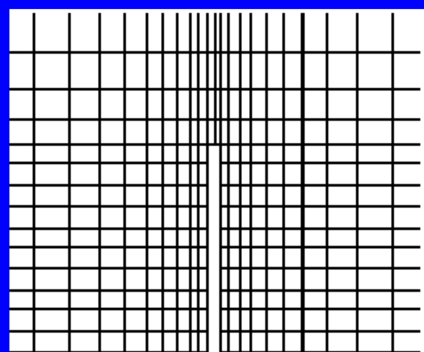
Validation of CCHE2D Model

- Mesh system used for the spur dike case

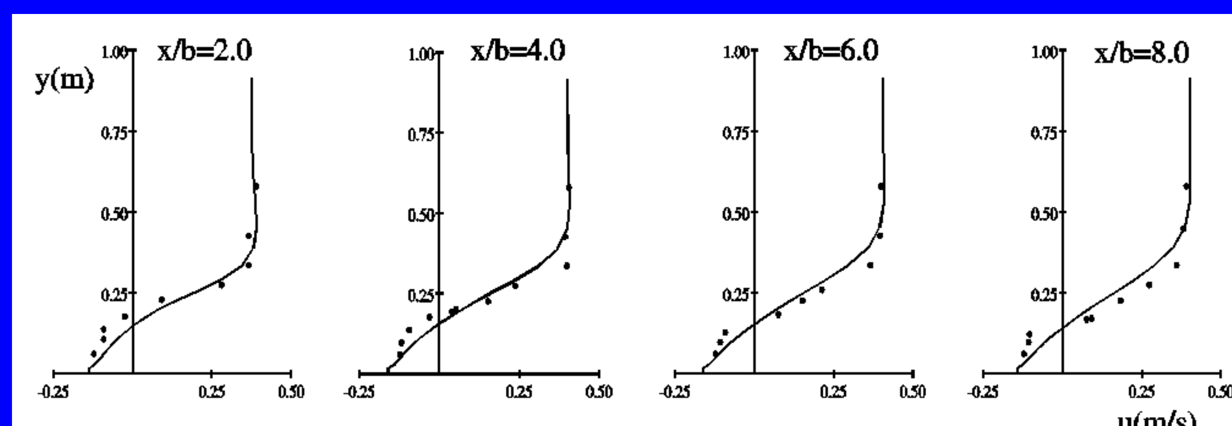
Mesh system

- Detail around the spur (three mesh-lines).

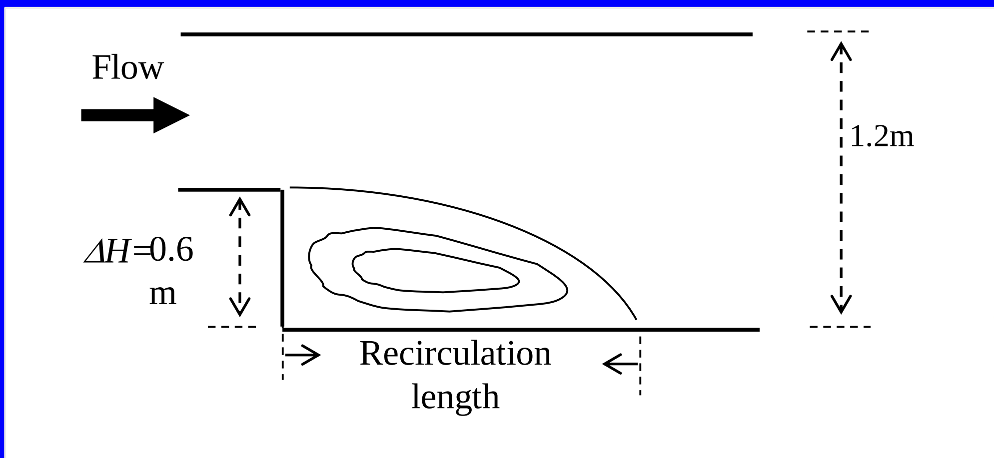


Position the inlet and outlet sections “far away” from the dike

Mixing length model (total slip boundary condition)

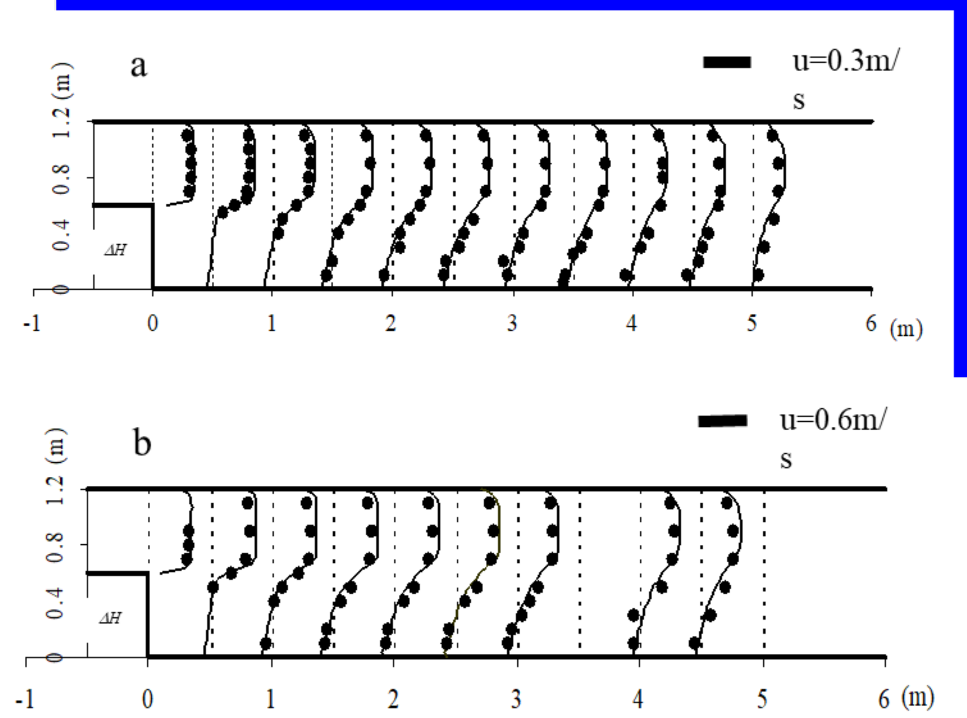


Sketch of the flow pattern and the flume of sudden expansion



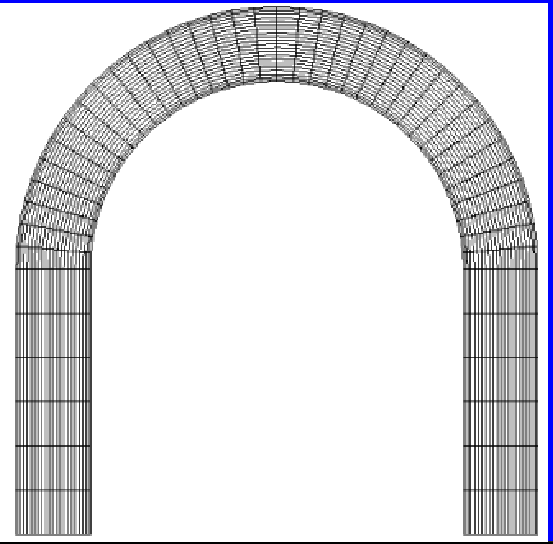
Discharge (m^3/s)	Width (m)	Depth (m)	Step Height(m)	Slope	Approach main velocity (m/s)	Approach Froude Number	Recirculation Length (m)
0.01815	1.2	0.101	0.6	1/1000	0.30	0.30	4.60
0.03854	1.2	0.105	0.6	1/1000	0.60	0.60	4.60

- Steady flow
- k-ε turbulence model
- Log law

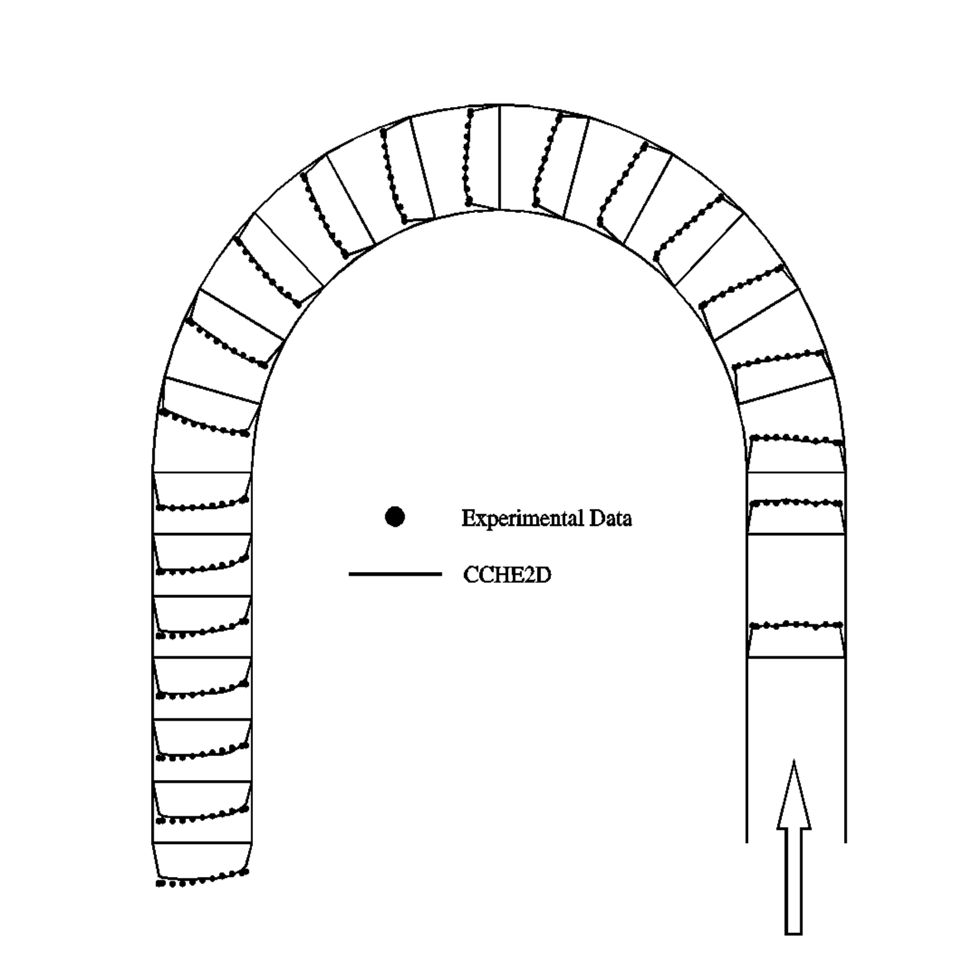


Comparisons of the simulated and measured flow field in the channel sudden expansion, a: Q=0.01815m^3/s, b: Q=0.03854m^3/s

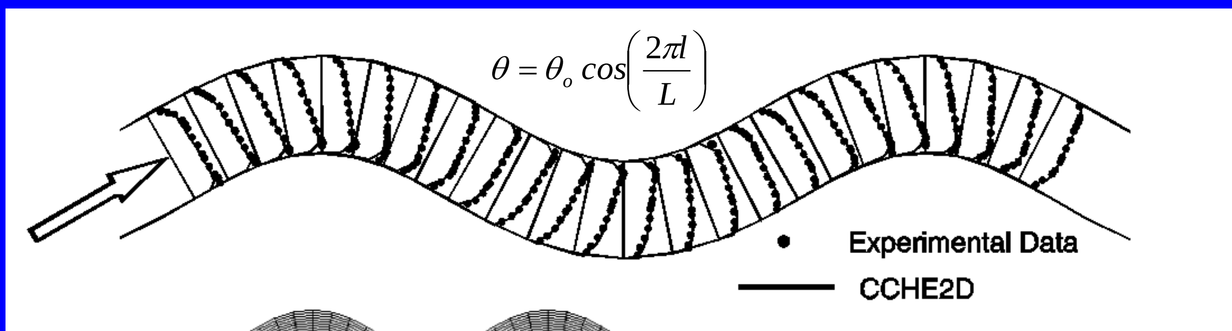
Flow in a 180^{o} U shaped channel

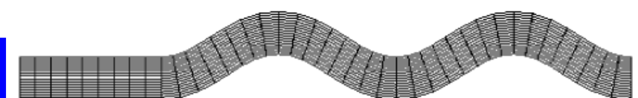


Q (m^3/s)	D_{50} (mm)	B (m)	h_m (m)	s_b	u_m (m/s)	Re_*	F_r	R
0.180	1.0	1.7	0.1953	0	0.542	1513	0.392	5.1



