communities and the media and build relationships Hosts many community-centric, in-person events: press events, open houses, hurricane tours Have provided guest speakers at local institutions and schools

APPENDIX F. PRACTICAL GUIDE PILOT TESTING

Approach

ERG conducted an exercise to test the interactive components of the draft product, "A Practical Guide for Natural Hazard Risk Communication," with representative users from each of the NOAA LOs. The goal was to gather feedback to help make the final product as relevant and user-friendly as possible.

ERG and NOAA used the following procedure:

1. ERG and NOAA compiled a list of reviewers. Candidates were identified by NOAA's Research Council and others. The list included six primary reviewers (one from each LO) and four alternates.

2. ERG drafted a brief recruitment email that the NOAA project manager sent to candidates.

3. ERG developed a brief set of instructions for reviewers, including the expected time commitment and whether the review must occur in one contiguous block of time.

4. ERG developed an instrument (a short Google form with questions) to gather feedback. Questions were designed to elicit constructive, actionable input. They provided opportunities for open-ended response.

5. ERG distributed the instructions, the draft "practical guide," and a general idea about the questions (i.e., the "charge" to reviewers). ERG answered clarifying questions as needed.

6. Each reviewer was given a week to review the guide. We asked each reviewer to:

    a. Determine whether they would prefer to test the guide as an individual or assemble a small team to explore a scenario together. They could choose. We encouraged a diversity of approaches.

    b. Select a specific risk, relevant to their line office, that they would like to use as a case study. We provided examples drawn from the guide.

    c. Go through all steps in the guide and fill out (or at least start to fill out) all eight worksheets.

    d. Complete and submit the feedback instrument.

7. ERG reviewed the feedback and held follow-up discussions with two individual testers to get clarification on selected comments.

Ultimately, we received feedback from seven reviewers, representing all six LOs. A few commenters provided feedback by email in addition to—or in lieu of—the Google form.

Instructions to Reviewers

Overview

Thank you for agreeing to serve as a test user for our guide. This product, "A Practical Guide for Natural Hazard Risk Communication," is designed to help all NOAA line offices identify risk communication needs

and walk through a stepwise process to develop a successful communication plan. It includes a series of eight worksheets.

Some of you may have been involved in earlier stages of product development, which included prior iterations of a "risk communication framework" and a series of interviews conducted by NOAA's contractor, Eastern Research Group, Inc. (ERG). The product you will review is a refined draft that we plan to finalize for internal publication and distribution by July.

Detailed Instructions

1. **Set aside time for your review.** Out of respect for everyone's time, we're just asking you to do as much as you can in about two hours. You don't necessarily need a contiguous two-hour block, but you'll probably find it most efficient to work without too many interruptions.

2. **Please read (or at least skim) the background material in the guide.** We recommend reviewing the entire guide before you start to fill out the worksheets. This will give you a more complete picture of the whole exercise before you start.

3. **Choose a real or hypothetical risk that you would like to use as your scenario for testing.** Consider a risk that is relevant to your line office—i.e., a risk that you or your colleagues might have to communicate to some type of audience (internal, general public, emergency managers, policymakers, etc.). Box 1 provides some examples for inspiration.

Box 1: Examples of Risks that NOAA Might Need to Communicate About

- Hazardous weather events
- Dangerous waves and currents
- Navigation hazards
- Longer-term coastal risks due to sea-level rise
- Ocean acidification
- Overfishing
- Harmful algal blooms
- Reduced research budgets
- Deferred maintenance for research vessels/aircraft

4. **Decide whether you'd like to fill out the worksheets individually or as part of a group.** Some testers might find it useful to brainstorm with colleagues while completing this exercise. It's entirely up to you if you have colleagues who are interested in helping.

5. **Fill out the eight worksheets in order.** The worksheets are designed to build sequentially. You might not need to fill out each worksheet in its entirety, but just fill out enough of it to get a feel for how well the exercise is working. We suggest spending no more than 15–20 minutes on any one sheet. You can choose to fill out the worksheets on paper or as fillable PDF forms.

6. **Provide feedback through a Google form.** See the link under "Logistical Details" below. The form will ask for your thoughts on each specific worksheet with respect to clarity of instructions, usefulness of background material, time spent, difficulty, and any suggestions for improvement. Altogether, we estimate that the form will take about 20 minutes to complete. If you have more feedback than you are able to provide on the form, we can schedule a brief call for further discussion.

Feedback Questionnaire

Questions About Each Worksheet

This set of questions will be repeated eight times. Questions are open-ended unless otherwise noted.

1. Did the background information give you appropriate context for filling out this worksheet? If not, please explain.
2. Were the instructions clear and helpful? If not, please explain.
3. Did you have enough information to be able to fill out the worksheet? If not, what other information, expertise, or resources would you need?
4. How long do you think it would take someone to fill out this worksheet in its entirety? [less than 10 minutes, 10-20 minutes, 20-30 minutes, more than 30 minutes]
5. What other suggestions do you have (if any) to improve this worksheet?

Overarching Questions

Questions are open-ended unless otherwise noted.

1. What risk did you choose for your testing scenario?
2. What other risks might be particularly relevant for your office?
3. How likely would you be to use this guide in your work? [highly likely, moderately likely, not sure, moderately unlikely, highly unlikely]
4. What suggestions do you have (if any) to make this "practical guide" more usable and more likely to be used?
5. Did you follow any of the links to other resources cited in the guide? [yes/no]
6. Please share any other comments you have about this product.

Results

The table below documents all of the comments received during the pilot exercise, along with a record of how they were addressed in the final edition of the practical guide. Comments are organized by worksheet, question, and commenter (anonymized).

