Title: NOAA National Ocean Service  
Response Team efforts during the 2004 Hurricane Season  

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Abstract:  

The 2004 Atlantic Hurricane Season has been one of the most active and destructive seasons on record in decades. The Office of Coast Survey’s Navigation Services Division coordinated the broadest emergency response effort ever carried out by NOAA. This effort included significant intra-agency coordination, unprecedented interagency coordination, and the most extensive deployment of Navigation Response Teams over the broadest area of coverage providing rapid generation of survey results so that waterways and critical ports could be reopened as quickly and safely as possible for commerce and vessel traffic.  

The Navigation Response Branch’s NRTs were deployed for harbor clearance efforts on three of the five hurricanes and tropical storms to make landfall in the southeast United States. Major deployment issues were encountered and overcome to get equipment and personnel to the inundated ports. Ten port response efforts were completed in seven different ports, some visited twice, from Port of West Palm Beach, Florida to Pascagoula, Mississippi.  

NSD’s philosophy is to ensure clear channels from the sea buoy or open water to the pier. The use of various techniques allows the NRT to ensure a clear channel in a relatively short time frame. NOAA processing procedures primarily using off the shelf software allow quick processing of data which is extremely critical to documenting and disseminating information regarding the waterways in a clear and concise manner.  

The uninterrupted barrage of hurricanes in the Southeast United States tested the capabilities of the Navigation Response Branch’s NRTs. However, most of the challenges were overcome, many lessons learned, and several limitations identified. With this new experience the Navigation Services Division is taking steps to improve and document its emergency response procedures.
The 2004 Atlantic Hurricane Season was one of the most active and destructive seasons on record in decades. Five cyclones made landfall in the Southeast United States. Maintaining safe navigable waterways is critical to post-disaster emergency relief efforts and restoring commerce minimizing economic impacts. The National Oceanic and Atmospheric Administration Office of Coast Survey’s (OCS) Navigation Services Division (NSD) coordinated its broadest emergency response effort ever carried out by the OCS. This effort included significant intra-agency coordination, unprecedented interagency coordination, and the most extensive deployment of Navigation Response Teams (NRT) from Palm Beach, Florida to Pascagoula, Mississippi.

As tropical storm Bonnie began to build in the tropical Atlantic in early August the National Oceanic and Atmospheric Administration (NOAA) Office of Coast Survey (OCS) Navigation Services Division (NSD) sprung into action. With Bonnie approximately one week from predicted landfall somewhere on the Southeast United States NSD anticipated the potential for the need of hydrographic surveys to clear the approaches to ports that might be devastated by potential hurricane destructive powers and began coordinating a potential response effort.

An incident command center for the OCS response was established at NSD headquarters in Silver Spring, MD. Contacts with key intra-agency groups were established with National Geodetic Survey (NGS) for photogrammetry support, NOAA Marine and Aviation Operations (NMAO) for potential marine and air platforms of opportunity and other operational support, Center for Operational Oceanographic Products and Services (CO-OPS) for water levels and tidal zoning support. In addition NSD’s Customer Affairs Branch (CAB) regional Navigation Managers, the eyes and the ears in the field began making contacts with the USCG and Florida Emergency Operations Center (EOC), and local Pilot Associations. The above organizations made up NOAA’s NOS incident Response Team.

Daily conference calls were initiated once all the contacts were established for information exchange, scenario planning, logistical coordination, contingency planning. As tropical storm Bonnie moved closer two Navigation Response Teams were put on alert. The Navigation Response Teams had to not only secure the Navigation Response Team equipment and ready needed equipment for travel but also secure their personal abodes.
Tropical storm Bonnie dissipated prior to making landfall August 12, 2004 in a relatively less populated area of NW Florida. However before Bonnie made landfall hurricane Charley was brewing out in the Atlantic. Hurricane Charley made landfall August 13, 2004 in SW Florida. It was fairly devastating to the area however neither Bonnie or Charley created any significant marine navigational hazards requiring field investigations by the OCS. However, these two events turned out to be extremely important for NSD and NOAA for establishing communication protocols and emergency response procedures which later became so important to the success of later responses (figure 1).
The stand down from Hurricane Charley was barely completed when the Incident Response Team was called into action again in late August. The above procedures practiced on the first two storms to make landfall laid the groundwork for the hurricane responses to come.

Hurricane Francis made landfall in Southeast Florida as a category 2 hurricane on September 5, 2004. Sustained hurricane force winds of 90 knots were encountered and a storm surge of approximately 6 feet hit the coastal ports of Southeast Florida. The destruction of Francis was the 4th costliest in history causing approximately 9 billion in property damage and causing 42 deaths – 32 in Florida\(^1\).

