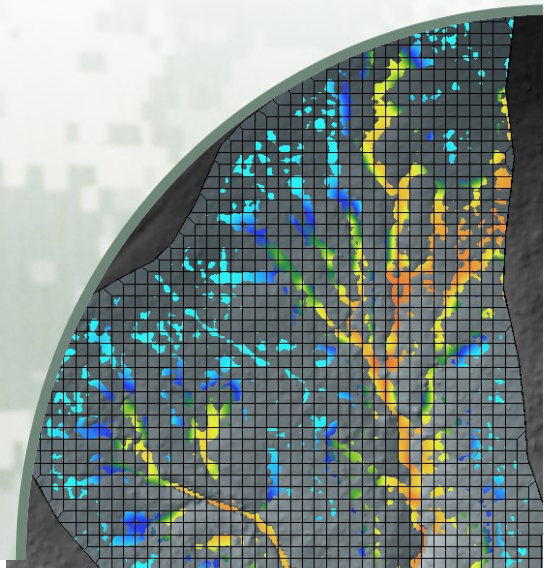
HEC-RAS 2D Sediment Workshop: Example Applications



Alex Sánchez, PhD
Stanford Gibson, PhD

Hydrologic Engineering Center,
Institute for Water Resources,
U.S. Army Corps of Engineers, U.S.A.

November 30, 2021

US Army Corps of Engineers®

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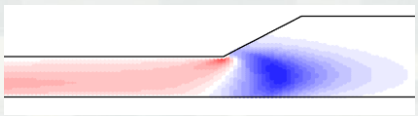
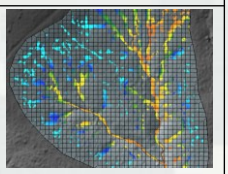
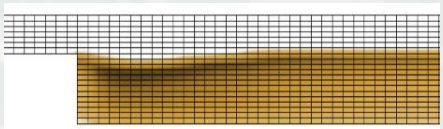
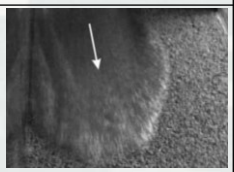
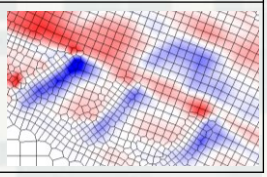
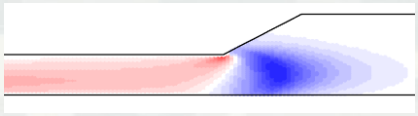
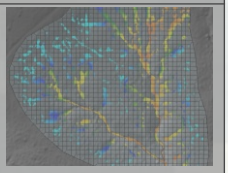
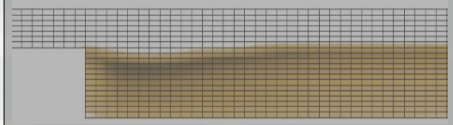
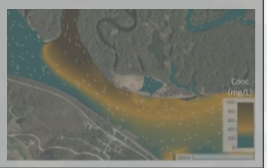
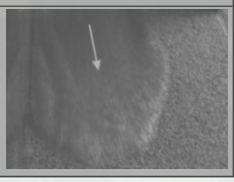
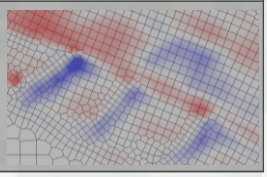
Example Applications

Laboratory Scale	Prototype Scale
Weise (Expansion Contraction Flume) 	Lucky Hills Study Site 
Floodplain Deposition Flume 	Chippewa Dredge Study 
Dam Break Non-Newtonian Flume Experiment 	Mississippi River 

2

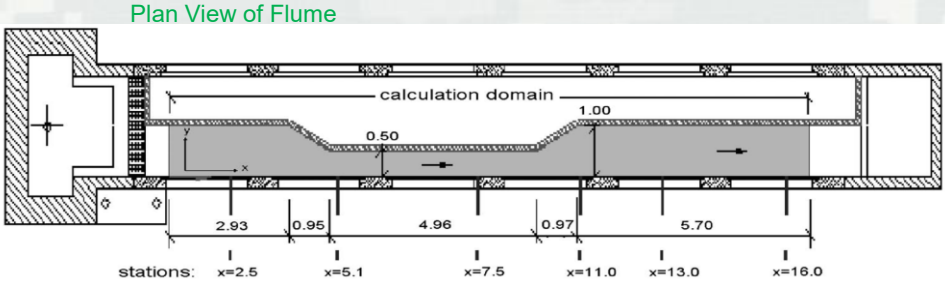
Example Applications

Laboratory Scale	Prototype Scale
Weise (Expansion Contraction Flume) 	Lucky Hills Study Site 
Floodplain Deposition Flume 	Chippewa Dredge Study 
Dam Break Non-Newtonian Flume Experiment 	Mississippi River 

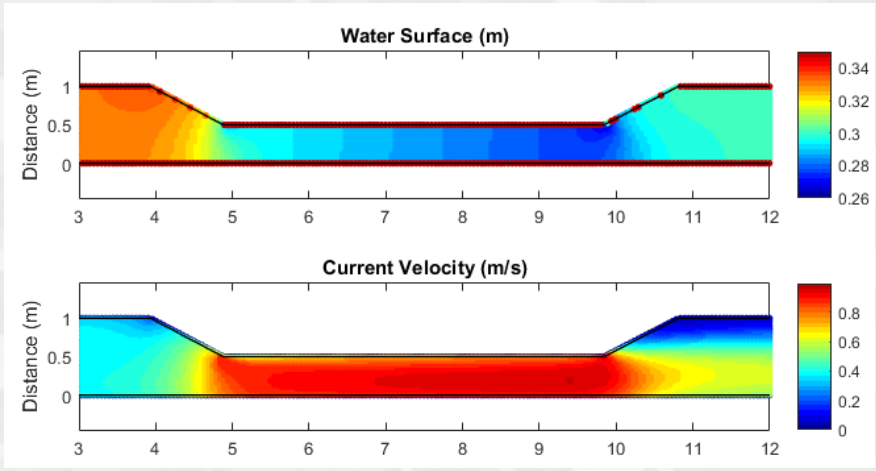
HEC-RAS 2D Sediment Validation: Flume Experiment of Weise (2002)

- Flow
  - Upstream flow: 150 l/s
  - Downstream depth: 0.312 m
- Sediment
  - Mean grain size: 5.5 mm
  - Geometric Standard Deviation: 1.47
- Duration:130 min