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
1	Enough background context?	1	Yes	No change needed.
1	Enough background context?	2	No. It is not clear if this is to communicate risks internal (such as LxC for programmatic, budget, personnel, etc... risks) vs external communications for hazards. It appears to solely focus on the latter and has nothing to do with internal communications using internal RMPs (Risk Management Plans) which incorporate LxC, Waterfall Charts, and enterprise risk tools.	Clarify in the intro that the focus is on external communication.
1	Enough background context?	3	I believe so. If anything, it was on the long side but for those with little background/experience with risk communication, is warranted.	No change needed.
1	Enough background context?	4	Would like more on what characteristics affect perception of risk.	The table provides examples, and given the desired short length of this product, we encourage readers to visit the products cited in the resources and the footnote for more details. We recommend no change.
1	Enough background context?	5		Blank response; no change needed.
1	Enough background context?	6	Yes	No change needed.
1	Enough background context?	7		Blank response; no change needed.
1	Enough info to fill out worksheet?	1	Probably	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
1	Enough info to fill out worksheet?	2	No. In Key Terms, Risk is defined as "Hazard x Exposure x Probability" in all Risk Management Plans or Training, Risk has been defined as a LxC, Likelihood by Consequence.	Acknowledge that some of these terms may be defined differently in different disciplines or contexts. Here, for risk comm., THIS is how we're defining them…
1	Enough info to fill out worksheet?	3	Nothing comes to mind. So yes, had enough information.	No change needed.
1	Enough info to fill out worksheet?	4	Amount of time to complete would depend on how much detail I would want to include and how this information would be used.	No change needed.
1	Enough info to fill out worksheet?	5		Blank response; no change needed.
1	Enough info to fill out worksheet?	6	Besides not understanding the assessments -- I wasn't sure where to find the probabiliity of uncertainty. I'm guessing its from literature that someone familiar with the hazard would know -- but would everyone filling out this worksheet have that information?	Text acknowledges that this information should be included where possible—i.e., where known. This guide isn't really able to tell people exactly where to find uncertainty information, as the best sources will be highly case-specific. We recommend no change.
1	Enough info to fill out worksheet?	7		Blank response; no change needed.
1	How long would it take?	1	More than 30 minutes	No change needed.
1	How long would it take?	2	10-20 minutes	No change needed.
1	How long would it take?	3	More than 30 minutes	No change needed.
1	How long would it take?	4		Blank response; no change needed.
1	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
1	How long would it take?	6	10-20 minutes	No change needed.
1	How long would it take?	7		Blank response; no change needed.
1	Instructions clear and helpful?	1	Yes	No change needed.
1	Instructions clear and helpful?	2	Yes, but see answer to 1a about the type of risks communication that this is intended to address. That needs to be clearly spelled out up front to ensure proper application of this tool.	Clarify in the intro that the focus is on external communication.
1	Instructions clear and helpful?	3	I appreciated the links to additional content.	No change needed.
1	Instructions clear and helpful?	4	I was not sure what 'assessments already conducted' were referring to and if I should do these or just look for existing assessments. You could point to an existing process to conduct a vulnerability assessment.	Change to "Review **ANY** assessments already conducted."
1	Instructions clear and helpful?	5		Blank response; no change needed.
1	Instructions clear and helpful?	6	The instructions say to "review the assessments already conducted." I wasn't sure which assessments they were referring to. Also, in the table with more acceptable and less acceptable factors --- why is low media attention more acceptable. If people are at risk (e.g., tornado warnings) - wouldn't it be better to have more media attention?	Change to "Review **ANY** assessments already conducted." Clarify the table headings to make clear that we're talking about what's acceptable or concerning *to the public*, not what might seem acceptable to NOAA.
1	Instructions clear and helpful?	7		Blank response; no change needed.
1	Other suggested improvements?	1	More on limiting the scope of the risk. Broad hazards present multiple risks, and many may be out of the expertise or awareness of the individual filling out the work sheet.	Make clear that worksheet #1 is for one risk at a time. Note that if they want to fill out for multiple risks, they can use additional copies of worksheet.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
1	Other suggested improvements?	2	Change "Cardiac Arrest" to "Death" It says to "Review the assessments already conducted" That should be removed as often there may not be any and this is the first time this is being conducted.	Change to “death.” Change to “Review **ANY** assessments already conducted.”
1	Other suggested improvements?	3	I look forward to seeing the "glossy" final version that will be more visually appealing. We have a great point of contact in the NWS if you need additional graphical expertise to create or review content.	No change needed.
1	Other suggested improvements?	4	I was not sure where I could capture info about the make up of a community that might be affected by a flood for example...the demographic type information so I could fine tune my audience a bit based on a community that might experience future flooding.	Steps 2 and 3 provide opportunity to document characteristics of the audience. We’ve made this clearer in response to a few other comments. We recommend no change.
1	Other suggested improvements?	5		Blank response; no change needed.
1	Other suggested improvements?	6	Not sure how long it would take to complete - but if its to hone in on the problem --- one could spend as much or as little time on it - depending on how much information they would need later on.	No change needed.
1	Other suggested improvements?	7		Blank response; no change needed.
2	Enough background context?	1	yes	No change needed.
2	Enough background context?	2	yes	No change needed.
2	Enough background context?	3	Yes	No change needed.
2	Enough background context?	4	I think so.	No change needed.
2	Enough background context?	5		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
2	Enough background context?	6	Yes - it set the stage for answering the questions	No change needed.
2	Enough background context?	7		Blank response; no change needed.
2	Enough info to fill out worksheet?	1	Probably	No change needed.
2	Enough info to fill out worksheet?	2	unknown obstacles for some of those groups, so was some speculation	Point forward to Step 3 re: learning about audience characteristics.
2	Enough info to fill out worksheet?	3	Yes	No change needed.
2	Enough info to fill out worksheet?	4	yes but depends on the level of the user	No change needed.
2	Enough info to fill out worksheet?	5		Blank response; no change needed.
2	Enough info to fill out worksheet?	6	If someone knows the topic - they should be able to fill it out without much hesitation,	No change needed.
2	Enough info to fill out worksheet?	7		Blank response; no change needed.
2	How long would it take?	1	More than 30 minutes	No change needed.
2	How long would it take?	2	10-20 minutes	No change needed.
2	How long would it take?	3	20-30 minutes	No change needed.
2	How long would it take?	4	20-30 minutes	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
2	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.
2	How long would it take?	6	Less than 10 minutes	No change needed.
