NRPT: Learning from the Past and Moving Forward: Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities

Coastal Response Research Center (CRRC)
NOAA REGIONAL PREPAREDNESS TRAINING (NRPT): PUERTO RICO

Learning from the Past and Moving Forward: Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities

APRIL 23 – 25, 2019
U.S. EPA FACILITY, PUERTO RICO

This workshop is a partnership between NOAA’s Gulf of Mexico Disaster Response Center and the Disaster Preparedness Program with the Coastal Response Research Center.
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I. Acronyms

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>AST</td>
<td>Atlantic Standard Time</td>
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<tr>
<td>(B)EOC</td>
<td>(Business) Emergency Operation Center</td>
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<td>CARICOOS</td>
<td>Caribbean Regional Association for Coastal Ocean Observing</td>
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<td>CERT</td>
<td>Community Emergency Response Team</td>
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<td>COA</td>
<td>Course of Action</td>
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<td>CRRC</td>
<td>Coastal Response Research Center</td>
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<td>CTWP</td>
<td>NOAA NWS Caribbean Tsunami Warning Program</td>
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<td>CWA</td>
<td>Cyclone Watch Area</td>
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<td>DNER/DRNA</td>
<td>Puerto Rico Department of Natural and Environmental Resources (Spanish=DRNA)</td>
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<td>DOI</td>
<td>U.S. Department of the Interior</td>
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<td>DPP</td>
<td>Disaster Preparedness Program</td>
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<td>DRC</td>
<td>NOAA’s Gulf of Mexico Disaster Response Center</td>
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<td>EAS</td>
<td>Emergency Alert System</td>
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<td>Emergency Management System</td>
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<td>EOC</td>
<td>Emergency Operations Center</td>
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<td>ESF</td>
<td>Emergency Support Function</td>
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<td>EWW</td>
<td>Extreme Wind Warning</td>
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<td>FEMA</td>
<td>U.S. Federal Emergency Management Agency</td>
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<td>GOM</td>
<td>Gulf of Mexico</td>
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<td>GSA</td>
<td>U.S. General Services Administration</td>
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<td>HHW</td>
<td>Household Hazardous Waste</td>
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<td>HLS</td>
<td>Hurricane Local Statement</td>
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<td>IDSS</td>
<td>Impact-Based Decision Support Services</td>
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<td>IOOS</td>
<td>Integrated Ocean Observing System</td>
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<td>IOC</td>
<td>Intergovernmental Oceanographic Commission of UNESCO</td>
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<td>IPaC</td>
<td>U.S. Fish and Wildlife Service Information for Planning and Consultation</td>
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<td>ISER-Caribe</td>
<td>Institute for Socio-Ecological Research, Inc. – Caribbean</td>
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<td>JFO</td>
<td>Joint Field Office</td>
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<td>MEOW</td>
<td>Maximum Envelop of Water</td>
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<td>MER</td>
<td>U.S. Coast Guard Marine Environmental Response</td>
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<td>MOM</td>
<td>Maximum of MEOW</td>
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<td>NARA</td>
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<td>NCR</td>
<td>Natural and Cultural Resources</td>
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<td>NEA</td>
<td>National Endowment for the Arts</td>
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<td>NEH</td>
<td>National Endowment for the Humanities</td>
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<td>NESDIS</td>
<td>National Environmental Satellite, Data and Information Services</td>
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<td>NFWF</td>
<td>National Fish and Wildlife Foundation</td>
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<td>NGO</td>
<td>Non-governmental organization</td>
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<td>NHC</td>
<td>National Hurricane Center</td>
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<td>NMEAD</td>
<td>Negociado para el Manejo de Emergencias y Administracion de Desastres (The Bureau of Emergency Management and Disaster Management of the Department of Public Safety)</td>
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<td>NMFS</td>
<td>National Marine Fisheries Service</td>
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<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
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<td>NOS</td>
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Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources & Mission Responsibilities

NRPT: NOAA Regional Preparedness Training
NRT: National Response Team
NWS: NOAA National Weather Service
OEM: Office of Emergency Management
OFA: Other Federal Agencies
OR&R: NOAA Office of Response & Restoration
PA System: Public Announcement System
PPAPG: FEMA Public Assistance Program Policy Guide
PSMA: Pre-Scripted Mission Assignments
PRSA: Puerto Rico Aqueduct and Sewer Authority
PREMA: Puerto Rico Emergency Management Agency
PRSN: Puerto Rico Seismic Network
PTWC: Pacific Tsunami Warning Center
RRF: Resource Request Form
RSF: Recovery Support Function
RSS: Rich Site Summary and Really Simple Syndication (respectively) is a type of web feed which allows users and applications to access updates to online content in a standardized, computer-readable format.
SJFO: San Juan Forecast Office
TCV: Tropical Cyclone Watch/Warning
TWC: Tsunami Warning Center
TWFP: Tsunami Warning Focal Point
UPR: University of Puerto Rico
USACE: U.S. Army Corps of Engineers
USDA: U.S. Department of Agriculture
UNESCO: United Nations Educational, Scientific and Cultural Organization
USEPA/EPA: U.S. Environmental Protection Agency
USCG: U.S. Coast Guard
USVI: U.S. Virgin Islands
VHF: Very High Frequency
VITEMA: Virgin Islands Territorial Emergency Management Agency
VTEC: Valid Time Event Code
WEA: Wireless emergency alerts
WFO: Weather Forecast Office
WWTP: Wastewater treatment plant
II. Acknowledgements

This workshop and report were supported by the National Oceanic and Atmospheric Administration’s Disaster Preparedness Program (DPP) and the University of New Hampshire’s Coastal Response Research Center (CRRC). The content for the workshop was developed in cooperation with NOAA’s Gulf of Mexico Disaster Response Center and the following Organizing Committee members:

- Nancy Kinner, Coastal Response Research Center, University of New Hampshire
- Charlie Henry, NOAA Gulf of Mexico Disaster Response Center
- Christa von Hillebrandt-Andrade, NOAA National Weather Service, Caribbean Tsunami Warning Program
- Roberto Garcia-Hiraldo, NOAA National Weather Service, San Juan Weather Forecast Office
- Sean Griffin, NOAA Restoration Center
- Jennifer Koss, NOAA Coral Reef Conservation Program
- Lisamarie “Lee” Carrubba, NOAA Fisheries, Office of Protected Resources

This workshop was facilitated by Dr. Nancy Kinner from the Coastal Response Research Center (CRRC; [www.crrc.unh.edu](http://www.crrc.unh.edu)). CRRC is known for its independence and excellence in areas pertaining to environmental engineering, marine science and ocean engineering as they relate to oil spills. The Center has widespread experience working with disaster preparedness and hazardous spill-related issues. CRRC has conducted 60+ workshops that bring together practitioners, researchers, and scientists of diverse backgrounds (e.g., industry, academia, government, NGOs).

We would like to thank each of the presenters for their participation in the workshop:

- Carmen R. Guerrero-Perez, Director of the Caribbean Environmental Protection Division (Lessons Learned following Hurricane Maria)
- Ernesto Rodríguez, NOAA National Weather Service, San Juan Weather Forecast Office (Learning from the Past, Improvement for the Future)
- CAPT Ricardo Alonso, USCG MER (Mission Response)
- Charlie Henry, NOAA Gulf of Mexico Disaster Response Center (Introduction to NOAA’s Disaster Preparedness Program)
- Jennifer Koss, NOAA Coral Reef Program (NOAA Caribbean Overview, Mission Response)
- Jose Marchand, FEMA Capacity Building Sector (FEMA Capacity Building Sector)
- Debra Payton, U.S. Department of the Interior (DOI) (Responsibilities, Efforts and Lessons Learned for Natural and Cultural Resources (NCR) Recovery Support Function (RSF))
- Carlos Huertas-Hernandez, EPA, On-Scene Coordinator (EPA Response Perspective)
- Ernesto Diaz, DNER (Lessons Learned)
- Carlos Irigoyen Gonzalez, Puerto Rico Emergency Management Agency (PREMA) (Lessons Learned & Risk Communication)
- Christa von Hillebrandt-Andrade, NOAA Tsunami Center (Tsunami Mission, Products and Protocols)
Thank you to Christa von Hillebrandt-Andrade, Carolina Hincapié, Ernesto Rodríguez and Odalys Martinez for organizing and facilitating the tsunami and hurricane preparedness training that took place on the final day of the workshop.

A special thanks to (1) the Breakout Group Leads: CAPT Ricardo Alonso, Debra Payton, Charles Grisafi, Charlie Henry and Jennifer Koss; and (2) Kathy Mandsager, Jesse Ross, Zak Mandsager and Melissa Gloekler for their note-taking during the workshop.

We greatly appreciate the U.S. Environmental Protection Agency (EPA), Caribbean Environmental Protection Division in Guaynabo, Puerto Rico for their hospitality and providing an excellent meeting venue.

### III. Introduction

On April 23-25th, 2019, CRRC and DPP co-sponsored a National Oceanic and Atmospheric Administration (NOAA) Regional Preparedness Training (NRPT) Workshop at the USEPA facility in Guaynabo, Puerto Rico. The workshop, titled “Learning from the Past and Moving Forward: Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities”, focused on preparedness, planning and improving response to an extreme weather event or natural disaster.

*For the purpose of this workshop, the term “response” includes a continuum from emergency response activities through recovery activities.

Forty-five participants (Appendix B) represented federal, commonwealth and local agencies, academia, and industry.

This was the fourth workshop in a series of NRPT events, the goal of this workshop is to provide focused discussion regarding lessons learned from hurricane and natural disaster response for specific regions. NRPT workshops are conducted to improve preparedness and build a common understanding of how disasters can be addressed when they threaten personnel, infrastructure or natural resources. This program uses NOAA resources to address localized problems and concerns with respect to emergency preparedness and planning. The focus of the workshop was improving preparedness- through communication, logistics and building relationships/planning season for the Caribbean region (e.g., Puerto Rico, U.S. Virgin Islands) following the 2017 hurricane.

**Workshop Objectives:**

1. Improve knowledge and skills to enhance risk communications before and after a damaging or disastrous tropical hurricane (cyclone) or tsunami event.
2. Apply lessons learned to “disaster readiness” for safety of staff and families as well as shared trust resources.
3. Enhance effective mission response and recovery activities.
4. Build resilient local coastal communities on the islands through preparedness planning to: (a) gain knowledge, (b) enhance cross-agency and cross-regional coordination, and (c) foster response/recovery planning and informed actions.
Workshop Goals:

1. With adequate information and communicated knowledge, the public and response community will make informed decisions relative to personal protection and safety.
2. With adequate information and effective communications, responders and natural resource managers are prepared for and respond effectively to mitigate disaster impacts.

The workshop consisted of plenary presentations, three breakout group discussions and two table-top exercises. The first two days included plenary presentations from local and federal emergency responders outlining organization missions and responsibilities, lessons learned from the 2017 hurricane season and improvements for the future. A summary of the presentations can be found Section III “Plenary Presentations”, slides are located in Appendix C.

Participants were split into four breakout groups (Groups A-D), and remained in these same groups for all three of the breakout group discussions. Breakout groups were tasked with: (1) identifying lessons/practices/skills learned from the plenary presentations, (2) highlighting actions to improve/put into practice the previously identified “lessons learned”, and (3) recommend actions for implementation. The third day consisted of two table top exercises, the first was on tsunami preparedness and planning, and the second focused on hurricane emergency response planning and preparedness.

The agenda for the workshop can be found in Appendix A.

IV. Plenary Presentations

Day 1 – April 23, 2019

Carmen Guerrero-Perez, Director of EPA Region 2’s Caribbean Environmental Protection Division, discussed lessons learned with respect to terrestrial and marine chemical spills and response following Hurricane Maria. Director Guerrero-Perez drew specific attention to the quantity of disaster debris generated and removed (e.g., approximately 12 million cubic yards of debris, 52% construction debris and 44% vegetative debris) and the management of household hazardous wastes (HHW) (e.g., 322,148 HHW containers in Puerto Rico, 145,575 HHW containers in USVI). Following the hurricane, 22 of 51 wastewater treatment plants (WWTP) in Puerto Rico were out of service, three WWTPs completely flooded, and 222 of 714 pump stations were out of service. Out of service facilities and infrastructure resulted in sewage overflows into surface and coastal waters. Coastal flooding was also exacerbated due to inoperable stormwater management systems. In order to protect public health and determine environmental conditions post hurricane, the restoration of the water- and air-quality monitoring networks were a priority in the emergency response.

There were many pre-existing conditions that were exacerbated by the hurricanes. Examples of these include: the fiscal situation, deterioration of infrastructure, lack of maintenance and resources, history of non-compliance, threats from extreme weather and natural disaster events (e.g., hurricanes, drought, precipitation, sea level rise, salinity intrusion to aquifers).

Director Guerrero-Perez discussed methods to move forward and improve disaster preparedness and planning. The first recommendation emphasized the need for continuous improvement because “being
prepared is not a one-time effort”. In order to do this, multisector and multidisciplinary engagement is needed to clarify roles during a response and improve emergency preparedness. Stakeholders for a multisector approach include local government (e.g., DNER, PREMA), Federal government (e.g., NOAA, DOI, USCG, FEMA, USACE, USEPA), academia (e.g., UPR, Sea Grant, CARICOOS, PR Seismic Network, etc.), NGOs (e.g., Para la Naturaleza, Foundation for Puerto Rico, ISER-Caribe) and the private sector. The second take-away message was focusing on emergency management plans, specifically on pre-selected locations for temporary staging areas, pre-agreements with municipalities, waivers and permit pre-approvals with local and federal agencies. Third, was leveraging resources allocated by the federal government and disaster recovery plans to avoid duplication of efforts. Finally, she recommended focusing on risk communications before, during and after an extreme weather event/natural disaster to minimize public health impacts and coordinate a successful emergency response.

**Ernesto Rodríguez, NOAA NWS**, introduced the mission and vision outlined by the NWS. The mission is to provide weather, water and climate data forecasts and warnings for the protection of life and property and the enhancement of the national economy. Preparation for the hurricane season is a year-long event, which requires building trust between emergency response organizations to minimize stress during actual events. NWS employees meet with decision makers to work through various tabletop exercises, full-scale exercises and outreach activities. There are pre-event coordination meetings conducted with island commonwealth, local governments and federal agencies that include briefings and information sharing sessions. Core partners (e.g., PREMA) use information provided by NWS to make critical decisions; exercises and briefings provide a venue for NWS to teach partners how to correctly interpret information, weather maps and forecasts.

NWS also coordinates internal meetings to update graphic outputs to be more user friendly, answer questions asked by decision makers, and discuss the best ways to tailor information with respect to region. Internal coordination meetings allow NWS to be on the same page in case one office needs to cover for another other during an emergency event. This occurred in 2017; the Miami office was in charge of day-to-day work when the San Juan office was supporting the Emergency Operations Center (EOC) following Hurricane Maria.

The highlighted lessons learned were: (1) the need for back-up communication in the event of a disaster, (2) the realization that not all tools will be available following a catastrophic event, and (3) contingency planning including multiple back-up NWS offices outside of threat zone to act as support offices.

**CAPT Ricardo Alonso, USCG Marine Environmental Response (MER)**, focused on the USCG’s mission response and the role of the Coast Guard during a response operation. The National Response Team (NRT) is activated in the event of oil or hazardous substances discharge, transect national boundaries, or threatens public health, property, or natural resources. CAPT Alonso stressed the importance of good communication and understanding the framework for how the federal government operates in an emergency. He also recommended that all response organizations read the overarching regulatory authority (e.g., 40 CFR 300 National Contingency Plan), and know the functions (e.g., roles and responsibilities) of each organization and personnel when responding to a disaster. Although preparedness is a slow and tedious process, it is the most important piece when saving lives. Preparedness planning needs to be done both internally (e.g., local, district, families) as well as externally (e.g., area contingency plans). The local and regional scale should include tabletop and
hands-on exercises (e.g., pre-staging equipment) to identify weaknesses and gaps prior to a disaster. Exercises should also encourage interaction between stakeholders, opening early lines of communication and introducing critical players.

CAPT Alonso documented five key points: (1) USEPA and USCG coordinate and direct the response, USEPA for inland areas and USCG for the coastal zone; (2) other federal agencies with appropriate jurisdiction and expertise support the lead agency; (3) activities are done in partnership with state/commonwealth and local officials; (4) industry is responsible for being prepared for, responding to, and paying for cleanup and damages from pollution incidents when they are designated the primary responsible party; (5) the NRT uses the National Incident Management System/Incident Command System to bring these parties together to manage response actions.

Throughout the presentation, four response and recovery challenges were identified: (1) interagency coordination, (2) the ability to rapidly set-up communications for interagency coordination, (3) response dependent upon logistics, surge forces and equipment, and (4) infrastructure critical for survivors and responders.

Major lessons learned following recent hurricane responses include: (1) issues identified with respect to USCG flood response assets (e.g., equipment, communication); (2) satellite phones capable of placing and receiving calls should be used during response operations; and (3) additional internet technology support should be on-hand during a disaster. A more general summary of lessons learned that can be applied to an array of agencies consist of: (1) use of resources to enhance alignment with partner agencies’ goals; (2) use of Flood Punt Teams to conduct urban Search and Rescue; (3) Emergency Support Function (ESF)-10 and mission assignment training; (4) training of unmanned aircraft system; (5) plan for and execute exercises spanning across multiple districts; (6) ensure personnel support teams are adequately staffed to manage call volume for accountability of CG members an family; and, (7) continually engage with external agencies pre and post hurricane season, as well as leverage relationships during event.

Jennifer Koss, Director of the Coral Reef Conservation Program at NOAA, gave an overview of NOAA’s presence in the Caribbean, including NOAA’s role as a science based organization to provide the best available science when assisting decision makers. Additionally, NOAA NWS/NOS keeps citizens aware of any climate and weather related changes, help with fisheries management, and provide support to fisheries commerce. With respect to response organizations, NOAA maintains the NWS Caribbean Tsunami Warning Program (CTWP), the National Hurricane Center (NHC), the National Marine Fisheries Service (NMFS), National Ocean Service (NOS), the Integrated Ocean Observing System (IOOS), Sea Grant and the National Environmental Satellite, Data and Information Service (NESDIS).

Following Hurricane Maria, there were mission assignments through FEMA to conduct coral restoration. FEMA and NOAA/NFWF reattached over 17,000 corals at 70+ field sites and surveyed over 400,000 m² of reefs. This was the first ever mission assignment FEMA authorized for coral assessment and triage work; it was recognized by FEMA that coral reefs are the first line of defense to reduce storm related impacts (e.g., storm surge, wave energy).

Charlie Henry, NOAA OR&R DPP, noted all of the line offices in NOAA have a role in disaster response. The FEMA pre-scripted mission assignments assigned to NOAA’s National Ocean Service (NOS) include: coastal science support coordinator, geodetic surveys, aerial imagery/LIDAR,
hydrographic surveys, scientific support for oil and chemical spills, and marine debris assessment. If there are other needs or requests by FEMA for NOAA support (e.g., recovery functions) additional and new missions can be assigned. NOAA OR&R’s mission is to provide world-class science and information-based solutions to protect and restore the nation’s resources and their uses from coastal environmental hazards. The Disaster Response Center (DRC) was established as a hub in the Gulf of Mexico (GOM) which serves as the center for emergency preparedness and response in the case of a disaster/environmental hazard.

**Jose R. Marchand-Parnell, FEMA Acting Deputy Director for the Capacity Building Sector of FEMA** noted the main challenge when responding to Hurricane Maria was the lack of preparation, better preparedness supports a faster recovery. The FEMA mission was to provide essential support, guidance and tools to the whole community including federal, commonwealth, municipal, private sectors and NGO partners. To build upon, restore and strengthen their capability and capacity as entities and individuals, to be prepared and able to perform their essential functions effectively, efficiently, and sustainably in response and recovery efforts. The core partners that FEMA worked with during recovery included the Puerto Rico Emergency Management Agency (PREMA), Puerto Rico Planning Board and 78 local Emergency Management Offices. The programs/units that fall under recovery include: community resiliency/preparedness, continuity of operations, training and exercise, mass care, and others.

Mr. Marchand outlined major innovations/lessons learned: (1) The need for assessing current capabilities of local communities to determine their level of preparedness when responding to a disaster. If preparedness seems to be inadequate, then teaching communities and providing technical advice to improve the baseline knowledge level is essential. Outreach programs include, the FEMA lifelines situational reporting integration which was developed to ensure response is coordinated in the same manner regardless of language, background to ensure that all communities are on the same page when preparing for an event. The initiation of the Youth Preparedness Council provides in-school learning opportunities to practice preparedness, and spreads knowledge through community outreach and projects. Another outreach program is through the Core Advisory Groups; these are made up of community volunteers and different NGO’s throughout the island, working with various planning tools, whose goal is assessing and identifying population needs that should be accounted for during a response, and to ensure disability integration throughout all emergency planning phases. (2) The establishment of the Business Emergency Operation Center (BEOC) that involves private businesses in planning and response stages. In the past, engagement with private businesses was limited, but it is a valuable asset during a response. (3) The need to work with academia to engage local colleges and universities in developing an emergency management curriculum to encourage students to think of it as a career path. (4) The need to minimize the high employee turnover rate within local organizations and improve the flow of information for new employees. In order to keep people prepared, continuous training of employees is necessary.

**Debra Payton, Department of Interior (DOI)** noted that FEMA operates as a coordinating agency following five frameworks associated with disasters: prevention, protection, mitigation, response and recovery. Following Hurricane Maria, DOI is supporting FEMA as the Natural and Cultural Resource coordinator under the Recovery framework. DOI’s mission is to protect natural and cultural resources and historic properties through appropriate actions to preserve and restore them consistent with post-disaster community priorities and best practices, and in compliance with applicable environmental and historic laws and orders. This objective is delivered through the Natural and Cultural Resources (NCR)
Recovery Support Function (RSF) which encompasses primary agencies such as DOI, NOAA, USEPA and FEMA and several supporting agencies. There are many classifications of cultural resources, including archeological sites, buildings and structures, landscapes, burial sites, objects/collections/records. Additionally, DOI focuses on protection and restoration of natural resources, which includes wildlife, vegetation, land, water (e.g., salt and fresh, surface and groundwater, drinking, irrigation), and recreational sites.

The effort to restore damaged natural and cultural sites begins through a series of assessments. Following Hurricane Maria, DOI conducted over 40 different types of assessments. It was imperative to do the work upfront because it is hard to capture the devastation once restoration begins. The initial assessments resulted in courses of action (COAs); there are a total of 276 COA’s that were in the governor’s report. NCR “owns” 22 of those COAs. COA development was supported by many agencies and partners (e.g., DOI, NOAA, EPA, USDA, NEA, GSA, NEH, NARA, the Commonwealth, UPR and NGOs), and was conducted by using Solutions Based Teams. Solution Based Teams can identify solutions to COAs, provide advice/recommendations and expertise to the Commonwealth, provide the Commonwealth assistance in prioritizing projects, determine/suggest appropriate sources of funding, and provide technical assistance in scoping projects. Most resources under NCR do not qualify for FEMA funds. Therefore, the next step after assembling the COAs is to identify potential funding sources and/or partnerships to move projects forward (e.g., public/private partnerships, grants, Federal Agency supplemental funds, NGOs, philanthropic sources).

The lessons learned from the perspective of DOI included: (1) the scope of potentially impacted resources is difficult to determine initially and damages may not be known upfront; 18 months later there are still a few assessments that are underway, (2) in tropical areas, downed wood is not necessarily debris, (3) application of FEMA’s Public Assistance Program Policy Guide (PAPPG) for non-traditional natural features is complex, and (4) it is important to be bold when conducting initial assessments.

Carlos Huertas-Hernández, U.S. Environmental Protection Agency (EPA), noted that during a declared disaster response, the USEPA operates under “Emergency Support Function #10: Oil and Hazardous Materials Response” of the National Response Framework. Under this function, USEPA provides personnel to assist FEMA and other EOCs in response operations. Additionally, USEPA is responsible for removal, cleanup and disposal of oil and hazardous materials. This includes collection and disposal of household hazardous waste (HHW) and monitoring immediate threats to public and environmental health and safety in Puerto Rico and the U.S. Virgin Islands. Following Hurricane Maria, USEPA was also tasked with drinking water monitoring in the U.S. Virgin Islands, repairing ambient air monitoring stations in Puerto Rico and providing emergency power to non-PRASA systems in Puerto Rico. Coordination and execution of all necessary assessments, evaluations, sampling and analytical services/support was performed by USEPA employees to ensure the safety and quality of drinking water and wastewater systems in Puerto Rico.

These tasks brought to light a number of challenges/lessons learned, which included: (1) difficulties/delays in transporting personnel and equipment into Puerto Rico and the U.S. Virgin Islands via flights and barges, (2) many responders were not Spanish speakers, but local translators were (success story), (3) USEPA coordinated the segregation, transportation and disposal of all oil and hazardous substances collected under ESF#10 by both USEPA and USCG, (4) equipment was held up in
U.S. Virgin Island ports due to demands for tax payments, (5) equipment was held in the continental U.S./hard to get on a barge because of low priority compared to food or water (i.e., pre-staged equipment), (6) administrative hurdles from FEMA in efforts to make non-PRASA systems eligible for temporary repairs or emergency power, (7) all hazardous materials needed to be transported to the mainland, (8) contracting issues associated with the procurement of ambient air monitoring equipment for Puerto Rico, (9) use of DOI’s IPaC system to conduct Endangered Species Act Section 7 consultations for HHW staging areas worked well, and (10) central drop off locations for community members to bring HHW was the most efficient collection system.

Ernesto Diaz, DNER/DRNA, started the presentation stating that communities were not prepared for a category 4 or 5 hurricane. For example, the power grid failed, communications went down and fuel (e.g., gasoline) was not being distributed post-disaster. In the midst of the disaster, DNER submitted a request for Mission Assignments under FEMA ESF 10 to work with the USCG, USACE, and NOAA. DNER submitted a resource request form (RRF) for sunken vessel removal in coordination with USCG, as well as an RRF for coastal, nearshore and beach debris removal with the USACE. The USCG came prepared to respond and had a clear path towards response which helped to guide DNER protocols. Through this process, DNER began developing and fine tuning their own protocol for sunken vessel removal and recommended that the protocol be further refined. Due to legal issues, marine debris removal halted progress and a lot of the work has not been completed. The process was divided into two phases: the first was manual removal of debris the second is debris removal using heavy equipment. Phase two has not been started. Additionally, DNER requested FEMA (i.e., NCR) to conduct damage assessments and support progress when developing COAs for coral reefs, seagrasses, beaches, dunes and wetlands. In order for coral reefs to be eligible as a critical maintained natural infrastructure’ and receive funding, FEMA required documentation through a scientific review, regarding how reefs protect coastlines. In cooperation with CariCOOS, they were able to show that waves were attenuated by reefs and that damage costs were minimized and not incurred by FEMA because reefs were able to protect shorelines. Now, insurance has recognized that reefs are an important coastal protection and worth rebuilding and maintaining.

Due to short staffing and limited resources the DNER was divided, some employees conducted damage assessments, while others stayed at the JFO to work on reports. A major lesson learned was that some communities did not know what an RRF was, how to submit it and check that it was filed properly. If an RRF was not submitted, then FEMA was unable to address the issue. It is recommended that training be conducted at the municipality level to inform workers what an RRF is and how to properly file one.

In order to be prepared for future natural disasters and storm events, DNER recommends that detailed maps of built up areas and natural assets be compiled ahead of time. This will help to set a baseline and streamline the damage assessment process. Through this rebuilding process, it has been highlighted that infrastructure must be built back stronger than before, and retrofitting of homes needs to provide resiliency for future events. Additionally, corals and natural infrastructure must be maintained and restored to protect coastal communities, critical infrastructure and biodiversity.

Carlos Irigoyen Gonzalez, Puerto Rico Emergency Management Agency (PREMA), noted that the mission of PREMA is to coordinate all resources from the government and private sector, in order to provide the fastest and most effective services before, during and after emergency situations to ensure the protection of life and property of citizens. Hurricane Maria devastated Puerto Rican municipalities,
and many were designated eligible for the Public Assistance and Individual Assistance programs. 70,000 homes lost their roofs and there was a total collapse of essential services such as communications and warehouse space. The Emergency Operational Plans of the government agencies and municipalities were scaled up from lower category hurricane to address damages from a category 4 or 5 hurricane such as Hurricane Maria.

As a result, uniform systems of plans, training and exercises have been developed. The state/commonwealth and the municipal emergency management structure is strengthened, and changes have been made to the supply distribution plan, so as to avoid running out of warehouse space and commodities, and to ensure citizens receive important necessities quickly and in an orderly fashion. Working on the installation of satellite communication systems is a major priority; radios of 100 watts are being installed in hospitals, police stations, fire stations, EMS Central Communications Center, and OEM offices around the island. These radios have the ability to work without the need for repeaters. An alliance with the private sector has been initiated, which is the first time private companies have been included in the EOC. Sectors such as manufacturing, food, hospitals, telecommunications, broadcasters, media, infrastructure, transportation and fuel industries have all been part of this conversation. Many lessons were learned during the implementation of ESFs and now we must apply those lessons learned to change the way response is implemented.

Christa von Hillebrandt-Andrade, NOAA NWS Caribbean Tsunami Warning Program, discussed missions, products and protocols that can be expected in the event of a tsunami. Communication is crucial because time is of the essence. Once the earthquake occurs there is limited time for citizens to go to high ground (minutes to as most hours). There are both natural and official warning signs of a tsunami that people need to know. In the case of a local earthquake and tsunami, the first natural warning will be strong earthquake shaking; other natural cues are rapid sea level changes and roaring sounds. Self-evacuation is key for survival and requires individuals to identify and act on these natural warnings. Official information will be distributed through federal, state/commonwealth and local entities.