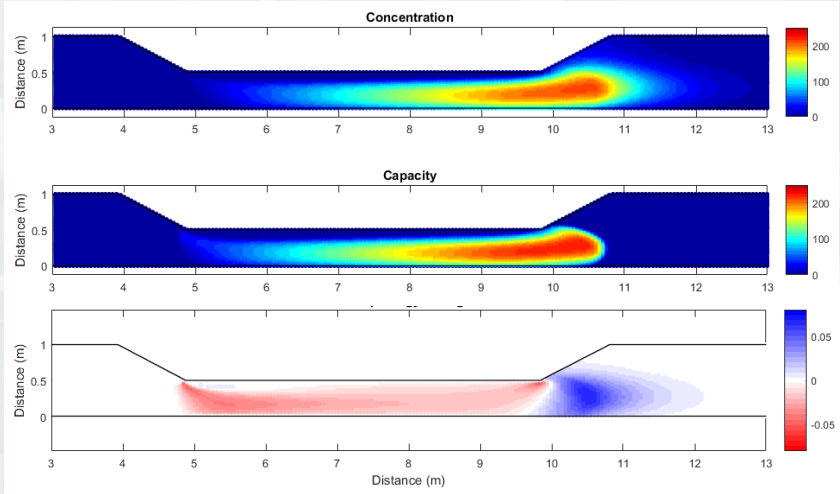
Plan View of Flume



Results: Hydrodynamics

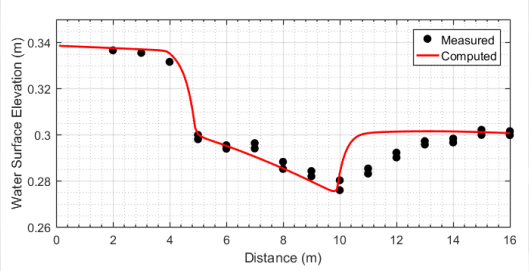


Results: Sediment Transport

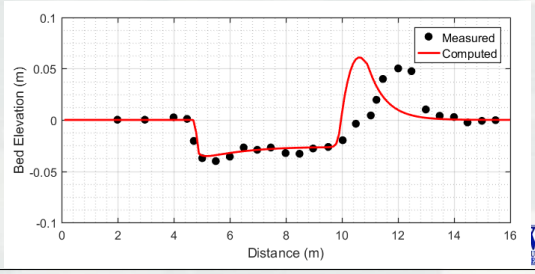


Results - Continued

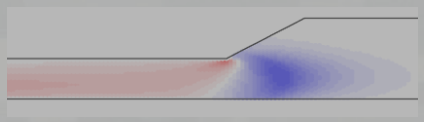
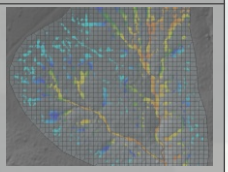
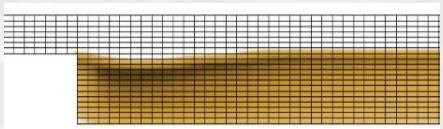
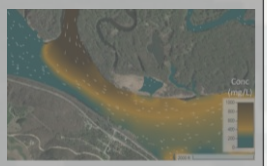
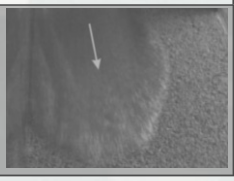
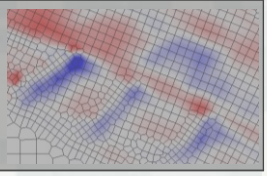
Averaged XS Water Level



Averaged XS Bed Change



Example Applications

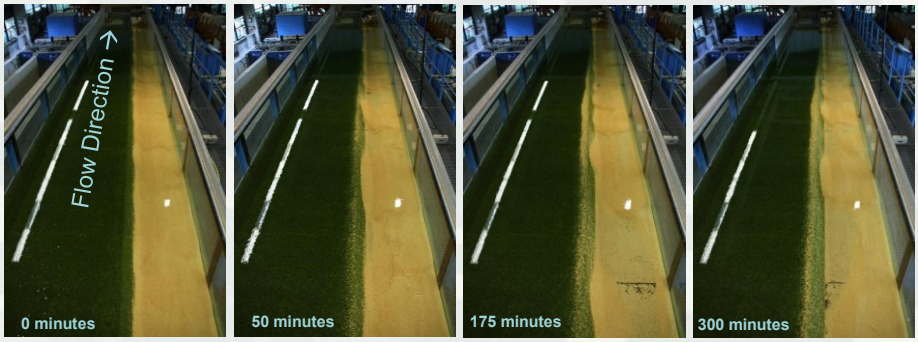
Laboratory Scale	Prototype Scale
Weise (Expansion Contraction Flume) 	Lucky Hills Study Site 
Floodplain Deposition Flume 	Chippewa Dredge Study 
Dam Break Non-Newtonian Flume Experiment 	Mississippi River 

Floodplain Deposition

River Flow 2016 – Constantinescu, Garcia & Hanes (Eds)
© 2016 Taylor & Francis Group, London, ISBN 978-1-138-02913-2

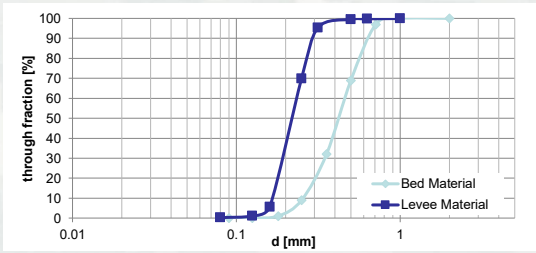
Reproducing natural levee formation in an experimental flume

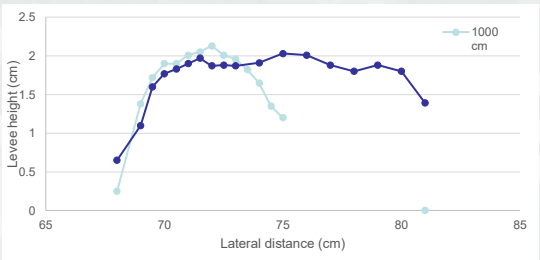
T. Branß, A. Dittrich & F. Núñez-González
Leichtweiß-Institut für Wasserbau, Technische Universität Braunschweig, Braunschweig, Germany



With Michael Mansfield (NWK)

Floodplain Deposition





With Michael Mansfield (NWK)