2	How long would it take?	7		Blank response; no change needed.
2	Instructions clear and helpful?	1	There is a real complexity difference between immediate safety hazards and more long term risks, that should be spelled out and examples of how to deal with that should be presented.	Long-term = more about education, decision-making. Point to Step 4 where we'll talk about the different categories and how to address them.
2	Instructions clear and helpful?	2	in the instructions, it says "for each risk you characterized in Step 1..." In step one, it was the "hazard" not the "Risk" that was characterized, so this needs to be reworded as that is a subtle but important distinction	Clarify that Worksheet 1 is for characterizing one specific risk, not to simultaneously characterize all risks associated with one hazard.
2	Instructions clear and helpful?	3	Yes	No change needed.
2	Instructions clear and helpful?	4		Blank response; no change needed.
2	Instructions clear and helpful?	5		Blank response; no change needed.
2	Instructions clear and helpful?	6	i was confused by "each risk you characterized in Step 1. I wasn't sure whether to look at the big picture (intensive rainfall leading to flooding) --- or the resulting possible risks --- e.g. drownings, property destruction... Eventually I went back to the more general (1) risk rather than each risk.	Revise to clarify that Worksheet 2 is for a specific risk arising from a hazard.
2	Instructions clear and helpful?	7		Blank response; no change needed.
2	Other suggested improvements?	1	There is a risk of adding bias into the communication strategy by making assumptions about the motivations of the target audience, and the obstacles that they may present. For example assuming that people don't trust scientists or agencies, without understanding the reasons for that.	Point forward to Step 3 re: learning about audience characteristics.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
2	Other suggested improvements?	2	can only fit one line per box, so when continuing to type, the font kept getting smaller and didn't wrap around like other boxes on page 11 for the examples of sea level rise and beach hazards, instead of using semicolons to separate the 3 items in each bullet, suggest using sub bullets.	This was a formatting quirk in a draft PDF that we had to assemble quickly. It'll be optimized in the final publication.
2	Other suggested improvements?	3	The limited space in the table format (applies to all of the worksheets) impacted how much detail I included. For final product, maybe more space?	In desktop-publishing, consider which table cells should be relatively larger than others to accommodate more text.
2	Other suggested improvements?	4	The left side with the check boxes for type of risk com needed should be at the top so it does not dominate the shape/size of the rest of the worksheet where I need more room to type. The text got too small too quickly and I really just wanted to focus on help people work together as my risk com need.	We'll make the checkbox column smaller in the final fillable PDF version. In final fillable PDF version, we'll try to optimize cell size so the ones that require the most info will have the most space available to type. We'll set them all to wrap text.
2	Other suggested improvements?	5		Blank response; no change needed.
2	Other suggested improvements?	6	Obstacles or challenges could be separated out. Why use both words? Is one meant to be nearly impossible to change and the other one could be changed? If not, consider using only one term.	Streamline the worksheet to just use "Challenges." All types of challenges (immovable obstacles, etc.) can be addressed in this one column.
2	Other suggested improvements?	7		Blank response; no change needed.
3	Enough background context?	1	Yes	No change needed.
3	Enough background context?	2	yes	No change needed.
3	Enough background context?	3	Yes	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
3	Enough background context?	4	I think so. I like the addition of the population of concern content.	No change needed.
3	Enough background context?	5		Blank response; no change needed.
3	Enough background context?	6	on list of unique needs - why separate visually impaired from physical disabilities category? color blind can exist without the words visual impaired.	Changed to just say colorblind in final bullet, as visual impairment is a physical disability. Added visual and hearing impairment in parentheses as examples of physical disabilities.
3	Enough background context?	7		Blank response; no change needed.
3	Enough info to fill out worksheet?	1	No. Demographic information and information from the target audience is critical. Without this there is a real risk of the people developing the communication strategy injecting their own bias about the audience into the strategy.	Text explains some sources for information about audiences. Add census/specific sources at end of sentence that currently ends with "demographic and historical information."
3	Enough info to fill out worksheet?	2	perhaps - also speculation on some of the audience and what they may do/trust, etc...	Addressed in response to other comments about getting a better understanding of the audience to avoid making guesses.
3	Enough info to fill out worksheet?	3	Yes	No change needed.
3	Enough info to fill out worksheet?	4	Would be good to remind folks that they are probably making a lot of assumptions about their audience when filling this out and that is dangerous. Maybe add a column or section to note where they are making assumptions and how they will find out the truth about these audiences.	Added "Make sure to research these questions, rather than just making assumptions about your audiences."
3	Enough info to fill out worksheet?	5		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
3	Enough info to fill out worksheet?	6	Yes again - if the person completing this worksheet knows their population - it should be fairly easy and quick to complete.	No change needed.
3	Enough info to fill out worksheet?	7		Blank response; no change needed.
3	How long would it take?	1	More than 30 minutes	No change needed.
3	How long would it take?	2	10-20 minutes	No change needed.
3	How long would it take?	3	More than 30 minutes	No change needed.
3	How long would it take?	4	20-30 minutes	No change needed.
3	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.
3	How long would it take?	6	Less than 10 minutes	No change needed.
3	How long would it take?	7		Blank response; no change needed.
3	Instructions clear and helpful?	1	Yes	No change needed.
3	Instructions clear and helpful?	2	similar to answer for worksheet #2, this asks about for each "risk" you characterized in step 1, but step 1 characterized hazards, not risks. And Assume this should be done for just ONE risk/hazard as only one was identified in step 1	Addressed in response to other comments about clarifying worksheet instructions re: hazard vs. risks.
3	Instructions clear and helpful?	3	Yes	No change needed.
3	Instructions clear and helpful?	4	Yes. I like the mention of the different types of audiences (partners, harmed, sub-populations)	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
3	Instructions clear and helpful?	5		Blank response; no change needed.
3	Instructions clear and helpful?	6	yes - except again, I wasn't sure what "each risk" was	Addressed in response to another comment.
3	Instructions clear and helpful?	7		Blank response; no change needed.
3	Other suggested improvements?	1	Provide sources for possible demographic information (census data, marketing data websites). The kind of information that this worksheet asks for really requires research and audience engagement to get at.	Text explains some sources for information about audiences. Add census/specific sources at end of sentence that currently ends with “demographic and historical information.”
3	Other suggested improvements?	2	talks about "use additional sheets" if needed, but where are they? Suggest additional sheets are made available in an appendix.	Change to “Use additional copies of the worksheet.”
