Exploring an Automated Mapping Methodology for Coastal Runup Zones

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Agenda

- Coastal Background
- Purpose
- Approach
- Tool Automation
- Data Applications
Coastal Background

- Steep coastlines are usually exposed to flooding hazards generated by large ocean wave impact at the shore.
- Dominant factor: Wave Runup
- Crucial part of Coastal Study
Wave Runup

Maximum vertical extent of wave uprush on a beach or structure

Wave runup is usually computed on cliffs, bluffs, steep dunes, structures
Wave Runup, Traditional Approach

- Determine 1% TWL along each transect
- Establish representative reach along each transect (or grouping of transects)
- Manually digitize 1% TWL for each representative reach in a GIS environment, following topographic contours
Traditional Approach: Challenges

- Manual Digitization
  - Time consuming
  - Subjective
  - Precision required in very steep areas, where contour lines are close to each other

  LOWER PRECISION ➔ HIGHER COST

- Higher expectation of 1% boundary, as the use of digital GIS products are becoming more accessible to a wider audience (digital resolution vs. printed resolution)

  PRECISION ➔ DIGITAL QUALITY ➔ BOUNDARY ACCURACY
Traditional Approach: Challenges
Traditional Approach: Challenges

1”:500’

1”:2000’

1”:6,000’
Revised Approach

• Map the 1% runup inundation boundary using an automated (and therefore standardized) approach, to reduce time and effort associated with translating the coastal runup analysis results into spatial boundaries.

• Apply widely-available tools
  – ESRI ArcToolbox basic tools + Spatial Analyst + 3D Analyst
  – AECOM WISE Terrain Analyst
Efficiency

Efficiency

Modeling

Analysis

Coastal Products

Mapping
Approach

- **Data Sources, 3 inputs:**
  - Terrain: WTA, DEM
  - Coastal Transects
  - Runup Reaches

- **Data Medium:**
  - Shapefile (or Geodatabase), Raster
  - Spatial Analyst Raster Calculator & Raster Conversion Tools
Approach

- Using the (general) analysis runup elevations, a “bounding polygon” is established that fully covers the area to be mapped.

- Complete coverage is necessary, from a seaward extent up to a high inland elevation.
Approach

- This bounding polygon is divided using the Runup Reach locations, and the resulting individual polygons are attributed with the coastal analysis BFE values.
Approach

- This result is converted into a flat WSEL raster, from which the ground raster is subtracted.
- The result is an “initial depth” raster:
Approach

- This raster is further processed to clarify and visualize the results
  - Re-classify Raster based on Greater-Than-Equal-To Depth (1, 0)
  - The 0 values are then removed from the raster
Approach

- The resulting clean raster is converted to a “Total Water Level” polygon and line, which is then smoothed.
Approach

• Smoothing tolerances
Toolbox Automation

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• Use WISE Terrain Analyst to check the results of the TWL/inundation mapping.
  – Applicable where the boundary intersects the terrain
  – Not applicable where the boundary is manually mapped according to special circumstances such as AO Zones in overtopped areas, or where the runup TWL is capped.
Analysis and Mapping Refinement:

- In some areas, due to the coastal geomorphology, or due to the coastline orientation, reach delineation may be subject to engineering judgment.

- Because of the “one-click” nature of the Tool, the Coastal Engineer/Scientist can use this to refine reach boundaries.
Analysis and Mapping Refinement
Analysis and Mapping Refinement

- As in the process above, use the Greater-Than Equal-To approach to find variable depths
3D Visualization
Conclusion

• Good cost-benefit ratio for creating Tool
• With the basic input of the 3 data elements, the Tool can be run repeatedly, during analysis and to prepare mapping.
• Anticipate traditional mapping tasks during analysis; increase efficiency during both analysis and mapping.
• Provide regulatory inputs for FEMA non-regulatory products
Questions?

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