HEC-RAS 1D Model

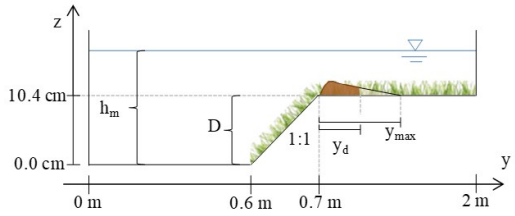
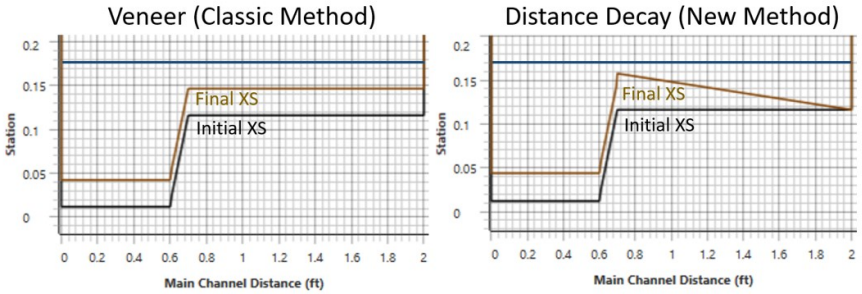


Figure 2. Floodplain Deposition Flume Experiments



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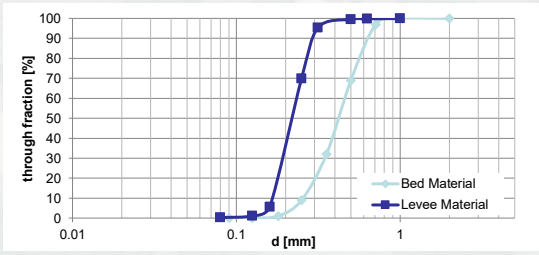
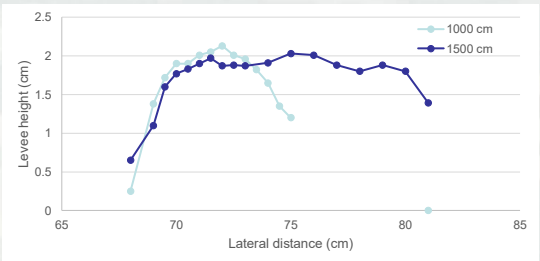
Floodplain Deposition





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Branβ *et al.* (2016) Floodplain Deposition Flume

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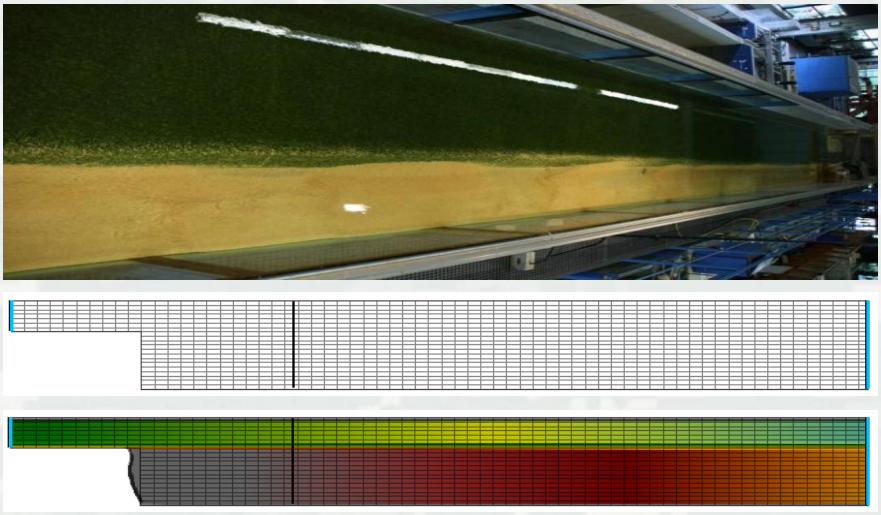
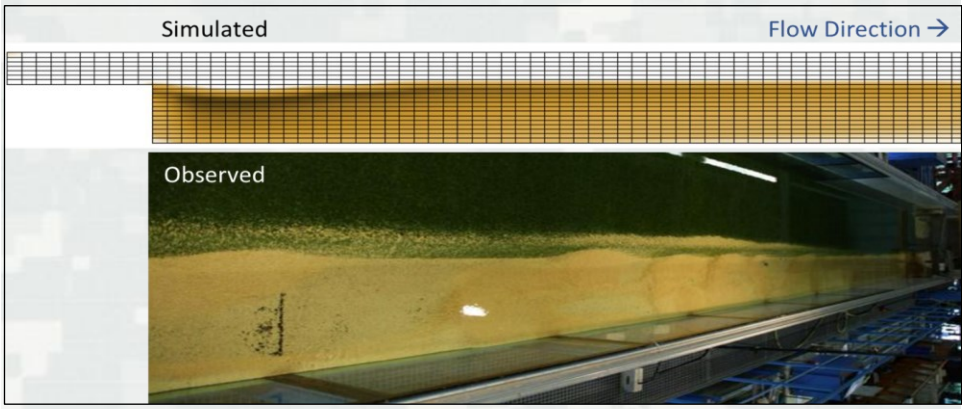
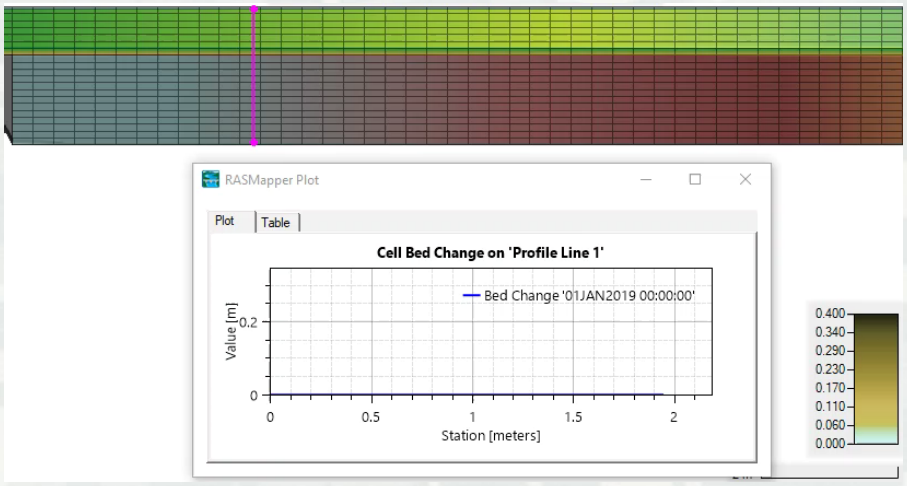
Floodplain Deposition



Floodplain Deposition



Floodplain Deposition



With Michael Mansfield (NWK)

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Branβ *et al.* (2016) Floodplain Deposition Flume

