Session 21

Mark Gosselin

Ocean Engineering Associates, Inc.

Coastal Contraction Scour Study of Jensen Beach Blvd. Bridge

Topic Description

One component of bridge scour is contraction scour. There is guidance in the FHWA HEC-18 for estimating design contraction scour depths for simple geometry riverine situations. These methods are difficult to apply for complex boundary and flow conditions. Results from a study that compares contraction scour estimates using HEC-18 methods and those using a sediment transport model (SED2D) at a coastal bridge site are presented along with measured data.

Speaker Biography

Mark Gosselin is the Vice President of Ocean Engineering Associates Inc. He is an accomplished Coastal Engineer, Hydraulic Modeler, and Wave Modeler. Mark graduated from Dartmouth College with a Bachelors degree, earned his Masters degree from University of California at Berkeley in Naval Architecture, and earned a Ph.D. from the University of Florida, Department of Coastal Engineering. Mark is a registered Professional Engineer in Florida and Louisiana.

Session 21

Tom Glasser

Ocean Engineering Associates, Inc.

Coastal Contraction Scour Study of Jensen Beach Blvd. Bridge

Topic Description

Coastal Contraction Scour Study of Jensen Beach Blvd. Bridge:
There is guidance in the FHWA HEC-18 for estimating design contraction scour depths for simple geometry riverine situations. There is little guidance for bridges in complex coastal waters. Results from a study that compares contraction scour estimates using HEC-18 methods and those using a sediment transport model (SED2D) at a coastal bridge site are presented along with measured data.

Speaker Biography

Max Sheppard is President of Ocean Engineering Associates, Inc. (OEA, Inc.) and Professor Emeritus in the Civil and Coastal Engineering Department at the University of Florida. His areas of expertise include: bridge scour, coastal hydraulics, sediment transport, coastal structures, and wave loading on coastal and offshore structures.

Jensen Beach Causeway Erosion Study

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Presentation Outline

- Motivation – Damage from 2004 Hurricane Season
- Compare Methodologies for Computing Contraction Scour
  - SED2D
  - Laursen equation
- Summary

2004 Hurricane Season

Hurricane Frances

Hurricane Jeanne

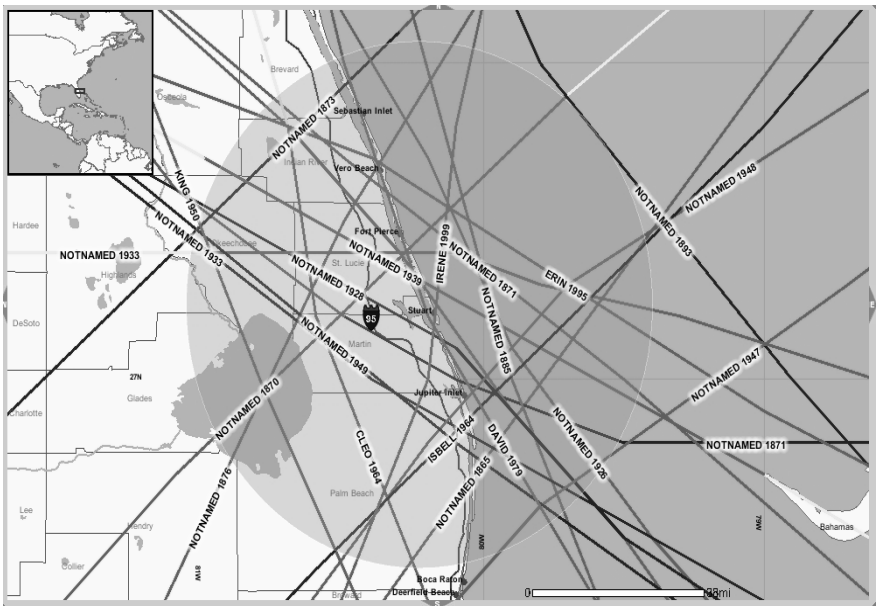
Jensen Beach Abutment

Procedure

- Review Hurricane History
- Hindcast Storms
- Perform Sediment Transport Modeling
- Compare with Laursen Equation
- Formulate Conclusions