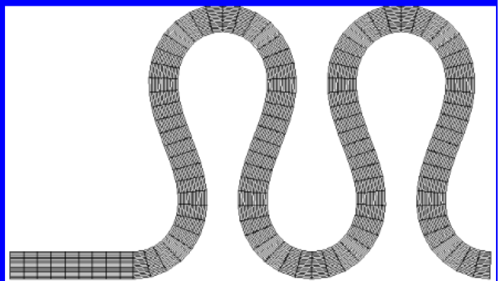
Flow in sine-generated channel, θ=30^o

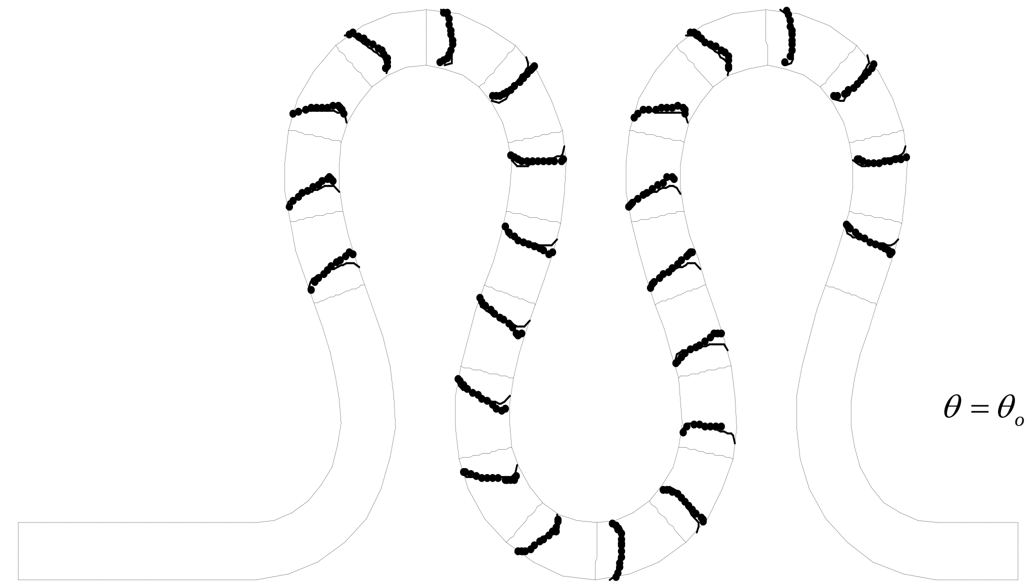




Q (l/s)	D_{50} (mm)	B (m)	h_m (m)	s_b	u_m (m/s)	Re_*	F_r	B/h_m
2.10	2.2	0.4	3.2	1/1000	6.4	5250	0.086	12.5

Comparison of the computed and measured velocity for sine-generated channel: $=110^{o}$.



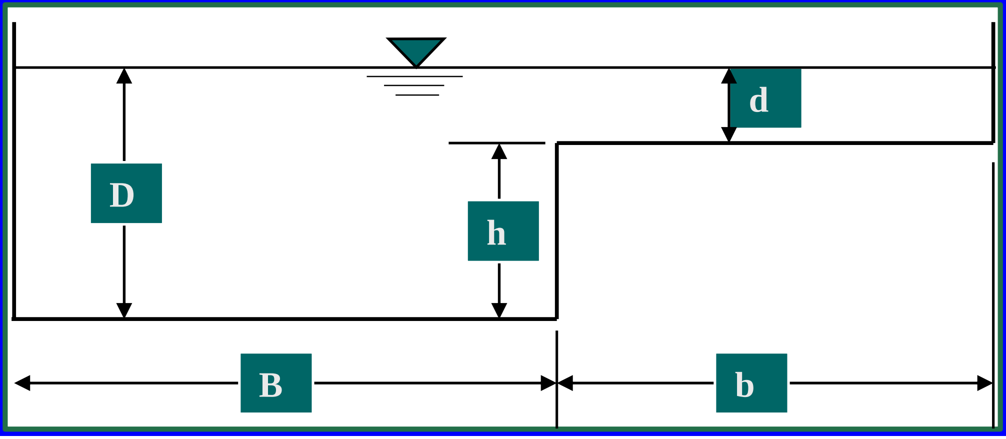


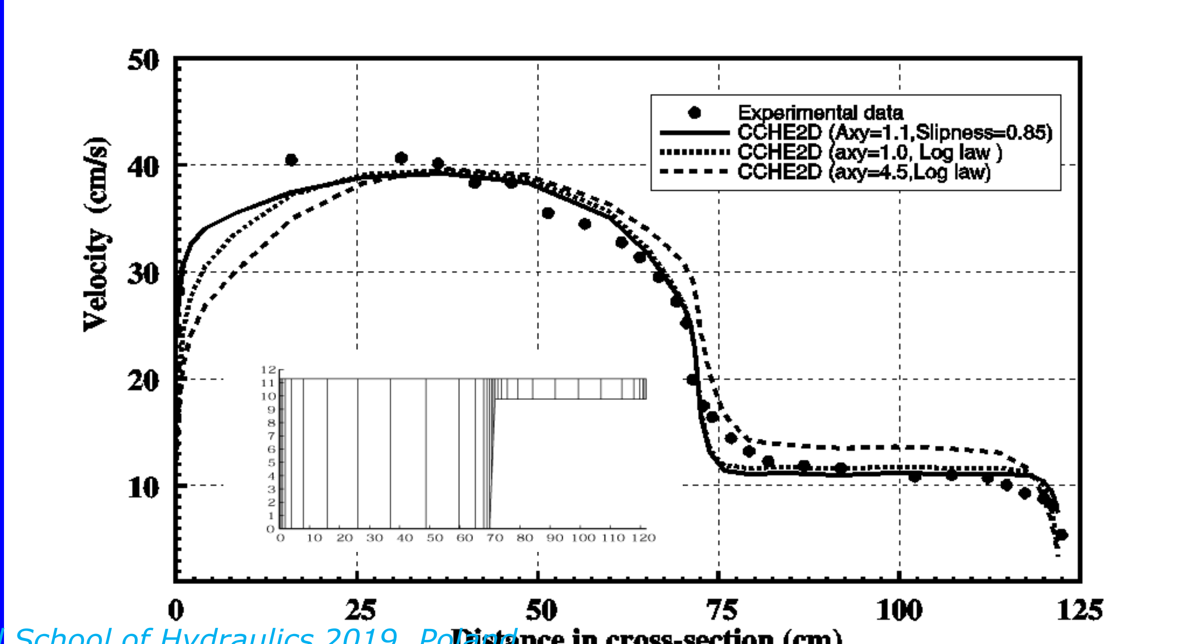
$$\theta = \theta_o \cos\left(\frac{2\pi l}{L}\right)$$

Q (l/s)	D_{50} (mm)	B (m)	h_m (m)	s_b	u_m (m/s)	Re_*	F_r	B/h_m
2.10	2.2	0.4	3.0	1/1120	16.7	5000	0.095	13.3

Sketch of an experimental compound channel

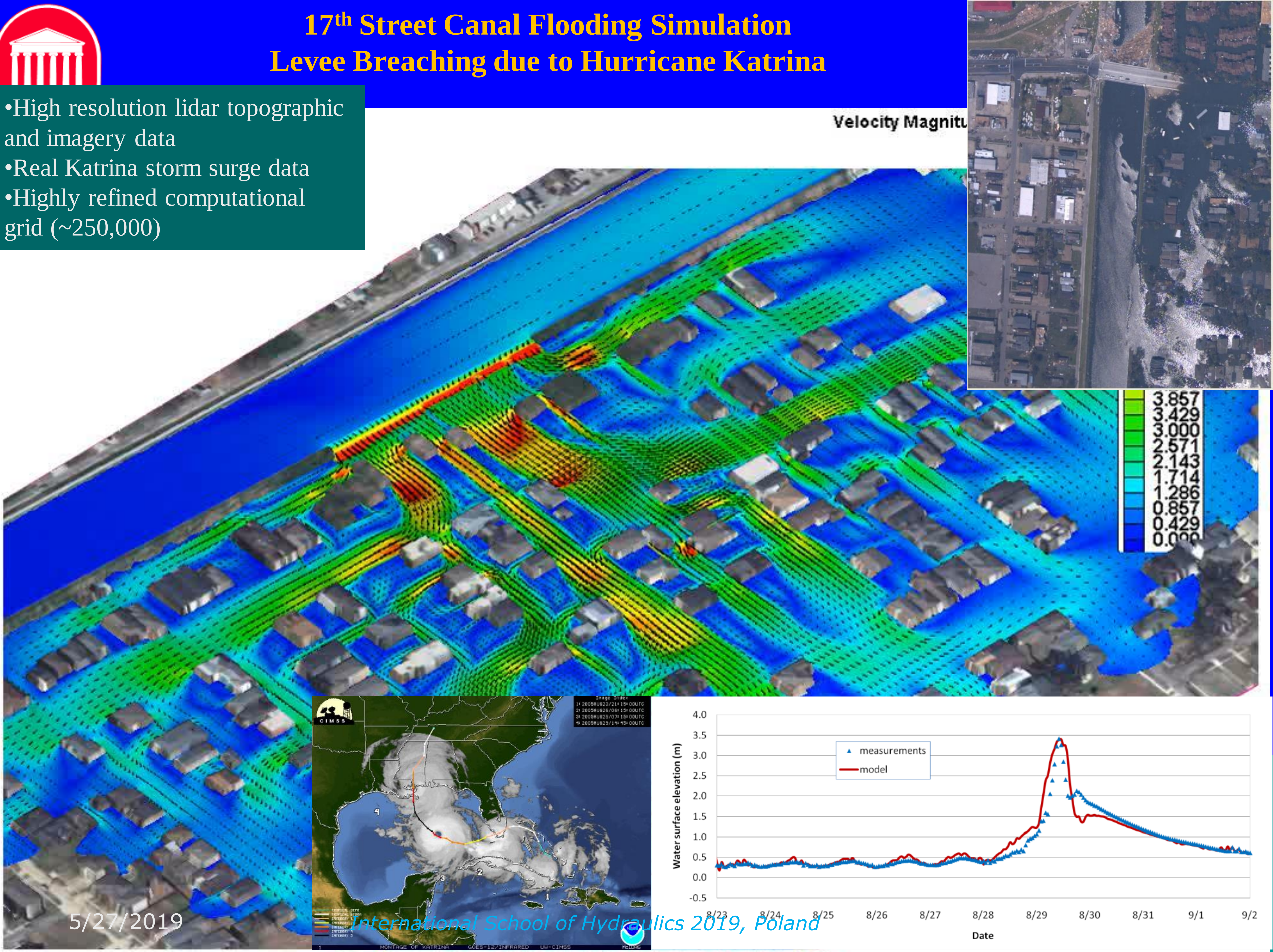
(Rajaratnam and Ahmadi, 1981)





17th Street Canal Flooding Simulation
Levee Breaching due to Hurricane Katrina

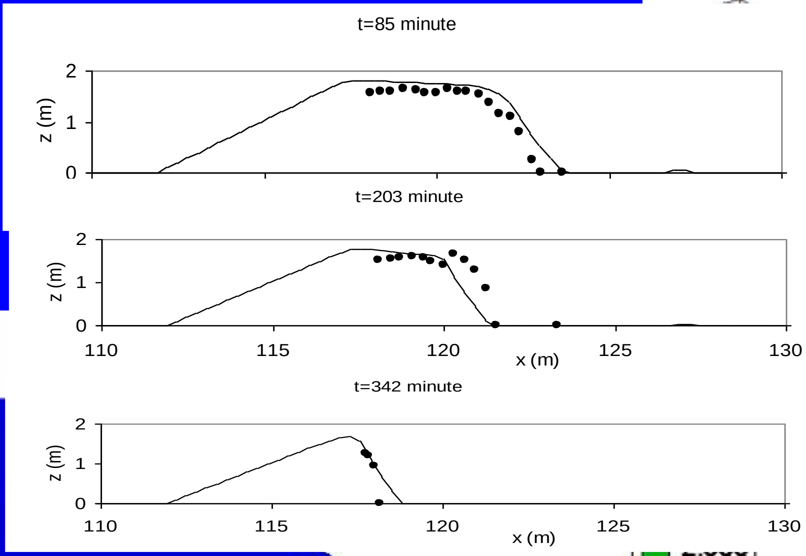
- High resolution lidar topographic and imagery data
- Real Katrina storm surge data
- Highly refined computational grid (~250,000)