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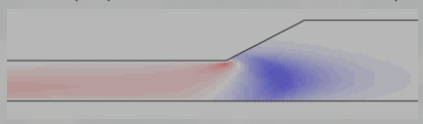
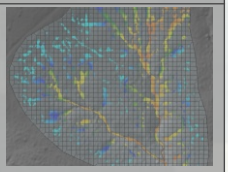
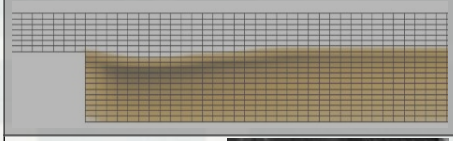
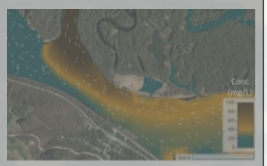
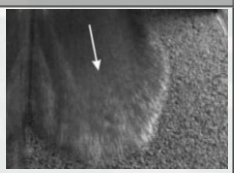
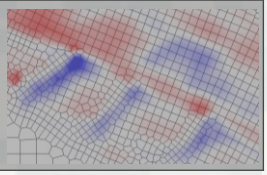
Example Applications

Laboratory Scale	Prototype Scale
Weise (Expansion Contraction Flume) 	Lucky Hills Study Site 
Floodplain Deposition Flume 	Chippewa Dredge Study 
Dam Break Non-Newtonian Flume Experiment 	Mississippi River 

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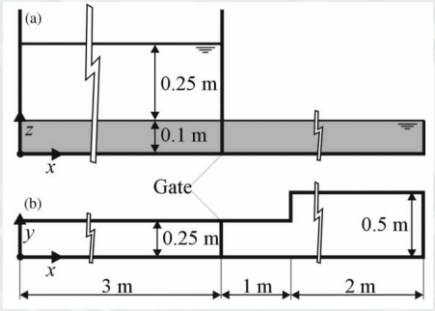
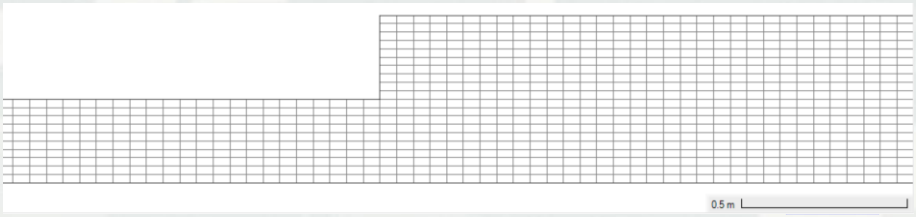
Lab Dam Break Experiment

- Université Catholique de Louvain (UCL)
- Gate opening: <0.1 s
- Median diameter: 1.72 mm
- Bed layer thickness: 10 cm
- Froude number: <3.8

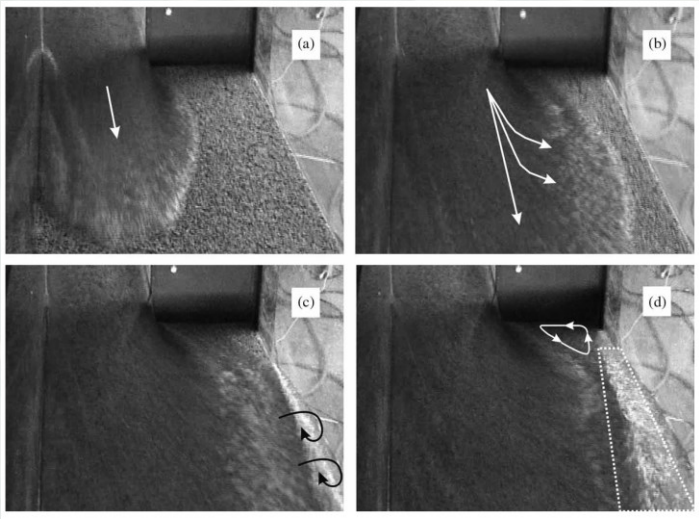


Model Setup

- Resolution: 5 x 2.5 cm
- Manning's n: 0.02 $s/m^{1/3}$
- Single grain class
- Diameter: 1.72 mm
- Transport potential: Wu et al.
- Fall velocity: Soulsby
- Hindered settling: Richardson and Zaki



Results



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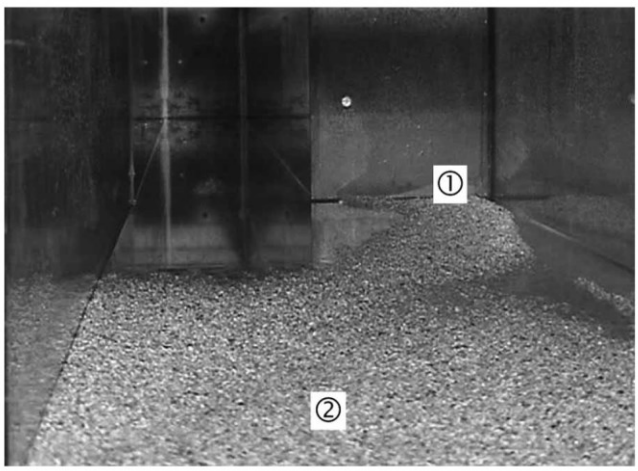
Lab Results



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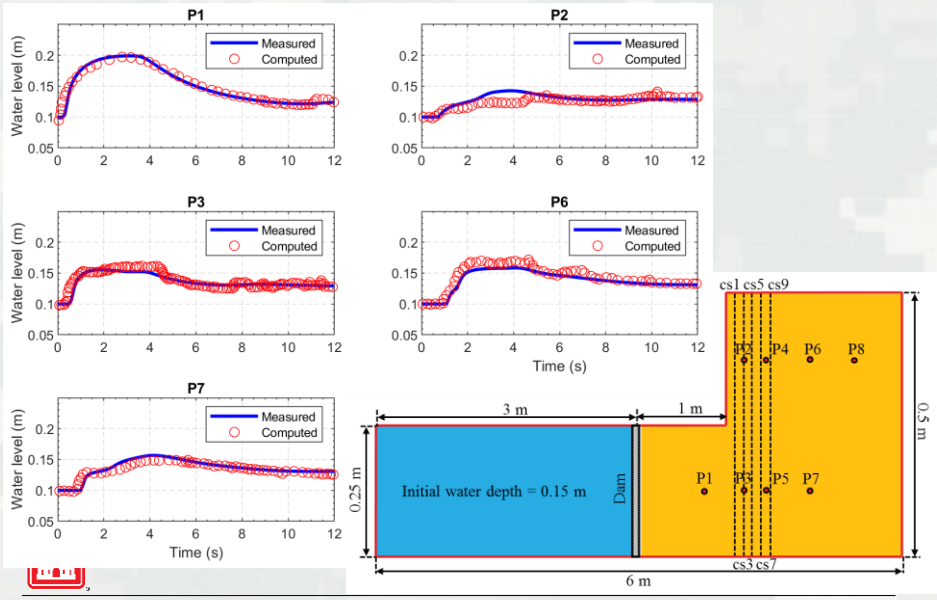
Water Levels