Jensen Beach Hurricane History

- 1886 - 2003
  - 23 Hurricanes passed within 50 miles
  - 2 category 4
  - 4 category 3
- 2004
  - Hurricane Frances ~ 105 mph
  - Hurricane Jeanne ~ 120 mph



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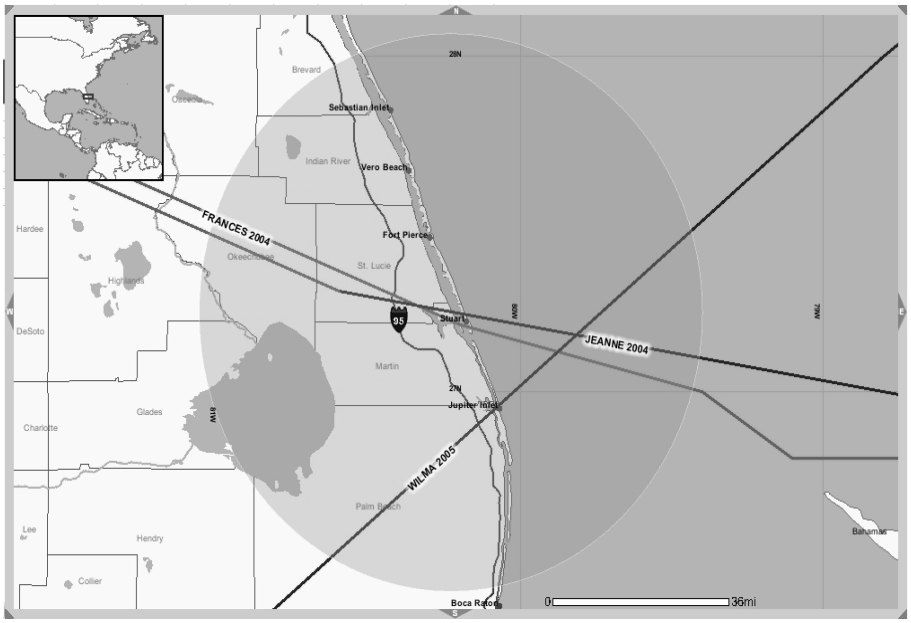

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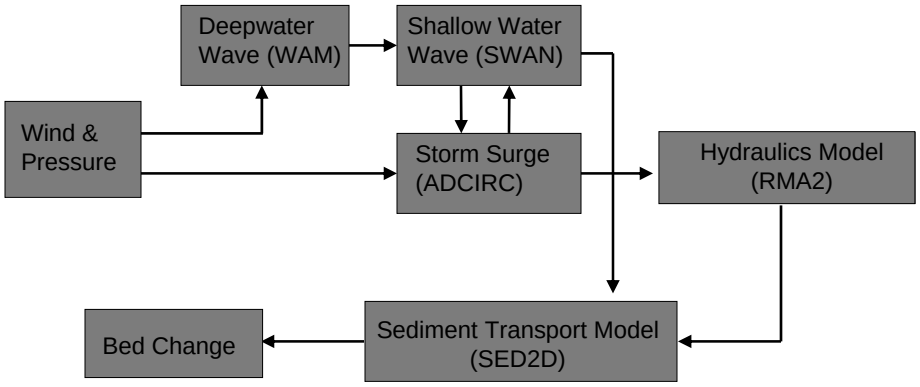
Extremal Analysis