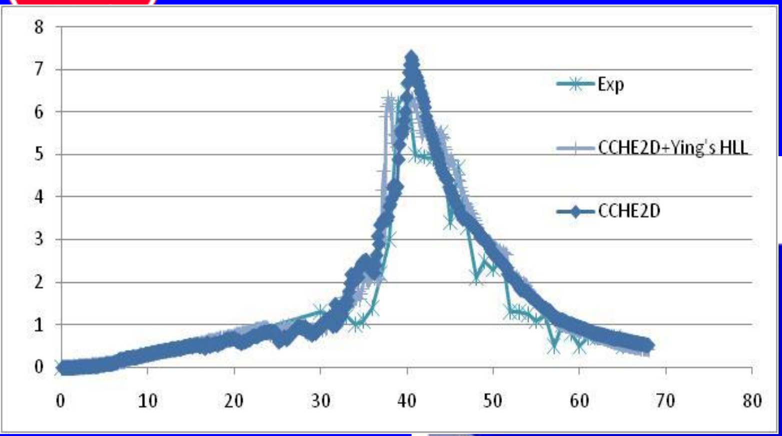

Water Surface (m)
Time = 0(d): 0(h): 0(m): 0(s)

Physical Experiment E1S1

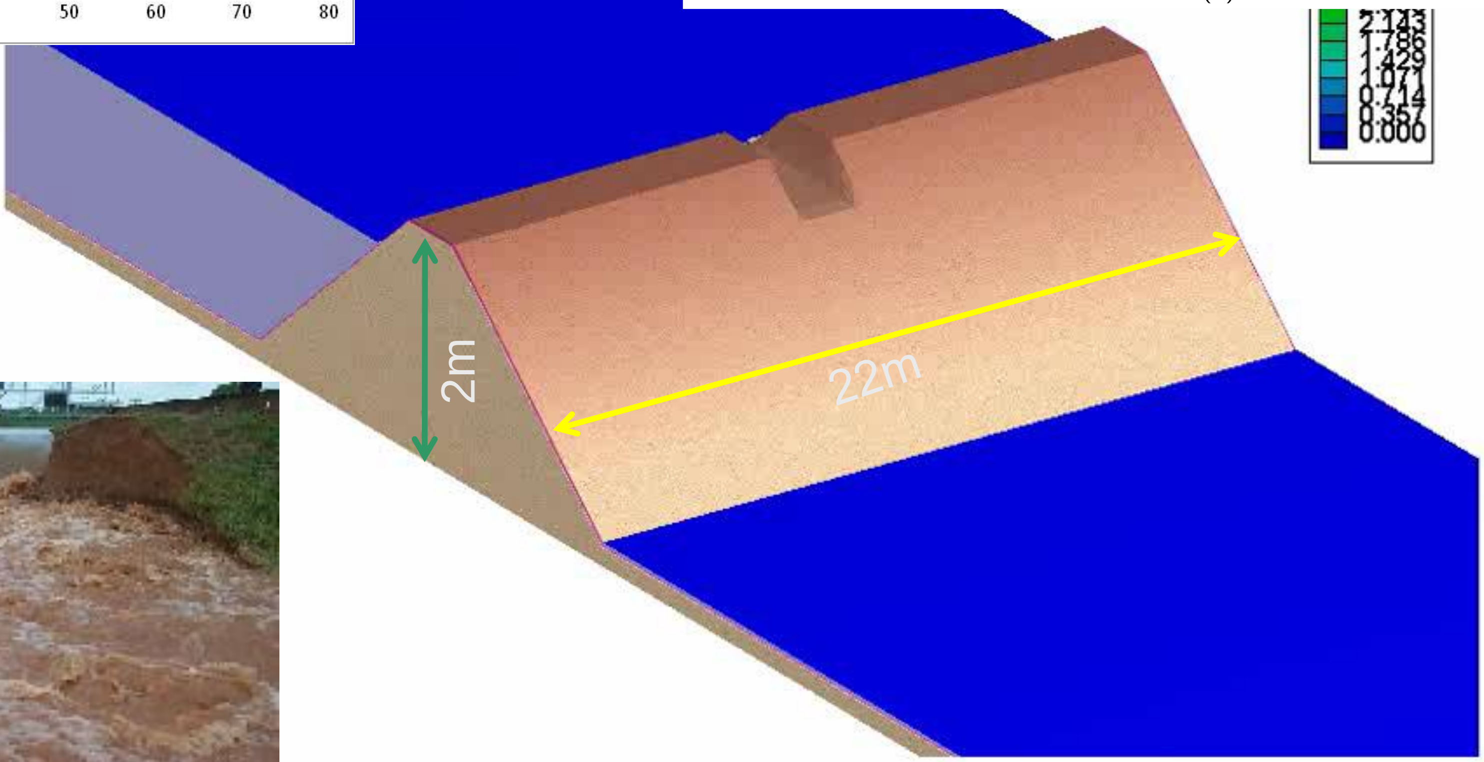
Comparison of Simulated Breaching Process of A Large Scale Cohesive Earth Dam



Comparison of simulated and measured erosion process

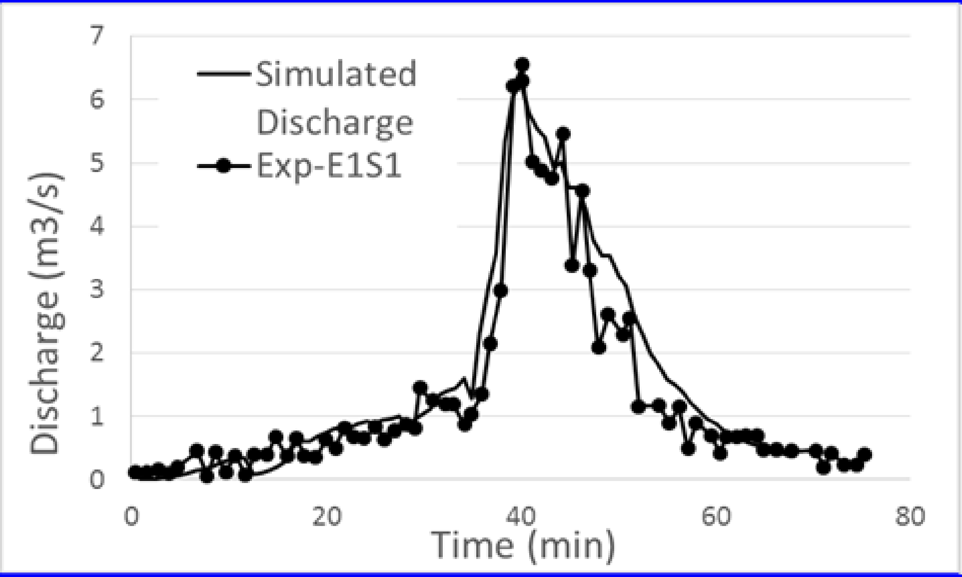


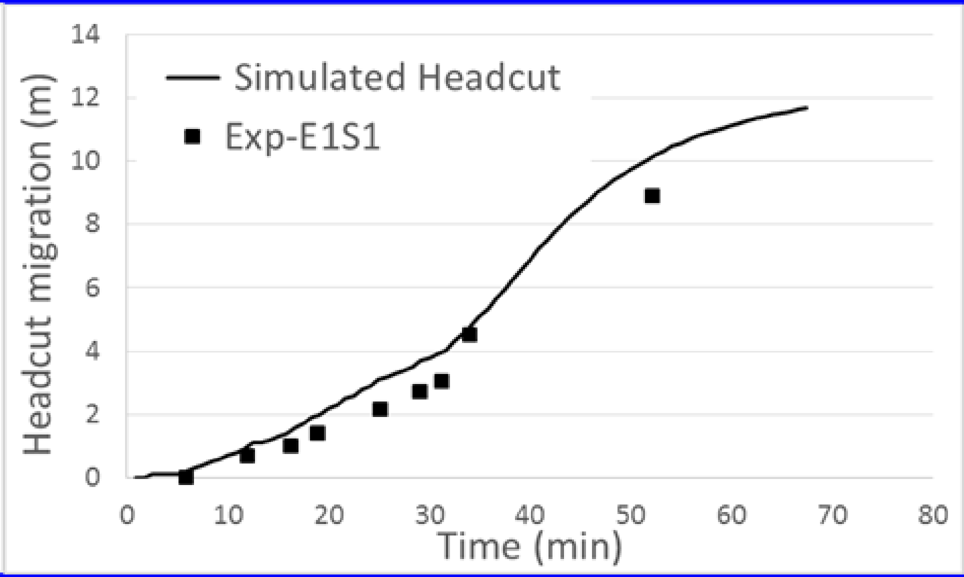
Comparison of simulated and measured dam break flood processes



Hanson, Cook and Hunt, 2005, Physical modeling of Overtopping Erosion and Breach Formation of Cohesive Embankment

Experiment I, Soil type I

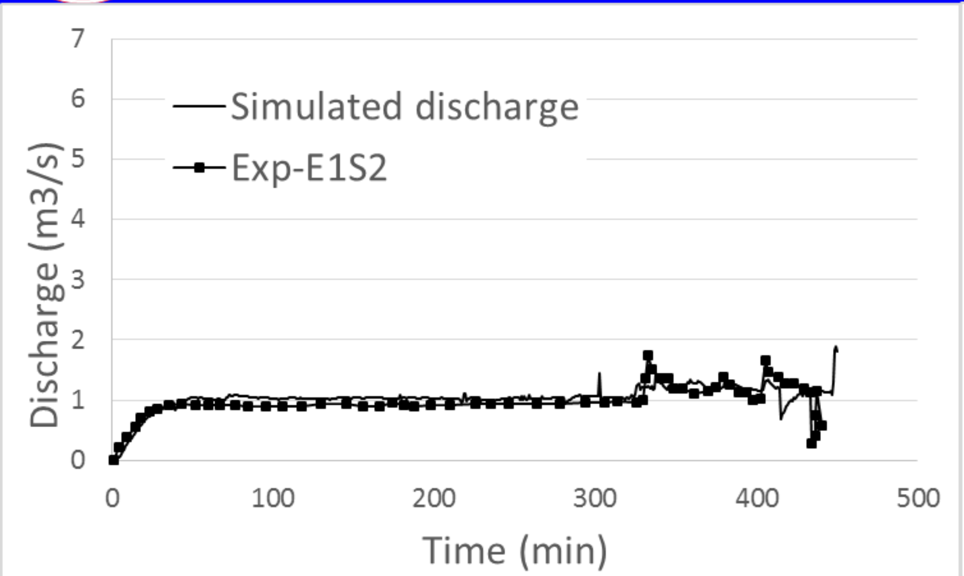


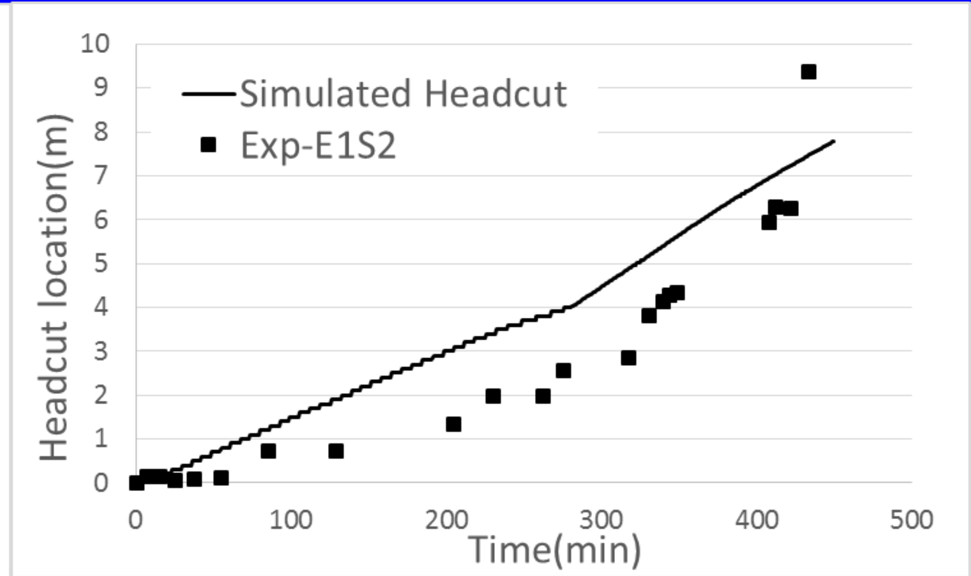


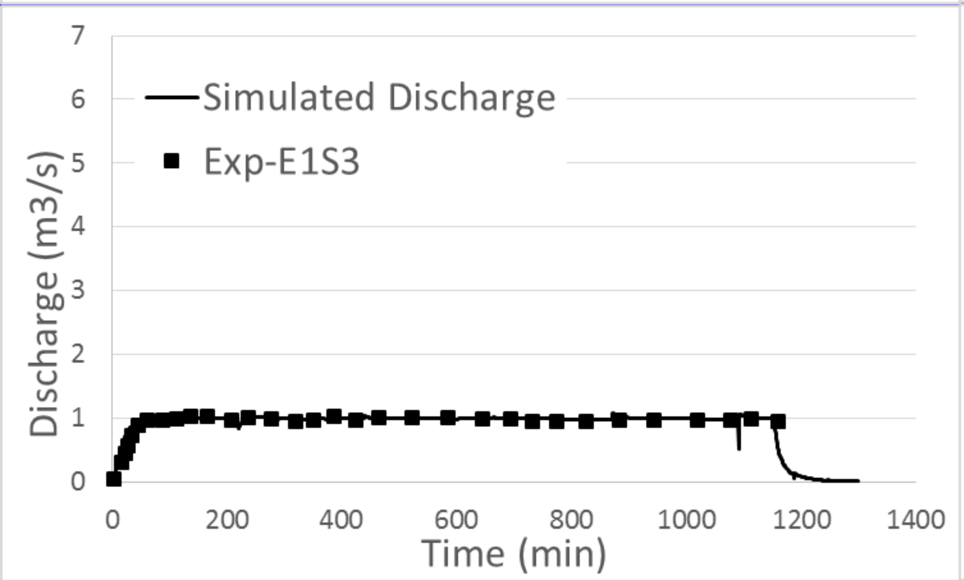
Comparison of the simulated and measured flood discharge at the crest