Tsunami warning centers (TWC) monitor seismic and sea level data 24-hours a day, 7-days a week. There are five types of messages that they issue:

- Warning (highest threat level, inundation expected)
- Advisory (second level, strong currents expected, but not coastal flooding)
- Watch (for distant tsunamis, when travel times are greater than three hours, threat level still under evaluation)
- Information Statement (no tsunami threat expected)
- Cancellation (dangerous waves/currents no longer expected - different from all clear which is issued by emergency management indicating safe to return)

The Pacific Tsunami Warning Center (PTWC) tracks the Caribbean and is responsible for issuing the official tsunami alerts for Puerto Rico and the U.S. and British Virgin Islands. If the TWC detects a strong earthquake, the data are analyzed and, if necessary, a message is pushed out to the public and authorities through various communication channels. Communication channels include NOAA Weather Radio, Emergency Alert System, NWS website https://tsunami.gov/. State EOCs, local weather forecast offices, the Puerto Rico Seismic Network (in the case of PR and the Virgin Islands) and USCG, which
distribute to specified audiences (e.g., USCG in charge of alerting mariners), all support the dissemination of tsunami alerts. In the case of a warning, certain wireless phones and other compatible mobile devices will receive a Wireless Emergency Alert (WEA) from the TWC. The text like geo targeted message will alert of the imminent tsunami threat in the area. The WEA will probably be the fastest way to receive a tsunami warning as it is generated directly from the PTWC. PRSEMA is also authorized to send WEAs.

Once the initial tsunami warning goes out, local authorities use this information to alert the community and initiate evacuation plans. The warning messages include information useful to emergency managers and responders, such as threat level and an estimate time of arrival and forecast wave height and duration of the tsunami. The most important take-away message from Ms. von Hillebrandt-Andrade was to keep messaging to the public consistent, use a central information source and be familiarized with tsunami messaging prior to an emergency response.

More detailed description of tsunami preparedness was discussed on the third day of the workshop and can be found in the NRPT Training Section: Tsunami Scenario.

Day 2 – April 24th, 2019

Ernesto Morales, NOAA NWS, discussed his agency’s role in assisting decision makers for emergency management and preparation before an extreme weather event. The NOAA/NWS mission is to provide weather, water and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy. Within NWS there are two offices: the Weather Forecast Office (WFO) San Juan and the National Hurricane Center (NHC), which have the same mission, but a different scope. The NHC focuses on the forecast of the intensity and trajectory of tropical cyclones whereas, WFO San Juan concentrates on local forecasts and impacted areas based on the NHC forecast.

Communication between NWS and emergency managers is an intensive process which begins prior to and continues throughout the extreme weather event. Depending upon the timeframe prior to an extreme weather event, the types of graphics and information available to decision-maker changes. Very long-term forecasts (e.g., 7 day) are less accurate than a short-term forecast (e.g., 48 hour), and the graphics available to external partner changes. Once a cyclone begins forming, and confidence in the storm intensity is established, meteorologists conduct hazardous weather outlooks, emergency management briefings, media interviews, social media posts, graphicasts and NHC tropical weather outlooks.

As time gets closer to the predicted extreme event (i.e., day 2 to 12 hrs.), NWS puts out multiple products: a hurricane local statement, Tropical Cyclone Valid Time Event Code (VTEC), track forecast cone, hurricane watch, hurricane warning, and NHC wind speed probabilities. A new forecast cone is developed displacing the old forecast cones; updates include highlighted warnings and a smaller cone due to less model error. The newer forecast cones give more information regarding wind speed at the center of the cone and miles outside of the center that are likely to be impacted by tropical storm winds.

As the extreme weather event gets closer (i.e., 12 hr. to 3 hr.), hurricane local statements, Tropical Cyclone Watch/Warning (TCV) and other short term standalone products are available to decision makers. Just prior to the weather event, a notice of extreme wind, flash floods and other potential
hazards is released. A major lesson learned is the need for decision makers and emergency managers to build a relationship with local weather service folks prior to extreme events. This helps build trust and formulates a central, official source for weather information. Additionally, it is important for emergency responders to understand how to read forecasts and interpret important graphics.

A more detailed description regarding how to read and interpret weather and forecast documents is covered in the NRPT Training Section: Hurricane & Coastal Flooding Scenario.

Carlos Irigoyen Gonzalez, Negociado para el Manejo de Emergencias y Administracion de Desastres NMEAD, detailed the importance of risk communication, outlined challenges when responding to severe weather events and discussed ongoing projects. During severe weather, it is important to keep in contact with the NWS and maintain an official source of information. Once the official source is identified and messages are formed, information needs to be distributed to the community. Information generally flows from the Hurricane Center in Miami and NWS to the EOC headquarters, from there to regional EOCs and then to the municipalities. It is important to have redundant systems of communication (e.g., satellite phones, 100 watt radios, internet, media, TV, radio stations), such that messages are being properly relayed to municipalities and the public.

NMEAD is working with FEMA in a pilot program to install new all warning sirens systems, including the 87 sirens already existing for the Tsunami Program in Puerto Rico, of the 46 sirens in coastal municipalities, only 28 are working after Hurricane Maria; the other are still pending for insures companies to pay for the repairs. In coordination with FEMA, the new all hazard warning systems will cover all municipalities in Puerto Rico. All hazard warning systems include places such as Guajataca Dam, in case it fails a proper warning system would be in place. Additionally, installation of 100 watt radios in different municipalities has been underway, to increase back-up communication in the event of an emergency. There has been a lot of effort to educate communities on preparedness and planning, as well as keeping the public engaged about the potential threat of tsunamis and hurricanes.

Dr. Mirelsa Modestti González, Universidad del Sagrado Corazón, provided feedback and tips on how to successfully use social media in the event of a natural disaster or extreme weather event. It is important to recognize that people of all ages and demographics are using social media as a valued source of information. In order to build an audience and maintain followers before an event, organizations need to be an online presence by posting on a regular basis. Posts need to be created taking into consideration the public and characteristics of the different types of social media. Information needs to be presented in an easy to read manner, with critical information at the forefront and secondary information via links to other webpages. Use of graphics (e.g., videos, interactive maps, pictures) and simple, common language in the form of bullets are aesthetically pleasing and essential when reaching all demographics. Culture should be taken into consideration when developing posts and announcements, and celebrities and 'influencers' should be invited to trainings, as they can be extremely valuable because of their outreach. They should have access to official information websites and be asked to share official posts on their pages. Also, they should be encouraged to have links to official information websites on their fan pages.

Special care should be taken with certain types of messages. For example, when a Tsunami Warning cancellation is emitted, many people will interpret the cancellation as an “all clear” notification and will try to go back to their homes. It is of utmost important to state that it is NOT safe to go back to the coast before using the word "cancellation".
In the event of an emergency, downloading large files (e.g., videos, graphics) may not be possible given data limitations. Therefore, content should be concise and ingestible when data is limited. Prior to writing public messages, consider the audience trying to be reached (e.g., cultural preferences, language). When formulating them, use bolded fonts and colors to convey your information efficiently (e.g., bold, red letters indicates warning).

Misinformation or incomplete information is a problem. During emergencies, many people share incorrect or incomplete information. Therefore, a central page for disaster information that can be accessed by the public is highly recommended. In addition, each municipality could use their own specific platform as a central form of communication. It could be used to update the public about open or closed roads, available drinking water sources, etc. These platforms can be linked to the central disaster information page. Some platforms and social media require less bandwidth than others, and this caveat should be considered when choosing or retrofitting an existing central communication platform or service.

V. Breakout Session I

The first breakout session took place following the plenary presentations on Day 1. The plenary discussion covered federal, state/commonwealth and local government challenges and lessons learned through hurricane response. The participants were divided into four groups (i.e., Groups A, B, C and D). Each group was tasked with identifying response challenges and subsequent lessons/skills/practices learned as highlighted from plenary presentations. For each identified response challenge and associated lessons learned, the participants compiled information on: type of event, timeframe of occurrence, safety of staff or staff families, cross jurisdictional issues, and shared trust resources. The summaries of the breakout group discussions capture major discussion points. See Appendix D for exact wording and all of the identified challenges and lessons learned.

Group A

Group A explored eight response challenges, and divided them into: communication, resources, preparation and leadership (Table 1). For example, one response challenge was that as a hurricane approaches, community members do not take forecasts seriously because there are too many unofficial sources of information. The lesson learned coming from that discussion was the need to socialize which media outlets are reliable, existing official sources of information and unofficial, misleading sources. This challenge occurs throughout mission response, and it threatens the safety of staff as well as their families and is a cross jurisdictional concern (e.g., federal, commonwealth, municipal). One solution is to conduct ongoing education in schools and at community meetings to inform the public where they can find credible sources of information and socialize official information sources such as NWS.
Table 1: Response challenges and lessons learned determined by Group A’s breakout group discussions.

<table>
<thead>
<tr>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/Skills Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desensitizing of alarms</td>
<td>Take culture into account when designing communication</td>
</tr>
<tr>
<td>Not taking forecast seriously</td>
<td>Information needs to put everyone on same page (official source)</td>
</tr>
<tr>
<td>Sources of information</td>
<td>Educate public to follow official source(s) of weather information</td>
</tr>
<tr>
<td>Lack of maintenance of resources</td>
<td>Prepared before event, need maintenance logs and funding necessary</td>
</tr>
<tr>
<td>Not enough resources</td>
<td>Cannot properly respond causing “snowball” effect, improvisation insufficient, must plan ahead, stockpile supplies beforehand, (access and distribution) *More efficient distribution system that is equitable, prior plans (&amp;funding?) of impartial parties responsible for distribution of resources to communities (NGO, Red Cross, churches)</td>
</tr>
<tr>
<td>Communication infrastructure</td>
<td>Redundancy with options, total loss of communication can happen, ham radio can work</td>
</tr>
<tr>
<td>Lack of plans for an event of this magnitude</td>
<td>Need to plan, practice, train for worst case scenarios</td>
</tr>
<tr>
<td>Leadership</td>
<td>Empower (training, organizing, informing) communities is crucial, developing volunteering structure (cultural shift); in response to communities not relying on government, training of leadership,</td>
</tr>
</tbody>
</table>

Group B

Group B identified 16 response challenges; priority challenges are bolded (Table 2). Examples of response challenge categories included rapid assessments of damage/debris, consideration of policy changes to include green technologies when applying for funding, and the need for pre-scripted mission assignments. One response challenge identified by Group B was to avoid restructuring organizations during a response, (e.g., do not introduce new sectors or grant managers part way through a disaster response). The lesson learned were: that building a new type of structure during a disaster creates added pressure, lack of experience and unclear goals. While this is a concern throughout mission response and recovery activities, it specifically focused on federal jurisdiction and FEMA. There is an added concern for the safety of staff/staff families both mentally and for field safety.

Table 2: Response challenges and lessons learned determined by Group B’s breakout group discussions.

<table>
<thead>
<tr>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/Skills Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response plans exist</td>
<td>Lack of ownership, accountability, dissemination, actualization</td>
</tr>
<tr>
<td>Land Use Plan</td>
<td>Enforcement of sensible use of land use plan and zoning; assess on paper, but not in reality (i.e., zoning)</td>
</tr>
<tr>
<td>Communicate the severity danger/risk</td>
<td>Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond</td>
</tr>
</tbody>
</table>
Simultaneous hazard events may require unknown flexibility

Tabletop exercises that are more complex, multi-scenario, some scenarios require staff safety ahead of protocols, need redundancy

Capacity for multiple, simultaneous disasters

Climate change could lead to stressors to staff/resources/retention.

Marine/land debris hindered by lack of staging areas and logistics

Pre-identified staging areas needed

Rapid assessments of damage/debris are critical

Areas that had quick assessments made it easier to scope federal funding

No restructuring of organization during a disaster*

Building a new type of structure during a disaster leads to added pressure, lack of experience, unclear goals

Policy guidelines need to be revisited due to new technology and climate change*

Policies need to be revised before an incident

Police evacuation of people in danger zones when cell service down

Pre-emergency coordination with municipalities (door knocking, whatsapp) repeat weather messages

Deadlines need to be flexible, but...

FEMA extends deadlines. Is this good or bad? False expectations. Inefficient timeframe

Broad and bold on initial assessments

Baseline for FEMA to consider funding opportunities (e.g., repair, restoration)

Lack of Pre-Scripted Mission Assignments (PSMA)/Duplicity of efforts*

The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies

Other Federal Agencies (OFAs) need to be assertive in their supplemental funding request*

You snooze, you lose (i.e., there is often a very limited window for supplemental funding requests. Identifying the needs and collecting the appropriate information must be conducted prior to the funding request, making a timely, speedy response more difficult.

Community response efforts. Develop a community plan.

Community members segregating debris; reaching out to the elderly; local communities will engage if given the opportunity, they take ownership, sense of community (helping your neighbors)

* Bolding indicates priority items

**Group C**

Group C captured nine response challenges within their discussion (Table 3); ranging from logistics e.g., getting resources to the island, and distribution of resources once received), to high turnover rates of emergency response positions at the local and commonwealth levels. One response challenge identified by this group was not pre-emptively involving the private sector when developing emergency response plans. A lesson learned was that the private sector be involved during contingency planning in coordination with PREMA. Connecting the private sector to municipalities could improve distribution of goods after a disaster, and allow private businesses to contribute to response efforts using their connections and assets at all levels (e.g., community, regional). This is a cross jurisdictional problem (i.e., federal, regional, local) and spans throughout planning, response and recovery.
Table 3: Response challenges and lessons learned determined by Group C’s breakout group discussions.

<table>
<thead>
<tr>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/Skills Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications &amp; interoperability between organizations/groups</td>
<td>Requires a compatible system</td>
</tr>
<tr>
<td>Communication</td>
<td>Back to basics- simple solutions (e.g., radio, information runners)</td>
</tr>
<tr>
<td>Interpersonal- layers of bureaucracy slowed progress</td>
<td>Need to identify an authority- previously only identified problem</td>
</tr>
<tr>
<td>High turnover rate of response positions</td>
<td>Need to maintain and document experiences, and put them into practice. Done through education and more trainings</td>
</tr>
<tr>
<td>Pre-emptively involve private sector</td>
<td>Involve private sector during contingency planning. Make the link on how to support municipalities/local organizations (e.g., transportation/ gas/food)</td>
</tr>
<tr>
<td>Release of emergency supplies in ports</td>
<td>Circumvent barriers using emergency declarations to streamline (e.g., turn off taxation during response)</td>
</tr>
<tr>
<td>Assets to people</td>
<td>Use multiple avenues to distribute resources (e.g., NGOs, faith based &amp; private)</td>
</tr>
<tr>
<td>Getting community to know and buy into existing procedures/frameworks</td>
<td>Better communication of information &amp; informing communities at the grass roots level</td>
</tr>
<tr>
<td>Logistics</td>
<td>Pre-planning on how to get resources to the island, and distribution in reasonable amount of time</td>
</tr>
</tbody>
</table>

Group D
Group D highlighted ten response challenges (Table D), ranging from access to clean water, identification of vulnerable populations before a disaster, port accessibility during response and lack of enforcement of residential building codes. An example of a response challenge was that vulnerable populations (e.g., disabled, sick, elderly) were stranded following Hurricane Maria. The associated lesson learned was not to wait until hospitals are actually impacted by a storm to make decisions, but to have a contingency plan for back-up energy sources and access to other necessary resources. This falls under the preparation timeframe including the safety of staff/staff families and is potentially a cross-jurisdictional concern (e.g., federal, commonwealth).

Table 4: Response challenges and lessons learned determined by Group D’s breakout group discussions.

<table>
<thead>
<tr>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/Skills Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to communicate with small communities</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
</tr>
<tr>
<td>People inadequately prepared for Category 4 or 5 hurricane</td>
<td>Should prepare regardless of category level</td>
</tr>
<tr>
<td>Communities relying on social media and not official sources of information</td>
<td>More outreach about official sources of information</td>
</tr>
</tbody>
</table>
VI. Breakout Session II

Breakout Session II took place on the second day of the workshop, following morning plenary presentations. Participants were asked to expand upon challenges and lessons learned established during Breakout Session I. The challenges and lessons learned were condensed and categorized into one of eight categories: communication, infrastructure, leadership, logistics, policy, preparedness, response, and logistics. Each group received the same template. The template had 23 response challenges and lessons learned; the groups were tasked with identifying improvements (i.e., actionable tasks) and how their approach would differ with respect to a tsunami or a hurricane. The number of items each group discussed varied, but all 23 items were covered. The summaries below do not detail every topic discussed by the groups, but focus on critical points. See Appendix D for exact language and completed templates from each group. The condensed and categorized response challenges included:

1. Communication
   a. Communication with small communities
   b. Communities relying on social media and not official sources of information
   c. Contingency planning for emergency communication
   d. Communication of the severity of danger/potential risks

2. Infrastructure
   a. Lack of and enforcement of residential building codes
   b. Lack of access to clean water
   c. Current infrastructure was/is not hurricane ready
   d. Poorly maintained infrastructure

3. Leadership
   a. High turnover within leadership positions and trained personnel; limited capacity for multiple, simultaneous disasters.

4. Logistics
   a. Port accessibility is limited during response because of existing laws (e.g., Jones Act)
   b. Marine/land debris clean-up hindered by lack of staging areas and removal logistics
5. Policy
   a. Land use policy (e.g., rebuilding in high-hazard zone)
   b. Policy guidelines need to be revisited due to change in technology, climate, etc.
   c. Other federal agencies (OFA) need to be assertive in their supplemental funding request
   d. Interpersonal layers of bureaucracy slowed progress (i.e., politics getting in the way of progress)

6. Preparedness
   a. People inadequately prepared for Categories 4 or 5 hurricanes
   b. Lack of emergency planning at family, local and regional levels
   c. Simultaneous hazard events may require unknown flexibility
   d. Lack of Pre-Scripted Mission Assignments (PSMA) led to duplicity in efforts
   e. Private sector not pre-emptively involved

7. Response
   a. Rapid assessments of damage/debris were critical; FEMA needs a baseline to consider funding opportunities

8. Inequity
   a. Vulnerable populations left stranded during/after disasters

Group A
Group A discussed 10 of the response challenges, the categories they focused on included: communication, infrastructure, leadership, logistics, policy, and preparedness. Within the communication category (1b), the group focused on actionable tasks such as certifying official information sources so that community members can trust those sites. This would require community outreach, socialization of official sources of information, and learning how to read forecast maps. Within the infrastructure category (2b), this group focused on improving access to clean drinking water. The actionable tasks included: promoting/educating communities on how to install and fix rainwater collection systems, requiring new residential construction to include cisterns or rain collection systems, and community workshops to teach members about potential risks associated with drinking untreated water. Under the logistics category, port accessibility in the event of a disaster (4a), and the need for establishing a protocol which automatically waives laws such as the Jones Act for a reasonable time frame were key. Another topic of discussion was policy changes with respect to land use (5a), and rebuilding in high-hazard areas following a disaster. The action items include enforcement of existing codes, consistency in codes, and implementation of new codes to consider zoned and future land planning. The final category covered was preparedness, lack of emergency planning (6b); this group recommended educating/outreach to remind people of the possible devastation following a disaster. Keeping the memories fresh in their mind, but also providing avenues to educate communities on how to plan and prepare their families. This could be done in coordination with existing organizations (e.g., faith based groups, schools, NGOs), as well as practicing evacuations through exercises.

Group B
Group B covered five response challenges within the categories of: communication, policy, preparedness and response. Action items under the communication (1a), included the ability to communicate with small communities, and recommendations that responders be aware of language and cultural needs when working with various communities. Following a disaster, there should be multiple, central locations where information can be posted regarding weather forecasts and other critical information.
Pre-training at the community level would help families understand the necessary resources to survive many days following a disaster (e.g., food, water, radio). Additionally, under the policy category (5b) policy guidelines (e.g., PAPPG) should be revisited to include new technology and climate change. Potential improvements would require high-level policy agreements on existing FEMA public assistance, mitigation and recovery policies. Within the preparedness category (6a), this group recommended that social scientists be active and engaged in community outreach to educate the public and local leaders regarding family planning for disasters. Exercises should be completed at the community level to test storm-readiness, and develop a checklist of necessary items families should have in the case of a disaster. Another facet of preparedness includes PSMA (6d) to avoid duplicity of efforts. This could be done by reviewing existing mission assignments, developing new ones and integrating federal mission assignments with local response organizations. Fast-tracking mission assignments could be completed with automating approval documents by obtaining signatures ahead of time, and responders could prepare for assignments through training and exercises. During the response and recovery activities, communities that conducted quick assessments of damage made it easier to scope federal funding. Building from this lesson learned would require a centralized application to collect assessment information from multiple sectors. This would ultimately allow the public to report on their municipalities.

**Group C**

Group C covered response challenges under the categories of: communication, preparedness, response, and inequity. With respect to communication challenges, this group provided actionable tasks to improve communication with small communities (1a) and contingency planning for emergency communication (1c). These improvements entail using short wave radios for response, satellite phones and back-up power sources such as generators, installation of PA systems, low-wattage phones, satellite computers and solar powered hard-drives accessible by community members to communicate with exterior networks. Additionally, it is important to educate the community at large on how to use these technologies and practice using equipment during planned exercises. Providing training for communities is important to instill emergency readiness at the individual level, because individual preparedness leads to a stronger central response. In addition to communication improvements, there was a lack of emergency planning and preparedness (6b) at the local and family level with respect to necessary supplies. This group recommended that aggressive pre-planning would help allow individuals to be self-sufficient for a longer period; this would include having appropriate quantities of food and water, redundant energy sources, and first-aid/logistical resources (e.g., maps, flash lights). These tools and readiness checklists could be socialized through existing outreach programs (e.g., CERT) and practiced in schools and at community centers. During the response phase (7a), rapid assessment of damages resulted in a higher likelihood for funding through FEMA. Therefore, establishing a pre-storm baseline would streamline the assessment process and clarify what damage was caused by the recent disaster. Documentation of the current state of infrastructure establishes who is responsible for rebuilding after the disaster. This group discussed the challenge of vulnerable populations being stuck in place/stranded following a disaster (8a) and the need for pre-identification of vulnerable populations to determine who is at risk, where they are located and how people/community members are accounted for during and after a disaster.
Group D
Group D covered five of the eight categories: communication, infrastructure, logistics, preparedness, and inequity. A major topic of discussion was identification of vulnerable populations (8a), through preplanning and existing contingency plans. Assessment of vulnerable populations allows emergency responders to preemptively determine the communities’ strengths and weaknesses, who is capable of evacuation, and how responders get to those people faster. The action items included: (1) using census and demographic data to identify vulnerable populations during emergency preparedness planning in order to focus response efforts during an emergency event; (2) creating compliance checks within low-income communities to identify any obvious hazards in homes; (3) providing recommendations for improvements rather than punitive penalties. Within the infrastructure category, (2a) enforcement of building codes would ensure a safe structure in the event of a disaster; if not possible for all residences, there should be a safe structure where the community members can go. Additionally, community outreach efforts should provide training on how to harvest rainwater, install tanks appropriately, the importance of treating water prior to drinking it, and solutions such as sand filters or camp filters to increase individual self-sufficiency following a disaster.

VII. Breakout Session III
The final breakout session took place on the afternoon of Day 2. Building upon Breakout Session II, each group was asked to: (1) recommend steps for implementation, (2) rate the ease of implementation, and (3) document any potential coordinating partners. The summaries below focus on high level ease of implementation outlined by each group and/or topics unique to that group discussion. For completed templates and exact language, see Appendix D.

Group A
Group A highlighted two lessons learned that have the potential to be easily implemented. They focused on improving the maintenance of infrastructure and avoiding rebuilding critical infrastructure in high-hazard areas. In order to improve the maintenance of infrastructure, this group recommended that courses and certification programs be developed to authenticate contractors. This would mandate specific training, and teach contractors best management practices when preparing for hurricanes. Additionally, Category 4 and 5 rated buildings should be built in centralized locations to provide shelter and protection for evacuated families. This would require coordination between governments and engineering organizations, insurance industries and the community. The second area of improvement falls under land-use planning. This would require identification of risk-prone areas, and development of new land use regulations to prohibit new construction within high-hazard areas. If buildings need to be reconstructed in those areas, then they should follow special codes and best practices to ensure buildings are structurally sound. Coordinating partners include local and state governments, permitting agencies, municipalities and community members.

Group B
This group did not have any lessons learned with a high ease of implementation, but rather prioritized a challenging lesson learned. The lesson learned is that OFAs need to be more assertive in their supplemental funding requests. Some items FEMA cannot fund, but delays in OFA submission requests mean they are less likely to be funded. Action items to accomplish this would be identifying and establishing consistent language across agencies; each agency should be responsible for educating their
employees. Agencies should be aware of supplemental funding opportunities (i.e., grants, special project funding) and responsible for requests relative to their particular mandates. Socialization of coverage/vocabulary could be completed through workshops on how to find funding opportunities, how to write grants, petitions, and procurements and how to submit federal grants. Annual meetings needed between local emergency coordinators along with state officials to start knowledge sharing from the federal level to the municipal level. Recommendations for implementation include: (1) interagency training on procedures of funding opportunities, (2) a survey for commonwealth agencies to take in order to gather post-event lessons learned on the supplemental grant process, (3) awareness raising for federal agencies on supplemental funding opportunities (e.g., grant, special project funding) for requests relative to their mandates, and (4) federal agencies preparedness with requests to Congress of supplemental funding according to their mandates.

**Group C**

Group C focused heavily on local level preparedness, creating contingency and emergency plans that direct community members to a central or multiple information source(s) around a community. Pre-emergency planning would include local law enforcement, impartial parties (e.g., faith based organizations, NGOs) and local emergency managers. Recommendations for implementation include education as a priority. This would require planning and executing workshops to build knowledge for local leaders, parents and/or children to teach families about preparedness planning. The workshops could be broken into regions to allow more people to attend from multiple communities. They would encourage community members to take ownership in emergency planning and promote self-sufficiency. This could potentially be done in coordination with NOAA’s Office of Coastal Management and Sea Grant. The second recommendation is focused on outreach efforts (e.g., media blitz). This would include ads at movies, TV commercials, radio announcements, advertisements at stores, etc. to raise awareness about how to prepare and develop individual emergency plans and where to find official sources of information. Outreach/education could also take place at public or private classes (e.g., home improvement stores), youth organizations (e.g., boy scouts, girl scouts), or faith based organizations. The goal of this is to create self-sufficient communities through empowerment of individuals. Start with a pilot project, in one or two communities, to show that training exercises and education can improve preparedness, and would share results at a regional scale to encourage buy-in. This would require coordination between communities, NGOs, universities, media outlets, photo journalists and emergency management entities.

**Group D**

Group D highlighted two lessons learned that had a high ease of implementation. The first centered on removal of marine/land debris and the other on lack of emergency planning at the family and local level. In order to improve removal of debris, Florida’s emergency management plans should be referenced as a best management practice document. Current contingency plans would then be updated to include pre-identified staging areas for marine debris, construction/demolition debris, and a final location for debris (e.g., landfill on the island vs. shipping off the island). This would require coordination between FEMA, USCG, local emergency managers, NOAA Marine Debris and local public works divisions. The second lesson learned is improving local level preparedness through: (1) re-instituting the CERT program in schools, churches, communities, etc., (2) its use in coordination with neighborhood watch programs, and (3) use of existing web-apps/phone apps to share information (e.g., “next-door” app). VITEMA models are good and could and potentially be replicated as best management practices. Consistent
messages/information should be socialized at community events. The final recommendation is improving consistency of delivery of information, and institutionalizing self-reliance. Coordination partners include local agencies, emergency management agencies, FEMA, school systems/universities, and community members.

VIII. NRPT Training

The design of the NRPT format includes a day of training. For this workshop held in Puerto Rico, the decision was made to conduct two table top exercises: (1) a tsunami scenario and (2) a coastal flooding/hurricane scenario. The exercises not only allowed for discussion as to good practices and not so effective practices, but how to properly interpret and communicate the meaning of watches, warnings, and specific NOAA products for decision making. The participants were divided into four groups to discuss and develop messaging products for different phases of these events. The exercises focused on effective communication, specifically:

*What to say and how to say it effectively: fundamentals of risk communication and the use of social and traditional media to enhance communications and messaging before, during and after a major coastal event.*

Tsunami Scenario

Prior to the exercise, Christa von Hillebrandt-Andrade and Carolina Hincapié from the NOAA NWS Caribbean Tsunami Warning Program, gave an overview about the U.S. Tsunami Warning System. Real-time seismic and sea level data are collected and sent through satellites to Tsunami Warning Centers (TWCs); the Pacific TWC (PTWC) covers the Caribbean region. If data shows anything out of the ordinary, it is reviewed and if necessary, a warning is sent from the PTWC through satellites to the NWS Gateway, State Emergency Operations Centers (EOCs), and the USCG (Figure 1). From there, each of those groups is responsible for distributing the warning message. The NWS Gateway sends out a wireless emergency alert (WEA) to those in coastal zones and in locations under threat. Additionally, the NWS Gateway distributes the message to the NWS San Juan Forecast Office (SJFO) activating (1) NOAA Weather Radio, and (2) Emergency Alert System (EAS) (e.g., TV, radio, fax). The State EOCs send warning messages to the local EOCs, and from there the local EOCs alert TV stations and local alarms/sirens. The USCG is responsible for notifying mariners, harbor and port masters, and releases a PanPan message (i.e., critical message for mariners). There are multiple routes of communication, some methods include: voice, text (satellite based), internet, phone and mobile technology (Figure 2). Each tsunami ready center has an office, and receives warning messages through multiple mechanisms (e.g., fax, NOAA weather radio, internet).
Figure 1: Communication diagram used by the United States Tsunami Warning System

The official roles for the tsunami warning process start with the TWC, which is responsible for determining alert level and issuing the message (e.g., PTWC). The tsunami warning focuses, those
responsible for disseminating official alerts to authorities and the public including: (1) Puerto Rico State Emergency Bureau; (2) WEA; (3) VHF radio; (4) U.S. Virgin Islands Emergency Management Agency (VITEMA); (5) NWS SJFO to activate the NOAA weather radio, EAS and social media; and, (6) PRSN as an alternated tsunami warning focal point for PR and USVI, RSS, website, social media, VHF radio and ham radio.