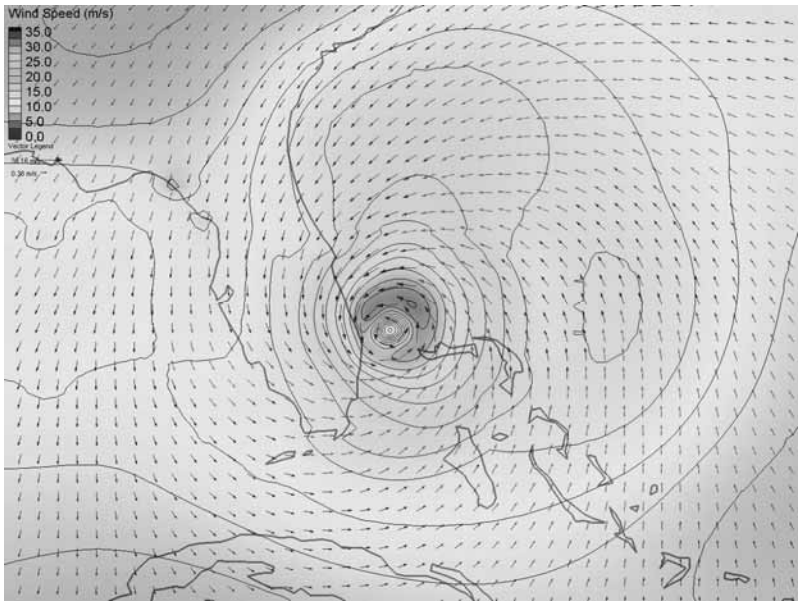
- Most Probable Extreme Values:
  - 100-year – 112 mph
  - 152-year – 116 mph
  - 200-year – 119 mph
  - 350-year – 125 mph
  - 500-year – 127 mph
- Frances (109 mph) < 100-year Storm
- Jeanne (121 mph) ~ 250-year Storm

Hindcast Modeling

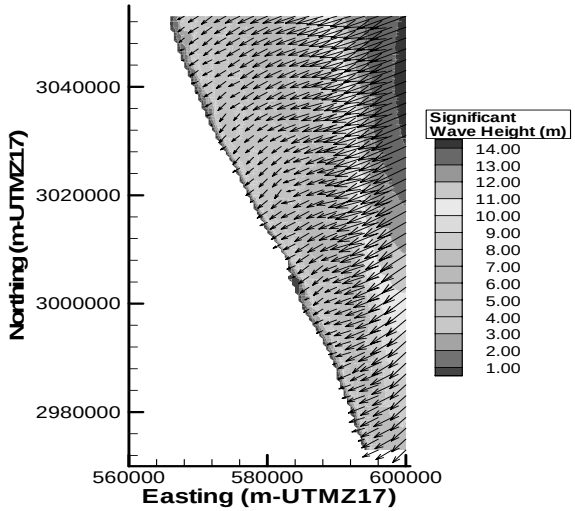
- Hurricane Wind and Pressure Fields from Oceanweather Inc.
- ADCIRC Model of the North Atlantic
- WAM of North Atlantic
- SWAN Model of Coastal Area
- RMA2 Model of Indian River Lagoon
- SWAN of Indian River Lagoon
- SED2D Model of the Area Near the Bridge

Modeling Procedure





Nearshore Waves for Frances



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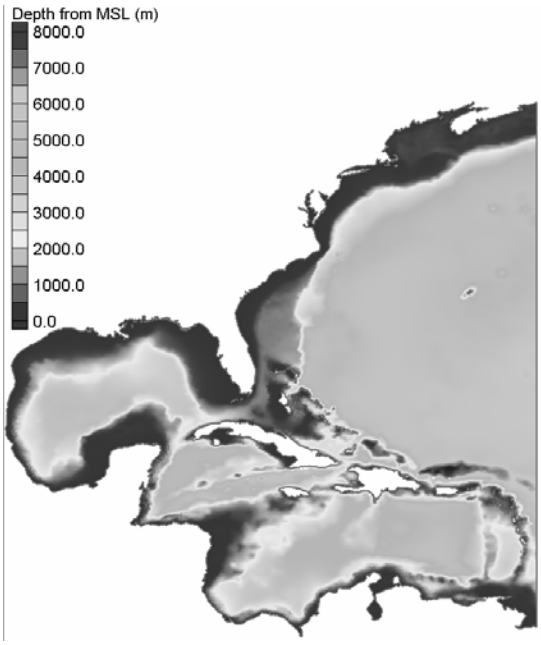