3	Other suggested improvements?	3	appreciate the links.	No change needed.
3	Other suggested improvements?	4	see 3c above	Addressed in response to specific comment referenced by respondent.
3	Other suggested improvements?	5		Blank response; no change needed.
3	Other suggested improvements?	6	none	No change needed.
3	Other suggested improvements?	7		Blank response; no change needed.
4	Enough background context?	1	Yes	No change needed.
4	Enough background context?	2	Yes and no. LOTS of information that was good, but perhaps too much.	Other NOAA reviewers and product development team have said we need all this info, so we recommend no change.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
4	Enough background context?	3	yes	No change needed.
4	Enough background context?	4	I like the background info you provided. I am dealing with a longer term planning situation and feel like this activity can possibly set a bad precedent since those situations are more about building relationships which you do explain well if folks are trying to get people to work together.	The commenter clarified that the issue here is that risk communicators will ideally take the time to engage in dialogue with their audience in advance, so they can listen and learn. We can add a piece about audience dialogue to the best practices in the introduction. This topic is also covered already in the last paragraph of Step 1.
4	Enough background context?	5		Blank response; no change needed.
4	Enough background context?	6	Yes	No change needed.
4	Enough background context?	7		Blank response; no change needed.
4	Enough info to fill out worksheet?	1	Yes	No change needed.
4	Enough info to fill out worksheet?	2	May need to do more self research then to gather supporting information	No change needed.
4	Enough info to fill out worksheet?	3	yes	No change needed.
4	Enough info to fill out worksheet?	4	Would be good to suggest they include someone with expertise in the conversation so they don't fall into old habits.	In intro, we'll add that we encourage users to do this exercise in a group, ideally with diverse experiences and perspectives.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
4	Enough info to fill out worksheet?	5		Blank response; no change needed.
4	Enough info to fill out worksheet?	6	Yes - it all depends on your familiarity with the hazard and the area that you are concentrating on to answer these questions.	No change needed.
4	Enough info to fill out worksheet?	7		Blank response; no change needed.
4	How long would it take?	1	More than 30 minutes	No change needed.
4	How long would it take?	2	More than 30 minutes	No change needed.
4	How long would it take?	3	More than 30 minutes	No change needed.
4	How long would it take?	4	More than 30 minutes	No change needed.
4	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.
4	How long would it take?	6	Less than 10 minutes	No change needed.
4	How long would it take?	7		Blank response; no change needed.
4	Instructions clear and helpful?	1	An examples of a filled out worksheet would be helpful	One of the pilot testers provided a set of fully filled-out worksheets. The project team will review them. If they appear to be good examples, and if the tester who created them is comfortable sharing, we will make these files available to users of the practical guide.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
4	Instructions clear and helpful?	2	Not entirely. There is a statement about "To develop a message map (as shown in the worksheet on page x)" I could not find the message map anywhere. Under the "empathy in your message" section, it says "... in any of the situations described above (see Figure X)" is that the figure way back on page 4? or elsewhere? not entirely clear what that was linking back to	We will more clearly label the worksheet as a “message map.” Now the content has stabilized, we will number the figures so the connection will be more clear.
4	Instructions clear and helpful?	3	yes	No change needed.
4	Instructions clear and helpful?	4	yes...like the suggestion to do this in a group.	No change needed.
4	Instructions clear and helpful?	5		Blank response; no change needed.
4	Instructions clear and helpful?	6	Yes	No change needed.
4	Instructions clear and helpful?	7		Blank response; no change needed.
4	Other suggested improvements?	1	Better organization, there may also be multiple questions that need addressing, so there may be multiple message maps needed.	Tell the user in the worksheet instructions that if they want to do this for multiple questions, they can use multiple copies of the worksheet.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
4	Other suggested improvements?	2	shorten this chapter. great info, but compared to other section is is VERY long there is a table that has text of " "cone of uncertainty" (currently undergoing revision)" get rid of that part about the revision as the cone currently exists and when this is published or used, that revision may be done For the "words matter" for Anomaly - "Better choice" could be "change from what was expected" For Uncertainty - "better choice" could be "Range of possibilities"	Other reviewers have said we need the information in this chapter, so we recommend no change. We need the "revision" wording for the cone of uncertainty to satisfy other reviewers' concerns, but can clarify "as of May 2019." We appreciate the suggestions for the "words matter" table, but this table is drawn from published literature, so we're reluctant to change the content. We recommend no change.
4	Other suggested improvements?	3	Maybe add a link to plain language writing (goes along with the small table on what words are better).	In Worksheet 4 instructions, note that user will need to think about more specific wording refinements later, after considering formats/channels in Step 5. Also add column to worksheet 5 to prompt user to think about how they'd adapt the message to the chosen format/medium. These changes help to address the spirit of this comment and related comments, which is that there seemed to be a gap as far as when the message should be translated to plain language. Note that Step 5 already has a link to an authoritative plain-language writing resource, so we recommend no additional change.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
4	Other suggested improvements?	4	Could have a separate worksheet for folks that are trying to get a group to work together that gets more at the back and forth engagement and partnership building and is less focused on messages. Maybe that one is coming in a later worksheet?	Step 3 points to “Introduction to Stakeholder Participation”—a good resource that helps with partnership building more effectively than anything we could fit into this space-constrained guide. We recommend no change.
4	Other suggested improvements?	5		Blank response; no change needed.
4	Other suggested improvements?	6	Would have liked to see an example of how a person could answer this - in a text box to see the wording and specificity.	Another comment suggested providing a filled-out worksheet as a companion resource. We have presented an option for doing this in response to the other comment.
4	Other suggested improvements?	7		Blank response; no change needed.
5	Enough background context?	1	Yes	No change needed.
5	Enough background context?	2	no - that figure X needs help. Can't tell if that is flowing from top to bottom, left to right, etc.. It certainly is not "inverted" else the "supporting details" would be at opposite ends. Does background for a scientist = bottom line for the public, for example? Need better explanation of that chart	The figure is from a cited source, so we shouldn’t change it. Improve the explanation in the figure caption.
5	Enough background context?	3	yes	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
