FEMA’s Coastal Risk MAP study for Georgia

Georgia Association of Floodplain Managers: 8th Annual Conference, Lake Lanier, GA

March 13, 2013
Agenda

- Welcome/Introductions
- Project Overview
- Schedule
- Technical Presentation
- Questions and Answers
Introductions

- **Risk MAP Project Team**
  - FEMA Region IV
  - BakerAECOM, LLC (Production and Technical Services (PTS) contractor)
    - Michael Baker Corp.
    - AECOM,
    - Taylor Engineering, Inc.
    - Marea Technology, LLC
    - University of Central Florida
    - University of Notre Dame
    - Oceanweather, Inc.
    - Worldwinds, Inc.

- **Open Introductions**
  - (“Hi, I am Scott from ….”)
FEMA Region IV Coastal Flood Risk Studies in Florida
Why Surge Analysis for GA Was Updated

- Your flood risk changes over time.
- We chose your counties to review to more accurately define risk and account for significant development in the counties.
  - Significant flood risk from coastal storms (hurricanes, tropical storms, nor'easters)
  - Increase in population and development since current effective FIRMs published
- A complete, current picture of your coastal flood hazards and risks will help you better:
  - Plan for the risk
  - Take action to protect your communities
  - Communicate the risk to your citizens
Why Surge Analysis for GA Was Updated (Cont’d)

- Your risk is better defined through
  - Updated guidelines
    - *PM 50 Limit of Moderate Wave Action (LiMWA)* (2008)
  - Updated elevation data (topographic data and aerial imagery)
  - New climatological data based on recent storms
  - Newer coastal hazard methodologies (developed since Hurricane Katrina)
  - Improvement in Geographic Information System (GIS) technologies to improve coastal mapping accuracy
FEMA works with you and other communities to develop flood risk products and flood hazard maps that are:

- Based on the best available data from community and latest technologies
- Conducted by watershed (riverine)
- Conducted by affected communities and counties (coastal)
- Strengthened by partnerships

You can use Risk MAP tools and data to:

- Create or improve your Hazard Mitigation Plans
- Make informed decisions about development, ordinances, and flood hazard mitigation projects
- Communicate with citizens about flood risk
Traditional NFIP products are regulatory and subject to statutory due-process requirements.

New Risk MAP products are non-regulatory and are not subject to statutory due-process requirements.
Coastal Flood Risk Study Timeline

Coastal Risk MAP Project Timeline

Year 1
- Discovery Meeting
  - Discovery Kickoff Meeting
  - Updated Discovery Map
  - Draft Project Plan
- Technical Update Meeting
  - Provide update on study and information on expected changes to Stillwater Elevation (SWEL) and Base Flood Elevation (BFE)

Year 2
- Storm Surge Analysis Update Meeting
  - Provide update on study and information on expected changes to Stillwater Elevation (SWEL) and Base Flood Elevation (BFE)
- Flood Risk Review Meeting
  - Draft Outreach Strategy and Communication Plan
  - Non-Regulatory Risk MAP Products (Flood Risk Map, Report, & Datasets)
- Resilience Meeting
  - Potential actions to incorporate into Hazard Mitigation Plans
- Changes Since Last FIRM & Impacts

Year 3
- Consultation Coordination Officer (CCO) Meeting/ Open House
  - FIRM & FIS Report (Regulatory)
  - Flood Risk Map, Report, & Datasets (Non-Regulatory)
- Preliminary FIRM & FIS Report Issuance

Year 4
- Preliminary FIRM & FIS Report Effective

Year 5

Risk MAP
3-5 years

A. Planning & Budgeting, Discovery Preparation
B. Discovery Kickoff Meeting, Follow-up
C. Perform Coastal Surge Risk Analysis
D. Risk Awareness & Mitigation Outreach
E. Proposed NFIP Map Changes & Impacts
F. Preliminary NFIP Map Release & Mitigation Plan Path Forward
G. Due Process & Path Forward
Base Flood Elevation (BFE) on a FIRM includes four components:

- Storm surge stillwater elevation (SWEL)
- Wave setup
- Wave height above total SWEL
- Wave runup above storm surge elevation (where present)

All applied to an eroded beach profile (when applicable)

The above components are computed through:

- Terrain processing and profile erosion
- Storm surge study for SWEL determination
- Coastal hazard analysis
Project Work Plan

- Work assigned to BakerAECOM as PTS:
  - Perform coastal storm surge and wave height analyses for GA and NEFL counties
  - Develop coastal floodplain boundary delineations and produce work maps
  - Provide work maps to GA
Projected Schedule

- Production Runs: August 2013
- Statistical Analysis: September 2013
- Overland Wave Analysis: December 2013
- Flood Hazards Work Maps: September 2014
  - BakerAECOM gives work maps to GA CTP
Extent of Coastal Surge Study

**NEFL Coastal Counties**
- Bryan
- Duval
- Flagler
- Nassau
- St. Johns
- Volusia

**Georgia Coastal Counties**
- Camden
- Chatham
- Glynn
- Liberty
- McIntosh

**NEFL Interior Counties**
- Clay
- Putnam

**Georgia Interior Counties**
- Brantley
- Charlton
- Effingham
- Long
- Wayne
Approach - Storm Surge SWEL

Storm Forcing
- Hurricane Tracks

Storm Surge Modeling
- Winds
- Waves
- Water Levels

Return Period Analysis
- JPM-OS 2%, 1%, 0.2% Annual Chance
- Tide Gage Analysis 50%, 20%, 10% A.C.

SWEL

High-Resolution Bathymetry / Topography Mesh

JPM-OS: Joint Probability Method - Optimum Sampling
Initial Results

- **Model Mesh Development**
  - Developed seamless topographic and bathymetric data surface (Digital Elevation Model [DEM])
  - Developed SWAN+ADCIRC Mesh
  - Tasks completed in parallel

- **Storm Climatology**

- **Validation Storm Selection**

- **Validation Comparisons**
Seamless Topographic and Bathymetric Data Surface (DEM) Development

- LIDAR
- National Elevation Dataset
- Geo Database
- Shoreline
- Convert to NAVD88
- GEOphysical Data Management System
- Electronic Navigational Charts
- USACE/SJRWM Hydro Survey

Seamless Topographic/Bathymetric Data Surface

NAVD88: North American Vertical Datum of 1988
LIDAR and Bathymetric data
LIDAR Coverage (Cont’d)
LIDAR Coverage (Cont’d)
LIDAR Coverage (Cont’d)
Bathymetric Data Coverage (Cont’d)

NOS Data, Different Survey Dates and Data Extents
Bathymetric Data Coverage (Cont’d)

Same Area, Different Data Sources, Survey Dates, and Data Extents

Legend
- USACE (2011)
- SJRWMD (1993)
- NCS (1958)
- NOAA (Varies)
SWAN+ ADCIRC Model Mesh Development

• SWAN+ADCIRC Model
  ➢ Finite element model
  ➢ Uses unstructured, triangulated mesh
  ➢ Node spacing set to accurately represent topography/bathymetry
  ➢ Created “feature arcs” to represent elevated or depressed features (i.e. roads or channels)
DEM to SWAN+ADCIRC Mesh: Step 1
DEM to SWAN+ADCIRC Mesh: Step 2
DEM to SWAN+ADICIRC Mesh: Step 3
DEM to SWAN+ADCIRC Mesh: Step 4
SWAN+ADCIRC Mesh
SWAN+ ADCIRC Model Mesh Development (Cont’d)

GANEFL STUDY EXTENT

- Mesh Nodes
  - 2,632,740 within red
  - 2,980,548 entire mesh
Initial Results

- Mesh Development
  - Development of Seamless Topographic and Bathymetric Data Surface
  - Development of ADCIRC Mesh

- Storm Climatology

- Validation Storm Selection

- Validation Comparisons
Storm Climatology: Storms in Study Area

Tropical Storms: 1940 - 2010

Passing within 175 nm of Jacksonville

Typically Category 1 or less at landfall
Storm Climatology: Storms in Study Area (Cont’d)

Tropical Storms:
1842 - 1939
Passing within
175 nm of
Jacksonville

Instances of
greater than
Category 3
storms
Tropical Cyclone Tracks and Parameters

Landfalling storms: 1940 – 2010
Central Pressure < 980 mb
Category 1 or greater
Limited activity in study area
Tropical Cyclone Tracks and Parameters