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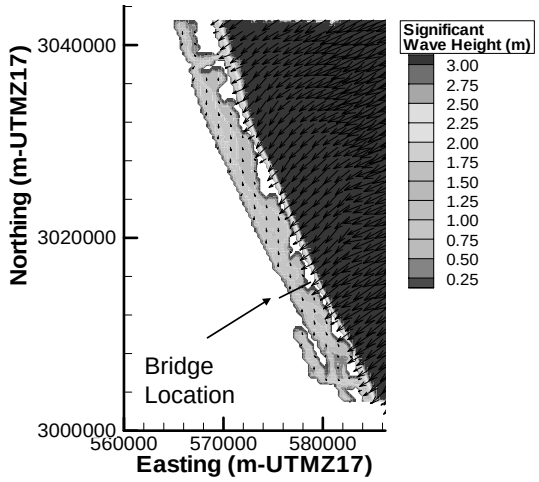
IRL Waves for Jeanne



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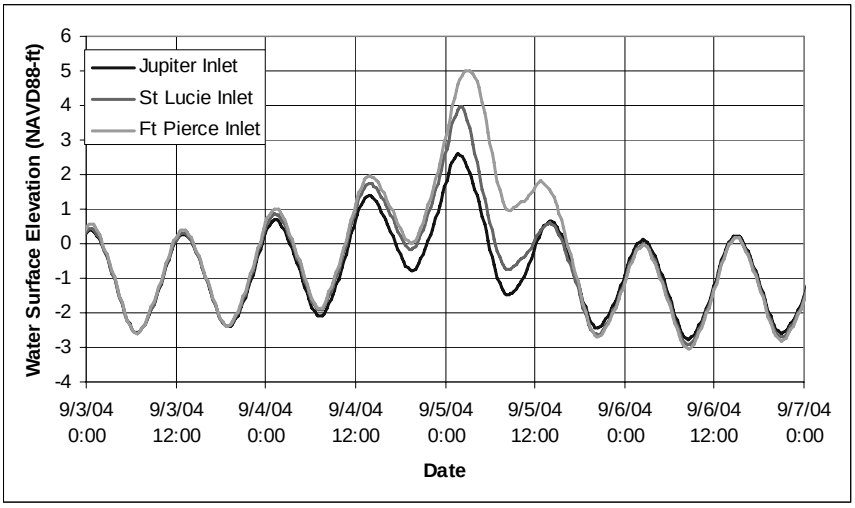
Hurricane Frances Hindcast



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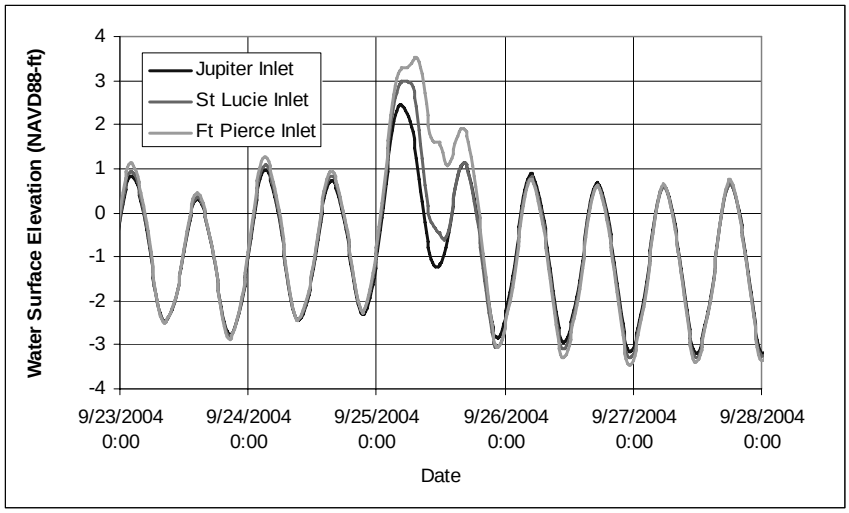
Hurricane Jeanne Hindcast



