STORM SELECTION
ICM AND RISK MODELS

DAVID R. JOHNSON

FEBRUARY 2021
OVERVIEW

STORM SELECTION

- JPM-OS and Storm Updates
- Storm Selection
  - Storm Sequence for the ICM
  - Reduced Storm Set for CLARA
JPM-OS AND STORM UPDATES
NEW SUITE OF AVAILABLE SYNTHETIC STORMS

HAZARD CHARACTERIZATION

- Transitioned from 446-storm suite to 645 synthetic storms
- More variation in storm parameters
  - $c_p$ - 865 to 1005 millibars
  - $r_{max}$ - 4.3 to 76.3 nautical miles
  - $v_f$ - 4.3 to 27 knots
  - 60 kilometer track spacing
  - 20 degree intervals for heading

Updated synthetic storm tracks for 645-storm suite
UPDATES TO JPM-OS METHODOLOGY
HAZARD CHARACTERIZATION

- HURDAT record augmented by ERDC to impute missing values of $r_{max}$ and $c_p$ for some storms
- Added a linear drift term allowing $c_p$ to vary over time
- Changed distribution for $r_{max}$ to a log-normal

Updated synthetic storm tracks for 645-storm suite
STORM SELECTION: ICM
STORM SEQUENCES
STORM SELECTION FOR THE ICM

• Goal was to identify sequences with specific characteristics:
  • Synthetic storms that closely resemble past 50 years (parameters and sequence)
  • Storms producing water surface elevations matching 10-, 50-, and 100-year exceedances at 33 locations
• Sample from 645-storm suite
• Exceedances estimated under 2017 Coastal Master Plan’s current conditions landscape
MATCHING HISTORIC STORM EVENTS
STORM SELECTION FOR THE ICM

- Identify storm tracks proximal to 61 historic storms at landfall (1970-2019)
- Select the storm on those tracks with minimal Euclidean distance to historic landfall $c_p$, $r_{max}$, and $v_f$ parameters
- Sequence synthetic storms over 50 years in the same way

Updated synthetic storm tracks for 645-storm suite
MATCHING WATER SURFACE EXCEEDANCES
STORM SELECTION FOR THE ICM

- WSE exceedances calculated using our previous JPM-OS method applied to new suite of 645 storms
- Algorithm added storms to a sequence that match as many values as possible
- Able to generate “balanced” sequences over all points and return periods
  - Same number of storms as historical record
STORM SELECTION: CLARA
IDENTIFYING A HIGH-PERFORMING REDUCED STORM SET
STORM SELECTION FOR CLARA

- US Army Corps of Engineers used a genetic algorithm to identify 95 storms that best replicate surge elevation exceedances associated with the full 645-storm suite
  - 427 sample points
  - 2- to 10,000-year return periods (50% to 0.0001% annual exceedance probability)

Sample points used to evaluate reduced storm subsets
IDENTIFYING A HIGH-PERFORMING REDUCED STORM SET
STORM SELECTION FOR CLARA

- We calculated surge exceedances with 645 storms using updated CLARA JPM-OS
- Greedy algorithm adds or subtracts storms that best improve the comparison
  - Started with 90 storms provided by USACE
  - Maintained a total of 90 storms by adding and subtracting until convergence
  - Final recommended set contains 38 storms not in original ERDC set
COASTWIDE COMPARISON OF RECOMMENDED SET TO FULL SUITE

STORM SELECTION FOR CLARA

- No systematic bias or clear spatial patterns of bias relative to 645-storm suite
  - Differences less than 0.5 ft not shown
- Root mean squared error (RMSE) over all unenclosed grid points considerably smaller than that from 2017 storm selection process

Difference in 100-year surge depths (CLARA 2023, 90 storms minus 645 storms)

RMSE (ft) over all unenclosed grid points

<table>
<thead>
<tr>
<th>Return Period</th>
<th>RMSE (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Year</td>
<td>0.28</td>
</tr>
<tr>
<td>50-Year</td>
<td>0.36</td>
</tr>
<tr>
<td>100-Year</td>
<td>0.43</td>
</tr>
<tr>
<td>500-Year</td>
<td>0.64</td>
</tr>
</tbody>
</table>
COMPARISON TO 2017 COASTAL MASTER PLAN

STORM SELECTION FOR CLARA

- Estimated exceedances are generally greater than those produced in 2017
  - Differences less than 0.5 ft not shown
- Attributable to inclusion of less intense but higher-frequency storms, JPM-OS updates

![Difference in 100-year surge depths (CLARA, 2023 - 2017)]
THANK YOU