The overview included a step-by-step discussion of the messages sent by the PTWC. Messages are issued in both English and Spanish and can be found at tsunami.gov, and in the case of a tsunami threat, include critical information such as: (1) message number, (2) who is sending the message, (3) time and date of message, (4) alert level, (5) parameters including location, magnitude and depth,, (6) earliest estimated time for tsunami arrival in coastal regions, (7) recommended actions to protect human life (e.g., evacuation, move to 4th story) (8) specific information about what NOT to do, (9) forecasts of tsunami activity, (10) anticipation of flooding/inundation, and (11) information about the next update. As time passes, more messages are sent to update information. For example, Message 2 includes information such as: updated estimated time of arrivals, height and duration of tsunami, and revision of earthquake magnitude, if necessary. Message 3 contains updates and confirmation of wave heights. The final cancellation message directs the public listen to local, public authorities for the official “all clear”.

The short version of the message which is sent through WEAs to individual cell phones, currently reads:

_Tsunami danger on the coast. Go to high ground or move inland. Listen to local news._ -NWS

As part of WEA modernization, after much discussion the NWS has recommended a new message and send alerts in both Spanish and English depending upon the individual’s preference. After review of messaging, it was determined that the order of message content is important. In addition to the shorter message (90 character), a longer message (360 character) has also been agreed upon and is awaiting FEMA for implementation. For shorter messages, the order of content is as follows: source, guidance, hazard, location, time. The newly proposed English message reads:

**NWS: Tsunami danger on the coast. Move to high ground or inland now.**

The order of content for the larger messages is slightly different. It includes: source, hazard, location, time and guidance. Participants quickly learned that there is very little time for action once the warning is provided; it was stressed that they need to know what to do and act quickly. The proposed longer message, in English reads:

_The National Weather Service has issued a tsunami warning. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high ground or inland now. Keep away for the coast until local officials say it is safe to return. Check local media for more information after you are safe._

The Tsunami Scenario learning objectives were:

1. Familiarization with TWC products and timelines
2. Improvement of communication of the threat message in PR/USVI by official Tsunami Warning Focal Point (TWFP) and social influencers.
3. Focus on four stages of warning:
   - Response to earthquake shaking
NRPT: Learning from the Past and Moving Forward: Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources & Mission Responsibilities

- Tsunami warning
- Tsunami confirmation
- Warning cancellation
- All clear

The participants were divided into four groups, groups included members with critical messaging roles, other members who acted as social influencers during the warning, and those who would normally be located outside of the Caribbean region. There were five activities. The first activity was done individually, but all others were conducted as a group. The five activities mimicked time as it would occur during a real event; members were to document their individual response as well as group discussion and messaging.

The activities included:

- Activity 1: Communications based on natural signs
- Activity 2: Communications with Message #1
- Activity 3: Communications with Message #3
- Activity 4: Communications with Message #8
- Activity 5: Communications for Response and All Clear

Tsunami Scenario Overview:

A magnitude 7.9 earthquake NE of Puerto Rico occurred at 11:00 PM. The earthquake occurred in the Puerto Rico Trench, where the North American Plate subducts under the Caribbean Plate.

This training included discussing the impact of a local tsunami to at-risk communities along the coast, examined the types of TWC messages in the scenario, and considered type, timing, audience and mechanisms for communications.

Activity 1: The earthquake is strong and is felt at 11:00 PM. Some buildings collapse; phone lines are immediately jammed as everyone tries to find out what happened. No TWC messages have been issued yet. The earthquake shaking occurred for 1 minute, during which time folk would likely be protecting themselves. The first scenario asked participants what they would do in the first three minutes (including the 1 minute of shaking). The following questions were answered by each individual: (1) How do you respond to the earthquake? (2) What do you think is going to happen (list the risks). (3) What can you do to communicate, to whom and how are you going to do it?

One member from Group B, who works at the Seismic Network of Puerto Rico (PRSN) pretended as though he was working on shift and saw information about the earthquake. Once the shaking began, he protected himself, waited until it was over and then watched his monitor to see if there was going to be another earthquake. Upon determining there was not another earthquake threat, he proceeded to try and send a rapid earthquake alert and establish that his partner was safe. If the partner was safe, then that person would try and establish communication with the PTWC. If no communication was available, there might be an issue with communication lines. If no information was received from PTWC then it is anticipated that all routes of communication are down; if no message from the PTWC comes within 5 minutes, then they radio to PREMA the magnitude and depth of the quake. If it is 100 km or shallower, PREMA must be provided with tsunami warning or watch information.
The participant representing PREMA assumed from the intensity and length of the earthquake that a tsunami was a high possibility. Therefore, he contacted local offices/regions to start evacuations immediately. Most other participants were either social influencers or out of the Caribbean region at the time of the event. Social influencers were focused on protecting themselves and establishing if their families were safe; some people were shocked by what happened and froze for a minute or two. Some said they attempted to contact community members, but did not want to clog-up lines of communication.

**Activity 2:** The time is now 11:03 PM, PTWC has issued its first message. Telephones are jammed, social media is viral, and the earthquake impact has been significant. Groups were then given 5 minutes to determine individual action, and 15 minutes for group discussion. Participants were asked to answer: (1) What and how did you receive the official product? (2) What is the alert level? (3) What is the expected time of arrival of the tsunami? (4) What, to whom, how and when are you going to communicate?

In terms of receiving official products, the answer would be through aWEBS (tsunami.gov) and WEAs. The next step is relaying NWS messaging. This would be via NOAA weather radio, fax, and phone calls; if normal lines of communication are down then satellite phones or radio would be necessary. The alert level is a warning and would be included in the message. The entire island must be included when issuing directions; messaging would be the same for all regions. Areas highlighted in yellow on the provided tsunami evacuation areas were designated as priority evacuation regions. Information would be shared with local EOCs and sirens sounded to alert areas under threat. Messaging should focus on the need for community members to get to higher ground (e.g., parking garage is a great option) or to the 4th story of a building and to remain there until local emergency response gives the “all clear”.

Social influencers said they would re-tweet information put out by official sources (e.g., NWS, SJFO), contact neighborhood watch programs to see if community members are safe, and continue moving themselves and families to higher ground if they were in a threatened area. Some discussion focused on confusion about official sources’ language in messaging; making sure it is clear to the public, avoiding use of acronyms and providing specific directions (e.g., imminent danger- get to higher ground).

**Activity 3:** It is now 11:55 PM, and the PTWC Message #3 has been issued. Media is reporting the tsunami is inundating the U.S. Virgin Islands and Puerto Rico; additionally, reports are showing that people are flocking to beaches to watch the arrival of the tsunami. This is causing coastal evacuation problems. The groups were tasked with identifying their actions over the next five minutes, followed by a 15-minute group discussion answering the questions: (1) What important new information does the message include, and (2) What, to whom, how and when are you going to communicate?

USCG participants mentioned that the communication center is in a tsunami risk area, and therefore, the center may not be functional if they are in the middle of evacuating. There are alternative operations centers, but the ultimate conclusion was that there would be limited capabilities in them. A take-away from this discussion was that in the case of a tsunami, it is unclear how USCG would issue warnings to mariners if the operations center is evacuating.

PREMA has sent their evacuation messages and continues to send out alerts with the time of wave arrival as it was described in the third message from the PTWC. After hearing media reports of people swarming beaches, PREMA contacted local media to encourage people to evacuate and keep away from
coastal zones. If people continue to swarm beaches, then the National Guard will be activated to move people inland. At the same time, PREMA is dealing with problems that arose as a result of the earthquake, such as power outages, road blocks and hospital damages.

A VITEMA spokesperson said that because it is a small island, information gets distributed quickly and emergency response is mobilized at a fast pace. When relaying important information to the public, specific estimated time of wave arrival should be avoided because if it does not hit at that time then people assume the threat is over and they are safe. Communicate after that the public must continue to evacuate threatened areas and remain evacuated until further notice from local authorities. Due to limited resources, VITEMA focused their efforts in locations where the wave is expected to arrive first, especially on evacuating vulnerable populations (e.g., hospitals, schools).

The PRSN receives an alert within five minutes after the earthquake, indicating that lines of communication are open ultimately allowing for information updates (e.g., magnitude of quake, estimated time of wave arrival). Messages from the Seismic Network continue to encourage evacuation. Even after the first wave makes landfall, there is still a high risk of larger waves following. The next step would be to update/change which municipalities are flooded, the tsunami height, arrival time and duration. Continuous monitoring of tide gauges and UNESCO IOC water monitoring stations to see water level changes in real time is on-going.

Social influencers would try to share official sources of information, and warn people not to go into the streets after the first wave because more could be coming.

**Activity 4:** It is now 0225 AM, and the PTWC Message #8 is released; media reports the tsunami has inundated Puerto Rico coasts, and people are wanting to enter the evacuated areas. The groups have five minutes for action and five minutes of group discussion about: (1) what important new information should the message include, and (2) what, to whom, how and when to communicate?

There is a lot of controversy regarding Message #8 from the PTWC. The word “cancellation”, for most people, means that evacuation zones are safe, and people can return. However, in this case, it means there is no more threat of a tsunami, and that the public should seek information from their local authorities about returning to evacuation zones. The threat of a tsunami is over, but the resulting damages from waves/flooding is mostly unknown and could pose life-threatening scenarios in coastal zones. PRSN recommends communities wait for further information from PREMA regarding when it is safe to return to their evacuated/affected areas. Concerns of how the media would interpret this message was discussed, and the PRSN representative said that they do outreach with local media to educate them about language used in warning messages. The warning messages are a public document, therefore, upfront education helps to eliminate the spread of misinformation. An action item that came out of this discussion was, rather than using the word ‘cancellation’; the term ‘end of tsunami threat’ should replace it because that phrase is clear and concise.

A second action item was that other media outlets such as news broadcasters, and radio announcers should be trained about how to interpret PRSN messages and how the media should relay information. The media should keep messages simple, and avoid talking about the earthquake magnitude until after the event is over. Additionally, more outreach in schools would hopefully help educate people about terminology surrounding physical sciences to help prevent false information.
Activity 5: It is now 7 AM and the Puerto Rican Governor’s press conference is taking place. Topics covered in the press conference include: (1) an initial report of the event and its effects, (2) an announcement that emergency management officials are in the field performing evaluations and will be the ones to issue the “all clear” when evacuated areas are safe, and (3) the fact that a curfew for citizens not participating in emergency response will be enforced. At this point, all participants have assumed their agency roles, and have 10-minutes to discuss: (1) what is the government guidance? (2) What are additional information sources? (3) What, to whom, how and when are you going to communicate? (4) What will be the roles in response?

At this point, participants said they would re-tweet official sources of information if there was access to the internet. WhatsApp is a great avenue for communication because it generally requires less data/bandwidth than social media outlets. When communicating to the public, social influencers would post messages such as: i) stay clear of activities, ii) it is important to let authority do their job, iii) be cautious of earthquake associated risks (e.g., collapse of structures), iv) go to the closest shelter, or v) do not return to evacuated areas until the official agency says it is safe to do so. An important take-away is the need for pre-emptive action to educate the public about emergency preparedness, and encourage self-sufficiency (i.e., what are you going to do to improve your situation?).

From the perspective of NOAA DPP in Mobile, AL; part of the role for DPP is supporting response coordination and information flow up through senior leadership. The first action would be to account for all NOS personnel in affected areas. Coordination of incident management and response such as mobilizing the National Geodetic Survey for an aerial survey and getting teams to support the USCG and EPA associated with hazmat and opening ports/navigational channels. The Office of Coastal Zone Management would be used to assist in anyway necessary; most importantly to get confirmation that folks in affected areas are safe (i.e., encourage a communications list or phone tree).

Hurricane & Coastal Flooding Scenario
The second scenario was led by Ernesto Rodriguez and Odalys Martinez, WFOSJ, regarding communications for a hurricane and coastal flooding scenario. There was an initial presentation reminding participants how to read forecasts, which forecasts to use as the hurricane approaches and how the WFO knowledge changes as a storm approaches (Figure 3). Providing responders with as much information as possible is important when preparing for a hurricane. When the hurricane is many days out (e.g., 7 days), guidance is general and there is minimal knowledge of the potentially impacted area, but as the hurricane approaches land, forecasts become more precise and information is provided for pre-staging operations.
Five-day outlooks can be used to monitor a potential cyclone. Figure 4 shows an orange track, which is the area of tropical storm formation potential; the chance of formation is illustrated by the color (i.e., yellow=low risk, orange=moderate, red=high). The hatched (orange shaded) area does not represent trajectory, it is the area where conditions are favorable for development. The graphic has an associated text-box which outlines the potential formation chances through a 48-hour and 5-day timeframe. It discusses which direction the storm is approaching from, the direction it is moving, and how quickly it is moving. As the storm gets closer to landfall, forecasters can more accurately predict the formation chance, time to landfall and the subsequent impacts (e.g., heavy rainfall).
Figure 4: An example of a five-day graphical tropical weather outlook showing one disturbance (orange).

In general, the media does not cover hurricanes until there is a cone of uncertainty. NWS forecasters are monitoring its movement, development and track, but the model accuracy is not good enough to capture the attention of media outlets. The goal is to get information out to emergency managers as early as possible in order for them to start planning evacuation routes, staging equipment, etc. Due to associated costs with emergency planning (e.g., shipping equipment), the NWS does not tell partners about a potential storm event until they are confident in their predictions. The warnings of a storm can begin as early as 7-days; these will consist of email briefings, but will not give the exact location or impacts.

Module 1: Pre-Storm

1. What should be considered when interpreting the Potential Tropical Cyclone Forecasts?

Potential Tropical Cyclone Forecasts are issued only for systems threatening land within the watch or warning time period. Forecasts are likely to have greater uncertainty the further out they are. The NHC issues early advisories for weather systems that pose a long-range threat to the U.S. or other land areas.

An internal Model Guidance forecast track was shown to participants to illustrate the complexity of forecast models. Different models have different tracks; they are called “members”. All models have a purpose and limitations, some of the model types are: climatological, historic, and deterministic or
Comparing the outputs of multiple models provides forecasters and decision makers with more data to make an informed decision. Forecasts are generally accurate 48-72 hours prior to an event, further out than 72 hours the uncertainty increases exponentially and model outputs vary dramatically (Figure 5). Typical NHC track errors are: i) 2-day error ~ 75 nautical miles (n mi), ii) 3-day error ~ 110 n mi, iii) 4-day error ~160 n mi, and iv) 5-day error ~ 220 n mi.

![Figure 5: An example of internal Model Guidance of intensity forecasts, illustrating that model uncertainties increases with respect to forecast hour.](image)

Models with cones of uncertainty explain two things, the timing of the cyclone and the related uncertainty. Error is not storm dependent. It is based on the 5-year historic averages and is included in every forecast track. Figure 6 is an example of a forecast with a cone of uncertainty. The hatched area is the 4 to 5-day outlook, and the solid white area is a 1 to 3-day outlook. The letters in the middle of the track represent different wind speeds. The cone itself contains the probable path of the storm center, but does not show its size. Hazardous conditions can occur outside of the cone. Additionally, the orange circle with the black dot, shows the current known information such as sustained winds and direction of movement. The goal is to send out an updated forecast every 6 hours; as computers get faster the ability to run models more often increases. It is generally hard to identify the center of a hurricane as it is developing, but as it intensifies the center is more obvious to forecasters.
Figure 6: Example of a forecast graphic showing the cone of uncertainty (white area); showing the timing of the cyclone and the related uncertainty.

The graphic, *Most Likely Arrival Time of Tropical-Storm-Force Winds*, is more recently developed and can be used by decision makers to decide when business, schools, etc. should be closed because of high winds (Figure 7). The figure uses a color map to show the five-day chance of receiving sustained winds of 34 knots or greater; dark green indicates ~5-10% chance, whereas the purple represents a 100% chance. The storm location and wind speed are indicated by a small symbol. This graphic shows that winds will likely be expected in that location at the specified time.

Figure 7: A forecast graphic that can be used for emergency preparedness to show the “Most Likely Arrival Time of Tropical-Storm-Force Winds”.
2. **What storm surge product should be used for planning purposes?**

National Storm Surge Hazard Maps include the Maximum Envelop of Water (MEOW) and Maximum of MEOWs (MOMs). MEOWs are used operationally when narrowing decisions to a specific location, whereas MOMs are used in planning to design evacuation zones and operationally when uncertainty is high. Additionally, MOMs are used for mapping steep boundaries, when inundation is close to shore, and coastal damage is not extended inland.

**Module 2: Close to Landfall**

1. **How can you determine when preparation should be rushed to finish based on the arrival of tropical storm force winds?**

The graphic, "earliest reasonable arrival time of tropical-storm force winds", should be used to determine when preparation should be completed. By that time, individuals can safely assume that they can prepare for tropical-storm force winds. When winds are 35 knots or greater people should hunker down. Information that can be obtained from this graphic includes: (1) the expected, or most-likely time for the onset of tropical-storm force winds, and (2) that individuals may have this much time, but should not plan on using it.

2. **What is the difference between a hurricane watch and a warning?**

A hurricane warning means that conditions are expected, whereas a hurricane watch is used when conditions are possible in a specified area (e.g., sustained winds of 74 mph or higher). Hurricane warnings indicate that hurricane conditions (i.e., sustained winds of 74 mph or higher) are expected somewhere within the specified area. The hurricane warning is issued 36 hours in advance of the anticipated onset of tropical storm-force winds to allow for important preparation. A watch is issued 48 hours in advance of the anticipated onset of tropical storm-force winds in an area.

3. **What is the difference between extreme and severe WEA emergency alerts?**

Hurricanes use the word *extreme* and flash floods use the word *severe*.

4. **Which product provides a good overview of the overall tropical impacts situation?**

A Hurricane Local Statement (HLS) is a good overview of the overall tropical situation in a given CWA. It provides a summary of the worst impacts to plan for with aerial descriptions. It does NOT contain specific meteorological or threat information. It is NOT detailed for decision makers. The HLS contains a header, followed by any new information that has been issued (e.g., changes to watches and warnings), potential hazards (e.g., winds), potential impacts (e.g., structural damage), precautionary/preparedness actions or statements (e.g., evacuations) and the time that the next update will be sent out (e.g., issued by NWS for San Juan, PR around 8 PM Atlantic Standard Time (AST), or sooner, if conditions warrant).

The hurricane’s threat and impacts can be found in the form of a graphic, possible threats include wind, storm surge, flooding rain, and tornados. The type of threat can be selected for a specific location using the [National Digital Forecast Database Graphical Forecasts](https://digital.weather.gov/) at weather.gov. After choosing the threat, the level will be color coded (e.g., yellow = elevated, pink = extreme). The map provides the reasonable worst-case scenario, taking into account the forecast magnitude of the hazard, along with the associated uncertainty of the forecast. Grids are available at: [https://digital.weather.gov/](https://digital.weather.gov/).
Module 3: Landfall

1. **When is an Extreme Wind Warning (EWW) issued?**

   It is only issued in association with major hurricanes. The criteria for an EWW is sustained surface winds of 115 mph or greater. The EWW is intended to alert the public to prepare for potentially life-threatening conditions. In the instance of Hurricane Irma, three EWW were issued by WFOSJ.

2. **What is the difference between a flash flood warning and flash flood emergency?**

   A flash flood warning informs individuals that flash flooding is in progress, imminent, or highly likely. Flash flood warnings are urgent messages that dangerous flooding can develop very rapidly, with a serious threat to life and/or property (i.e., warnings issued for areas usually expect flooding). A flash flood emergency is an exceptionally rare life-threatening situation (i.e., people are unaware that flooding is going to take place in that location). Examples of flash flood situations include: (1) a total failure of a major dam, (2) multiple swift water rescue teams have been or are being deployed in response to flash flooding of an exceptional magnitude, and (3) water has rapidly risen or will rapidly rise to levels where people who are ordinarily in safe locations during previous flash flood events are no longer safe.

Module 4: Post-Storm

1. **After warnings and watches have expired, what products are issued?**

   WFOSJ returns to normal operations. Any weather hazard is then treated on a case-by-case scenario (e.g., flash flood warning, severe thunderstorm warning, hazard weather outlook). If required, WFOSJ will provide IDSS briefings in order to assist in the recovery process.

Scenario Overview

Using information discussed in Modules 1-4, groups were asked a series of questions when provided the necessary tools (e.g., graphics, text). All participants assumed the role of state emergency managers and were required to provide the Tropical Cyclone Formation Chance to regional emergency managers. The activity was divided into four parts: 1) Preparation, 2) Preparation and Threats-Tropical Cyclone Watches and Warnings in Effect, 3) Risk Communication, and 4) Ongoing Threats-Tropical Cyclone Watches and Warnings in Effect. Most of the questions asked during training can be found in descriptions of Modules 1-4. For the specific questions asked during this exercise, see Appendix E.

Following the exercise, the group discussed important lessons learned from the exercise or prior experience. A lesson learned from St. Croix’s hurricane preparation was that school and work were cancelled the day before a major hurricane in order to encourage families to prepare. A curfew was also enforced. A major take-away from this exercise was that the HLS covers various potential hazards and threats associated with the hurricane. Prior to the storm hitting, the NWS sends out an overview of the situation, assuming that people will not have access to information updates during the storm event. For some of the potential threats; the phrase “unfolding” was used; this raised concern because it did not have a word associated with it to describe the threat level (e.g., elevated, extreme). “Unfolding” explains that the hazard is already occurring, but does not specifically describe how detrimental it will be or how conditions will change over time. Feedback from the group was that a precautionary statement should be included regarding the threat level, and that the maximum expected threat level and the expected time frame of the threat be included (i.e., “potential, elevated” or “unfolding, catastrophic”).
IX. Conclusion and Outcomes

Common themes throughout the workshop’s plenary presentations and breakout group discussions were compiled and distilled into 19 lessons learned (Appendix F). Three major outcomes were identified as high priority items: 1) the need to identify vulnerable populations, 2) updating PSMAs, and 3) improving local level preparedness. Items one and two have specific end-goals and action items associated with the lessons learned, whereas, item three was broken into multiple parts, and requires extensive local, state and federal coordination.

An outcome highlighted by participants was the need to identify vulnerable populations prior to a disaster, and ensure that all hospitals have back-up power sources, multiple lines of communication (e.g., 100 Watt radios), and conduct employee training and exercises. If municipalities have not already identified vulnerable populations within their communities, then they should be identified and information should be added to contingency plans and updated regularly.

An action item included the need for more PSMAs; this would enable faster response activities and minimize duplicity of efforts at the federal and state level. Federal organizations (e.g., FEMA, NOAA) need to review existing PSMAs and potentially develop new ones in coordination with local emergency managers. Outreach to state and local level is necessary to establish what local needs are to appropriately determine mission assignments. Pre-emptively determining PSMAs would allow responders to train and prepare for assignments, ultimately resulting in a rapid response time and more damage assessment. A major lesson learned from Hurricane Maria was that areas/communities who boldly and promptly performed initial damage assessments made it easier to scope federal funding. An outcome from this workshop was therefore a need to a set a baseline for areas without one, to enable a rapid damage assessment and begin the restoration process. This could be streamlined by a standardized application used to collect assessment information for multiple sectors, establishing a centralized communication center during the assessment process, educate employees on external funding opportunities and training on grant writing and submissions.

A reoccurring theme was the need to focus disaster preparedness and planning at the community and individual level. This would include outreach programs educating community members regarding official sources of information (e.g., NWS, emergency managers), where to find information before, during and after a disaster. Setting up contacts within the community and establishing central information locations. Trainings would help community members prepare resources necessary to encourage self-sufficiency after a disaster, and educational opportunities to improve individual preparedness (e.g., rainwater harvesting). Through these outreach events and trainings, the concept of disaster readiness would remain current and at the forefront of community planning. Additionally, it would professionalize emergency management and response positions, and raise awareness around the need for emergency management curriculum at the grade school and university levels. Participants agreed these tasks will be challenging to develop, and coordination among local, state and federal levels will be necessary.

Local, state and federal disaster readiness and decision making can be enhanced by applying these lessons learned. The action items outlined by this report will help facilitate a strong emergency response network in the Caribbean region, enhance effective mission response and recovery activities, and build resilient local communities.
X. Appendices

Appendix A: Workshop and Training Agenda
Appendix B: Workshop and Training Participants
Appendix C: Workshop Presentations
Appendix D: Workshop Breakout Group Notes
Appendix E: Training Presentations
Appendix F: Conclusion and Outcomes Notes
Appendix A: Workshop and Training Agenda
NOAA Regional Preparedness Training (NRPT)

LEARNING FROM THE PAST AND MOVING FORWARD: RESPONSE* CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES

APRIL 23 – 24 – 25, 2019
U.S. EPA FACILITY, GUAYNABO, PUERTO RICO

AGENDA

DAY 1 – APRIL 23

8:00 Registration

8:30 Welcome, Background, Goals

- Carmen R. Guerrero-Pérez, Caribbean Environmental Protection Division
- Charlie Henry, NOAA
- Nancy Kinner, Coastal Response Research Center

9:00 Participant Introductions

9:30 Plenary Presentation: Learning from the Past – Improvements for the Future (e.g., Hurricane Maria/Coastal Flooding)

- NOAA National Weather Service - Ernesto Rodriguez
- USCG Mission Response - CAPT Ricardo Alonso
- NOAA Mission Response – Charlie Henry and Jennifer Koss
- FEMA – José Marchand Parnell
- DOI – Debra Payton
- US EPA – Carlos Huertes-Hernandez, On-Scene Coordinator
- Local Mission Response:
  - DNER – Ernesto Diaz
  - PREMA – Carlos Irigoyen González

*For the purposes of this workshop, response is a continuum from emergency response activities to recovery activities.
11:45  **LUNCH**

1:00 Overview of Scenario: Tsunami Mission and Products/Protocols – Christa von Hillebrandt-Andrade

2:00 Overview of Breakout Group Charge

2:15 Breakout Group - Session I

- Discussion Questions: Per the plenary sessions what lessons/practices/skills have been learned from the past?

4:00 Group Reports

4:30 **ADJOURN**

************************************************************************

**DAY 2 – APRIL 24**

8:30 Plenary Presentation - NOAA/NWS-Weather and Forecast Products For Decision Makers – Ernesto Morales, NOAA NWS

9:30 Plenary Presentation – Risk Communication – Carlos Irigoyen González, NMEAD

9:45 Plenary Presentation – Social Media Tips - Mirelsa Modesti González, PhD, Sagrado Corazón University

10:00 **BREAK**

10:30 Breakout Group - Session II

- Discussion Questions: What needs to be done to improve/put into practice the previously noted ‘lessons learned’? How do we improve for the future (with possible threat of Tsunami, big hurricane, big Tsunami, catastrophic event, earthquake, major oil spill, tornado)?

11:45 **LUNCH**

12:45 Group Reports

1:45 Breakout Group - Session III: The Path Forward

- Discussion Questions: What recommendations for improvement, or exercised, communications, implementation, coordination with partners, etc.

**Break**
3:00 Group Reports
4:00 Closing comments including points of agreement & moving forward
4:30 ADJOURN

*****************************************************************************

Workshop Objectives:
1. Participants gain additional knowledge and skills to enhance risk communications before and after a damaging or disastrous tropical cyclone (hurricane) or tsunami event.
2. NOAA staff and regional partners apply lessons learned from past events to future preparedness planning creating “disaster readiness” for the safety of staff, staff families, and shared trust resources and effective mission response and recovery activities. The goal of preparedness planning is to build resilient local coastal communities on islands through gained knowledge, cross-agency and cross-regional coordination, and response/recovery planning and informed actions.

Outcomes of the NRPT Workshop:
1. With adequate information and communicated knowledge, the public and the response community will make informed decisions relative to personal protection and safety.
2. With adequate information and effective communications, responders and natural resource managers are prepared for and respond effectively to mitigate disaster impacts.

*****************************************************************************
**DAY 3 - APRIL 25, 2019**

**NRPT - TRAINING THEME:**

What to Say and How to Say it Effectively: Fundamentals of Risk Communication and the Use of Social and Traditional Media to Enhance Communications and Messaging Before, During and After a Major Coastal Event

8:30 – 11:30  Tsunami Scenario – A Communications Exercise  
*Christa von Hillebrandt-Andrade*

Breakout Groups to discuss and develop messaging products:
- Initial Messaging
- Intermediate Messages
- End Messages
- Recovery Message (several days post-event)

11:30 – 12:30  *Lunch provided*

12:30 – 3:30  Coastal Flooding Scenario – A Communications Exercise  
*Ernesto Rodriguez and Odalys Martinez*

Breakout Groups to discuss and develop messaging products:
- Initial Messaging - Watch
- Intermediate Messages - Warning
- End Messages – All Clear
- IDSS - Recovery Message (several days post-event); Search & Rescue, Weather

4:00  *Adjourn*
Appendix B: Workshop and Training Participants
# NOAA Regional Preparedness Training (NRPT)

**LEARNING FROM THE PAST AND MOVING FORWARD:**
RESPONSE CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES

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**APRIL 23 – 24 – 25, 2019**

**U.S. EPA FACILITY, GUAYNABO, PUERTO RICO**

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*Indicates Steering Committee Member

This workshop provided in partnership with NOAA’s Disaster Preparedness Program and the Coastal Response Research Center
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*Christa von Hillebrandt-Andrade  
NOAA NWS, Caribbean Tsunami Warning Program  
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Appendix C: Workshop Presentations
1. Recognize Charlie Henry from NOAA’s Disaster Preparedness Program and Nancy Kinner Director of the Coastal Response Research Center

2. Learning from the Past and Moving Forward: Challenges from Severe Natural Events to Shared Trust Resources and Mission Responsibilities
   - **Lessons Learned (ESF-10 – Chemical and Oil Spills):**
     - 19 Superfund (NPL) and 177 regulated facilities
     - Sunken and grounded vessels (377 in PR and 477 in USVI), oil, fuel, and hazardous waste removal / marine debris impacts to coral reefs (Mona case)
     - Disaster debris management and household hazardous wastes (12 million cubic yards of debris, 52% construction debris and 44% of vegetative debris) (322,148 HHW containers in PR and 145,575 containers in USVI)
     - Wastewater treatment plants and pump stations (22 WWTP of 51 out of service, 3 facilities completely flooded (Dorado, Toa Alta, and San Sebastian) and 222 pump stations out of 714 out of service / largest WW pump station in Torrecillas - Loiza had major damages with 25 MGD = sewage overflows, collapsed trunk sewers or main pump station with problems)
     - Stormwater system management (municipalities mapping and ownership, coastal flooding)
     - Restoration of water quality monitoring network / Air quality monitoring network (how safe to use surface and coastal waters (river, streams, beaches)?)
     - Sargassum accumulation
   - **Recognize our challenges and vulnerabilities:**
     - Pre-existing conditions exacerbated by the hurricanes (fiscal situation, deterioration of infrastructure, lack of maintenance, lack of resources (staff and equipment), history of non-compliance, threats from extreme weather and natural disaster events – hurricanes, drought, precipitation, sea level rise, salinity intrusion to aquifers, etc.)
   - **Moving Forward in Preparedness Planning:**
     - A. Multisectoral and multidisciplinary engagement for emergency preparedness, role clarification, “Being prepared is not a one time effort” – continuous improvement:
       - Local Government (DNER, PREMA,)
       - Federal Government (NOAA, DOI, USCG, FEMA, USACE, EPA)
       - Academia (UPR, Sea Grant, CARICOOS, PR Seismic Network, American University, Sacred Heart University)
       - NGOs (Para la Naturaleza, Foundation for Puerto Rico, ISER-Caribe)
       - Private Sector (Crespo Advisors)
     - B. Emergency management plans: pre-selected locations for temporary staging areas, pre-agreements with municipalities, waivers and permit pre-approvals with local and federal agencies
     - C. Leveraging resources: Disaster recovery plan for PR = more than $139 billion / USVI = $7.5 billion (Federal Govt allocated approximately $45 billion)
     - D. Watershed approach - Role of green infrastructure in disaster recovery (wetlands, coral reefs) as our shared Trust resources
     - E. Risk communications – before, during, and after an event
   - **Thank you!**
     - Recognize EPA Staff (Sergio Bosques, Paul Fericelli and Carlos Huertas) – Thank you Sergio
     - Recognize NOAA (Charlie, Nancy and Kathy) – potential funding towards the future
WELCOME

NOAA’s Regional Preparedness Training

Learning from the Past and Moving Forward: Response Challenges from Severe Weather or Tsunamis to Shared Trust Resources and Mission Responsibilities

U.S. EPA FACILITY, GUAYNABO, PUERTO RICO

THIS WORKSHOP PROVIDED IN PARTNERSHIP WITH: NOAA’S DISASTER PREPAREDNESS PROGRAM AND UNH COASTAL RESPONSE RESEARCH CENTER.