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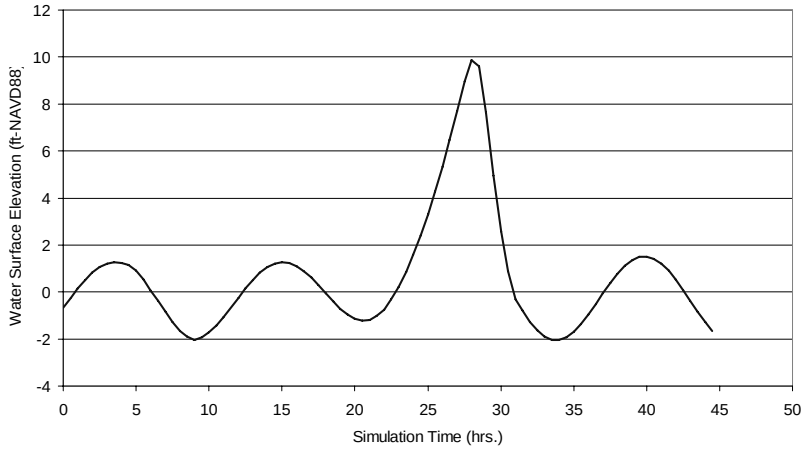
FDOT 100-Year Storm Surge



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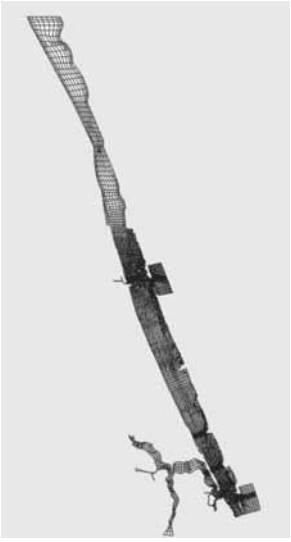
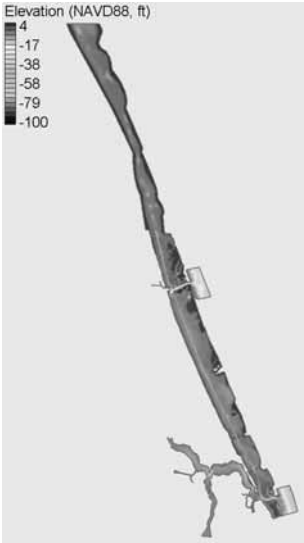
RMA2 Modeling





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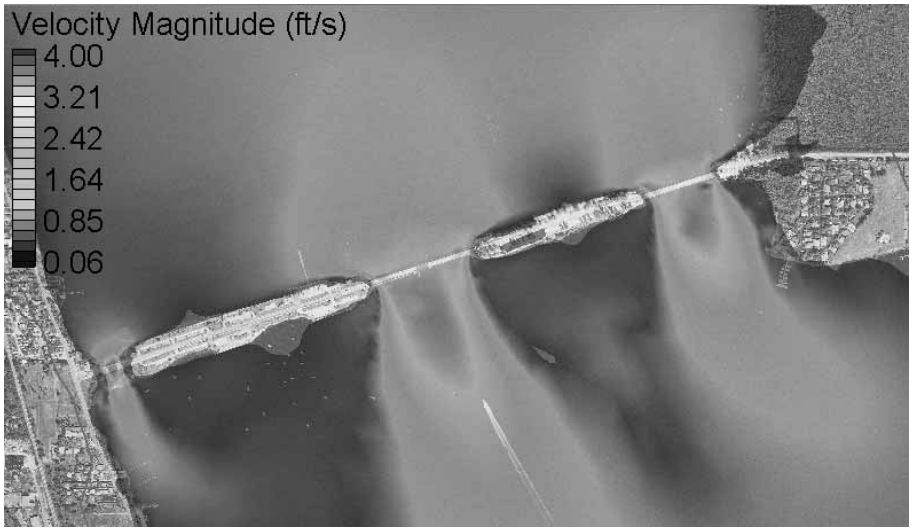