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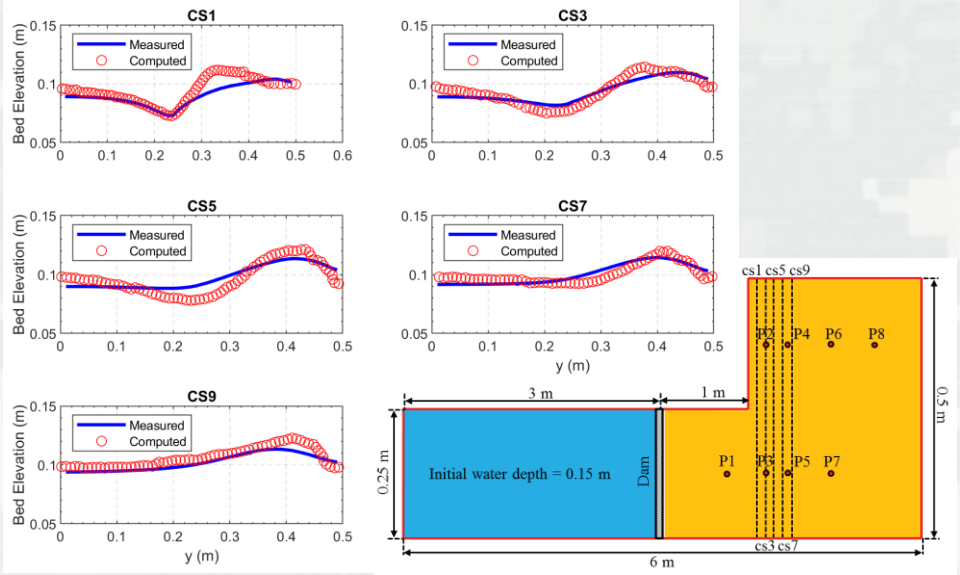
Bed Elevations



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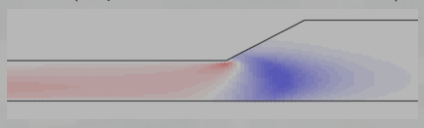
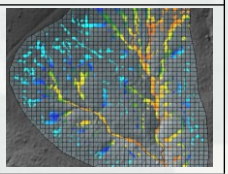
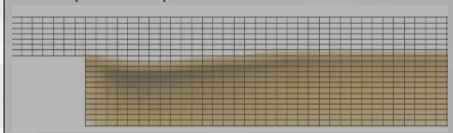
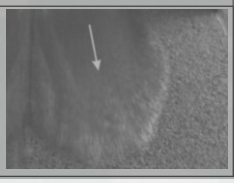
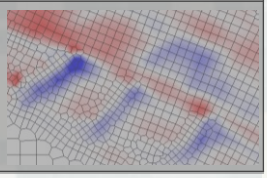
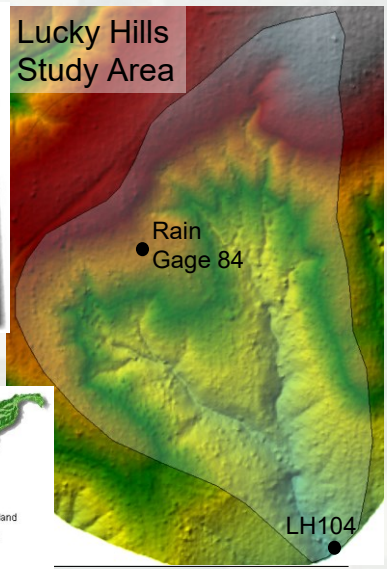
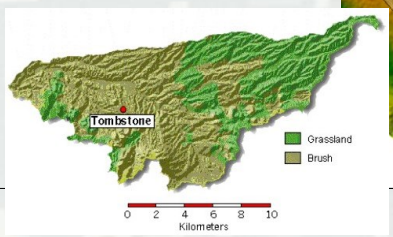
Example Applications

Laboratory Scale	Prototype Scale
Weise (Expansion Contraction Flume) 	Lucky Hills Study Site 
Floodplain Deposition Flume 	Chippewa Dredge Study 
Dam Break Non-Newtonian Flume Experiment 	Mississippi River 

Validation: Lucky Hills Study Site

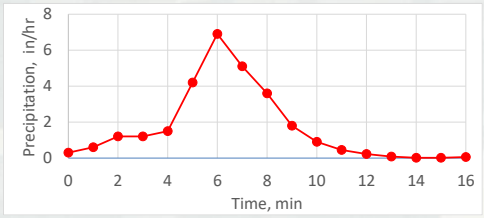
- USDA Walnut Gulch Experimental Watershed
- Area: ~1 ac
- Sandy Loam
- Cover
  - Rock: 67%
  - Basal: 5%
  - Litter: 5%

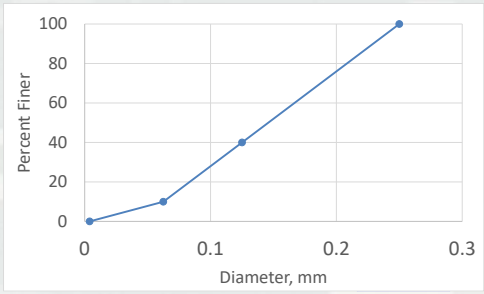




Model Setup

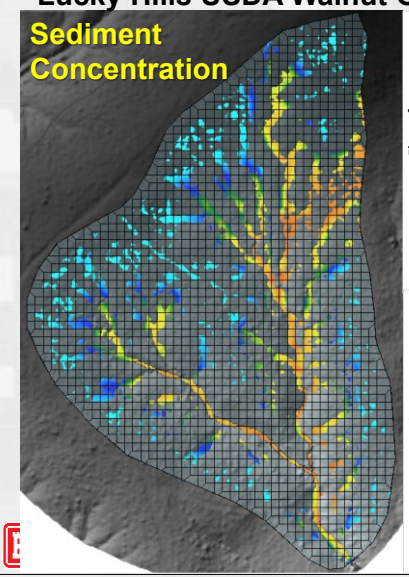
- Precipitation:
  - Gage 84
- Sediment
  - Yalin transport potential
  - Krone and Partheniades
  - Clay: 10%
  - Silt: 30%
  - Sand: 60%

