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NRPT: Improve Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Coastal Response Research Center

NOAA's Regional Preparedness Workshop & Training (NRPT)

Improve Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

June 18 - 19, 2019

Old Dominion University Tri-Cities Higher Education Center
Portsmouth, VA

Coastal Response Research Center

This workshop is a partnership between NOAA's Disaster Preparedness Program and the Coastal Response Research Center.

Table of Contents

I. Acronyms

AGO	Acquisition and Grants Office
AHB	Atlantic Hydrographic Branch
AHPS	Advanced Hydrologic Prediction Service
ATON	Aids to Navigation
C-CAP	Coastal Change Analysis Program
COOP	Continuity of Operations
CO-OPS	Center for Operational Oceanographic Products and Services
COTP	Captain of the Port
CRRC	Coastal Response Research Center
CZM	Coastal Zone Managers
DPP	Disaster Preparedness Program
DSCA	Defense Support Civil Authority
EPFAT	Emergency Power Facility Assessment Tool
ERAD	Eastern Region Acquisitions Division
ERMA	Environmental Response Management Application
ESF	Emergency Support Functions
FEMA	Federal Emergency Management Agency
GETS	Government Emergency Telecommunications Services
GIS	Geographic Information System
HREMC	Hampton Roads Emergency Management Committee
IOT	Internet of Things
LIDAR	Light Detection and Ranging
MEOW	Maximum Envelope of Water
MEP	Mission Essential Personnel
MLE	Marine Resources Law Enforcement
MOM	Maximum of MEOWs
NGO	Non-Governmental Organization
NGS	National Geodetic Survey
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRAD	NOAA Response Asset Directory
NRPT	NOAA Regional Preparedness Training
NWS	National Weather Service
OCM	Office for Coastal Management
OCS	Office of Coast Survey
ODU	Old Dominion University
P-Surge	Probabilistic Storm Surge
SLOSH	Sea, Land & Overland Surge from Hurricanes
UC	Unified Command
UNH	University of New Hampshire

USAE	United States Army Corps of Engineers
USCG	United States Coast Guard
USGS	United States Geological Survey
VIMS	Virginia Institute of Marine Science
WPS	Wireless Priority Services

II. Acknowledgements

This workshop and report were supported by the National Oceanic and Atmospheric Administration's (NOAA) Office of Response and Restoration (OR&R) Disaster Preparedness Program (DPP) and the Coastal Response Research Center (CRRC). The content for the workshop was developed in cooperation with NOAA DPP and the following Organizing Committee members:

- Nancy Kinner, CRRC, University of New Hampshire
- Becky Allee, NOAA Office for Coastal Management (OCM), Gulf Region
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- Alyson Finn, NOAA OR&R Disaster Preparedness Program (DPP)
- Ryan Hippenstiel, NOAA National Geodetic Survey (NGS)
- CDR Matthew Jaskoski, NOAA Marine Operations Center (MOC)
- CAPT Anne Lynch, NOAA Homeland Security Program Office (HSPO)
- Jeff Orrock, NOAA National Weather Service (NWS)
- Kate Wheelock, NOAA OR&R DPP

This workshop was facilitated by Dr. Nancy Kinner from the CRRC (www.crrc.unh.edu). CRRC is known globally as an independent, intermediary that brings all stakeholders to the table to develop and implement viable and trusted solutions to complex problems related to environmental disasters. CRRC has conducted 70+ 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:

- LT Anthony Klemm, NOAA Office of Coast Survey (OCS)
- Kate Bosley, NOAA Center for Operational Oceanographic Products & Services (CO-OPS)
- Emily Clark, NOAA Acquisition and Grants Office (AGO)
- CDR Matthew Jaskoski, NOAA Office of Marine and Aviation Operations (OMAO)
- Ryan Hippenstiel, NOAA National Geodetic Survey (NGS)
- Michael Dutter, NOAA National Weather Service (NWS)
- Jeff Hayhurst, U.S. Navy
- CAPT Kevin Carroll, U.S. Coast Guard (USCG)
- MAJ Alex Samms, U.S. Army Corp of Engineers (USACE)
- Becky Allee, NOAA Office for Coastal Management (OCM)
- Bill Burket, Port Authority of Virginia
- Jim Redick, Norfolk City Emergency Managers

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We also thank (1) the Breakout Group Leads: Becky Allee, Kate Wheelock, and Ryan Hippenstiel; and (2) Grace Walker (MARACOOS and Sea Grant Extension), Quinn Wilkins (CRRC), and Melissa Gloekler (CRRC) for their note-taking during the workshop.

We greatly appreciate the Old Dominion University Tri-Cities Higher Education Center (Portsmouth, VA) for their hospitality and providing an excellent meeting venue.

III. Introduction

On June 18-20th, 2019, CRRC and DPP co-sponsored a NOAA Regional Preparedness Training (NRPT) Workshop at Old Dominion University Tri-Cities Higher Education Center (Portsmouth, VA). The workshop, titled "*Improve Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region*", focused on preparedness, planning and response to extreme weather events and nuisance flooding. See Appendix A for the agenda.

The 40 participants (Appendix B) represented federal, state and local agencies, academia, and industry.

This was the fifth workshop in a series of DPP NRPTs. The overall goal of the Norfolk workshop was to provide focused discussion regarding lessons learned from local partners during the 2018 Atlantic hurricane season and build a common understanding of how storm events and nuisance flooding will be addressed when they threaten mission personnel, infrastructure or natural resources.

The specific objectives were to:

1. Establish networks with local partners to improve preparedness.
2. Identify gaps and ways to improve regional preparedness.
3. Increase coordination among participants to bolster regional preparedness.
4. Determine ways to provide adequate information and communicate knowledge, so that (1) the public and response community will make informed decisions relative to personal protection and safety, and (2) responders and natural resource managers more effectively mitigate regional disaster impacts.

A one-day Tools Café was held prior to the workshop (see Appendix A for the agenda), with presentations (Appendix D) and subsequent hands-on demonstrations of national and regionally-specific preparedness and response tools that are currently available to responders or the public. The two-day workshop included plenary presentations from local and federal emergency responders outlining their day-to-day operations, continuity of operations during an emergency, tools used to make decisions, and lessons learned from previous events. A summary of the presentations can be found in Section IV "Plenary Presentations," presentation slides are located in Appendix E.

Participants were divided into three breakout groups with representatives from the various agencies/entities (Groups A-C). Breakout groups were tasked with identifying: (1) the primary challenges/impacts to mission that must be addressed for storm events and nuisance flooding, (2) the current practice to handle these challenges, (3) how preparedness and readiness could be enhanced to address these challenges, and (4) an implementation strategy for these enhancements.

IV. Plenary Presentations by Norfolk Regional Entities

The presenters discussed: (1) their perspective regarding preparedness for storm events, (2) day-to-day operations (e.g., organizational mission, facility/assets, number of employees), (3) continuity of operations during an emergency (e.g., employee expectations, telework readiness), (4) tools used to make decisions, (5) recent storm preparedness lessons learned, (6) areas for improvement, and (7) knowledge/tools the participant would like to learn and apply during future flooding and storm events. A discussion period followed each presentation; dialogues encouraged audience participation, relationship building, and knowledge sharing between participants to bolster regional preparedness.

Lieutenant Anthony Klemm, a Mid-Atlantic Navigation Manager for NOAA's Office of Coastal Survey (OCS) described his position and mission, and the importance of improved preparedness. The OCS navigation manager collects hydrographic data to update NOAA nautical charts, and provides hydrographic support in port recovery operations, working in conjunction with U.S. Coast Guard (USCG) and USACE to make risk-based decisions to ensure the safety of commerce in ports. During response, navigation managers embed themselves within the incident command system (ICS) to help coordinate hydrographic response with survey assets. LT Klemm provided examples of previous relevant tasks, such as identifying sunken containers post-Hurricane Maria, identifying possible hazards to ensure the safety of the public and allowing the opening of port. The Atlantic Hydrographic Branch (AHB) in downtown Norfolk is the main facility and provides data processing support and data stewardship for hydrographic surveys. This facility operates with approximately 30 employees. Many AHB employees deploy to disaster areas to assist in emergency hydrographic surveys. There is a national need for the AHB expertise and for AHB during storms, however the branch has a commitment to the Norfolk region.

Kate Bosley, the Chief of the Field Operations Division of NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) discussed day-to-day operations including the maintenance of 340+ coastal observing stations, enabled by 40 federal/contract employees, and close connection with federal partners. CO-OPS relies on the NWS forecasts, CO-OPS Quicklook, and evacuation and closure notices to make operational decisions before, during, and after storm events. Their continuity of operations includes: assessing operating conditions of potentially impacted stations, securing facility assets before the storm, checking contact information for all employees, confirming contract options for telework, and assigning telework and duration requirements. Chief Bosley shared some recent lessons learned, describing the challenge to maintain reporting to CO-OPS HQ in midst of evacuation, and the uncertainty of some employees regarding their evacuation during the event. CO-OPS requested a refresher on the Employee Notification System (ENS) to be more prepared for the next major event.

Emily Clark, the Oceanic Branch Chief of the Acquisition and Grants Office (AGO) in the Eastern Region Acquisitions Division (ERAD), discussed her position and AGO's relevance to preparedness. ERAD is the largest division of all AGO, providing acquisition solutions for NOAA and other entities. Day-to-day operations are focused on insuring NOAA maintains mission. ERAD supports OMAO, NMFS, NWS, and NOS. ERAD's operations are conducted by a staff of 72, located in the Norfolk Federal Building. During an emergency, their continuity of operations plan includes: safety and accountability of all staff, telework capabilities for federal and contractor staff, emergency acquisitions procedures maintained by each branch, and designated offices to continue operations

should ERAD be unable to work remotely or directly. To make decisions, ERAD primarily uses local weather channels, the NWS website, and the Virginia Hurricane Evacuation Zone Lookup Tool. Chief Clark shared recent lessons learned in storm preparedness, particularly challenges in staff evacuation zone identification. She suggested the identification of evacuation zones for staff annually along with all other emergency identification and notification information, to be better prepared in a storm event. ERAD wishes to identify additional tools for use in preparation for, as well as after any emergency event.

Commander Matthew Jaskoski, Executive Officer at NOAA's Marine Operations Center (MOC-A) – Atlantic (OMAO), provided insight into his position. OMAO Atlantic's day-to-day operations includes mission and logistical support for nine ships and five port offices located along the East and Gulf Coasts. These operations are conducted by approximately 50 employees, located on the Elizabeth River. Facilities include an 800 ft. pier face, two main buildings, a staging area, and warehouse facilities. During an emergency, their continuity of operations includes: a workload shifts to its sister facility located on the West Coast, leadership providing continued operations from an offsite location, and a possible shelter-in-place for ships alongside the facility. To make decisions, OMAO typically uses tools from USCG captain of the port (COTP), local and state evacuation notices and Hampton Roads Emergency Management Committee (HREMC). Recent lessons learned include: the need for staging vessels for response needs due to their facility pier capabilities, and more certainty in staffing and personnel available during an event. OMAO could use help with locations for safe havens for small boats, staging locations for larger ships, and local alternative muster stations during an event.

Ryan Hippenstiel, Field Operations Branch Chief for NOAA's National Geodetic Survey (NGS), discussed his position and relevance to emergency preparedness. NGS' day-to-day operations include the collection and processing of surveying data for various NOAA missions. These operations are conducted by 12 NGS employees, in a NOAA owned building, equipped with a data center, remote sensing Continuity of Operations (COOP), and an NOS server onsite. These activities align with NGS' mission, to provide access to the national spatial reference system, enabling common coordinate systems which feed the various models and programs mentioned in the Tools Café. During an emergency, NGS' continuity of operations includes: a branch chief who is a CO-OPs employee maintaining daily checks and reporting to HQ, teleworking capabilities for many employees, and field staff deployable for response support. The primary tools used for decision making are tide levels and predictions, standard weather reports, storm evacuation notices, and staff experience. Lessons learned from recent storm events are focused around multiple sources of information complicating the decision-making process (e.g. referencing conflicting media sources, varying chains-of-command during an event). Hippenstiel shared that his office could use help with clarifying NGS' role during an evacuation, correctly documenting their response, and possible consistency with partnering offices/agencies to simplify response for employees and managers.

Michael Dutter, Science and Operations Officer for NOAA/NWS, shared his position and relevance to emergency response and preparedness. The mission of his office is to protect life and property from weather and water hazards, which is a major asset during a response. His office is responsible for all of southeastern Virginia, Maryland, and northeastern North Carolina. Day-to-day and during the event, his office is responsible for forecasts, warnings, and communicating weather risks to the public for inland, marine, and coastal environments. Dutter expressed that his office has a commitment to communicate during an event, often facilitating weather briefings with on-site

personnel. During an emergency, their continuity of operations includes: 24/7 operation of their facility even during adverse conditions, facilities capable of housing staff during an event, and a backup office in Newport, NC or Raleigh, NC to preserve full services. Dutter explained the major needs of his office are consistent communication with relevant entities, stressing that communication to the NWS should be "two-way" and partnering entities should regularly contact NWS with any questions or concerns.

Tom Tyree, Navy Region Mid-Atlantic Port Operations, represented the region's port operations office. The mission of the office is to execute national defense tasking, with force generation occurring at the facilities in the region's Area of Operations (AOR). This mission is executed by 220 employees, both military and civilian, with four HRA AOR/Ports and 45 boats. During an emergency, their continuity of operations includes: continued operations with mission essential personnel (MEP), maintenance of operations at COOP site as required, defense support civil authority (DSCA) response capabilities, and deployment to another region, if needed. Recent storm preparedness lessons learned include the effective execution of evacuation upon orders when roughly 50,000 people are on base daily, and methods to deal with old base infrastructure that is susceptible to flooding. The office requests assistance to improve communications with port partners in the event of an evacuation, and a better understanding of their partners' capabilities to facilitate collective assistance with port clearance and/or reconstruction. The Hampton Roads Hurricane Timeline Diagram (Figure 1) was presented to the group, detailing the Navy's course of action beginning at 120 hours before storm landfall, with the goal of getting all personnel and assets safely out of port and staged at alternative locations. A flow chart for Post Storm Recovery Actions (Figure 2) was also shared, detailing the common decisions required in order to reopen a port safely after an event has occurred.

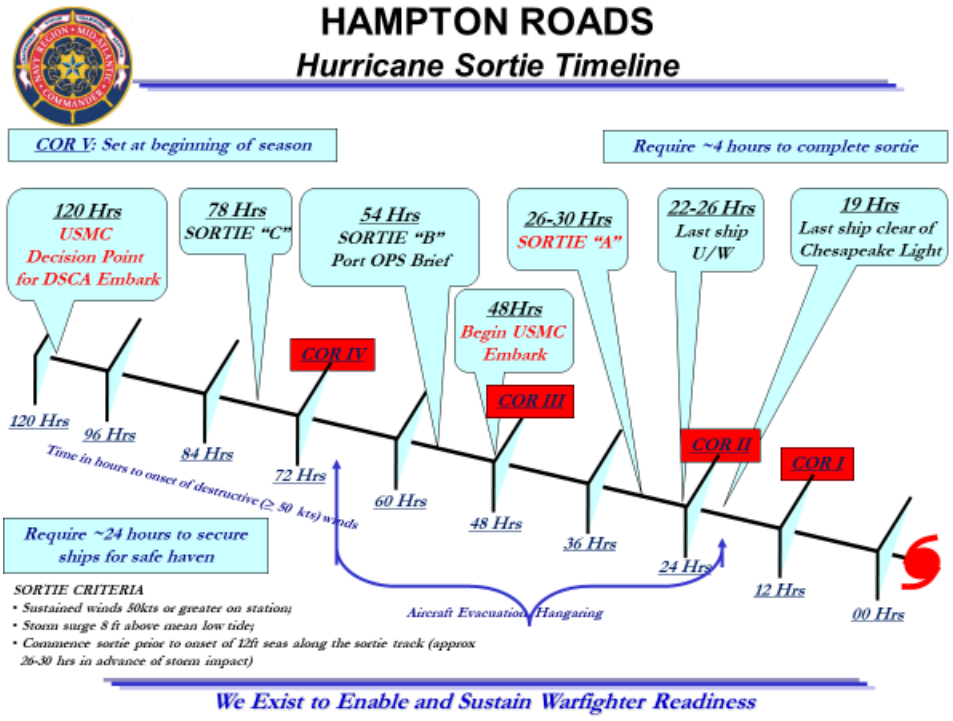

Figure 1: Hampton Roads Hurricane Shortie Timeline Diagram, detailing events 120 hours before landfall of a storm.

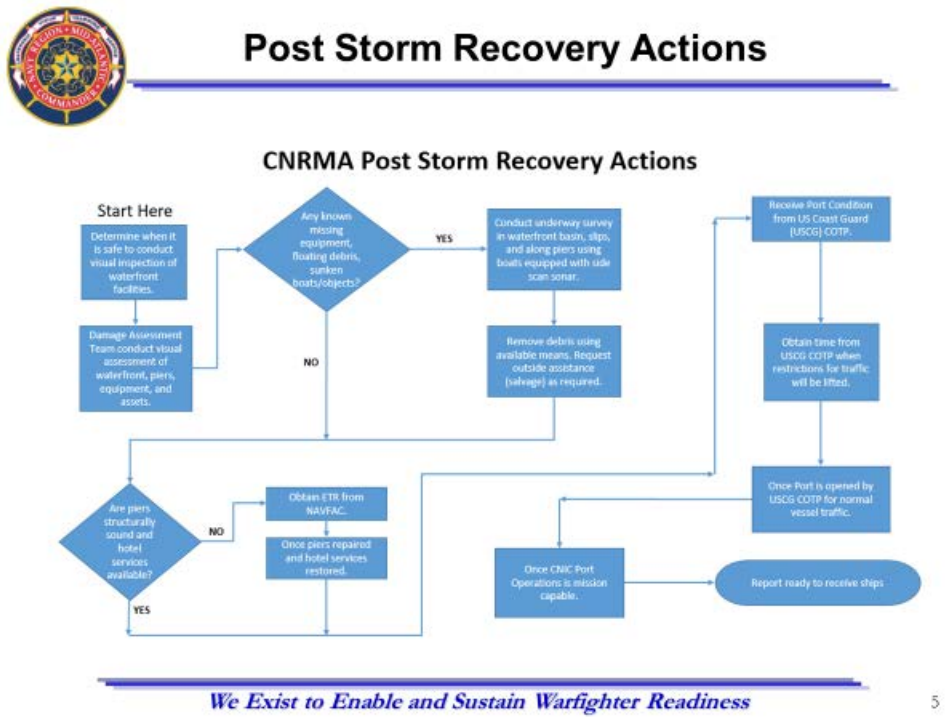

Figure 2: CNRMA Post Storm Recovery Actions, detailing a flow chart of recovery decision-making after a storm has passed.

Captain Kevin M. Carroll, U.S. Coast Guard Sector Hampton Roads, discussing his position and role during emergency response. The mission of USCG Sector Hampton Roads is to carry out the USCG's 11 statutory missions, which include search and rescue (SAR), living marine resources, law enforcement (MLE), aids to navigation (ATON) and port safety and security. There are over 600 active duty and reserve members in the region, and roughly 1,300 Coast Guard Auxiliary volunteers. During an emergency, their continuity of operations includes their involvement in a unified command (UC) under the National Incident Command System (NIMS). The Sector has multiple locations for COOP staging needs. Carroll stressed the importance of the Norfolk region in national security, and that during an event, response needs to be a collaborative effort between USCG, NOAA and all relevant entities. Carroll discussed the COOP capabilities with the U.S. Maritime Administration (MARAD), which has storage, berthing and emergency power capabilities onboard a Ready Reserve Vessel, essentially a "floating command center". The primary tools Carroll uses for decision-making are the sector's Severe Weather Plan to coordinate all vessel arrivals and departures with the Navy, and frequent port partner calls. He stressed the complexity of the port and noted all entities must have a voice. Recent lessons learned include: the importance of evacuations pre-storm, all personnel understanding evacuation zones, early communications with partners for exercises and clear lines of communication during an event, and the need for multiple COOP locations for multiple storm types and conditions. The sector would benefit from improved trajectories and modeling as these are crucial for decision-making, recovering sunken vessels to open waterways, and conducting emergency support functions (ESF) 9 (search and rescue) and 10 (hazardous materials) for location and mapping. They hope to learn tools for identification and forecasting of trouble areas, as well as long-term plans and realities in responding to storm events in the region. Carroll also stressed the importance of risk communication in evacuation zone

planning, and the importance of early evacuation to ensure the safety of the public, even if they do not correctly perceive the risk due to some previous evacuations.

Major Alex Samms, Deputy District Commander of the US Army Corps of Engineers (USACE), shared his position and relevance to emergency response. The mission of USACE and his district is to provide engineering solutions for water resources, and military, interagency, environmental and disaster preparedness programs. His day-to-day operations include an operations branch which is responsible for 79 channels in Virginia, including dredging and removing materials and maintaining coastal assets. These day-to-day operations are conducted by a staff of ~370 employees. During an emergency, their continuity of operations includes the Richmond Emergency Operations Center with multiple locations for redundancy and Flood Risk Management. The tools frequently used for decision-making are the SLOSH model, LIDAR, DEM, and HURREVAC. All the tools are used to determine the scale of the mission to be executed, including debris management requirements, and temporary "blue roof" implementation. Recent lessons learned include the need for concrete staging areas for generators deployed by the Power Planning and Response team, and the importance of PM/non-federal sponsored pre-storm surveys. Samms explained the district would benefit from improved planning triggers for stream gauges and forecasts to anticipate areas of concern for federal response, Emergency Power Facility Assessment Tool (EPFAT) input, and first floor elevations and depth damage curve assignment sharing (which is crucial for the Virginian coast). He hopes to learn GIS tools for digestion and dissemination of available data, and the locations of any unknown critical infrastructure in the region.

Becky Allee, Senior Scientist, NOAA's Office for Coastal Management (OCM) – Gulf Region, shared information about her position and relevance to emergency preparedness. OCM's day-to-day operations provide oversight, implementation and technical assistance for approved State Coastal Zone Management programs. The focus of OCM is to make coastal communities more resilient against natural disasters. The Virginia Coastal Zone Management Program's (6 local staff) mission is to create more vital and sustainable coastal communities and ecosystems through the development and implementation of coastal policies. During an emergency, OCM's continuity of operations includes telework-ready capabilities for all staff, and communication with all partners to help identify and ensure their needs are met. Allee stressed the importance of post-storm mapping to conduct assessments, a caution about roof solar panels damaging infrastructure in a storm event and the need for OCM to identify opportunities to improve post-storm communications with partners when communications services are impacted.

Bill Burket, Director, MIRT and Emergency Operations, Virginia Port Authority. The mission of the Port Authority is to enhance and ensure commerce in the ports of Virginia. There are five state owned/operated terminals by the VA Port Authority (VPA). Other port terminals are operated / owned by the private sector and Department of Defense. The Maritime Incident Response Team's (MIRT) day-to-day operations include the coordination of regional planning, response and recovery operations, and support of the USCG with "All Hazards" response and search and rescue (SAR). During an emergency response, the port's continuity of operations includes mass notifications to partners, maintenance of "ride out" teams to keep IT systems active, address cargo issues, and colleague well-being checks. They also conduct annual table top planning exercises. The VPA uses the COOP plan, human resource policies and procedures, the USCG Severe Weather Plan, MTSU plans and scripted 204 plans. Recent lessons learned due to the mandatory evacuation include the inability for several modes of transportation (i.e., rail, trucks) to enter the evacuation zones), the

need for the MARAD SafeStore program to have prepositioned ships, and the usefulness of NWS web tools. The VPA uses a private weather company for terminal operations, but port wide decisions are based on NWS forecasts. Burket stressed the importance of coordination with other agencies, especially when attempting to get supplies for port re-opening, which may be hindered by mandatory evacuation orders.

Jim Redick, Norfolk City Emergency Manager, shared information about his position and relevance to emergency preparedness. Redick stressed the importance of coordination between entities noting that no one entity has the expertise or resources to handle response in the region, and that network establishment prior to a crisis is crucial. Redick described his office's close coordination with NWS, in the provision and description of forecast data for preparedness. As an emergency manager, Redick's most important task is bringing regional entities together for planning and preparedness. The continuity of operations in the city is the homeland security network, shelter openings, mitigation plans, and resilience strategies. The primary tools used are those of the NWS, the VIMS tools discussed in the café, and information from the National Hurricane Center.

V. Breakout Session I – Challenges

A summary of Breakout Session I can be found in this section, see Appendix F for details and all of the documented challenges. Workshop participants were divided into Groups A-C with local, state, and federal decision-makers in each group. A list of participants in each Group A-C can be found in Appendix C. During Breakout Session I, participants were tasked with identifying major flood and storm related challenges that impact mission in the Norfolk region, as well as the agencies/entities impacted by these challenges. Following Breakout Session I, one member from each group summarized the discussions during a plenary report-out.

Group A

Group A discussed the psychological dimensions during evacuation, including the tendency not to evacuate in an attempt to protect possessions, and disbelief of the orders. The challenges of re-constitution were discussed, with concerns about citizens not returning to the state post-storm and the resulting economic and social impacts. From the city's perspective, human evacuation is significantly challenged by financial, transportation and housing constraints. Planning and response fatigue were considered from a federal/responder perspective. The concerns regarding planners and responders being fatigued as a result of successive storms poses a problem, with potential impacts including less planning/preparedness and aversion to conduct exercises and drills. Concerns about staffing during successive storms were considered, and how to best address whether there are adequate personnel and resources available to tackle multiple storms.

There was consensus that expectations for employees, responders and managers must be evaluated pre-storm (e.g., obligations, evacuation zones) to improve overall response efficiency and accountability during a mandatory evacuation. The group also discussed the challenges associated with a lack of common terminology between responders, citizens, and agencies attempting to coordinate response efforts during an event. These two challenges are further exacerbated with limited communication during response, caused by downed communication systems or problems with the Everbridge notification system. The challenges of unclear employee expectations, lack of common terminology, and limited communications avenues, greatly challenge coordination and execution of mission during flooding or a storm event.

The movement of assets was also considered, with concerns about access to the evacuation zone, adequate space for asset staging, safe and readily deployable dock staging locations, and plans for the transportation of assets before, during and after a storm. One primary concern of the Port Authority was the ability to get resources into the port during a mandatory evacuation, as trucking companies will often not travel into an evacuation zone, delaying the opening of a port.

Various challenges related to infrastructure were discussed. For example, potential damage to infrastructure that is necessary to complete response efforts was a large concern (e.g., shipping channel blockage, downed communication infrastructure, road closures). Post-storm infrastructure permitting and rehabilitation were primary concerns of the city, as they are a significant financial challenge. Permitting can often take months to gain approvals.

Group B

Group B identified challenges associated with planning timeframes, (e.g., short-, mid-, long-term), strategies and coordination between agencies/entities (e.g., municipalities, USCG, first responders, contractors). Considering a long-term planning timeframe, the acquisition of contracts and establishment of networks need to happen prior to events, to avoid hindering response efforts. With the increase in frequency of storms, the timeframe for planning is decreasing, requiring longer-term solutions for coastal areas. The group also stressed the need for education about sea level rise and flooding, as it is a major challenge to coordinate with citizens in coastal areas who are not aware of the risks. This requires outreach and planning strategies to educate the public.

Comprehensive COOP plans are also a challenge, as well as the lack of coordination between the entities (e.g., the City of Norfolk, the Port Authority, Navy). COOP plans should be coordinated cross-agencies and entities to have the most effective response. Participants shared that COOP plans often work for individual groups, but must be validated by other entities. One concern is nursing homes, and the need for comprehensive COOP plans for these facilities, because of the sensitive population. Clear expectations with vendors and partners during shut-downs or emergency evacuations need to be established prior to an event to ensure effective response. In the event of limited cellular service, or when there are unaccounted personnel, executing a COOP plan becomes increasingly difficult, especially without coordination with outside parties. The group noted that outside resources and personnel can be included in a COOP plan, with the realization that most employees may have to help their families during a major event.

Challenges related to funding were a major topic of discussion during this breakout group. The availability of funding for response and recovery efforts creates challenges for most participants, delaying work until funding is available. The possibility for reallocation of funds was discussed, allowing cities and entities to divert non-critical funding to response and recovery, if needed. The group shared that contracts should have mechanisms built in to receive supplemental funding for addressing major storm and flooding events. Considering the recent government shut-downs, and potential for an event to occur during a future shut-down, the group expressed that contracts and funding mechanisms should be established pre-storm to ensure the compensation of all entities and personnel.

Group C

Group C addressed the challenge of communication between entities, specifically, the need for more communication among the local, state and federal agencies/organizations (e.g., Norfolk Port partner federal entities). As a result of insufficient communication, there is a lack of comprehensive

COOP plans validated by multiple stakeholders and agencies. Communication challenges also extend to public perception of flooding events and mandatory evacuations. Without a complete understanding of the risks associated with sea level rise and flooding, the public cannot respond effectively at the time of an event. The shortcomings of communication and education also create challenges associated with responder and citizen fatigue when facing successive storms. Communication gaps exist during the transfer of institutional knowledge. A major challenge is the loss of experience and knowledge in a region with high military/political turnover. As a result of high personnel turnover, relationships and expertise in certain areas cannot be easily maintained.

Access challenges were focused primarily on getting employees and resources on-site. It is a challenge to get personnel and resources back into an evacuation zone once the order has been given, inhibiting the re-opening of ports and critical facilities. Identification of available resources and personnel for deployment could be aided by tools such as NRAD discussed in the Tools Café. The group highlighted the importance of staging assets prior to events based upon forecasts, to help mediate identification and access challenges. Without an understanding of what resources are available, and the ability to stage or transport these resources, response efforts are greatly hindered.

