Hurricane Matthew Anatomy of a Flood: Impacts and Forecasts

Mike Dutter
National Weather Service

Bill Sammler
National Weather Service

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Hurricane Matthew
Anatomy of a Flood

Impacts and Forecasts

Mike Dutter – Science and Operations Officer
Bill Sammler – Warning Coordination Meteorologist

National Weather Service – Wakefield, VA
Overview

- Third Significant Rainfall Event in 6 weeks
- Interaction with Cold Front Enhanced Winds near the coast (SE VA/NE NC)
  - Matthew Not Truly Tropical
- Storm Surge/Beach Erosion a Problem
  - Tides combined with fresh water a MAJOR problem
- Track Forecasts Were As Not Helpful in Assessing Potential Impacts As They Normally Are
Tropical Cyclone Rainfall

Hurricane Irene – 2011 vs. Floyd - 1999

Hurricane Irene
August 24-30, 2011
3423 sites

Maximum: 15.74"
Bayboro, NC

Hurricane Floyd
September 14-17, 1999

Maximum: 24.06"
Southport 5N, NC
Tropical Cyclone Rainfall

Hurricane Irene – 2011 vs. Isabel - 2003

Hurricane Irene
August 24-30, 2011
3423 sites

Maximum: 15.74"
Bayboro, NC

Hurricane Isabel
Storm Total Rainfall
September 17-21, 2003
3009 stations

Maximum: 20.20"
Upper Sherando, VA
Why did SE VA/NE NC see so much rain, while being 100-200 miles away from the “center” of the storm?
Predecessor Rain Events (PRE)

- Marked by a mid-latitude system interacting with a Tropical System (TC)
- Strong Moisture flux from the TC interacts with the associated mid-latitude cold front and/or coastal front and creates intense precipitation near and on the cool side of the front
Radar Loop – 11 am to 11 am
The Anatomy of the Flood
Salient Points

- Widespread Major Floods Rarely Result from a Single Heavy Rain Event
- Antecedent Moisture Conditions Play a Critical Role
- Heavy Rainfall in September Made Matthew’s Flooding Possible
- Rainfall Pattern Resulted in Unusual Impacts
- *Looking at rainfall climatology (Average Recurrence Intervals) can help us understand the potential severity beforehand*
September Rainfall

September 01, 2016 Monthly Observed Precipitation

Created on: November 22, 2016 - 20:39 UTC
Valid on: October 01, 2016 12:00 UTC

[Map showing precipitation data with a circled area indicating high rainfall]
Hurricane Matthew Rainfall

25”-35” of Rain in 30-45 Days!!!
How Historic Was This 30-45 day period?

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1. PDS-based precipitation frequency estimates with 90% confidence intervals (in inches).

Average recurrence interval (years):

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What prompted us to issue this?

Remember, we had flood warnings and flash flood warnings throughout the evening.
Precipitation Frequency and Average Recurrence Intervals (ARI)

- Can be found in NOAA Atlas 14: (http://www.nws.noaa.gov/oh/hdsc/index.html)
- Gives us various precipitation estimates and confidence levels for various time intervals, and their return periods
  - i.e. What is the amount of rainfall that needs to fall over 24 hours which would lead to a 1 in 100 event
- Important to note that even though you can get information for any place in the region, the data is valid for a point – not a region.
  - There may be several “100 year” events in the region throughout a given year
24h Average 100yr Recurrence Interval
So, the overall event suggested that it was a 1 in 200 event (0.5% probability). This is one of the reasons why there was such widespread and persistent flooding.
This information prompted the issuance of a Flash Flood Emergency.
Where Does the Water Go?

Max Rainfall September through Matthew
Lawrenceville, VA - 9/15 to 10/18

- ~2 ft.
- ~3 ft.
- ~4 ft.
- ~+20 ft.
Franklin, VA - 9/15 to 10/18

~+6 ft.
~+13 ft.
~3.5 ft.
How can we better communicate flooding from the combination of tides and freshwater???
Tidal vs. River Graphs


Site Time (EDT)
- Graph Created (12:31PM Oct 12, 2016)
- Observed

PSQN7 (plotting HGIRG) "Gage 0" Datum: -5.5'

Observations courtesy of US Geological Survey
Tidal vs. River Graphs

South Mills, NC - 9/15 to 10/18

“Record” Stage

~6.5 ft.

~7.5 ft.

6 Days above “record” stage!!
Post Disaster Photos
Thank You!

Any Questions?

michael.dutter@noaa.gov
william.sammler@noaa.gov