5	Enough background context?	4	I feel like the use of graphics and visualizations could be an entire section on its own so people don't fall into bad habits. Maybe some examples here of how to convey science with powerpoint would help.	We agree that guidance on data visualization could be helpful, but we asked around and determined that NOAA does not have definitive guidance at this time. There are more outside resources than we could possibly curate and list within the scope of this project. Guidance on data visualization could be a project unto itself—perhaps a future effort that could build on this one. We recommend no change at this time.
5	Enough background context?	5		Blank response; no change needed.
5	Enough background context?	6	Yes	No change needed.
5	Enough background context?	7		Blank response; no change needed.
5	Enough info to fill out worksheet?	1	I am not sure how to determine what channels will best reach my audience, this would appear to require more demographic and marketing information than is available.	Point back to Step 3 and note that part of understanding the audience comes through talking with them and learning how they like to receive information. And you can ask others within NOAA who've worked with this audience before.
5	Enough info to fill out worksheet?	2	need to know more about intermediaries and who can be used as part of that effort	Clarify worksheet instructions to make it less prescriptive and more of a thinking exercise. Going into detail about how to identify intermediaries is beyond the scope of this short, high-level guide.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
5	Enough info to fill out worksheet?	3	Would be helpful if you had sample questions	Worksheet 5 doesn't require questions, but if this comment is referring to worksheet 6, we've added sample questions to the instructions in response to another similar comment.
5	Enough info to fill out worksheet?	4		Blank response; no change needed.
5	Enough info to fill out worksheet?	5		Blank response; no change needed.
5	Enough info to fill out worksheet?	6	Yes initially - this might require more research	No change needed.
5	Enough info to fill out worksheet?	7		Blank response; no change needed.
5	How long would it take?	1	More than 30 minutes	No change needed.
5	How long would it take?	2	10-20 minutes	No change needed.
5	How long would it take?	3	10-20 minutes	No change needed.
5	How long would it take?	4	Less than 10 minutes	No change needed.
5	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.
5	How long would it take?	6	10-20 minutes	No change needed.
5	How long would it take?	7		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
5	Instructions clear and helpful?	1	There is not much information on how to choose between channels.	Point back to Step 3 and note that part of understanding the audience comes through talking with them and learning how they like to receive information. And you can ask others within NOAA who've worked with this audience before.
5	Instructions clear and helpful?	2	instruction state "for the key messages you developed..." isn't it really for "ONE" of the key messages from that step 4 to use in this step, and not all of the key messages? For the table where it says "Audience" I assume these are the audiences identified in step 3? If so, it should say so	Clarify that the worksheet can be used to consider the suite of messages developed in the previous step—not just one of those messages—but that the user can use an additional worksheet if they need to develop a distinctly different strategy for certain messages. Clarify worksheet instructions re: audiences defined in Step 3.
5	Instructions clear and helpful?	3	yes	No change needed.
5	Instructions clear and helpful?	4	yes	No change needed.
5	Instructions clear and helpful?	5		Blank response; no change needed.
5	Instructions clear and helpful?	6	Yes - again - it might be helpful to have an example in the first line	Another comment suggested providing a filled-out worksheet as a companion resource. We have presented an option for doing this in response to the other comment.
5	Instructions clear and helpful?	7		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
5	Other suggested improvements?	1	Consider incorporating multiple key messages on one sheet, or point out that multiple worksheets will be needed.	Tell people in instructions that if they want to do it for multiple key messages, they can use multiple copies of the worksheet.
5	Other suggested improvements?	2	fix that first graphic	Addressed in response to another comment.
5	Other suggested improvements?	3		Blank response; no change needed.
5	Other suggested improvements?	4		Blank response; no change needed.
5	Other suggested improvements?	5		Blank response; no change needed.
5	Other suggested improvements?	6	Add a column that allows the person completing the worksheet - to be able to note an effective communication campaign/product that they remember that might be copied or tried with their current audience	We've added a note to the instructions to encourage users to consider existing models.
5	Other suggested improvements?	7		Blank response; no change needed.
6	Enough background context?	1	Yes, but more detail would be appreciated.	Addressed in response to a more specific comment from this respondent.
6	Enough background context?	2	No. It says to "tie the questions you ask to the goals you want..." What "questions" are we asking and of whom? In testing of "messages" that to me does not convey to be asking questions. Section seems to be using 'question' and 'message' interchangeably	We revised the worksheet instruction text and added an example to make it clearer.
6	Enough background context?	3	yes	No change needed.
6	Enough background context?	4	I would suggest you provide more questions for the testing as examples.	We’ve added example questions to the worksheet instructions.
6	Enough background context?	5		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
6	Enough background context?	6	Yes - but --- see question in 6e below. How do you know you are targeting the right audience --- what is an adequate representative sample for testing?	Good point. We've added a step to the text: "Work with in-house experts to ensure a proper sample design that accounts for the various audience segments you are trying to reach."
6	Enough background context?	7		Blank response; no change needed.
6	Enough info to fill out worksheet?	1	Probably	No change needed.
6	Enough info to fill out worksheet?	2	not sure - I struggled the most with the worksheet (see answers 6a and 6b on that....) Are the audiences the same audiences identified in earlier step? If so, state that (or auto populate the form)	Clarified column header as "Audience(s) for testing."
6	Enough info to fill out worksheet?	3		Blank response; no change needed.
6	Enough info to fill out worksheet?	4		Blank response; no change needed.
6	Enough info to fill out worksheet?	5		Blank response; no change needed.
6	Enough info to fill out worksheet?	6	May need to consider your goal from different vantage points.	Good point. We've added a step to the text: "Work with in-house experts to ensure a proper sample design that accounts for the various audience segments you are trying to reach."
6	Enough info to fill out worksheet?	7		Blank response; no change needed.
6	How long would it take?	1	More than 30 minutes	No change needed.
6	How long would it take?	2	10-20 minutes	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
6	How long would it take?	3	10-20 minutes	No change needed.
6	How long would it take?	4	10-20 minutes	No change needed.
6	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.
6	How long would it take?	6	20-30 minutes	No change needed.
6	How long would it take?	7		Blank response; no change needed.
6	Instructions clear and helpful?	1	There is a big step between worksheet 5 and 6, the information products need to be developed. This isn't clearly spelled out in the instructions.	Remove "products" so this is clearly just about testing *messages*, which were developed in a previous step, but also acknowledge that testing may need to account for the fact that messages are disseminated in a variety of ways.