Access to funding for local partners is a major challenge. Without long-term contracts or plans, funding can be hard to acquire in a short time. Avenues for funding need to be identified to aid in response recovery, including what recurring funding is available, and how to obtain access to it. Even if responders have identified required resources, and have means of transportation, access to adequate funding may take additional time, delaying a response.

VI. Session II – Best Practices

The Organizing Committee compiled and categorized the challenges identified during Breakout Session I. The challenges were sorted into eight categories: 1) capacity, 2) communications, 3) continuity planning, 4) data management, 5) funding, 6) infrastructure, 7) logistics, and 8) policy. After refinement and organization, the 41 challenges were equally distributed among the three groups. During Breakout Session II, Groups A-C were tasked with: i) identifying the current best practices to address each challenge, ii) the desired practice to address each challenge, and iii) the next steps for implementing the desired practice. Following Breakout Session II, one member from each group presented an overview at a plenary session. This section includes paragraphs summarizing priority items identified. See Appendix F for specific details.

1. Capacity Challenges
    a. Planning and response fatigue resulting from multiple storms in succession, and regions with frequent flooding.
    b. The loss of institutional knowledge once a staff member leaves, especially as a function of their longevity in the position at the local level, and the lack of continuity of relationships/knowledge transfer following turnover (e.g., political, military).
    c. Employee mental health and wellness concerns (e.g., required personnel are also impacted by the incident).
    d. The availability of local knowledge and acquiring resources (e.g., where can federal entities get local resources quickly when an event occurs?).

e. Managing employee work and family responsibilities (e.g., accounting for all personnel, encouraging focus on families rather than getting back to work, smoothly evacuating dependents while maintaining essential employees).
f. "Conference call burn-out" resulting from multiple communications among local, state, and federal entities.

2. Internal (I) and External (E) Communication Challenges
    a. Road closure information communication/identification issues (e.g., communication process of which evacuation route to take or avoid, text message vs. email vs. other methods). [I, E]
    b. Emergency coordination with no method of communication (e.g., no-comms scenario, operating by SAT phone or radio, incomplete directory of SAT phone numbers). [I, E]
    c. Identification of who has evacuated and where they are located. [I, E]
    d. Communications preparation for shorter evacuation/planning periods in the event of a rapidly moving storm. [I, E]
    e. Media interpretation and public perception of mandatory evacuation orders and weather forecasts (e.g., influence from certain sources such as local weather forecasters, sensationalism). [E]
    f. Clarity of emergency and scientific messaging when relaying information on affected areas and associated risks (e.g., managing public expectations and messaging to the public). [E]
    g. Management of public interaction while trying to accomplish response missions (e.g., communicating safe practice, public not listening to notices). [E]
    h. Identification of the people using the products directly and how to improve them (e.g., end-user assessment for quality assurance and control. [E]
    i. Lack of standardization of communication and breakdown of responsibilities at the national level during response (e.g., relaying best practices, need for a lessons learned summary, different backgrounds of personnel or new personnel who have their own approaches). [I]
    j. Communication issues involving texting complications while using Everbridge. [I]

3. Continuity Planning Challenges
    a. Lack of reconstitution plans, and maintenance operations after mandatory evacuation (e.g., re-entry concerns, conflict with recovery/response operations).
    b. Semi-automated off-loading equipment for cargo if the port does not have manual option in the event of downed systems (e.g., lack of contingency plans in the port).
    c. Emergency designation of roles and responsibilities under any disaster conditions (e.g., people leave, or are unavailable to leave, including essential personnel during an emergency event).
    d. Avoiding conflicts in COOP planning at a regional scale (e.g., what happens at federal level if DC is incapacitated? what happens if entire Atlantic coast in impacted? Do COOP plans account for that?).
    e. Appropriate staging of assets based on forecasts (e.g., access to resources ahead of time, identification of areas that are not going to flood).
    f. Clear, honest, actionable plans for emergency situations.

g. Scalability of preparedness for varying storm conditions (e.g., storms forming faster resulting in less lead time to prepare/evacuate).
h. Mitigation hazards to response personnel related to methods of communication.

4. Data Management Challenges
    a. Information collection and historical data analysis to aid in the determination of extent of flooding, depth of water, and timing to keep citizens informed.
    b. Maintenance of up-to-date information in databases (e.g., keeping pace with climate change/sea level rise, incorporating data predictive models).
    c. Frequency of nuisance flooding and accurate predictions of future floods.
    d. Identification of major impact zones in the region.
    e. Post-storm flood validation of affected areas (e.g., uncertainty of what flooded, no system to collect data on damage, risk of crowd-sourcing information during an event, visualization of what features look like with increasing levels of water).
    f. Multiple sources of information and models, resulting in potentially conflicting messages to public and decision-makers.
    g. The lack of consideration of compound flooding in models (e.g., precipitation on top of high tide, dam breaks, culvert failure).

5. Funding/Budget Challenges
    a. Lack of long-range funding streams to fix permanent issues at local level (e.g., non-conflicting community expenditures).
    b. Lack of mechanism built into contracts to receive supplemental funding leading to acquiring funding after ceiling is reached.
    c. Lack of an emergency funds available for hurricane season (e.g., funding similar to oil spill liability trust fund).

6. Infrastructure Challenges
    a. The loss of natural features due to frequent flooding and storm events (e.g., parks, wetlands).
    b. Aging infrastructure that is not designed to handle current flooding and storm scenarios.

7. Logistics Challenges
    a. Knowledge regarding where to relocate assets prior to storm events to avoid damage, and allowing access.
    b. Optimization of staff locations to ensure their safety, while allowing access to impacted areas (e.g., sending response teams for survey support, knowing where those people can stay for a few days, with limited cell service).
    c. Synchronization of resources and priorities to efficiently respond to a storm event.

8. Policy/Processes Challenges
    a. Mechanisms for servicing low income populations who may be at higher risk during an event (e.g., lack of transportation, insufficient shelter).
    b. Lack of pay for federal employees/military until mandatory evacuation is initiated; no guarantee that payment will occur during evacuation, a deterrence to proactive response measures.

Group A

Group A developed many solutions for planning and response fatigue due to multiple consecutive storms. The current best practice to combat this fatigue is a maximum response or planning time, followed by time off, to mitigate the effects of successive storm events. The potential for force multipliers during an event was a possible enhancement, by having an MOU with entities and contractors to build up a response cadre. Another way of addressing this challenge would be to share streamlined planning among entities. Plans could be shared across agencies using the Prebus Star application (i.e., sharing, connecting, editing). Sharing plans for NOAA or other federal entities posed a challenge due to sensitivity concerns. To aid in NOAA preparedness, the focus should be on prioritization in planning, including for essential staff and actions. The potential for staging was considered, by sending out responders and response actions in phases to reduce fatigue. In order to reduce fatigue and support response, inter-agency drills were proposed, reducing the amount of required drills and exercises, while increasing networking between entities.

Group A had many potential solutions for reconstitution and re-entry. Many members in the group recognized a large gap in the reconstitution plan, questioning if a comprehensive plan even exists. The group suggested having all stakeholders involved in the reconstitution planning and process. The proposed reconstitution plan should be a part of the continuity of operations plan. The reconstitution process needs to be clarified to all stakeholders, with explanations of how decisions are being made, and how they are handled at the local level. Solutions need to be investigated surrounding the communication of reconstitution plans to communities. Regional reconstitution should be developed that consider local needs.

The group suggested continued implementation of gauges to identify areas of flooding and to provide a better understanding of the coastal inundation trends. The main challenge identified with the implementation of new flood sensors was funding. Another best practice and future enhancement is the ability to crowdsource flooding photos from the public for more data on at-risk areas. The implementation of more water level indicator rods along roadways and coastlines would allow citizen scientists to report flooding.

Group B

In regard to managerial training and communication issues a current best practice and possible desired protocol identified was the implementation of ‘no-comms’ scenarios in exercises and training to better prepare responders for this situation. Blue skies orientation/trainings could occur after the regular workplace trainings. The communication of data was a large challenge, especially when obtaining data from multiple sources and models. There is an identified need for information validation across multiple sources or models to make sure decision-makers are getting one clear message on the actions that need to be taken. A desired protocol would be making city databases interoperable within regions. Communication from managers to employees needs to be more transparent regarding responsibilities during an event. Managers need to clearly define steps taken to ensure employee wellness, employee compensation during an event, and plans for

employees' families regarding housing and wellness. There was a clear gap in contracts and communications with contractors prior to events. There needs to be better communication with contractors, clearly defining roles and compensation avenues prior to an event.

Group C

The group stressed the importance of up-to-date phone contacts for all employees, managers, and emergency contacts for employees to use during evacuation. The desired protocol was identified as a continually updated phone-tree detailing all positions, names, and contact information. Another current best practices and desired protocol is a self-reporting system for employees and families to declare the position they evacuated to, their wellbeing, and ability to telework or venture back to the office. Mandated trainings or drills should be designed to simulate an evacuation scenario, to practice this new system, and ensure a coordinated response during an event. Drills would solidify employee's evacuation plans, with information regarding where to evacuate, how long it will take to reach this location, and giving managers a level of confidence of employee's well-being. These drills are particularly important if two spouses are essential personnel, making it critical to determine how to get their dependents to safety ahead of time. It was suggested to work these conversations into annual performance reviews with employees, and annually updating contact info and evacuation information.

In the event that communications went down during a storm event, the group suggested using government emergency telecommunication services such as the Government Emergency Telecommunications Services (GETS)/Wireless Priority Service (WIPS) wireless priority services. Verizon offers a similar priority service for government employees, and it was suggested to sign up for this program, or see if current service providers have similar options. It was suggested that all first responders and emergency personnel have access to alternative communications source, including SAT phones and other options.

The group suggested clear, realistic and actionable COOP plans to address gaps. They stressed the constant updating of COOP plans, incorporating relevant contacts, teleworking requirements and specific trigger points to initiate action (e.g., when a flood stage reaches a certain height, a certain magnitude storm is approaching). The group also stressed the importance of regional plans with a specific localized detailed plan (e.g., flooding in Norfolk). These plans should be created and executed by a network of local, regional, and federal boards. One major gap identified was the lack of a network for federal employees during an event, inhibiting effective interagency coordination. Some closure information is available via TV reporting, but it would be helpful for a single federal source of information (e.g., online, centralized closure messaging bulletin). Ultimately, the group thought there needs to be more extensive planning, coordinated with stakeholders at every level, to create a comprehensive COOP plan.

Though most entities reference NWS for their forecasts, the information can often conflict with localized forecasts and other sources of information. One implementation plan to solve this issue is to publish a list of authoritative sources to reference, including explanations of why each source is preferred, and what information it provides. This proposed implementation will ensure that appointed and elected officials know which resources to trust during an event. One lesson learned from the recent government shutdown was the unavailability of websites during an incident. This is especially true when networks are being accessed by thousands of users; adequate bandwidth is essential. One common platform for information was recommended, with capabilities to handle large volumes of users, relying on different entities to publish information on it.

VII. Tools Trainings

A summary of each tool presented in the Tools Café on the first day of the workshop can be found in this section. See Appendix D for actual presentations. The purpose of the Tools Café was to provide training with tools (e.g., real-time data, forecasts/predictions, asset inventory) used for improved response decisions and communications. The six presenters provided a brief overview of the potential applications of each tool, followed by a demonstration session providing interaction and discussion with participants.

NOAA's Environmental Response Management Application (ERMA)

Robb Wright, NOAA OR&R Spatial Data Branch, discussed NOAA's Environmental Response Management Application (ERMA) tool and its various uses. ERMA provides a web-accessible common operating picture (COP) for responders, increasing communication, coordination and efficiency during a response. ERMA is national in scope, but has accessible regional sites for coastal planning and response. ERMA allows responders to prepare for, respond to, and assess impacts from various incidents or conditions through analysis and visualization of environmental information relevant to all hazards. ERMA differs from a responsible party's (RP) COP as it includes both operational and environmental data, allowing holistic mapping of an event. Wright also described the requirements for a comprehensive COP, and how ERMA meets these requirements including: (1) 24/7 access for responders, (2) security capabilities to protect users and sensitive data, and (3) an intuitive interface, with data, symbology and products allowing interoperability between agencies. Wright provided examples of the various applications of ERMA's visualization of data such as quantitative precipitation forecasts, flooding/storm surge warnings, stream gauge forecasts, and electrical outages.

NOAA Response Asset Directory (NRAD)

Alyson Finn, NOAA OR&R, discussed the applications of the NOAA Response Asset Directory (NRAD). NRAD is an all hazards directory for information about vessels and federal services. This searchable directory allows NOAA responders and approved external partners to identify assets that are in the region, enabling them to manage them efficiently. NRAD was created for responses in the Gulf of Mexico, but has since widened its focus nationally. NRAD is overseen by a team of data managers to update information and ensure its quality. The most important function of this tool is the "search" function, allowing users to find any asset of interest, with category filters and refinements such as location and type. Though many assets are defined in the system, some such as NOAA vessels, move frequently and it is important to consult with the contacts to verify status and location. Most of the data are self-reported, so data managers must remain vigilant in updating NRAD to insure it is a comprehensive source of asset information during a response.

Digital Coast, Coastal Flood Exposure Mapper, and Coastal Change Analysis Program (C-Cap)

Becky Allee, NOAA Office of Coastal Management (OCM) – Gulf Region, discussed the applications of Digital Coast and its associated tools. Digital Coast is a platform for coastal communities to access data, visualizations tools and training. It houses over 50 web-based, decision support tools, which can be accessed without additional software. The platform was first developed in 2007 by a network of partners including academia, NGO's and industry. These partners are responsible for

maintaining and adding tools necessary for coastal zone management and conservation. The most used tools are shown on the home page, making the platform easily accessible for preparedness-focused end users.

The Coastal Flood Exposure Mapper (CFEM), a frequently used tool, allows communities to identify vulnerabilities and types of hazards which helps start discussions of risks and areas of concern. The CFEM is a preparedness planning aid, and is not intended to replace similar FEMA resources. The tool is user friendly, with the ability to download, send, or share maps with fellow planners and community members via unique URLs. CFEM was initially created for Hurricane Sandy, but has now been adapted to regions across the nation.

The Coastal Change Analysis Program (C-CAP) is another tool available on the Digital Coast. C-CAP is a database of coastal land uses around the country. It is sourced from the National Land Cover Database using LandSAT technology. The database has a 30-meter resolution, with land categories updated approximately every five years. It helps monitor trends and changes of land use, development, wetlands, and other planning considerations. C-CAP data are also used in the CFEM, allowing comparison between the two resources. C-CAP developers are working toward one-meter resolution throughout coastal regions. However, in the interim some areas may be categorized at a 10 meter resolution due to the high cost associated with this the 1 meter product.

VIMS Storm Surge Models

Derek Loftis discussed the applications of VIMS' StormSense, and associated tools such as Tidewatch Charts, and Tidewatch VA Coastal Inundation Forecast Maps. StormSense is one of the VIMS projects focusing on forecasting flooding from storm surge, rain, and tides. The objective of Storm Sense is to enhance the capability of communities to prepare for and respond to the disastrous impacts of sea level rise and coastal flooding in ways that are repeatable, scalable, measurable and make a comparative difference. StormSense operates using three major platforms: ESRI ArcGIS Online, Valarm Tools Cloud, and Amazon Web Services EC2 Cloud Platform. ArcGIS online enables dynamic inundation mapping and spatial comparisons with flood maps and the National Weather Model. The Valarm Tools Cloud receives, interprets and plots Internet of Things (IoT) sensor data for automated flood threshold exceedance alerts and serves as an input into flood visualization tools. Amazon Web Services allows public application programming interface (API) ingestion from external sources. Most of the regional data inputs originate from installed water level sensors around Norfolk. In addition to water level sensors, road inundation sensors have been deployed in frequently flooded intersections to identify when these areas are impacted. Some of StormSense's low-cost ultrasonic sensors were co-located adjacent to USGS' more expensive radar sensors to determine that their Root Mean Squared Error (RMSE) is 1.18 cm. This comprehensive system of sensors and analysis alerts users when certain areas are inundated or forecasted to flood. The project is geared towards response, however, has applications for city planning for flooding trends and forecasts.

Tidewatch Charts provide an effective way to visualize and predict the magnitude and impacts of coastal flooding at specific locations within the Chesapeake Bay and along Virginia's shoreline. The charts are a series of water-level sensor plots updating each hour. Tidewatch Charts also feed data to sea level report cards that VIMS provides based upon NOAA reports, providing explanations of

datum, trends, and all available information including consideration for local subsidence and regional ocean dynamics. In an effort to be user friendly for both communities and planners, Tidewatch Charts is a web-based application, not requiring programs such as GIS. The validation of information is undertaken through reference of more accurate NOAA and USGS sensors, as well as volunteer reporting of flooding events.

Tidewatch VA Coastal Inundation Forecast Maps are used as a basis of storm surge modelling visualization. Using a web-based interactive platform, the maps do not require extra software, making them accessible to all members in a community. Tidewatch Maps are automated geospatial water level maps driven by VIMS' SCHISM hydrodynamic model, updated with NWS atmospheric inputs every 12 hours, providing inundation scenarios 36 hours in advance of a storm or flooding event. The model updates the inputs twice a day (noon and midnight), to provide continually relevant planning information. The resolution of the model is dependent on the accuracy of the LIDAR data used (average resolution = 5m). 2.3 million nodes and 1.5 million elements are incorporated into the model, and it is constantly validated and updated for accuracy.

National Hurricane Center Storm Surge Prediction Model

Mike Dutter explained the applications of the NWS and NOAA's National Hurricane Center Storm Surge Prediction Model. The goal of this model is to accurately predict and assess storm water levels, intuitively describe inundation as flooding above ground level, and to communicate actionable information. This model strives to answer many common customer questions, such as: Who and how much will get flooded? When will it arrive and leave? What will the impacts be? How often will it occur? How should I act?. One of the primary models is the Sea, Lake and Overland Surges from Hurricanes (SLOSH). SLOSH is a numerical model developed by the NWS to estimate storm surge heights resulting from historical, hypothetical or predicted hurricanes considering parameters such as atmospheric pressure, size, forward speed and tracking data. SLOSH model physics are applied to a specific locale's shoreline, incorporating the unique bay and river configurations, water depths, bridges, roads, levees and other physical features. The SLOSH model also has the capability to analyze hypothetical situations such as "What would happen if a category 1 hurricane hit Hampton Roads, VA". The SLOSH approach incorporates three primary models for warnings/analyses with different timeframes: Probabilistic Storm Surge (P-Surge) model, Maximum Envelope of Water (MEOW) model, and the Maximum of the MEOWs (MOM) model. The MEOWs and MOMs are not storm specific, providing the worst case scenarios for a particular category storm, incorporated into the SLOSH products. The P-Surge predictions provide information during the response timeframe of an event, less than 48 hours before landfall. It focuses on actionable information, providing forecasts for storms with varying intensity and all possible tracks. These predictions can produce visualizations of many crucial elements to response, such as locations predicted to have greater than 5ft of storm surge with a 10% exceedance threshold. These models and visualizations provide actionable information, informing decision-makers when to issue a coastal flood advisory or warning, or a storm surge warning.

Tide Forecaster

Michael Dutter described the applications of the Total Water Level Point Forecasts. This tool provides daily tide forecasts at point locations, allowing accurate historical analysis and future forecasts. The primary data input for this tool is various stream and coastal gauges along the eastern coast. This tool can provide hydrographs and enhanced warnings to affected areas. The

total water predictions are integrated into Advanced Hydrologic Prediction Service (AHPS) with all river flood data accessible. The information and alerts from this tool are shared in text format, providing insight into the location, timing, and possible coastal impacts from a storm. The impacts shared by this tool are generalized and cannot predict specific impacts of inundation. They are meant to provide essential information for planning and preparedness.

NOAA's Center for Operational Oceanographic Products and Services

Paul Fanelli presented on several of NOAA's coastal flood tools, including the new Coastal Inundation Dashboard, Seasonal High Tide Bulletins, and the Inundation Analysis Tool. The Coastal Inundation Dashboard provides real-time and historic coastal flooding information at a majority of the coastal water level stations operated by the National Ocean Service's (NOS) Center for Operational Oceanographic Products & Services (CO-OPS). This web mapping tool highlights real-time coastal inundation data regardless of the cause (e.g., tropical cyclone storm surge, high tide flooding, runoff events). It allows users to view real-time and 48-hour forecasts of water levels, and historic flooding information. A quick click on any station will show the latest water level data, wind speed, barometric pressure, time of next high tide, and highest forecast water level for the next day. Within the map, CO-OPS integrates the latest NWS tropical cyclone forecast information, storm surge and coastal flood watches and warnings. This allows users to easily monitor water levels at stations that may have the highest impact from a storm. Water levels are conveyed relative to the Mean Higher High Water (MHHW) tidal datum, (i.e., average daily highest tide) in order to provide a good estimate of when flooding inundation may begin. With average highest tide as the zero-line, data that are positive depict "excess water" being observed. Within the map, blinking station markers indicate that water levels have exceeded (or in some cases are forecast to exceed) the known minor flooding threshold usually set by the local NWS Weather Forecast Office (WFO). When viewing water level data, these WFO flood impact thresholds are clearly depicted using the same colors used in NWS products, signifying minor, moderate or major flooding. Emergency managers and other coastal decision-makers can use this information to understand and prepare for the impacts of coastal flooding and monitor real-time water level conditions as a storm approaches. Sharing of information between community members is made easy through the creation of custom regional maps with unique URLs that can be sent to partners, with data constantly updating in real-time. The coastal planning community can use this information to gain a better understanding of past peak water level events and the increased frequency of days when flooding has occurred as sea levels have changed. Information such as the annual number of flood days, top 10 historic observed water levels and sea level trends can be found on a station's *Inundation History* page.

The Seasonal High Tide Bulletin tool shows when regions around the nation may experience higher than normal tides. These predictions are based upon the relative position of the sun and moon and the distance of the moon from Earth. When the sun and moon are in alignment (full moon and new moon), the tidal forcing is amplified. When the moon is closest to Earth, the tidal forcing is also higher. When these two phenomena co-occur, there are higher than average tides. During these periods, (which typically last a few days), coastal flooding is more likely during onshore wind events, coastal storms and instances of excess runoff or can occur without any of these factors. Specific dates are provided indicating when tides will be higher than normal, allowing for planning and preparedness. This tool is region based, providing outlooks that can be used by all parties, from decision-makers to community members.

The Inundation Analysis tool provides frequency and duration of inundation above a user-specified threshold elevation at a given location based on historic data from the NOAA's Center for Operational Oceanographic Products and Services tide stations. Input thresholds and tidal datum can be input (e.g., average highest tide, average low tide) for exceedance analysis during a specified period (up to 5 years). This tool is very helpful for planning as any threshold can be used, which allows community planners to easily view whether and how often coastal water has impacted a specific location.

VIII. Workshop Outcomes

The outcomes represent actionable items, and commonalities identified during the workshop and by the organizing committee in a follow-up meeting. The three main NOAA actionable items address major gaps in training, communication, and reconstitution/COOP plans.

The first gap identified is the **disconnect between decision-makers and response staff**. After identifying gaps in planning, policy and response, it was clear more communication is needed between those creating policy and those executing orders. Staff may not be involved in decision-making processes but should be to improve response and preparedness. Staff members do not necessarily have the authority to make decisions, yet have vital information that leadership may not know. The goal is to identify items actionable by staff, and those that need to be sent up to leadership. This disconnect could be partially eliminated by more consistent briefings between leadership and staff by requiring a liaison to transfer information. This challenge is policy-based and thus may not immediately be actionable by NOAA.

There is an **internal regional communications gap within NOAA**. Most communication structures in NOAA are vertical, with reporting requirements going up through an individual's work unit. For multiple, co-located personnel, regional situational awareness can be obscured. Creation of a template for regional employees to complete, including contact info, evacuation plans, and teleworking capability could improve communication with employees during an event, and clear understanding of who manages regional communications across operating units. If such a template exists, it could be updated. The rules and requirements during response should be clarified. Staff should be regularly reminded of their responsibilities and requirements during response, with realistic expectations considering family and wellbeing requirements. The importance of alternative methods of communications should be established, exploring which alternative is most suitable (e.g., GETS/WPS, SAT phones, service provider programs). Increased communication within NOAA before and during response will increase preparedness and response capabilities.

There is a need for **more training for NOAA supervisors** to increase their effectiveness during response. These could be online, or in conjunction with other federal trainings, and should be directed at increasing supervisory awareness of response procedures, and consistent employee check-ins. Supervisors should regularly update staff directories, and all emergency information to have more accountability of staff during an event. These directories could be updated annually during employee performance evaluations or at other convenient times. Overall, supervisors should be aware of their responsibility for the safety of their employees, especially during response and evacuations. This information gathering, and training should be conducted prior to hurricane season, establishing updated cell phone numbers, evacuation zones, addresses, leave times, and anticipated evacuation destinations. With increased supervisory training and accountability for employees, emergency preparedness and response action will be improved.

Many **gaps were identified within reconstitution and COOP plans**, requiring revision or creation of the plans to increase preparedness. Comprehensive reconstitution plans were a major concern, requiring action to create or modify existing plans. Reconstitution plans could be embedded within all COOP plans for them to be comprehensive. There was an identified gap between the creation and operation of local, regional and federal COOP plans. Local COOP plans should be coordinated with regional ones to improve both and ensure the effective use of resources and time. A holistic local Norfolk region COOP plan could be developed with the partners identified from this workshop. This coordinated regional COOP plan could serve as a model for others. Comprehensive COOP plans involving local, regional and federal partners would increase the preparedness of coastal regions.

A **tool matrix should be created that decision-makers** can reference for preparedness and response. During the Tools Café, and workshop discussions, there were many concerns about the number of tools available, differences among tools, and uncertainty of which tools best suit specific needs. Potential users are often not aware of the available tools, hindering effectiveness. The creation of a tools matrix would streamline the process of choosing an effective tool, and increase preparedness and response. A similar platform, GulfTREE, was created for the Gulf region, and could be referenced or expanded to meet the Norfolk region's needs. The creation of a tools matrix is a NOAA actionable item, and VIMS proposed to help in this effort.

IX. Appendices

A. Workshop and Tools Café Agendas

B. Workshop Participants

C. Breakout Group Participants

D. Tools Café Presentations

E. Workshop Presentations

F. Workshop Breakout Group Notes

Appendix A

Workshop and Tools Café Agenda

NOAA's Regional Preparedness Workshop & Training (NRPT)

Improve Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Tools Café

Date: Tuesday, June 18, 2019
Location: ODU TriCities Center, 1070 University Blvd, Portsmouth, VA
Time: 1:00 – 4:00 pm

Tuesday, June 18, 2019 - Join us for an overview and hands-on training of tools used for improved response decisions and communication.

- NOAA Environmental Response Management Application (ERMA®) – *Robb Wright, NOAA OR&R Spatial Data Branch*
- NOAA Response Asset Directory (NRAD) – *Alyson Finn, NOAA OR&R, Disaster Preparedness Program*
- Digital Coast – B*ecky Allee, NOAA Office for Coastal Management, Gulf Region*
  - Coastal Flood Exposure Mapper
  - C-CAP – Coastal Change Analysis Program
- VIMS Storm Surge Models – *Derek Loftis, Virginia Institute of Marine Science*
  - StormSense
  - VIMS' CCRM's AdaptVA.org tools
  - Tidewatch Charts
  - Tidewatch VA Coastal Inundation Forecast Maps
- NOAA/NWS Coastal Flooding/Storm Surge Products and Tools – *Mike Dutter, NOAA National Weather Service (NWS)*
  - Hurricane Storm Surge/Inundation from the National Hurricane Center – Psurge Model, Storm Surge Watch/Warning
  - Total Water Level Forecasts – Tools and Products
- NOAA's Center for Operational Oceanographic Products and Services – *Paul Fanelli, NOAA/National Ocean Service, Center for Operational Oceanographic Products and Services*
  - Coastal Inundation Dashboard
  - Seasonal High Tide Bulletin
  - Inundation Analysis Tool

There will be brief presentations on each of the tools with additional time for discussing tools' application and interaction. Following the discussion there will be time for hands-on training.

Coastal Response Research Center

This workshop is a partnership between NOAA's Disaster Preparedness Program and the Coastal Response Research Center.

NOAA

NOAA's Regional Preparedness Workshop & Training (NRPT)

Improve Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

WORKSHOP AGENDA

Date: June 19 & 20, 2019
Location: ODU TriCities Center, 1070 University Blvd, Portsmouth, VA
Time: 8:30 – 4:30

Wednesday, June 19 (Workshop)

8:00 am Registration

8:30 am Welcome and Logistics
- Facility Host, Michelle Covi, ODU, Virginia Sea Grant Climate Adaptation and Resilience Program
- Nancy Kinner, Coastal Response Research Center
- Nicole LeBoeuf, NOS, Ocean Services and Coastal Zone Management

8:45 am Background, Objectives and Workshop Goals
- Kate Wheelock, NOAA Office of Response & Restoration, DPP

9:00 am Participant Introductions

9:30 am Plenary Presentations by Norfolk Region Entities
- NOAA OCS – LT Anthony Klemm
- NOAA COOPS – Kate Bosley
- NOAA AGO – Emily Clark
- NOAA OMAO – CDR Matthew Jaskoski

10:15 am *BREAK*

10:30 am Plenary Presentations by Norfolk Region Entities
- NOAA NGS - Ryan Hippenstiel
- NOAA NWS – Michael Dutter
- Navy - Jeff Hayhurst
- USCG – CAPT Kevin Carroll
- USACE – MAJ Alex Samms

11:45 pm *LUNCH*

1:00 pm Plenary Presentations by Norfolk Region Entities
- Coastal Zone Management Program – Becky Allee/designee
- Port Authority – Bill Burket
- Local Emergency Responders – Norfolk City Emergency Manager - Jim Redick

1:45 pm Breakout Group I - Challenges

- What are the primary challenges/impacts to mission that must be addressed for storm events and nuisance flooding?

