Leveling Up

Partnering with USACE HEC to Enhance Model Functionality

Texas General Land Office • Commissioner Dawn Buckingham, M.D.

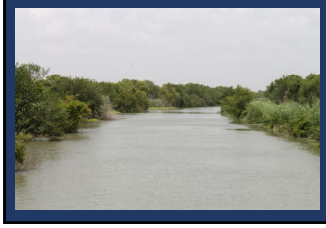
Community Development & Revitalization

Agenda

- River Basin Flood Studies (RBFS) Background:
  Modeling to Enable Communities
- USACE & GLO Coordination: Recognizing Opportunities, HEC Enhancement Process, and Enhancements Introduced by USACE
- HEC Software Enhancements Introduced by GLO RBFS Vendors
- Conclusion and Takeaways

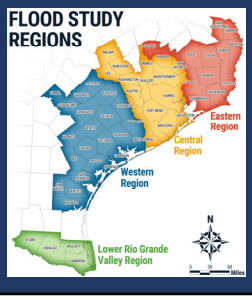
River Basin Flood Studies

Modeling to Enable Communities



Stephen McDonald
Program Manager | Texas GLO

RBFS Overview



Goals
- Leverage existing data and flood risk information
- Accurately model and evaluate flood risks
- Assist communities in developing cost-effective flood mitigation strategies
- Determine potential funding sources for mitigation projects

Benefits
- Builds on data and projects communities may have already identified
- Supports planning and feasibility studies for local and regional risk reduction projects
- Increases community disaster resilience

Delivery Partners

Texas A&M AgriLife Extension · TXGLO · FEMA · National Weather Service · Texas Water Development Board · Texas Department of Transportation · TNRIS · US Army Corps of Engineers · NOAA · USGS science for a changing world · Texas Division of Emergency Management

Strategic Framework

USACE & GLO Coordination

Recognizing Opportunities, HEC Enhancement Process, and Enhancements Introduced by USACE

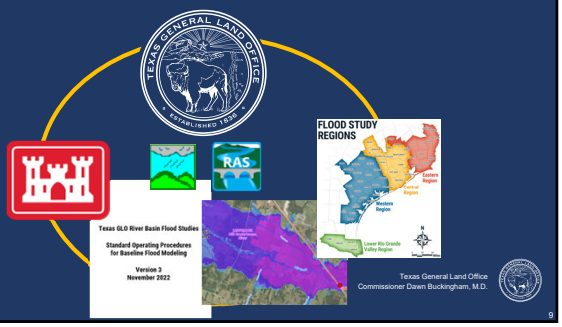
Molly Ross, EIT, CFM
H&H Engineer | USACE Galveston District

USACE & GLO Coordination

Early Stages

- USACE has a history of successful interagency coordination
  - InFRM, Harvey Inundation Mapping
- Opportunities identified to improve technical approach
  - Under contract in 2020
  - Early collaboration resulted in Minimum Modeling Standards developed by USACE for GLO flood planning studies

USACE & GLO Coordination



Slide 7

EEL0 May change subtitle based on updates to Slides 13-16.
Levitz, Elizabeth, 2023-03-02T15:36:07.523

Recognizing Opportunities

Enhancing tools and improving process

- Problems
  - Time-consuming manual processes
  - Likelihood of errors with manual processing and workarounds
  - Significant external processing of source data results in model review challenges
- Opportunities
  - Simplifies model review if process is built-in
  - Can keep source data with model, simplifies updating with new source data
  - Likelihood of continued and repeated use
  - Potential cost savings
    - Initial development cost will be higher
    - Repeated use on future projects will pay off

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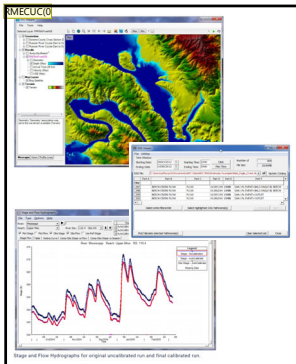

Stage and Flow Hydrographs for original uncalibrated run and final calibrated run.