6	Instructions clear and helpful?	2	No. this worksheet is a bit confusing... what question is this for the table? a question that I am creating or a question expected to hear from the audience? S	We revised the worksheet instruction text and added an example to make it clearer.
6	Instructions clear and helpful?	3	yes	No change needed.
6	Instructions clear and helpful?	4		Blank response; no change needed.
6	Instructions clear and helpful?	5		Blank response; no change needed.
6	Instructions clear and helpful?	6	Yes	No change needed.
6	Instructions clear and helpful?	7		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
6	Other suggested improvements?	1	The other worksheets have much more background. More information about what kinds of products are appropriate for what messages, and how to evaluate across different scales of urgency. Immediate hazard messaging is going to be different from longer term risk messaging, and the evaluation will probably be different as well.	This is really more about Step 5 re: conveying the message. Step 5 lays out more considerations for what kinds of products can be created. Just at a high level, but that's really all we're charged with doing here. We recommend no change.
6	Other suggested improvements?	2	need to rethink this one... as stated, I struggle the most with this concept - message vs question, what questions (us or audience) etc...	Addressed in response to other comments.
6	Other suggested improvements?	3		Blank response; no change needed.
6	Other suggested improvements?	4		Blank response; no change needed.
6	Other suggested improvements?	5		Blank response; no change needed.
6	Other suggested improvements?	6	How do you know you have the right audience - or a good representative sample? Let's say you were interested in and AR -- and were worried about people going through flooded streets --- how do you target various groups - do you need a different message for a 16 year old girl vs. a 70 year old man?..	Good point. We've added a step to the text: "Work with in-house experts to ensure a proper sample design that accounts for the various audience segments you are trying to reach."
6	Other suggested improvements?	7		Blank response; no change needed.
7	Enough background context?	1	It was a bit limted	Addressed in response to a more specific comment from this respondent.
7	Enough background context?	2	Yes, mostly	No change needed.
7	Enough background context?	3	yes	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
7	Enough background context?	4	I feel like this could use more information so folks can do it themselves and do it well. Even just explaining the terms a little more with some examples could be helpful.	Many examples are in the text on the previous page, but we can add a few more to the worksheet instructions, and we will harmonize the terminology a bit more to make the intent clearer.
7	Enough background context?	5		Blank response; no change needed.
7	Enough background context?	6	Yes	No change needed.
7	Enough background context?	7		Blank response; no change needed.
7	Enough info to fill out worksheet?	1	No. The information about metrics for outcomes becomes pretty sparse. There should be more information about how to find performance information.	Add resources that this respondent suggested in another comment. Given the desired short length of this publication, pointing to additional resources is the best way to help readers learn more details.
7	Enough info to fill out worksheet?	2	Since it was unclear as to the communication method, this section was a bit hazy to me. This section and section 6 were the two that caused me the most head scratching	Addressed in response to other comments.
7	Enough info to fill out worksheet?	3	Some more examples of metrics would be helpful.	Some examples are on the previous page, and we encourage readers to visit the cited resource (an FDA guide) for additional examples and discussion. We recommend no change.
7	Enough info to fill out worksheet?	4	Might help to have another resource to point people to. We have a couple: https://coast.noaa.gov/data/digitalcoast/pdf/meaningful-evaluation.pdf https://coast.noaa.gov/digitalcoast/training/data-collection-methods.html	Add these helpful resources to the list.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
7	Enough info to fill out worksheet?	5		Blank response; no change needed.
7	Enough info to fill out worksheet?	6	I think so.	No change needed.
7	Enough info to fill out worksheet?	7		Blank response; no change needed.
7	How long would it take?	1	More than 30 minutes	No change needed.
7	How long would it take?	2	10-20 minutes	No change needed.
7	How long would it take?	3	10-20 minutes	No change needed.
7	How long would it take?	4		Blank response; no change needed.
7	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.
7	How long would it take?	6	10-20 minutes	No change needed.
7	How long would it take?	7		Blank response; no change needed.
7	Instructions clear and helpful?	1	Yes but more detail is needed.	Addressed in response to a more specific comment from this respondent.
7	Instructions clear and helpful?	2	No. Is this a communication plan for the overall hazard in Work Sheet 1, or a Communications Goal from in Step 2, or one of the Messages Developed in Step 4? It is not clear what communication we are striving for - broad hazard or specific message And instruction say "risk communication effort" Is it "risk" or "hazard" Again, those terms are used a bit interchangeably up front of this document.	Clarify in the title of Step 7 and Worksheet 7 that the evaluation is for the risk communication plan for a specific risk identified in Step 1.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
7	Instructions clear and helpful?	3	yes	No change needed.
7	Instructions clear and helpful?	4	Not sure I would know how best to do some of this on my own unless you are just asking them how often they could do data collection and not really hoping they follow best practices for this sort of thing.	Commenter is correct; this worksheet is really about high-level ideas on how you might handle metrics. We will update the worksheet instructions to make clear that we're asking for brainstorming ideas here, not necessarily final answers.
7	Instructions clear and helpful?	5		Blank response; no change needed.
7	Instructions clear and helpful?	6	Yes	No change needed.
7	Instructions clear and helpful?	7		Blank response; no change needed.
7	Other suggested improvements?	1	What is the scope if this from? Collecting performance metrics especially for outcomes can be a very complex, difficult task. This is not the kind of thing that someone is going to be able to easily address in 30 minutes.	Make sure our text and instructions acknowledge that evaluation is a long-term activity. Modify instructions to say that the exercise is brainstorming, which acknowledges that detailed research would take more time.
7	Other suggested improvements?	2	none	No change needed.
7	Other suggested improvements?	3		Blank response; no change needed.
7	Other suggested improvements?	4		Blank response; no change needed.
7	Other suggested improvements?	5		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
7	Other suggested improvements?	6	Would have liked to see a sample answer on the worksheet - to gauge my own response in terms of detail and appropriatness	Another comment suggested providing a filled-out worksheet as a companion resource. We have presented an option for doing this in response to the other comment.
7	Other suggested improvements?	7		Blank response; no change needed.
8	Enough background context?	1	No, the background was too sparse, there is more detail needed.	Addressed in response to a more specific comment from this respondent.
8	Enough background context?	2	yes	No change needed.
8	Enough background context?	3	yes	No change needed.