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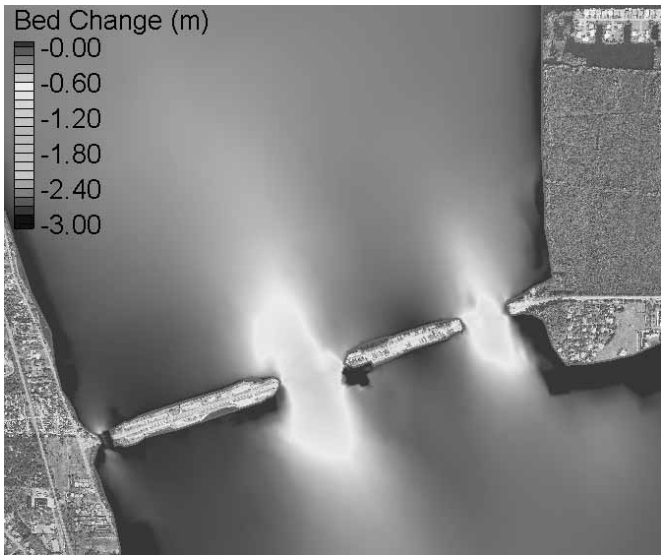
Contraction Scour

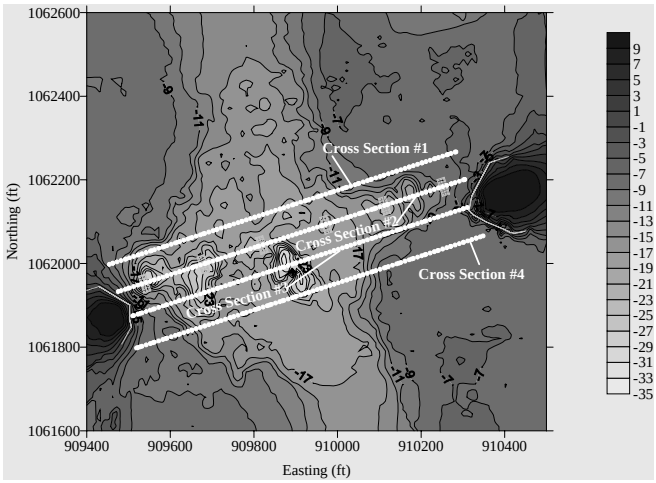
SED2D Simulations

- SED2D Modeling
  - Without Waves
  - Two-way Coupling
  - With Waves
- SED2D with Waves Provided Best Calibration with Measured Data