3:15 pm *BREAK*

3:30 pm Breakout Groups Report Out to Plenary

4:30 pm *ADJOURN*

Thursday, June 20 (Workshop)

8:30 am Overview and Recap

8:45 am Breakout Group II – Best Practices

- What are the practices currently in place to handle these challenges?
- How could the preparedness posture and readiness be enhanced to address these challenges?

11:00 am Breakout Groups Report to Plenary

12:00 pm *LUNCH*

1:00 pm Breakout Group III – Path Forward

- What is the path forward?
- Next steps for better preparing NOAA in the region. Joint and individual interactions [local, regional, national].
- What is the path forward to achieve the preparedness posture and readiness? How do we implement this? How do we get there?

2:45 pm *BREAK*

3:00 pm Breakout Groups Report Out to Plenary

3:45 pm Key Points and Wrap Up

4:00 pm *ADJOURN*

Appendix B

Workshop Participants

NOAA's Regional Preparedness Workshop & Training (NRPT)

Improve Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Participants

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*Workshop Organizing Committee Member

Appendix C

Breakout Group Participants

NRPT: Norfolk Breakout Groups

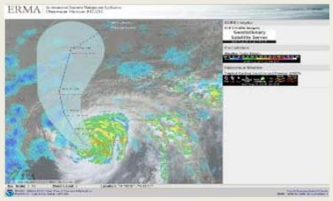
Group A - Room 2109	Group B - Room 2105	Group C - Room 2115
Lead: Becky Allee	Lead: Kate Wheelock	Lead: Ryan Hippenstiel
Recorder: Quinn Wilkins	Recorder: Melissa Gloekler	Recorder: Grace Walker
Rich Bourgerie	Tom Allen	Mike Dutter
Alyson Finn	Kate Bosley	Paul Fanelli
Brian Swets	Cameron Burke	CDR Matthew Jaskoski
Corinna Green	CAPT James Crocker	Ed Owens
Liz Gunnufsen	Jeff Hayhurst	Meg Pittenger
Robb Wright	CAPT Anne Lynch	

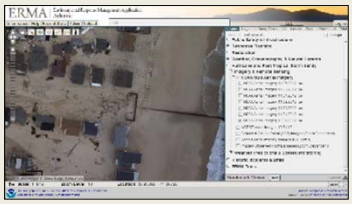
Appendix D

Tools Café Presentations

NOAA | National Ocean Service
Office of Response and Restoration

Situational Awareness for Disaster Planning and Response





NOAA's Office of Response & Restoration

NOAA | National Ocean Service | Office of Response and Restoration

Data Management for Incidents

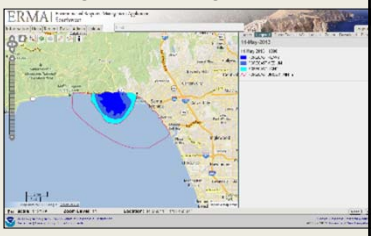
- **Mutual Aid and Assistance Agreements:** Specifying communication protocols and information-sharing arrangements.

- **Data Inventory**: Evaluate Data you may need in *advance* of incident

- **Exercising:** Establishing partnerships and testing communications protocols in *advance* of an incident.

Environmental Response Management Application (ERMA)

- NOAA Common Operating Picture (COP)
- Web-based mapping tool
- Centralized access to information
- Increases communication, coordination, and efficiency
- Prepare for, respond to, assess impacts from incidents or conditions
- Analyze and visualize environmental information relevant to all hazards



https://erma.noaa.gov

3

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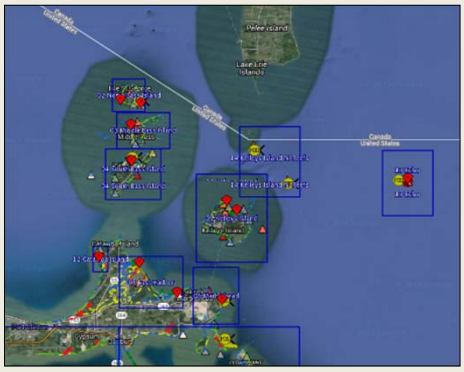
What is Required for a Good COP?

- Operational field and Environmental Data
- Provides secure 24/7 access
- Presentation: Interface, Data, Symbology, & Products
- Supported by data sharing plans
- Data Interoperability with other agencies
- Planning & reporting tools
- Maintains data after the Incident ends
- Secure Access of Data & Users
- Internal and external audience
- Support On-Scene and Off-Site Leadership Needs



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COP in Action

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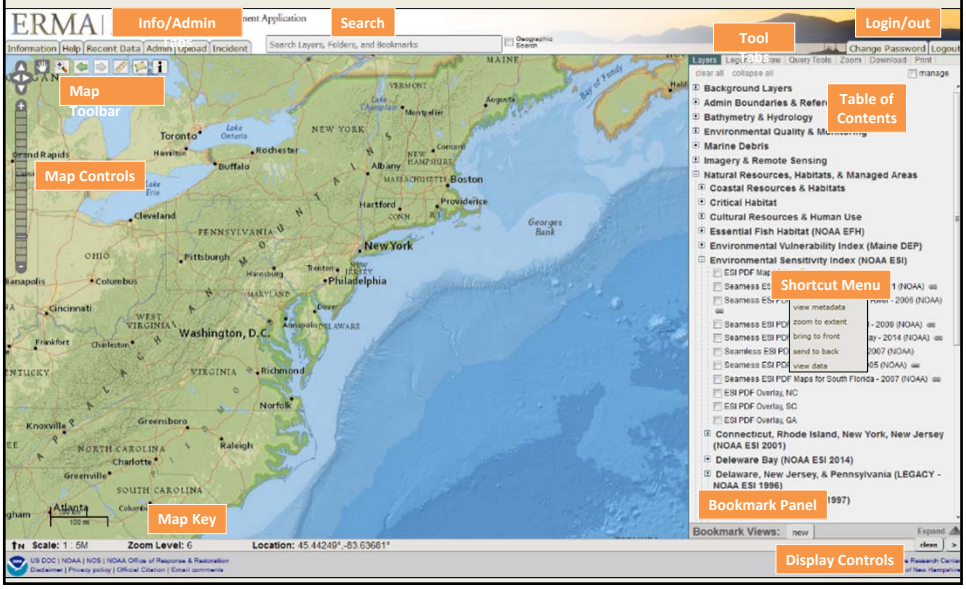
ERMA Layout



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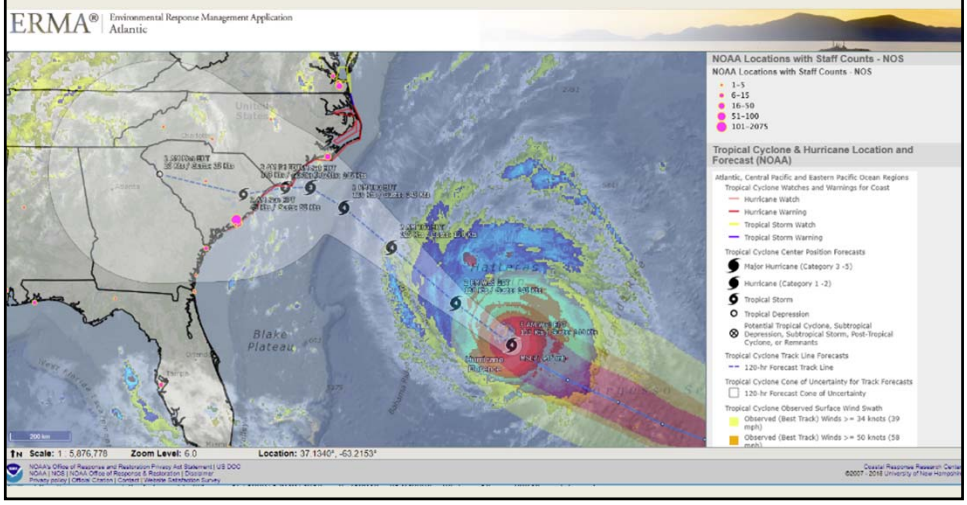
Hurricane Florence with NOAA Locations : 9/12/18



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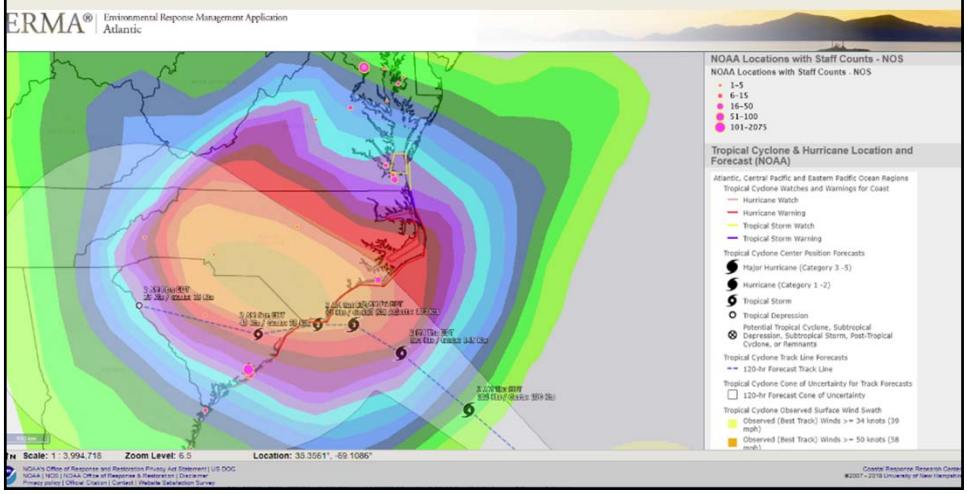
Hurricane Florence with NOS Locations and Quantitative Precipitation Forecast, 4-5 days from : 9/12/18



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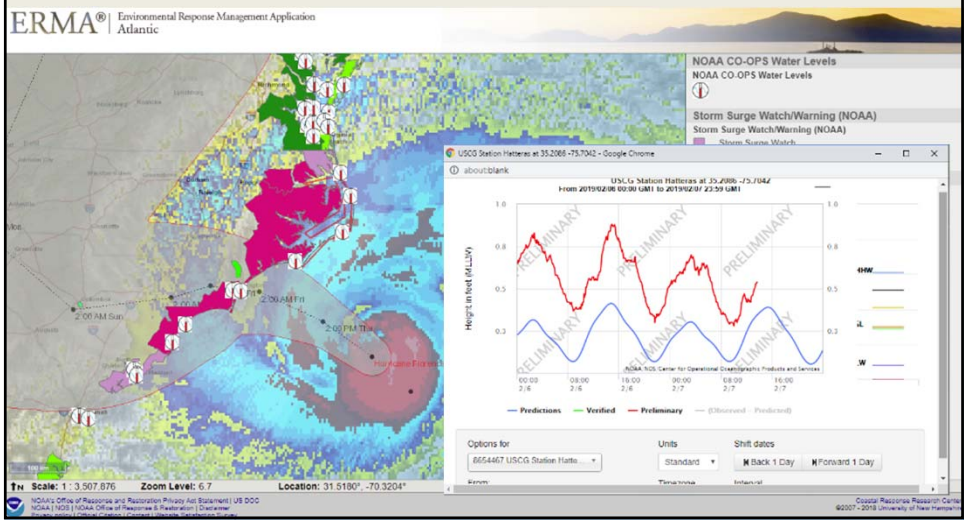
Flooding/Storm Surge Warnings/Watches and Water Level Stations : 9/13/18, 10:00



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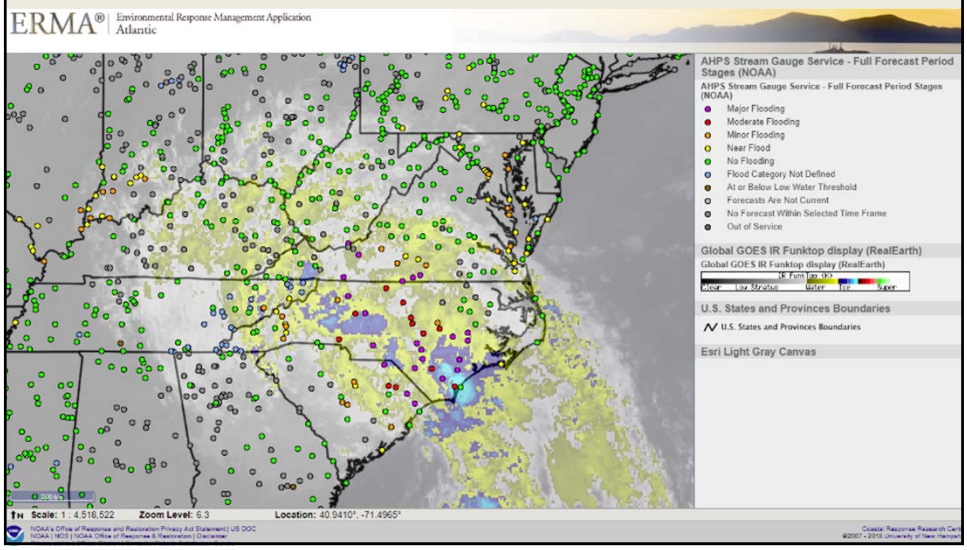
AHPS Stream Gauge Full Forecast : 9/16/18



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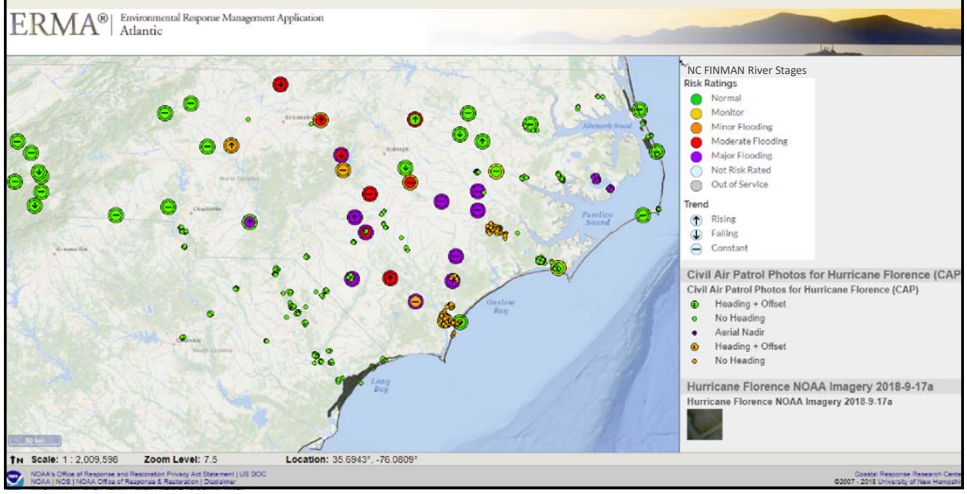
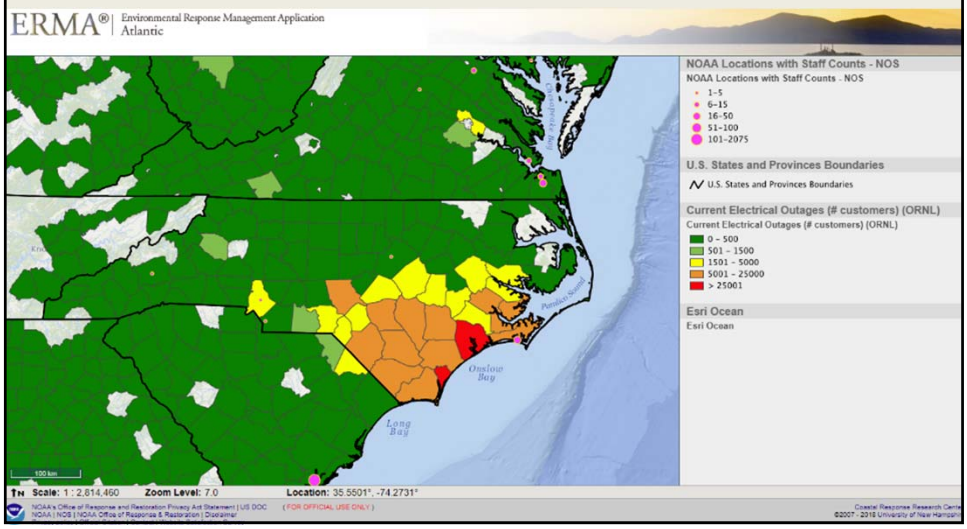
NOAA NGS Photography, CAP Photography and NC FIMAN Stream Gauge Status, 9/18/18



NOAA | National Ocean Service | Office of Response and Restoration

Current Electrical Outages : 9/18/18, 07:00



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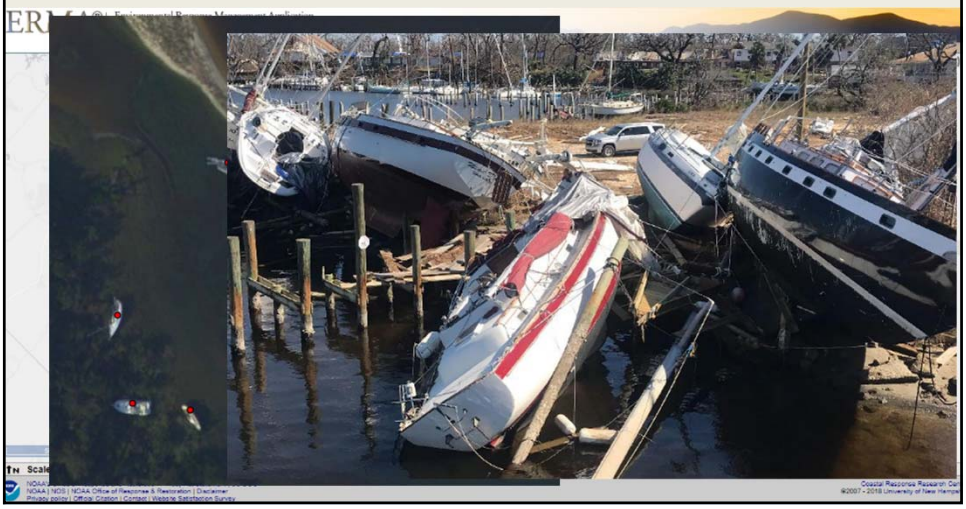
Emergency Support Function 10 Target Status (ESF-10, Oil and Hazardous Materials), with status grid: 10/12/18



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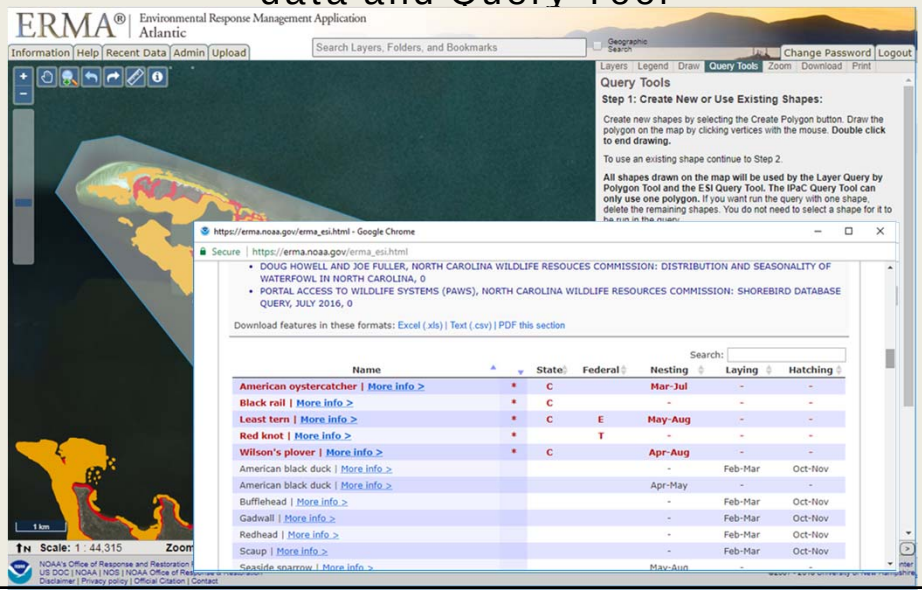
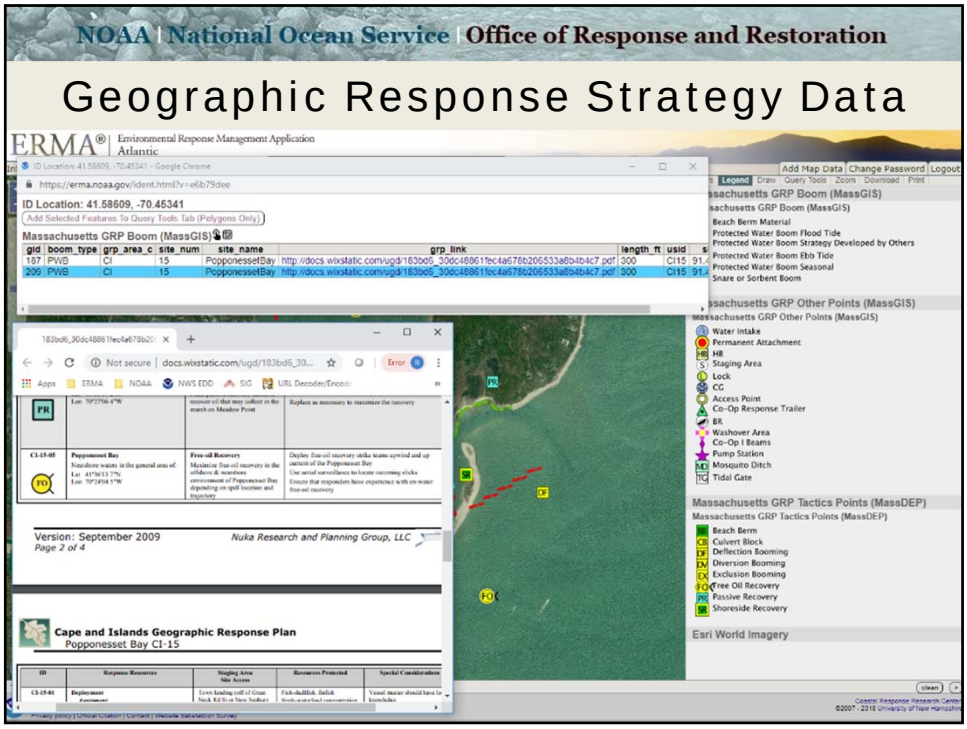
Environmental Sensitivity Index (ESI) data and Query Tool




NOAA | National Ocean Service | Office of Response and Restoration
Geographic Response Strategy Data
ERMA® Environmental Response Management Application
Atlantic
ID Location: 41.58609, -70.45341
Massachusetts GRP Boom (MassGIS)
Version: September 2009
Page 2 of 4
Nuka Research and Planning Group, LLC
Cape and Islands Geographic Response Plan
Popponesset Bay CI-15
Massachusetts GRP Other Points (MassGIS)
Massachusetts GRP Tactics Points (MassDEP)
Esri World Imagery

NOAA Response Asset Directory (NRAD)

Quick Reference Guide

To Login

1. In your web browser, go to https://ResponseDirectory.orr.noaa.gov.
2. Click the **Login** button at the top right of the screen.
3. Read the Terms of Use and select the **Accept Terms** button.
4. At the Login screen, enter your NOAA email address and associated LDAP password. If you do not have a NOAA email address, select **Reset Password** and follow the email directions.
5. Check the box next to "I have read and agree to the NRAD Terms of Use" and click **Login**.

To Logout

1. Click your name in the upper-right corner of the screen.
2. A drop-down menu will appear – choose **Logout**.

Navigating the Site

NRAD is organized in a tabbed horizontal toolbar format as depicted below. The complete User Guide, Glossary of Terms, and Acronym Listing links are on the right side of the toolbar.

- All users can view the ***Home***, ***Search***, and ***Spatial Search*** tabs
- Users setup as Asset Data Managers can also view the ***My Assets***, ***Add Asset***, and ***Edit Asset*** tabs.

Managing Your Assets in *My Assets*

The ***My Assets*** tab displays all assets for which you are the Asset Data Manager. Asset Data Managers can manage their assets using the function buttons that appear at the top of the My Assets table and are described below. Key functions may be performed on individual assets or multiple assets at a time.

- **To verify that an asset(s) has been reviewed, but no changes were required:** Select the asset you wish to mark as reviewed and click Reviewed With No Changes. To mark multiple assets as reviewed at one time, first select Enable Batch Mode, select the assets you wish to mark as reviewed, and click Reviewed With No Changes. Clicking the "Reviewed With No Changes" button will update the asset(s) "Last Reviewed" date. This function may be used during periodic updates to NRAD to verify the accuracy of information.

- **To edit an asset:** Select the asset you wish to edit and click Edit Asset to open the ***Edit Asset*** tab. Make desired changes and select "Save Asset".

- **To delete an asset(s):** Select the asset you wish to delete and click Delete Asset(s). To submit multiple assets for deletion at one time, first select Enable Batch Mode, select the assets you wish to delete, and click Delete Asset(s). Clicking the "Delete Asset(s)" button will submit a request to the Site Administrator to remove the asset(s) from NRAD. While the deletion is pending approval, the selected asset(s) will remain visible to NRAD users and will appear in the ***My Assets*** tab as pending Site Administrator approval for deletion.

- **To copy an asset (duplicate an asset record):** Select the asset you wish to copy and click Copy Asset. Clicking the "Copy Asset" button will open the ***Add Asset*** tab with pre-populated information to create a new asset. Make any desired changes and select "Create Asset".

- **To transfer an asset(s) to a new Asset Data Manager:** Select the asset you wish to transfer and click Transfer Asset(s). To transfer multiple assets at one time, first select Enable Batch Mode, select the assets you

wish to transfer, and click Transfer Asset(s). Clicking the "Delete Asset(s)" button will submit a request to the Site Administrator to remove the asset(s) from NRAD. If assets are transferred, they will no longer appear in your ***My Assets*** tab. Note that assets can only be transferred to NRAD users who are already setup as Asset Data Managers. To transfer assets to a user who is not an Asset Data Manager, that user must first email the NRAD Site Administrator to request this permission level.

- **To enable/disable batch mode:** Batch mode allows an Asset Data Manager to modify multiple assets at one time, which includes marking as reviewed, deleting, or transferring assets to a new Asset Data Manager. Click Enable Batch Mode and Disable Batch Mode to turn batch mode on and off. Note that when batch mode is enabled "Edit Asset" and "Copy Asset" will not be displayed as options.

To Add an Asset

1. Click the ***Add Asset*** tab.
2. Complete all required data fields. For a description of each field, see the complete User Guide or click the help button next to each field name.
3. Select "Create Asset". The new asset will now appear in the ***My Assets*** tab.

Searching for Assets

- ***Search* tab:** Search for assets using prescribed data fields in the Search table.
  1. Click the ***Search*** tab in the horizontal toolbar near the top of the screen.
  2. Within the Search table, filter results by selecting from the drop-down menu options or entering text in the "Search here" text boxes. Results will be filtered based on selections/entries. To remove all filters, click Reset Filters at the top of the Search table.
  3. To view an individual asset's complete record, click the asset in the Search table. Scroll down to the Selected Asset section to view complete details for the selected asset.

- ***Spatial Search* tab:** Search for assets spatially or using prescribed data fields.
  1. Click the ***Spatial Search*** tab in the horizontal toolbar near the top of the screen.
  2. Zoom in and out of the Spatial Search map to view assets based on home base location. (For multiple assets at a single address, double-click on the map location to view assets as individual points.) As the map extent is changed, only assets displayed in the current map extent are included in the Search Results in Current Map Extent table below. To reset the map extent, click Full Extent at the top of the Spatial Search map.
  3. To view additional detail for assets within the current map extent, scroll down to the Search Results in Current Map Extent table. Additional filters may be applied using the table and will be reflected in the Spatial Search Map. To remove all filters, click Reset Filters at the top of the Search Results in Current Map Extent table.
  4. To view an individual asset's complete record, click the asset in the Spatial Search map or in the Search Results in Current Map Extent table. Scroll down to the Selected Asset section to view complete details for the selected asset.

Downloading Data

Data may be downloaded from the ***My Assets***, ***Search***, and ***Spatial Search*** tabs in CSV, PDF, or XLS format. The Download section is located at the bottom of each of these tabs.