Carmen Guerrero-Pérez

Caribbean Environmental Protection Division
Logistics

- Fire Exits
- Restrooms
- Cell Phones/Email: “Let It Go”
- Breaks (coffee, tea, soda, water, snacks)
- Meals: on your own: local cafeterias
- Packet contents
- Logistical Questions – See Kathy Mandsager or me

Coastal Response Research Center

- Partnership between NOAA’s Office of Response and Restoration and University of New Hampshire (UNH)
- Since 2004
  - UNH Co-Director – Nancy Kinner
  - NOAA Co-Director – Benjamin Shorr
Overall CRRC Mission

- Conduct and oversee basic and applied research and outreach on response and restoration
- Transform research results into practice
- Serve as hub for response R&D
- Facilitate workshops bringing together ALL STAKEHOLDERS to discuss spill and disaster response issues and concerns

NOAA Regional Preparedness Trainings (NRPT)

- History/Background
NRPT Workshop

THANK YOU
Participants, Group Leaders, Recorders, Organizing Committee, EPA Facilities, and Speakers!

Clarifications

• For this workshop, response is continuum from emergency response activities to recovery activities.
• Response = Response + Recovery
Workshop Objectives

• Improve knowledge and skills to enhance risk communications before and after a hurricane or tsunami
• Apply lessons learned to “disaster readiness” for:
  • safety of staff and staff families
  • shared trust resources
• Enhance effective mission response and recovery activities

Workshop Objectives

• Preparedness planning builds resilient local coastal communities on islands through:
  • gained knowledge
  • cross-agency and cross-regional coordination
  • response/recovery planning and informed actions
Workshop Outcomes

• With adequate information and communicated knowledge, public and response community make informed decisions relative to personal protection and safety.
• With adequate information and effective communications, responders and natural resource managers prepared for and respond effectively to mitigate disaster impacts.

Meeting Products

• Copies of All Slide Presentations
• Workshop Report
• All Posted on CRRC Website
Workshop Agenda - today

8:30 Welcome, Background, Goals
   - Carmen R. Guerrero-Pérez, Caribbean Environmental Protection Division
   - Charlie Henry, NOAA
   - Nancy Kinner, Coastal Response Research Center

9:00 Participant Introductions

9:30 Plenary Presentation: Learning from the Past – Improvements for the Future (e.g., Hurricane Maria/Coastal Flooding)
   - NOAA National Weather Service - Ernesto Rodríguez
   - USCG Mission Response - CAPT Ricardo Alonso
   - NOAA Mission Response – Charlie Henry and Jennifer Koss
   - FEMA - TBD
   - DOI – Debra Payton
   - US EPA – Carlos Huertas-Hernandez, On-Scene Coordinator
   - Local Mission Response:
     o DNER – Ernesto Díaz
     o PREMA – Carlos Irisoyen González

Workshop Agenda

11:45 **LUNCH**

1:00 Overview of Scenario: Tsunami Mission and Products/Protocols – Christa von Hillebrandt-Andrade

2:00 Overview of Breakout Group Charge

2:15 Breakout Group - Session I
   Discussion Questions: Per the plenary sessions what lessons/practices/skills have been learned from the past?

4:00 Group Reports

4:30 **ADJOURN**
Workshop Agenda

**DAY 2 – APRIL 24**

8:30  Plenary Presentation - NOAA/NWS-Weather and Forecast Products For Decision Makers – *Ernesto Morales*, NOAA NWS

9:30  Plenary Presentation – Risk Communication – *Carlos Irigoyen González*, NMEAD

9:45  Plenary Presentation – Social Media Tips - TBD

10:00  **BREAK**

10:30  Breakout Group - Session II

  Discussion Questions: What needs to be done to improve/put into practice the previously noted ‘lessons learned’? How do we improve for the future (with possible threat of Tsunami, big hurricane, big Tsunami, catastrophic event, earthquake, major oil spill, tornado)?

11:45  **LUNCH**

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**Workshop Agenda**

12:45  Group Reports

1:45  Breakout Group - Session III: The Path Forward

  Discussion Questions: What recommendations for improvement, or exercised, communications, implementation, coordination with partners, etc.

  **Break**

3:00  Group Reports

4:00  Closing comments including points of agreement & moving forward

4:30  **ADJOURN**
Risk Communications Training

What to Say and How to Say it Effectively: Fundamentals of Risk Communication and the Use of Social and Traditional Media to Enhance Communications and Messaging Before, During and After a Major Coastal Event

Training Agenda

8:30 – 11:30  Tsunami Scenario – A Communications Exercise  
Christa von Hillebrandt-Andrade

Breakout Groups to discuss and develop messaging products:

- Initial Messaging
- Intermediate Messages
- End Messages
- Recovery Message (several days post-event)

11:30 – 12:30  Lunch provided
**Training Agenda**

12:30 – 3:30   Coastal Flooding Scenario – A Communications Exercise  
*Ernesto Rodriguez and Odalys Martinez*

Breakout Groups to discuss and develop messaging products:
- Initial Messaging - Watch
- Intermediate Messages - Warning
- End Messages – All Clear
- IDSS - Recovery Message (several days post-event); Search & Rescue, Weather

4:00   Adjourn

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**Facilitation Pledge**

- I will recognize and encourage everyone to speak
- I will discourage side conversations
- I commit to:
  - Being engaged in meeting
  - Keeping us on task and time
- Stop me if I am not doing this!
Participation Pledge

- Be Engaged
  - Turn off cell phones and computers, except at breaks
- Listen to Others
- Contribute
- Use microphones
- Speak Clearly: We will need to repeat questions for those on WebEx
- Learn from Others
- Avoid Side Conversations

Participant Introductions

Name
Affiliation
Job
Reason for Participating in Workshop
Breakout Session 1

• Per the plenary sessions what lessons/practices/skills have been learned from the past?

Breakout Session 2

• What needs to be done to improve/put into practice the previously noted ‘lessons learned’? How do we improve for the future (with possible threat of Tsunami, big hurricane, big Tsunami, catastrophic event, earthquake, major oil spill, tornado)?
Breakout Session 3

• What recommendations for improvement, or exercises, communications, implementation, coordination with partners, etc.

Workshop Website

https://crrc.unh.edu/NRPT_PuertoRico
Thank you

Nancy Kinner
UNH Coastal Response Research Center
Learning from the Past, Improvement for the Future

NOAA National Weather Service
WFO San Juan

Ernesto Rodriguez
Science and Operation Officer
Outline

Mission and Vision
National Weather Service

Hurricane Maria
From the National Weather Service’s Perspective

Lessons learned after Hurricane Maria
Major Hurricane Maria

Improvement for the Future
Tailored forecast through Impact Decision Support Services
National Weather Service
Mission and Vision

**Mission:**
Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.

**Vision:**
A Weather-Ready Nation Society is prepared for and responds to weather, water, and climate-dependent events.
Hurricane Maria from the National Weather Service’s San Juan Perspective

**PREPARATION**
for the Hurricane Season
Jan-May 2017

Hurricane Maria made **LANDFALL**
September 20

Service **BACKUP**
Sep 20 - Oct 23

Hurricane Maria
**COORDINATION**
September 14 - 19

**COMMUNICATIONS FAILED**
September 20

NOAA Regional Preparedness Training (NRPT)
Building TRUST

NWS San Juan build trust with decision makers of U.S. Virgin Islands and Puerto Rico through table top, full-scale exercises and outreach activities before the Hurricane Season.
Pre-event COORDINATION

Briefings with the Puerto Rico and the U.S. Virgin Islands state and federal agencies.

Core Partners use the information provided by the National Weather Service San Juan to make critical decisions.
NWS Internal COORDINATION

- Numerous coordination calls with the National Hurricane Center, Weather Prediction Center and the Southeast River Forecast Center were made before the hurricane affected the warning area.

- Conference calls and planning meetings with Southern Region and WFO Miami.
Lesson learned after Hurricane Maria

Thankfully the worst case scenario did not happen with Hurricane Maria.
Imagine Irma with sustained winds of 185 MPH moving over Puerto Rico.
GOES-16 meso-sector

- 16 channels
- 1-min imagery
AFTER

Communications Failed

Utilized two way radio and satellite phones to get information on the flooding situation.

Forecasters at the Emergency Operation Center kept updating our core partners.

After failed attempts to reach out the public, the office contacted the only radio station working at that time to brief the public on current situation and forecast.
IDSS are forecast advice and interpretative services the NWS provides to help core partners, such as emergency personnel and public safety officials, make decisions when weather, water and climate impacts the lives and property.
This support may be needed in response to a particular event or routinely to support high-value decision making.
Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks.
Authorities

Statutory Authorities

- Federal Water Pollution Control Act (FWPCA) as amended by CWA (1972)
  - Oil Pollution Act (OPA90)
  - Oil Spill Liability Trust Fund
- Comprehensive Environmental Response Compensation Liabilities Act (CERCLA)

Regulatory Authority

- 40 CFR 300 National Contingency Plan
MEP & MER Missions

**Marine Environmental Protection**
- Regulate the discharge of oil, HAZSUB, and other shipboard wastes into U.S. and international waterways
- Protect marine life and ecosystems
- Regulate invasive species into U.S. waterways

**Marine Environmental Response**
- Respond to oil and hazardous substance incidents
- Develop environmental regulations and standards

Federal On Scene Coordinator

**FOSC Roles & Responsibilities IAW NCP:**
- Provides access to federal resources and technical assistance
- Coordinates all federal containment, removal, and disposal efforts and resources during an oil spill or hazardous material release
- Coordinates, monitors, and directs response efforts
On-Scene Coordinator

- Predesignated official responsible to coordinate and direct responses to oil discharges and hazardous substance releases
- Provides access to federal resources and technical assistance
- Coordinates all federal containment, removal, and disposal efforts and resources during an oil spill or hazardous material release
- Coordinates, monitors, and directs response efforts, including responsible party
Preparedness

**Internal**

- Heavy Weather/Disaster Plans
- Exercises (local and District)
- Personnel and equipment preps
- Pre-stage

**External**

- Area Contingency Plan
- Exercises (critical to meet/know players early for familiarity, resources, needs, vulnerabilities)

National Contingency Plan

40 CFR § 300.205(g)
NRS Assets

**On-Scene Coordinators (OSCs)**
Coordinate all containment, removal, and disposal efforts/resources.

**Other NRS components**
- National Response Center
- USCG Strike Teams
- Area Committees
- State/Local Governments
- Special Teams
- Private Sector
- Joint Response Teams with neighboring countries

Responsibilities and Organization

**National Response Team (NRT)**
The NRT is responsible for national response and preparedness planning, for coordinating regional planning, and for providing policy guidance and support to the RRTs
40CFR300.105 (c) (1)

**13 Regional Response Teams (RRTs)**
The RRTs are responsible for regional planning and preparedness activities before response actions, and for providing advice and support to the OSC or RPM when activated during a response.
40CFR300.105 (c) (2)
NRT Mission

To provide technical assistance, resources and coordination on preparedness, planning, response and recovery activities for emergencies involving hazardous substances, pollutants and contaminants, hazmat, oil, weapons of mass destruction in natural and technological disasters and other environmental nationally significant incidents.

Activating the National Response Team

- The NRT should be activated as an emergency response team when:
  - Oil or HAZMAT discharge exceeds the capability of the Region in which it occurs;
  - Transects National Boundaries;
  - The threat to public health, property, or natural resources is substantial
  [Reference: 40CFR300.110 (j)]

**The NRT may also be activated to support an ESF-10 response, even if the three previous criteria have not been met**
INCIDENT TIMELINE

PRE-INCIDENT
- Pre-stage resources through SURGE ACCOUNT
- NATIONAL/REGIONAL RESPONSE COORDINATION CENTER activated
- POTUS approves EMERGENCY DECLARATION
- NATIONAL/REGIONAL INCIDENT MANAGEMENT ASSIST TEAM arrives on scene

RESPONSE
- POTUS approves MAJOR DISASTER DECLARATION
- MISSION ASSIGNMENTS issued to/executed by Federal Agencies
- JOINT FIELD OFFICE established and assumes on scene INCIDENT MANAGEMENT and SUPPORT
- NATIONAL/REGIONAL RESPONSE COORDINATION CENTER deactivated

RECOVERY
- NATIONAL/REGIONAL INCIDENT MANAGEMENT ASSIST TEAM arrives on scene
- MISSION ASSIGNMENTS issued to/executed by Federal Agencies
- NATIONAL/REGIONAL RESPONSE COORDINATION CENTER deactivated

EMERGENCY SUPPORT FUNCTIONS

ESF 1 TRANSPORTATION
ESF 2 COMMUNICATIONS
ESF 3 PUBLIC WORKS AND ENGINEERING
ESF 4 FIREFIGHTING
ESF 5 INFORMATION AND PLANNING
ESF 6 MASS CARE, EMERGENCY ASSISTANCE, TEMPORARY HOUSING, AND HUMAN SERVICES
ESF 7 LOGISTICS
ESF 8 PUBLIC HEALTH AND MEDICAL SERVICES
ESF 9 SEARCH AND RESCUE
ESF 10 OIL AND HAZARDOUS MATERIALS RESPONSE
ESF 11 AGRICULTURE AND NATURAL RESOURCES
ESF 12 ENERGY
ESF 13 PUBLIC SAFETY AND SECURITY
ESF 15 EXTERNAL AFFAIRS
Response Management

Key points:

• EPA and USCG coordinate and direct the response, EPA for inland areas, USCG for the coastal zone.
• Other federal agencies with appropriate jurisdiction and expertise support the lead agency.
• Activities are done in partnership with state and local officials.
• Industry is responsible for being prepared for, responding to, and paying for cleanup and damages from pollution incidents when they are designated the PRP. Additionally, industry may work with the government as an OSRO/Contractor.
• The NRS uses the National Incident Management System/Incident Command System to bring these parties together to manage response actions.

Coast Guard National Strike Force

• National Oil & Chemical Response Capability
• Support On-Scene Coordinators, Other Agency Incident & Combatant Commanders
  – National Strike Force Coordination Center
  – Atlantic, Pacific, and Gulf Strike Teams
• Reorganization:
  – CG Incident Management & Assist Team
  – Public Information Assistance Team

- 2016 Budget: $3.4M
- FTE (IMAT & PIAT): 161
- Yearly Responses: ~45
Response & Recovery Challenges

- **Interagency Coordination** – NRS, NRF and NRT

- **Communications** – Ability to rapidly setup comms for interagency coordination

- **Logistics** – Response dependent on logistics, surge forces and equipment

- **Infrastructure** – Critical for survivors & responders

“Critical Needs During a Response Always include Public-Private Partnerships (PPP)”

Recent Hurricane Lessons Learned

- **MRO / Flood Response**: CG flood response assets such as the Western River Flood Punt teams were extensively utilized during Harvey and Irma. Several issues were identified relating to the best platform to use, equipment, communications, logistics, and qualifications. CG-731 (Boat Forces) convened a workgroup to examine these issues.

- **Satellite Phones**: Due to limited range of VHF radios, 800 MHz radios, and damaged cell phone towers, satellite phones capable of placing and receiving phone calls should be utilized. Verify with the manufacturer that satellite phones are able to place/receive phone calls. Provide IMT with user guide/training for satellite phones.

- **IT Support**: A lack of IT support hampered IMT interoperability at the ICP.

- **NOAA SSC**: Confusion arose regarding funding SSCs deployed to Sectors to conduct hurricane flood modeling and imagery interpretation because Sectors were unsure how to fund the SSC beyond the scope of a pollution response. **Recommendation**: Review existing NOAA-USCG IAA and develop a funding and deployment process exclusively for non-pollution-related weather events.
Summary of Lessons Learned:

- Maximize the use of resources (such as ombudsmen and auxiliary) to enhanced alignment with partner agencies’ goals and FEMA-District-Sector coordination when deploying EPLOYs, LNOs and AREPs to EOCs.
- Documented a surge in the use of Flood Punt Teams to conduct urban SAR
- Provide ESF-10 and Mission Assignment training
- Provide training on use of UAS
- Plan for and execute exercises spanning across multiple Districts and AORs
- Ensure Personnel Support Teams (PSTs) are adequately staffed to manage call volume for accountability of CG members and family. **Best Practice: Test phone numbers ahead of hurricane season. Recommendation: Create a PST App for Smartphones.**
- Leverage External Agencies: The inclusion of the National Hurricane Marine Branch in the response yielded valuable tidal and wind information that informed key decision-makers during the 2018 hurricane season. Continual engagement pre and post hurricane season will benefit future responses.

Questions?

CAPT Ricardo Alonso  
(202) 372-2232  
Ricardo.M.Alonso@uscg.mil
NOAA Caribbean overview
April 23-25, 2019
NRPT Meeting

NOAA in the Caribbean

- Mission
  - NOAA in the Caribbean (NOAA Carib) is a forum for communication, partnership, and user engagement that supports the delivery of the agency’s mission in the domestic and international Caribbean.

- Goal
  - Identify and respond to local and regional challenges, needs, and opportunities in the Caribbean region by increasing communication and providing a platform that connects NOAA, its core partners, and key users in the region.
NOAA in the Caribbean

- Guiding Principles
  - Share information within NOAA and with external partners regarding engagement in the region and the products and services NOAA offers.
  - Enhance stakeholder communication with NOAA personnel and access to NOAA resources and capabilities.
  - Serve as a connecting link between NOAA headquarters and line offices, and NOAA activities in the Caribbean region.
  - Improve collaboration among NOAA and its regional partners.
  - Stress the application of “an integrated NOAA approach”, where NOAA employees understand and are knowledgeable about NOAA activities in the region, and look for opportunities to provide additional value to efforts through integration.
  - Facilitate implementation of the NOAA Caribbean Strategy via alignment of NOAA Carib activities, protocols, and membership.

National Weather Service

The National Weather Service provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas.

- Caribbean Tsunami Warning Program (CTWP) - Tsunami and Seismic Data, Educator Resources, Student Opportunities
  - The CTWP office supports an increased capability of the tsunami warning system for the Caribbean and Adjacent Regions. This includes the observational system (sea level, seismic and GPS) and the continued enhancement of tsunami outreach and education capacity, including the implementation of the TsunamiReady® (US) and Tsunami Ready (International) Programs.
  - Located in Mayagüez, Puerto Rico

- National Hurricane Center (NHC) - Educator and Student Resources, Tours, Hurricane Information and Data
  - The mission of the NHC is to save lives, mitigate property loss, and improve economic efficiency by issuing the best watches, warnings, forecasts, and analyses of hazardous tropical weather and by increasing understanding of these hazards. Located in Miami, FL
National Marine Fisheries Service

The NOAA Fisheries Service is dedicated to the stewardship of living marine resources through science-based conservation and management, and the promotion of healthy ecosystems. They have regional offices and several smaller field offices.

- **Northeast Marine Corridor and Culebra Island Habitat Focus Area**
  - As part of the Habitat Blueprint administered by the NOAA Fisheries Office of Habitat Conservation, NOAA has selected ten Habitat Focus Areas (HFAs), place-based locations across the country to maximize the effectiveness of habitat conservation. In Puerto Rico, NOAA developed an implementation plan and associated action plans for the Northeast Marine Corridor and Culebra Island Habitat Focus Area in Puerto Rico.
  - Primary activities are to restore threatened corals, implement watershed restoration projects, research fishery and recreational impacts to fragile marine ecosystems, and improve the predictions of real-time storm surge, to conserve this area's coral reefs, seagrass beds, mangroves, and the people and animals that depend on them.

National Ocean Service

The National Ocean Service provides data, tools, and services that support coastal economies and their contribution to the national economy.

- **National Estuarine Research Reserve System - Field Trips, Professional Development, Educator Resources**
  - The National Estuarine Research Reserves System protects more than 1.3 million coastal and estuarine acres in 28 reserves located in 22 states and Puerto Rico for purposes of long-term research, environmental monitoring, education and stewardship. Jobos Bay Reserve

- **Integrated Ocean Observing System (IOOS) - Curriculum, Real World Data, and Multimedia**
  - The Caribbean Coastal Ocean Observing System (CariCOOS) operates a network of observing assets including data buoys, coastal meteorological stations, vessels, instruments and radars. Data from these assets and value-added data products such as graphs and maps are provided free of charge to the general public on their website.
National Environmental Satellite, Data, and Information Service

NESDIS provides secure and timely access to global environmental data and information from satellites and other sources to promote and protect the Nation’s security, environment, economy, and quality of life.

- Caribbean Atmospheric Research Center ("Atmos Carib") - Satellite Data, Forecasts, Local Climatology
  - Atmos Carib is affiliated with the National Climate Data Center and aims to offer the most comprehensive weather and climate information for the Caribbean Region. Located in Mayagüez, PR

Oceanic and Atmospheric Research

NOAA Research provides the research foundation for understanding the complex systems that support our planet.

- Sea Grant is a nationwide network of 32 university-based programs that conduct scientific research, education, training, and extension projects designed to foster science-based decisions about the use and conservation of our aquatic resources.
NOAA Regional Preparedness Training (NRPT) Workshop

San Juan, PR
23 April, 2019

Charlie Henry, Director
Disaster Response Center
Mobile, AL
NOAA Primary Mission Assignments:

PMEF #1: Collect and provide the Nation with critical intelligence data, imagery, and other essential information for predictive environmental and atmospheric modeling systems and space-based distress alert systems by operating NOAA-controlled satellites, communications equipment, and associated systems.

NOAA Primary Mission Assignments:

PMEF #2: Provide the Nation with environmental forecasts, warnings, data, and expertise critical to public safety, disaster preparedness, all-hazards response and recovery, the national transportation system, safe navigation, and the protection of the Nation’s critical infrastructure and natural resources.
NOS FEMA Pre-Scripted Mission Assignments:

- Coastal science support coordinator (FOS)
- Geodetic surveys
- Aerial imagery/LIDAR
- Hydrographic surveys
- Scientific support for oil and chemical spills
- Marine debris assessment

NOS FEMA Pre-Scripted Mission Assignments:
- Could be just about anything from response through recovery.

...each office in NOS provides some role in disaster response.
Office of Response and Restoration
Our Mission and Mandates

To provide world-class science and information-based solutions to protect and restore the nation’s resources and their uses from coastal environmental hazards.
A bit of history…
Origins of NOAA “HAZMAT” Program…

1970  NOAA Created
1976  Argo Merchant oil spill, Nantucket, MA
1977 – Special Force in the NCP

Scientific Support to FOSC
Scientific Support Coordinators

NOAA’s Office of Response and Restoration (OR&R)
“We have been part of the science of oil and chemical spills for a very long time.”

Annually, OR&R…

• provides 24/7 support for emergency response support.
• responds to 120-170 oil & chemical spills.
• trains more than 2000 emergency responders and planners.
• supports over 40 spill drills with the U.S. Coast Guard and other agencies.
• settles 4-7 natural resource damage assessment cases & works on over 200 additional cases.
• supports removal of hundreds of tons of marine debris.
• develops new tools & conducts research to address hazards on the water and prevent marine debris.
• …and respond to disasters.

(small program office, big job)
Leveraging Science to Solve Problems during Emergency Events
Chemical Spills

Damage Assessment and Restoration
The origins of the NOAA GOM Disaster Response Center started with a storm in the Gulf of Mexico...

Disaster Response Program
DRC – A Hub for Gulf of Mexico Coordination
NOAA
Gulf of Mexico Disaster Response Center (DRC)
All-Hazards Preparedness Mission
Disaster Preparedness Program
18,700 sq-ft hardened complex (up to cat. 5)

Dedicated on 15 Oct. 2012 – Supporting Hurricane Isaac the Next Day
https://response.restoration.noaa.gov/
CAPACITY BUILDING SECTOR

Mission

Provide the essential support, guidance, and tools to the whole community, including Federal, Commonwealth, Municipal, Private Sectors, and NGO partners to build upon, restore and strengthen their capability and capacity as entities and individuals to be prepared and able to perform their essential functions effectively, efficiently, and sustainably in response and recovery efforts.
PARTNERS AND RESILIENCE PROGRAMS

Recovering on a different perspective. A Better preparedness will support a faster recovery

**Recovery / Resilience Partners**

**COR3 - Partners in the Resilience:**
- Puerto Rico Emergency Management Agency Bureau
- Puerto Rico Planning Board
- 78 Local Emergency Management Offices
- Local Government Agencies
- Other Federal Agencies
- Non Governmental Organizations

**Units / Programs**
- Community Resiliency / Preparedness
- Continuity of Operations
- Training & Exercise
- Mass Care
- Hazard Mitigation Community and Education Outreach
- Hazard Mitigation Community Planning
- Community Planning Capacity Building - RSF

**Innovations**

**INNOVATIONS**
- PR-IMT National Qualification System (MOA).
- Lifeline State Integration
- Youth Preparedness Council.
- Core Advisory Groups.
- Multisectoral Disaster Feeding Plan
- Business EOC.
- Reverse Engineering on Soft Projects.
- Technical Assistance for Partners.
- Hazard Mitigation Planning
- Municipal and Regional Baseline Assessments.
- Preparedness & Mitigation Curriculum for Schools
- Relaunch of CERT (Community Approach & Schools).
- PR Agency COOP Plans and EOPs
- Community Preparedness Outreach
Questions & Discussion
Challenges, Innovation, the way forward
FEMA
Natural and Cultural Resources (NCR) Recovery Support Function (RSF)

Responsibilities, Efforts and Lessons Learned

Learning from the Past and Moving Forward
23 April 2019
Debbie Payton/DOI
NCR RSF – Hurricane Maria

Background

- DOI/RSF new role for me
- Speaking ONLY from DOI/RSF perspective; no explicit or implied FEMA representation
- Puerto Rico/USVI experience
- Lessons are evolving
Five frameworks:
Prevention, Protection, Mitigation, Response, Recovery

Natural and Cultural Resources
Core Capability

- Objective: Protect natural and cultural resources and historic properties through appropriate actions to preserve and restore them consistent with post-disaster community priorities and best practices and in compliance with applicable environmental and historic laws and orders.
- Delivered:
  Natural and Cultural Resources Recovery Support Function
NCR RSF TEAM – Primary Agencies

Department of the Interior – Coordinating Agency
Federal Emergency Management Agency
Environmental Protection Agency
National Oceanic and Atmospheric Administration

Supporting Agencies

• U.S. Department of Agriculture (USDA)
• Council on Environmental Quality (CEQ)
• U.S. Department of Commerce (DOC)
• U.S. General Services Administration (GSA)
• Corporation for National and Community Service (CNCS)
• Heritage Emergency National Task Force (HENTF) – Smithsonian Institute
Other Supporting organizations

• Advisory Council on Historic Preservation (ACHP)
• Institute of Museum and Library Services (IMLS)
• Library of Congress (LOC)
• National Archives and Records Administration (NARA)
• National Endowment for the Arts (NEA)
• National Endowment for the Humanities (NEH)
• U.S. Army Corps of Engineers (USACE)

Cultural Resources Definition

• Aspects of a cultural system that are valued by or significantly representative of a culture or that contain significant information about a culture
• Cultural resources may be tangible entities or intangible cultural practices
Cultural Resources

- Archeological/Archaeological Sites
- Submerged Cultural Resources
- Built Environment (Buildings & Structures)
- Traditional Cultural Properties (TCPs)
- Landscapes
- Burial Sites/Cemeteries
- Objects, Collections, and Records

Cultural Resources as Critical Facilities

- Critical Facilities definition in Stafford Act includes Cultural resources
- Libraries, Museums, non-profits
- May be eligible for FEMA Public Assistance
Traditional Cultural Property

A traditional cultural property can be defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community.

Objects, Collections, and Records

- **Object** is an item or artifact with artistic, educational, historic, scientific, or social importance to a community.
- **Collections** are a group of objects with some unifying characteristic, or that have been assembled from a variety of sources.
- **Records** are documentary materials, regardless of physical form or characteristics, that are preserved or appropriate for preservation and used as an extension of human memory or to demonstrate accountability.
Archeological Sites
A location that contains the physical evidence of past human behavior that allows for its interpretation.