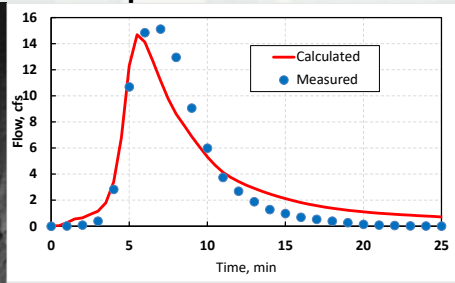


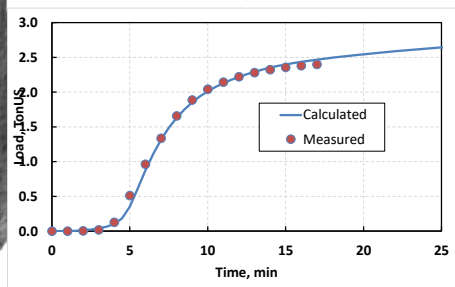


Results

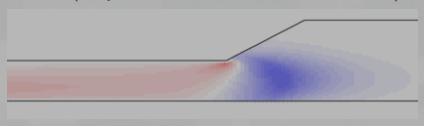
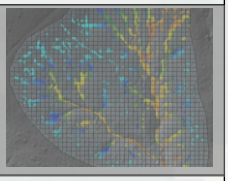
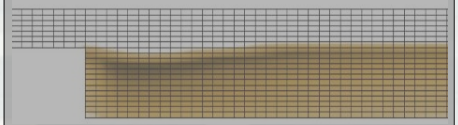
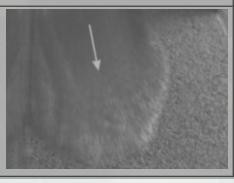
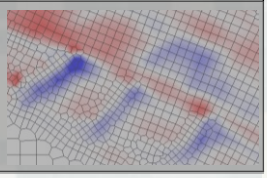
Lucky Hills USDA Walnut Gulch Experimental Watershed



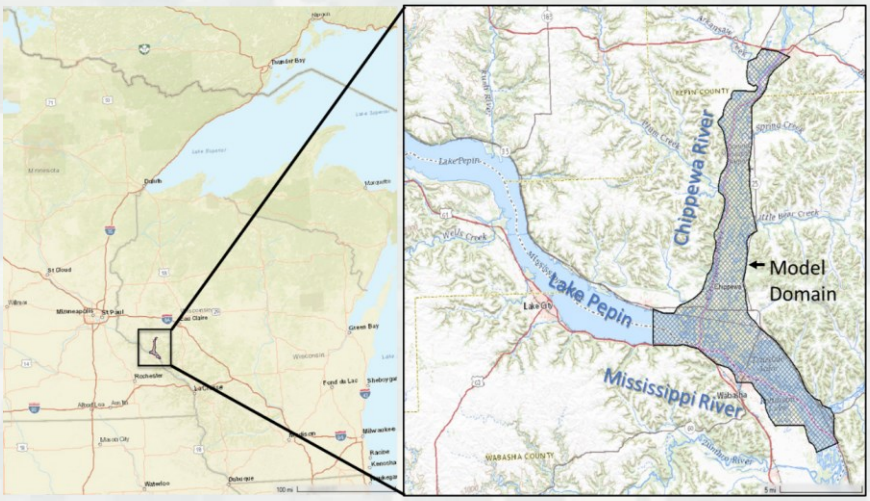




Example Applications

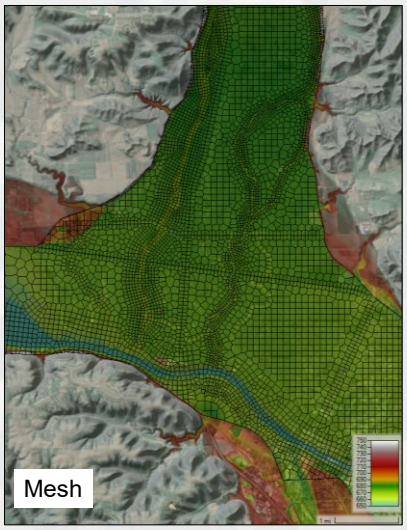
Laboratory Scale	Prototype Scale
Weise (Expansion Contraction Flume) 	Lucky Hills Study Site 
Floodplain Deposition Flume 	Chippewa Dredge Study 
Dam Break Non-Newtonian Flume Experiment 	Mississippi River 

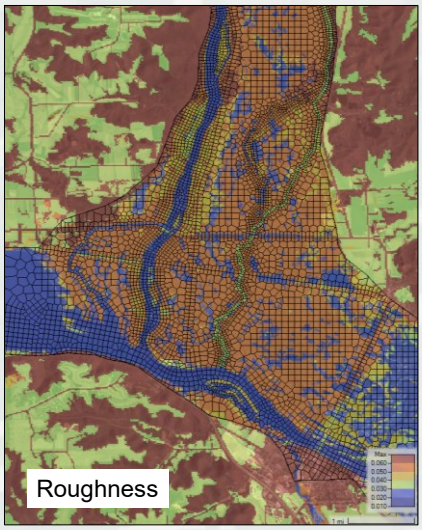
Chippewa River, Wisconsin



With Alex Nelson – St Paul District

Chippewa River, Wisconsin





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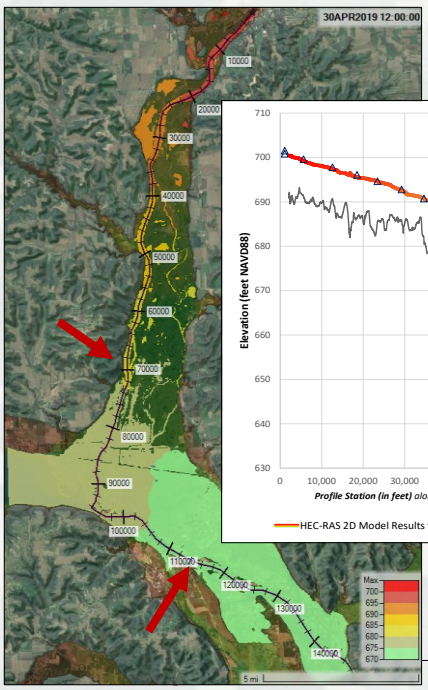
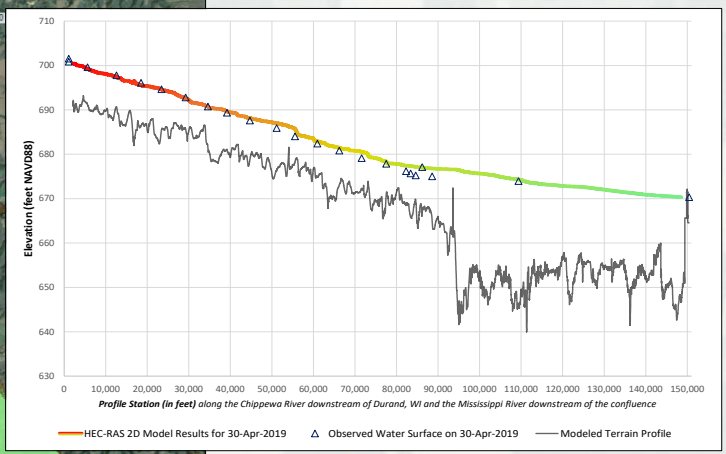


