The Mighty Mississippi:
Development of Mighty 2D Models
Introduction

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Background
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Purpose of Study

• Develop regional hydraulic models on Red River and Black River in LA

• Determine natural valley flood extents in areas with de-accredited levee systems

• Establish basis for future LAMP studies with regional H&H data
What is LAMP?

• Levee Analysis and Mapping Procedures for Non-Accredited Levees (LAMP)

• 5 Procedures outlined in the LAMP Final Approach Document
  • Natural Valley
  • Sound Reach
  • Freeboard Deficient
  • Overtopping
  • Structural-Based Inundation
Non-Accredited Levee Systems

- Concordia-Black River Levees
- Lake Larto Ring Levee
- Louisiana Delta Plantation Levee
- Vick Levee
- Brouillette Levee
- Atchafalaya River Levee
- Red River East and West Bank Levees
Model Selection Considerations

• FEMA FIS does not have a detailed study in the region. BFEs from gage frequency analysis.

• USACE previously developed models were developed for conveyance between the levees.

• Natural Valley analysis needed for flat Mississippi River Delta
Mississippi Backwater Areas

- Loss of flood storage with construction of Mississippi River West Bank Levee
- Backwater areas naturally occur where gaps in levee occur near tributaries
- 1941 Flood Control Act authorized plan to protect Red River back water area.
Model Selection Considerations

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June 23, 2016
Model Selection Considerations
What Causes a Significant Flood?
What Causes a Significant Flood?

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Hydrograph Development
Model Inflow
Initial Model Setup

• Initial model run time was over 4 days.
• Time to open model and make edits took over 1 hour.
• Needed to develop model that would run significantly faster.
• Initial grid was rectangular covering approx. 4,300 square miles.

• Developed boundary for 2D region and clipped grid to boundary reducing to 1,530 square miles. Almost $3\times$ smaller.
Grid Data

- Terrain grids for Natural Valley simulations were reduced further by clipping to levees not in system
Land Use

- Began using the NLCD 2011 dataset in shapefile format converted from raster.
Land Use

• Switched to a more generalized dataset by using the 1980 GIRAS.

• Reduced vertices in database by almost 15x.

• This alone fixed the long wait times to open model. Now only 10 seconds.
Grid Size

- Experimented with several computational runs at various grid step sizes.
- Calibration runs were performed with largest grid step size without causing instability.
Computational Time Step

- Input hydrographs varied from 50 to 100 days.
- Computational time steps played a dramatic role in model run time with excessive hydrograph lengths.
- Time steps were adjusted to larger values as long as model remained stable.
- 1D – 1 hour, 2D – 30 seconds
- Output time steps also increased, 2D – 1 hour.
Hot Start Files

• Flood Hydrographs for large watersheds are relatively long in duration.

• Using hot start files were successful in reducing the model duration by only modeling peak time frame.
Hot Start Files

• Hydrograph duration reduced by a minimum of 30%
Conclusions

• Large scale modeling begins to tax your computer hardware and software.

• Methods can be implored to reduce model computation time.

• Can these generalized modeling methods be used to develop detailed FIS studies?
Questions