8	Enough background context?	4		Blank response; no change needed.
8	Enough background context?	5		Blank response; no change needed.
8	Enough background context?	6	Yes	No change needed.
8	Enough background context?	7		Blank response; no change needed.
8	Enough info to fill out worksheet?	1	More information about how to identify the team functions is needed.	Let's reduce confusion by pre-populating the worksheet with the team functions from Table 5.
8	Enough info to fill out worksheet?	2	Depends - what communication plan are we working for - global or specific message.	Addressed by clarifying worksheet instrux.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
8	Enough info to fill out worksheet?	3	yes	No change needed.
8	Enough info to fill out worksheet?	4		Blank response; no change needed.
8	Enough info to fill out worksheet?	5		Blank response; no change needed.
8	Enough info to fill out worksheet?	6	Yes	No change needed.
8	Enough info to fill out worksheet?	7		Blank response; no change needed.
8	How long would it take?	1	More than 30 minutes	No change needed.
8	How long would it take?	2	20-30 minutes	No change needed.
8	How long would it take?	3	20-30 minutes	No change needed.
8	How long would it take?	4	10-20 minutes	No change needed.
8	How long would it take?	5	Respondent calculated total time, which works out to an average of 15-20 minutes per worksheet	No change needed.
8	How long would it take?	6	10-20 minutes	No change needed.
8	How long would it take?	7		Blank response; no change needed.
8	Instructions clear and helpful?	1	Yes	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
8	Instructions clear and helpful?	2	sort of - but this section, as compared to others, seemed light in information and background for the instructions of "implement your communication plan" I assume that is the plan from a prior step? Such as specific message or the whole plan? That needs to be spelled out and tied back specifically to one of those steps.	We say about all we can about how to do this step, as further details will be office- and situation-specific. We recommend no further additions. However, we *can* clarify the instructions to make clear that the risk communication plan was developed over previous steps.
8	Instructions clear and helpful?	3	yes	No change needed.
8	Instructions clear and helpful?	4		Blank response; no change needed.
8	Instructions clear and helpful?	5		Blank response; no change needed.
8	Instructions clear and helpful?	6	Yes	No change needed.
8	Instructions clear and helpful?	7		Blank response; no change needed.
8	Other suggested improvements?	1	As above, more detail is needed.	Addressed in response to a more specific comment from this respondent.
8	Other suggested improvements?	2	Perhaps add a column for what skills current staff already have, not just the needs. For each Team Function, there may be multiple skills needed, but form doesn't lay out that way. Guess Team Function can be input several times then?	Clarify instructions and worksheet headers to avoid implying that we are only listing skills that are lacking. Simplify table layout to eliminate sub-rows. Make sure the instructions convey that the user will be able to list multiple skills, names, etc., in any given cell.
8	Other suggested improvements?	3		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
8	Other suggested improvements?	4		Blank response; no change needed.
8	Other suggested improvements?	5		Blank response; no change needed.
8	Other suggested improvements?	6	Is there a database or location to find experts at NOAA to help with this step?	We confirmed that no database or list of internal experts exists at this time. If a particular office does not have the desired expertise, they should feel free to reach out to PRSSO, as the draft guide suggests. No change.
8	Other suggested improvements?	7		Blank response; no change needed.
General	Additional comments by phone?	1	No	No change needed.
General	Additional comments by phone?	2	No	No change needed.
General	Additional comments by phone?	3	No	No change needed.
General	Additional comments by phone?	4		Blank response; no change needed.
General	Additional comments by phone?	5		Blank response; no change needed.
General	Additional comments by phone?	6	No	No change needed.
General	Additional comments by phone?	7		Blank response; no change needed.
General	Did you follow any links?	1	Yes	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
General	Did you follow any links?	2	No	No change needed.
General	Did you follow any links?	3	Yes	No change needed.
General	Did you follow any links?	4	Yes	No change needed.
General	Did you follow any links?	5		Blank response; no change needed.
General	Did you follow any links?	6	Yes	No change needed.
General	Did you follow any links?	7		Blank response; no change needed.
General	Likely to use guide? (5=most likely)	1	2	No change needed.
General	Likely to use guide? (5=most likely)	2	2	No change needed.
General	Likely to use guide? (5=most likely)	3	5	No change needed.
General	Likely to use guide? (5=most likely)	4	4	No change needed.
General	Likely to use guide? (5=most likely)	5		Blank response; no change needed.
General	Likely to use guide? (5=most likely)	6	4	No change needed.
General	Likely to use guide? (5=most likely)	7		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
General	Other comments?	1	The framework that this product provides is good, and covers the important aspects of how to approach developing a communication strategy. However if this is intended to be something that an individual can go though unaided, them there needs to be more detail guiding people through the thought process	Addressed in response to more specific comments from this respondent.
General	Other comments?	2	Great product so far. But how does this tie into any current Risk Management Plans for addressing internal risks with a LxC and waterfall etc... This is more of a communications plan on hazards as written. Need to tie sections and linkages back and forth to ensure person using knows where to go back to for information from one section to populate the next section.	We agree that this document is more about communication planning than about risk management more generally. We also note that this document is focused on external communications, not internal risk planning. We have made this aspect of the purpose more explicit in the introduction. We have also edited instructions in several places to more explicitly link between steps, in response to this comment and others.
General	Other comments?	3	Very well done. Helpful already to me as a practitioner.	No change needed.
General	Other comments?	4	I am willing to chat further and answer questions about my comments if you have them.	We discussed with this commenter, got clarification, and addressed in response to a specific comment.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
General	Other comments?	5	Overall, I thought the templates were useful though I did not realize you would be asking for so much content (I skipped some items or just put in a few). In general, I would say that the templates and the associated guidance were useful in terms of defining a communications message on risk. There did seem to be some redundancy in the materials or perhaps just a bit too much detail but on the other hand, the detailed templates also triggered useful and thoughtful stages of developing a risk plan. Last thought is about project planning in general. The materials I reviewed were/are reminiscent of basic planning templates that a reasonable project plan would need to include to ensure an increased probability of success. You are surely aware of such templates - e.g. the type of templates (charter, goals, objectives) one would see as part of the PMBOK approach (Project Management Body of Knowledge) or perhaps the type of thinking that SixSigma is intended to provoke. In this sense, I thought some of the basic pieces that say a PMBOK template would include - purpose, objectives, outputs, metrics, timeline, success factors, etc. were either missing or not accentuated enough per the minimal information needed to put a project in motion.	We feel this comment is insightful but beyond the intended scope of the Practical Guide. We recommend no change.