Hydraulic Calibration



Hydraulic calibration by Alex Nelson (MVP)

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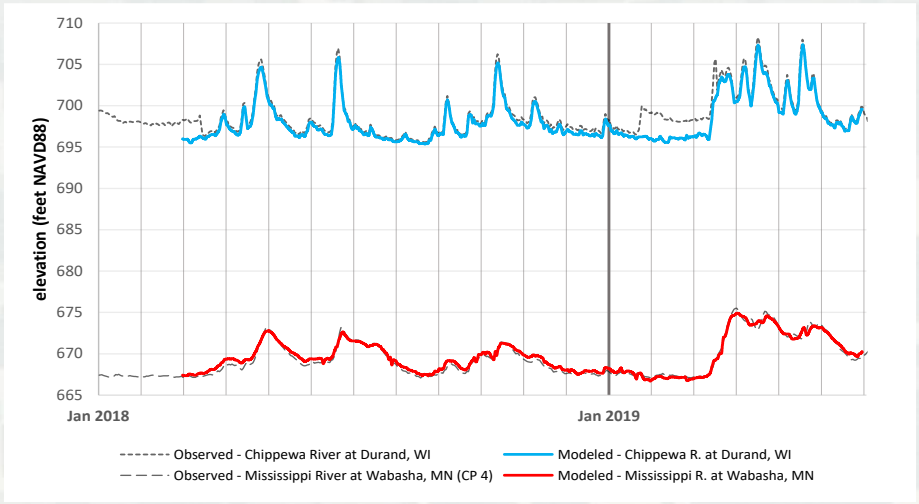
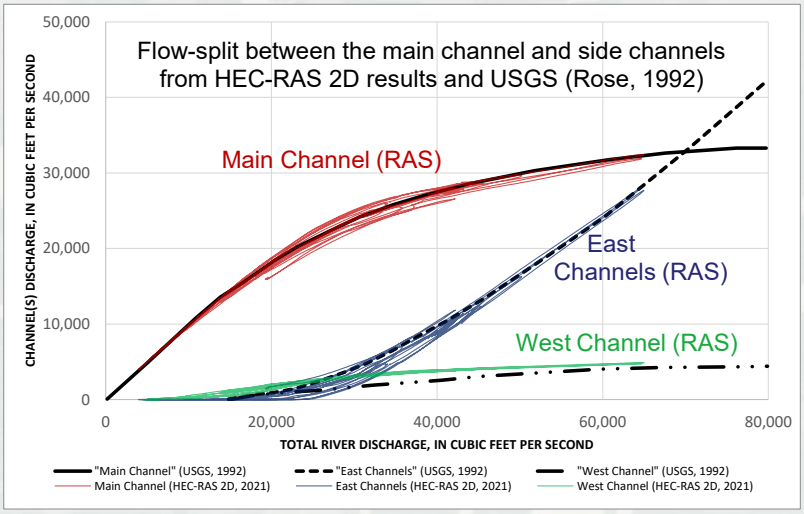
Hydraulic Calibration Cont…



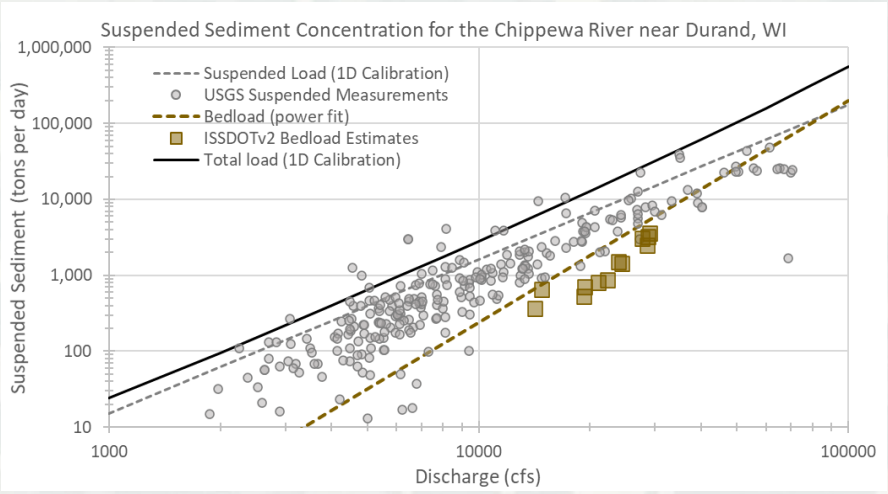
Hydraulic calibration by Alex Nelson (MVP)

Hydraulic Calibration Cont…



Hydraulic calibration by Alex Nelson (MVP)

Chippewa River – Sediment Data



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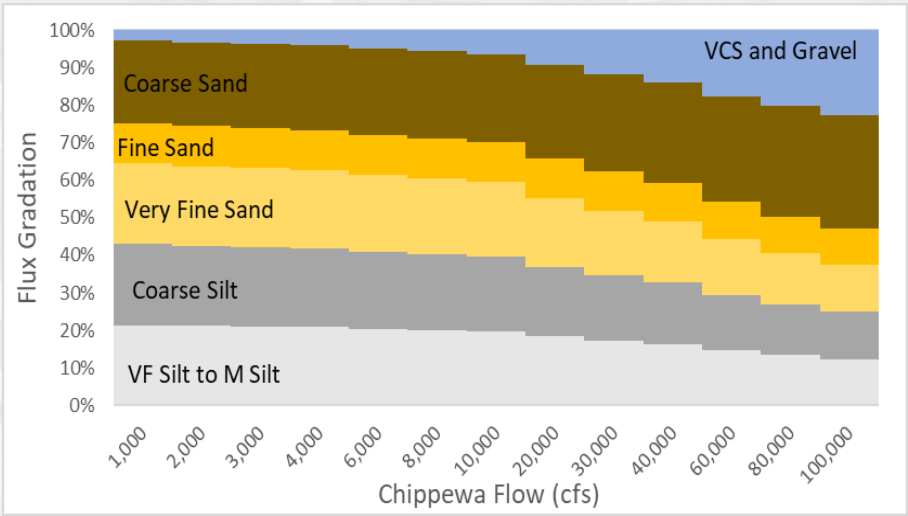
Chippewa River – Sediment Data