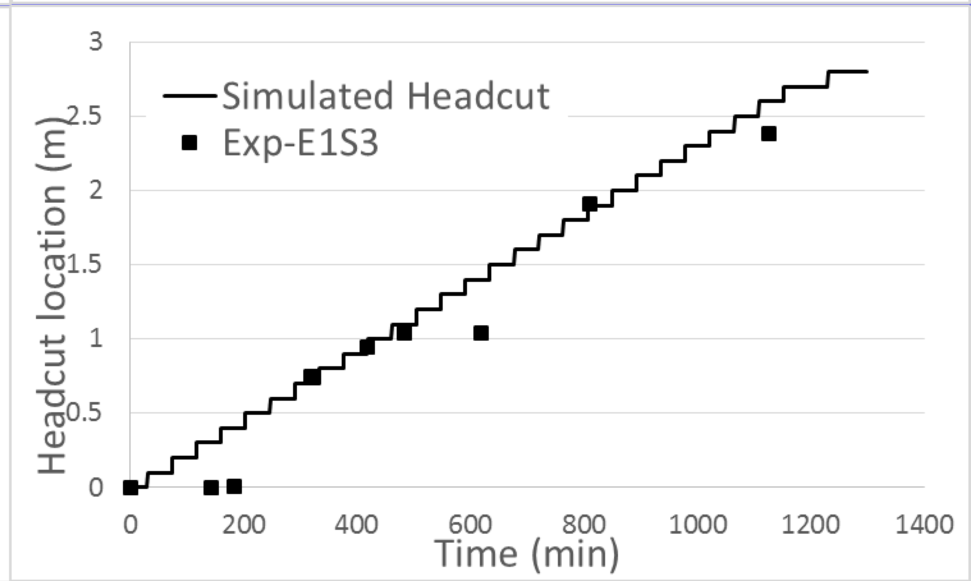
Comparison of the simulated and measured headcut advance

Experiment II, III, Soil type II, III

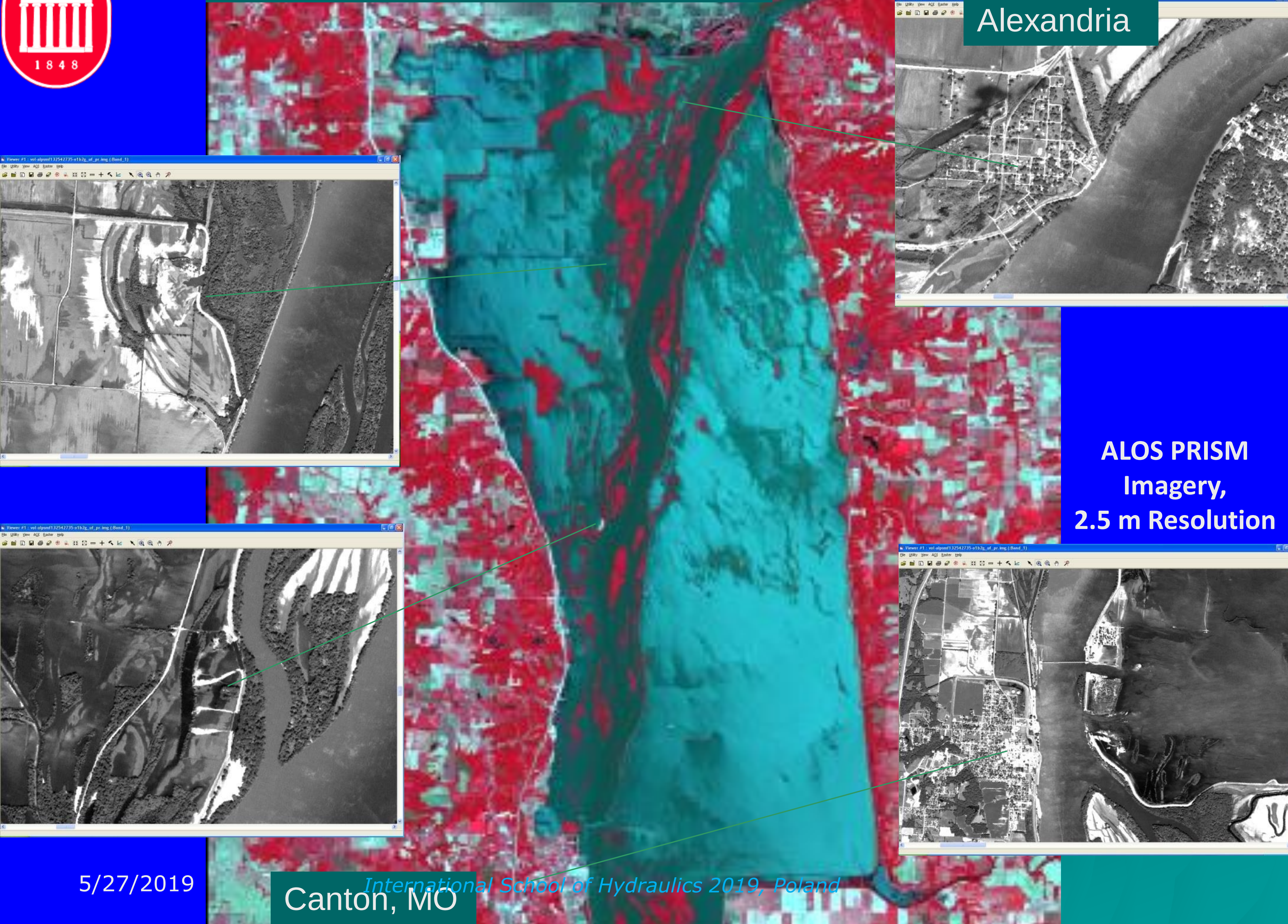




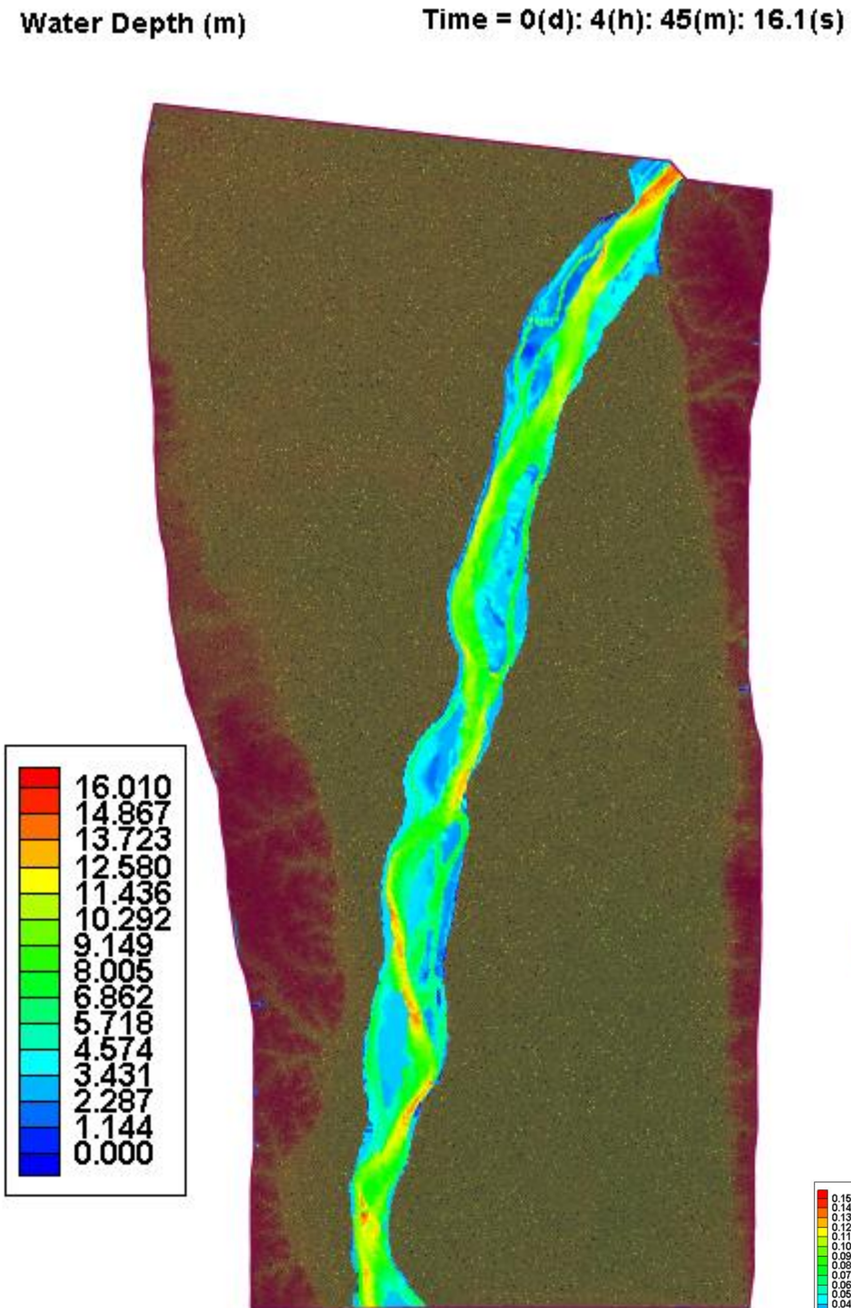


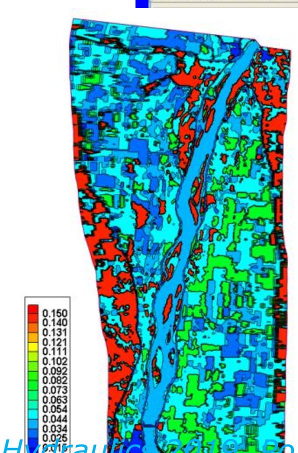


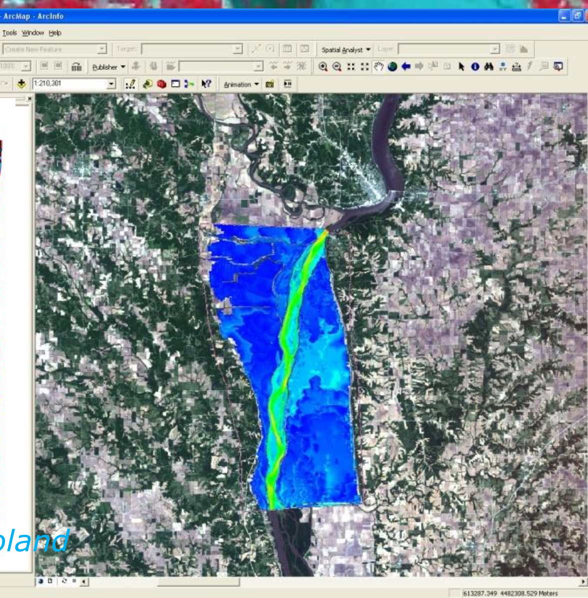
ALOS AVNIR 2 Imagery, 10 m Resolution



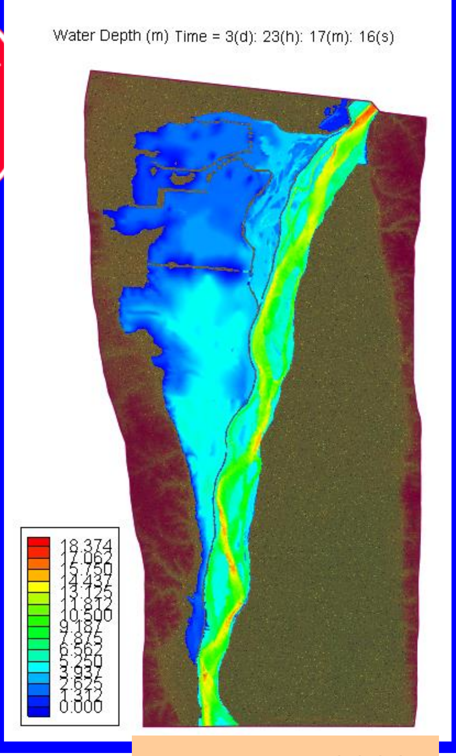
ALOS PRISM Imagery, 2.5 m Resolution


Water Depth (m)
Time = 0(d): 4(h): 45(m): 16.1(s)
16.010
14.867
13.723
12.580
11.436
10.292
9.149
8.005
6.862
5.718
4.574
3.431
2.287
1.144
0.000