The ports of Palm Beach, Fort Pierce, and Canaveral were closed to all marine traffic. The USCG Marine Safety Office requested survey support the evening of September 5\(^{th}\) just hours after landfall. Surveys of these ports were requested to investigate the condition of the approaches after the passage of hurricane Francis and ensure safe navigation for marine traffic.
Through the previously established communication channels with the Florida EOC the Florida EOC a state patrol escort was arranged for NRT2 from Saint Augustine to the Port of Palm Beach which began at 0520 on the September 6th. The escort turned out to be a critical necessity to avoid impassible roads due to destruction debris and traffic. In addition access to fuel was not available unless you were blessed by the State EOC. All fuel supplies and fresh water were strictly controlled. Resources were very scarce and continual communication with various agencies through the EOC was critical. Lodging was acquired in USCG barracks and survey operations commenced at approximately 1200 on the 6th approximately 36 hours after landfall.

The Navigation Response Branch protocol for emergency response surveys is to clear a channel from the Sea Buoy or safe navigable area to the pier. This spans several jurisdictions but is necessary to ensure safe navigation from sea to pier. The mariner is not served if approaches are cleared except the last 100 yards and one can’t get a vessel to the pier.

The general survey methodology for the NRT is to collect 200% high resolution side scan sonar coverage of the channel with a Klein 3000 operated on the 75-meter range scale. Single beam hydrographic data is simultaneously acquired with the side scan sonar data. In addition hydrographic data is acquired the center of the channel and each quarter. If an anomaly is found during standard side scan sonar survey operations then the anomaly is developed with tighter line spacing to investigate the least depth of any shoal or obstruction.

Shortly after commencing survey operations in the Port of Palm Beach the NRT found sea conditions not conducive to acquiring acceptable data and survey operations were halted. The Port of Palm Beach approach survey commenced at 0530 August 7th and was completed at approximately 1230. NRT2 found several of the floating aids to navigation were missing or off station and that a significant shoal had encroached on the channel from the north significantly restricting traffic. With preliminary data in hand the Captain of the Port opened West Palm Beach with restricted navigation. Full draft vessels were restricted to use of the southern half of the channel and only one vessel at a time was allowed to be in the Entrance Channel.

The NRT2 was then escorted to Port Canaveral that afternoon. That evening, Sept 7th, the survey results from Port of Palm Beach were finalized and electronically submitted to the MSO (figure 4).
Port Canaveral survey operations commenced at 0800 September 8th and concluded at 1800. Survey data were processed that evening and results submitted to the Port Authorities at 0730 and the NRT2 departed for the port of Fort Pierce. Similar results were found. A significant shoal had encroached on the channel from the south restricting traffic into the Port Canaveral.
The Port of Fort Pierce was surveyed September 9th and the channel was found to be clear however a new obstruction was found in the southern end of the turning basin. Three ports were cleared within 4 days of hurricane Francis landfall.
Hurricane Ivan was another animal. As the hurricane Francis response was wrapping up planning began for hurricane Ivan as it made its way towards the United States. Unlike Francis, Ivan caused death and destruction across several states. The process of preparations was the same but the magnitude and complexity of the response was larger in every way. Navigation Managers were stationed at each state’s EOC. One NRT was evacuated from Gulf Shores to high ground in Pensacola, FL another NRT was pre-positioned in Tallahassee, FL, additional NRT personnel were flown in from the Northwest NRT, and a third NRT set on standby in Saint Augustine, FL. Aircraft were readied and the OCS Incident Response Team was conducting twice daily conference calls to coordinate activities.

Predicting the landfall of Ivan proved to be most difficult and it was a challenge to resist the urge to pre-stage a team for quicker response. The projected United States landfall for Ivan was a moving target. The landfall moved over 700 miles from the southern tip of Florida to Gulf Shores, Alabama.

Hurricane Ivan made landfall on September 16, 2004 as a category 3 hurricane. It was a large storm packing 77 kt winds and gusts to 99 kts. Just south of Gulf Shores upper level wind speeds were measured at 120 kts which convert to 108 kt surface winds. Storm surges of 10 to 15 feet were measured from Destin, FL to Mobile Bay, AL and the coastal areas were battered with 20 to 30 foot waves on top of the storm surge. Ivan was responsible for 31 deaths in the United States and approximately 14.2 billion in property damage(2). In all Ivan was the most destructive hurricane in this area in 100 years.