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Chippewa River – Results

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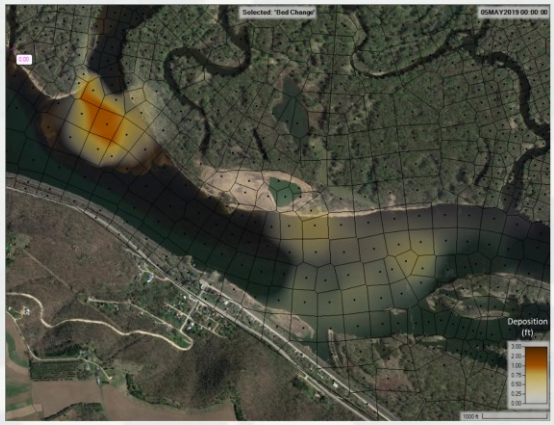
Chippewa River – Results



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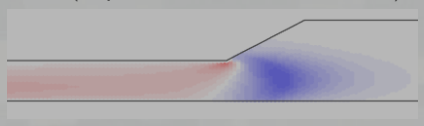
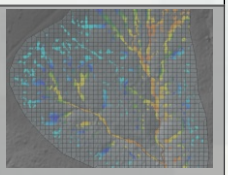
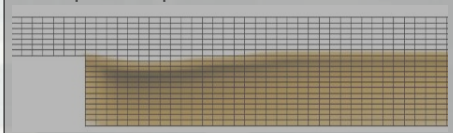
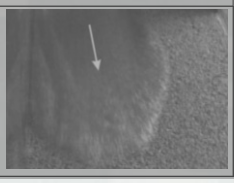
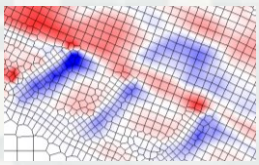
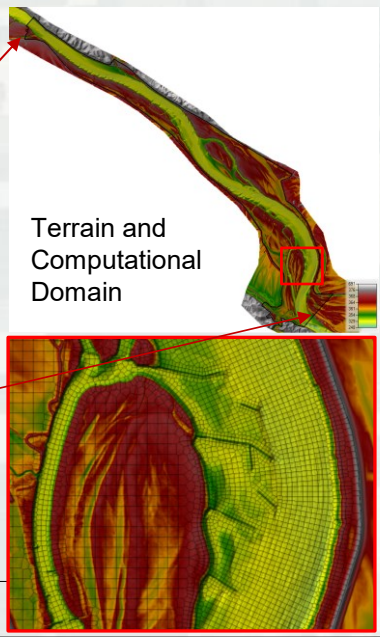
Example Applications

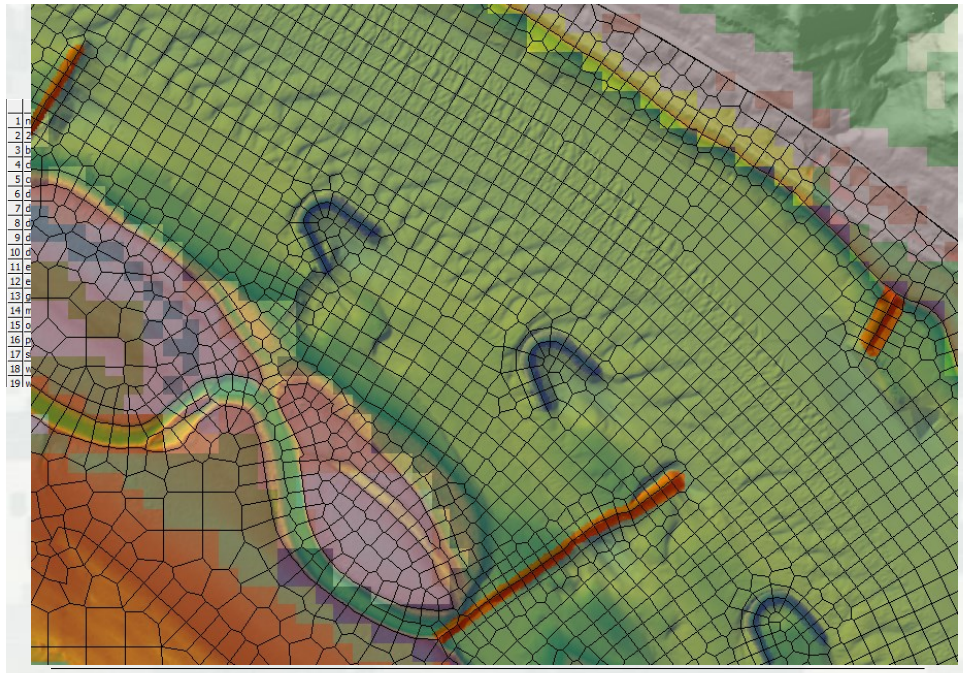
Laboratory Scale	Prototype Scale
Weise (Expansion Contraction Flume) 	Lucky Hills Study Site 
Floodplain Deposition Flume 	Chippewa Dredge Study 
Dam Break Non-Newtonian Flume Experiment 	Mississippi River 

Validation: Upper Mississippi

- **Time Period:** 2014 to 2016
- **Study Extent:** River Station 110 (Chester Gage) to River Station 92 (two miles downstream of Red Rock Gage)
- **Upstream Boundary Condition:** Chester Flow Hydrograph
- **Downstream Boundary Condition:** Normal Depth, Red Rock Rating Curve



Terrain and Computational Domain



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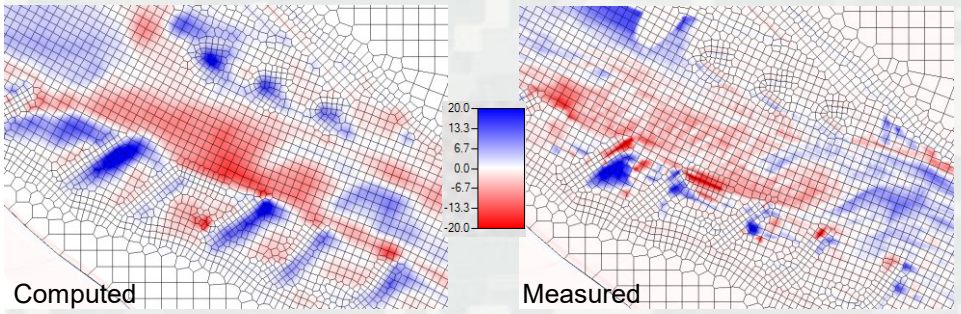
Results – In Progress Calibration

Comparison of measured and computed bed change



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