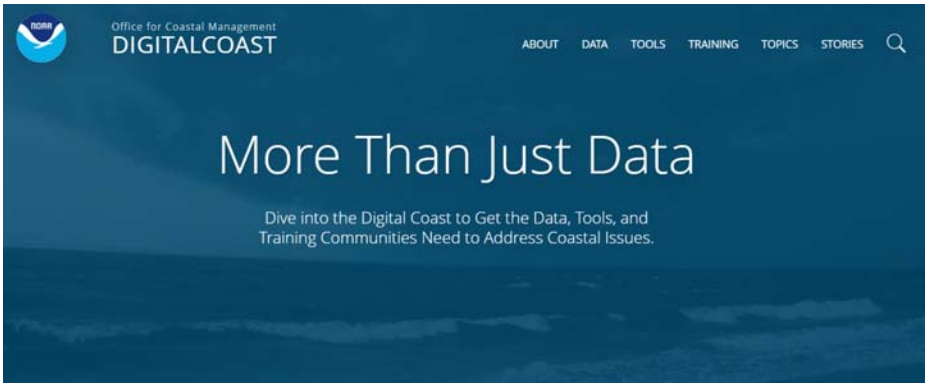
NRAD Site Administrator Contact

orr.nrad.admin@noaa.gov

Digital Coast

An Enabling Platform for Coastal Communities

Becky Allee
Senior Scientist
NOAA Office for Coastal Management – Gulf Region
June 18, 2019



Office for Coastal Management

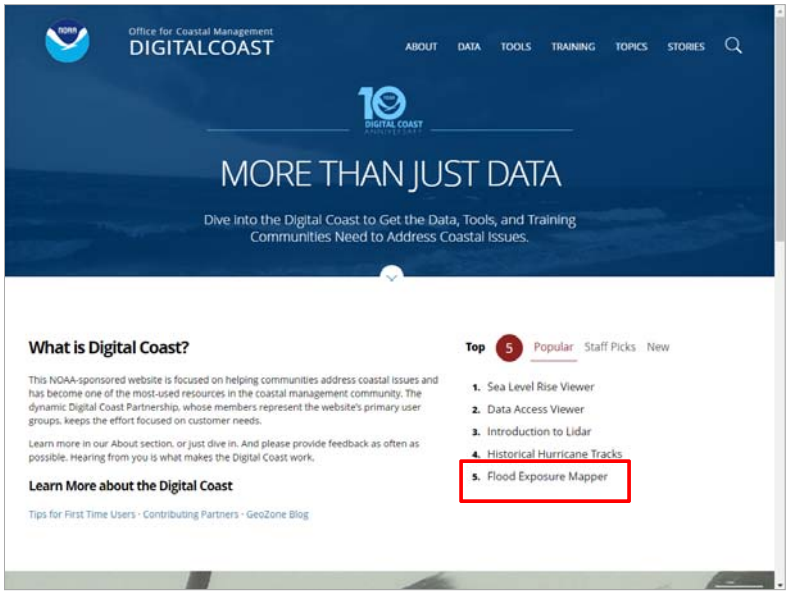
Digital Coast Tools

Sea Level Rise Viewer

Coastal County Snapshots

CanVis

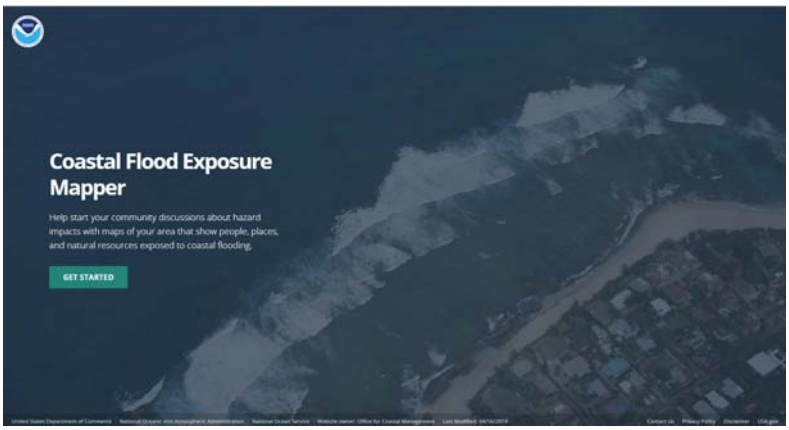
- An inventory of over 50 decision-support and information visualization tools
- Many provide visualization and analysis capabilities without the need for GIS software



Digital Coast Partnership

- American Planning Association
- Association of State Floodplain Managers
- Coastal States Organization
- National Association of Counties
- National Estuarine Research Reserve Association
- National States Geographic Information Council
- NOAA Office for Coastal Management
- The Nature Conservancy
- Urban Land Institute

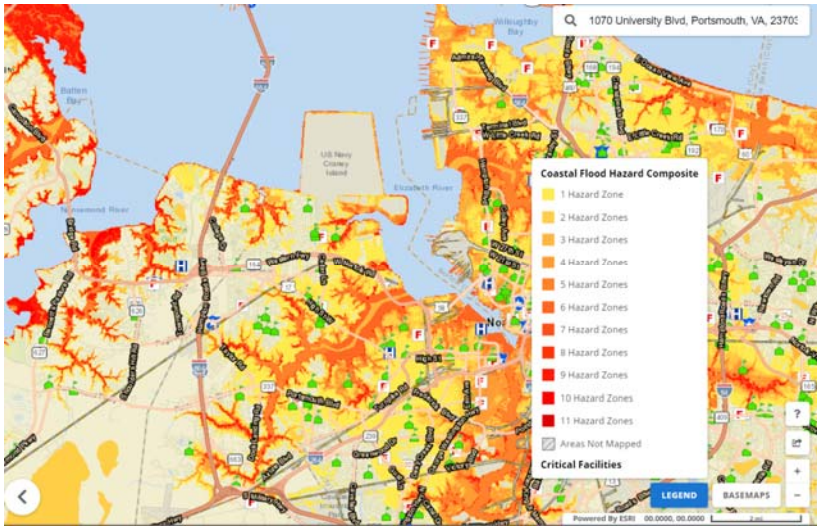
Office for Coastal Management



- Access maps that show people, places, and natural resources exposed to coastal flooding
- Provides a foundation for a community-based approach to assessing coastal hazard risks and vulnerabilities

Office for Coastal Management

Coastal Flood Exposure Mapper



Office for Coastal Management

Coastal Flood Exposure Mapper

Office for Coastal Management

Coastal Change Analysis Program
Regional Land Cover and Change

Monitoring Past to Present

- Based on Landsat Imagery (30-meter)
- Coastal expression of the National Land Cover Database (NLCD)
- Updated every 5 years
  - 1975, 1985, 1996, 2001, 2006, 2011
- 2016 update release in July 2019
  - Based on recently released NLCD data
  - Re-release of all existing NLCD & C-CAP dates
  - Likely will be the last (native) 30-meter C-CAP
  - Considered a "historic C-CAP" in the future

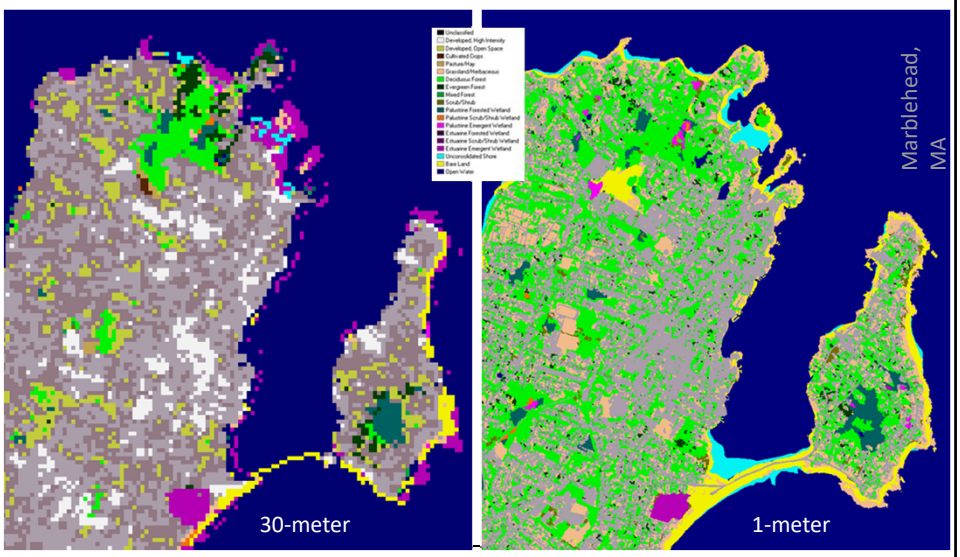
Office for Coastal Management

Coastal Change Analysis Program
High Resolution Land Cover and Change

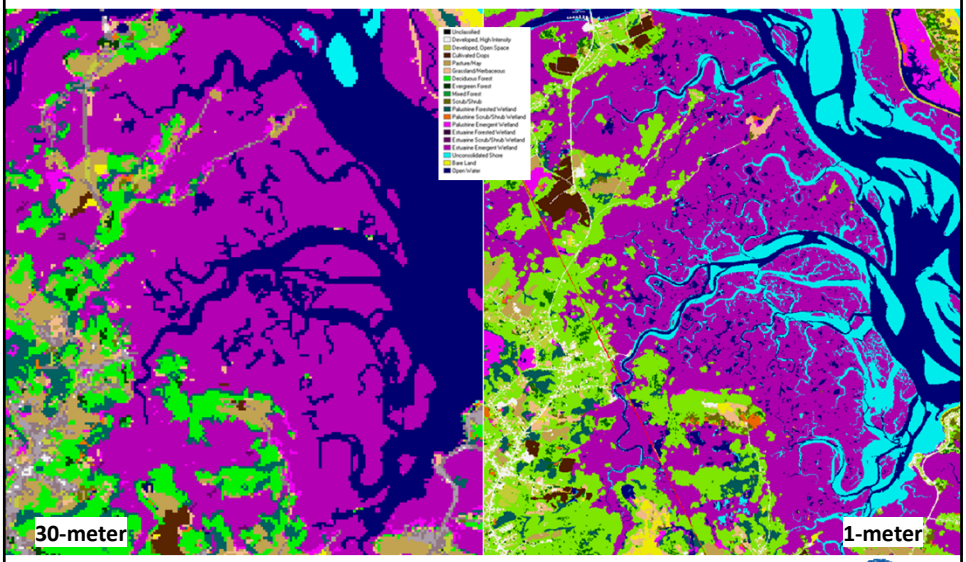
Focus on the Future

- Based on imagery and Lidar (1 to 4 m)
- Constituent demand / needs
- Historically expensive to produce
- Technology and data availability
  - Allowing for faster, cheaper, better*
- OCM has made a down payment
  - Transition in phases, over multiple years
- Vision: future updates at this scale

Office for Coastal Management



Office for Coastal Management



Office for Coastal Management

For More Information

Please Visit:

https://coast.noaa.gov/digitalcoast

StormSense Project

Forecasting Flooding from Storm Surge, Rain, and Tide

…among other things

Dr. Jon Derek Loftis
Associate Research Scientist
VA Inst. of Marine Science

NOAA NRPT Workshop Tools Café Presentation

Forecasts

Evidence-based planning for changing climate

Climate change is responsible for changes in water levels, temperature, and precipitation. Our ability to forecast these changes helps mitigate impacts and plan for resilient communities. Forecasting traditionally uses historic data to determine the direction of future trends. Uncertainty is introduced when processes affecting change are not static over long time periods. Strategic integration of information across planning horizons can allow communities to more effectively plan for the next tide, a catastrophic storm, or a future landscape that might look very different from today.

WATER LEVELS

Information on water levels now and into the future; real-time data, near and long-term predictions

About VA Sea Level

Historic data and projections

Tidewatch

Tidewatch network of 10 observing stations predicts a 36 hour water level forecast

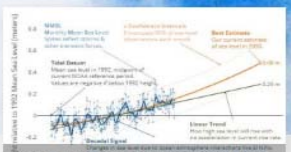
WATER LEVEL VIEWERS

How deep and where will the water be from various sea level rise scenarios

Sea Level Projection Viewer

See the 36 hour water level forecast. Currently functional for Hampton Roads.

Tidewatch Viewer



SEA-LEVEL REPORT CARDS

The Virginia Institute of Marine Science display of sea-level trends and projected sea-level height for 32 U.S. coastal locations

Report Cards

ADAPT VA AdaptVA.org

1. StormSense Project

- 36 new Internet of Things (IoT) water level sensors installed in 2017-18 through NIST Smart Cities Award:
  - 10 installed in Newport News
  - 8 installed in Norfolk
  - 18 installed in Virginia Beach
- 6 more to be installed in Summer 2019 through Award from Natural Resources Defense Council, & more through city CIPs
- Harmonic Analysis for all sensors installed in tidal areas was completed in Spring 2018 for integration into CCRFR's Tidewatch service in Summer 2018

Figure 1 from Loftis *et al.*, 2018. *IEEE Smart Cities SCOPE Journal*

StormSense Budget Breakdown

List of Grants VIMS has written (or aided in writing) and City Expenditures on StormSense:

- $300,000, 2016-2018 Virginia Beach CIP
- $75,000, 2016-2017 NIST RSCT Grant
- $50,000, 2017 Amazon Web Services (City on a Cloud Innovation Challenge Winner, Best Practices)
- $30,000, 2017-2018 Newport News CIP
- $7,500, 2017-2018 Norfolk CIP
- $30,000, 2017-2018 VDEM (SLEMPG Grant)
- $26,000, 2018-2019 NRDC
- $109,000, 2019-2020 VDEM (HMGP Grant)
- $627,500 Total

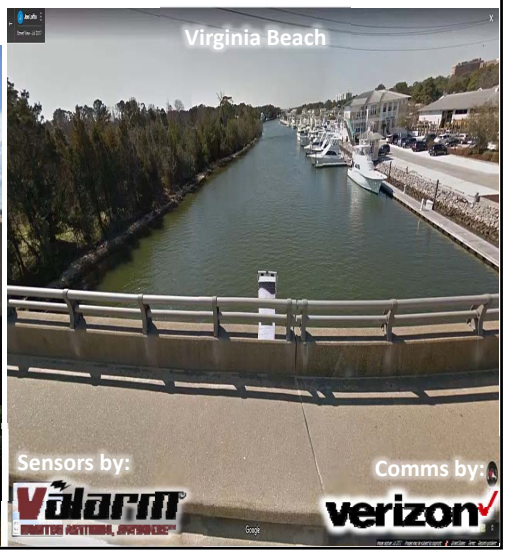
*Grants were mostly used to purchase sensors; city Capital Improvement Program (CIP) budgets paid to install and maintain them

Figure 4 from Loftis *et al.*, 2018. *Marine Tech. Soc. Journal.*

StormSense Sensor Deployment Workflow

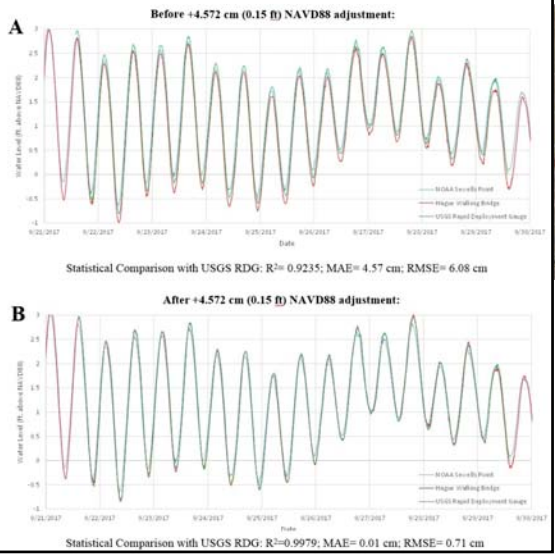
1. Apply for grants to defray sensor costs
2. Order the sensors
3. Receive the sensors:
   - Radar/Sonar Level Sensor
   - A Control Box
     - o Data Logger
     - o Transmission Hub
     - o Solar Controller
     - o Antenna
     - o GPS
   - 30W Solar Panel

Installed Sensors & Virtual Tours



Road Inundation Sensors

- Green stream sensors deployed in frequently flooded intersections.
- Found to measure water level within ±4.5 cm during 2017 Hurricane Maria when compared with USGS RDG.
- After artificial adjustment, the sensor could measure as accurately as *RMSE* = ± 0.71 cm.



StormSense Accuracy

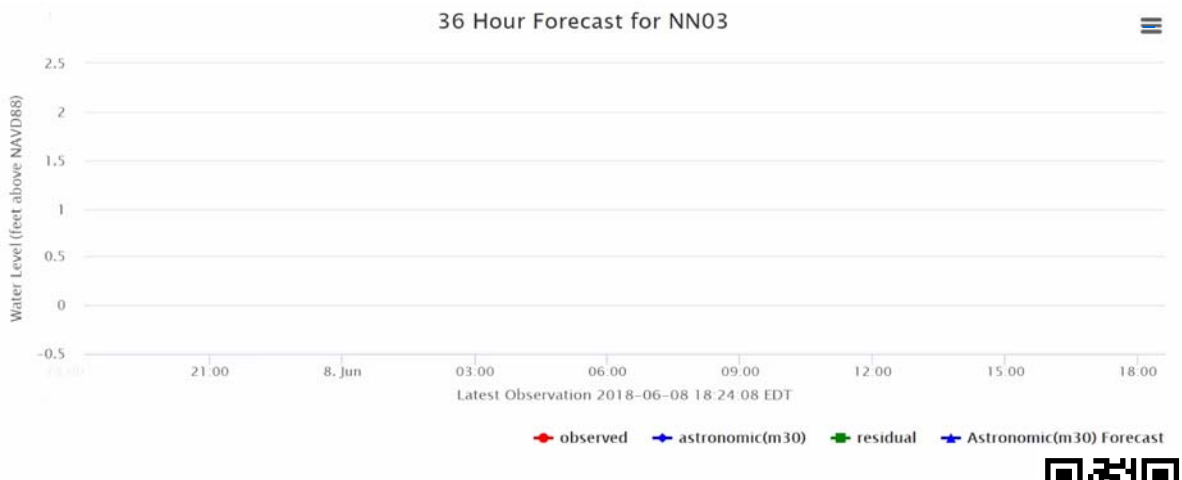
- Some sensors were temporarily co-located on the same bridges in Virginia Beach to test StormSense's low-cost (≈$3,000) ultrasonic sensor accuracy compared to USGS' radar sensors (≈$30,000).
  - Over a 4-month period (Nov. 2017 - Mar. 2018) an aggregate RMSE of ±1.18 cm (n=4) were observed.
  - During this time, a king tide (Nov.), and 4 relatively minor nor'easters (Mar.) occurred
- These sensors will be relocated in Fall 2018 after collecting 12 months of data
- Knowing this preliminary comparison, Virginia Beach has submitted a PO for 13 more water level sensors through a CIP.

Figure 5 from Loftis *et al.*, 2018. *Marine Tech. Soc. Journal.*

StormSense Recognitions

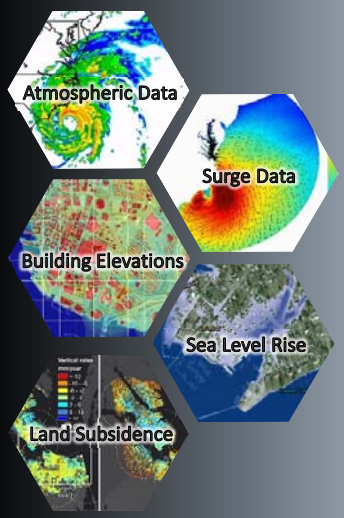
1. NIST/US Ignite Global City Teams Challenge Winners
2. AWS City on a Cloud 2017
3. GovLoop Top 30 Govt. Innovations of 2017
4. Smart 50 Awards '18 Recipient
5. Alliance for Innovation – Transforming Local Govt. 2018 Featured Case Study & Innovation Award Winner
6. Internat'l Data Group's 2018 CIO 100 Award Winner
7. Gov't Innovation Awards 2018 Public Sector Winner
8. 2019 ESRI Special Achievement in GIS

2. Near-Term Forecasts: 36-hr Tidewatch Charts



Sensor Data API URLs: http://www.vims.edu/people/loftis_jd/HRVASensorAssets/index.php
Sensor Data Tidewatch Pages: http://www.vims.edu/bayinfo/tidewatch/stations/cbbt/index.php
Aggregated Recurrent Flooding Data: http://www.vims.edu/people/loftis_jd/HRVASensorAssets/hrva-persistent-flood-data.php

2. Near-Term Forecasts: 36-hr Tidewatch Maps (SCHISM Model)



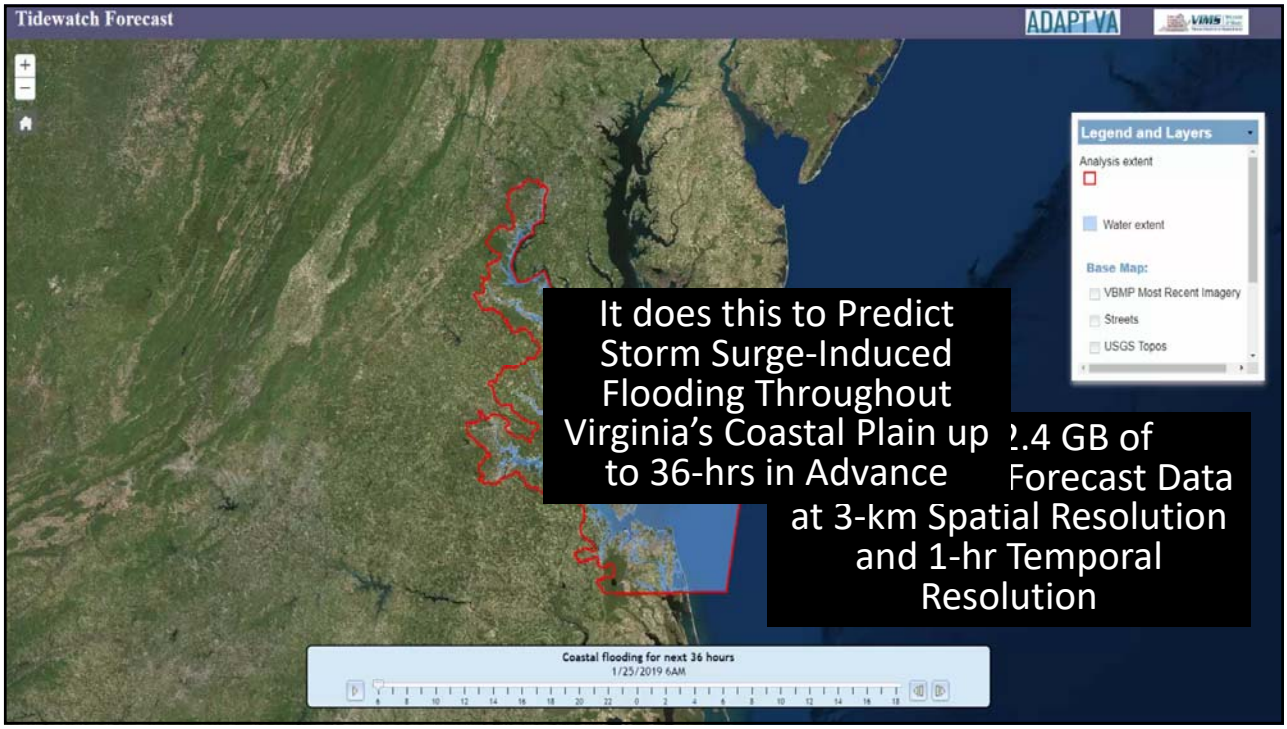
Atlantic Model Grid

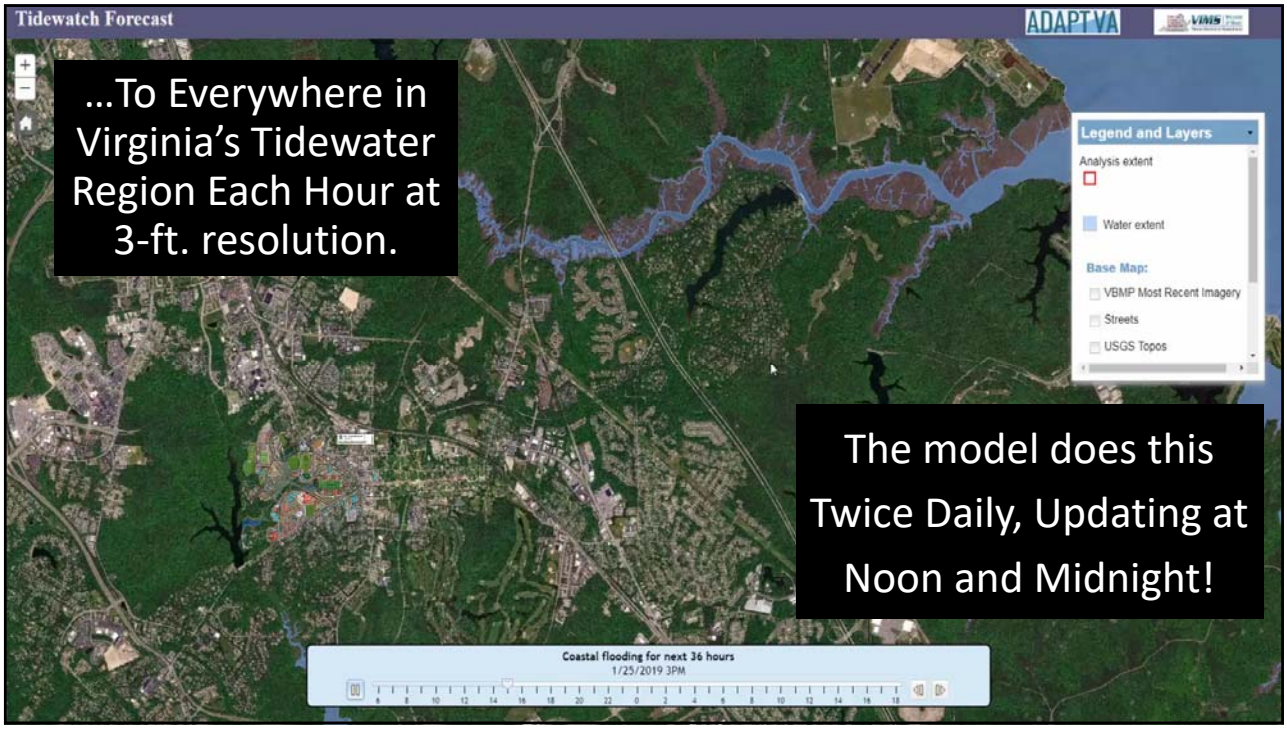
2,348,351 Nodes

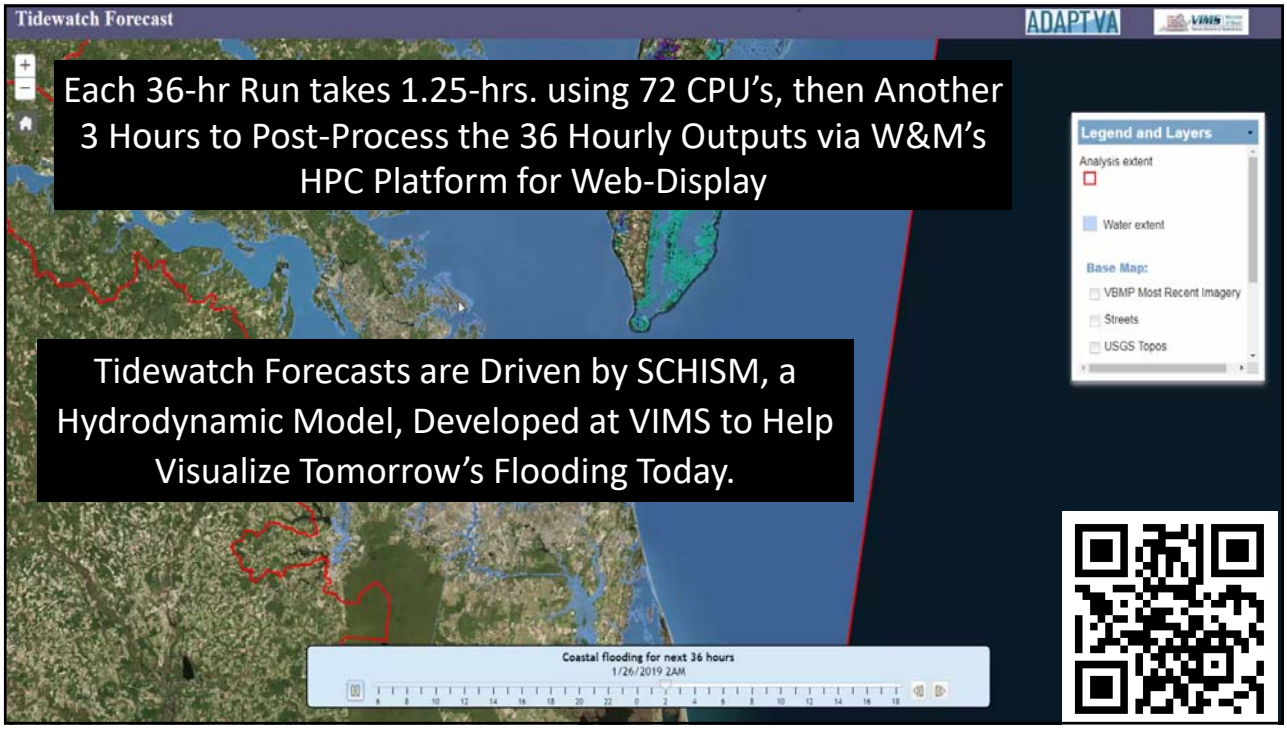
1,565,567 Elements

13 Vertical Layers

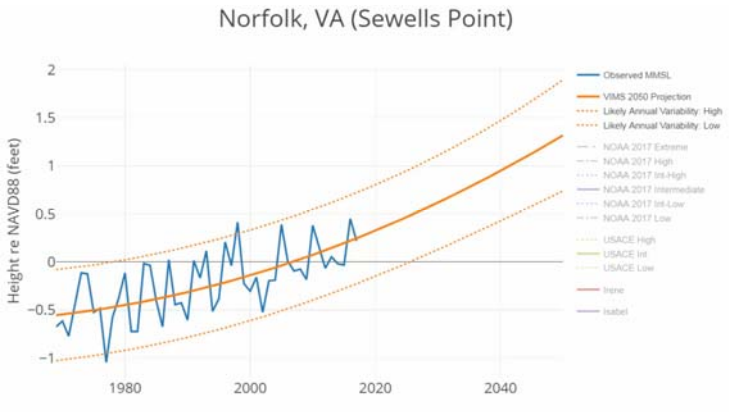
Water Levels & Velocities
Every 6 mins.