General	Other comments?	6	Interesting and helpful product --- can be used for related work -	No change needed.
General	Other comments?	7	On Page 4, in the box of Extreme Risks identified, I would strongly recommend you add River Flooding and/or Flash Flooding, as that is the number one weather phenomena killer.	Added flash flooding as an example. Thanks for the suggestion!
General	Other comments?	7	Curious if any research took place that would cover "short fuse risk communication"? This would be very applicable to rapid onset hazards that NOAA is responsible for. I recommend at least acknowledging a short term risk communication strategy in this document, where NOAA has to share its science-based information, however uncertain, with an external partner who must make a decision at that moment, without time to consider more data. Happy to discuss further.	An earlier draft of this report pointed to the “2015 NOAA Fisheries Risk/Crisis Communications Guide” as a potentially useful resource, but during the review stage, members of the NOAA project team expressed a strong preference against getting into much detail about “crisis communication” in this product. In deference to the project team and its desired focus and balance, we suggest no change.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
General	Other comments?	7	On Page 13, I believe "General Public" should be added in the example box on the right.	Changed box to “Example Audiences…” and added two examples that might be larger groups of people in the community (homeowners/renters; parents of young children). We didn’t say “general public” because communications professionals warn that there’s really no such thing as the “general public.” It’s more appropriate to think about specific segments of a target audience.
General	Other risks relevant to your office?	1		Blank response; no change needed.
General	Other risks relevant to your office?	2	Oil spill detection and thus avoidance	Already captured in list of example risks in the introduction, so nothing to add.
General	Other risks relevant to your office?	3	all weather hazards	Already captured in list of example risks in the introduction, so nothing to add.
General	Other risks relevant to your office?	4	all natural hazards	Already captured in list of example risks in the introduction, so nothing to add.
General	Other risks relevant to your office?	5		Blank response; no change needed.
General	Other risks relevant to your office?	6	droughts, impacts of ENSO, etc.	Drought and extreme weather are already captured in list of example risks in the introduction, so nothing to add.
General	Other risks relevant to your office?	7		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
General	Suggestions for usability?	1	What this guide really does is highlight how complex it can be to develop a good risk communication strategy, which is good. I am not sure that I really understood that when I started looking at it. However, as it is now, this guide feels to me like more of an outline for a 2 day facilitated workshop, rather than something that an individual could effectively go through in an afternoon. There is a good amount of demographic information about the audience that is required that a person may not have available. There should be more guidance about how to get that information.	Demographics: Addressed in response to another comment from this respondent. General: Up front in the guide, let's say more about how long it might take and how best to do it (i.e., as a team with diverse input).
General	Suggestions for usability?	2	shorten the document and the steps	We appreciate the suggestion. All content here was desired/requested by the NOAA product development team, so we can't easily shorten. Users are free to skip around if desired, but the key point is that risk communication really is a process that benefits from a comprehensive plan. We recommend no change.
General	Suggestions for usability?	3	Create a link or document of success stories of NOAA offices using this practical guide...success builds success.	Indeed, NOAA may want to consider developing "success stories" as a future product.
General	Suggestions for usability?	4	I like where you suggest they work in groups. That should be an overarching theme to this guide if it is not already. Also working with social scientists or others with experience should be emphasized. This could help them to realize they don't know what they don't know and to keep them from falling back into old habits. I have the feeling a lot of folks might say yeah I already do that and not push themselves enough to do things differently particularly if they are not undertaking this for their own personal growth in this area.	Add text to the intro to encourage people to work in groups with diverse perspectives.
General	Suggestions for usability?	5		Blank response; no change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
General	Suggestions for usability?	6	more examples	We've added a few more examples throughout the guide. For additional examples, we encourage readers to visit the resources we've linked. The goal here is to find the right balance and keep this guide fairly succinct.
General	Suggestions for usability?	7	I am very impressed at the comprehensive review of this guide! It certainly frames the risk communication concept well, provides very valuable cited resources, and I really like the worksheets included throughout. Coming from the NWS Impact-Based Decision Support Services (IDSS) Program, which focuses on operational engagement with emergency managers and other core partners during hazardous weather events, I must say, communicating risk effectively is a top priority for my program. This content, while a bit too involved and detailed for daily operational use, could be beneficial in training and internal table top scenarios for NWS field offices. I love the language comparisons and suggested language emphasis charts, such as the table on page 8. Those will be extremely useful for our NWS operational folks. I think the document really gets the reader thinking in the right direction to determine effective and impactful risk communication strategies for our NOAA customers.	No change needed.
General	Suggestions for usability?	7	At the very beginning, the first box in the introduction, I would change the language from "About this document" to "The purpose of this document", and also make that box/font really big. I think it's important to flash loudly right at the beginning that this is an internal NOAA guide for all NOAA staff. Also I will say that most NWS Field personnel are not familiar with the term "Line Office" when referencing other parts of NOAA. You may want to edit that last sentence to read "To help all NOAA personnel communicate effectively..." or something like that. I think the box to the right of that defining the Line offices is fine, but I would recommend that intro box language change.	Changed to "Purpose of this document" and changed to "To help all NOAA personnel communicate effectively…" as suggested.
General	What risk did you choose?	1	Fish migration in response to warming climate.	No change needed.

Work-sheet	Question	Tester	Comment (original form, not edited)	Response
General	What risk did you choose?	2	Volcanic Ash avoidance for Aircraft	No change needed.
General	What risk did you choose?	3	Flash Flooding	No change needed.
General	What risk did you choose?	4	future flooding in my community	No change needed.
General	What risk did you choose?	5	Overfishing	No change needed.
General	What risk did you choose?	6	High intensity precip event (like an Atmospheric River) that resulted in flooding	No change needed.
General	What risk did you choose?	7		Blank response; no change needed.