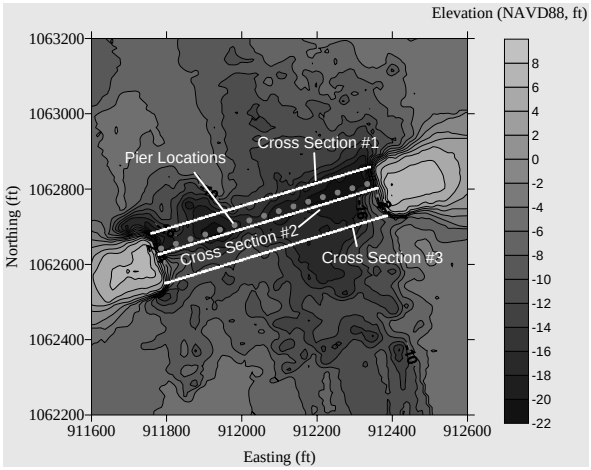
SED2D Results



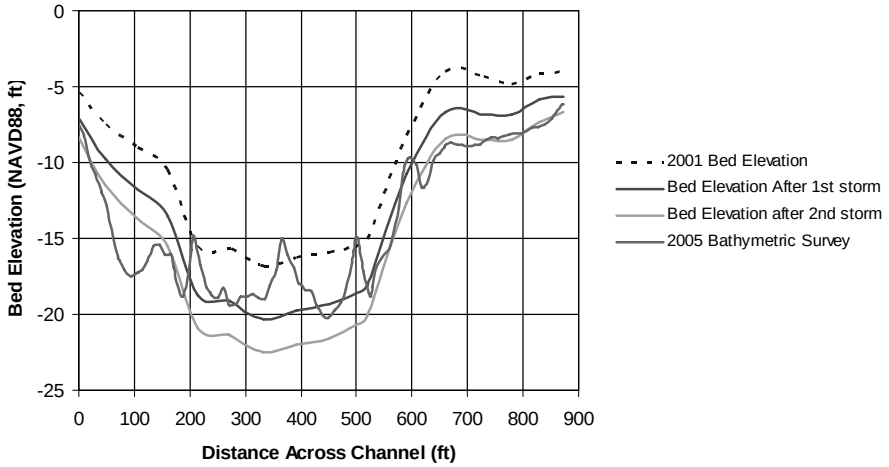
Main Bridge Cross Sections



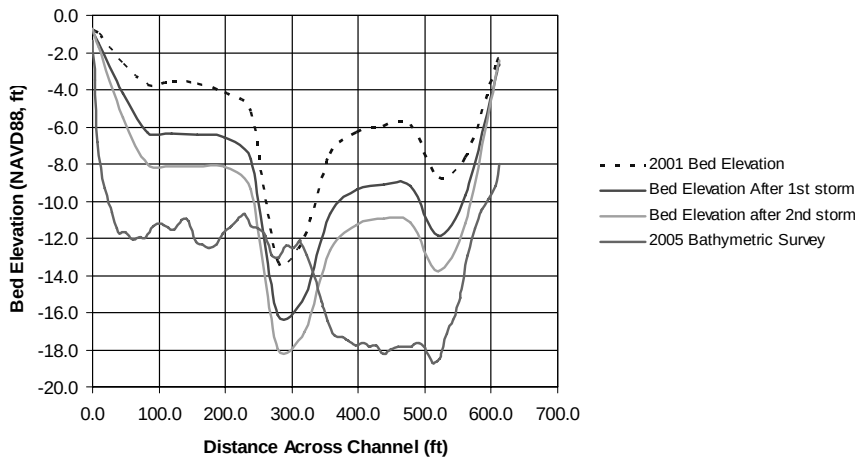
East Bridge Cross Sections



SED2D Results with Waves



SED2D Results with Waves



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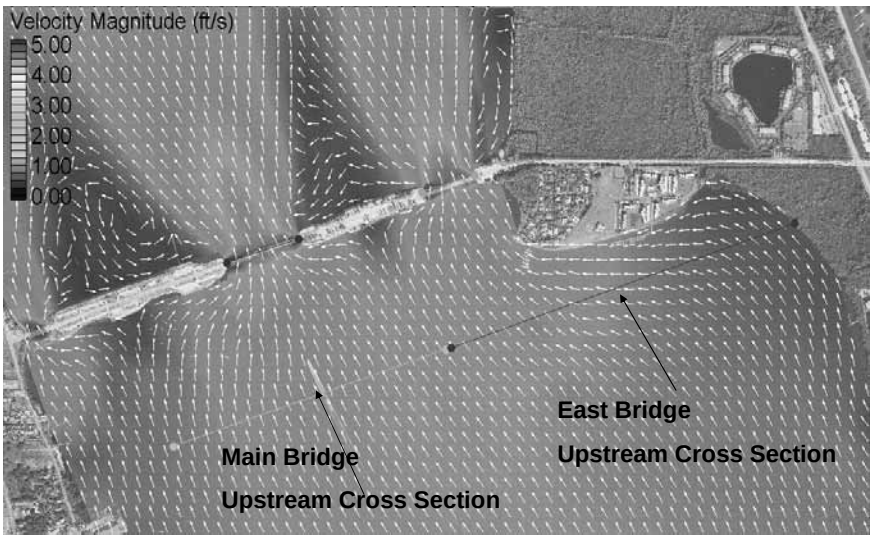
Laursen Equation