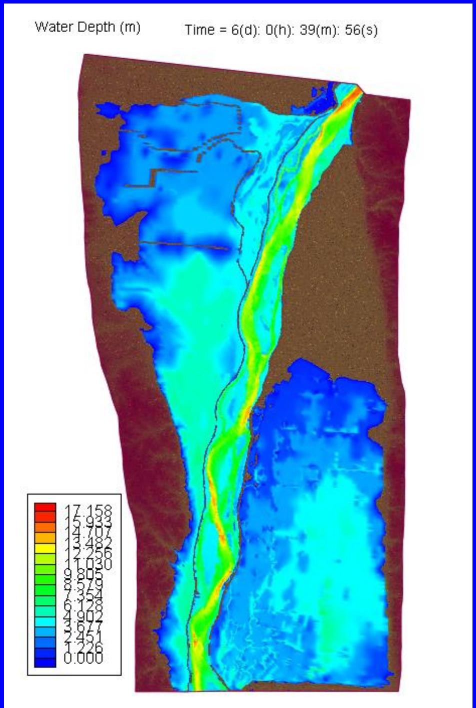

0.150
0.140
0.131
0.121
0.111
0.102
0.092
0.082
0.073
0.063
0.054
0.044
0.034
0.025


NCCHE_Hydroinformatics_SYSTEM - ArcMap - ArcInfo

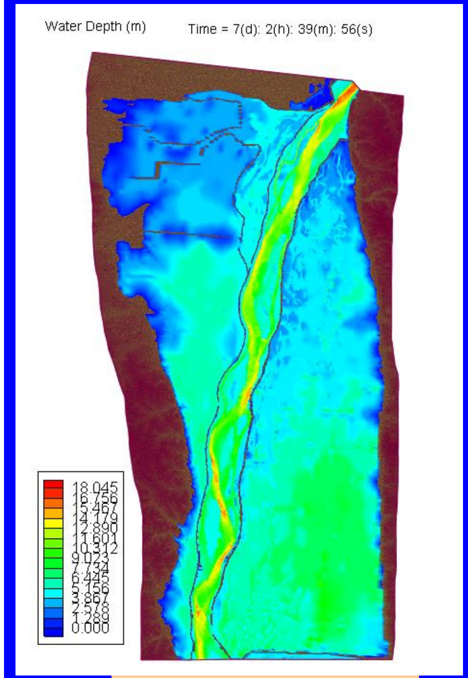
Simulated flood wave propagation, the flooded area and the observed from satellite



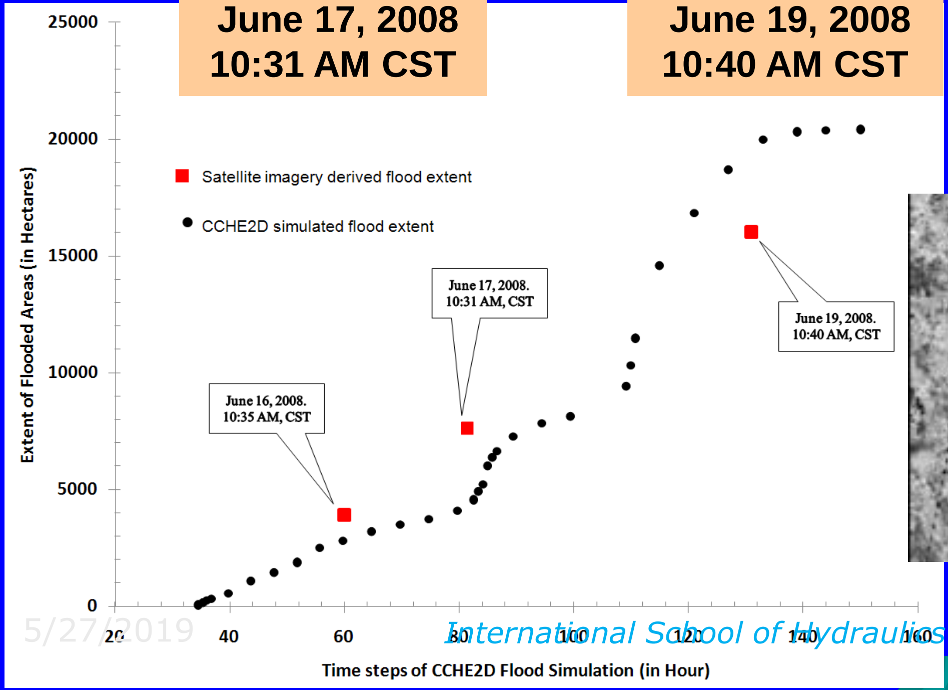
June 17, 2008
10:31 AM CST

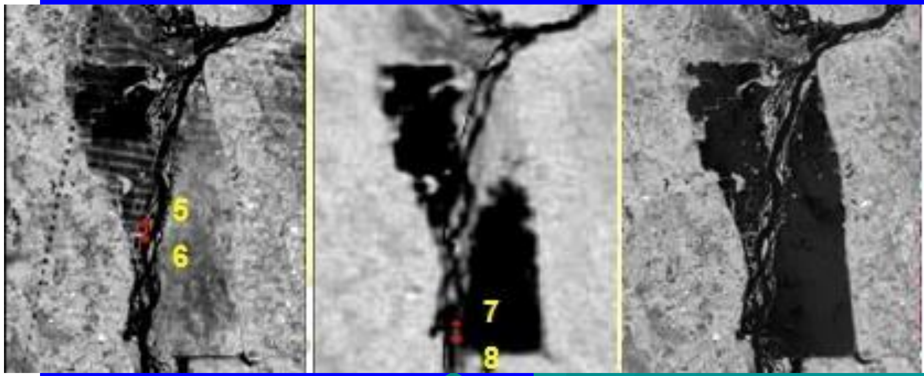


June 19, 2008
10:40 AM CST



June 21, 2008
11:00 AM CST

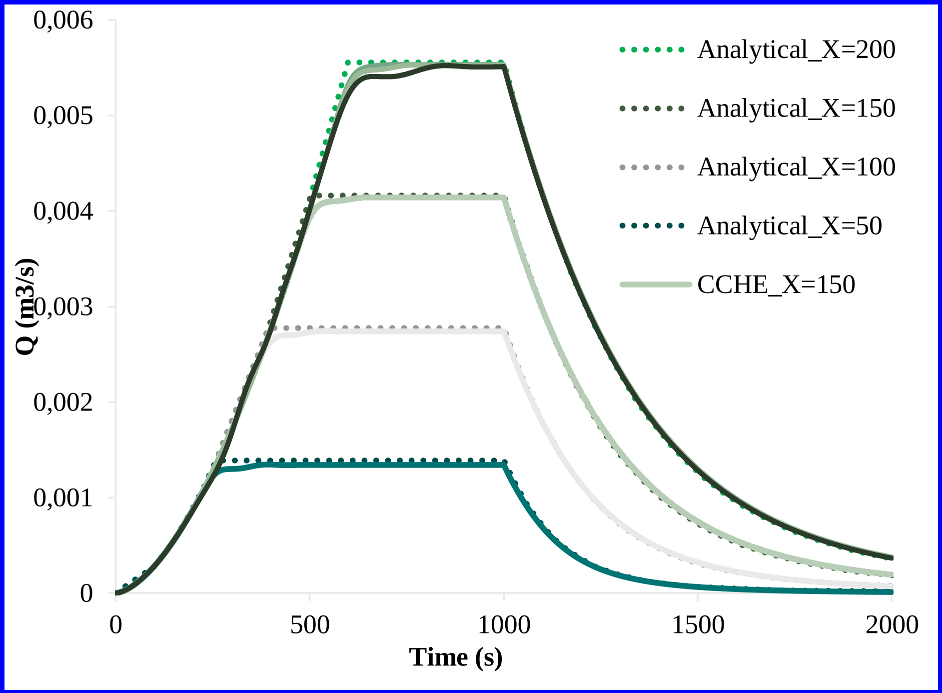




Simulation of Watershed Soil, Gully Erosion and Landscape Evolution

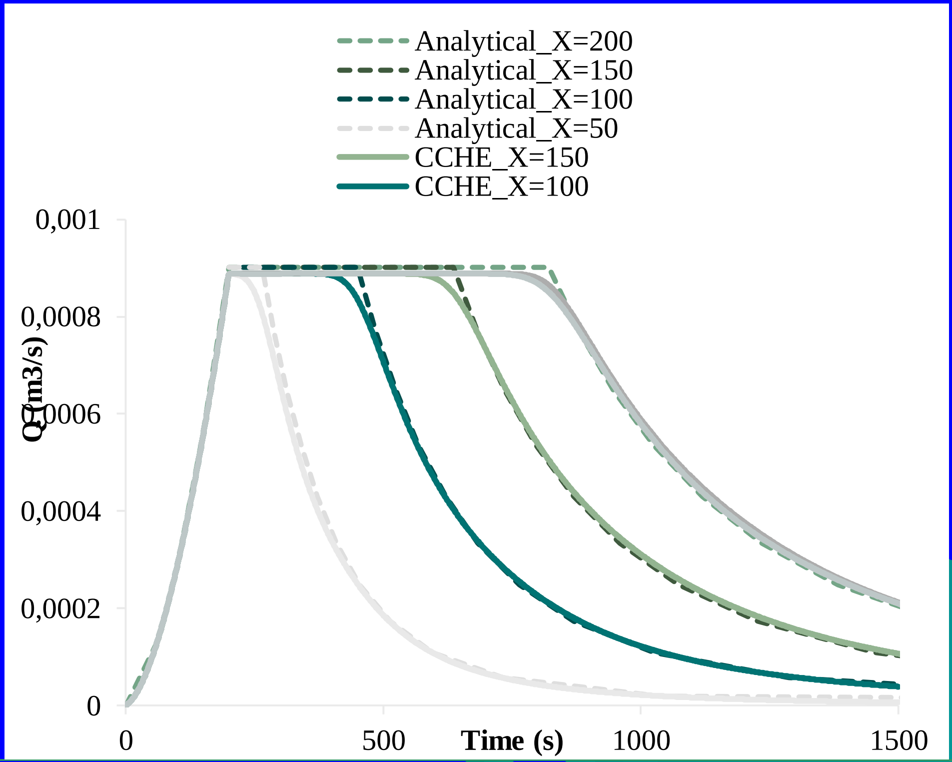
- ***USDA***
- ***NWAFST UNIV.***

Validation with Analytical Solutions

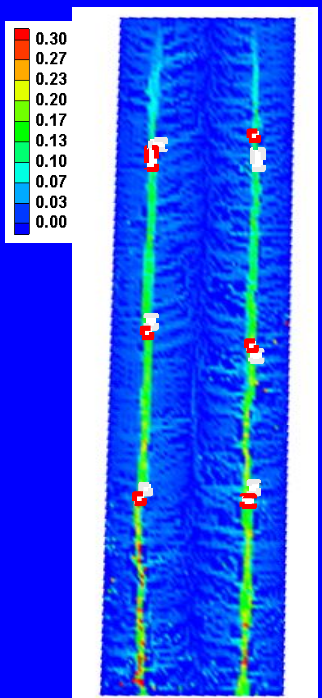


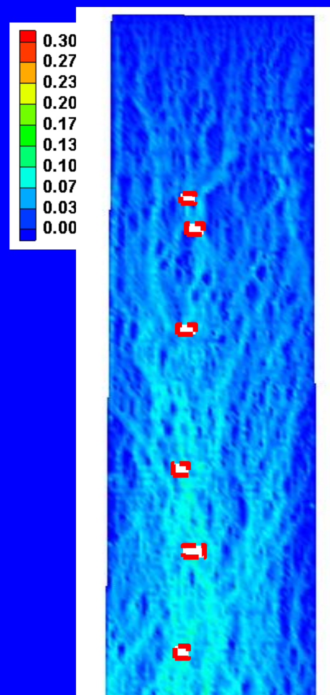
Runoff hydrograph for analytical solution and numerical solution for rainfall of **finite** duration.