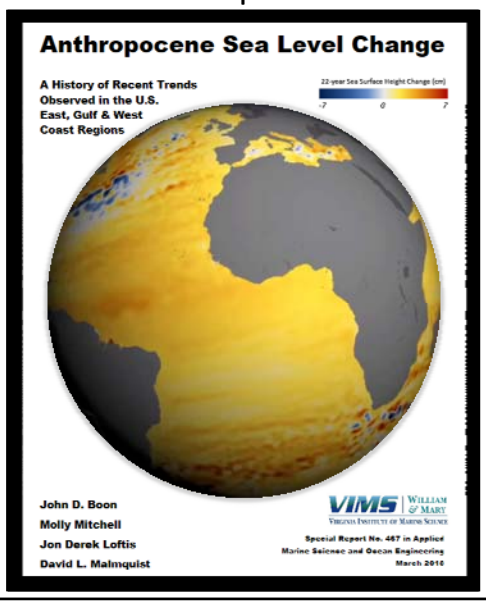

Tidewatch Forecast
ADAPT VA
Legend and Layers
Analysis extent
Water extent
Base Map:
VBMP Most Recent Imagery
Streets
USGS Topos
It does this to Predict Storm Surge-Induced Flooding Throughout Virginia's Coastal Plain up to 36-hrs in Advance
.4 GB of Forecast Data at 3-km Spatial Resolution and 1-hr Temporal Resolution
Coastal flooding for next 36 hours
1/25/2019 6AM

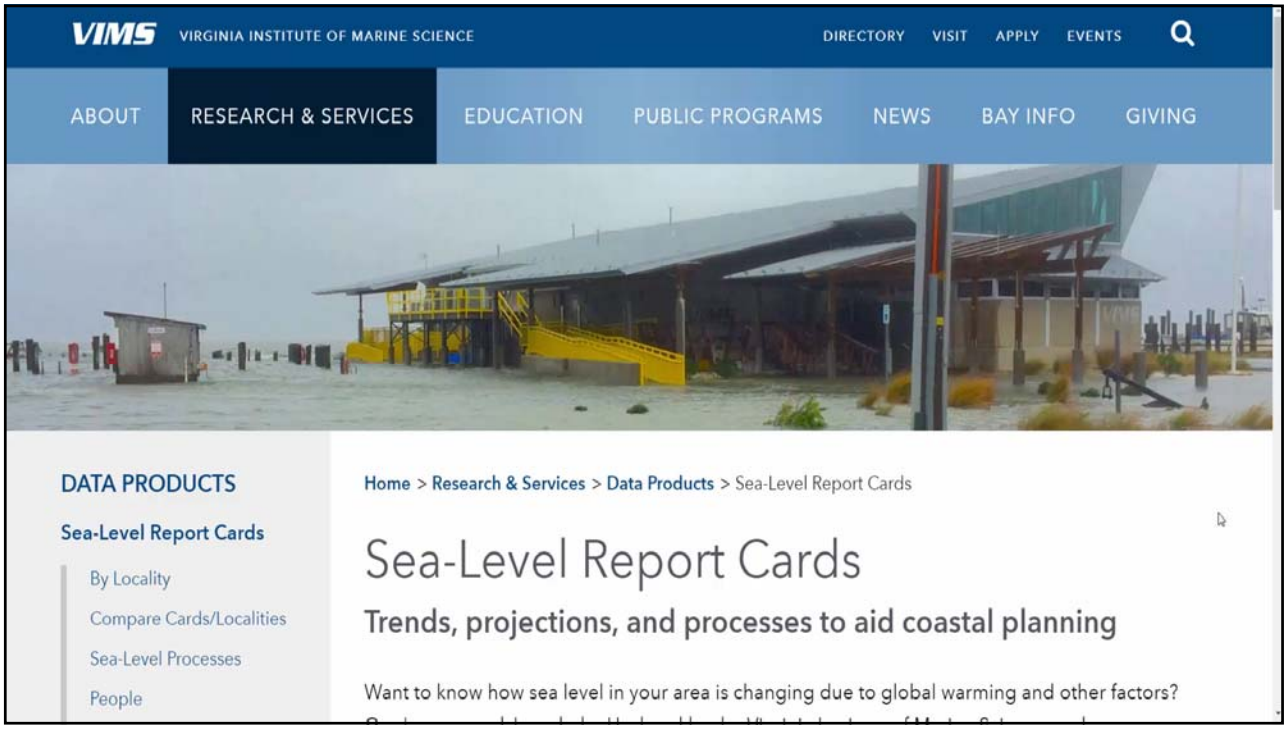

Tidewatch Forecast
ADAPT VA
…To Everywhere in Virginia's Tidewater Region Each Hour at 3-ft. resolution.
Legend and Layers
Analysis extent
Water extent
Base Map:
VBMP Most Recent Imagery
Streets
USGS Topos
The model does this Twice Daily, Updating at Noon and Midnight!
Coastal flooding for next 36 hours
1/25/2019 3PM



3. Long Term Forecast Trends - Sea Level Report Cards



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DATA PRODUCTS
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By Locality
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Sea-Level Processes
People
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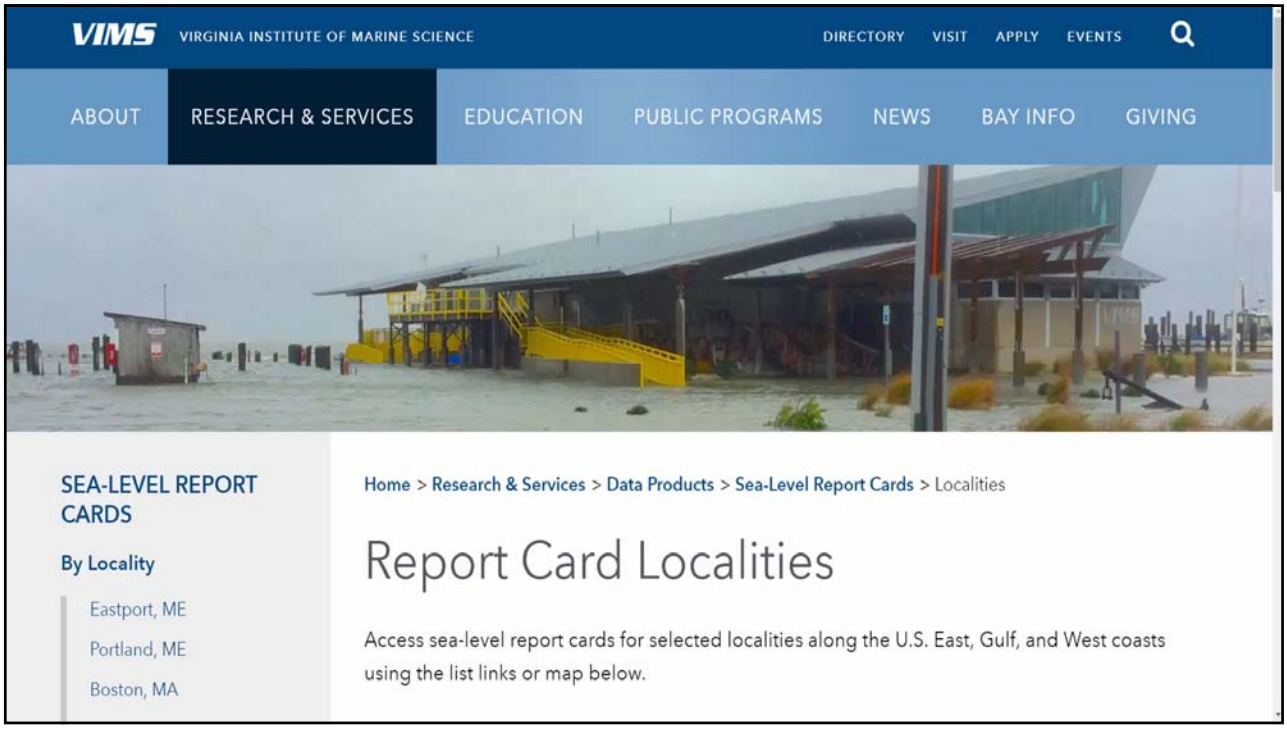
Sea-Level Report Cards
Trends, projections, and processes to aid coastal planning
Want to know how sea level in your area is changing due to global warming and other factors?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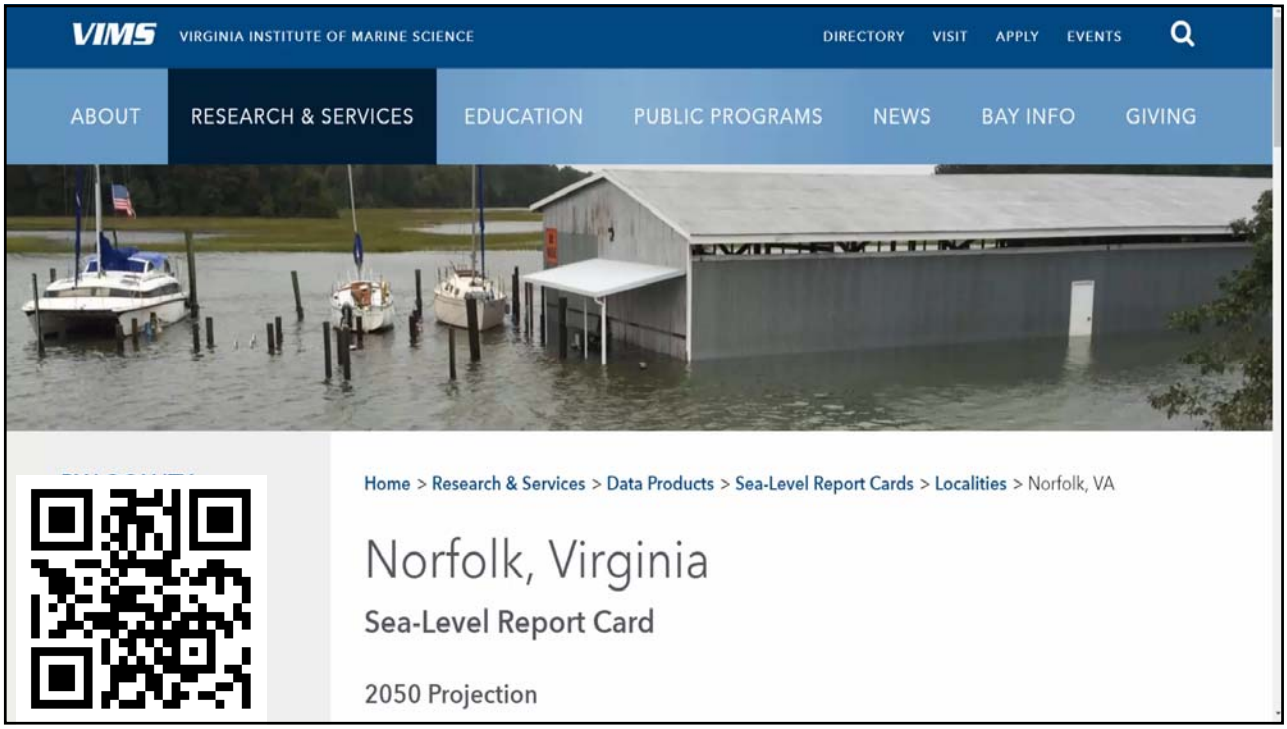
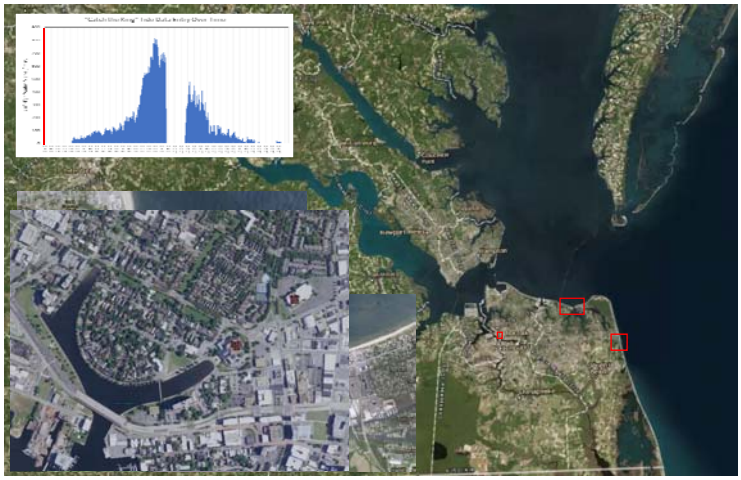
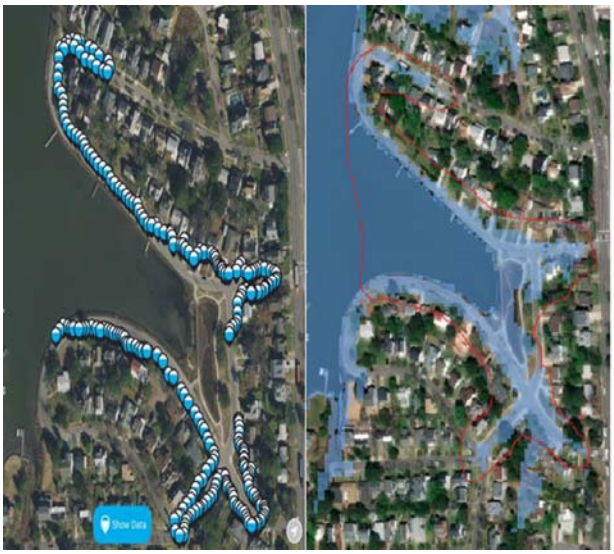
GIVING
SEA-LEVEL REPORT CARDS
By Locality
Eastport, ME
Portland, ME
Boston, MA
Home > Research & Services > Data Products > Sea-Level Report Cards > Localities
Report Card Localities
Access sea-level report cards for selected localities along the U.S. East, Gulf, and West coasts using the list links or map below.



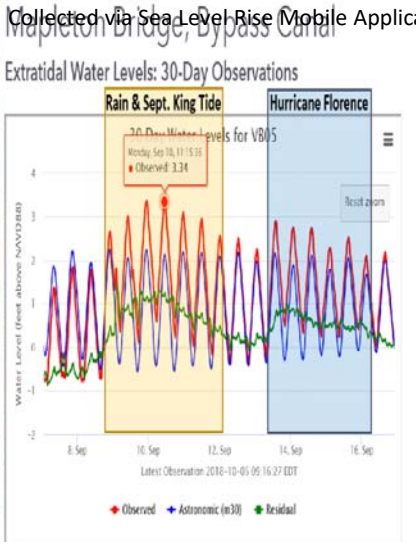
4. Catch the King Tide



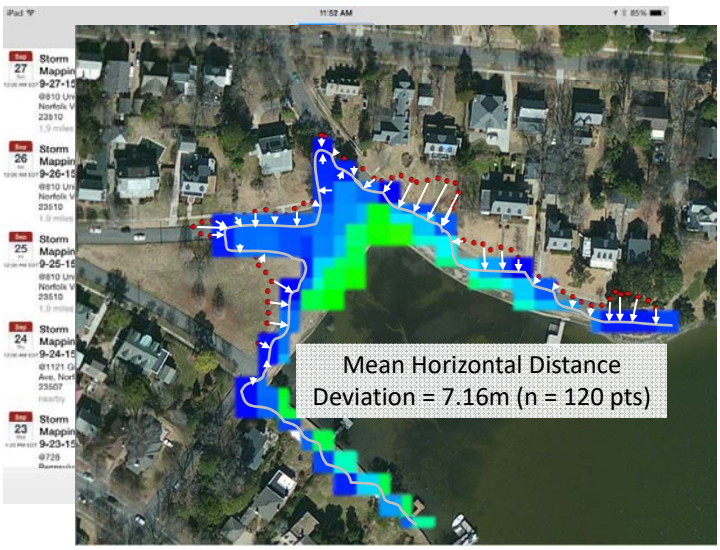
Ctach the King Tide Data Collection



Collected via Sea Level Rise Mobile Application.



Catch the King Model Data Comparison




How Can Deep Learning and AI Aid Automated Flood Alerting and Future Route Guidance?
Traffic Conditions during Flood Event
Potential App-Advised Traffic Conditions
aws
GPS Car Accident - The Office, NBC/Universal

Tools to help Communicate Coastal Flood Risk & Impacts

Mike Dutter
Science and Operations Officer
NOAA/NWS Wakefield, VA

The Bottom Line for NOAA

Customers Ask:

- Who will get flooded? How much?
- When will it arrive and leave?
- What will the impacts be?
- How often will it occur?
- How should I act?

Goals:

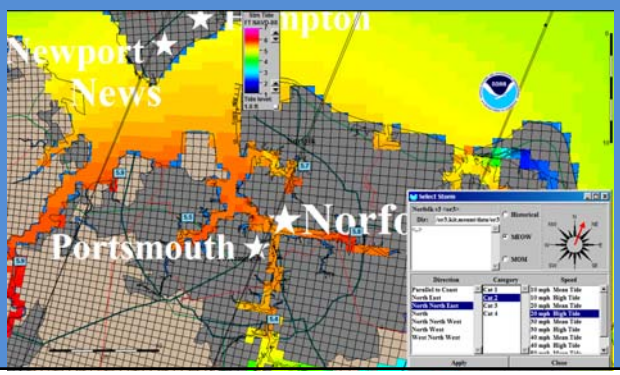
1. Accurately predict and assess storm water levels
   - Total Water Level (surge + tides + waves + rivers)
   - Account for uncertainty
2. Intuitively describe inundation as flooding above ground level
   - In statements and maps
3. Communicate actionable information

2

NOAA/NWS Hurricane Storm Surge Information

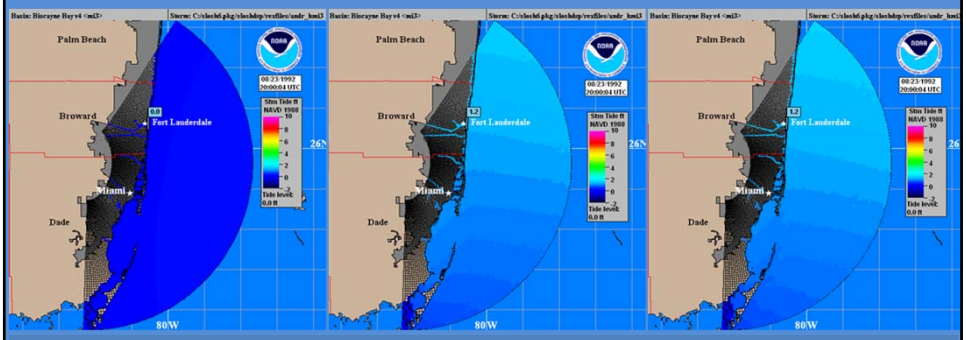
Sea, Lake & Overland Surges from Hurricanes (SLOSH)

- SLOSH is a numerical model developed by the NWS to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes taking into account atmospheric pressure, size, forward speed, and track data.
- SLOSH model physics are applied to a specific locale's shoreline, incorporating the unique bay and river configurations, water depths, bridges, roads, levees and other physical features.



SLOSH Total Water Level: Adding Tides to SLOSH

- NOS' model tide predictions coupled to NWS' surge model
- ***Also used for generating probabilistic P-Surge predictions and Potential Storm Surge Flooding map***

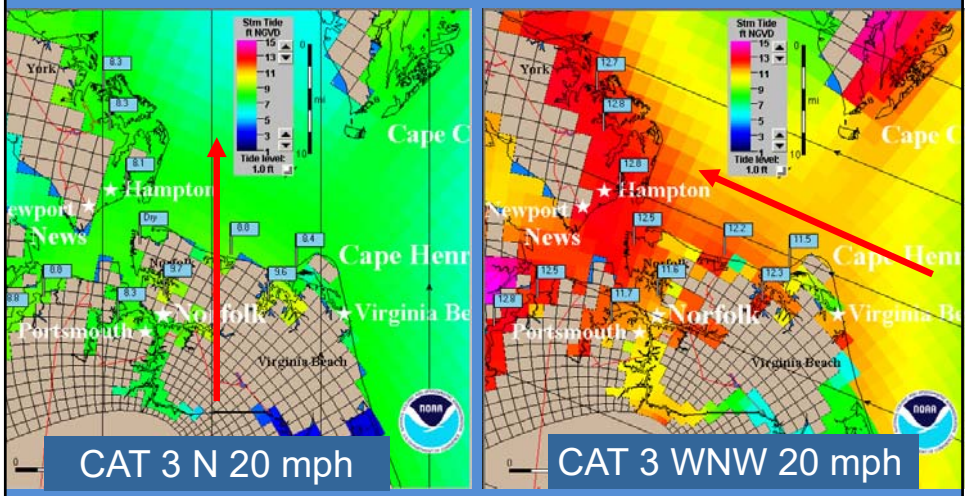


NWS Surge + NOS Tides = SLOSH+Tides

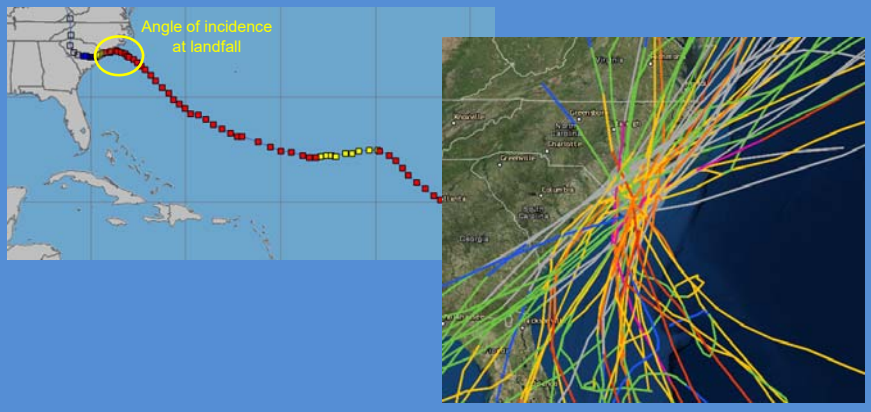
5

Storm Surge

FACTOR = ANGLE TO COAST

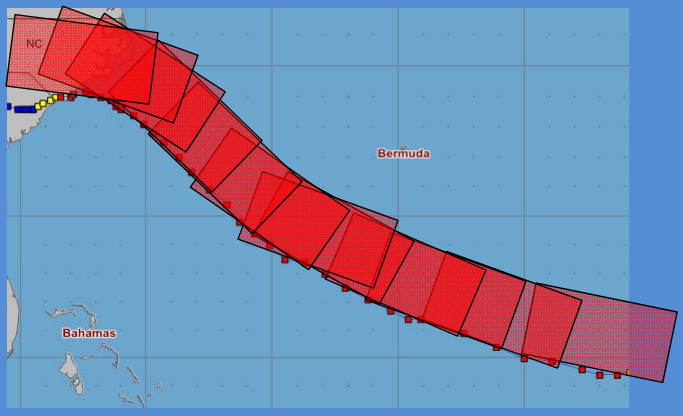


Perspective: Hurricane Florence



Most land-falling hurricanes this part of the country are from a southerly to northerly direction

Florence Impacts: Storm Surge



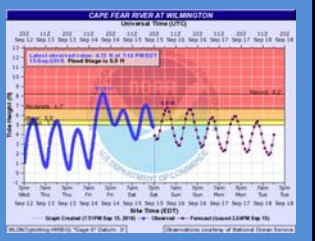
Effective Fetch – the side of the storm where the winds are blowing the same direction the storm is moving.

Effective Duration – the amount of time an effective fetch is in place. Florence's effective fetch was focused on the NC for several days.

Florence Impacts: Storm Surge

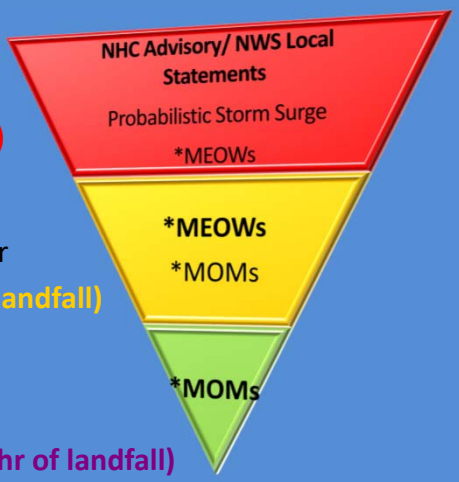
Extremely lucky that the peak surge occurred around low tide. Regardless there was easily 4-6' inundation in places causing dune breaches & significant damage

The water flowing out of the Cape Fear River was bottled up and caused significant surge up the river.

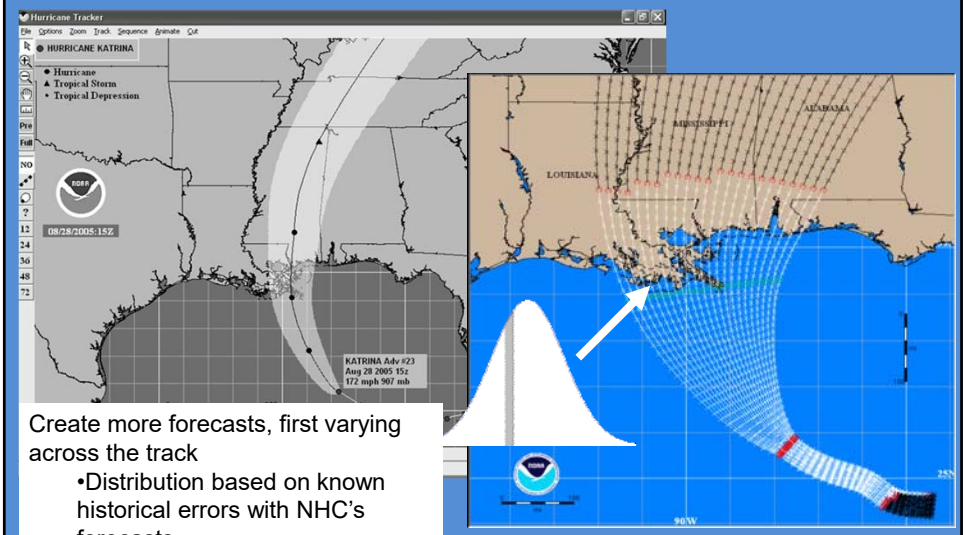


SLOSH Approach

- P-Surge – NHC runs
  - Probabilistic Storm Surge
  - **Response (<48 hr of landfall)**
- MEOW
  - Maximum Envelope Of Water
  - **Readiness (48hr – 120 hr of landfall)**
- MOM
  - Maximum Of the MEOWs
  - **Planning / Mitigation (>120 hr of landfall)**



Probabilistic Surge / P - Surge

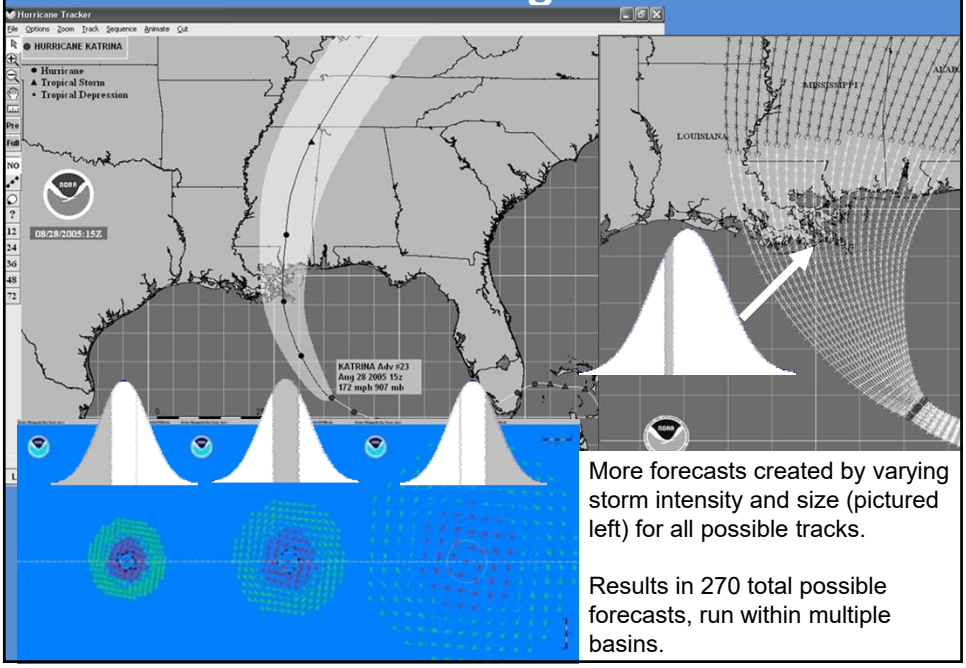


Create more forecasts, first varying across the track

- Distribution based on known historical errors with NHC's forecasts

https://slosh.nws.noaa.gov/psurge2.0/

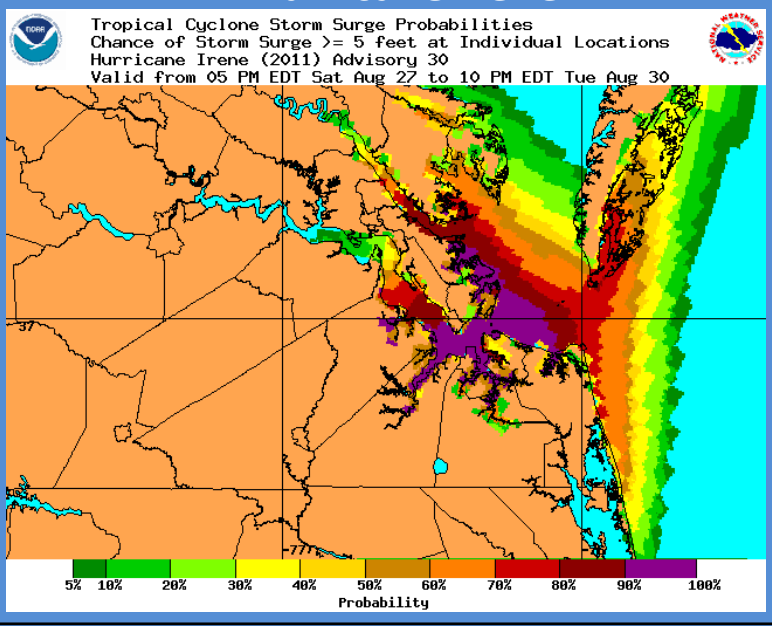
P - Surge



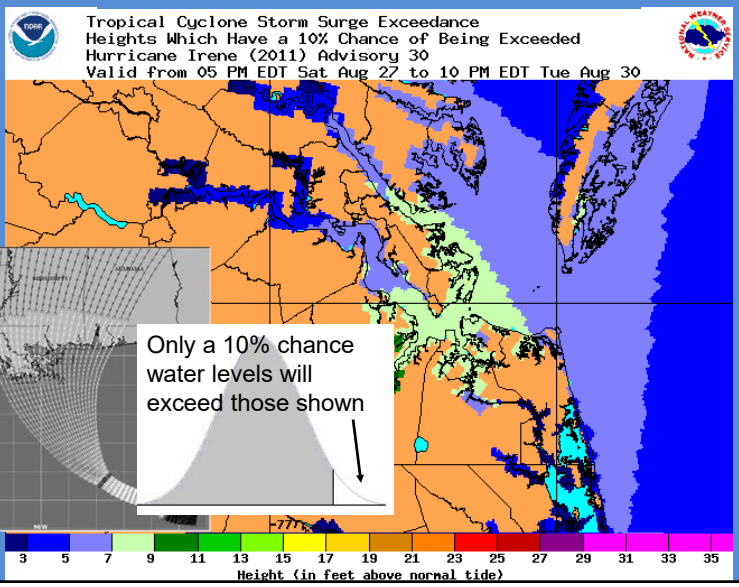
More forecasts created by varying storm intensity and size (pictured left) for all possible tracks.