Natural Resources Definition

- Wildlife, fish, trees, and other biota
- Land
- Water
  - salt and fresh
  - surface or groundwater
  - used for drinking, irrigation, aquaculture, recreational purposes, and as fish and wildlife habitat
Wildlife & Fish & Habitat

Natural Resource Uses impacted

Recreation Sites

Fishing/Hunting Areas

Boat Launches

Hiking, biking, and horse trails
Efforts

DR-4339 NCR

Assessments > COA Development > Potential funding sources > Implementation Plans

Resources > Plan > Sustainability

Recovery
Coastal Systems Recovery
- NCR15 Corals and Seagrass
- NCR16 Wetlands
- NCR17 Beaches/Dunes
- NCR18 San Juan MPA

Historic and Cultural Resources
- NCR1 Historic & Cultural Properties
- NCR2 Arts
- NCR3 Archives Mitigation and Modernization
- NCR4 Preservation, Research and Safe Storage
- NCR29 Museums

Historic and Cultural Resources
- NCR1 Historic & Cultural Properties
- NCR2 Arts
- NCR3 Archives Mitigation and Modernization
- NCR4 Preservation, Research and Safe Storage
- NCR29 Museums

Landfills
- NCR8 Increase Capacity
- NCR9 Landfill Repair and Closure
- NCR10 Illegal Dumps
- NCR11 Sustainable SWMP

Natural Resources
- NCR5 Forest Recovery
- NCR12 Forest Products Industry
- NCR6 At-Risk Species Recovery
- NCR7 Partner Networks for Species
- NCR13 Sediment Pollution/Landslides
- NCR14 Water Quality
- NCR21 Land Management Approaches
- NCR23 Alternative Tourism
- NCR20 Parks

NATURAL AND CULTURAL RESOURCES SOLUTION TEAMS

Incident Occurs

Solution Based Team

Unified Solutions Identified

Best Resources Identified & Applied

OUTCOME/END STATE
- Public/private partnership
- A new, more resilient system benefitting and serving all residents of Puerto Rico
- New system allows for forward movement in future development
What can Solution Teams Do?

- Identify solutions to COAs
- Provide advice, recommendations and expertise to the Commonwealth
- Provide Commonwealth assistance in prioritizing projects
- Determine/suggest most appropriate sources of funding
- Provide technical assistance in scoping projects

Funding Recovery

- FEMA 428 Public Assistance
- FEMA 406 Hazard Mitigation
- 404 Hazard Mitigation (SHMO)
- HUD CDBG-DR
- Other Federal Agency – Supplemental
- Federal Agency – Grants
- NGOs
- Philanthropic
Lessons?

Archives & Collections

• Issue: Motion Picture Vault (MPV) follow-up from 11/18 assessment, several other requests for assistance
• Team of four (three NARA, one Smithsonian; two with film expertise)
• Activity: Assessed MPV, Luis Munoz Marin collection, ICP building plans, ICP Archives object vault and Artes Plasticas objects
• Lesson: Scope of potentially impacted resources difficult to determine initially

PHOTOS COURTESY OF PRESTON HUFF, NARA
Hardwoods

• Issue: Several piles of woody debris in 16 different municipalities that need to be disposed of properly
• Lesson: In tropical areas downed wood IS NOT necessarily debris
• Activity: Assessment of valuable woods in piles. USDA (IITF, FPL) (March 12-22, 2019)

Corals

• Issue: Will coral reef restoration be considered eligible for PA?
• No decision yet, but questions re: constructed changes to corals
• Lesson: Application of PAPPG for non-traditional natural features is complex
Questions?
Response Challenges for Severe Weather or Tsunamis

Emergency Support Function #10
Oil and Hazardous Materials Response

- Provide EPA personnel to the FEMA RRCC and NRCC, JFOs, the EPA REOC, PR and VI EOCs and other coordination venues to support FEMA response operations in PR and the USVI.
- Removal, cleanup and disposal of oil & hazmat; collect and disposal of HHW; monitor immediate threats to public H&S and the environment in both PR and VI.
- Coordinate/Execute all necessary assessments, evaluations, sampling and analytical services/support to ensure the safety and quality of drinking water & wastewater systems in PR.
- Conduct Drinking Water Sampling Across the USVI.
- Repair of Ambient Air Monitoring Stations in PR.
- Provide Emergency Power to Non-PRASA Systems in PR.
Challenges / Lessons Learned

- Difficulties/delays in transporting personnel and equipment into PR and VI via flights and barges.
- Spanish speaking personnel.
- Equipment being held up in the VI ports due to demands for tax payments.
- Administrative hurdles from FEMA in efforts to make non-PRASA systems eligible for temporary repairs and emergency power.
- All hazardous materials needed to be transported to the mainland.
- Contracting issues associated with the procurement of ambient air monitoring equipment for PR.
- Use of DOI’s iPac system to conduct Endangered Species Act Section 7 consultations for HHW staging areas worked well.

Puerto Rico Branches

U.S. Environmental Protection Agency
Puerto Rico Waste Data

Puerto Rico Waste Data
Contacts

U.S. Environmental Protection Agency, Region II
Caribbean Environmental Protection Division (CEPD)
City View Plaza II, 48 Carr. 165 Suite 7000
Guaynabo, PR, 00968-8073

• Carlos Huertas, On-Scene Coordinator
  Office: 787-977-5861
Lessons learned from Hurricanes Irma and Maria:
FEMA NCR RSF (2017-2019)

Ernesto L. Díaz

Overview ...and first lessons learned!

- Hurricanes Irma and María (Sep 2017) ...Not prepared for Cat 4 or 5!
- Major Disaster declaration and response under FEMA ESF10-
  Request for Mission Assignments:
  - RRF Sunken vessels removal (USCG)
  - RRF Coastal, Nearshore and Beach Debris Removal (USACE)
- DNER requests FEMA Natural and Cultural Resources Sector to conduct
  Damage Assessments and support to develop COA for Coral Reefs, Seagrasses, Beaches, Dunes and Wetlands.
- DNER requests: Corals as eligible facility for Public Assistance:
  Critical Maintained Natural Infrastructure (Our Ask and the Evidence)
Puerto Rico’s coastal uses and assets

**ECONOMICS**
- GDP: $105 billion/year (PRPB2016)
- Tourism $2B/year
- Built up Areas/Coastline 24%
- Industrial Parks (81)
- Commercial/Recreational Fisheries

**HOUSING**
- Public Housing (15)
- Individual Housing (xx)

**PUBLIC BUILDINGS**
- PNP, Public Buildings not under other sectors

**TRANSPORTATION**
- Airports (11)
- Ports (12)
- Bridges, Culverts, Piers
- Miles of Primary Roads (17,387mi/27,982km)

**NATURAL AND CULTURAL RESOURCES**
- Protected Areas (Land) DRNA 8.7% (2015) – CLCC 16% (2016)
- Protected Areas (Marine) 27.2%
- Shallow coral reefs and associated communities designated for protection 49%
- Historical Properties (22+)

**HEALTH AND SOCIAL SERVICES**
- Hospitals (3)
- Treatment Centers (xx)

**COMMUNICATIONS**
- Fiber Optic Cables (15)
- Internet Infrastructure
- Public comms systems

**ENERGY**
- Power plant systems (7; 5 public, 2 private)
- Substations
- Distribution and transmission lines

**WATER**
- PRASA infrastructure at coastal zone: 200km potable water
- 260km sanitary infrastructure
- 6 water systems
- Pump stations
- Waste Water Treatment Plants (28 coastal)

**EDUCATION**
- Schools (36)
- PNP (xx)
...be ready to provide detailed maps of built up areas and natural assets!
Hurricane Irma 06 SEP 2017
Hurricane María 20 SEP 2017
Coral Reef as Critical Maintained Natural Infrastructure

PRESENTED TO FEMA PA (2018)
FEMA requests: System Definition and Investments Documentation

1. OCCURRENCE OF WAVE ATTENUATION:
   - Potentially joint project (for all geographic coastal regions) to include inventory conditions for coastal and specific of coastal
   - Specific inventory by geographic and major (beach and type of coastal region)

2. DISCUSS APPLICANT'S HURRICANE RISK ASSESSMENT DATA:
   - Associated data for damage to coral reef regions both prior and post hurricanes time and space
   - Include data of damage for pre-disaster events, e.g., oil spills, ship accidents, etc.
   - Include data of damage for post-disaster events, e.g., hurricane and storm surge damage
   - Involved site (specific reef locations and consequences within coastal regions)
   - Storage (short-term/long-term storage of damage)
   - Associated costs (short-term/long-term storage of damage in place)

3. DISCUSS CORAL REEF IMPROVEMENT PROJECTS AND MAINTENANCE DOCUMENTATION:
   - List of coral reef rehabilitation programs prior to and post hurricanes time and space
   - Description of each program, e.g., coral transplants, artificial reefs, seagrass cultivation (followed generally)
   - For each project and division reef, provide any surveys/success/scenarios and materials used for construction
   - Information on condition of reef locations, e.g., living areas, dead areas, etc.

4. DISCUSS UNDERWATER PARTNERSHIP AGREEMENTS AND MAINTENANCE SCHEDULES:
   - Collaboration between agencies to include a joint program with the National Oceanic and Atmospheric Administration
   - Monitoring (post-corals in place) and other hurricane time and space
   - Evaluation of projects, including whether and how each was performed, who was performed, and who performed it
   - Provide: a copy of any records, agreements, permits, publications, or analyses that allowed the monitoring or monitoring to be performed
   - Define the periods of time that monitoring plans were executed.

Coral Reef and Hardbottom Substrates in Waters Around Puerto Rico (San Juan - Culebra)

>220 papers on coral reefs wave attenuation reviewed
Coral reef structural complexity provides important coastal protection from waves under rising sea levels

Coral reefs are diverse ecosystems that support millions of people worldwide by providing coastal protection from waves. Climate change and human impacts are leading to degraded coral reefs and to rising sea levels, posing concerns for the protection of tropical coastal regions in the near future. We use a wave dissipation model calibrated with empirical wave data to calculate the future increase of breakwater wave height. We show that, in the near future, the structural complexity of coral reefs is more important than sea-level rise in determining the coastal protection provided by coral reefs from average waves. We also show that a significant increase in average wave heights could occur at present sea level if there is sustained degradation of benthic structural complexity. Our results highlight that maintaining the structural complexity of coral reefs is key to ensure coastal protection on tropical coastlines in the future.

Designing a new type of insurance to protect the coral reefs, economies and the planet

A new type of insurance to protect coral reefs has been announced at the 2018 World Ocean Summit in Mexico. Swiss Re is proud to have supported the design of this new product which will not only help the conservation and swift restoration of the reef, if damaged by a major hurricane, but it will also support the economic resilience of the region and offers an opportunity to create a scalable new market for the insurance.

San Juan metro coral reef system
FEMA requests: Investment Documentation

1. DISCUSS CORAL REEF GIS REQUIREMENTS:
   - Polygon and point shape files for all geographic coral reef regions and includes boundaries for each geographic region and types of coral reefs in each region.
   - Data repository for sharing.

2. DISCUSS APPLICANTS HURRICANE MARIA ASSESSMENT DATA:
   - Associated costs for damage to coral reef regions prior to and after the hurricane.
   - Data on coral reef recovery and strategies for future restoration efforts, e.g., coral reef management initiatives, etc.
   - Data on current and future threats to coral reef systems.
   - Associated costs for assessment efforts/data collection.

3. DISCUSS CORAL REEF IMPROVEMENT PROJECTS AND MAINTENANCE DOCUMENTATION:
   - List of all reef improvement projects done and projects in progress along with costs, timelines, and completion dates.
   - How the projects were funded and if they were successful.
   - Include any data or reports associated with each project.

4. DISCUSS STAKEDER PARTNERSHIP AGREEMENTS AND MAINTENANCE SCHEDULES:
   - Collaboration research agreements between NFRP and other agencies, e.g., NOAA, universities, private sector, etc.
   - Monitoring programs that are ongoing and those that were completed.
   - Describe methodology and any metadata related to the data that was shared.
   - Provide a copy of any contracts, agreements, or memos that addressed the maintenance and monitoring of the forests.
Coral Reef Maintenance Takes Many Forms

PR Coral System Investments: Collaborators

More detailed provided in the Spreadsheet
Investments estimates

- Assessments, Response and Restoration: $17,664,034 (30%)
- Maintenance and Monitoring: $27,255,572 (47%)
- Improvement and Maintenance: $13,574,201 (23%)

$58,493,807 of investments in the Northeast Coral Reef System during the last 30 years

Eligible Facility

Applicant – DNER ✔

Facility
- Is it the legal responsibility of an eligible applicant? ✔
- Is it located in a designated disaster area? ✔
- Is it not under the specific authority of another Federal agency? ✔
- Was it in active use at the time of the disaster? ✔
- Was it damaged as the result of the declared disaster or emergency? ✔
- Is it a designed and constructed improvement? ✔
- Does the constructed improvement enhances function? ✔
- Does the applicant maintain the improvement? ✔
Eligible Facility

**Work**
- Is work required as a result of the declared event? ✓
- Is the work within the designated disaster area? ✓
- Was the work the legal responsibility of the applicant at the time of the disaster? ✓
- Does it fit into a FEMA category of work [Permanent work – Category G] ✓

**Cost**
- Is it reasonable and necessary to accomplish the eligible work? ✓
- Does it comply with Federal, State, local and tribal requirements for procurement? ✓
- Can the costs be reduced by all applicable credits, such as anticipated insurance proceeds and salvage values? ✓

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**Policy Advisory**

**Title:** Coral Reef facility eligibility

**Keywords:** Coral Reef, facility, eligibility, planting, beach,

**Project Description:** Coral Reef Restoration

**Requestor:** Puerto Rico Department of Natural and Environmental Resources (DNER)
**Sector:** NCR
**Subrecipient:** Puerto Rico DNER
**Project Category:** G
**Project Size:** $

**Policy Issue or Question:** Is the restoration of a coral reef by the Puerto Rico DNER eligible for Public Assistance?
Lessons learned:

• Must prepare for the next one.

• Build back and retrofit stronger and resilient.

• Corals and natural infrastructure must also be restored to protect coastal communities, critical infrastructure and biodiversity.
PREMA - Mission

Coordinate all the resources of the government and the private sector, to provide the fastest and most effective services before, during and after emergency situations to ensure the protection of life and property of citizens.
Hurricane Maria – September 20th, 2017

- Was a category 4 hurricane and could be reclassified to category 5.
- $3,919,899,824.36 - Total Public Assistance Grants
- $1,226,870.001.79 - Total in Individuals and Household Program
- 463,752 applications approved for the Individual Assistance Program

Municipalities of Puerto Rico

- The 78 municipalities of Puerto Rico were designated under the Public Assistance and Individual Assistance Programs.
Hurricane Maria

- More than 70,000 houses lost their roofs.
- Total collapse of essential services.
- 64 direct deaths caused by the hurricane.
- 2,975 deaths related to the hurricane, according to a study conducted by the University of George Washington.

PREPA
PRASA

Communications

Fotos: NMEAD
Flood

Comerío

Toa Baja

Foto: Facebook

Guajataca Dam
Structural Damages

Aibonito

Foto: NMEAD
Foto: El Nuevo Día

Structural Damages

Adjuntas

Foto: Facebook

Utuado

Foto: FEMA
Commodities Distribution

Maricao

Changes in Emergency Operational Plans
Changes in Emergency Operational Plans

• The Emergency Operational Plans of the government agencies and municipalities were worked from scratch to bring them to a catastrophic level and temper them to the reality faced after the passage of Hurricane Maria.

• Before the passage of the phenomenon by Puerto Rico, the plans were prepared for the scenario of a category one hurricane (1).

• Uniform systems of plans, training and exercises are developed.

• The state and municipal emergency management structure is strengthened.

Warehouses
• Important changes were made to the Supply Distribution Plan to ensure that citizens receive them fast, safely and orderly.

• As part of these efforts, in conjunction with the Department of Housing, over 20,000 cots were distributed to be located in the shelters of the municipalities.

• One of the priorities of the Bureau has been to deliver supplies to the 78 municipalities so that, in the event of an emergency or disaster, they can meet the needs of citizens.

• Historically, Puerto Rico has depended on the supplies provided by FEMA that have warehouses located on the Island.

• To meet the need of Puerto Rico, the Bureau acquired two warehouses, located in Guaynabo and Ponce where water and food supplies are maintained, as well as emergency response equipment and basic necessities.

• The Bureau is preparing to locate more warehouses.
Communications

• In order to guarantee communication between the response agencies during emergencies, we are installing satellite communication systems in all Police Commanders, Fire Stations, Ambulance Dispatches, Emergency Management Bureau regions, as well as the Emergency Operations Centers (COE) of the 78 municipalities.

• In addition, radios of 100 watts are being installed in the facilities, as well as in more than 300 hospital institutions around the Island.

• These radios go from one antenna to another, without the need for a repeater, which ensures a better response and communication in case of a collapse.
Alliance with the Private Sector

• For the first time, representatives of private companies have a space in the Emergency Operations Center (COE), to work together with the government and respond to the needs of citizens.

• Among the sectors that are present in the COE are: manufacturing, food, hospitals, telecommunications, broadcasters, media, infrastructure, transportation and gasoline.
Tsunami Mission and Products

NOAA NRPT LEARNING FROM THE PAST AND MOVING FORWARD: RESPONSE CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES
San Juan, PR
April 23-25, 2019
Christa von Hillebrandt-Andrade
NOAA NWS Caribbean Tsunami Warning Program

Japan 2011
Tsunami Warning Information

Natural Tsunami Warnings
• Strong coastal earthquake shaking
• Rapid sea level changes
• Roaring sound

Official Information
• Federal, State, Local govt
• Important for distant tsunamis

Informal Information
• Friends, neighbors, relatives
• Media, SMS, social networks...

Strong Earthquake

ACTION
Drop, Cover, and Hold.
Go Inland to High Ground Immediately.

DO NOT WAIT FOR OFFICIAL EVACUATION ORDERS
Noticeable Rise or Fall of Coastal Waters

**ACTION**

**Go Inland to High Ground Immediately**

DO NOT WAIT FOR OFFICIAL EVACUATION ORDERS

---

For Official Information:

**Tsunami Warning Centers**

- TWCs are reliable and dependable; 24x7
- Monitor seismicity for large earthquakes
- Monitor sea levels for tsunamis
- When alarms trigger, evaluate earthquake for tsunami threat
- Issue official tsunami threat messages to authorities and public
Pacific Tsunami Warning Center (PTWC)

NOAA Inouye Regional Center, Ford Island, Pearl Harbor, Hawaii

Operations Center PTWC
PTWC Services PR, USVI and BVI and with international messages the rest of the Caribbean

Director: Dr. Chip McCreery

TWC Communication Pathways

- TWC messages are:
  - authoritative, coordinated among other TWCs
  - issued simultaneously to many customers (international, national, local, private sector, public)
  - reliable since they are working 24x7
  - redundant since they are issued through many communication pathways
  - broadcast because of time urgency
U.S. Tsunami Warning System Communications Diagram

Métodos de comunicación

Para recibir mensajes del PTWC con productos del Caribe, enviar un Txt al 40404 y escribir en el mensaje: Follow NWS_CTWP

US Tsunami Alert Levels

Tsunami Messages: Alert Levels

- **TWC Alert Level:**
  - **WARNING**
  - **ADVISORY**

- **TWC-determined Threat:**
  - **EXPECTED FLOODING**
  - **STRONG CURRENTS LIKELY**

- **Local Authority Safety Action:**
  - **EVACUATION RECOMMENDED**
  - **STAY AWAY FROM SHORE**
Tsunami Messages: Alert Levels

**TWC Alert Level:**
- **WATCH**
- **INFORMATION STATEMENT**

**TWC-determined Threat:**
- **DANGER LEVEL NOT KNOWN**
- **NONE or MINOR WAVES AT MOST**

**Local Authority Safety Action:**
- **PREPARE, STAY ALERT FOR MORE INFORMATION**
- **NO ACTION SUGGESTED**

---

*Tsunami travel time contours at 15-minute intervals across the Caribbean region to the island of Puerto Rico. The white contours are labelled in hours of travel time. Red dots show the location of historical earthquakes having depths less than 100 km. They primarily outline boundaries between tectonic plates in the Caribbean region.*
### Ejemplos de productos de los TWC: Terremoto en PR/VI o el Caribe, Peligro Potencial de Tsunami

<table>
<thead>
<tr>
<th>Transcurrido</th>
<th>Producto</th>
<th>Descripción</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00</td>
<td>Terremoto</td>
<td>Ocurre terremoto local, Mw ≥ 7.1</td>
</tr>
<tr>
<td>00:03</td>
<td>Observatory Message*</td>
<td>Parámetros del terremoto preliminares y revisados por PTWC – Activa entrada en el CISN</td>
</tr>
<tr>
<td>00:04</td>
<td>Aviso PRVI</td>
<td>Aviso de Tsunami para PRVI basado en los criterios iniciales</td>
</tr>
<tr>
<td>00:25</td>
<td>Aviso, Advertencia o cancelación PRVI</td>
<td>Pronóstico de tsunami basado en el mecanismo del terremoto y la data de nivel del mar. Mantiene, actualiza o degrada el nivel apropiado de Alerta o genera una cancelación.</td>
</tr>
</tbody>
</table>

* Usado principalmente por instituciones sismologicas y entidades tecnicas (RSPR, CTWP)

<table>
<thead>
<tr>
<th>Transcurrido</th>
<th>Producto</th>
<th>Descripción</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:55</td>
<td>Aviso, Advertencia o cancelación PRVI</td>
<td>Mensaje complementario con lecturas de nivel del mar de mareógrafos costeros cercanos o DARTS. Cambio en nivel de alerta es posible basado en las lecturas.</td>
</tr>
<tr>
<td>01:25</td>
<td>Aviso, Advertencia o cancelación PRVI</td>
<td>Mensaje complementario con lecturas del nivel del mar de mareógrafos costeros cercanos o DARTS Cambio en nivel de alerta es posible basado en las lecturas.</td>
</tr>
<tr>
<td>01:45</td>
<td>TWC Anuncio llamada de conferencia</td>
<td>Mensaje a PREMA, VITEMA, BVIDDM, WFOSJ, y PRSN anunciando llamada de conferencia.</td>
</tr>
<tr>
<td>02:00</td>
<td>TWC Llamada de conferencia</td>
<td>Llamada de conferencia del TWC con PREMA, VITEMA, BVIDDM, WFOSJ, y PRSN para discutir situación.</td>
</tr>
<tr>
<td>03:00+</td>
<td>Aviso, Advertencia o cancelación PRVI</td>
<td>Cada media hora hasta que la alerta disminuya o se cancele.</td>
</tr>
</tbody>
</table>
NOAA/NWS Pacific Tsunami Warning Center Users’ Guide Tsunami Warning Products for Puerto Rico, U.S. Virgin Islands and British Virgin Islands

• Product Description
• Timeline for issuance of products
• Product Identifiers and Dissemination
• Example of Products

Caribewave.info

Cancellation versus All-Clear

• Cancellation Message issued by TWCs
  • Officially cancels warning, watch, and advisory messages
  • Means that destructive waves have stopped
  • Does not mean it is safe to return to Tsunami Hazard Zone
• Official All-Clear issued by local authority when it is safe to re-enter the Tsunami Hazard Zone
Warning Process: How it Reaches the “last mile” on the coast

• Emergency Alert System: Radio and Television
• NOAA Weather Radio
• Sirens

Wireless Emergency Alerts

• Current: Tsunami danger on the coast. Go to high ground or move inland. Listen to local news. —NWS
• Proposed (English/Spanish):
  NWS: Tsunami danger on the coast. Move to high ground or inland now.
  SNM: Peligro de tsunami. Vaya a un lugar alto o tierra adentro ahora.
• Proposed (Longer Message English/Spanish)
  The National Weather Service has issued a tsunami warning. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high ground or inland now. Keep away from the coast until local officials say it is safe to return. Check local media for more information after you are safe.

Tsunami.Gov – one stop for official tsunami products (national and international)

How People Get Warnings:
Assumption

- Official Information
- Information flow is linear from one source
How People Get Warnings: Reality

- Official & Informal (Unofficial) Information
- From many sources at same time

Need to Test the System: CARIBE WAVE
Summary

• Described types of tsunami warning information
• Described how Tsunami Warning Centers work
• Described types of tsunami messages
• Described the warning process and how it reaches “the last mile on the coast”
• Emphasized importance of communication testing
Products and Forecast for Decision Makers

Ernesto L. Morales
Warning Coordination Meteorologist
NOAA/NWS Weather Forecast Office San Juan
Ernesto.Morales@noaa.gov

NOAA/NWS MISSION

• Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.
WFO San Juan and NHC

- **Same Mission but with a different scope**
- **NHC** focus on the forecast of the intensity and trajectory of the tropical cyclone.
- **WFO SJU** focus on the impacts in our local forecast area based on the NHC forecast.

WFO Knowledge of Potential Peak Impacts

- **Very Long-term**
  - Climatology
  - Statistics
  - Seasonal Outlook
  - Preparations
  - Takus
  - MOM

- **Long-term**
  - HVO, PNS, EM Briefings
  - Media Interviews
  - Social Media
  - NHC Wind Speed Probabilities

- **Long-term**
  - Hurricane Watch, Hurricane Warning, HLS, TCV, EM Briefings
  - Media Interviews
  - Social Media
  - NHC Wind Speed Probabilities
  - Probabilistic Storm Surge
  - Potential Storm Surge Flooding Map

- **Short-term**
  - HLS, TCV
  - Other short-term products

User Needs - Plan/Prepare, Implement According to Plan, Last Chance, Recovery

NWS/NOAA
Very Long-Term

- Seasonal Outlooks
- Climatology/Statistic
- Preparedness talks

Tropical Cyclone Climatology
Long-Term (day7-day2)

- Hazardous Weather Outlook
- Emergency Management briefings
- Media Interviews
- Social Media
- Graphicast
- NHC Tropical Weather Outlooks *

*Issued by NHC

5-Day Graphical Tropical Weather Outlook
Two-Day Graphical Tropical Weather Outlook

Hazardous Weather Outlook

Weather.gov/sju
Graphicast

Long-Term (day2-12hr)

- Hurricane Local Statement
- TCV
- Emergency Management briefings
- Media interviews
- Social Media
- Track Forecast Cone*
- Hurricane Watch*
- Hurricane Warning*
- NHC Wind speed probabilities*
New NHC Forecast Cone Product

Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds
Short-Term (12hr-3hr)

- Hurricane Local Statements
- Tropical Cyclone VTEC (TCV)
- Other short term products
  - Stand Alone Products

Very Short-Term

- Emergency Flash Flooding
- Extreme Wind Warning
Emergency Flash Flooding

• Winds associated to the center of the cyclone.
• Hurricane Category 3 or more.
• Sustained winds of 115mph or higher.

Extreme Wind Warning
Recovery

Follow the Official Source of Weather Information

- National Weather Service SAN JUAN PR
  (787) 253-4501 or (787)253-0615
- www.weather.gov/sju
- Twitter: @NWSSanJuan
- www.facebook.com/
- www.nhc.noaa.gov
Puerto Rico Emergency Management Bureau

CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS
RISK COMUNICATION

LEARNING FROM THE PAST — IMPROVEMENTS FOR THE FUTURE

Severe weather
Severe weather

Hurricane
Hurricane

Earthquake
In order to response in a proper way and inform the community of the hazard or the possibility of one so they can be prepare and take the necessary actions to save lifes

We use different official sources and elements to collet information and to get it to the public as fast as we can and necessary
We are in constant contact with the NWS via phones, radio and personal to our EOC if need be.

We are in contact and follow the information from the National Hurricane Center in Florida.

We receive information from the PTWS, PRSN and the NTWC, also the NWS.

We use the ENWIN System, internet systems, Ring down systems, faxes and phones systems.
Once confirmed the source of information, we deliver the alert messages to everyone concerned: Regions or Zones, Municipalities, responds Agencies, using different forms of communications as: IPOW, regular radios, p-25 interoperability's radios, 100w radios, internet, phones and the media, included commercial TV and radio stations.

This alert information could be just update information, watching awareness or a warning alert for a Tsunami already in a way to hit Puerto Rico.
At the same time we will activate the State EOC and all the components of every EFS to give the support needed at the field.

Basically the key and critical point handling this phenomenons is the risk to lose the communication before, in the middle or after the emergency happened, so you can not give the coordination and help to the communities that you suppose to offer and they need.
We must educate the communities, other responders, agencies, work together and be prepared and ready to anything and everything in order to accomplish our mission with the people of Puerto Rico.

