# USING FORECASTS TO PROTECT FEDERAL FACILITIES IN THE PATH OF HURRICANE ISABEL

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## ABSTRACT

Hurricane Isabel made landfall as a Category 2 Hurricane on 18 September 2003, on the North Carolina Outer Banks between Cape Lookout and Cape Hatteras, then coursed northwestward through Pamlico Sound and west of Chesapeake Bay where it downgraded to a tropical storm. Wind damage on the west and southwest shores of Pamlico Sound and the western shore of Chesapeake Bay was moderate, but major damage resulted from the storm tide. The NOAA, National Ocean Service, National Centers for Coastal Ocean Sciences, Center for Coastal Fisheries and Habitat Research at Beaufort, North Carolina and the Center for Coastal Environmental Health and Biomedical Research Branch at Oxford, Maryland have hurricane preparedness plans in place. These plans call for tropical storms and hurricanes to be tracked carefully through NOAA National Weather Service (NWS) watches, warnings, and advisories. When a hurricane watch changes to a hurricane warning for the areas of Beaufort or Oxford, documented hurricane preparation plans are activated. Isabel exacted some wind damage at both Beaufort and Oxford. Storm tide caused damage at Oxford, where area-wide flooding isolated the laboratory for many hours. Storm tide also caused damage at Beaufort. Because of their geographic locations on or near the open ocean (Beaufort) or on or near large estuaries (Beaufort and Oxford), storm tide poses a major threat to these NOAA facilities and the safety of federal employees. Damage from storm surge and windblown water depends on the track and intensity of a storm. One tool used to predict storm surge is the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model of the NWS, which provides valuable surge forecasts that aid in hurricane preparation.

## INTRODUCTION

Hurricane Isabel made landfall on 18 September 2003 between Cape Lookout and Cape Hatteras, North Carolina as a Category 2 hurricane, moved across Pamlico Sound, then traveled northwestward passing to the west of Chesapeake Bay where it downgraded to a tropical storm (Figure 1). This storm track brought the storm into close proximity to the National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Centers for Coastal Ocean Sciences Center for Coastal Fisheries and Habitat Research (CCFHR) at Beaufort, North Carolina, and the Center for Coastal Environmental Health and Biomedical Research (CCEHBR) Branch at

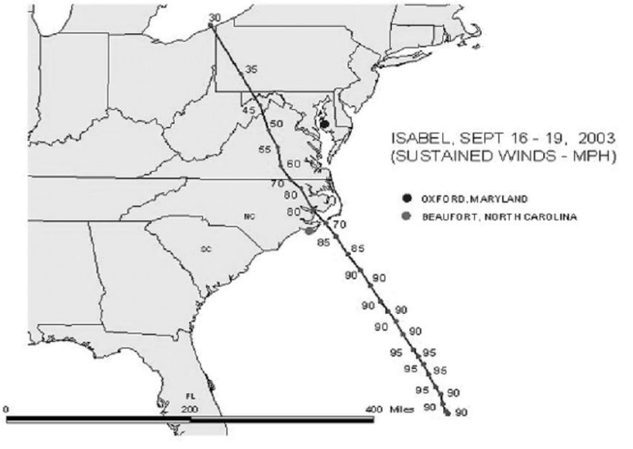


**Figure 1.** The storm track of Hurricane Isabel.

*K.G. Sellner (ed.). 2005. Hurricane Isabel in Perspective. Chesapeake Research Consortium, CRC Publication 05-160, Edgewater, MD.*

Oxford, Maryland. Because of this storm track, both Beaufort and Oxford were subject to high winds and storm tide (Figure 2).

## NOAA ACTIVITIES

Each NOAA office is charged with the responsibility of protecting federal property at its facilities as well as ensuring the safety of personnel. Preparatory procedures for the NOAA facilities at Beaufort and Oxford are documented in hurricane preparation plans. When a hurricane watch is posted for the areas encompassing these facilities, regular surveillance through the NOAA National Weather Service (NWS) National Hurricane Center begins. When a hurricane warning is posted for the surrounding areas of these facilities, documented hurricane preparation plans are activated with personnel pre-assigned to prescribed responsibilities and tasks. Generally, these plans call for securing these facilities by:

- Securing all computers and analytical equipment on second floors or elevating these instruments to desktops or elevated shelves or benches;
- Securing all government or leased vehicles by moving them to high ground in wind-protected areas;
- Securing vessels by moving the small boats to high ground in central, wind-protected areas;
- Securing research vessels by moving to secure dockage or hauling-out;
- Securing inside of buildings with plastic sheeting over bookshelves, desks, computers, and analytical instruments; and
- Securing buildings by boarding windows (those not protected by impact- resistant glass or film) and sandbagging doorways and entryways.

When the center director in Beaufort or the branch chief in Oxford deems that the facilities are secure, staff personnel are released to tend to personal property.