Figure 7: NSD Hurricane Tracking Prior to Landfall
The first NOAA asset to deploy was NMAO’s Gulfstream Commander aircraft. It collected 2000 aerial images from Fort Walton, FL to Gulfport, MS for the Remote Sensing Division the day after Ivan made landfall. The images were rectified, georeferenced, and posted on the web. The images were critical for the EOCs and emergency responder agencies to evaluate the damage because access to many coastal areas were blocked due to the Ivan’s destruction.

September 16th was spent assessing the damages and coordinating response activities. All ports and waterways were closed from Panama City, FL to the Mississippi Delta. In this part of the country a considerable amount of commerce is conducted in coastal waterways such as the Gulf Intercoastal Waterway as well as larger channels servicing major ports. The Herculean task of clearing all these channels was to much for any one agency and task was divided between OCS NRTs and the USACE field teams with the USACE taking the lead on coordination. The general division had NRT clearing the channels from the Gulf to the major ports with the exception of Mobile, AL and the USACE clearing all the smaller intercoastal waterways.

NRT1 was almost at ground zero in Pensacola the day after landfall and they could not move. No traffic was moving as all roads to the water were impassable due to the destruction. NRT5 whom was pre positioned in Tallahassee was assigned to clear Pascagoula and received an escort across state lines from Tallahassee to Mobile Alabama where they were released to continue on. Again the escorts and access to state fuel depots was essential for successful transportation. NRT2 was deployed from Saint Augustine to Panama City and Destin Florida.
In the larger ports such as Pascagoula, Pensacola, and Panama City the approaches to the port facilities were prioritized to clear the most critical areas for emergency response agencies responding to the area. Figure 11 shows the division of priorities for the Port of Pensacola. The primary concern was to get the channel clear to the Pensacola Naval Air Station so that barges with relief supplies could be brought in. Secondly to clear the maintained channel into the Port of Pensacola Piers for barge access, and thirdly to clear the channel to Bayou Chico so fuel barges can bring in fuel to the depot, the primary source of gasoline for the region. Lastly, not shown in the image was to clear a channel through Escambia Bay to the I-10 bridge so that barges with construction equipment could be brought in for reconstruction efforts.

The NRT response effort began 1 day after landfall and took approximately one week. Four ports were cleared. Many aids to navigation were found missing, no new shoals were found but many new obstructions were found primarily in the channels leading in to Pensacola. These dangers to navigation were reported to the USCG. The dangers were broadcast in the Local Notice to Mariners and the port was reopened in a staged fashion.
As the response effort for Ivan wound down hurricane Jeanne was brewing out in the Atlantic. Jeanne eventually made landfall on September 26th, 2004 as a category 3 hurricane packing sustained 105 knot winds. Jeanne caused 3 deaths in Florida and approximately 6.9 billion in property damage (3).

Two NRT’s were placed on alert however only one NRT was deployed for response to hurricane Jeanne. The NRT2 responded to the USCG request to survey the approaches to the ports of Palm Beach and Fort Pierce. NRT2 was able to deploy within 18 hours of notice and complete survey operations of both ports within 48 hours.

The survey of Port of Palm Beach found additional shoaling in the same area as identified during hurricane Francis encroaching further on the entrance channel. A Danger to Navigation report was made for inclusion in the Notice to Mariners. The approaches to Fort Pierce were found to be clear.

The uninterrupted barrage of the SE United States tested the capabilities of the Navigation Services Division’s Response Team. The Response Team was actively engaged in response efforts almost continuously from early August, 1 week prior to tropical storm Bonnie through the hurricane Jeanne response two months later. However the progression of storms severity during the 2004 hurricane season allowed the OCS Incident Response Team to prepare and learn from each successive cyclone.

Many lessons were learned some of which are listed below:

1) It was found that responding too quickly was unsuccessful because sea conditions were unfavorable for collecting good data.
2) Frequent broad communications were critical to coordination.
3) Pre-established communication contacts reduced response time considerably.
4) Escorts were necessary for effective transportation.
5) Access to scarce fuel and other resources critical for success.
6) Need to have quick response shipping protocols established.
7) Need for field electronic technical support.
8) Depending on severity a shoreside processing team may be required.

From these and numerous other lessons learned the Navigation Response Division is taking steps to improve and document its emergency response procedures.

In the two months of response efforts, ten port response efforts were completed in seven different ports, some visited twice, from Port of West Palm Beach to Pascagoula. The success of this response in the face of the duration and scope is not only a testament to the ability and mobility of the Navigation Response Teams but also all the logistics, planning, and communication of the NOS Incident Response Team.
References:

(2) Stewart Stacy R., 6 January 2005, “Tropical Cyclone Report, Hurricane Ivan, 2-26 September”