Results in 270 total possible forecasts, run within multiple basins.

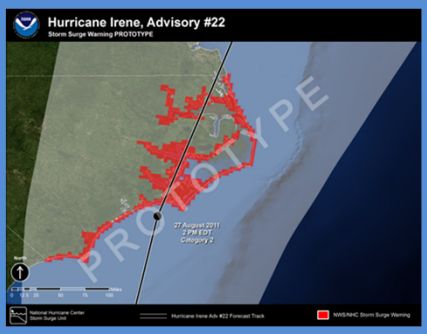
Result Example / Probability of Surge >= 5 ft Hurricane Irene



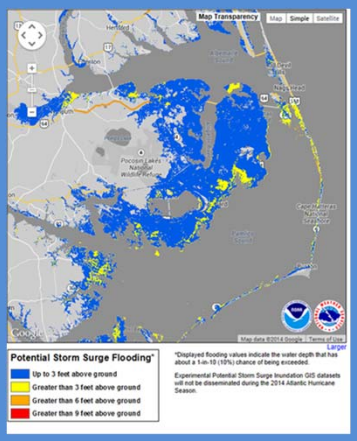
Planning based on forecast uncertainty
Surge Height Exceedence of 10%
Reasonable Worst Case



Communicating Actionable Information



Storm Surge Warning (based on 10% exceedance or reasonable worst case)



Potential Storm Surge Flood Map

https://www.nhc.noaa.gov/cyclones/ - Available only while the storm is in progress

15

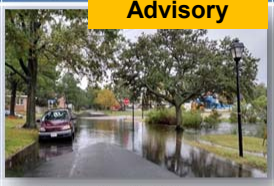
Definitions

- **Storm Surge Watch** - **Life-threatening inundation from rising water** moving inland from the shoreline is possible somewhere within the specified area, **generally within 48 hours**, in association with a tropical, subtropical or post-tropical cyclone.
- **Storm Surge Warning** - Life-threatening inundation from rising water moving inland from the shoreline is expected somewhere within the specified area, **generally within 36 hours**, in association with a tropical, subtropical or post-tropical cyclone.
- **The watch / warning may be issued earlier when other conditions, such as the onset of tropical-storm-force winds, are expected to limit the time available to take protective actions.**

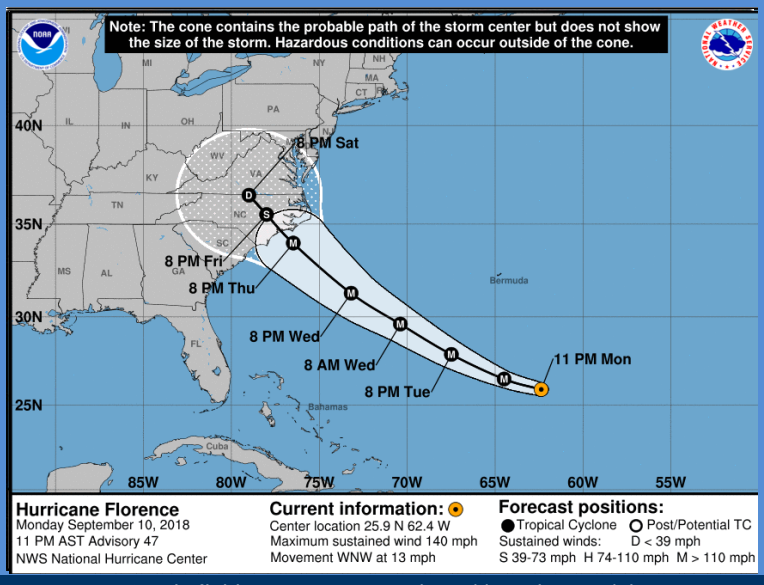
AGL used to better communicate impacts from inundation.

Coastal Flooding Thresholds

National Weather Service Wakefield, Virginia

	Minor — Coastal Flood Advisory	Moderate — Coastal Flood Warning	Major — Storm Surge Warning
Picture			
Hazard	➢ **Shallow flooding** in the most vulnerable locations near the waterfront and shoreline resulting in a **low threat of property damage.** ➢ **Up to 1 foot of inundation** in shoreline and vulnerable areas.	➢ **Widespread flooding** of vulnerable areas will result in an **elevated threat of property damage.** ➢ **1 to 2 feet of inundation** primarily in shoreline and vulnerable areas.	➢ **Severe flooding** will cause extensive inundation and flooding of numerous roads and buildings resulting in a **significant threat to property and life.** ➢ **2 to 3 feet or more of inundation.**
Impact	➢ A few shoreline and vulnerable roadways and adjacent properties will experience shallow flooding. ➢ Minor beach erosion with possible erosion to the front of vulnerable dune structures.	➢ Inundation of roads and low lying property near the waterfront. ➢ Flooding will extend along tidal rivers and creeks resulting in some road closures, flooding of vehicles, and some property. ➢ Severe beach erosion and considerable erosion of dunes, especially during long duration events.	**Extreme Category added for near record or worse. Catastrophic flooding** severe erosion of dunes.

Monday Forecasts
Hurricane Florence



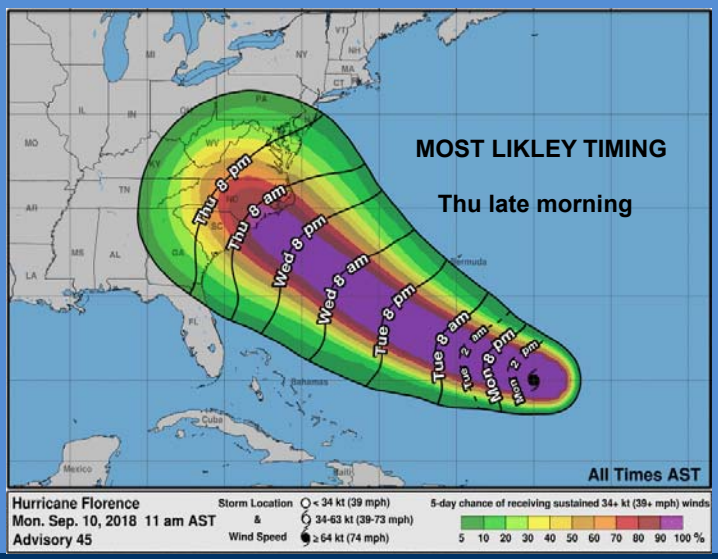
Hurricane Florence
Monday September 10, 2018
11 PM AST Advisory 47
NWS National Hurricane Center

Current information:
Center location 25.9 N 62.4 W
Maximum sustained wind 140 mph
Movement WNW at 13 mph

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

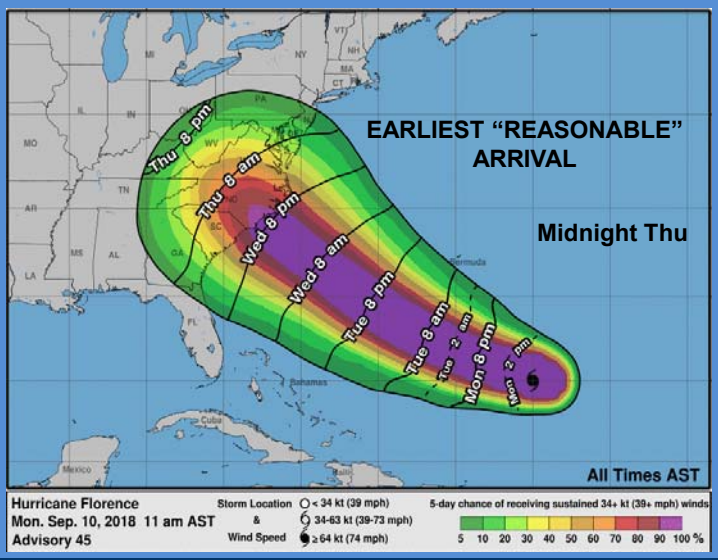
NWS Wakefield, VA http://weather.gov/akq

Monday Wind Prob Forecasts
Hurricane Florence



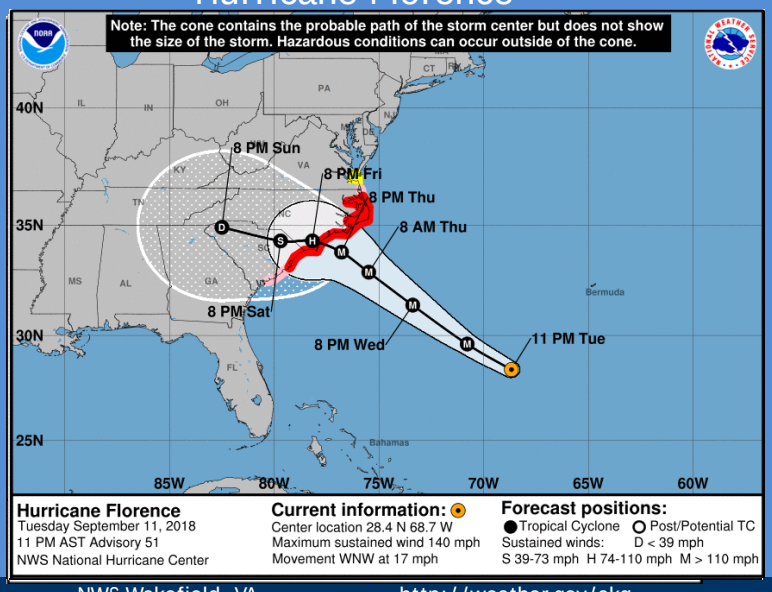
NWS Wakefield, VA http://weather.gov/akq

Monday Wind Prob Forecasts
Hurricane Florence



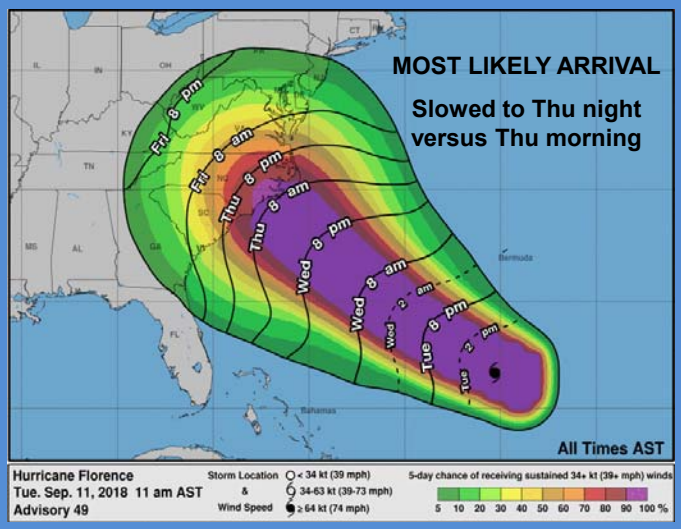
NWS Wakefield, VA http://weather.gov/akq

Tuesday Forecasts
Hurricane Florence



NWS Wakefield, VA http://weather.gov/akq

Tuesday Wind Prob Forecasts
Hurricane Florence



NWS Wakefield, VA http://weather.gov/akq

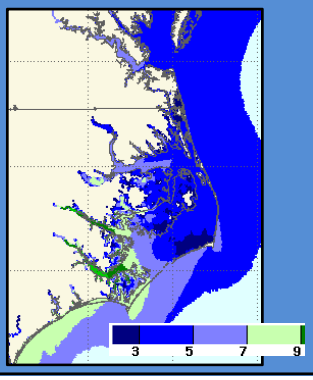
Addressing Wind vs. Water Threats

- No Storm Surge Warning (SSW) was issued for VA. The SSW stopped at the NC border based on uncertainties.
- Coastal Flood Advisories and Warnings were issued for MINOR to MODERATE flooding (@ 1-2 ft above normal tide). These coincided with the Tropical Storm Warning for wind.
- Tropical Wind Warnings (Tropical Storm / Hurricane Warning) are based on wind only and NOT storm surge

Storm surge focus in NC

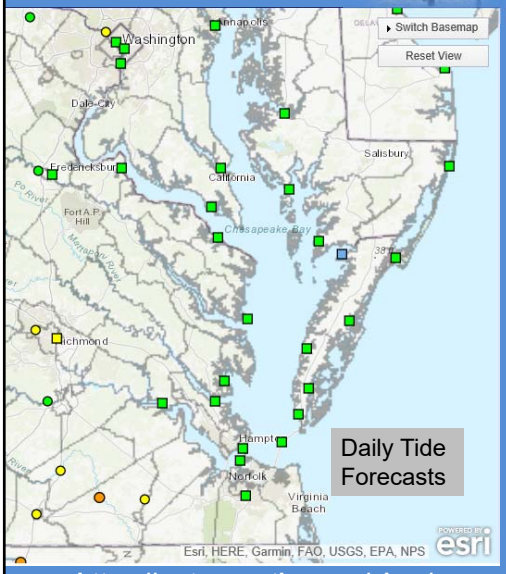
10% chance of 3-5 ft (image). This was based on a close storm approach on right edge of error cone early on.

Worst case early on was to apply Cat2 MEOW for NNW moving storm

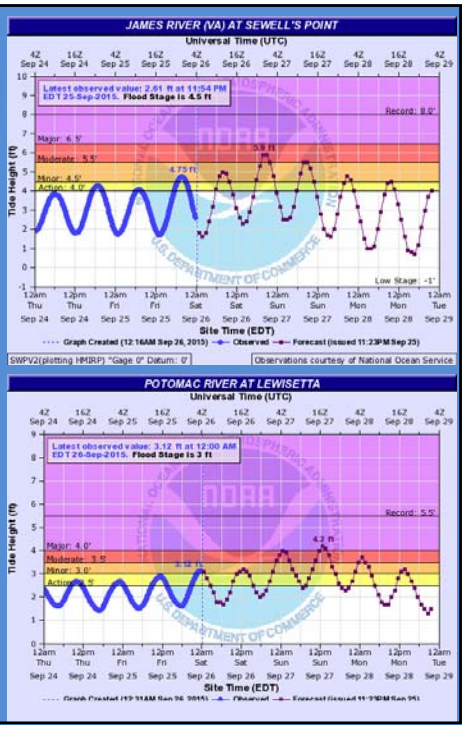


NWS Total Water Level Point Forecasts

NWS Total Water Predictions



https://water.weather.gov/ahps/



Total Water Predictions

- Provides hydrographs and enhanced warnings
- Integrated into AHPS with all river flood data
- NEW in 2018 – Coastal Flood Warnings and Advisories cover areas beyond SSW.

http://www.erh.noaa.gov/akq/brief/tides.php

```
VAZ099-151315-
/O.CON.KAKQ.CF.W.0007.000000T0000Z-180916T1000Z/
/O.CON.KAKQ.BH.S.0010.000000T0000Z-180916T0000Z/
Virginia Beach-
111 AM EDT Sat Sep 15 2018

...COASTAL FLOOD WARNING REMAINS IN EFFECT UNTIL 6 AM EDT
SUNDAY...
...BEACH HAZARDS STATEMENT REMAINS IN EFFECT THROUGH THIS
EVENING...

* LOCATION... The coastal flood warning is primarily for the
  Chesapeake Bay side of the Virginia eastern shore where minor
  to moderate flooding is expected. On the ocean side flooding
  from Hurricane Florence is expected to be minor. The rip
  current threat is for Virginia eastern shore beaches.

* TIMING... The coastal flooding is expected to occur within in
  a couple hours either side of each high tide cycle through
  Sunday Morning. The high risk for rip currents continues today,
  and will likely continue through the weekend. The High Surf
  Advisory is in effect through early this morning.

* COASTAL FLOOD IMPACTS...Widespread flooding of vulnerable
  areas could result in an elevated threat of property damage to
  homes and businesses near the waterfront and shoreline. Water
  could lead to 1 to 2 feet above ground level in some areas
  resulting in a sufficient depth to close numerous roads and
  threaten homes and businesses. Flooding could extend inland
  from the waterfront along tidal rivers and bays resulting in
  some road closures and flooding of vehicles.

&&

Time of high total tides are approximate to the nearest hour.

SEWELLS POINT VA
MLLW CATEGORIES - MINOR 4.5 FT, MODERATE 5.5 FT, MAJOR 6.5 FT
MHHW CATEGORIES - MINOR 1.7 FT, MODERATE 2.7 FT, MAJOR 3.7 FT

 DAY/TIME      TOTAL TIDE FT MLLW   TOTAL TIDE FT MHHW   DEPARTURE FROM NORM FT   WAVES FT   FLOOD IMPACT
 ---------     ----------           ----------           ----------               -------    ------------
 15/02 AM      4.5                  1.7                  1.9                      3          MINOR
 15/02 PM      4.8                  2.0                  1.9                      3-4        MINOR
 16/03 AM      4.1                  1.3                  1.7                      3          NONE
 16/03 PM      4.2                  1.4                  1.4                      2          NONE
 17/04 AM      3.5                  0.7                  1.2                      1          NONE
 17/04 PM      3.7                  0.9                  1.0                      1-2        NONE

CHESAPEAKE BAY BRIDGE TUNNEL VA
MLLW CATEGORIES - MINOR 5.0 FT, MODERATE 5.5 FT, MAJOR 6.0 FT
MHHW CATEGORIES - MINOR 2.1 FT, MODERATE 2.6 FT, MAJOR 3.1 FT

 DAY/TIME      TOTAL TIDE FT MLLW   TOTAL TIDE FT MHHW   DEPARTURE FROM NORM FT   WAVES FT   FLOOD IMPACT
 ---------     ----------           ----------           ----------               -------    ------------
```

Coastal Flooding Thresholds

National Weather Service Wakefield, Virginia

	Minor	Moderate	Major
Picture			
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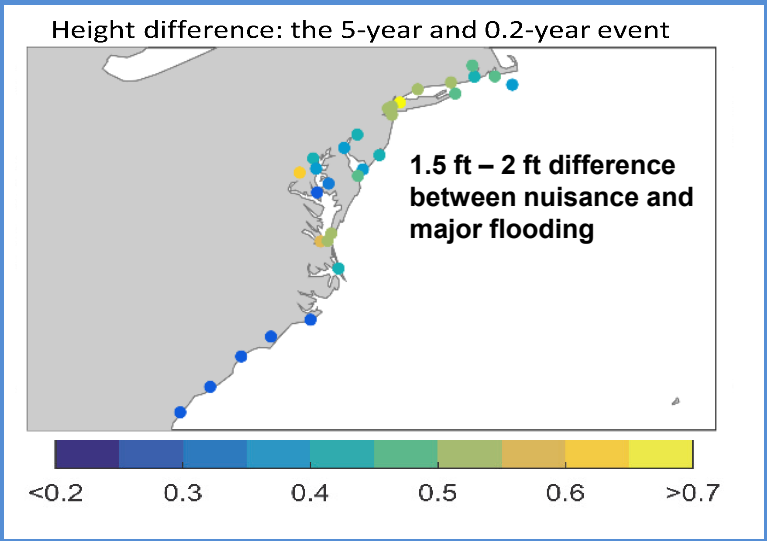
Impact	➢ A few shoreline and vulnerable roadways and adjacent properties will experience shallow flooding. ➢ Minor beach erosion with possible erosion to the front of vulnerable dune structures.	➢ Inundation of roads and low lying property near the waterfront. ➢ Flooding will extend along tidal rivers and creeks resulting in some road closures, flooding of vehicles, and some property. ➢ Severe beach erosion and considerable erosion of dunes, especially during long duration events.	➢ Numerous roads will be impassable, with many unprotected cars submerged. ➢ Evacuations will be necessary for the most vulnerable areas. ➢ Flood waters may extend well inland. ➢ Substantial coastal damage and severe erosion of dunes.

Nuisance Versus Major Flooding



Sweet et al. (2017)

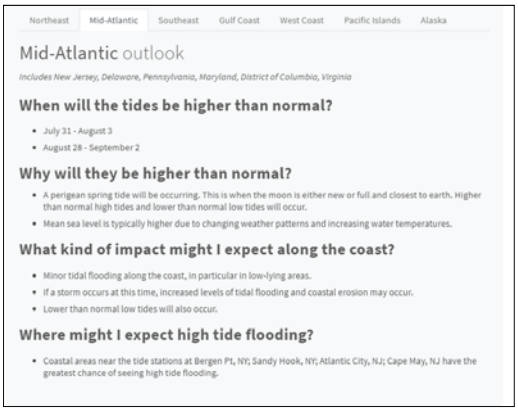
Questions & Comments

michael.dutter@noaa.gov
jeff.orrock@noaa.gov

Thank You!

- **VIMS CCRM for developing AdaptVA, and to VA Legislature and Blue Moon Fund** for supporting its development.
- **StormSense Funding & Partners**
  - National Institute of Standards and Technology (Repl. Smart City Tech. Grant)
  - Commonwealth of Virginia (Commonwealth Ctr. for Recur. Flooding Resiliency)
- **Newport News**
  - Information Technology
    - Andy Stein, Eric Beach, and Tammie Organski
  - Public Works
    - Mike Ashe, Wade Gerze, and Frank James
  - Emergency Management
    - Jay Bowden, George Glazner, and Chief R.B. Alley
- **Norfolk**
  - Office of Resilience
    - Christine Morris and Kyle Spencer
- **Virginia Beach**
  - Comm. and Information Tech.
    - Robert Jessen and Sridhar Katragadda
    - Natasha Singh-Miller and Mike Zecca

Seasonal High Tide Bulletin

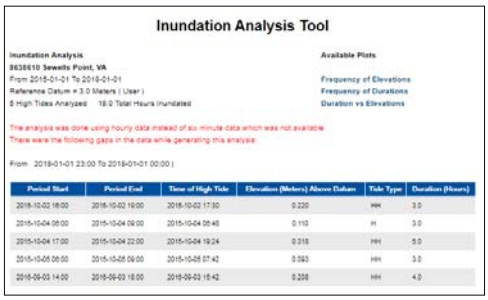


- Based on tidal predictions
- Regional look at dates where tides will be higher than what is "normally" seen from day to day
- Additional factors that push water onshore will compound effects
  - Onshore winds
  - Storm surge
  - Excessive runoff

https://oceanservice.noaa.gov/news/high-tide-bulletin/welcome.html

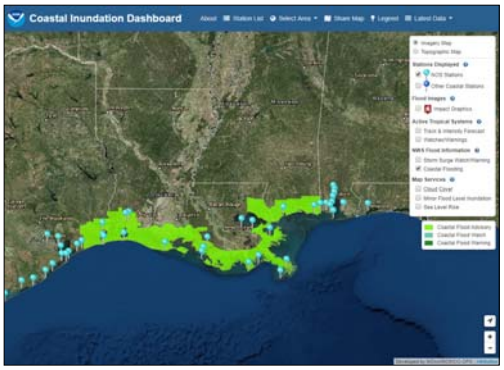
Inundation Analysis Tool

- Quickly analyze frequency and duration of historically observed water levels above a user defined threshold



https://tidesandcurrents.noaa.gov/inundation/

Coastal Inundation Dashboard

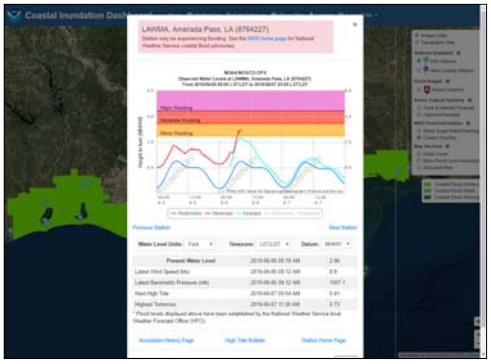


- Interactive map-based web application targeted towards coastal decision makers and planning community
- Real-time & historic flood information at NOS water level stations
- Customizable - create your own custom map URL!
- Water levels relative to high tide

https://tidesandcurrents.noaa.gov/inundationdb/

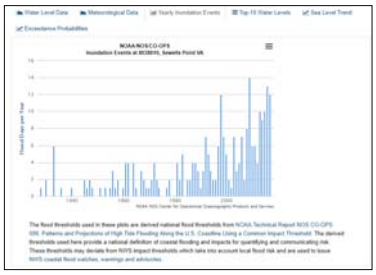
Coastal Inundation Dashboard

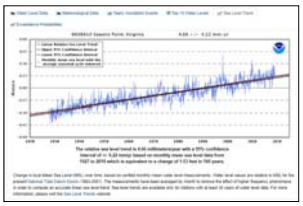
- Integrates NOS and other relevant NOAA flood information
  - Local NWS weather forecast office flood impact thresholds
  - Tropical cyclone forecast information from National Hurricane Center
  - Coastal flood advisory & storm surge watch/warning
  - OCM Sea Level Rise Viewer
- Compares observed water levels with known flood impact thresholds automatically!



https://tidesandcurrents.noaa.gov/inundationdb/

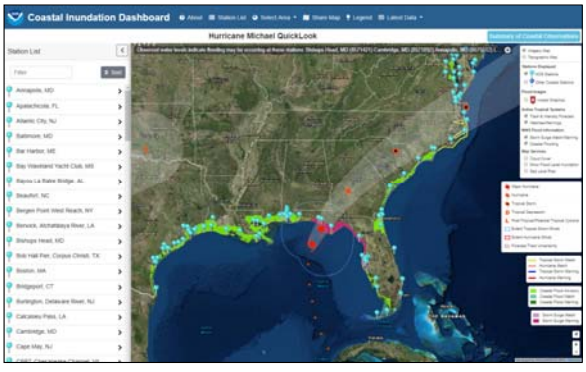
Coastal Inundation Dashboard: Historical Flood Information





- Historical water levels
- Annual number of "flood days"
- Top-ten water levels
- Sea Level Trends

Coastal Inundation Dashboard: Monitoring Storm Surge (Storm QuickLook)



- Storm-specific dashboard page with custom URL
  - Storm track/intensity, coastal watches/warnings and flood "alerts" update automatically
  - More complete coastal flood product
- Activated at first tropical storm or hurricane watch
- Summary of Coastal Observations
  - Updated 3 times daily

https://tidesandcurrents.noaa.gov/inundationdb/

Links

- Coastal Inundation Dashboard
  - https://tidesandcurrents.noaa.gov/inundationdb/
  - https://tidesandcurrents.noaa.gov/inundationdb_info.html
- Storm QuickLook
  - https://tidesandcurrents.noaa.gov/quicklook.html
- High Tide Bulletin
  - https://oceanservice.noaa.gov/news/high-tide-bulletin/welcome.html
- Inundation Analysis Tool
  - https://tidesandcurrents.noaa.gov/inundation/

Appendix E

Workshop Presentations

Local Contacts Perspective

June 18-20, 2019

LT Anthony Klemm
Mid-Atlantic Navigation Manager
NOAA's Office of Coast Survey

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

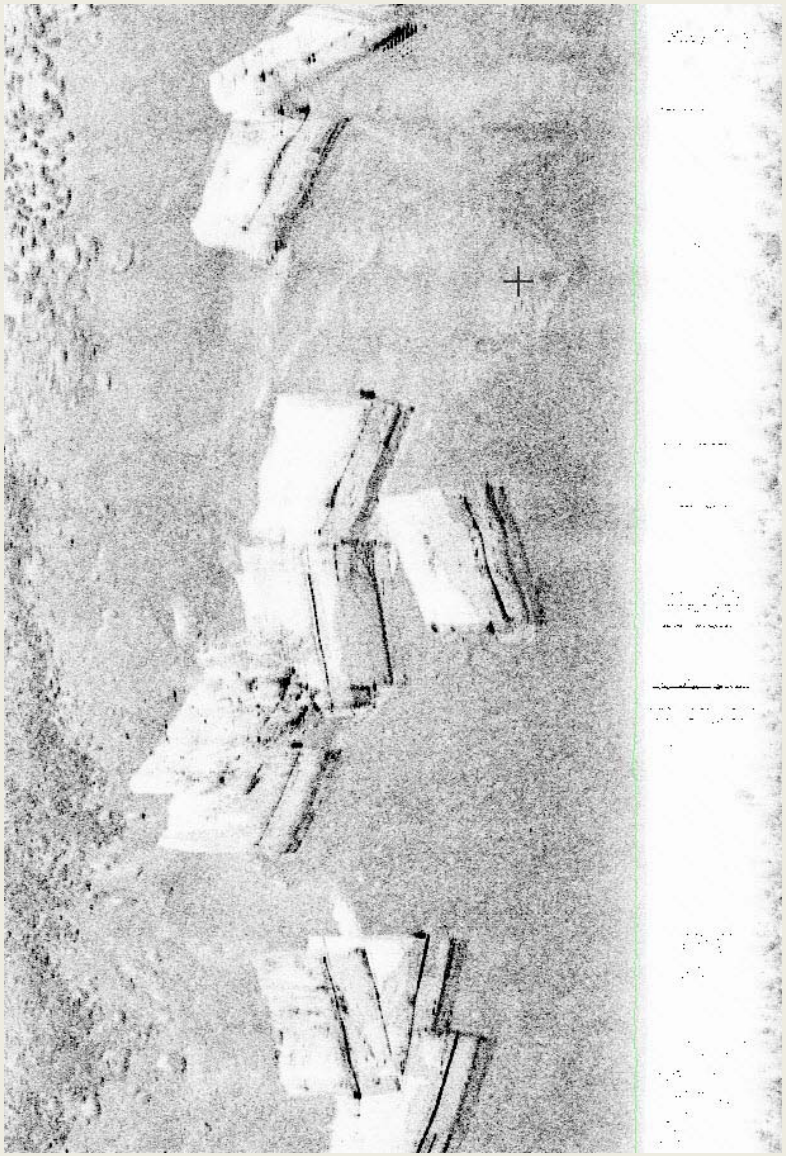
Mission

- Collect hydrographic data to update NOAA nautical charts
- Provide hydrographic (informational) support in port recovery operations

Navigation Response Teams

Navigation Managers

Shipping Containers post-Maria



Atlantic Hydrographic Branch

Facilities

- Atlantic Hydrographic Branch
  - Provide data processing support and data stewardship for hydrographic surveys
  - Many AHB employees deploy to disaster areas to assist the emergency hydrographic surveys
  - Approximately 30 employees
  - Located on Elizabeth River at OMAO's Marine Operations Center - Atlantic

Local Contacts Perspective

Kate Thompson Bosley, PhD
Chief, Field Operations Division
NOAA/National Ocean Service/
Center for Operational Oceanographic Products and Services

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and
Nuisance Flooding in the Norfolk Region
June 18-20, 2019

Preparation & Impacts

Our day-to-day operations include:

- Maintain 340+ coastal observing stations
  - East Coast & Great Lakes
- 37k sq. ft. office, lab, & warehouse space in Chesapeake
- 40 federal/contract employees

Our continuity of operations include:

- Assess operating condition of potentially impacted stations
- Secure facility assets pre-storm
- Check contact info for all employees
- Confirm contract options for telework
- Assign telework & duration

Tools we use to make decisions:

- NWS Forecasts
- CO-OPS Quicklook
- Evacuation & Closure Notices

Needs

Recent storm preparedness lessons learned:

- Some employees were uncertain of their evacuation zones
- It was challenging to maintain reporting to CO-OPS HQ in midst of evacuating

We could use help with:

- Employee Notification System (ENS) – Coordination & Refresher

At this workshop we hope to:

- Meet and coordinate with local colleagues
- Learn about preparedness, response, and communication tools
- "Advertize" tools and services we offer

Local Contacts Perspective

June 18-20, 2019

Emily Clark
Oceanic Branch Chief
Acquisition and Grants Office (AGO)
Eastern Region Acquisition Division (ERAD)

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Operational Overview

Our day-to-day operations include:

- Enabling the NOAA mission through premier acquisition solutions.
- ERAD processes the majority of actions and obligations across AGO.
- Norfolk, VA, 72 staff
- FY18 ERAD Norfolk 7,874 total actions, $521,440,340.00 total obligations.
- Norfolk Federal Building, GSA leased office space including general office equipment and furniture. 8th and 4th floor.
- ERAD Norfolk supports OMAO, NMFS, NWS, NOS simplified and formal acquisition requirements.
- Norfolk Systems Division also resides in the Norfolk Federal Building, total of four staff onsite.