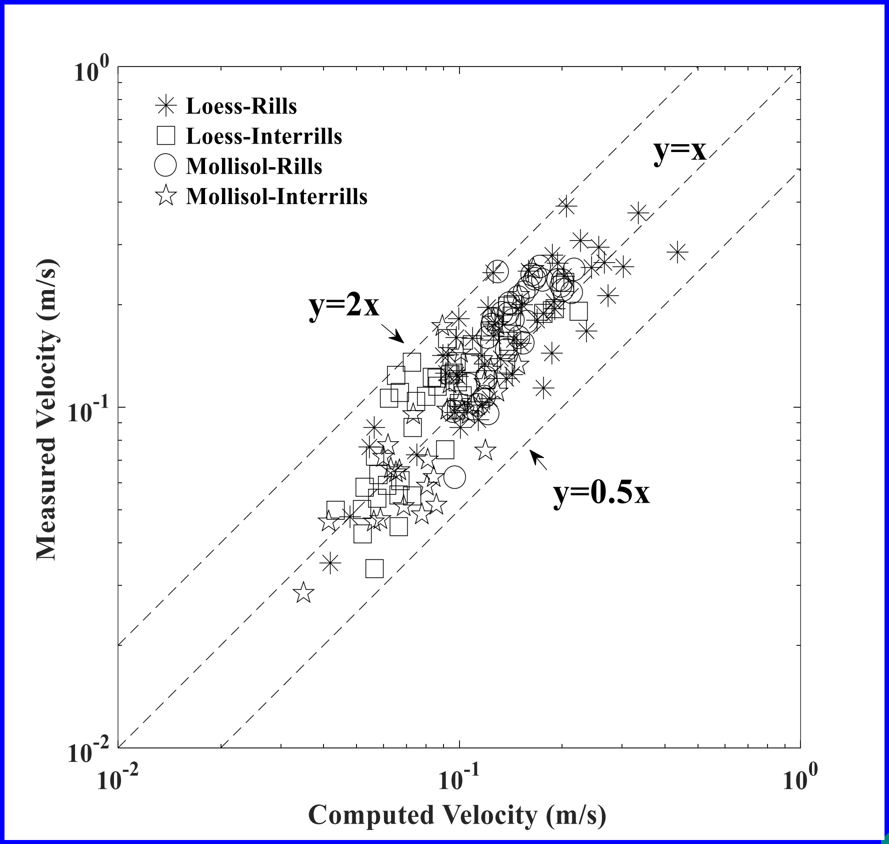
Runoff hydrograph for analytical solution and numerical solution for rainfall of **indefinite** duration.