Figure Source: https://www.hec.usace.army.mil/confluence/hecdocs/reservoir-training/latest

USACE Goals

Making the development of flood data more:

- **Accurate**
  - Improving confidence in analysis
  - Adding new functionality that improves analysis
- **Usable**
  - User interface improvements
  - Process improvements for data entry and mapping
- **Affordable**
  - Speed improvements for the engine
  - Avoiding costly workarounds

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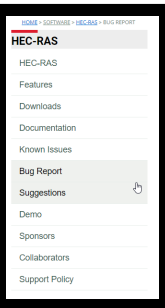
Road to Improvement

Initiating HEC Enhancements

- Project funded
- Highly requested enhancements are prioritized
- Process is entity dependent
  - Agreements with USACE Districts
  - Interagency Agreements (IAA) with other Federal Agencies
  - Memorandum of Agreements (MOA) with State or Local Entities
  - Private entities through Floodplain Management Services (FPMS) or WRDA 1988 Section 318
- Suggestion "Box" and Bug Fixes

HEC-HMS Link https://www.hec.usace.army.mil/software/hec-ras/bug_report.aspx
HEC-RAS Link - https://www.hec.usace.army.mil/software/hec-hms/bug_report.aspx



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Slide 11

RMECUC(0 Added a few figures
Ross, Molly E CIV USARMY CESWG , 2023-03-02T19:41:58.576

Slide 12

EEL0 Considering dropping this slide.
Levitz, Elizabeth, 2023-03-02T15:41:03.479

RMECUC(1 Suggest keeping but adjusting slide content to review HEC enhancement process (as shown).
Ross, Molly E CIV USARMY CESWG , 2023-03-02T18:53:41.291

HEC Software Enhancements

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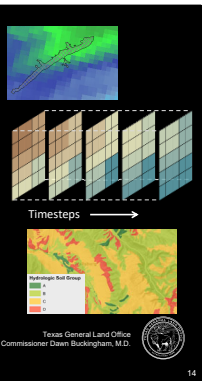
Spatial Precipitation and Infiltration

Introduced by USACE and funded by GLO

- Need: Variable precipitation within 1D and 2D models
- Approach: Grids or interpolation from points of precipitation time series and loss parameters
- Previously not possible, no workarounds
- New feature for HEC-RAS 6.0
- See HEC-RAS 6.0 Release Notes
  - Major Improvements Item 1
  - Spatial Precipitation and Infiltration for 2D, SA, and XS



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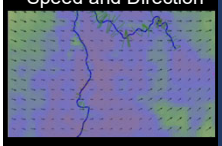
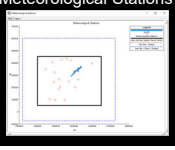
Gridded Wind Speed and Direction



Interpolating from Meteorological Stations



1D and 2D Wind Forces

Introduced by USACE and funded by GLO

- Need: Coastal water elevation changes due to wind effects
- Approach: Gridded wind speed/direction data or gaged data interpolated between meteorological stations
- Previously not possible, no workarounds
- New feature for HEC-RAS 6.0
- See HEC-RAS 6.0 Release Notes
  - Major Improvements Item 5
  - Wind forces to HEC-RAS 1D and 2D

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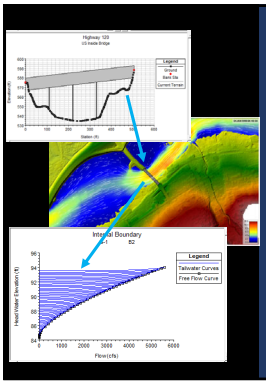

2D Bridge Hydraulics

Introduced by USACE and funded by GLO

- Need: Bridge calculations within a 2D area
- Approach: Bridge data entry similar to 1D. Hydraulics calculations using a family of curves that alter the 2D face flow.
- Limited workarounds to model the bridge as a culvert
- New feature for HEC-RAS 6.0
- See HEC-RAS 6.0 Release Notes
  - Major Improvements Item 2
  - Bridge hydraulics inside a 2D area

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HEC Software Enhancements

Introduced by GLO RBFS Vendors

Anthony Holder, PE, CFM
Civil Engineering
Discipline Lead | AECOM

Garrett Johnston, PE, CFM, GISP
Central Texas Stormwater Group
Manager | Freese and Nichols, Inc.

Cindy Engelhardt, PE, CFM
Water Resources Deputy Practice
Leader | Halff Associates, Inc.