Analysis of important storm parameters (considered random in JPM-OS analysis)

- Central pressure
- Radius to maximum winds
- Forward speed
- Storm heading
- Holland’s B (shape parameter)
Tropical Cyclone Tracks and Parameters (Cont’d)

- Optimized set of 178 storms
- Final SWAN+ADCIRC simulations apply storms
Comparison of reference set and optimal set at specific comparison locations

Results indicate optimal set adequately reproduces reference values
Initial Results

- Mesh Development
  - Development of Seamless Topographic and Bathymetric Data Surface
  - Development of ADCIRC Mesh

- Storm Climatology

- Validation Storm Selection

- Validation Comparisons
Validation Storm Selection: Significant Surge Events 1950-1959

Landfalling, bypassing, exiting storms that passed near study area
Validation Storm Selection: Significant Surge Events 1960-1969

Landfalling, bypassing, exiting storms that passed near study area
Validation Storm Selection: Significant Surge Events 1970-1979

Landfalling, bypassing, exiting storms that passed near study area
Validation Storm Selection: Significant Surge Events 1980-1989

Landfalling, bypassing, exiting storms that passed near study area
Validation Storm Selection: Significant Surge Events 1990-1999

Landfalling, bypassing, exiting storms that passed near study area
Validation Storm Selection: Significant Surge Events 2000-2010

Landfalling, bypassing, exiting storms that passed near study area
Validation Storm Selection: Significant Surge Events

NOAA stations with water level (WL) data
NOAA National Buoy Data Center (NDBC) stations with wave data
## Criteria Sorting of Storms

<table>
<thead>
<tr>
<th>1. Local Landfall</th>
<th>2. Significant WL Difference</th>
<th>3. WL Data Availability (&gt; 3 Stations)</th>
<th>4. Wave Data Availability (2 or more stations)</th>
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### Validation Storm Selection: Significant Surge Events (Cont’d)

#### Criteria Sorting of Storms

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Five validation storms selected

- Hurricane Dora (1964)
- Hurricane David (1979)
- Hurricane Frances (2004)
- Tropical Storm Tammy (2005)
- Tropical Storm Fay (2008)
Initial Results

- Mesh Development
  - Development of Seamless Topographic and Bathymetric Data Surface
  - Development of ADCIRC Mesh
- Storm Climatology
- Validation Storm Selection
- Validation Comparisons
Validation: Tides

Tide validation based on comparisons to NOAA stations with tidal constituent data
Validation: Tides; Amplitude
Validation: Historical Storms; Hurricane Dora
Validation: Historical Storms; Hurricane Dora (Cont’d)

Maximum Modeled Water Levels from Hurricane Dora — Nassau and Duval Counties, FL
Validation: Historical Storms; Hurricane Dora (Cont’d)

Hurricane Dora Hydrographs at Fort Pulaski, GA (NOAA Station 8670870)

Hurricane Dora Hydrographs at Fernandina Beach, FL (NOAA Station 8720030)

Hurricane Dora Hydrographs at the Mayport Ferry Depot, FL (NOAA Station 8720220)
Validation: Historical Storms; Hurricane David
Validation: Historical Storms; Hurricane Frances
Validation: Historical Storms; Tropical Storm Tammy
Validation: Historical Storms; Tropical Storm Fay
Validation: Historical Storms; All
Validation: Historical Storms; Waves, Hurricane Frances

![Map showing maximum wave height](image-url)
Validation: Historical Storms; Waves, Hurricane Frances (Cont’d)
Validation: Historical Storms; Waves, Height
Validation: Summary

- Validation completed for tides and five historical storms
- Demonstrated model capability to reproduce water levels and waves in project area
- Comparisons to available data showed reasonable agreement for water levels and waves
Upcoming Work

- Production runs (with synthetic storms) using supercomputer
- Frequency analysis for 0.2%- 1%- 5%- 10%- 20%- and 50%-annual-chance storms
- Overland wave analysis
- Work map production
Open Discussion – Questions?

- Technical questions about data applied…?
- Technical questions about methodology…?
- Technical questions about model validation or application…?
- General questions about project schedule?
- General questions about outreach activities?
- Other questions?
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