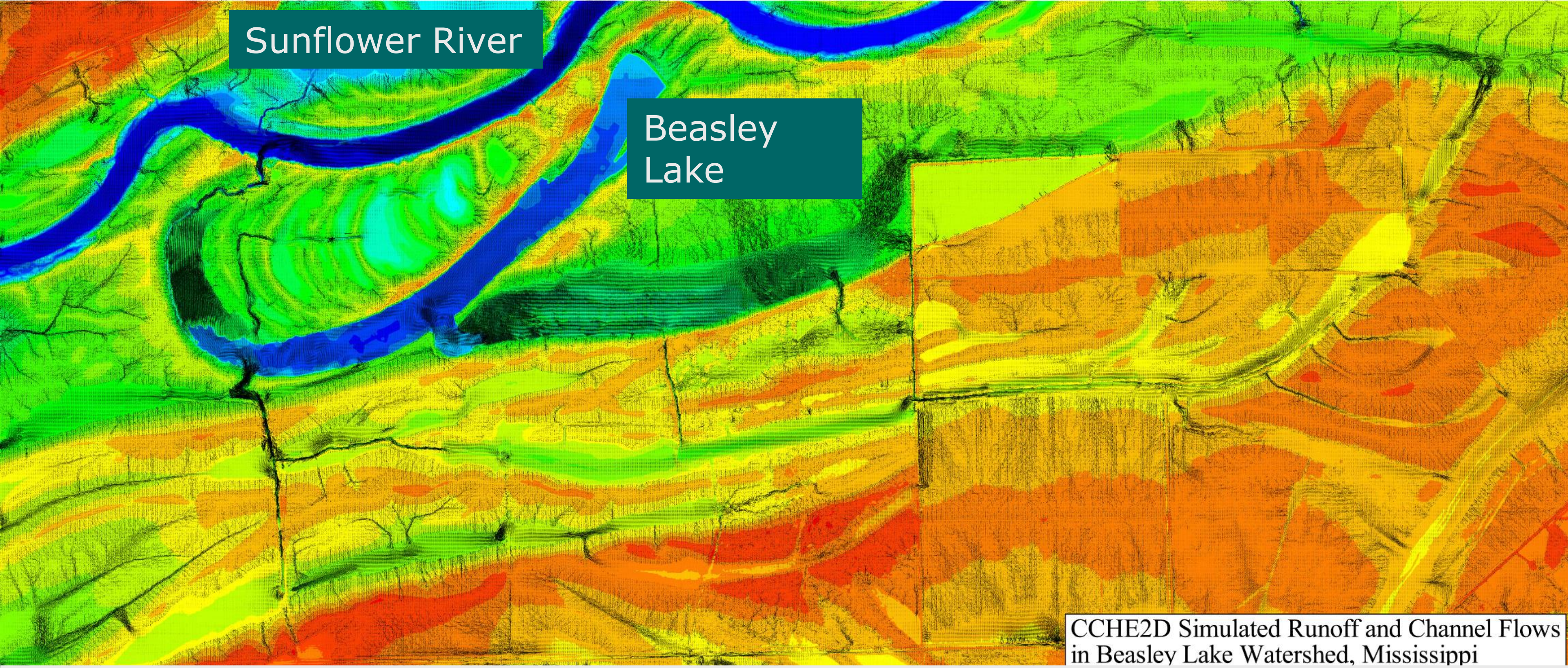


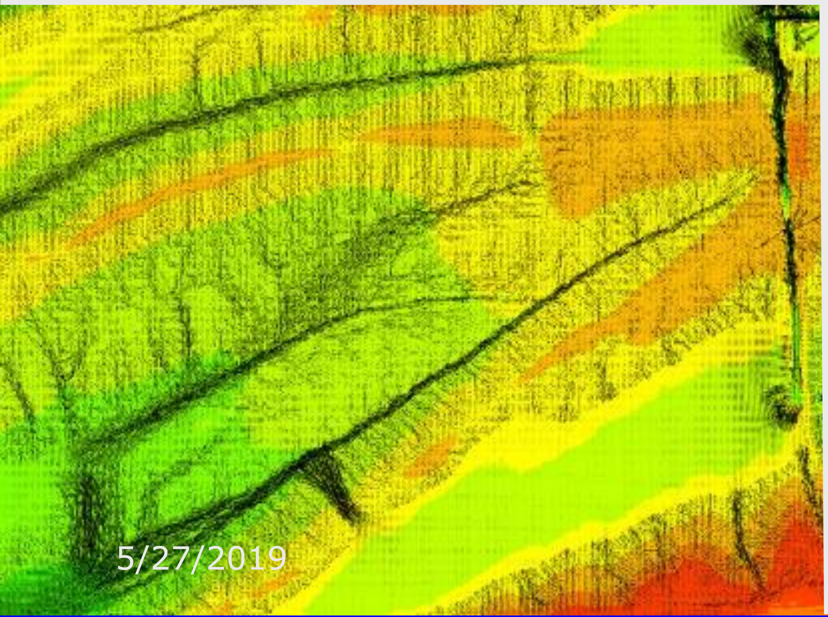
Validation using measured velocity data

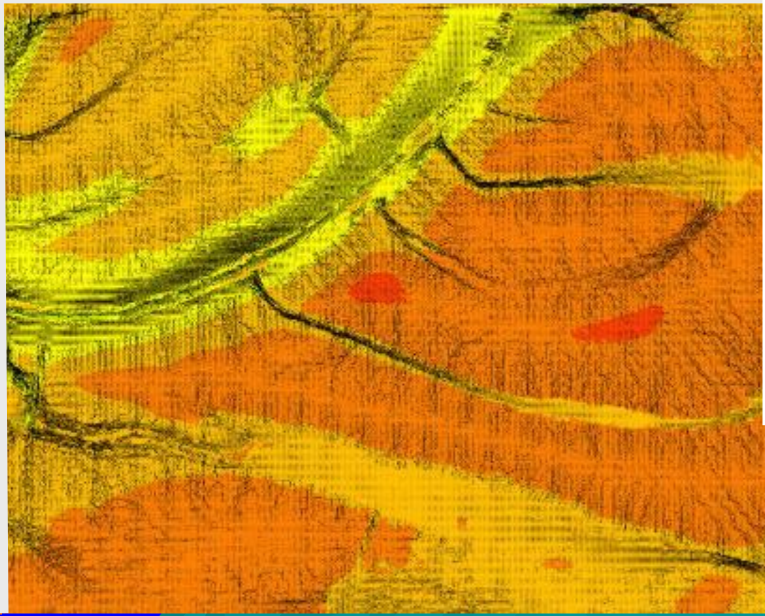






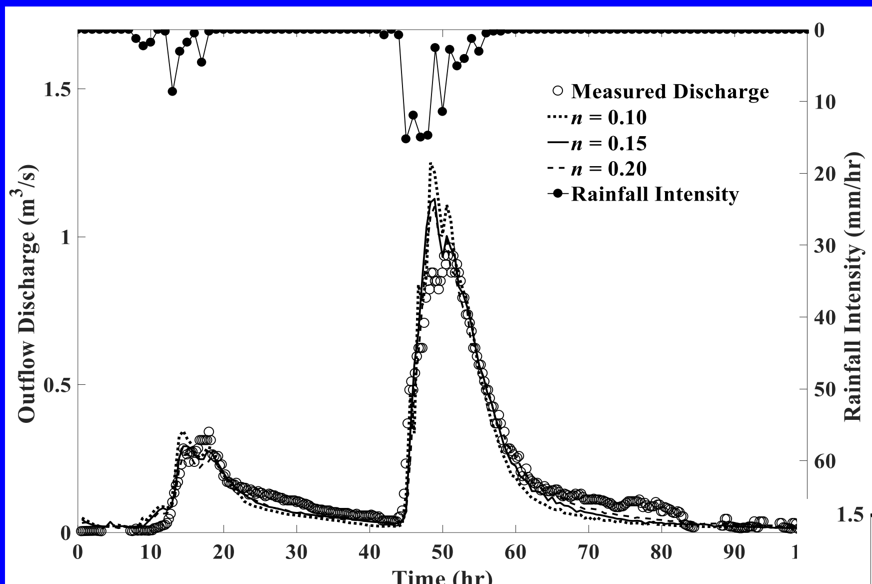




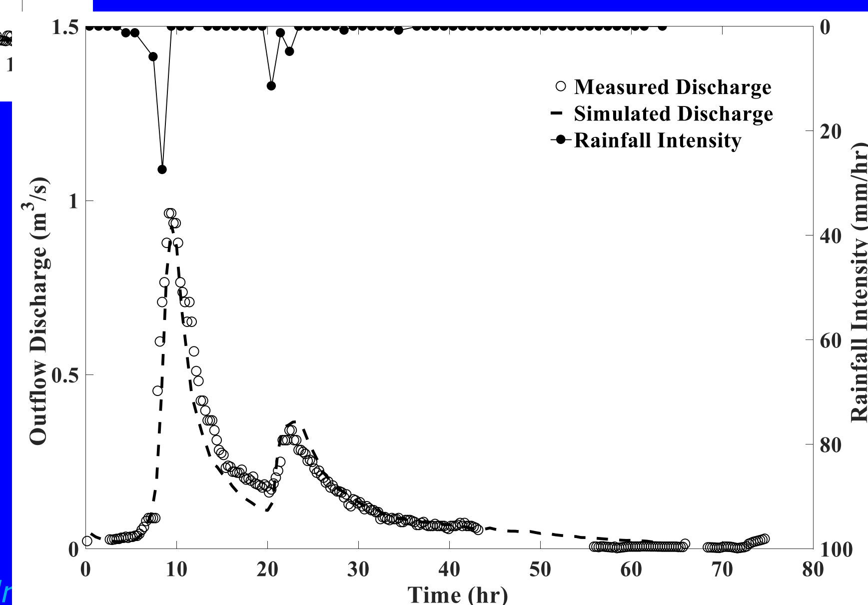


Watershed high resolution surface runoff, soil erosion and sediment transport

Simulated hydrological processes



Beasley Lake watershed, MS



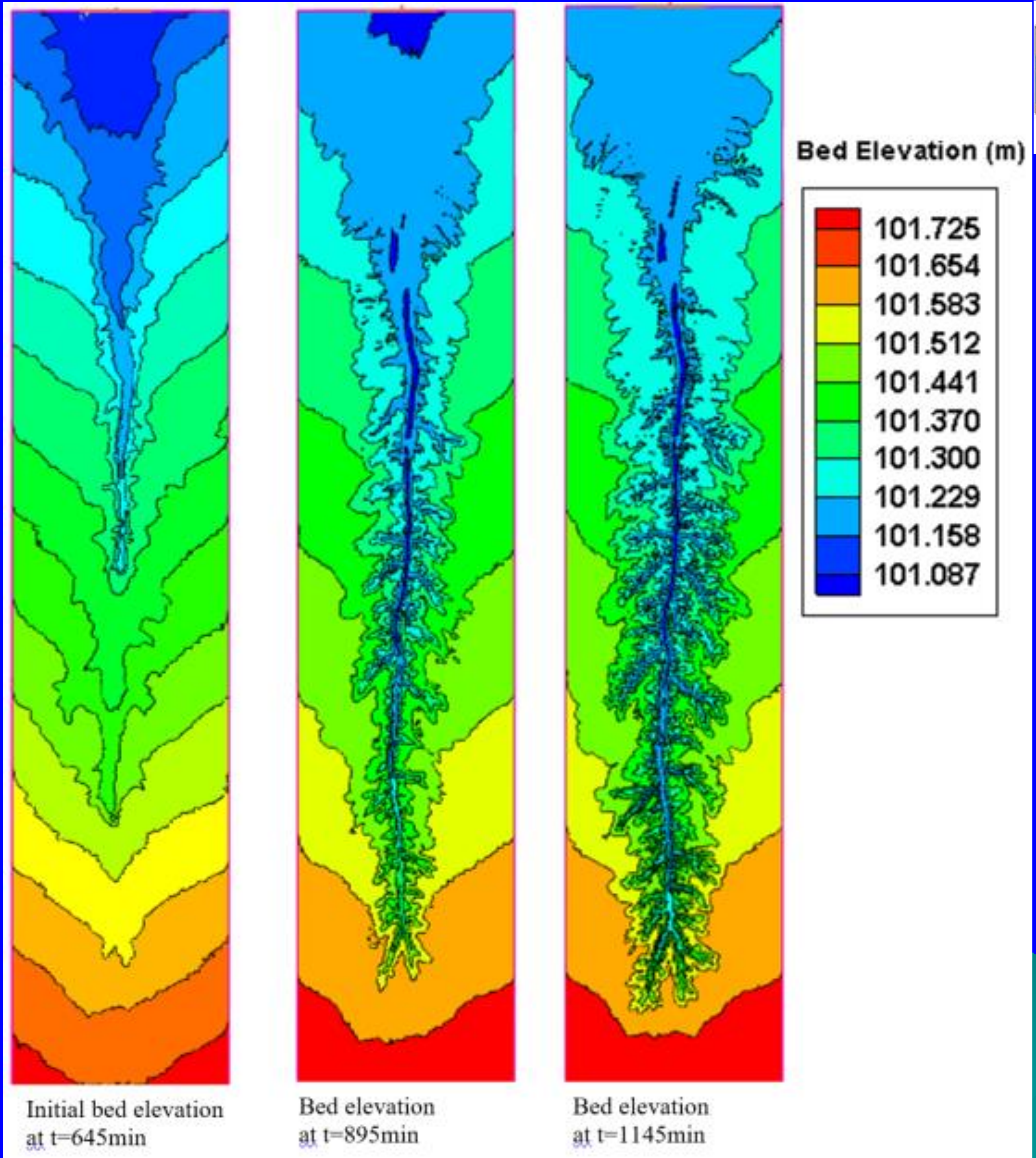
Watershed soil erosion and sediment transport are significantly different from those in rivers

Sheet runoff erosion

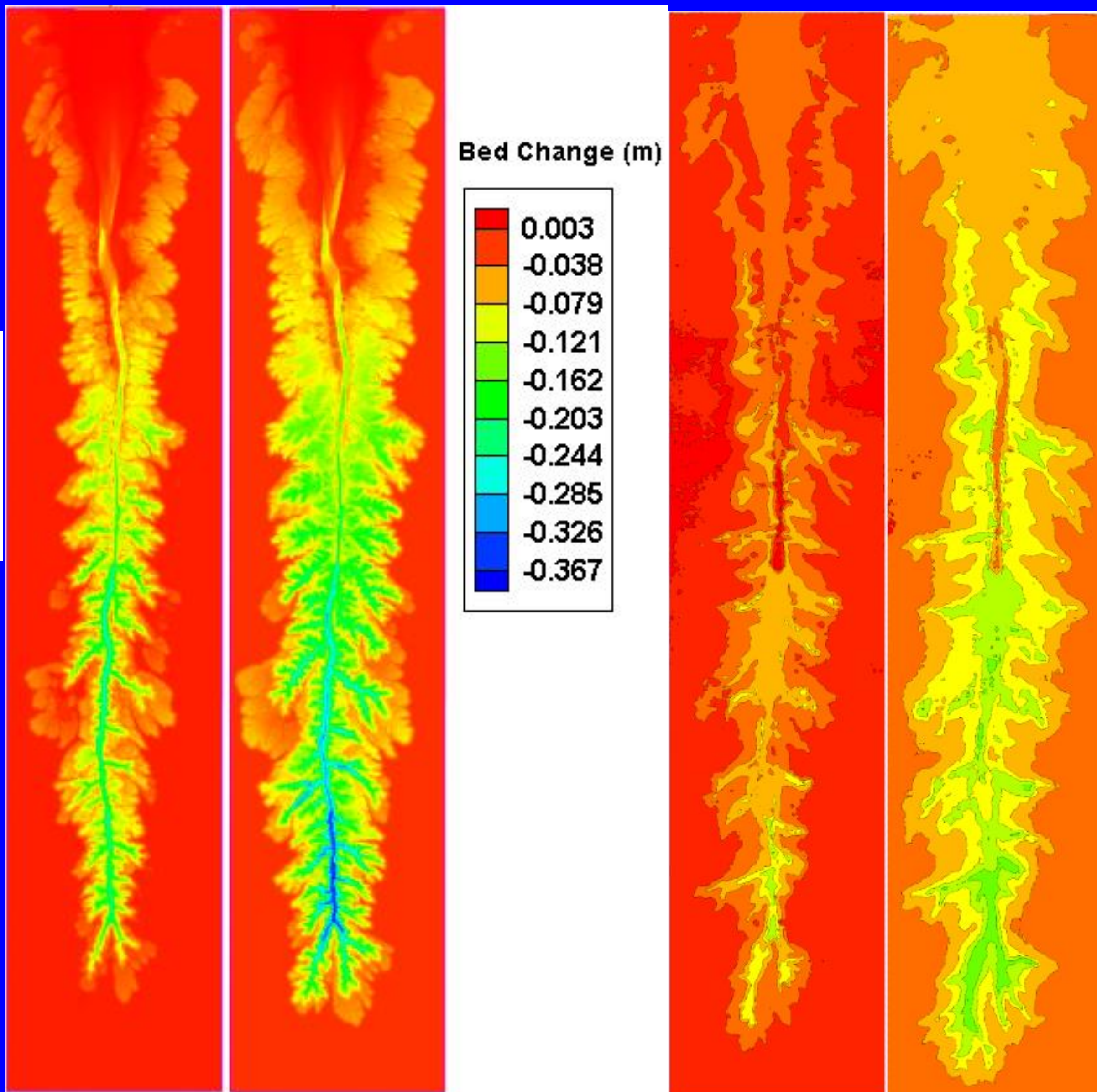
Splash erosion

Rainfall-soil erosion experimental facility at NSL-USDA-ARS

Simulated soil topography at t= 645 min, 895 min, and 1145 min



The simulated soil topography change

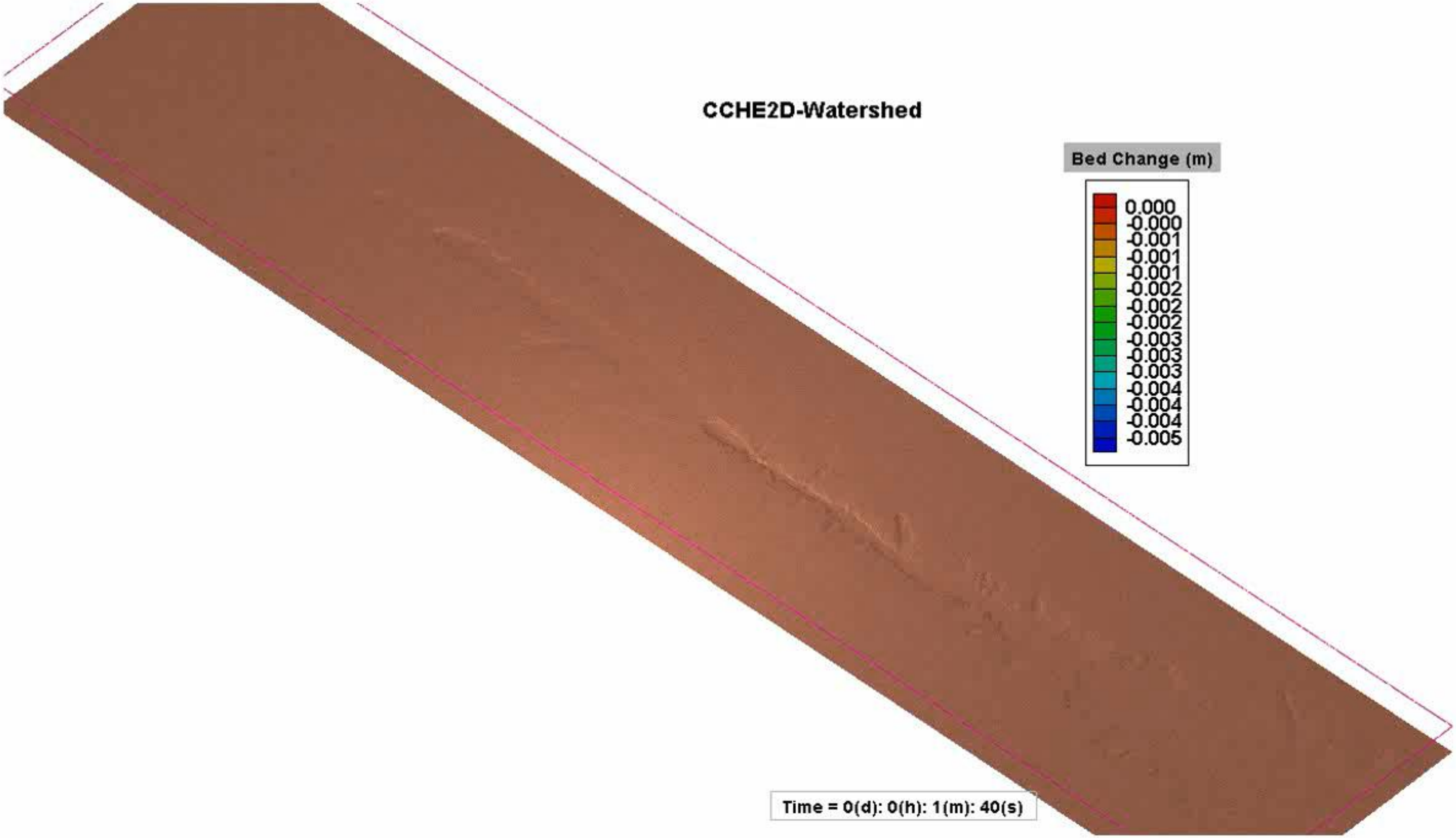


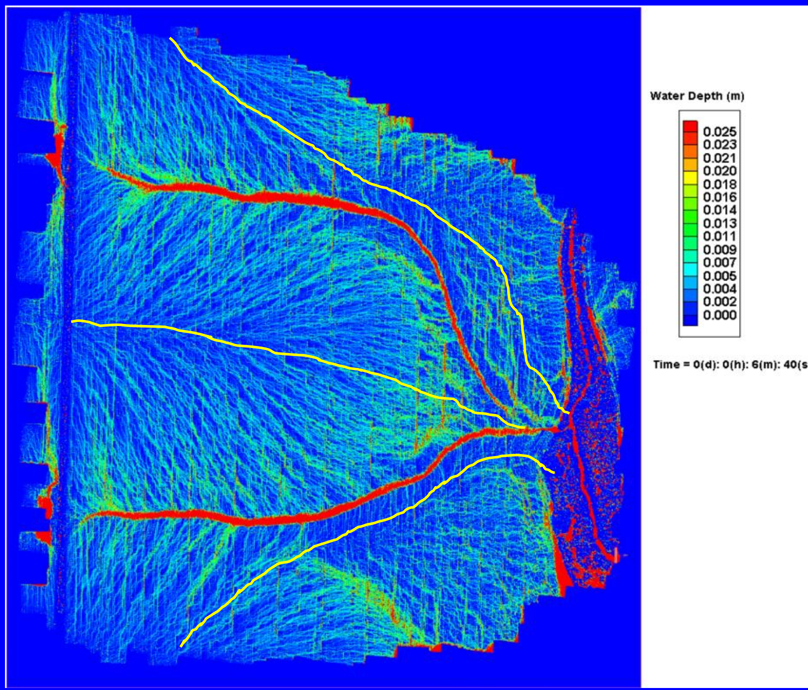
Simulated bed elevation change at t=895min