Impacts & Preparation

During an emergency, our continuity of operations includes:

- Safety and accountability of all staff.
- All staff, both federal and contractor, are telework ready and approved on an adhoc basis inclusive of emergency events.
- Emergency Acquisition procedures are maintained by the Branches, updated as needed and at least annually.
- Kansas City offices are the first line of support should ERAD Norfolk be unable to work remotely due to evacuations, loss of electricity, etc.
- Norfolk Federal Building Emergency Information Hotline

Impacts & Preparation

Tools we use to make decisions:

- Local Weather Channels
- National Hurricane Center Website
- Virginia Hurricane Evacuation Zone Lookup Tool – Virginia Department of Emergency Management

Needs/Desires

Recent storm preparedness lessons learned:

- Identify evacuation zones for staff annually along with all other emergency identification and notification information.

We hope to learn and could use help with:

- Identifying additional tools for use in preparation of, during and post any emergency event.
- Additional insight or best practices

Local Contacts Perspective

June 18-20, 2019

Commander Matthew Jaskoski, NOAA
Executive Officer,
NOAA Marine Operations Center - Atlantic

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Impacts & Preparation

Our day-to-day operations include:

- Mission and logistical support for 9 ships and 5 port offices located along the East and Gulf Coasts.
- Locally, 1 location on the Elizabeth River (across from Hospital Point) with ~800 FT of pier face, 2 main buildings, staging area, and warehouse facilities, GOVs, etc.
- Approximately 50 employees all based locally
- One floating pier, no boat ramp.

During an emergency, our continuity of operations includes:

- Workload shift to sister facility located on the West Coast
- Leadership (officers and some civilian employees) expected to continue operations from an offsite location, and muster as soon as practicable.
- Possible shelter in place for ships alongside at the facility.

Tools we use to make decisions:

- USCG COTP, local, and state evacuation notices
- HREMC

Needs/Desires

Recent storm preparedness lessons learned:

- Staging a vessel for response. Keeping a ship/boat at safe location but ready to respond with 72 hours of storm passage
- Storm surge at our pier can break at ~5 ft above MHW
- Staffing and personnel availability is dynamic and case by case for each storm, and subject to a high degree of uncertainty.

We could use help with:

- Safe havens for small boats
- Local alternative muster stations, NOAA, USCG, USN,
- Alternative locations for ships

We hope to learn:

- Additional tools, information about our colleagues protocols.
- Facility availability in the area, facility contacts, potential alternative locations for ships/boats and personnel.
- A network for information sharing, and decision making tools.

Local Contacts Perspective

June 18-20, 2019

Ryan Hippenstiel
Field Operations Branch Chief
National Geodetic Survey

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Impacts & Preparation

Our day-to-day operations include:

- Collection and processing of surveying data for various NOAA missions
- NOAA-owned building & ~12 vehicles, plus VA DEQ station
- ~12 NGS and 3-4 WFMO Labor Relations employees, (no contractors)
- ~Data center, Remote Sensing COOP, NOS server onsite

During an emergency, our continuity of operations includes:

- Branch Chief only COOP employee & responsible for daily checks. (Also completes sit reports for HQ awareness.)
- Many employees (and their office work) capable of telework but few are on current agreements.
- Most work can be delayed, although we do often have field staff deployed to support. **We have also had to evac field employees.**

Tools we use to make decisions:

- “Old-timers”
- Tide levels and predictions (primarily at Sewell’s point)
- Standard weather reports, storm and evacuation warnings

Needs/Desires

Recent storm preparedness lessons learned:

- Employees are drawing from a lot of sources of information (weather stations, neighbors, past experience, colleagues).
- Variety of conditions, concerns, personnel within a very small footprint
- .....variety of chains of command and approaches to decision-making
- .....variety of result.

We could use help with:

- What an evacuation formally means for us and how to document our response
- Possible consistency with other offices/agencies in the region to make it simpler for managers and employees to understand?

We hope to learn:

- What our partners and other agencies do to make decisions
- Tools or methods to make them more informed

Local Contacts Perspective

June 18-20, 2019

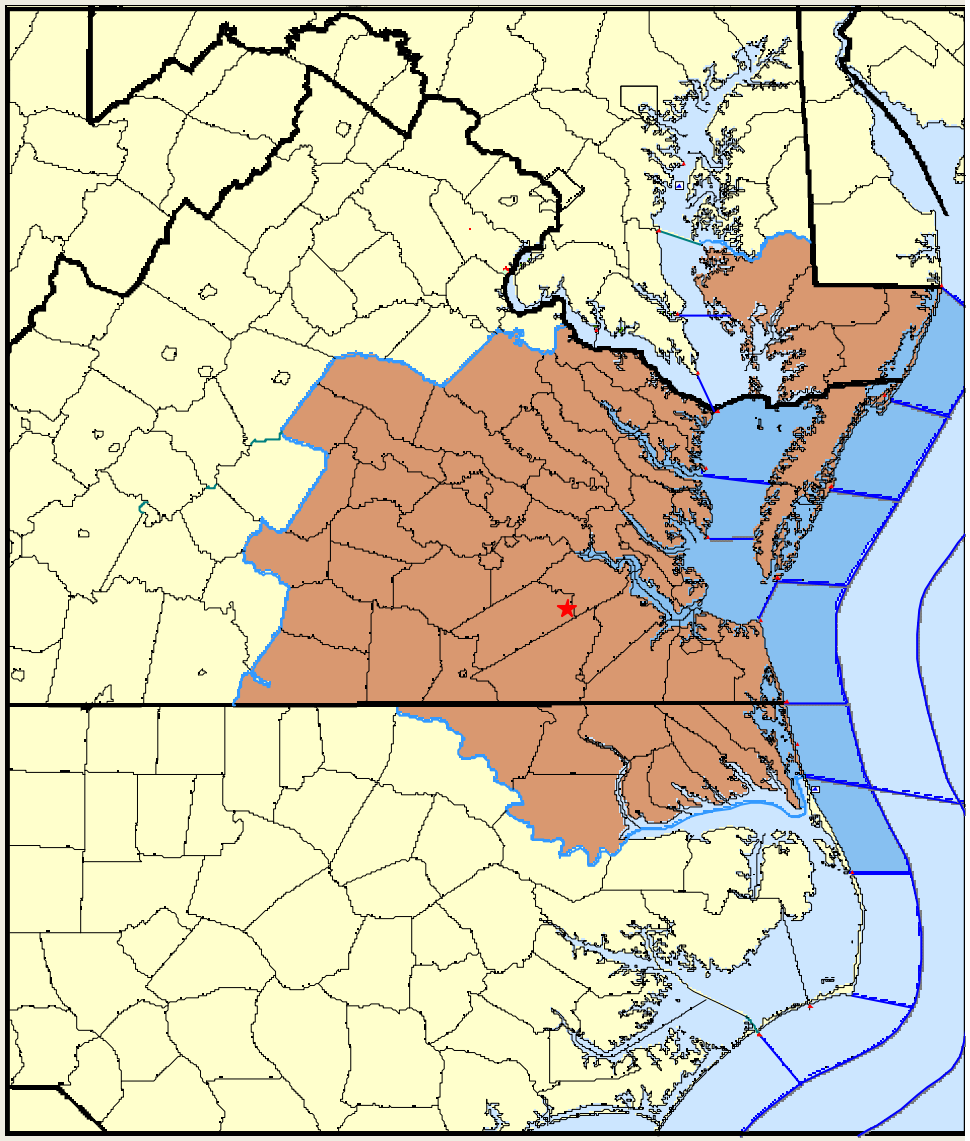
Mike Dutter
Science and Operations Officer
NOAA/National Weather Service – Wakefield, VA

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Impacts & Preparation

Our day-to-day operations include:

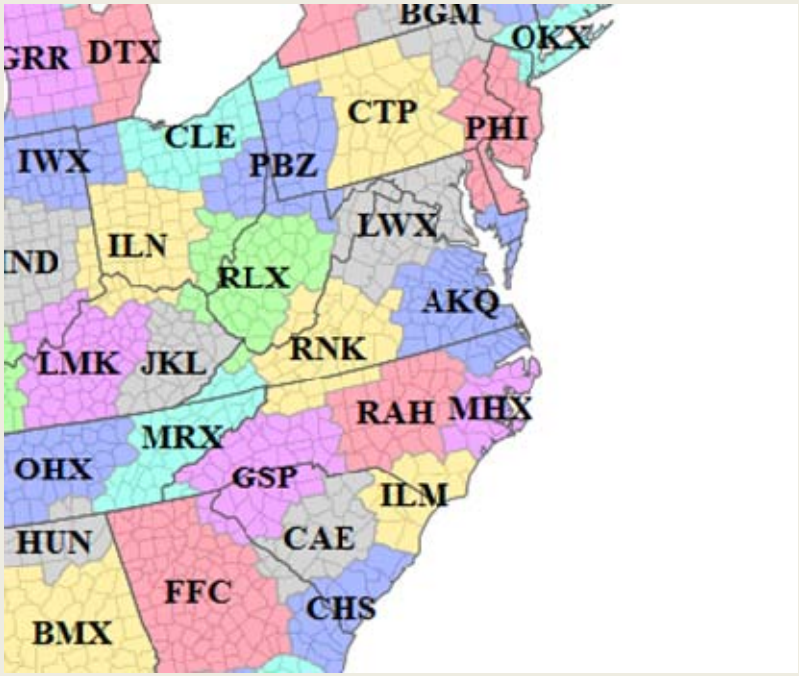
- Primary Mission is to **protect life and property from weather and water hazards**
- Our office is responsible for all of SE VA, the MD and VA Eastern Shore as well as NE NC
- Responsibilities include forecasts and warnings (and communicating weather/water risk) for land, marine, coastal flooding, aviation, fire weather)
- Currently 22 Total Employees (max 27)



Impacts & Preparation

During an emergency, our continuity of operations includes:

- Our office is 24/7/365. We are required to be at work even during adverse conditions.
- If the oncoming shift cannot make it to work due to adverse conditions, we have showers, cots, a couch, and extra food supply to allow people to stay for an extended period if needed. We prepare this ahead of time
- In addition, if our office loses comms or power (even though we do have a generator), we can be completely backed up by the Newport, NC NWS office or Raleigh, NC NWS Office to preserve full services.



Needs/Desires

Open and “two way” communication is critical in providing the best support we can.

Never hesitate to call us if you have any weather/water/climate related question, or if you have concerns about an upcoming weather event. That is what we are here for!!!

Also, make sure to have plans in place in case of significant weather. We can help with any safety plans or drills.

NOAA'S Regional Preparedness Workshop and Training (NRPT)

Navy Region Mid-Atlantic Port Operations

Mr. Jeff Hayhurst

19JUN19

Unclassified

Impacts and Preparation

- Our day-to-day operations include:
  - Mission: Execute National Defense Tasking
  - Facility/Assets 4 HRA AOR/Ports 45 Boats
  - Number of Employees: 220 MIL/CIV
- During emergency, our continuity of operations include:
  - Continue operational mission with Mission Essential personnel
  - Maintain Ops at COOP site as required
  - DSCA Response Capability/Requirements

Needs/Desires

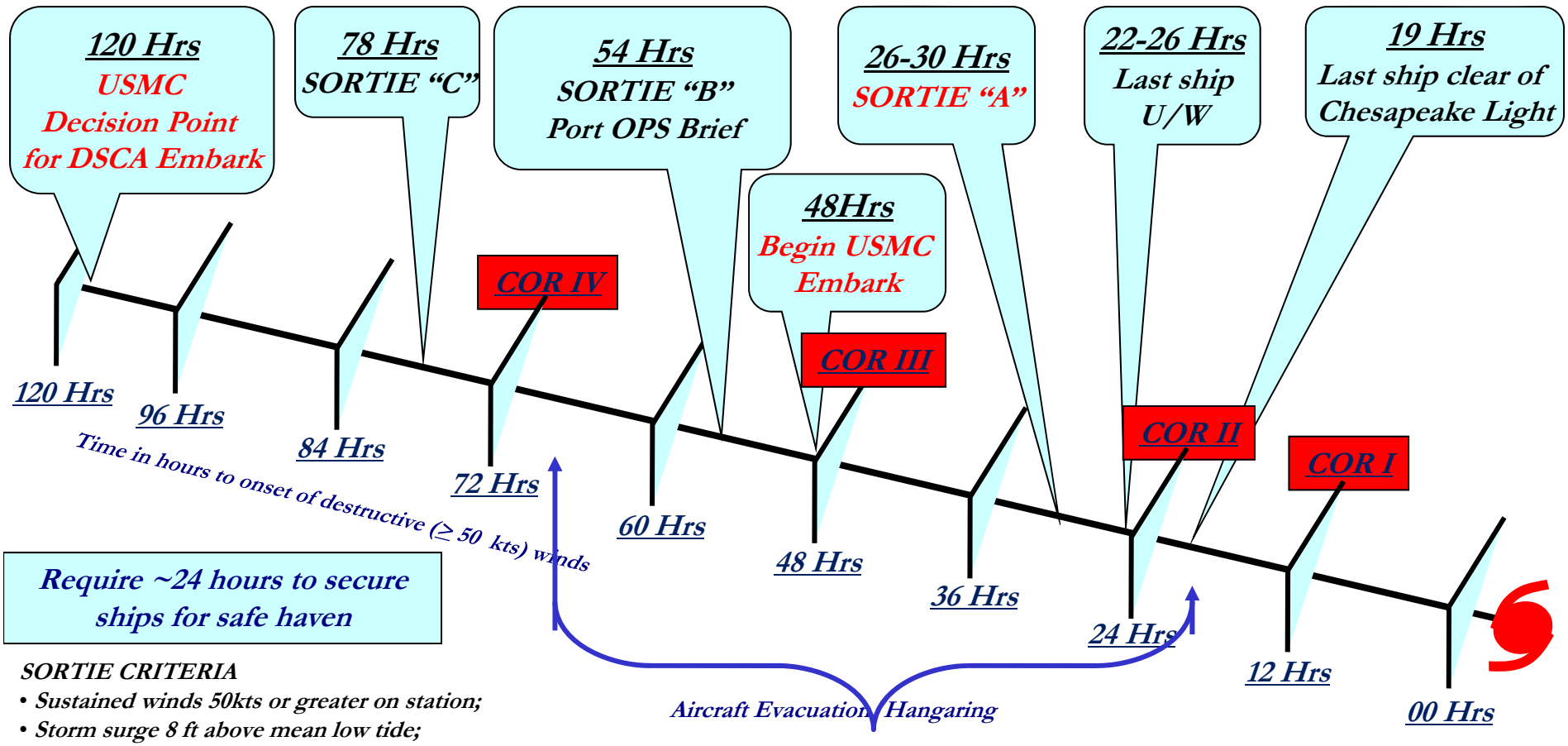
- Recent storm preparedness lessons learned:
  - Effective execution of evacuation upon order
  - Areas on Naval Station with significant flooding
- We could use help with:
  - Improving communications with Port Partners throughout the evolution
  - Better understanding of Port Partners capabilities to facilitate collective assistance with Port reconstitution

HAMPTON ROADS

Hurricane Sortie Timeline

***COR V**: Set at beginning of season*

Require ~4 hours to complete sortie



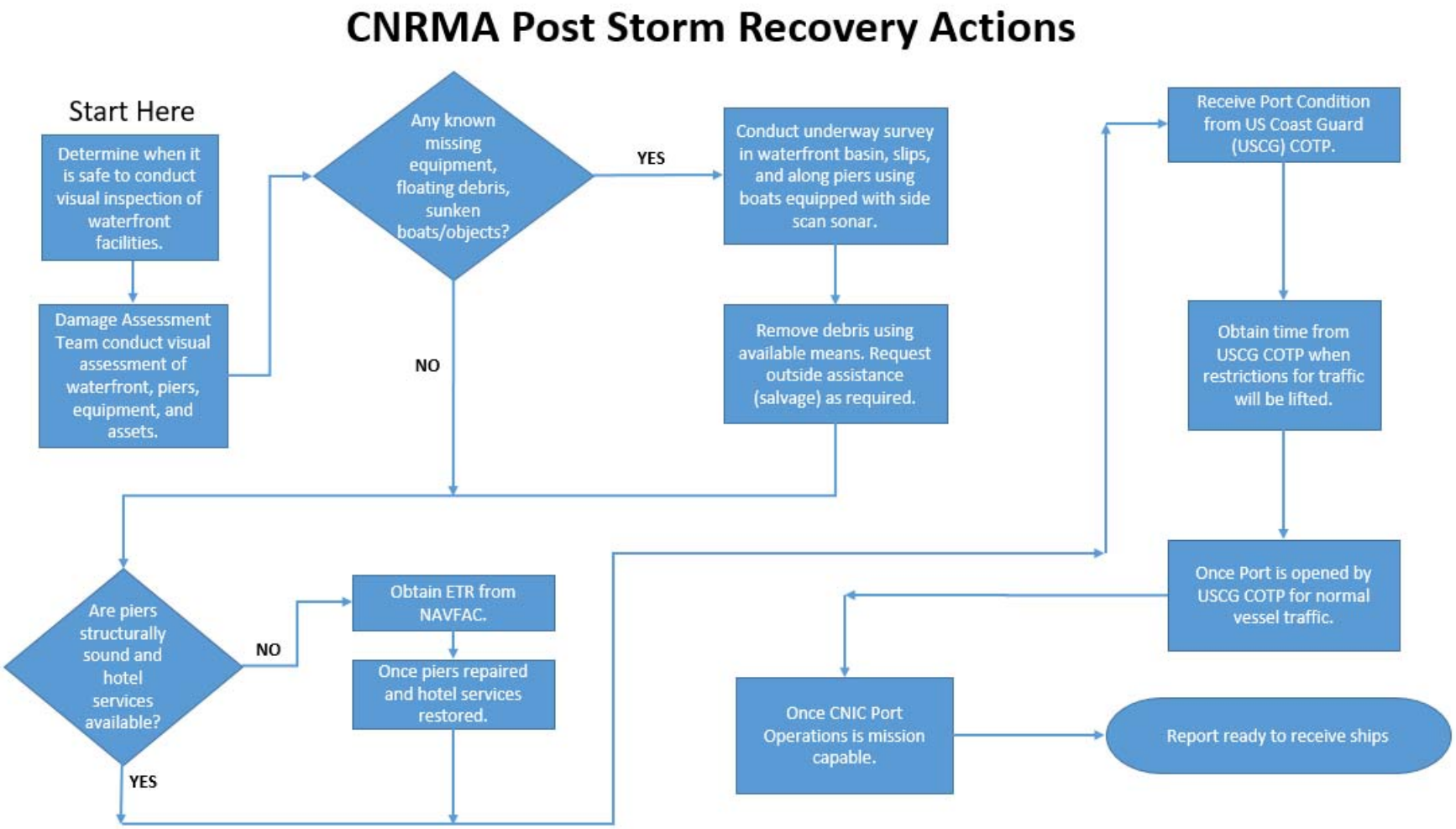
Require ~24 hours to secure ships for safe haven

SORTIE CRITERIA

- *Sustained winds 50kts or greater on station;*
- *Storm surge 8 ft above mean low tide;*
- *Commence sortie prior to onset of 12ft seas along the sortie track (approx 26-30 hrs in advance of storm impact)*

We Exist to Enable and Sustain Warfighter Readiness

Post Storm Recovery Actions



Local Contacts Perspective

June 18-20, 2019

Kevin M. Carroll
Captain
U.S. Coast Guard Sector Hampton Roads

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Impacts & Preparation

Our day-to-day operations include:

- Coast Guard's 11 Statutory Missions (SAR, MLE, AToN, Port Safety)
- Sector (Base Portsmouth), SFO Chincoteague, 6 Small Boat Stations, 3 ANTs, 5 CPBs
- 2,000
- COTP, OCMI, FMSC, FOSC, (etc.)

During an emergency, our continuity of operations includes:

- Unified Command/NIMS/ICS
- Multiple locations for COOP

Tools we use to make decisions:

- Severe Weather Plan
- Core and Port Partner Calls

Needs/Desires

Recent storm preparedness lessons learned:

- Evacuations pre-storm
- Need for Multiple COOP locations
- Importance of Early Comms

We could use help with:

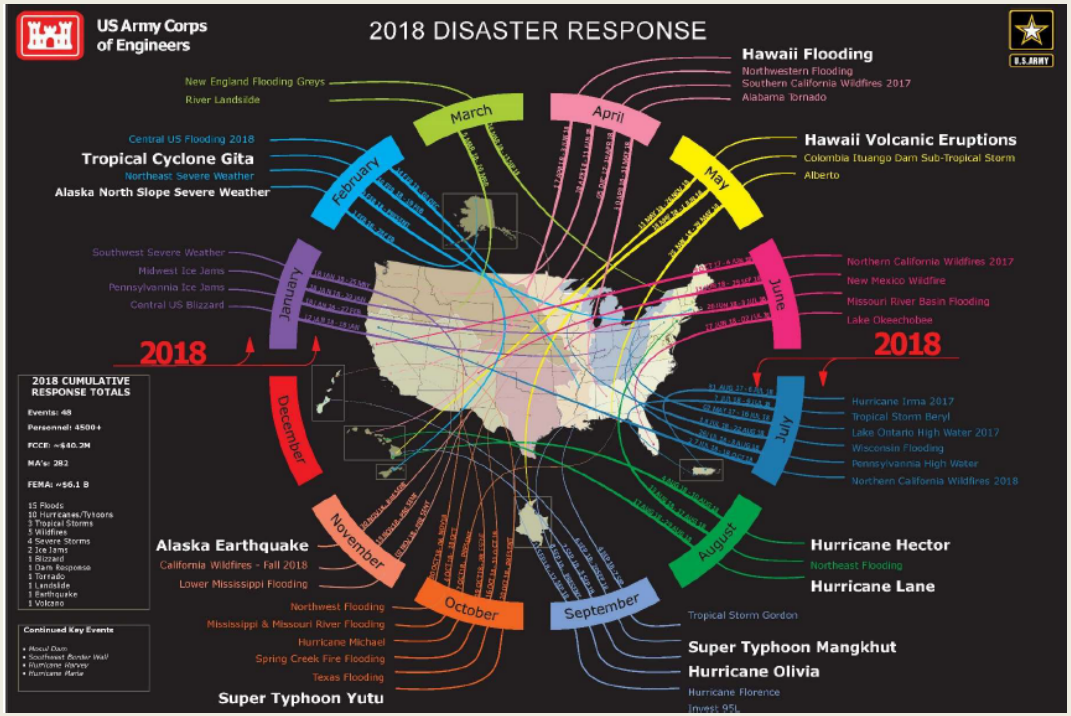
- Trajectories and modeling
- Joint Port Recovery Group (MTSRU)
- ESF 9 and 10 (location and mapping)

We hope to learn:

- Tools for identification and forecasting of trouble areas
- Long term plans and realities

Local Contacts Perspective

June 18-20, 2019
MAJ Alexander Samms
Deputy District Commander
US. Army Corps of Engineers



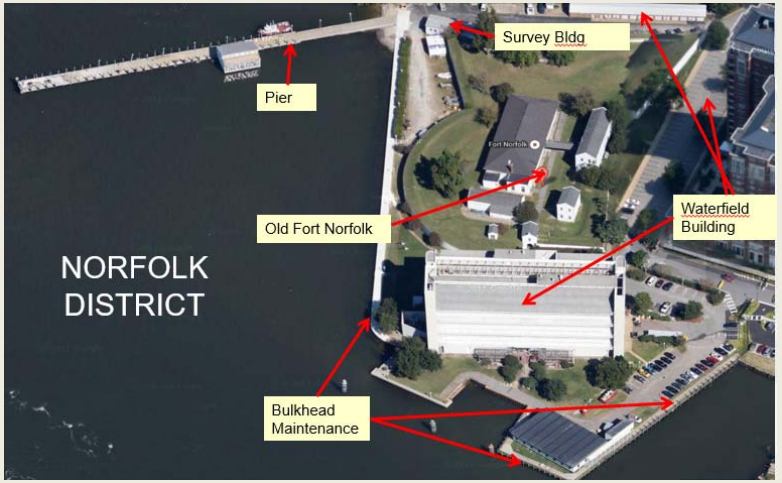
Impacts & Preparation

Our day-to-day operations include:

- Mission: Engineering solutions for water resources, military, interagency, environmental, and disaster response programs
- Facilities – See Pictures
- 370 Employees

During an emergency, our continuity of operations includes:

- Richmond Emergency Operations Center
- Flood Risk Management
- 60-80 Norfolk (Bring in 250)



Tools we use to make decisions:

- SLOSH Model
- LiDAR and DEM
- HURREVAC

Needs/Desires

Recent storm preparedness lessons learned:

- Power Planning and Response Team – Concrete Staging Area for Generators
- PM/Non-Federal Sponsor Pre-Storm Surveys

We could use help with:

- Planning Triggers for stream gages and forecasts – anticipate areas of concern for federal response / Failure of Infrastructure
  - Temp Power, Debris Management, Temp Roof, Temp Housing; VDCR Dams of Concern
- Emergency Power Facility Assessment Tool (EPFAT) input
- First floor elevations and depth damage curve assignment sharing

We hope to learn:

- GIS - digestion of available data – disseminate data
- Locations of critical infrastructure

Local Contacts Perspective

June 18-20, 2019

Becky Allee
Senior Scientist
NOAA Office for Coastal Management – Gulf Region

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Impacts & Preparation

Our day-to-day operations include:

- The Office for Coastal Management oversees implementation and provides technical assistance to federally approved state Coastal Zone Management programs
- OCM has two employees to support the area
- The Virginia Coastal Zone Management Program's mission is to create more vital and sustainable coastal communities and ecosystems
- The VA CZM has six full time employees, all located in Richmond

During an emergency, our continuity of operations includes:

- Communicate with partners to ensure their needs are met
- All employees are telework-ready
- VA DEQ maintains a Continuity of Operations Plan, updated in 2019, that details how the agency will continue to provide essential services during a disaster or other event that disrupts normal operations

Operations

- VA CZM Program works to develop and implement coastal policies, supported by NOAA funding of approximately $3M annually
- Projects address the ten goals of the Program, including Goal 4: "To reduce or prevent losses of coastal habitat, life, and property caused by shoreline erosion, storms, relative sea level rise, and other coastal hazards in a manner that balances environmental and economic considerations."
- Since 2000 the Program has supported over 90 projects with over $4M in funding to help build natural and community resilience to coastal flooding and to address the impacts of climate change on coastal resources
- Examples of project topics include: living shorelines, beneficial use of dredge material, first floor elevation data, regional adaptation to sea level rise plans, community rating system studies and training, locality resilience evaluations, and a resilience project database

Local Contacts Perspective

June 18-20, 2019

Bill Burket
Director, MIRT and Emergency Operations
Port of Virginia

NOAA's Regional Preparedness Training (NRPT)
Improved Preparedness for Storm Events and Nuisance Flooding in the Norfolk Region

Impacts & Preparation

Our day-to-day operations include:

- Coordinate Regional Planning, Response, and Recovery Operations
- Port of Virginia / USCG Sector Hampton Roads Area of Operation
- MIRT – 2 employees – OGAs - approximately 200 First Responders
- Coordinate POV Internal Emergency Operations and COOP
- All Hazards Response

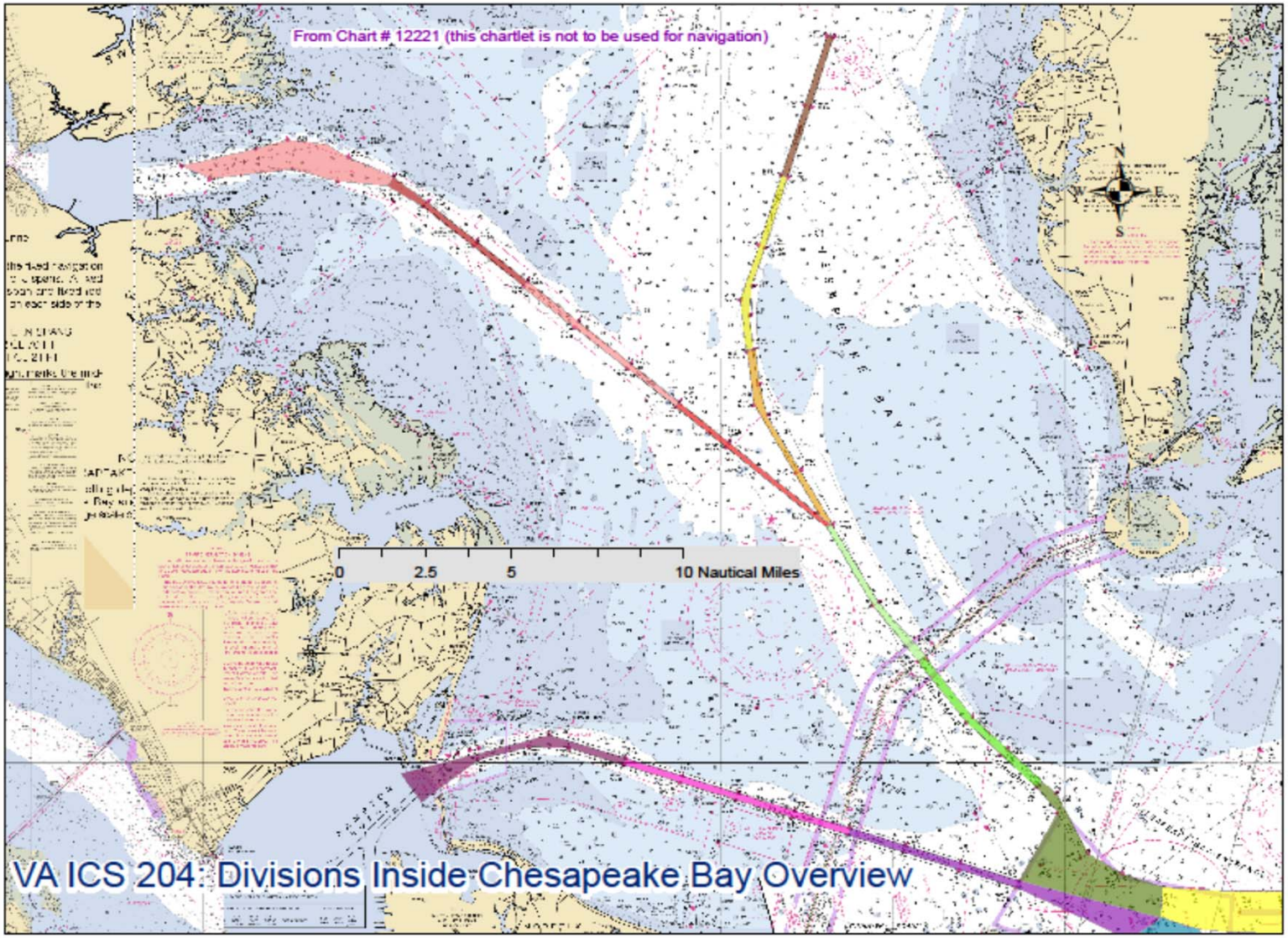
During an emergency, our continuity of operations includes:

- POV Internal: Mass Notifications, Ride Out Teams, Colleague Well Being, Alternate work sites
- Conduct Annual Table Top Exercises
- POV External: Assist USCG Sector Hampton Roads

Tools we use to make decisions:

- POV Internal: COOP Plan, HR Policies and Procedures
- POV External: USCG Severe Weather Plan, MTSU Plans, Scripted 204s to manage the reopening of the Port

Impacts & Preparation



Needs/Desires

Recent storm preparedness lessons learned:

- Virginia Governor's Mandatory Evacuation Order in 2018
- MARAD Safe Store Program on Pre-Positioned Ships
- COOP of USCG Sector Hampton Roads 2018
- NWS Web Tools

We could use help with:

- Weather Forecasts (source)

We hope to learn:

- Participating Colleagues / Agencies
- Tools (Present and Future)
- Recourses

Appendix F

Workshop Breakout Group Notes

NRPT: Norfolk -- BREAKOUT GROUP A discussion notes						
Flood/Storm Related Challenges that Impact Mission	***Agencies/Entities Impacted***	***Category***	***Current practice to address challenge***	***What is the desired practice to address the challenge? (e.g., preparedness/posture readiness)***	***Implementation Plan (i.e., path forward/next steps)***	Report-Out Notes
Planning and response fatigue (e.g., multiple storms in succession)	Everyone	Capacity	Maximum deployment time, and required time off. Force multipliers during an event. Creative planning activities. Priortization. Previstar (plan development software provided for free to cities)	More Priortization in planning. Scale back the ask. Having a timeline, with clear stakeholder responsibilities. Less or streamlined drills for professionals. Increased staff. Multi-diciplinary drills/plans (joint drills with other entities). Clear chain of command.	Having a timeline, with clear stakeholder responsibilities. Informed managers, and outreach (potential checklist).	Identifying the right people for planning and exercises. Using some tools which are already in existence, opposed to creating new ones.
Institutional knowledge once the staff person leaves because of their longevity in the position at the local level. Continuity of relationships/knowledge transfer following turnover (e.g., political, military)	City of Portsmouth, USCG	Capacity	Documentation. Onboarding protocall. Standard procedures.	Mentorship. Standard procedures. User-friendly, searchable, roles of position. Plan for no overlap in position.	Flow diagram of contacts. Specialized Org charts with positions.	
Road closure information communication/identification. communication process of which route to take or avoid (text message vs email vs other method)		Communication (E/I)	VDOT 511/App (does not include non-VDOT roadways). Private roads and tolls, Elizabeth River Commission. Posting flooded roads (social media). Waze/Google maps. HAM Radio channels. Flood gage (big stick).	Updated social media closures. Physcial inspection for flooding. Deployable flood sensors. ESRI apps for responders/inspectors. Crowdsourcing.	Contact with google maps/waze, to establish partnerships. ESRI geoforms. Aggregation of apps for simplicity/continuity. Data management coordination.	
Exercise no-comms scenario; operating by SAT phone or Radio. List of SAT phone numbers? Coordination with no communicaiton.	All	Communication (E/I) (Continuity)	GETS/WPS cards. SAT phone distribution to emergency personnel. HAM radio. Contunuity of operations plans (identification of contacts and numbers). 800 mH radios. ENS messaging.	Passive Cellphone tracking and location of essential personnel. Everbridge. Drills on communication.	Routine tests and education.	Get a list of SAT phone inventory, conduct regular testing of phones. Do we have the right distribution, do we have external partners. HSPO/DPP
Media interpretation and public perception (influence from certain people like local weather forecasters, sensationalism)	local, state, federal	Communication (External)	NWS consultation. Outreach programs. NOAA weather radio. TV. Work with the media to ensure correctly delivery of information.	PIOs/public affairs to monitor and correct mis-information. Consistent interpretation of weather. Work with/monitor the media to ensure correctly delivery of information.	Governmental weather app/source.	
Lack of standardization of communication and breakdown of responsibilities at a national level during response- best practices, lessons learned summary is needed, different backgrounds or new personnel have their own approaches	local, state, federal	Communication (Internal)	Afteraction reports, hotwashes, action items for program offices. Emergency operations plan/COOP.	Afteraction reports, hotwashes, action items for program offices. Emergency operations plan/COOP. Consistent training of individual offices/programs.	Inclusive of stakeholders in plan development/execution/drills. Adopting more ICS/NIMS into daily life.	
Reconstitution: once evacuated, re-entry and getting back to work which pushes back recovery/response operations. (e.g., how long can you maintain functions)	all	Continuity Planning	Advisory not to evacuate to a place you cannot get back to work/home. COOPs for reconstitution activities. Everbridge	COOPs for reconstitution activities.	Development of a reconstitution plan at the regional level, including re-entry expectations, coordinated with local level. Inclusion of cell phone numbers in state/local emergency messaging systems. Everbridge notification refinement. What does the end result of reconstitution look like?	Evaluating Coops and making sure reconstitution is defined and scope clear. (getting back to normal buisness, not personal considerations). Working at the regional level.
Semi-automated off-loading equipment for cargo; no option to go manual (some can run from generators). Need contingency plan	VA Port Authority	Continuity Planning	No expertise.	N/A	N/A	

Information and historical data to determine extent of flooding, depth and timing to keep citizens informed. (real-time)	Everyone	Data Management	Dependance on NWS. SLOSH maps. Virginia Flood Risk Information System. VIMS modeling. Rainstream flood sensing.	More (roadway) flood sensors, more real-time data available to public. Real-time impact assessments. Verification of impacted areas/roadways. Improvement of flood zones maps. Hampton roads planning district commission(HRPDC). VIMS modeling.	Prioritization of areas to develop/analyze. Visual interpretation of accurate flood information available to public. Combination of alert systems (flood sensors) (between fire, power, police, etc.). Identify flood sensors funding/partnerships. Higher resolution data for flood zone mapping. Development of working group with stakeholders to achieve these goals. Mining existing information to prioritize. Participatory mapping. Coordination between cities/leadership (HRPDC and officials). Tye flood gage implementation to reconstitution, in coordination with relevant stakeholders across city boundaries. Geocoded flooding photo databases for validation. Cameras on green stream sensors.	Discussion point for regional group to act on. HRPDC. Discussion of usefulness of sensors at a regional level.
Up-to-date information in databases. Keeping pace with climate change/sea level rise. Incorporate predictive models (Better floodplane maps)	Everyone	Data Management	Impervious surface mapping/tools.	Interactive mapping of hazards.	Improved impervious surface and runoff model mapping.	
The frequency of nuisance flooding	NOAA, USCG, ACE,	Data Management (Logistics/Policy)	Media reportage. Mapping of frequently flooded sites. Instrastructure projects to aleviate flooding. Measurement/Quantification and documentation of trends(depth, etc.).	Multiple small infrastructure projects or major sea wall/projects.	Identification of problems to solve/scope/prioritization of possible solutions.	
Long range funding stream to fix permanent issues at local level - what is the recurring money available? And how do we use it (e.g., nonconflicting community expenditures)	local, state, federal	Funding/Budget	Adhoc and reactive funding. Local and grant funding sources.	Hired staff expertise for grant acquisition. Money allocation for pre-disaster work.	Identification of pre-disaster and mitigation grants. Hired staff expertise for grant acquisition. Create a clearinghouse of available monies with expertise to apply. Partnerships to aid in grant writing. Develop a network for implementation of local level solutions.	
Relocating assets prior to storm to avoid damage	all	Logistics	Move assets to higher ground, accessible locations.	Move assets to higher ground, accessible locations.	Develop better building codes for asset storage. Public private partnerships for asset storage.	
How to service low income populations	Cities	Policy/Processes	Transferred to alternate group	N/A	N/A	

NRPT: Norfolk -- BREAKOUT GROUP B discussion notes				
Flood/Storm Related Challenges that Impact Mission	***Current practice to address challenge***	***What is the desired practice to address the challenge? (e.g., preparedness/posture readiness)***	***Implementation Plan (i.e., path forward/next steps)***	***Report Out Notes***
Employee mental health and wellness. People needed to do the work are also impacted by the incident, true for preparedness planning.	(1) Employees defined as mission essential. (2) Bring in surge capacity from other locations.	(1) Clarify who is mission essential and tailor mission essential list to specific scenarios. (2) Ensure people are trained/prepared to fill surge capacity roles. (3) Resources available for mission essential	(1) Continue to work with OHCS (i.e., work force management) to clarify roles/cross-walk internal policies. (2) Build in rotation/surge capacity to COOPs, train/prepare surge capacity roles, and make it scalable for different scenarios (e.g., major disaster scenario, compounding disasters). Leadership's role in ensuring regional staff safety and managing expectations. (3) Communications plan to handle long-term displacement. (4) Clarify if families can shelter-in-place or travel to response.	Increase manager responsibilities and accountability. Ensure adequate surge capacity
Availability of local knowledge and getting those resources - where can federal entities get local resources quickly when an event occurs?	Who you know (local emergency manager), finding it in command post	(1) Upfront research, for every response/location personnel is sent to . Understanding local requirements/zones, maintain/update records. (2) Post-storm: write down and maintain records. Document lessons learned (e.g., port guide).	(1) Local emergency managers or chamber of commerce (e.g., city), prepare port guide/update records as they change. Document safe havens, vet/pre-identify facilities to determine building capacity (e.g., category 2 capable)	After each event, document information gained
Communications, e.g., who has evacuated and where they have evacuated to.	Simple/one-way emergency notification system (ENS),	(1) For non essential personnel, part-time employees, in-house contractors develop localized communication tree. (2) Managerial accountability to follow-up with phone tree (3) two-way accountability system (e.g., ENS)	**(1) Make emergency response and management part of managerial training. (2) Place more emphasis on managerial responsibilities to employees. (3) Encourage/require employees to update emergency contact information.**	Manager training/accountability
Emergency and scientific messaging. Managing public expectations and messaging to the public (clarity in probability of being affected, warning fatigue)	NWS puts out messaging to public,	(1) Unified messaging across all emergency response entities, (2) Blue-skies campaign to educate/convey that climate is changing. (3) Reemphasize life/property is threatened, need to change complacent mindset. (4) Encourage self-sufficiency	(1) Annual training, compaigns to educate and compile resources/kits. (2) Emergency preparedness on-board training/orientation separate from workplace responsibilities (e.g., 1 month later)	Blue-skies outreach campaigns, manager/employee preparedness training
Public interaction while responding to an event if they do not listen and dealing with the public while also trying to accomplish your mission (e.g., communicating safe practice)	Publicly identifiable, unit depedent/event dependent	(1) Establish chain of command before going into field, inform local EOC. (2) Report any unsafe practices back within chain of command. (3) Develop/socialize messaging for field employees	(1) Ensure managers know responsibilitie for sending employees into the field (2) Prior to entering the field, require briefings, (3) local knowledge/ICS check-ins (4) real-time tracking/spot trackers or smart phones if cell service available	Equip field staff with proper knowledge and documentation
Roles and responsibilities under any disaster conditions. (emergency designation). People leave, or unavailable, including essential personnel during an emergency event. (e.g., alternate sites, co-location)	See Row 4	See Row 4	See Row 4	

Deconflicting COOP planning at regional scale; full cross-walk of COOPs (OK for NOAA), harder to do at regional scale. (e.g., What happens at federal level if DC is incompasitated; what happens if entire Atlantic coast is impacted. Do COOPs account for that?)	Close hold. Not well understood beyond COOP. Collateral duty for many in NOAA. Navy: publishes all of them at high level. Reported and exercised.	(1) Better coordination acrossline offices and vertically, visibility and regular exercising of COOP plans (2) Agreement with locations.	**(1) Update/re-think COOP plan; think about fundamental procedure. (2) Ocupent emergency plans are separate from COOP; coordinate the two plans.**	
Appropriate staging based on forecast (access to resources ahead of time, which areas aren't going to flood)	Base decision on best available information	(1) Assets staged in safe areas regardless of forecast, stay dynamic. (2) Use tools (e.g., digital coast) for planning purposes. (3) Training emergency managers on use of tools, (4) Tools taking surrounding elevations into account when staging equipment	(1) Model that takes into account total water, soil conditions, compounding storm effects. (2) Identify and tap into public and private partnerships (e.g., power companies, USCG, Port Authorities)	Improve environmental situational awareness w.r.t. models and continue to build public/private partnerships
Identifications of major impact zones	Pre-storm: communications, education. Post-storm: NGS flying coastal areas, social media	Prestorm: better historical data, higher resolution data. Visualization/landmarks of storm impact (e.g., markers showing historic storm impact) Post-storm: aggregation of pictures/videos, QA/QC and pull into common operating picture (COP).	(1) NOS mine data sent to NWS during/after storms. (2) Socialize/visualize impacts of storms (3) unified data management plans across cities within regional risk areas (e.g., common reference frame, interoperability)	Improving models/model resolution and public outreach campaigns
Post storm flooding validation - don't know what actually flooded, no system to collect damage (except fiduciary information); tightly held information. Inventory flooded locaiton, ultimately to improve forecasting. Competing models conflicts messaging. what does it look like to have 3 ft flooding - curbs, parking lots, etc (can't have staff/people out taking photos during a storm, only during sunny day floodings), looking for stillwater lines, a photo and time stamp, go back to the tide date. (i.e., waze to flag roads that are flooded) - City of Portsmouth started initial contact to do this with Greenstream	Pilot projects/pilot models	(1) Improve model reliability and one authoritative source. (2) Increase density of data inputs, and put on common reference frame.	(1) Identify landmarks in critical communities to track historic water levels to capture attention of the public (e.g., visual reference/artist in residence).	Improving models/model resolution and public outreach campaigns
Built into contracts in order to receive supplemental funding. Existing contracts have flexibility for supplemental funding. Need to be reserved in estimate. Additional money done in less productive manner because ceiling was reached.	Emergency contracts for spill response (OR&R); open up pre-identified contracts and pull in different scientific support. OCS have set a much higher ceiling than expected to reach. Unsure what NGS has	(1) Implement framework across more general contracts (e.g., facilities). (2) Include sustainability, adaptive management/restoration, when using supplemental funding.	(1) Working with AGO, education of AGO, congress and political team to impress the need for emergeny funds/supplemental funds and bolstering existing infrastructure after disasters (2) ensure CO-OPS has access to emergency contract options	Review NOS mission essential function (MEF) office contracts to ensure adequate emergency coverage. Engage NOAA facilities
Loss of natural features (parks, wetlands, etc.)	Rebuilding on own dollar, non-storm related. Post-storm: hard to show nexus of economic benefit of using/recovery natural features rather than hard engineering	(1) Showing nexus between natural features and economic recovery (2) proving historical baseline, (3) consider long-term resilience rather than short-term only	(1) Improving policy within the recovery support framework (RSF) - learn from Puerto Rico success and failures. (2) Adding green space to cities (3) Factor in stormwater impacts, show economic benefit	DPP hiring recovery specialists to improve relationships and FEMA RSF procedures
Sending responsers into the field, with limited cell service, knowing where those people can stay for a few days (optimizing location to make sure safe but able to get back to impacted area).	(1) In advance, identify locations within ~4hour drive of impacted area. Use local network to identify locations. Put folks as close as possible to respond promptly.	(1) Identify and use partners/federal facilities ahead of time. (2) Prestage facilities with resources to allow self-sufficiency in that location	**(1) Build SAT phone directory, SAT inventory, (2) improve coverage and testing of SAT phones, (3) Exercise/testing SAT phones. (4) develop catalogue of safe harbor lodging options by region**	Improving availability of communications and knowledge of end-directory

Federal/military don't get paid until mandatory evaction is instated; no guarantee that payment will occcur during evacuation. (stops proactive evacuation- puts people in dangerous situations)	General: Issue family travel orders of federal employees only after an evacuation order is mandatory. Challenge is that contractors are not covered. Navy has language built into contracts about safety and wellfare of contractors' employees. Responsibility lies with the contractor	(1) better communicate to employees what current practice is (2) devise messaging/standard practices for contractors in risk areas	(1) AGO, policical team to understand contractor evacuation rules. (2) Identify external assistance options for employees, workforce management outreach. (3) improving employee assistance oureach	Improve employee assistance outreach
How to service low income populations	Evacuated to shelters that are generally unsafe, crowded;	(1) communicating the science to public entities (e.g., SeaGrant) (2) city planning, improve shelter density/locations	(1) providing safer/less dense shelter options, improving density and locations, identify other private organizations/NGO's that could provide assistance or facilities. (2) outreach for evacuation options. (3) improve communication of public transportation options, (4) improve local stewardship of the environment. (5) Identify safe havens that are isolated (e.g., use existing vulnerability maps, evacuation zone maps). (6) Identify ways to get isolated safe havens resources, transportation (e.g., identified emergency bus route).	NOAA has mission responsibility to ensure coastal community resiliency while prioritizing environmental justice (outside of response framework)
** Bolded implementation plans are action items				

NRPT: Norfolk - BREAKOUT GROUP C notes				
Flood/Storm Related Challenges that Impact Mission	***Current practice to address challenge***	***What is the desired practice to address the challenge? (e.g., preparedness/posture readiness)***	***Implementation Plan (i.e., path forward/next steps)***	Plenary report-out notes
Managing employee work and family responsibilities. How to account for all personnel, encourage focus on families rather than getting back to work. smooth evacuation of dependents while maintaining essential employees	Emails, phone tree, notification procedures for employees in place but not for dependents; identify essential personnel; reporting employees and families are safe and where they are located; collecting dependent phone numbers for emergencies in a secure way; at a local level dependents are not tracked currently	keeping phone tree up to date; practice scenarios to report where you and your family would evacuate, how long you would take to get there, number of dependents traveling; text message alerts to employees to check phone numbers are accurate and have them respond if they received the alert	policy/procedure for managers to formalize a tracking system for employees and their families (i.e., 1x/yr have employees update contacts, test the system with an evacuation drill to ensure phone numbers are updated, evacuation destination and time needed to travel there is known, if they would evacuate or not). No new data system recommended but should build on current system (NOAA based) Primary responsibility on the first line supervisor. Annual manager refresher. Have employees come to annual review with updated staff directory information. *similarity with other groups*	Encourage line offices there can be suggested simple steps towards preparedness. Employees should know that supervisors care. Supervisors encourage employees to have emergency plans. Alternative contacts, clear lines of contact. Best practices document. This can be included in supervisor/on boarding (new employee/location) training.
Communication issues, (Everbridge notification system) and texting complications.	plan for if cell phone towers are down? - current practice is hoping system is restored, certain line offices have government communication priority cards that give access when phone communication lines are overwhelmed, wireless priority access cards, satellite phones	more robust network of people that have the ability to use other tools for communication	Analyze and define which essential personnel get one of these cards (only useful if phone lines are working): GETS - Government emergency Telecommunications Service (card you have to apply for to have priority access) - WPS - Wireless Priority Service (fee or charge to activate this on your personal or government phone)**HSPO working on line offices emergency responders/leadership/supervisors enrolling in priority service for verizon government phones (captain Lynch)**	Combine with group A
Clear and honest actionable plans for emergency situations.	update COOP plans, FEMA exercise to test plans, currently follow GSA procedure for offices being open or closed	actionable/realistic COOP plans, contacts are updated, incorporate telework, establish POCs at different office locations, increase detail for COOP plans that include challenges that are location based (i.e., flooding in Norfolk), knowing level of risk people are at, federal executive board at a regional level?, clarify who determines if federal Norfolk offices are closed or open	1) have trigger points with defined steps 2) create regional COOP plans or increase NOAA COOP plan detail 3) establish regional federal executive board network 4) Discuss with captain of the port (Hampton Roads Sector CAPT. Carroll) a centralized closure messaging board	Combine with group B, and key action items (regional action 3,4)
Multiple sources of information, potentially conflicting	outreach on different products and models available, messaging as a group - concise and clear throughout all NWS to avoid conflicting information, meet with local media directly who are communicating the messages, briefings with media partners, NWS chatroom (local & national)	priority/emergency information is most vocal/loudest message when needed (locally, media partners do a good job with this), communication enhancement between sources,	1) Publish a list of who authoritative sources are and **why** and distribute to our partners 2) Ensure appointed and elected officials know which resources to trust and have this list 3) Centralized message board creation (with ability for inter-agency access)	Clear decision making data set for life and property. Have a standardized list to elected official of authoritative sources.

Conference call burn out. Overlap in communications between local, state, and federal level is taxing and stresses out these agencies, redundancy	Everyone has their own response system. Key = consistency in messaging (NOAA NWS already groups like entities). Unnecessary to recreate wheel for each call but to keep the same message for each call. Stay in your lane. Little to none control in place to address this challenge. Conference calls are easy ways to disseminate large amounts of information.	USCG release document/report out to local entities to help reduce number of calls received. This is tricky because information can change quickly and needs to be distributed quickly. Conference calls reduce interpretation vs an email with pictures. Is there a way to schedule updates instead of guessing when the next update will be released? Better identify subcategories/groups on who needs what information. Better management of conference calls by working with professionals to manage information - send out information/briefing first and use conference call for questions only. Streamline calls. Training on communications, conference call exercises	1) standardize calls (e.g. length of time, setting expectations at beginning of call) - audience - agenda - frequency 2) proper training on call management - consult with organizational professionals to see best practices for conference call management	(Coast Guard Action?)
Communications preparation for shorter evacuation/planning periods	Compress information and speed up process.	less panic, defined rapid response, more practice; regular drills involving state and local groups in addition to federal entities; review how response process went	1) dissect case studies and review/debrief what went well, gaps, improvements 2) define communication plan with each scenario 3) Regular rapid response drills with anticipated scenarios (all partners internal and external)	
Who are using our products directly and how can we make them better - how can we message our products better to our audience (end user assessment)	user surveys (did not get good feedback), starting to use Google analytics to see what products are getting visited, discussion with NWS	approaching other groups with products, workshops, highlighting products to non-federal partners and getting their feedback, matrix on where to go for specific authoritative information (i.e., sea level rise) at local level, predictions of tides is very helpful (all digital coast products are helpful for explaining concepts/messaging)	1) leverage other NOAA entities to showcase products at different locations and increase outreach (NWS talk to locals often and can use them to get more product feedback, navigation managers), use OneNOAA approach, nautical charts 2) use Integrated Working Teams (IWTs) - people interested in your information, includes media 3) 5 minute videos or shorter on how product works and showcase videos on NOAA's main webpage and social media - hire professional media company to make these (prioritize flood products)	
Scalability of preparedness. (e.g., storms forming faster results in less lead time to prepare/evacuate), posture/response readiness, what if you don't have extended period to prepare. Nor'easters causing severe flooding/wave action/wind; hurricanes are not the only threat.	if situation becomes worse, currently call more people, work more hours, need more people	more defined grouping of people, more effective alert system to rally more people to get jobs done, better network of private resources/partners defined, MOUs in place to have certain people ready to help	1) identify needs where NOAA doesn't have the capacity 2) identify where those resources are 3) create MOUs or contracting mechanisms with those resources (i.e., USCG & Navy)	
Mitigating hazards to response personnel (ties to communication and how communication is transferred)	safety standards, PPE, standard risk assessment tool (GAR)	getting local knowledge, pre-response risk assessment, more problems with unknown hazards not from a lack of data/information of hazards, GIS-based user input that ties into ERMA that can be updated with hazards and where they are located	1) test rapid GIS solutions 2) discuss possible engineering developments 3) dissect case studies with lessons learned	

Models considering compound flooding (e.g., precipitation on top of high tide). Dam break/culvert failure, etc.	local and national efforts trying to address this issue at all levels (i.e., National Water Model should be able to handle these down the road in theory), coastal coupling to have national models feed into each other	need more rain data to tie into flooding data, wind and tide interaction, need more guidance to incorporate rain into flood models, OneNOAA water level forecast	1) continue collaboration between NWS, National Water Center, OCS, CO-Ops and other involved groups to work towards one model 2) find one consistent voice to message water level predictions	
How to hold funds in reserve, risk of caryover, etc. Can there be an emergency fund available for hurricane season? (e.g., similar to oil spill liability trust fund)				
Aging infrastructure				
Synchronizing resources and priorities				