Because of Hurricane Isabel, CCFHR suffered wind (windows blown out, roof and siding damage, and damage to scaffolding) and storm-tide flood damage (loss of docks, seawall erosion, and undermining of support structures). The CCEHBR at Oxford received minor wind damage, but survived the highest storm tide in 40 years. The laboratory was isolated by water for many hours and one building was damaged. Area communities situated on the southwestern shore of Pamlico Sound, 20 miles east of Beaufort, received extensive storm-tide flooding. Flood damage to communities on the western shore of the Chesapeake Bay was extensive. The tide gage at Cambridge, Maryland, about 10 miles from Oxford, recorded an all-time-record-high level of 6.18 ft (1.88 m) above mean lower low water.

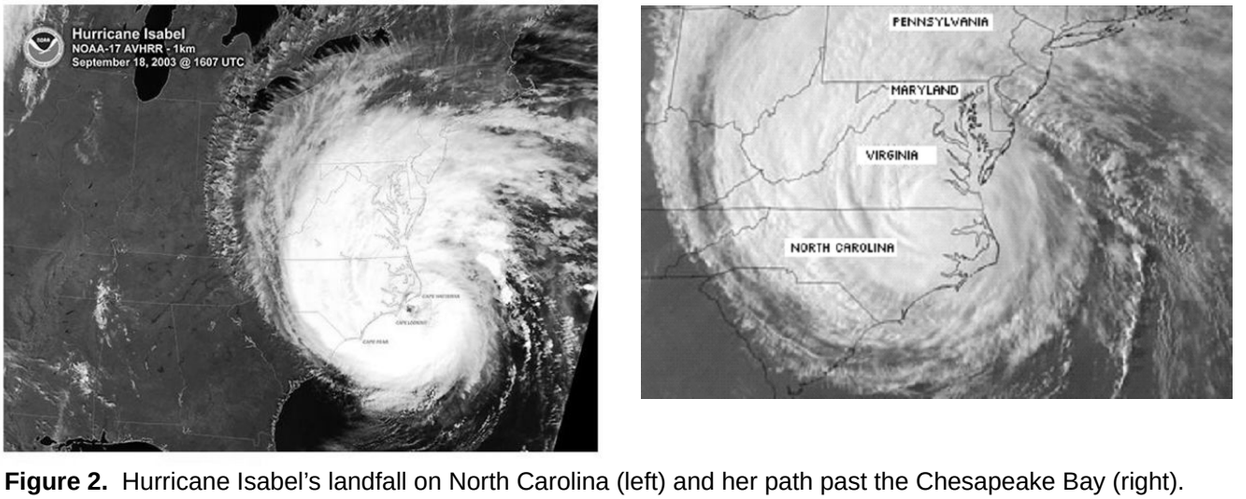


**Figure 2.** Hurricane Isabel's landfall on North Carolina (left) and her path past the Chesapeake Bay (right).

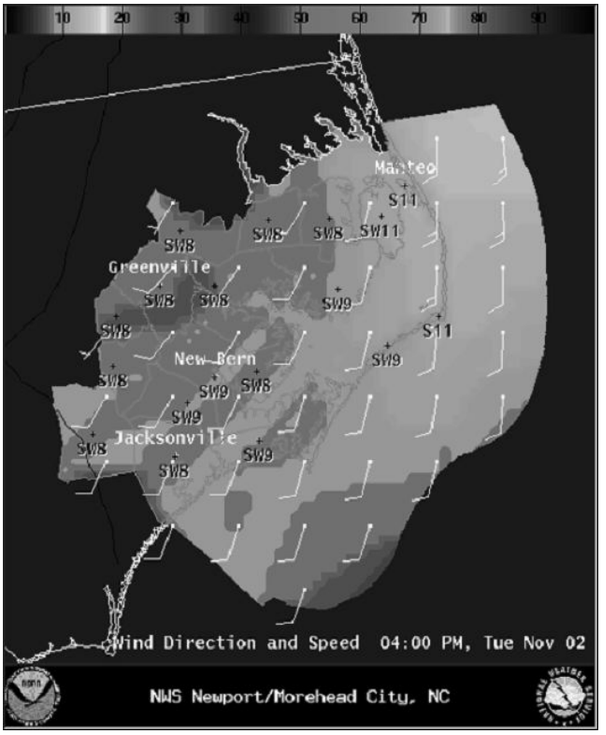


**Figure 3.** National Weather Service, National Digital Forecast Database prediction of wind direction and speed for 2 November 2003.

In addition to monitoring NWS National Hurricane Center's hurricane watches, warnings, and advisories, CCFHR also uses wind speed predictions from the National Digital Forecast database (Figure 3). The digital forecast data are available at *http://weather.gov.* The CCFHR also uses the NWS SLOSH (Sea, Lake, and Overland Surge from Hurricanes) model, which uses storm track, intensity, and size along with bathymetry and emergent terrain to predict storm surge.