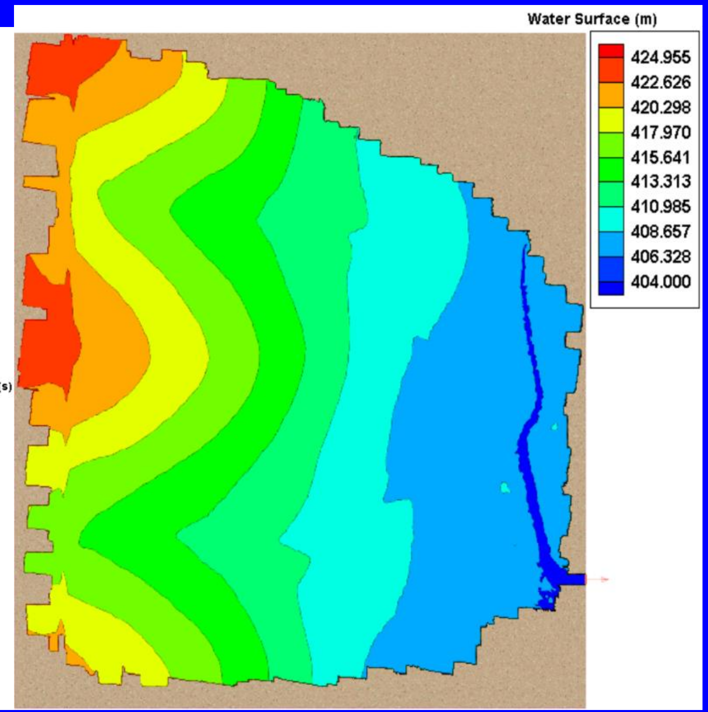
Simulated bed elevation change at t=1145min

Observed bed change from 645 min to 915 min

Observed bed change from 645 min to 1095 min

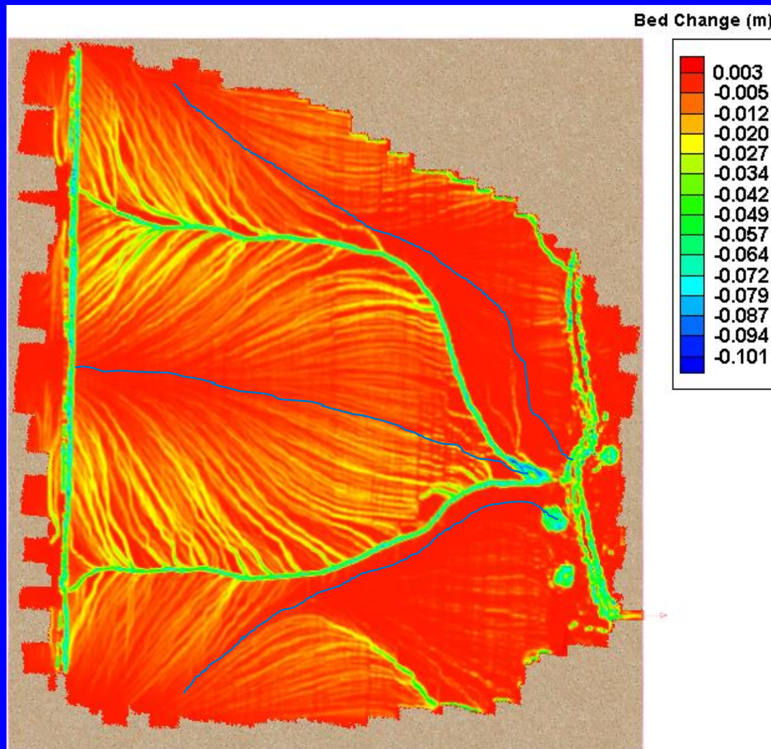

CCHE2D-Watershed
Bed Change (m)
0.000
-0.000
-0.001
-0.001
-0.001
-0.002
-0.002
-0.002
-0.003
-0.003
-0.003
-0.004
-0.004
-0.004
-0.005
Time = 0(d): 0(h): 1(m): 40(s)

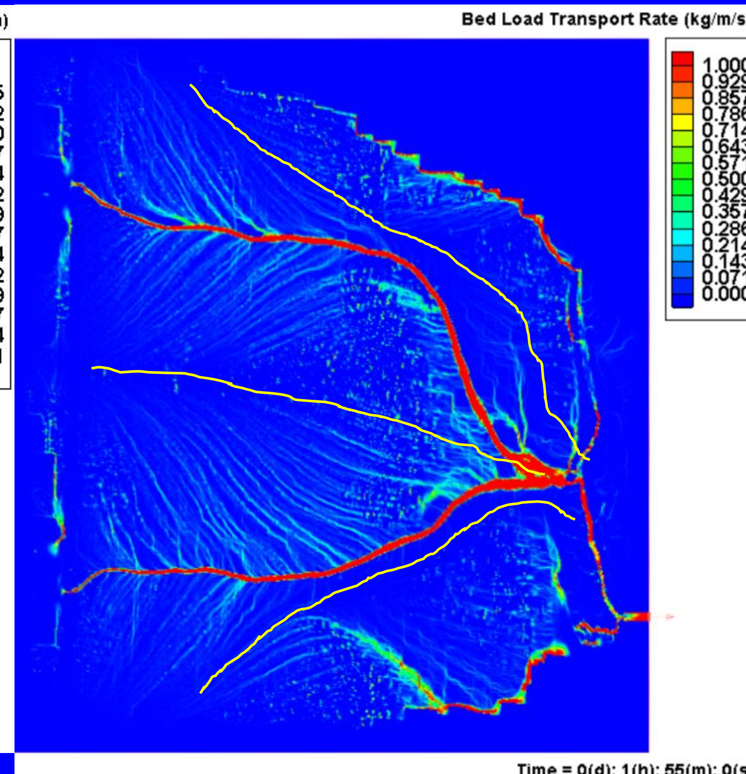




Simulated runoff water depth distribution near the peak of the rainfall. The yellow highlighted lines are divides between the sub-watersheds

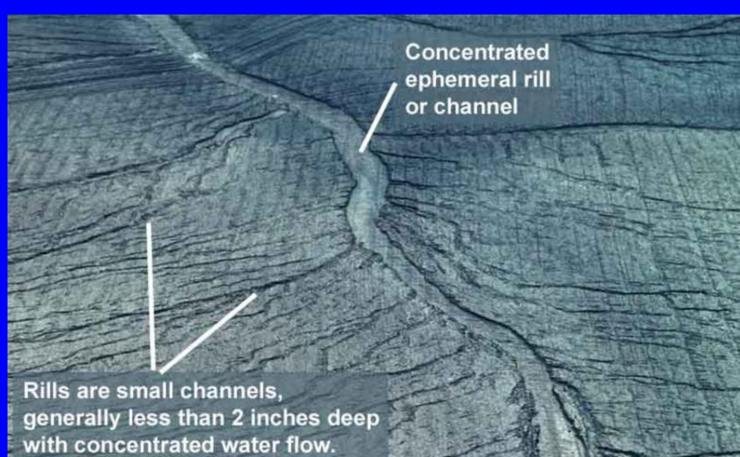
Watershed topography 250 m x250 m





Simulated soil erosion and gully incision in field watershed

Simulated sediment transport (sediment load) distribution at approximately 2 hours



Plant & Soil Sciences eLibrary[PRO]

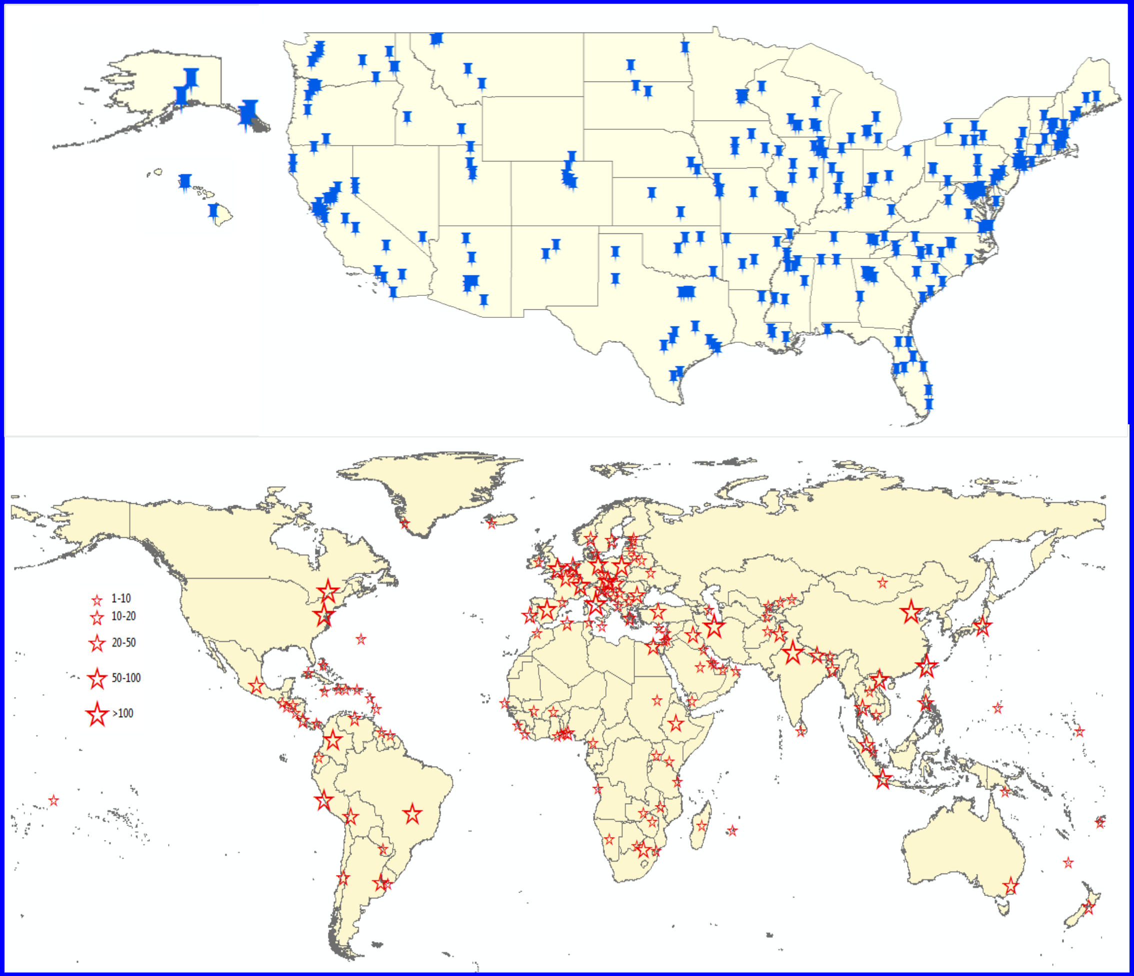
Summary

A procedure for numerical model verification and validation is presented. Computational examples are used to demonstrate:

- Mathematical verification for models' correctness
- Physical validation for models' capability of reproducing physics
- Application site validation for models' capability of solving real world problems in hydraulics and fluvial processes

This procedure is considered to be reliable and robust, it has been proven to be effective in enhancing the quality of CCHE3D/2D free surface flow models in the process of its development.

User Base of CCHE2D™



Thanks for your attention

Contact information:

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The University of Mississippi

jia@ncche.olemiss.edu

Cell Phone 662 202 6377

Office 662 915 7783