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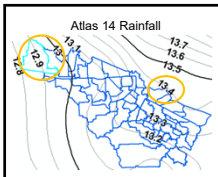

Gridded Precipitation Calculator

Introduced by GLO RBFS Vendors and funded by GLO

- Need: Variable rainfall across large model domains
- Approach: Frequency Storm depths by subbasin from a grid
- Previously possible only outside HEC-HMS
- Based on features already present in HEC-HMS
- Import depth rasters (e.g., 100-yr/5-min through 100-yr/24 hr)
  - Atlas 14 ASC grids work
- Spatial average from depth rasters
- See HEC-HMS 4.10 Release Notes
  - Frequency Storm Enhancements

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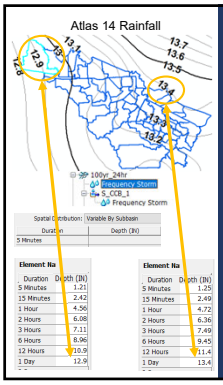

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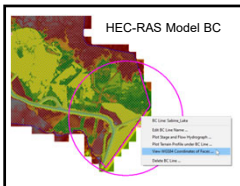
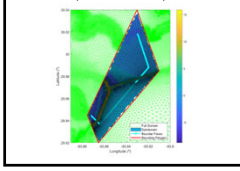




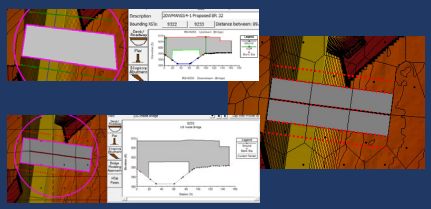
Spatially Variable Boundary Condition

Suggested by RBFS Vendors

- Need: Non-uniform boundary conditions especially for coastal modeling
- Approach: Create multiple time series along the BC at selected points. Interpolate WSE between those points.
- Workaround would be to create multiple boundary conditions
- Introduced in HEC-RAS 6.3
- See HEC-RAS 6.3 Release Notes
  - Spatially Varied Downstream Boundary Conditions
  - USACE developed scripts to extract from ADCIRC results.

2D Bridge Import from 1D

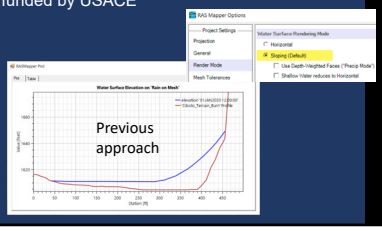
Introduced by GLO RBFS Vendors and funded by USACE



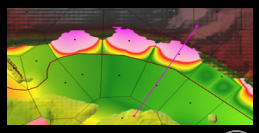
- Need: Conversion of existing 1D model to 2D
- Approach: Delete the 1D River and XS associated with the bridge in RAS Mapper. HEC-RAS will create a 2D Connection with much of the basic bridge data upon saving.
- Previously a completely manual process
- Introduced in HEC-RAS 6.3
  - Still needs manual editing of converted bridge.
- See HEC-RAS 6.3 Release Notes
  - Minor Improvements Item 27

Mapping Improvements

Introduced by GLO RBFS Vendors and funded by USACE



- Need: Mapping consistency at edge of floodplains, especially in ROM models.
- Approach: Weight adjacent cell WSE based on depth across cell faces
- Workaround would be mapping outside of HEC-RAS
- Introduced in HEC-RAS 6.2
- See HEC-RAS 6.2 Release Notes
  - Major Feature 2: Inundation Mapping – Render Mode Improvements



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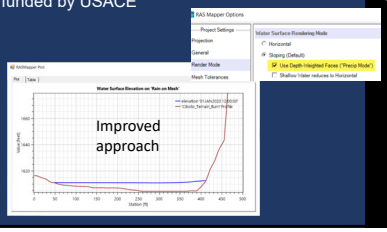
Mapping Improvements

Introduced by GLO RBFS Vendors and funded by USACE



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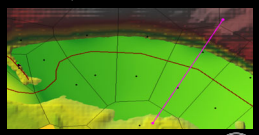

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Conclusion and Takeaways

- **Partnership and open collaboration yields multiplied benefits**
  - Unique perspectives from GLO, USACE, vendor firms
  - Baseline modeling SOP and pilot studies
  - Robust, relevant software, technical approaches, and guidance documents
  - Many beneficiaries including GLO, USACE, Texas communities, and the worldwide community of HEC software users

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Slide 22

EEL0 Was this introduced through GLO RBFS? - Asked by Garrett or Anthony.
Levitz, Elizabeth, 2023-03-02T15:54:32.213

HA0 0 Landon indicates that GLO vendors suggested this. I know AECOM is working on this concept for FEMA, but as post-processing as part of the FIS mapping. Landon did not state which vendor suggested it.
Holder, Anthony, 2023-03-06T05:20:27.105

CS0 1 Friendly reminder to always say GLO RBFS Vendors made suggestions. Please do not identify individuals or individual firms.
Castillo, Stephanie, 2023-03-06T15:41:02.291