Any Question?
Thank you
Appendix D: Workshop Breakout Group Notes
## Appendix D: Breakout Session 1

### Group A

<table>
<thead>
<tr>
<th>Category</th>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/ Skills Learned</th>
<th>Explanation/ Description</th>
<th>Timeframe Following Disaster</th>
<th>Safety of Staff/Staff Families</th>
<th>Cross Jurisdiction (federal, commonwealth, local)</th>
<th>Cross Jurisdiction (federal, commonwealth, local)</th>
<th>Shared Trust Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Desensitizing of alarms</td>
<td>Take culture into account when designing communication</td>
<td>&quot;Burn out&quot;</td>
<td>Mission Response</td>
<td>Yes (depends on education)</td>
<td>ALL</td>
<td>ongoing education</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>Not taking forecast seriously</td>
<td>Information needs to put everyone on same page (official source)</td>
<td>Too many unofficial sources of information</td>
<td>Mission Response</td>
<td>Yes (depends on education)</td>
<td>ALL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sources of Information</td>
<td>Educate public to follow official source(s) of weather information</td>
<td>Government (NWS) vs Mass media &amp; social media</td>
<td>Mission Response</td>
<td>Yes (depends on education)</td>
<td>ALL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td>Lack of maintenance of resources</td>
<td>Needs to be prepared before event, need maintenance logs and funding necessary</td>
<td>Infrastructure, equipment, generators, machinery, hospitals, water treatment, dredging (Most dependent on funding)</td>
<td>Yes - everybody</td>
<td>ALL</td>
<td>Funding availability, education, budgeting, accountability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td>Required Actions</td>
<td>Priorities</td>
<td>Details</td>
<td></td>
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<tr>
<td>Not enough resources</td>
<td>Cannot properly respond causing snowball effect, improvisation insufficient = must plan ahead, stockpiling supplies beforehand, Both access and distribution, *More efficient distribution system that is equitable, prior plans (&amp;funding?) of impartial parties responsible for distribution of resources to communities (NGO, red cross, churches)</td>
<td>Priority on imported supplies, permission limits some provisions. Do not having enough resources, leading to less accessibility and distribution</td>
<td>Both response and post event</td>
<td>Yes, directly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication infrastructure</td>
<td>Redundancy with options, total loss of communication can happen, ham radio can work</td>
<td>Similar to lack of maintenance, structures failed</td>
<td>Mission Response</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation</td>
<td>Lack of plans for an event of this magnitude</td>
<td>Need to plan, practice, train for worst case scenarios</td>
<td>ALL (pre, during, post)</td>
<td>Yes</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Planning, knowledge of resources (within agency and inter) and necessary MOU prior, awareness / transparency of resources

Reliance on other agency's structures
<table>
<thead>
<tr>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/Skills Learned</th>
<th>Explanation/Description</th>
<th>Timeframe Following Disaster</th>
<th>Shared Trust Resources</th>
<th>Safety of Staff/Families</th>
<th>Cross Jurisdiction (federal, commonwealth, local)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response plans exist</td>
<td>But not ownership, accountability, disseminated, activated on</td>
<td>Plans existed, not updated, not used, systems not adequate, did not reflect current codes and standards</td>
<td>Mission Response</td>
<td>many plans affect staff/families</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Land Use Plan</td>
<td>We must enforce sensible use of land use plan and zoning; assess on paper but in reality is different (i.e., zoning)</td>
<td>Building again in high-hazard area (i.e., schools, hospital, NWS)</td>
<td>Recovery Activities</td>
<td>yes - schools, sensitive public buildings</td>
<td>commonwealth and local</td>
<td></td>
</tr>
<tr>
<td>Task</td>
<td>Reason</td>
<td>Responsibility</td>
<td>Yes</td>
<td>Yes - all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>----------------</td>
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<td></td>
</tr>
<tr>
<td>Communicate the severity danger/risk</td>
<td>Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond</td>
<td>Mission response and recovery activities; large timeframe</td>
<td>NOAA</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simultaneous hazard events may require unknown flexibility</td>
<td>Need tabletop exercises that are more complex, multi-scenario, some scenarios require staff safety ahead of protocols, need redundancy</td>
<td>Mission Response</td>
<td>NOAA</td>
<td>yes</td>
<td>Yes - all</td>
<td></td>
</tr>
<tr>
<td>Capacity for multiple, simultaneous disasters</td>
<td>Climate change could lead to stressors to staff/resources/retention.</td>
<td>Mission Response</td>
<td>NOAA</td>
<td>yes</td>
<td>Yes - all</td>
<td></td>
</tr>
<tr>
<td>Marine/land debris hindered by lack of staging areas and logistics</td>
<td>Need pre-identified staging areas</td>
<td>Mission Response</td>
<td>FEMA</td>
<td>no</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Rapid assessments of damage/debris were critical</td>
<td>Areas that had quick assessments made it easier to scope federal funding</td>
<td>Mission Response</td>
<td>FEMA</td>
<td>no</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Don't restructure the organization during a disaster*</td>
<td>Building a new type of structure during a disaster leads to added pressure, lack of sectors and grant manager introduced part way during a disaster created problems</td>
<td>Mission Response</td>
<td>FEMA</td>
<td>yes (mental health)</td>
<td>federal but impacts all</td>
<td></td>
</tr>
<tr>
<td>Experience, unclear goals</td>
<td>Policies need to be revised before an incident</td>
<td>E.g., coral reef and green technologies</td>
<td>Timeframe: prior to disaster</td>
<td>FEMA; Staff PAPPG</td>
<td>No</td>
<td>Federal</td>
</tr>
<tr>
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</tr>
<tr>
<td>Police evacuated people in danger zones when cell down</td>
<td>Pre-emergency coordination with municipal (door knocking, whats app) repeat weather messages</td>
<td>Build relationships prior, build trust, work together</td>
<td>Mission Response</td>
<td>All</td>
<td>Yes</td>
<td>All</td>
</tr>
<tr>
<td>Deadlines need to be flexible, but...</td>
<td>FEMA extends deadlines. Are these good or bad? False expectations. Inefficient timeframe</td>
<td>Repairs and legislation</td>
<td>Both</td>
<td>All</td>
<td>No</td>
<td>All</td>
</tr>
<tr>
<td>Be broad and bold on initial assessments</td>
<td>Baseline for FEMA to consider funding opportunities (repair, restoration)</td>
<td>Puerto Rico initial RSF was broad and created opportunity for recovery</td>
<td>Both</td>
<td>All</td>
<td>No</td>
<td>All</td>
</tr>
<tr>
<td>Lack of pre-scripted mission assignments/Duplicity of efforts*</td>
<td>The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Other Federal Agencies (OFAs) need to be assertive in their supplemental funding request*

**You snooze, you lose**

<table>
<thead>
<tr>
<th>Community response efforts. Develop a community plan.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community members segregating debris; reaching out to the elderly; local communities will engage if given the opportunity, they take ownership, sense of community (helping your neighbors)</td>
</tr>
<tr>
<td>Encourage self-sufficiency and help others. Opportunity to teach young people. Resiliency</td>
</tr>
</tbody>
</table>

*Bolding indicates priority items

**Group C**

<table>
<thead>
<tr>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/Skills Learned</th>
<th>Explanation/Description</th>
<th>Timeframe Following Disaster</th>
<th>Shared Trust Resources</th>
<th>Safety of Staff/Staff Families</th>
<th>Cross Jurisdiction (federal, commonwealth, local)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications &amp; interoperability between organizations/groups</td>
<td>Requires a compatible system</td>
<td>Hard to communicate between regions due to economic and technical barriers</td>
<td>Pre-disaster</td>
<td>Yes</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>Back to basics- simple solutions (e.g., radio, information runners)</td>
<td>Cannot assume standard communication infrastructure</td>
<td>During, Post-disaster</td>
<td>Yes</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Issue</td>
<td>Countermeasure</td>
<td>Timeframe</td>
<td>Participants</td>
<td></td>
<td></td>
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<tr>
<td>----------------------------------------------------------------------</td>
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<td>-------------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal- layers of bureaucracy slowed progress</td>
<td>Need to identify an authority- in past only identified problem</td>
<td>During</td>
<td>Commonwealth and local</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E.g., resource request form- wanted submitted online but had no internet access, politics getting in the way of progress</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>High turnover rate of response positions</td>
<td>Need to maintain and document experiences, and put them into practice. Done through education and more trainings</td>
<td>Pre-, Post- disaster</td>
<td>Commonwealth and local</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loss of knowledge and details slip through the cracks. Use authority (knowledge of who has it)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Did not pre-emptively involve private sector</td>
<td>Involve private sector during contingency plans. Make the link on how to support municipalities/local organizations (e.g., Private sector often has resources it can contribute to response)</td>
<td>all (pre, during, post)</td>
<td>Yes</td>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Timeframe</td>
<td>Level(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>---------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Release of emergency supplies in ports</td>
<td>Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)</td>
<td>During</td>
<td>All</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Getting assets to people</td>
<td>Use multiple avenues to distribute resources (e.g., NGOs, faith based &amp; private)</td>
<td>During, Post-disaster</td>
<td>Commonwealth and local</td>
<td></td>
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<tr>
<td>Getting community to know and buy into existing procedures/frameworks</td>
<td>Better communication of information &amp; informing communities at the grass roots level</td>
<td>all (pre, during, post)</td>
<td>Commonwealth and local</td>
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</tbody>
</table>
Logistics

Pre-planning on how to get resources to the island, and distributing in reasonable amount of time

Prior contracts need to be in place before disaster, distribution networks need to be established

to municipalitie s on how to follow framework

all (pre, during, post)

All

**Group D**

<table>
<thead>
<tr>
<th>Identified Response Challenge</th>
<th>Lessons/Practices/Skills Learned</th>
<th>Explanation/Description</th>
<th>Timeframe Following Disaster</th>
<th>Shared Trust Resources</th>
<th>Safety of Staff/Staff Families</th>
<th>Cross Jurisdiction (federal, commonwealth, local)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to communicate with small communities</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
<td>Lacked proper terminology to inform community</td>
<td>Recovery Activities</td>
<td>Yes</td>
<td>Fed--&gt;c.w.--local</td>
<td></td>
</tr>
<tr>
<td>People inadequately prepared for category 4 or 5 hurricane</td>
<td>Should prepare regardless of category level</td>
<td>Prior close calls/hurricanes missing the island gave a false sense of security &amp; resources were moved to VI to deal with Hurricane Irma</td>
<td>Preparation</td>
<td>Yes</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Community or Issue</td>
<td>Solution</td>
<td>Exposure/Planning</td>
<td>Responsibility</td>
<td></td>
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<tr>
<td>Communities relying on social media and not official sources of information</td>
<td>More outreach about what official sources of information are</td>
<td>Pre, During, Post</td>
<td>Yes</td>
<td>Local</td>
<td></td>
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</tr>
<tr>
<td>Lack of emergency planning</td>
<td>Local level preparedness plan created with central point of information</td>
<td>Preparation</td>
<td>Yes</td>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contingency planning for emergency communication</td>
<td>Need more than everyday, standard communication</td>
<td>Preparation</td>
<td>Yes</td>
<td>Commonwealth/Local</td>
<td></td>
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</tr>
<tr>
<td>Lack/enforcement of residential building codes</td>
<td>More damage and loss of life due to unsafe structures</td>
<td>Preparation</td>
<td>Yes</td>
<td>Commonwealth/Local</td>
<td></td>
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</tr>
<tr>
<td>Vulnerable population</td>
<td>Don’t wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources</td>
<td>Preparation</td>
<td>Yes</td>
<td>Maybe federal, definitely Commonwealth/Local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to clean water</td>
<td>Ran out of water</td>
<td>Preparation</td>
<td>Yes</td>
<td>Commonwealth/Local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port accessibility limited because of law</td>
<td>Necessary aid could not be distributed/get to local communities quick enough</td>
<td>Pre, During, Post</td>
<td>Yes</td>
<td>Commonwealth/Local</td>
<td></td>
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</tr>
<tr>
<td>Current infrastructure was/is not hurricane ready</td>
<td>Maintain/update infrastructure to withstand hurricanes</td>
<td>Roads, power lines, etc.</td>
<td>Preparation</td>
<td>infrastructure, power</td>
<td>Commonwealth/local</td>
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</table>
### Appendix D – Breakout Session II

#### Group A

<table>
<thead>
<tr>
<th>Challenge Category</th>
<th>Identified Response Challenge</th>
<th>Explanation/Description</th>
<th>Lessons Learned</th>
<th>Improvement(s) (Actionable Tasks)</th>
<th>How does approach change with respect to Tsunami vs Hurricane?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td><strong>Communication with small communities</strong></td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
<td>Map communities &amp; identify liaisons, focus groups to identify effective language/terminology, science communication training for personnel in agencies 1. Database of community needs based on geography, demographics, resiliency center possibilities, existing infrastructure  2.Establishing community liaisons</td>
<td>Island wide for both (Pre emergency), evacuation communication, inland vs coastal impacts different (Post)</td>
<td></td>
</tr>
<tr>
<td><strong>Communities relying on social media and not official sources of information</strong></td>
<td>Lack of exposure for official sources, too much exposure for other information</td>
<td>More outreach about what official sources of information are</td>
<td>Local gov support of NWS, teach resource quality, scientists create &quot;internet image&quot;, before season: sit down with forecast communicators, consider certifications, spend time with communities to ensure understanding of maps / skills at community level to ID official sources. 1. create official emergency website/social media and promote/market it as a user friendly resource (2) link back to authoritative sources NWS</td>
<td>No</td>
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<tr>
<td><strong>Communication of the severity danger/potential risk</strong></td>
<td>Having public understand the risk; people think they are lucky, manage expectations, warning fatigue. &quot;Burn out&quot;- desensitizing of alarms</td>
<td>Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond. Take culture</td>
<td>&quot;remember Maria&quot;, continuous outreach to remind (e.g. poster), probability concept, Message: &quot;You control your risk&quot; by reducing your vulnerability</td>
<td>more desensitization with Tsunamis because of infrequency</td>
<td></td>
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</tr>
<tr>
<td>Infrastructure</td>
<td>Lack of access to clean water</td>
<td>No redundant water for residents/no cisterns</td>
<td>Ran out of water</td>
<td>Promote/fix policy for rainwater capture, investigate/revise rainwater capture policy (resiliency center example), community workshops on virus protection fitting into cultural norms (list of best practices). 1. Reduce barriers to home/commercial rainwater capturing  2. encourage rainwater collection/capture with safe treatment</td>
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<tr>
<td>Poorly maintained infrastructure</td>
<td>E.g., failure of infrastructure (water); waiting for gov. to maintain infrastructure</td>
<td>Empowering communities to take accountability/responsibility of infrastructure</td>
<td>Enforce construction code, certified inspectors, education for empowerment in maintenance solidarity training. 1. Informal contractor training  2. use best construction/maintenance practices from other hurricane/prone states and countries</td>
<td>coastal vs island wide (different types but similar problem)</td>
<td>benefit for local may have regional impacts</td>
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</tr>
<tr>
<td>Leadership</td>
<td>High turnover within leadership position and trained personnel; limited capacity for multiple, simultaneous disasters</td>
<td>Competition for resources. Trained/experienced resources. Turnover of political/experienced/burnout staff. Don't restructure the organization during a disaster</td>
<td>Climate change could lead to stressors to staff/resources/retention. Need local level leader- educated through trainings. Minimize turnover.</td>
<td>Professionalize emergency management positions, establish/increase emergency management schools, Local level leader training. 1. develop curriculum from vocational schools to higher learning institutions</td>
<td>No change</td>
<td></td>
</tr>
<tr>
<td>Logistics</td>
<td>Port accessibility is limited during response because of existing laws</td>
<td>San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.</td>
<td>Necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)</td>
<td>Laws impeding maritime supplies should be temporarily waived (Jones Act) for appropriate timeframe (or permanently). 1. neutral study on PR relevant Jones Act issues related to emergency support</td>
<td>No change</td>
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<tr>
<td>Policy</td>
<td>Land use plan</td>
<td>Building again in high-hazard area (i.e., schools, hospital, NWS)</td>
<td>Enforce sensible use of land use plan and zoning; assess on paper but in reality is different (i.e., zoning)</td>
<td>Enforce code, consistency in code, implement new code. 1. approve new land use regulations with strong focus on risk zones</td>
<td>No change</td>
<td></td>
</tr>
<tr>
<td>Preparedness</td>
<td>People inadequately prepared for Categories 4 or 5 hurricanes</td>
<td>Preparing for something you haven't experienced, increased challenge.</td>
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<tr>
<td><strong>Preparedness</strong></td>
<td>Prior close calls gave a false sense of security &amp; resources were moved to VI to deal with Irma</td>
<td>Education / outreach, use Maria as an example while fresh in memories, For Tsunami: prepare models and videos of what it would look like (overlay culturally significant places), storm surge water marks / signage (Keep reminders of physical damage), Art projects. Media and education campaign</td>
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</tr>
<tr>
<td><strong>Lack of Emergency planning</strong></td>
<td>Starting from family, community, local, regional.</td>
<td>Table top exercise to improve plan, use available funding and follow through, involve local level. Creative solutions like addressing faith based orgs), capitalizing on existing program infrastructure, community leaders, create plans in daily life (daycare, work, school with continuity)</td>
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<td></td>
<td>Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)</td>
<td>Some - hurricane gives family level planning, Tsunami = &quot;save self mindset&quot;,</td>
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<tr>
<td>Challenge Category</td>
<td>Identified Response Challenge</td>
<td>Explanation/Description</td>
<td>Lessons Learned</td>
<td>Improvement(s) (Actionable Tasks)</td>
<td>How does approach change with respect to Tsunami vs. Hurricane</td>
<td>Comments</td>
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<tr>
<td>Communication</td>
<td>Communication with small communities</td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community (municipalities)</td>
<td>Be aware of language and culture needs. Post flyers. Centralized information in public location. Verifying the community leaders. Pre-training at the community level.</td>
<td>Both</td>
<td>What to do if community is totally isolated and unable to access information.</td>
</tr>
<tr>
<td>Policy</td>
<td>Policy guidelines need to be revisited due to change and new technology, climate change etc.</td>
<td>Better integrate green technologies, climate change consideration into existing policies for funding and mitigation.</td>
<td>These policies need to be revised before an incident</td>
<td>High-level policy agreement on existing FEMA public assistance, mitigation and recovery policies.</td>
<td>Both</td>
<td>Coasts on island are particularly important.</td>
</tr>
<tr>
<td>Preparedness</td>
<td><strong>People inadequately prepared for Categories 4 or 5 hurricanes</strong></td>
<td>Use consistent vocabulary. Agencies should be responsible/aware for their own coverage/vocabulary. Host workshops/training on funding/grant writing/petitions/procurement/opportunities. Include the local emergency coordinators along with the state and mayors at annual meeting for training (not limited to local authority). Training of federal grant submission (preparedness). Improve liaison outreach/communication.</td>
<td>Both</td>
<td>This might be unique to Puerto Rico.</td>
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<tr>
<td><strong>Other Funding Agencies (OFA) need to be assertive in their supplemental funding requests</strong></td>
<td>There are some things FEMA cannot fund</td>
<td>You snooze, you lose</td>
<td>Both</td>
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</tbody>
</table>
Rapid assessments of damage/debris were critical. Be bold on initial assessment. Baseline for FEMA to consider funding opportunities. Areas/communities that had quick assessments made it easier to scope federal funding. Centralized application to collect assessment information multiple sectors. The public can report on their municipalities. Both

Inequity

Vulnerable population

Disabled/sick/elderly people were stuck in place

Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources

This goes beyond just FEMA. Post and report storm information i.e., #hurricanemaria (include GPS). Post-Tsunami survey guide is available. Language and culture must be taken into consideration.

Group C

<table>
<thead>
<tr>
<th>Challenge Category</th>
<th>Identified Response Challenge</th>
<th>Explanation/Description</th>
<th>Lessons Learned</th>
<th>Improvement(s) (Actionable Tasks)</th>
<th>How does approach change with respect to Tsunami vs. Hurricane</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Communication with small communities</td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
<td>Use of short wave radios (response), sat internet, power (generators)</td>
<td>same for both</td>
<td></td>
</tr>
<tr>
<td><strong>Contingency planning for emergency communication</strong></td>
<td>Back up communication routes, diverse ways to request help (e.g., internet not available)</td>
<td>Need more than standard communication (e.g., radio, paper map, ham radio)</td>
<td>Need of education on the technology used (be outside, pay fees for services), need power for sat phone, UHF, PA systems, use phones as communication with low wattage, solar powered hard drives</td>
<td>Invest and investigate in technologies, government can't fund all of it</td>
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</tr>
<tr>
<td><strong>Lack of Emergency planning</strong></td>
<td>Starting from family, community, local, regional.</td>
<td>Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)</td>
<td>Aggressive on pre plan-what is already there, educate the community, what should they do with supplies (have it ready before the event- bag of supplies, food, water, communication tools, etc.), have to train people on the concept</td>
<td>Same for both</td>
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<td></td>
</tr>
<tr>
<td><strong>Rapid assessments of damage/debris were critical. Be bold on initial assessment</strong></td>
<td>Baseline for FEMA to consider funding opportunities</td>
<td>Areas that had quick assessments made it easier to scope federal funding</td>
<td>Require prior base line, municipalities needed, pre plan for what we need to do (before and after), takes time for some response (why preparedness is so important), be able to grow food, apply for grants to building sick bank, communication center, etc.</td>
<td>Same for both</td>
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</tbody>
</table>

**Response**

**Lack of Emergency planning**

- Starting from family, community, local, regional.
- Local level preparedness plan created with central point of information.
- Need accountability w.r.t. response plans.
- Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations).
- Aggressive on pre plan-what is already there, educate the community, what should they do with supplies (have it ready before the event- bag of supplies, food, water, communication tools, etc.), have to train people on the concept.

**Rapid assessments of damage/debris were critical. Be bold on initial assessment**

- Baseline for FEMA to consider funding opportunities.
- Areas that had quick assessments made it easier to scope federal funding.
- Require prior base line, municipalities needed, pre plan for what we need to do (before and after), takes time for some response (why preparedness is so important), be able to grow food, apply for grants to building sick bank, communication center, etc.

**Contingency planning for emergency communication**

- Back up communication routes, diverse ways to request help (e.g., internet not available).
- Need more than standard communication (e.g., radio, paper map, ham radio).
- Need of education on the technology used (be outside, pay fees for services), need power for sat phone, UHF, PA systems, use phones as communication with low wattage, solar powered hard drives.
- Invest and investigate in technologies, government can't fund all of it.
<table>
<thead>
<tr>
<th>Inequity</th>
<th>Vulnerable population</th>
<th>Disabled/sick/elderly people were stuck in place</th>
<th>Don’t wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources</th>
<th>Better assessment of who’s at risk (people in hospitals, nursing homes, etc.)</th>
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</thead>
<tbody>
<tr>
<td><strong>Group D</strong></td>
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<tr>
<td><strong>Challenge Category</strong></td>
<td><strong>Identified Response Challenge</strong></td>
<td><strong>Explanation/Description</strong></td>
<td><strong>Lessons Learned</strong></td>
<td><strong>Improvement(s) (Actionable Tasks)</strong></td>
</tr>
<tr>
<td>Communication</td>
<td>Communication with small communities</td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
<td>1. Take information to community, and ask for feedback. 2. Which sources of social media are used? 3. Investigate which app are applicable to community, and use contact point to distribute information 4. pick a central location/focal point to distribute information and time for briefing</td>
</tr>
<tr>
<td>Communities relying on social media and not official sources of information</td>
<td>Lack of exposure for official sources, too much exposure for other information</td>
<td>More outreach about what official sources of information are</td>
<td>1. do community outreach on official sources of information, who and how to access official information</td>
<td></td>
</tr>
<tr>
<td><strong>Contingency planning for emergency communication</strong></td>
<td>Back up communication routes, diverse ways to request help (e.g., internet not available)</td>
<td>Need more than standard communication (e.g., radio, paper map, ham radio)</td>
<td>1. Encourage folks to get amateur/ham radio license. 2. Preposition sat phones, work with technology companies to develop low tech solutions 3. Training/drills</td>
<td>Useful for both situations</td>
</tr>
<tr>
<td><strong>Communication of the severity danger/potential risk</strong></td>
<td>Having public understand the risk; people think they are lucky, manage expectations, warning fatigue. &quot;Burn out&quot;- desensitizing of alarms</td>
<td>Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond. Take culture into account when designing communication lines</td>
<td>1. Show damage from previous storms, and consistent messaging each season. 2. Less emotion when messaging, keep message calm to prepare rather than scare community</td>
<td>Use for both situations</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>Lack of and enforcement of residential building codes</td>
<td>Building codes not enforced, and people did not understand homes were unsafe</td>
<td>More damage and loss of life due to unsafe structures</td>
<td>1. Messaging related to maintaining a safe structure, not exclusively collecting water. 2. Critical infrastructure should be evaluated 3. Properly use federal funds to repair and maintain infrastructure</td>
</tr>
<tr>
<td>Logistics</td>
<td>Port accessibility is limited during response because of existing laws</td>
<td>Professional education, assessment of curriculum in all academic settings</td>
<td>Lack of access to clean water</td>
<td>1. Education on rainwater harvesting, the importance of it. 2. Improve residential water collection to maintain a reserve. 3. Education on low cost filters (e.g., sand). 4. Education on maintenance of individual water sources. 5. Proper installation of tanks/cisterns.</td>
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<td>Logistics</td>
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<td>Lack of access to clean water</td>
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<td>Preparedness</td>
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<tr>
<td><strong>Lack of Emergency planning</strong></td>
<td>Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)</td>
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</tr>
<tr>
<td>Starting from family, community, local, regional.</td>
<td>1. Re-institute CERT program in schools, churches, communities, 2. Use in coordination with neighborhood watch programs, 3. use &quot;nextdoor&quot; type apps,</td>
<td></td>
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<tr>
<td><strong>Lack of pre-scripted mission assignments</strong></td>
<td>The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies</td>
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<tr>
<td>Minimize duplication of efforts</td>
<td>1. Do more outreach with state/territory/govt level to educate about what they can ask for in terms of mission assignments 2. looking back at historical lessons, to drive assessments</td>
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<tr>
<td><strong>Inequity</strong></td>
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<td><strong>Vulnerable population</strong></td>
<td>Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources</td>
<td></td>
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</tr>
<tr>
<td>Disabled/sick/elderly people were stuck in place</td>
<td>1. Census data/demographic data to focus efforts and identified during emergency preparedness planning to create a special needs plan. 2. Compliance checks done in low income communities, first. 3. Recommendations for</td>
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<td>Evacuation plan may vary between T and H</td>
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<td>Time of day may influence who is present in the community, family plan would identify who is</td>
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<td>improvements rather than fines. 4. Messages tailored to underserved communities.</td>
<td>available during the day vs. night.</td>
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</table>
## Appendix D – Breakout Session III

### Group A

<table>
<thead>
<tr>
<th>Challenge Category</th>
<th>Identified Response Challenge</th>
<th>Explanation/Description</th>
<th>Lessons Learned</th>
<th>Recommendation for Implementation</th>
<th>Ease of Implementation (1=easy, 5=hard)</th>
<th>Coordination w. Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Communication with small communities</td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
<td>1a. Evaluate/find existing data (private and public), (identify orgs already doing work in community) 1b. Visiting communities to document needs and points of contact (2)</td>
<td>2.5</td>
<td>Academia, NGOs, Community based orgs with established gov/commonwealth/territory partnership for information sharing</td>
</tr>
<tr>
<td>Communication</td>
<td>Communities relying on social media and not official sources of information</td>
<td>Lack of exposure for official sources, too much exposure for other information</td>
<td>More outreach about what official sources of information are</td>
<td>1. team (graphic artist, website builder, science communication expert, marketing specialist, social media expert)</td>
<td>1</td>
<td>PREMA &amp; VITEMA, academia or other private partners at local level</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Lack of access to clean water</td>
<td>No redundant water for residents/no cisterns</td>
<td>Ran out of water</td>
<td>1. create tax incentives to make collection/filtration more widespread 2. educate on proper use of water catchment filtration systems</td>
<td>1. 2.5 2.1</td>
<td>Homeowner association, private industry, engineering organizations, academia, government, SME (Small Medium Enterprise) incubators</td>
</tr>
<tr>
<td><strong>Current infrastructure was/is not hurricane ready</strong></td>
<td>roads, power lines, etc.</td>
<td>maintain/update infrastructure to withstand hurricanes</td>
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<td>Government and engineering organizations, insurance industries, community involvement/participation</td>
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<tr>
<td><strong>Poorly maintained infrastructure</strong></td>
<td>E.g., failure of infrastructure (water); waiting for govt to maintain infrastructure</td>
<td>Empowering communities to take accountability/responsibility of infrastructure</td>
<td>Create courses and certifications, mandate training. Build cat 4&amp;5 rated buildings and implement best practices for Tsunami resilience</td>
<td>4</td>
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<tr>
<td><strong>High turnover within leadership position and trained personnel; limited capacity for multiple, simultaneous disasters</strong></td>
<td>Competition for resources. Trained/experienced resources. Turnover of political/experienced/burn out staff. Don't restructure the organization during a disaster</td>
<td>Climate change could lead to stressors to staff/resources/retention. Need local level leaders-educated through trainings. Minimize turnover.</td>
<td>1. curriculum development (at all levels)</td>
<td>2.5</td>
<td>Academia &amp; dept. of education</td>
<td></td>
</tr>
<tr>
<td>Logistics</td>
<td><strong>Port accessibility is limited during response because of existing laws</strong></td>
<td>San Juan is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.</td>
<td>Necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that (e.g., turn off taxation during response.)</td>
<td>1. conduct study and analyze potential impacts of change</td>
<td>Academia, think-tank</td>
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<tr>
<td>Policy</td>
<td><strong>Land use plan</strong></td>
<td>Building again in high-hazard area (i.e., schools, hospital, NWS)</td>
<td>Enforce sensible use of land use plan and zoning; assess on paper but in reality is different (i.e., zoning)</td>
<td>1. Meet with risk experts and planning board to ensure best practices</td>
<td>4</td>
<td>local and state gov., (Permitting agencies, municipalities), community feedback</td>
</tr>
<tr>
<td>Preparedness</td>
<td><strong>People inadequately prepared for Categories 4 or 5 hurricanes</strong></td>
<td>Prior close calls gave a false sense of security &amp; resources were moved to VI to deal with Irma</td>
<td>Should prepare regardless of category level</td>
<td>Community involved: award competitions for campaign, education outreach all ages involved. Conduct for both hurricane and tsunamis at schools, mass media, higher ed. Institutions</td>
<td>2.5</td>
<td>All</td>
</tr>
</tbody>
</table>
Lack of Emergency planning

Starting from family, community, local, regional.

Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)

Project based learning platforms, find and edit existing checklists that can be PR relevant and distribute, emulate other places with similar programs, Create emergency management education program for communities at all levels year-round

2.5

Group B

<table>
<thead>
<tr>
<th>Challenge Category</th>
<th>Identified Response Challenge</th>
<th>Explanation/Description</th>
<th>Lessons Learned</th>
<th>Recommendation for Implementation</th>
<th>Ease of Implementation (1=easy, 5=hard)</th>
<th>Coordination w. Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Communication with small communities</td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community (municipalities)</td>
<td>In community workshops with community leaders and focus on rural and underserved communities.</td>
<td>2</td>
<td>NGOs, local emergency mgmt. organizations, faith-based orgs, schools &amp; universities.</td>
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</tbody>
</table>
Policy guidelines need to be revisited due to change and new technology, climate change etc.