The SLOSH model is generally accurate within plus or minus 20 percent. For example, if the model calculates a peak 10-foot storm surge for the event, one can expect the observed peak to range from 8 to 12 feet. The model accounts for astronomical tides (which can add significantly to the water height) by specifying an initial tide level, but does not include rainfall, riverflow, or wind-driven waves (*www.nhc.noaa.gov/HAW2/english/surge/slosh.shtml*).

The location of a hurricane's landfall is crucial for determining which areas will be inundated by the storm surge. In cases when the hurricane

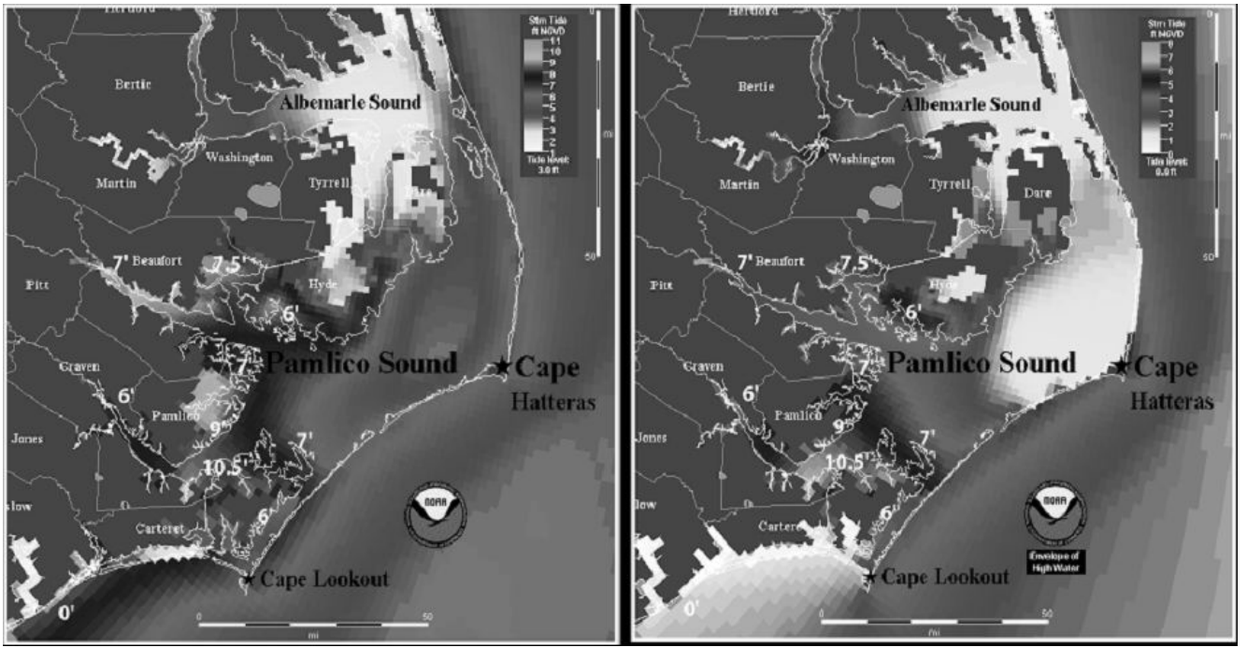


**Figure 4.** SLOSH model predictions of storm surge in central North Carolina given a worst case scenario, i.e., a Category 2 hurricane moving at 15 miles per hour over Cape Lookout (left); and operational prediction of storm surge given observed input parameters (right).

forecast track is inaccurate, SLOSH model results will also be inaccurate. The SLOSH model, therefore, is best used in defining the potential maximum surge for a location. Figure 4 shows the SLOSH output for a generic Category 2 storm and for Hurricane Isabel.

Isabel caused extensive flooding on the southwestern shore of Pamlico Sound because the storm made landfall over Core Banks at or near high tide and because water was blown across Pamlico Sound and piled on the southwestern shore. The storm's circulation drove water up the Chesapeake Bay, piling on the western shore. The CCFHR has the SLOSH installed at its facility, made available through the NWS Weather Field Office (WFO) in Newport, North Carolina. The SLOSH model, with a refined grid and updated database, is available for Chesapeake Bay through the NWS Wakefield, Virginia office.

## SUMMARY

The CCFHR at Beaufort, North Carolina and the CCEHBR at Oxford, Maryland are able to protect federal property to the extent possible by closely monitoring information made available through the NWS, by using model predictions from the NWS, and by activating documented hurricane preparation plans well in advance of hurricane landfall. The hurricane preparation plans employed by CCFHR at Beaufort and CCEHBR at Oxford, outlined here, are not intended to serve as a model for municipal or state facilities, but as suggestions for hurricane preparedness.

## ACKNOWLEDGMENTS

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