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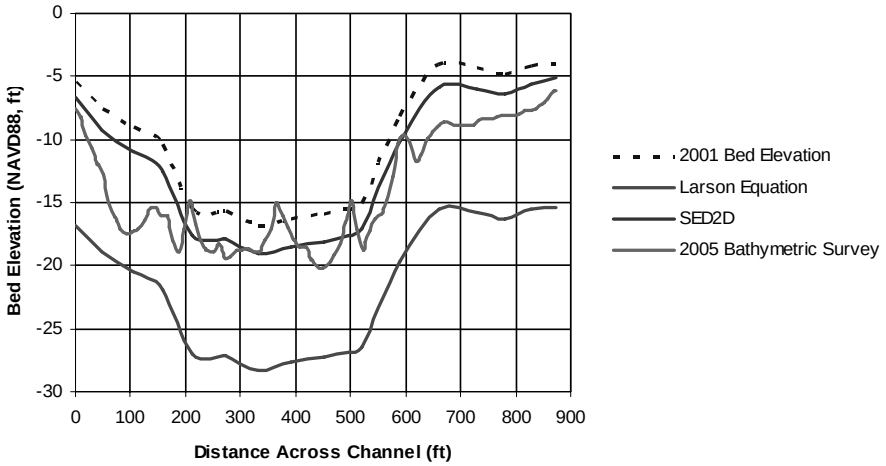
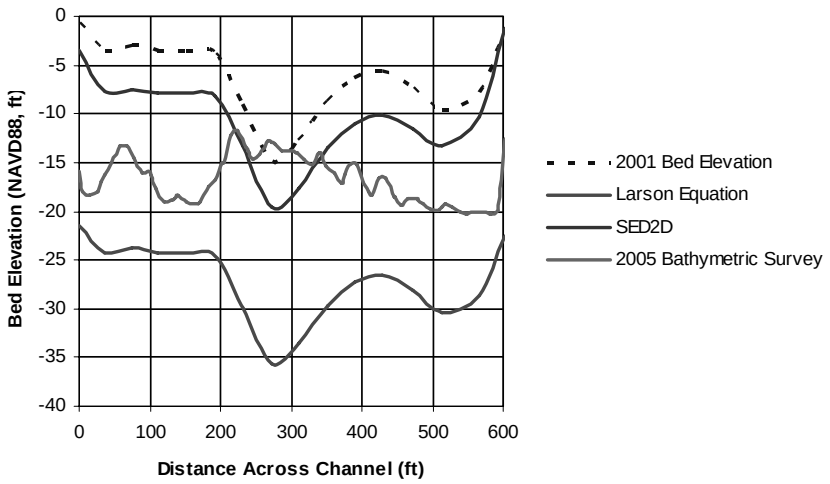
Laursen Contraction Scour

- Main Bridge
  - Live Bed Contraction Scour
  - 11.4 ft
- East Bridge
  - Clearwater Contraction Scour
  - 20.8 ft

Laursen Equation Results



Laursen Equation Results



Summary

- Waves Are Important
  - SED2D without Waves Under Predicts
  - SED2D with Waves Under Predicts at East Bridge
- Laursen Equation – Conservative Estimates
- Starting Bed Elevations Important
- Inlet Bathymetry Important

Summary Cont.

- SED2D Under Prediction at East Bridge
  - Resolution of Initial Bed Elevations
  - Evidence of Abutment, Toe, and Local Scour in Measurements
  - Wind Boundary Conditions

Questions, Comments

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