Better integrate green technologies, climate change considerations into existing policies for funding and mitigation.

These policies need to be revised before an incident.

GAO-focus group. Agency feedback to GAO and FEMA. Agencies/academia provide information on how green infrastructure fits into FEMA facilities.

Policy

Other Funding Agencies (OFA) need to be assertive in their supplemental funding requests

There are some things FEMA cannot fund

You snooze, you lose

Interagency training on procedures of funding opportunities. Create a survey (to commonwealth agencies) to gather post-event lessons learned on supplemental grant processes. Federal agencies aware of supplemental funding opportunities (grant, special project funding) and responsible for requests relative to their mandates. Federal agencies should be prepared with requests to

4

Federal agency. Ongoing GAO focus group on Maria. Universities

3

Federal agencies. Commonwealth is unique in that funding budget does not allow for
<table>
<thead>
<tr>
<th>Preparedness</th>
<th>People inadequately prepared for Categories 4 or 5 hurricanes</th>
<th>Congress for supplemental funding according to their agency mandates.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior close calls gave a false sense of security &amp; resources were moved to VI to deal with Irma</td>
<td>Social science (this is not a technical problem) how we can improve transfer of information. Research the effectiveness of training/translation. Implement NWS Storm Ready. Expand CERT to include specific training to community (i.e., storm surge, flood)</td>
<td>4</td>
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<tr>
<td>Should prepare regardless of category level</td>
<td></td>
<td>YES (NWS etc.)</td>
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<table>
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<tr>
<th>Lack of pre-scripted mission assignments</th>
<th>The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies</th>
<th>Agencies review what they have currently. Agencies develop new ones as appropriate. Conduct exercise to review and update PSMAs. Develop checklist for</th>
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<tr>
<td>Minimize duplicity of efforts.</td>
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<td></td>
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<td>Federal Agencies, state and local</td>
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</tbody>
</table>
## recommendations

**Response**

- **Rapid assessments of damage/debris were critical. Be bold on initial assessment**
  - Baseline for FEMA to consider funding opportunities.
  - Areas/communities that had quick assessments made it easier to scope federal funding.
  - Implement #hashtag.
  - Field exercise like CARIBEWAVE.
  - Develop app (see SERT-FL).

<table>
<thead>
<tr>
<th>Coordination w. Partners</th>
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<tbody>
<tr>
<td>Coordinators, NWS, FEMA, multi-agencies.</td>
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</table>

## Group C

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<thead>
<tr>
<th>Challenge Category</th>
<th>Identified Response Challenge</th>
<th>Explanation/Description</th>
<th>Lessons Learned</th>
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</thead>
<tbody>
<tr>
<td>Communication</td>
<td><strong>Communication with small communities</strong></td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
<td>Equipment compatibility</td>
<td>3</td>
<td>state level</td>
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<tr>
<td>Policy</td>
<td>Contingency planning for emergency communication</td>
<td>Interpersonal-layers of bureaucracy slowed progress</td>
<td>Lack of Emergency planning</td>
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<td></td>
<td>Back up communication routes, diverse ways to request help (e.g., internet not available)</td>
<td>Politics getting in the way of progress</td>
<td>Local level preparedness plan created with central point of information. Need accountability W.R.T. response plans. Pre-emergency planning to include local law enforcement and impartial</td>
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<td></td>
<td>Need more than standard communication (e.g., radio, paper map, ham radio)</td>
<td>Need to identify an authority- in past only identified problem</td>
<td>(1) Educate- workshops to build the knowledge for the local leaders to bring back to their communities (e.g., kids can take it home to their families), break up the workshops into regions to allow more people to attend (for different cultures), NOAA office for coastal management. (2) Outreach- media blitz (ads at the movies, on roads, radios, TV stations, at stores), public and private classes (home improvement stores), youth organizations (boy scouts, girl scouts, etc.), these need to be on how to prepare for these events. (3) Goal is to create self-sufficient communities. Put</td>
<td>3</td>
<td>community levels, NGO, Universities, media outlets, photo journalist workshops</td>
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<td></td>
<td>Training and education, map of who is able to educate. Being able to buy, use, and maintain the equipment. Use universities</td>
<td>People need to know their jobs (checklist), communication to avoid different decisions being made, held accountable by making sure people report problems (investigation), teams of public oversight to help. This might not help everyone but it could in the future. Turn over the information to theirs and new leaders (who has that information for when you are gone?)</td>
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<td>4</td>
<td>state level</td>
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<td>all levels (state municipalitie s)</td>
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<tr>
<td>Response</td>
<td>Vulnerable population</td>
<td>Inequity</td>
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<td><strong>Rapid assessments of damage/debris were critical. Be bold on initial assessment</strong></td>
<td>Baseline for FEMA to consider funding opportunities</td>
<td>Disabled/sick/elderly people were stuck in place</td>
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<td>Areas that had quick assessments made it easier to scope federal funding</td>
<td>Don't wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources</td>
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<td>Assessments, inventory, create culture</td>
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<td></td>
<td>4.5</td>
<td>communities, state, and municipalities</td>
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<td></td>
<td>all levels</td>
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<td><strong>Communication</strong></td>
<td>Communication with small communities</td>
<td>Lacked proper terminology to inform community</td>
<td>Post emergency communication needs to be simple and tailored to community</td>
<td>Be targeted (e.g., agencies and groups developing message, can plan events such as town hall) and opportunistic (e.g., if community is having an event, use the event to share information). Use an event organized by the community (especially with food and activities)</td>
<td>2.5</td>
<td>Communities/municipalities leaderships (e.g., mayor, elected political officials); grassroots community organizations (e.g., churches). Official message developers (e.g., NWS, FEMA, local emergency management- PREMA, VITEMA). SeaGrant</td>
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<td></td>
<td>Communities relying on social media and not official sources of information</td>
<td>Lack of exposure for official sources, too much exposure for other information</td>
<td>More outreach about what official sources of information are</td>
<td>Be targeted (e.g., agencies and groups developing message, can plan events such as town hall) and opportunistic (e.g., if community is having an event, use the event to share information). Use an event organized by the community (especially with food and activities)</td>
<td>2.5</td>
<td>Pre- events --&gt; same partners as Comm 2</td>
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<tr>
<td><strong>Contingency planning for emergency communication</strong></td>
<td>Back up communication routes, diverse ways to request help (e.g., internet not available)</td>
<td>Need more than standard communication (e.g., radio, paper map, ham radio)</td>
<td>Connect with university/radio clubs. Identify funding source/opportunities. Demonstrations to solicit interest, go to events and set up table. Stories/outreach about why some communities were better off post disaster because had sat phones/ham. Continuing education, training</td>
<td>5 (technical skills and need buy in, might still be problem with sat phone in PR)</td>
<td>Federal communications commission (FCC), ARRL - amateur radio relay league, emergency management agency, amateur radio clubs, local technical university (e.g., electrical engineering)</td>
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<tr>
<td><strong>Communication of the severity danger/potential risk</strong></td>
<td>Having public understand the risk; people think they are lucky, manage expectations, warning fatigue. &quot;Burn out&quot;- desensitizing of alarms</td>
<td>Because of the size of the island, confidence in the forecast/warning; people get desensitized with many hurricanes missing Puerto Rico; so many warnings with nothing happening, people choose not to respond. Take culture into account when designing communication lines</td>
<td>Create traveling exhibit of how things went wrong and why you should be prepared; vivid, be targeted and opportunistic. Creating videos/photo show</td>
<td>2.5</td>
<td>Communities/municipalities leaderships (e.g., mayor, elected political officials); grassroots community organizations (e.g., churches). Official message developers (e.g., NWS, FEMA, local emergency management- PREMA, VITEMA). SeaGrant</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Lack of and enforcement of residential building codes</td>
<td>Building codes not enforced, and people did not understand homes were unsafe</td>
<td>More damage and loss of life due to unsafe structures</td>
<td>Detailed assessment of critical infrastructure; meeting with engineers/architects in municipalities to go around communities to identify most important aspect of a structure. Different source of funding for public, private and municipal</td>
<td>5</td>
<td>Municipal architects/engineers; FEMA capacity build sector;</td>
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<tr>
<td>Lack of access to clean water</td>
<td>No redundant water for residents/no cisterns</td>
<td>Ran out of water</td>
<td>New construction require redundant water systems, existing construction improve collection systems, create document/demonstration for rainwater harvesting; low cost, implement at a few locations within the community to encourage community members to copy. educating about how to clean water/maintain system</td>
<td>sliding scale (depends on technology of choice)</td>
<td>local water company, non-profits, private business, commonwealth/territory/municipality responsible for building codes</td>
<td></td>
</tr>
<tr>
<td>Logistics</td>
<td>Port accessibility is limited during response because of existing laws</td>
<td>San Juan is major port for food/resource s coming to PR. Other ports are used for petroleum products, coal.</td>
<td>Necessary aid could not be distributed/get to local communities quick enough. Circumvent barriers using emergency declaration to streamline that</td>
<td>Have diverse ports, capable of handling other goods; back-up port for response operations. Policy shift by port authority by diversifying use of port. Contingency plans to have more than one viable port available.</td>
<td>5</td>
<td>port authority, govt of PR, private industry</td>
</tr>
<tr>
<td><strong>Marine/land debris hindered by lack of staging areas and logistics</strong></td>
<td>See Florida plans for an example</td>
<td>Need pre-identified staging areas</td>
<td>Identifying locations ahead of time in contingency plans,</td>
<td>1.5-2</td>
<td>FEMA, USCG, local agencies, NOAA Marine Debris, Public Works</td>
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</tr>
<tr>
<td><strong>Lack of Emergency planning</strong></td>
<td>Starting from family, community, local, regional.</td>
<td>Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and impartial parties (e.g., NGO, faith based organizations)</td>
<td>Look to VITEMA model to replicate, find more avenues of socializing information; demonstrations in communities during events, continued community outreach. Improve consistency of delivery. Institutionalizing self-reliance (i.e., stop relying on federal govt to make fixes)</td>
<td>1.5-2</td>
<td>Local agencies, emergency management agencies, FEMA, school system/education system, community members</td>
<td></td>
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<tr>
<td>Lack of pre-scripted mission assignments</td>
<td>The more pre-scripted mission assignments, the quicker response activities can commence and provides training opportunities within agencies. Involve private sector during contingency plans. Make the link on how to support municipalities/local organizations (e.g., transportation/gas/food). Keep hazard mitigation plan up to date. Educate commonwealth about FEMA missions to determine what can be asked for. FEMA relies on guidance from local govt level. Inform what can be asked for (e.g., guidance document/lessons learned).</td>
<td>5</td>
<td>Commonwealth/local govt (e.g., hazard mitigation office), FEMA, local management agencies (e.g., coastal agencies, all-encompassing plan), port authorities, schools, local chamber of commerce, private businesses</td>
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<tr>
<td>Private sector was not preemptively involved</td>
<td>Private sector often has resources it can contribute to response effort—have resources and assets connected at all levels.</td>
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<td>Multiple companies get hired or one primary contractor with sub-contractors. Advanced contracting initiatives for pre-planned contracts. List for potential companies available if needed pre-, during, post-disaster.</td>
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<td>Inequity</td>
<td>Disabled/sick/elderly people were stuck in place</td>
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<td>Sliding scale</td>
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<td>Vulnerable population</td>
<td>Don’t wait until hospital is impacted to make decisions/hospital need redundant or back up energy sources.</td>
<td>5</td>
<td>Census bureau, social services, health and human services, local law enforcement, local emergency response management, planning and development agency.</td>
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</table>
Tsunami Risk Communication Exercise

NOAA NRPT LEARNING FROM THE PAST AND MOVING FORWARD: RESPONSE CHALLENGES FROM SEVERE WEATHER OR TSUNAMIS TO SHARED TRUST RESOURCES AND MISSION RESPONSIBILITIES

San Juan, PR
April 23-25, 2019

Christa von Hillebrandt-Andrade and Carolina Hincapié
NOAA NWS Caribbean Tsunami Warning Program
U.S. Tsunami Warning System Communications Diagram

http://tsunami.gov
Communication Methods

Para recibir mensajes del PTWC con productos del Caribe, enviar un Txt al 40404 y escribir en el mensaje: Follow NWS_CTWP

Shorter Messages

• Order of Message Content is Important
• 90 characters (current WEA):
  • Source, guidance, hazard, location, time
• 280 – 360 character (eg. Twitter):
  • Source, hazard, location, time and guidance

NOAA Central Library: Creating Alerts and Warnings for Short Messaging Channels
Speakers: Jeannette Sutton, Ph.D., Associate Professor, Department of Communication, University of Kentucky & Erica Kuligowski, PhD, Research Social Scientist, Engineering Laboratory, National Institute of Standards and Technology, April 24, 2019

https://www.youtube.com/watch?v=MH3uBclHezE
Wireless Emergency Alerts

• **Current:** Tsunami danger on the coast. Go to high ground or move inland. Listen to local news. –NWS

• Proposed (English/Spanish):
  NWS: Tsunami danger on the coast. Move to high ground or inland now.
  SNM: Peligro de tsunami. Vaya a un lugar alto o tierra adentro ahora.

• Proposed (Longer Message English/Spanish)
  The National Weather Service has issued a tsunami warning. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high ground or inland now. Keep away from the coast until local officials say it is safe to return. Check local media for more information after you are safe.

Official Roles for Tsunami Warning Process

• Tsunami Warning Center – Responsible for determining alert level and issuing message
  • Pacific Tsunami Warning Center

• Tsunami Warning Focal Point – Responsible for disseminating Official Alerts to authorities and public
  • PR State Emergency Management Bureau is the Primary Tsunami Warning Focal Point for Puerto Rico, IPAWS (WEA), VHF Radio
  • VITEMA/911 is the Primary Tsunami Warning Focal Point for US Virgin Islands
  • NWS SJFO – Secondary Tsunami Warning Focal Point for PR and USVI – activate NOAA Weather Radio and EAS, Social Media
  • PRSN – Secondary Tsunami Warning Focal Point for PR and USVI, RSS, Website, Social Media, VHF Radio, Ham Radio

• USCG – Responsible for disseminating alert to boaters/maritime community
Roles During Exercise

• CTWP act as PTWC
• TWFP act as TWFP
• USCG acts as USCG
• Others are Social Influencers during warning, assume agency roles from Cancellation onward
• Define where you are in PR/VI or outside of PR
Enabling Learning Objectives

1. Familiarization with Tsunami Warning Center products and timelines
2. Improve the communication of the threat message in PR/USVI by official TWFP and social influencers.
3. Will focus on four stages of warning:
   • Response to Earthquake shaking
   • Tsunami Warning
   • Tsunami Confirmation
   • Warning Cancellation
   • All Clear
Overview and Instructions

• Comms based on natural signs (Activity 1 – 30 min)
• Comms with Message #1 (Activity 2 – 30 min)
• Comms with Message # 3 (Activity 3 – 30 min)
• Comms with Message # 8 (Activity 4 – 30 min)
• Comms for Response/All Clear (Activity 5 – 30 min)

• Working Groups established previously – ONLY Activity 1 to do individually.
• No communication between groups or consultation with facilitators.
• Mimic time during real event
• Write down your responses/message according to the time stipulated.
Group Learning Scenario Exercise

- Activities simulate M7.9 earthquake NE of Puerto Rico
- Earthquake occurs in Puerto Rico Trench, where North American Plate subducts under Caribbean Plate
Scenario Activity 1

• Strong earthquake shaking is felt, 11:00 PM
• Some buildings have collapsed.
• Phones lines are immediately jammed as everyone tries to find out what happened.
• No TWC messages have been issued yet.
Scenario Activity 1 Questions

Including earthquake, you have 3 minutes for action (all individual), 20 minutes group discussion

1. How do you respond to the earthquake?
2. What do you think is going to happen, number the risks.
3. What can you communicate, to Who and How are you going to do it.

Tsunami Warning Focal Point respond as Tsunami Warning Focal Point, USCG as USCG others as a social influencer
Scenario Activity 2

• Time 11:03

• PTWC message #1 issued

• Telephones are jammed, Social Media is viral

• Earthquake impact has been significant.
Scenario Activity 2 Questions
5 minutes to determine action, 15 minutes group discussion

1. What and How did you receive the official product?
2. What is the alert level?
3. What is the expected time of arrival of the tsunami?
4. What, to Who, How and When are you going to communicate.

Tsunami Warning Focal Point respond as Tsunami Warning Focal Point, USCG as USCG others as a social influencer
Scenario Activity 3

• It is 11:55 PM

• PTWC message #3 is issued

• Media reports the tsunami is inundating the U.S. Virgin Islands and Puerto Rico.

• Media reports people flocking to beaches to watch the arrival of the tsunami. This is causing coastal evacuation problems.
Scenario Activity 3 Questions
5 minutes for action, 15 minutes group discussion

1. What important new information does the message include?
2. What, to Who, How and When are you going to communicate.

Tsunami Warning Focal Point respond as Tsunami Warning Focal Point, USCG as USCG, others as a social influencer
Scenario Activity 4

• It is 0225 AM

• PTWC message #8 is issued

• Media reports the tsunami has inundated Puerto Rico coasts.

• People are wanting to enter to the evacuated areas.
Scenario Activity 4 Questions

5 minutes for action, 5 minutes group discussion

1. What important new information does the message include?
2. What, to Who, How and When are you going to communicate.

Tsunami Warning Focal Point respond as Tsunami Warning Focal Point, USCG as USCG, others as a social influencers/assume agency role
Scenario Activity 5

- PR Governor press conference at 7 AM
- Initial report of the event and its effects.
- Informs that EM Officials are in field doing the corresponding evaluations and will be issuing the all clear in a further intervention.
- Curfew for other citizens
Scenario Activity 5 Questions

10 minutes for group discussion

1. What is the government guidance?
2. What are additional information sources?
3. What, to Who, How and When are you going to communicate.
4. What will be the roles in response?

Everyone assumes agency role
Summary

• Discussed the impact of a local tsunami to at-risk tsunami communities along the coast.
• Examined the types of Tsunami Warning Center messages in the scenario
• Considered type, timing, audience and mechanism for communications
Hurricane Exercise

NOAA Regional Preparedness and Training (NRPT)

April 25, 2019

Guaynabo, PR
• Provide an opportunity to familiarize with the NOAA National Weather Service and NOAA National Hurricane Center products during the preparation, response and recovery phase from a major hurricane that impacted Puerto Rico.

• Explain Hurricane Threats based on the reasonable worst-case scenario using plain language.

• Understand the time in which individuals can safely assume they will have to prepare for TC force winds.
WFO Knowledge of Potential Peak Impacts

Very Long-term
- Climatology/Statistics
- Seasonal Outlooks
- Preparedness Talks
- MOM

Long-term
- HWO, PNS, EM Briefings
- Media Interviews, Social Media
- NHC Wind Speed Probabilities (5 days)
- MOM, MEOW

Long-term
- Hurricane Watch, Hurricane Warning, HLS, TCV, EM Briefings
- Media Interviews, Social Media
- NHC Wind Speed Probabilities
- Probabilistic Storm Surge
- Potential Storm Surge Flooding Map

Short-term
- HLS, TCV, and other short-term products

User Needs - Plan/Prepare
- 168 Day 7
- 120 Day 5
- 72 Day 3
- 48 Day 2
- 24 Day 1

Implement According to Plan
- Last Chance

0 Hours Until Peak Impact

Recovery

Very Short-term EWW

NWS/NOAA

WFO San Juan
For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Hurricane Jose, located several hundred miles east-northeast of the southeastern Bahamas.

1. A tropical wave located about 800 miles southwest of the Cabo Verde Islands continues to produce widespread showers and thunderstorms. Environmental conditions are expected to be conducive for gradual development of this system, and a tropical depression could form early next week while it moves westward at around 15 mph across the tropical Atlantic.
   * Formation chance through 48 hours...low...20 percent.
   * Formation chance through 5 days...medium...60 percent.
For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Tropical Storm Jose, located over the southwestern Atlantic Ocean, and on newly developed Tropical Depression Fourteen, located over the eastern Atlantic Ocean.

1. A tropical wave located about 1200 miles east-southeast of the Lesser Antilles continues to produce disorganized showers and thunderstorms. Environmental conditions are expected to be conducive for gradual development, and a tropical depression is likely to form early next week. Interests in the Lesser Antilles should closely monitor the progress of this system while it moves westward to west-northwestward at about 15 mph.
   * Formation chance through 48 hours...medium...40 percent.
   * Formation chance through 5 days...high...80 percent.
Tropical Weather Outlook
NWS National Hurricane Center Miami FL
200 AM EDT Sat Sep 16 2017

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Hurricane Jose, located several hundred miles southwest of Bermuda, and on Tropical Depression Fourteen, located over the eastern Atlantic Ocean.

1. Showers and thunderstorms associated with a tropical wave located about 800 miles east of the Windward Islands have continued to become better organized. Environmental conditions are conducive for additional development and a tropical cyclone could form at any time today or Sunday so while the system moves westward or west-northwestward around 20 mph. Interests in the Lesser Antilles and northeastern Caribbean should closely monitor the progress of this system. Tropical storm or hurricane watches could be issued for portions of the Lesser Antilles later this morning.
   * Formation chance through 48 hours...high...90 percent.
   * Formation chance through 5 days...high...90 percent.
Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.

Potential Tropical Cyclone Fifteen
Saturday September 16, 2017
11 AM AST Advisory 1
NWS National Hurricane Center

Current information: 
Center location 12.2 N 50.5 W
Maximum sustained wind 35 mph
Movement W at 22 mph

Forecast positions:
● Tropical Cyclone
○ Post/Potential TC
Sustained winds:
D < 39 mph
S 39-73 mph
H 74-110 mph
M > 110 mph

Potential track area:
Day 1-3
Day 4-5

Watches:
Hurricane
Trop Stm

Warnings:
Hurricane
Trop Stm

Current wind extent:
Hurricane
Trop Stm
Module 1: Pre-Storm

What should be considered when interpreting the Potential Tropical Cyclone Forecasts?

- It is issued only for systems threatening land within the watch/warning time period.
- Earlier NHC advisories for systems that pose a long-range threat to the United States, or other land areas.
- Forecasts are likely to have greater uncertainty!
Model Guidance forecast track (Internal)
Model Guidance intensity forecast (Internal)
Module 1: Pre-Storm

What storm surge product should be used for planning purpose?

- MOMs - Maximum of MEOWs
  - Used in planning to design evacuation zones and operationally when uncertainty is high

- MEOWs - Maximum Envelope of Water
  - Used operationally when you can narrow down to specific scenarios
National Storm Surge Hazard Maps

This is not a real-time product. For active tropical cyclones, please see hurricanes.gov and consult local products issued by the National Weather Service.

Texas to Maine  Puerto Rico and U.S. Virgin Islands  Hawaii  Hispaniola

Puerto Rico and USVI Category 1  Puerto Rico and USVI Category 2  Puerto Rico and USVI Category 3  Puerto Rico and USVI Category 4  Puerto Rico and USVI Category 5

This national depiction of storm surge flooding vulnerability helps people living in hurricane-prone coastal areas along the U.S. East and Gulf Coasts, Puerto Rico/USVI, Hawaii, and Hispaniola to evaluate their risk to the storm surge hazard. These maps make it clear that storm surge is not just a beachfront problem, with the risk of storm surge extending many miles inland from the immediate coastline in some areas. If you discover via these maps that you live in an area vulnerable to storm surge, find out today if you live in a hurricane storm surge evacuation zone as prescribed by your local emergency management agency. If you do live in such an evacuation zone, decide today where you will go and how you will get there, and if and when you’re instructed by your emergency manager to evacuate. If you don’t live in one of those evacuation zones, then perhaps you can identify someone you care about who does live in an evacuation zone, and you could plan in advance to be their inland evacuation destination. If you live in a structure that is safe from the wind and outside of flood-prone areas.

Legend:
- Less than 3 feet above ground
- Greater than 3 feet above ground
- Greater than 6 feet above ground
- Greater than 9 feet above ground

How this map was created:
The SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model is a numerical model used by NWS to compute storm surge.

https://arcgis.com/1jHzP
This national depiction of storm surge flooding vulnerability helps people living in hurricane-prone coastal areas along the U.S. East and Gulf Coasts, Puerto Rico/USVI, Hawaii, and Hispaniola to evaluate their risk to the storm surge hazard. These maps make it clear that storm surge is not just a beachfront problem, with the risk of storm surge extending many miles inland from the immediate coastline in some areas. If you discover via these maps that you live in an area vulnerable to storm surge, find out today if you live in a hurricane storm surge evacuation zone as prescribed by your local emergency management agency. If you do live in such an evacuation zone, decide today where you will go and how you will get there, if and when you’re instructed by your emergency manager to evacuate. If you don’t live in one of these evacuation zones, then perhaps you can identify someone you care about who does live in an evacuation zone, and you could plan in advance to be their inland evacuation destination - if you live in a structure that is safe from the wind and outside of flood-prone areas.

### Colors
- **Less than 3 feet above ground**
- **Greater than 3 feet above ground**
- **Greater than 6 feet above ground**
- **Greater than 9 feet above ground**

---

[How this map was created](https://noaa.maps.arcgis.com/apps/MapSeries/index.html?appid=d9ed7904dbec441a9c4dd7b277935fad&entry=2)
Module 1: Pre-Storm

What are the typical NHC track errors?

- Average NHC track errors increase by about 35 to 40 nautical miles per day.
  - 2-day error ~ 75 n mi
  - 3-day error ~ 110 n mi
  - 4-day error ~ 160 n mi
  - 5-day error ~ 220 n mi
Module 2: Close to Landfall

How can you determine when preparation should be rushed to finished based on the arrival of tropical storm force winds?

- **Earliest Time of Arrival Graphic**
  - Time in which individuals can safely assume that they will have to prepare for tropical-storm force winds.

![Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds](image-url)
Module 2: Close to Landfall

What information provide the Most Likely Time of Arrival Graphic?

- Messaging Concept:
  - The expected, or most-likely time for the onset of tropical-storm force winds.
  - Individuals may have this much time, but shouldn’t plan on it.
Module 2: Close to Landfall

What is the difference between a hurricane watch and a warning?

- A warning means that hurricane conditions are **expected** whereas a watch means that conditions are **possible**.
  
  - A **Hurricane Watch** means that hurricane conditions (sustained winds of 74 mph or higher) are possible within the specified area. A **hurricane watch** is **issued 48 hours in advance** of the anticipated onset of tropical-storm-force winds in an area.

  - **Hurricane warnings** indicate that hurricane conditions (sustained winds of 74 mph or higher) are expected somewhere within the specified area. The **hurricane warning** is **issued 36 hours in advance** of the anticipated onset of tropical-storm-force winds to allow for important preparation.
Emergency alert: Extreme

Hurricane Warning this area. Check local media and authorities. -NWS

OK

Emergency alert: Severe

Flash Flood Warning this area til 6:15 PM AST. Avoid flood areas. Check local media. -NWS

OK
Module 2: Close to Landfall

Which product provide a good overview of the overall tropical impacts situation?

- **Hurricane Local Statement (HLS):**
  - Good overview of the overall tropical situation in a given CWA
  - Provides a summary of the worst impacts to plan for with areal descriptions

What It Does Not Represent.

- It contains no specific meteorological or threat information
- It is not detailed for decision makers
WTCA82 TJSJ 152332  
HLSSJU  
PRZ001>013-VIZ001-002-160745-  

HURRICANE HUGO LOCAL STATEMENT ADVISORY NUMBER 20  
NATIONAL WEATHER SERVICE SAN JUAN PR AL111989  
732 PM AST FRI SEP 15 1989  

...HURRICANE WATCH IN EFFECT FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS...  

NEW INFORMATION  
-----------------

* CHANGES TO WATCHES AND WARNINGS:  
  - A HURRICANE WATCH HAS BEEN ISSUED FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS.  

* CURRENT WATCHES AND WARNINGS:  
  - A HURRICANE WATCH IS IN EFFECT FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS.  

* STORM INFORMATION:  
  - ABOUT 740 MILES EAST-SOUTHEAST OF SAN JUAN PR OR ABOUT 670 MILES EAST-SOUTHEAST OF SAINT THOMAS VI  
  - 14.8N 55.5W  
  - STORM INTENSITY 150 MPH  
  - MOVEMENT WEST-NORTHWEST OR 285 DEGREES AT 21 MPH
POTENTIAL IMPACTS

* WIND:
PREPARE FOR LIFE-THREATENING WIND HAVING POSSIBLE DEVASTATING IMPACTS ACROSS PUERTO RICO AND THE US VIRGIN ISLANDS. POTENTIAL IMPACTS INCLUDE:
- STRUCTURAL DAMAGE TO STURDY BUILDINGS, SOME WITH COMPLETE ROOF AND WALL FAILURES. COMPLETE DESTRUCTION OF MOBILE HOMES. DAMAGE GREATLY ACCENTUATED BY LARGE AIRBORNE PROJECTILES. LOCATIONS MAY BE UNINHABITABLE FOR WEEKS OR MONTHS.
- NUMEROUS LARGE TREES SNMPED OR UPROOTED ALONG WITH FENCES AND ROADWAY SIGNS BLOWN OVER.
- MANY ROADS IMPASSABLE FROM LARGE DEBRIS, AND MORE WITHIN URBAN OR HEAVILY WOODED PLACES. MANY BRIDGES, CAUSEWAYS, AND ACCESS ROUTES IMPASSABLE.
- WIDESPREAD POWER AND COMMUNICATIONS OUTAGES.

* FLOODING RAIN:
PREPARE FOR DANGEROUS RAINFALL FLOODING HAVING POSSIBLE SIGNIFICANT IMPACTS ACROSS PUERTO RICO AND THE US VIRGIN ISLANDS. POTENTIAL IMPACTS INCLUDE:
- MODERATE RAINFALL FLOODING MAY PROMPT SEVERAL EVACUATIONS AND RESCUES.
- RIVERS AND TRIBUTARIES MAY QUICKLY BECOME SWOLLEN WITH SWifter CURRENTS AND OVERSPOIL THEIR BANKS IN A FEW PLACES, ESPECIALLY IN USUALLY VULNERABLE SPOTS. SMALL STREAMS, CREEKS, CANALS, ARROYOS, AND DITCHES OVEFlOW.
- FLOOD WATERS CAN ENTER SOME STRUCTURES OR WEAKEN FOUNDATIONS. SEVERAL PLACES MAY EXPERIENCE EXPANDED AREAS OF RAPID INUNDATION AT UNDERPASSES, LOW-LOYING SPOTS, AND POOR DRAINAGE AREAS. SOME STREETS AND PARKING LOTS TAKE ON MOVING WATER AS STORM DRAINS AND RETENTION PONDS OVERFLOW. DRIVING CONDITIONS BECOME HAZARDOUS. SOME ROAD AND BRIDGE CLOSURES.
Potential Impacts

* SURGE: PREPARE FOR LOCALLY HAZARDOUS SURGE HAVING POSSIBLE LIMITED IMPACTS ACROSS PUERTO RICO AND THE US VIRGIN ISLANDS. POTENTIAL IMPACTS IN THIS AREA INCLUDE:

- LOCALIZED INUNDATION WITH STORM SURGE FLOODING MAINLY ALONG IMMEDIATE SHORELINES AND IN LOW-LYING SPOTS, OR IN AREAS FARther INLAND NEAR WHERE HIGHER SURGE WATERS MOVE ASHORE.
- SECTIONS OF NEAR-SHORE ROADS AND PARKING LOTS BECOME OVERSPREAD WITH SURGE WATER. DRIVING CONDITIONS DANGEROUS IN PLACES WHERE SURGE WATER COVERS THE ROAD.
- MODERATE BEACH EROSION. HEAVY SURF ALSO BREACHING DUNES, MAINLY IN USUALLY VULNERABLE LOCATIONS. STRONG RIP CURRENTS.
- MINOR TO LOCALLY MODERATE DAMAGE TO MARINAS, DOCKS, BOARDWALKS, AND PIERS. A FEW SMALL CRAFT BROKEN AWAY FROM MOORINGS.

* TORNADOES:
PREPARE FOR A TORNADO EVENT HAVING POSSIBLE LIMITED IMPACTS ACROSS PUERTO RICO AND THE US VIRGIN ISLANDS. POTENTIAL IMPACTS INCLUDE:

- THE OCCURRENCE OF ISOLATED TORNADOES CAN HINDER THE EXECUTION OF EMERGENCY PLANS DURING TROPICAL EVENTS.
- A FEW PLACES MAY EXPERIENCE TORNADO DAMAGE, ALONG WITH POWER AND COMMUNICATIONS DISRUPTIONS.
- LOCATIONS COULD REALIZE ROOFS PEELED OFF BUILDINGS, CHIMNEYS TOPPLED, MOBILE HOMES PUSHED OFF FOUNDATIONS OR OVERTURNED, LARGE TREE TOPS AND BRANCHES SNAPPED OFF, SHALLOW-ROOTED TREES KNOCKED OVER, MOVING VEHICLES BLOWN OFF ROADS, AND SMALL BOATS PULLED FROM MOORINGS.
Precautionary Statements

PRECAUTIONARY/PREPAREDNESS ACTIONS

* EVACUATIONS:

IF YOU ARE EXCEPTIONALLY VULNERABLE TO WIND OR WATER HAZARDS FROM TROPICAL SYSTEMS, CONSIDER VOLUNTARY EVACUATION, ESPECIALLY IF BEING OFFICIALLY RECOMMENDED. RELOCATE TO A PREDETERMINED SHELTER OR SAFE DESTINATION.

* OTHER PREPAREDNESS INFORMATION:

NOW IS THE TIME TO CHECK YOUR EMERGENCY PLAN AND TAKE NECESSARY ACTIONS TO SECURE YOUR HOME OR BUSINESS. DELIBERATE EFFORTS SHOULD BE UNDERWAY TO PROTECT LIFE AND PROPERTY. ENSURE THAT YOUR EMERGENCY SUPPLIES KIT IS STOCKED AND READY.

WHEN MAKING SAFETY AND PREPAREDNESS DECISIONS, DO NOT FOCUS ON THE EXACT FORECAST TRACK AS THERE ARE INHERENT FORECAST UNCERTAINTIES WHICH MUST BE TAKEN INTO ACCOUNT.

IF YOU LIVE IN A PLACE THAT IS PARTICULARLY VULNERABLE TO HIGH WIND, SUCH AS A MOBILE HOME, AN UPPER FLOOR OF A HIGH RISE BUILDING, OR ON A BOAT, PLAN TO MOVE TO SAFE SHELTER. TAKE ENOUGH SUPPLIES FOR YOU AND YOUR FAMILY FOR SEVERAL DAYS.

VISITORS TO THE AREA SHOULD BECOME FAMILIAR WITH NEARBY SURROUNDINGS. IF YOU ARE A VISITOR, KNOW THE NAME OF THE COUNTY OR PARISH IN WHICH YOU ARE LOCATED AND WHERE IT IS RELATIVE TO CURRENT WATCHES AND WARNINGS. IF STAYING AT A HOTEL, ASK THE MANAGEMENT STAFF ABOUT THEIR ONSITE DISASTER PLAN. LISTEN FOR EVACUATION ORDERS, ESPECIALLY PERTAINING TO AREA VISITORS.

CLOSELY MONITOR NOAA WEATHER RADIO OR OTHER LOCAL NEWS OUTLETS FOR OFFICIAL STORM INFORMATION. LISTEN FOR POSSIBLE CHANGES TO THE FORECAST.

* ADDITIONAL SOURCES OF INFORMATION:
  - FOR INFORMATION ON APPROPRIATE PREPARATIONS SEE READY.GOV
  - FOR INFORMATION ON CREATING AN EMERGENCY PLAN SEE GETAGAMEPLAN.ORG
  - FOR ADDITIONAL DISASTER PREPAREDNESS INFORMATION SEE REDCROSS.ORG

NEXT UPDATE

THE NEXT LOCAL STATEMENT WILL BE ISSUED BY THE NATIONAL WEATHER SERVICE IN SAN JUAN PR AROUND 8 PM AST, OR SOONER IF CONDITIONS WARRANT.
Hurricane Threat and Impacts

Consist of four elements:

- Wind
- Storm surge
- Flooding rain
- Tornado

Provide the reasonable worst case scenario, taking into account the forecast magnitude of the hazard, along with the associated uncertainty of the forecast.

Grids are available at:

When is issued an Extreme Wind Warning (EWW)?

- It is only issued in association with major hurricanes.
- The criteria for an EWW is sustained surface winds of 115 mph or greater.
- The EWW is intended to alert the public to prepare for potentially life-threatening conditions.
Extreme Wind Warning

★ Major Hurricane Irma (Category 5)
★ Three (3) warnings were issued by WFO San Juan
★ September 6, 2017
BULLETIN - EAS ACTIVATION REQUESTED
Extreme Wind Warning
National Weather Service San Juan PR
354 AM AST WED SEP 20 2017

The National Weather Service in San Juan has issued a
* Extreme Wind Warning for...
  Vieques Municipality in Puerto Rico...
* Until 600 AM AST
* At 353 AM AST, National Weather Service Doppler radar indicated extreme winds, associated with the eyewall of Major Hurricane Maria is quickly approaching Vieques from the south. This is an extremely dangerous and life-threatening situation!

PRECAUTIONARY/PREPAREDNESS ACTIONS...
TAKE COVER NOW! Move immediately to the safe room in your shelter. Take action now to protect your life!

The safest place to be during a major landfalling hurricane is in a reinforced interior room away from windows. Get under a table or other piece of sturdy furniture. Use mattresses, blankets or pillows to cover your head and body. Remain in place through the passage of these life-threatening conditions.

&&
LAT...LON 1814 6530 1815 6529 1813 6527 1813 6531
  1811 6535 1812 6534 1813 6536 1811 6538
  1811 6544 1810 6542 1811 6545 1809 6544
  1810 6546 1809 6551 1808 6552 1808 6555
  1810 6558 1812 6557 1816 6540
TIME...MOT...LOC 0753Z 000DEG 0KT 1811 6551

$$
ER/GRH
Module 3: After landfall

Which is the difference between a Flash Flood Warning and a Flash Flood Emergency?

- A **Flash Flood Warning** is issued to inform that flash flooding is in progress, imminent, or highly likely. Flash Flood Warnings are urgent messages as dangerous flooding can develop very rapidly, with a serious threat to life and/or property.

- A **Flash Flood Emergency** is an exceptionally rare life-threatening situation.
  - Total failure of a major dam.
  - Multiple swift water rescue teams have been or are being deployed in response to flash flooding of an exceptional magnitude.
  - Water has rapidly risen or will rapidly rise to levels where people who are ordinarily in safe locations during previous flash flood events are now placed in life-threatening situations.
Module 4: Post-Storm

After warning and watches expired, what products are issued?

WFO-SJU returns to normal operations. Any weather hazard is then treated on a case by case scenario.

For example:
- Flash Flood Warning
- Coastal Flood Warning
- Severe Thunderstorm Warning
- Special Weather Statements
- Hazard Weather Outlook

If required, WFO-SJU will provide IDSS briefing in order to assist the recovery process.
Exercise Tools
Tropical Weather Outlook
NWS National Hurricane Center Miami FL
200 AM EDT Fri Sep 15 2017

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

The National Hurricane Center is issuing advisories on Tropical Storm Jose, located over the southwestern Atlantic Ocean, and on newly developed Tropical Depression Fourteen, located over the eastern Atlantic Ocean.

1. A tropical wave located about 1200 miles east-southeast of the Lesser Antilles continues to produce disorganized showers and thunderstorms. Environmental conditions are expected to be conducive for gradual development, and a tropical depression is likely to form early next week. Interests in the Lesser Antilles should closely monitor the progress of this system while it moves westward to west-northwestward at about 15 mph.
   * Formation chance through 48 hours...medium...40 percent.
   * Formation chance through 5 days...high...80 percent.
ACTIVITY #1: Preparation

Assume that you represent the state EM Bureau and you need to provide the *Tropical Cyclone Formation Chance* to regional EMs.

1) Based on the latest *Tropical Weather Outlook* (TWO),
   a) Which is the formation chance through 48 hours?
   b) Which is the formation chance through 5 days?

1) What represents the hatched area?

In addition, they asked you about:

1) Which is the difference between a Tropical Storm Watch and a Tropical Storm Warning?

1) Which is the difference between a Hurricane Watch and a Hurricane Warning?
ACTIVITY #2: Preparation and Threats- TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the **earliest time of arrival** as well as the **most likely time of arrival** to regional EMs.

1) Provide the earliest time of arrival for:
   a) Saint Croix
   b) San Juan
   c) Arecibo
   d) Mayaguez

1) Provide the most likely time of arrival for:
   a) Saint Croix
   b) San Juan
   c) Arecibo
   d) Mayaguez
SCENARIO OUTLINE - Imminent
SCENARIO OUTLINE - Imminent

Most Likely Arrival Time of Tropical-Storm-Force Winds

Hurricane Maria
Mon. Sep. 18, 2017 11 pm AST
Advisory 12

Storm Location & Wind Speed (knots)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O &lt; 34</td>
<td></td>
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<tr>
<td>34-63</td>
<td></td>
</tr>
<tr>
<td>≥ 64</td>
<td></td>
</tr>
</tbody>
</table>

Five-day chance of receiving sustained 34+ knot (39+ mph) winds

5 10 20 30 40 50 60 70 80 90 100 %

WFO San Juan
ACTIVITY #2: Preparation and Threats-
TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs.

1) Based on the latest Hurricane Local Statement (HLS)
   a) Which are the current Watches and Warnings?
   b) Which are the Potential Impacts?
   c) When will be the next forecast update?
ACTIVITY #2: Preparation and Threats-
TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs. Now you are focused over southeast Puerto Rico.

1) Based on the latest Tropical Cyclone Watch/Warning (TCV)
   a) Provide the Threat Level (None, Elevated, Moderate, High, Extreme) for
      i) Winds
      ii) Storm Surge
      iii) Flooding Rain
      iv) Tornado
ACTIVITY #2: Preparation and Threats - TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs. Now you are focused over San Juan and Vicinity.

1) Based on the latest Tropical Cyclone Watch/Warning (TCV)
   a) Provide the Potential Impacts for
      i) Winds
      ii) Storm Surge
      iii) Flooding Rain
      iv) Tornado
ACTIVITY #2: Preparation and Threats-TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to provide the following information to regional EMs. Now you are focused over Saint Croix.

1) Based on the latest **Tropical Cyclone Watch/Warning (TCV)**, provide the following information
   a) Timing for tropical storm force winds
   b) Timing for hurricane force winds
   c) Peak wind and gust
   d) Equivalent Category
HURRICANE ALERT!

5 DAY FORECAST

✓ HURRICANE MARIA WILL ENTER OVER YABUCOA AND WILL EXIT OVER CRASH BOAT BEACH.
✓ RAINFALL AMOUNTS WILL GENERATE MAJOR FLOODING ACROSS THE ISLANDS.
✓ HURRICANE MARIA WILL BE SIMILAR TO SAN FELIPE.

Source: weatherconspiracy.net
ACTIVITY #3: Risk Communication

You as EM wants to communicate threats and impacts using social media.

1) Provide an example of a social media post, including #hashtags to communicate threats and impacts.

You as EM wants to clarify which are the official forecast sources.

1) Provide an example of a social media post in order to identify the official forecast sources.
Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.

**Hurricane Maria**
Tuesday September 19, 2017
2 PM AST Intermediate Advisory 14A
NWS National Hurricane Center

**Current information:**
Center location 16.6N 63.6W
Maximum sustained wind 160 mph
Movement WNW at 10 mph

**Forecast positions:**
- Tropical Cyclone
- Post/Potential TC

Sustained winds:
- D < 39 mph
- S 39-73 mph
- H 74-110 mph
- M > 110 mph

**Potential track area:**
- Day 1-3
- Day 4-5

**Watches:**
- Hurricane
- Trop Storm

**Warnings:**
- Hurricane
- Trop Storm
ACTIVITY #4: Ongoing Threats- TC Watches and Warnings in effect

Assume that you represent the state EM Bureau and you need to clarify the following information to regional EMs.

1) Which is the difference between a Flash Flood Warning and a Flash Flood Emergency?

1) What means an Extreme Wind Warning?
SCENARIO OUTLINE - Post Storm
Flood Threat
Valid from 6 AM AST Nov 08, 2018 to 6 PM AST Nov 08, 2018

<table>
<thead>
<tr>
<th>Threat</th>
<th>Flood</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLIGHT</td>
<td>Ponding of water in roads and poorly drained areas.</td>
</tr>
<tr>
<td>MODERATE</td>
<td>Urban and small stream flooding</td>
</tr>
<tr>
<td>HIGH</td>
<td>Widespread flooding possible, having major impact on structures &amp; road closures.</td>
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</tbody>
</table>

National Weather Service
San Juan, PR
11/08/2018 03:49 AST

Follow Us: Facebook, Twitter, YouTube
weather.gov/sju
Click a location below for detailed forecast.

Last Map Update: Sat, Nov. 3, 2018 at 8:49:38 pm AST
Click a location below for detailed forecast.

Last Map Update: Sat, Jan. 27, 2018 at 8:30:35 pm AST
Appendix F: Conclusions and Outcomes Notes
<table>
<thead>
<tr>
<th>Challenge Category</th>
<th>Identified Response Challenge</th>
<th>Explanation/Description</th>
<th>Lessons Learned</th>
<th>Improvement(s) (Actionable Tasks)</th>
<th>How does approach change with respect to Tsunami vs Hurricane?</th>
<th>Comments</th>
<th>Recommendation for Implementation</th>
<th>Ease of Implementation</th>
<th>Coordination w. Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Lack of exposure for official sources, too much exposure for other information</td>
<td>More outreach about what official sources of information are</td>
<td>More outreach about what official sources of information are</td>
<td>Improve official sources of information reach</td>
<td>Same for both: Increase use of tsunami ready guidelines, clarify tsunami warning 'cancellation' vs. 'all clear', WSA</td>
<td></td>
<td>1. Use of short wave radios (response), SAT internet, power (generators). 2. Be aware of language and culture needs. Develop focus groups to identify effective language/terminology, science communication training for personnel in agencies. 3. Outreach before events, such as posting informational flyers. Take information to community, and ask for feedback on material. Ask which sources of media are most widely used, investigate which apps are applicable to community and use contact point to distribute information. 4. Identify centralized information in public location. Map communities &amp; identify liaisons (e.g., community leaders). 5. Verify the community leaders, and conduct pre-training at the community level. Plot central location(s)/local point to distribute information and time for briefing. 6. Maintain a database of community needs based on geography, demographics, resiliency center possibilities, existing infrastructure.</td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>Contingency planning for emergency communication</td>
<td>Back up communication routes, diverse ways to request help (e.g., internet not available)</td>
<td>Need more than standard communication (e.g., radio, pager, map, ham radio)</td>
<td>Need more than standard communication (e.g., radio, pager, map, ham radio)</td>
<td>Conduct training/drills to teach community and make sure technology is working</td>
<td></td>
<td></td>
<td>1. Encourage folks to get amateur/ham radio license. 2. Propagation sat phones, work with technology companies to develop low tech solutions. 3. Conduct training/drills to teach community and make sure technology is working.</td>
<td></td>
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<tr>
<td>Communicate the severity danger/risk</td>
<td>Having public understand the risk; people think they are lucky, manage expectations, warning fatigue. &quot;Burn out&quot; desensitizing of alarms</td>
<td>Need to convey risk in a clear and understandable manner.</td>
<td>Need to convey risk in a clear and understandable manner.</td>
<td>Develop new tools to relay important information to community and make sure technology is working</td>
<td></td>
<td></td>
<td>1. Show damage from previous storms, and consistent messaging each season. 2. Less emotion when messaging, keep message calm to prepare rather than scare community.</td>
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<td>2.5</td>
</tr>
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<td>Challenge Category</td>
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<tr>
<td>Infrastructure</td>
<td>Lack enforcement of residential building codes</td>
<td>Building codes not enforced, and people did not understand homes were unsafe</td>
<td>More damage and loss of life due to unsafe structures</td>
<td>1. Messaging related to maintaining a safe structure, not exclusively collecting water. 2. Critical infrastructure should be evaluated. 3. Properly use federal funds to repair and maintain infrastructure. 4. Professional education, assessment of curriculum in all academic settings</td>
<td>Same for both</td>
<td>Dept. of transportation</td>
<td>Detailed assessment of critical infrastructure; meeting with engineers/architects in municipalities to go around communities to identify most important aspect of a structure. Different source of funding for public, private and municipal</td>
<td>5</td>
<td>Municipal architects/engineers; FEMA capacity build sector</td>
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<tr>
<td>Access to clean water</td>
<td>Infrastructure needs</td>
<td>Access to clean water is limited due to infrastructure</td>
<td>No redundant water for residents/homeowners</td>
<td>1. Education on rainwater harvesting, the importance of it. Community workshops on virus protection fitting into cultural norms (list of best practices). 2. Improve residential water collection to maintain a reserve. Encourage rainwater collection/capture with safe treatment. 3. Education on low-cost filters (e.g., sand). 4. Education on maintenance of individual water sources. Reduce barriers to home/commercial rainwater capturing. 5. Proper installation of tanks/systems. 6. Promote/fx policy for rainwater capture. 7. Investigate/review rainwater capture policy (resilience center example).</td>
<td>Same for both</td>
<td>Same for both</td>
<td>5</td>
<td>Education = 2 Implementation = 3 Policy Change = 5 Sliding scale (depends on technology of choice)</td>
<td>Homeowner association; private industry, engineering organizations, academia, government, SME (Small Medium Enterprise) incubators; local water company, non-profits, private business, commonwealth/territory/municipality responsible for building codes</td>
</tr>
<tr>
<td>Leadership</td>
<td>Leadership and capacity for multiple, simultaneous disasters</td>
<td>Leadership and capacity for multiple, simultaneous disasters</td>
<td>Competition for resources.</td>
<td>Professional emergency management positions, establish/increase emergency management schools, local level leader training. 1. Develop curriculum from vocational schools to higher learning institutions</td>
<td>Same for both</td>
<td>Same for both</td>
<td>Same for both</td>
<td>3</td>
<td>Academia &amp; dept. of education</td>
</tr>
<tr>
<td>Logistics</td>
<td>Port accessibility limited because of law</td>
<td>Port accessibility limited because of law</td>
<td>Port is major port for food/resources coming to PR. Other ports are used for petroleum products, coal.</td>
<td>1. Land-based facilities are geared toward handling only one type of commodity. 2. Require private ports to be capable and ready to act in the case of a disaster. 3. Identify alternate airports/transportation that would be viable in event of storm. 4. Identify/area impeding maritime supplies, and push for them to be temporarily waived (e.g., Areas A3 &amp; A4). 5. Neutral study on Puerto Rico landfill on maritime and environmental impact. 6. Develop contingency plans, 2. Encourage use of FEMA facilities.</td>
<td>Same for both</td>
<td>Same for both</td>
<td>1. Conduct study and analyze potential impacts of change 2. Have diverse ports, capable of handling other goods; back-up port for response operations. 3. Policy shift by port authority for diversifying use of port. 4. Update contingency plans to have more than one viable port available. 5. multi-port authority, govt of PR, private industry</td>
<td>4</td>
<td>FEMA, USCG, local agencies, NOAA Marine Debris, Public Works, EPA</td>
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<tr>
<td>Land Use Plan</td>
<td>Morata/land debris hindered by lack of staging areas and logistics</td>
<td>Morata/land debris hindered by lack of staging areas and logistics</td>
<td>See Florida plans for an example</td>
<td>1. Having a plan for where to put marine debris. 2. Destroyed building/construction materials. 3. Identify final location for debris (e.g., landfill, vs. off-island). 4. Conduct study and analyze potential impacts of change 5. Finally, locate area that is safe from natural hazards. 6. Identifying location ahead of time in contingency plans. 2. Encourage use of central drop-off locations for community members to dispose of household hazardous waste (HHW)</td>
<td>Same for both</td>
<td>Same for both</td>
<td>Study 1: Change = 5 1.5-2</td>
<td>FEMA, USCG, local agencies, NOAA Marine Debris, Public Works, EPA</td>
<td>FEMA, USCG, local agencies, NOAA Marine Debris, Public Works, EPA</td>
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<td>Policy guidelines</td>
<td>Policy guidelines (N/PAPS) need to be revisited due to change and new technology, climate change etc.</td>
<td>Policy guidelines (N/PAPS) need to be revisited due to change and new technology, climate change etc.</td>
<td>These policies need to be reviewed before an incident</td>
<td>1. Enforce code, consistency in code, implement new code. 2. Professional education in existing FEMA public assistance, mitigation and recovery policies. Maintain and modernize codes and natural infrastructure to protect coastal communities. Simplify FEMA’s public assistance program policies for non-traditional natural features. 3. Identify most important aspect of a structure. Different source of funding for public, private and municipal</td>
<td>Same for both</td>
<td>Same for both</td>
<td>Costs on island are particularly important.</td>
<td>4</td>
<td>Federal agency. Ongoing GAO focus group on Maria. Universities</td>
</tr>
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<td>Challenge Category</td>
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<td>Policy</td>
<td>OFAs (other federal agencies) need to be assertive in their supplemental funding request</td>
<td>There are some things FEMA can not fund; You snooze, you lose.</td>
<td>You need to identify an authority in past only identified problem.</td>
<td>1. Create checklist to identify tasks for each person, 2. Communicate/localize checklist and responsibilities, 3. Hold organizations accountable for responsibilities, 4. Share information with managers Same for both.</td>
<td>This might be unique to Puerto Rico.</td>
<td>Emergency training on procedures of funding opportunities. Create a survey to commonwealth agencies to gather post-event lessons learned on supplemental grant processes. Federal agencies aware of supplemental funding opportunities (grant, special project funding) and responsible for requests relative to their mandates. Federal agencies should be prepared with requests to Congress for supplemental funding according to their agency mandates.</td>
<td>3</td>
<td>Federal agencies. Commonwealth is unique in that funding budget does not allow for.</td>
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<tr>
<td></td>
<td>Interpersonal-layers of bureaucracy slowed progress</td>
<td>Politics getting in the way of progress.</td>
<td>Need to identify an authority in past only identified problem.</td>
<td></td>
<td></td>
<td>People need to know their jobs (checklist), communication to avoid different decisions being made, held accountable by making sure people report problems (investigation), forms of public oversight to help. This might not help everyone but it could in the future. Turn over the information to theirs and new leaders (who has that information for when you are gone?).</td>
<td>4</td>
<td>All levels (state-municipality)</td>
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<td></td>
<td>People inadequately prepared for cat. 4 or 5, tsunamis (high impact, low frequency events)</td>
<td>Prior close calls gave a false sense of security &amp; resources were moved to HR to deal with Irma.</td>
<td>Should prepare regardless of category level.</td>
<td>For Hurricane: 1. Involve social scientists, they may be able to help with effective, engaged outreach, 2. Education and buy-in from local community leaders. More effective exercises especially on the items we did wrong previously (i.e., AMI). Use Hurricane Maria as an example and spread lessons learned. Don't let AMI sit on a shelf. Reassess. Develop a checklist of activities. 3. Continuity planning to include multiple back-up NWS offices outside of threat zone. For Tsunami: prepare models and videos of what it would look-like (overlay culturally significant places), storm surge water marks / signage (keep reminders of physical damage), Art projects. Media and education campaign.</td>
<td>Both Tsunami: preparing for something you haven't experienced, increased challenge.</td>
<td></td>
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<td>3 to 4</td>
<td>Federal agencies. Commonwealth is unique in that funding budget does not allow for.</td>
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<td></td>
<td>Social science (this is not a technical problem)</td>
<td></td>
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<td>Social science (this is not a technical problem) how we can improve transfer of information. Research the effectiveness of training/translation. Implement NWS Storm Ready. Expand CERT to include specific training to community (i.e., storm surge, flood). Conduct multi-district/municipality exercises. Community involved: award competitions for campaign, education outreach all ages involved. Conduct for both hurricane and tsunamis at schools, mass media, higher ed. institutions.</td>
<td>3 to 4</td>
<td>Federal agencies. Commonwealth is unique in that funding budget does not allow for.</td>
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<td>Preparedness</td>
<td>Lack of emergency planning</td>
<td>Local level preparedness plan created with central point of information. Need accountability w.r.t. response plans. Pre-emergency planning to include local law enforcement and internal vulnerability assessments (e.g., NGO, faith-based organizations).</td>
<td>1. Aggressive on pre-plan: (a) what programs already have a plan in place? (b) create plans for schools, daycare, work, etc.; (c) work with existing organizations or program infrastructure/community leaders. 2. Educate the community regarding: (a) necessary supplies, (b) what should they do with supplies, (c) have it ready before the event: bag of supplies, food, water, communication tools, etc.), 3. Conduct community training/performance drills/battle top exercises. 4. Use table top exercises to improve plan/make changes. 5. Re-institute CERT program in schools, churches, etc. and use in coordination with neighborhood watch programs (e.g., “neighbor door” type app). 6. Consider worst case scenario (e.g., downed communications, limited tools available).</td>
<td>Both</td>
<td>Should we rethink approach? Times of disaster should include a checklist for community resilience planning.</td>
<td>Knowledge for the local leaders to bring back to their communities (e.g., kids can take it home to their families), break up the workshops into regions to allow more people to attend (for different cultures), NOAA office for coastal management. See VITENA model as a starting point. (2) Outreach- media blitz: lab at the movie, on roads, radio, TV stations, at stores, public and private classes (home improvement stores), youth organizations (boy scouts, girl scouts, etc.), invite those to be on how to prepare for these events. Use paper based learning platforms, find and edit existing checklists that can be relevant to Puerto Rico and distribute to community members. Create emergency management education program for communities at all levels year-round. Using existing avenues/organized community events to demonstrate how to use a map, why it is important to have freshwater, etc.</td>
<td>3</td>
<td>Community levels (school system, community members), NGOs, Universities, media outlets, photo journalist workshops, emergency management agencies, FEMA</td>
<td></td>
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<tr>
<td>Preparedness</td>
<td>Lack of federal Pre-Scripted Mission Assignments (PSMA)</td>
<td>The more prescribed mission assignments, the quicker response actions can commence and provide training opportunities within agencies.</td>
<td>1. Review of existing and development of PSMAS. Integrate commonwealth and FEMA prescribed efforts prior to disaster. 2. Conduct more outreach with state/territory/govt level to educate about what they can ask for in terms of mission assignments. 3. Automated PSMAS for approval, signatures. 4. Include mission assignments in training and exercises. 5. Review historical lessons learned to drive future assessments.</td>
<td>Same for both</td>
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<tr>
<td>Preparedness</td>
<td>Did not pre-emptively involve private sector</td>
<td>Private sector often has resources it can contribute to in a response effort- have resources and assets connected at all levels.</td>
<td>1. Getting to conversation early. 2. Potential for new contracts/prepositioning equipment ahead of time.</td>
<td>Same for both</td>
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<tr>
<td>Response</td>
<td>Rapid assessments of damage/debris were critical. Be bold on initial assessment.</td>
<td>Areas/communities that had quick assessments made it easier to scope federal funding.</td>
<td>1. Establish baseline prior to event for municipalities; 2. Centralized application to collect assessment information for multiple sectors (i.e., communication center); 3. Pre-plan for what we need to do (before and after), include lag-time for response operations (why preparedness is so important), be able to grow food, apply for grants to build-in redundant funding; 4. The public can report on their municipalities levels to the commonwealth and FEMA prescripted efforts prior to disasters.</td>
<td>Both</td>
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<td>Response</td>
<td>Did not pre-emptively involve private sector</td>
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<tr>
<td>Inequity</td>
<td>Vulnerable population</td>
<td>ElevatedICK/elderly people were stuck in place</td>
<td>1. Conduct demographic data to focus efforts and identified during emergency preparedness planning to create a special needs plan (e.g., assess who is at risk in each town/region). 2. Compliance checks done in low income communities, first. 3. Recommendations for improvements other than fines. 4. Messages tailored to underserved communities.</td>
<td>Both</td>
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<tr>
<td>Inequity</td>
<td>Inequity</td>
<td>Time of day may influence who is present in the community, family plan should identify who is available during the day vs. night.</td>
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