

**Modeling Watershed Erosion  
with CASC2D**

**Pierre Julien**  
**Rosalia Rojas Mark Velleux John F. England**

RCEM – U. Illinois  
October 2005

---

---

---

---

---

---

---

---

**PROBLEM: Upland Erosion**

*I  
n  
t  
r  
o  
d  
u  
c  
t  
i  
o  
n*



---

---

---

---

---

---

---

---

**PROBLEM: ... and Deposition**

*I  
n  
t  
r  
o  
d  
u  
c  
t  
i  
o  
n*



---

---

---

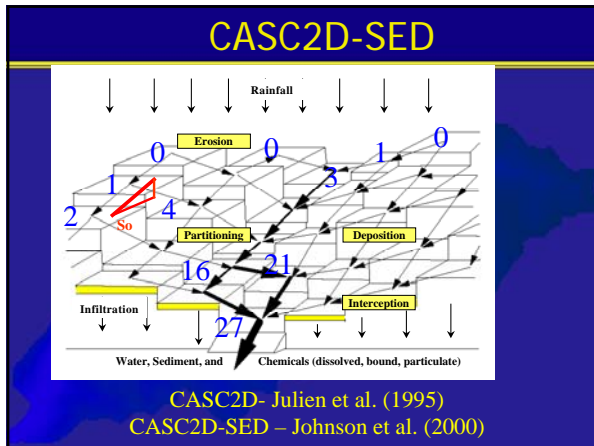
---

---

---

---

---




---

---

---

---

---

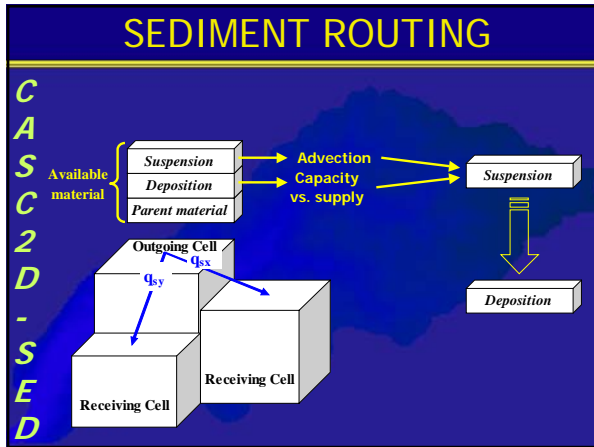
---

---

---

---

---




---

---

---

---

---

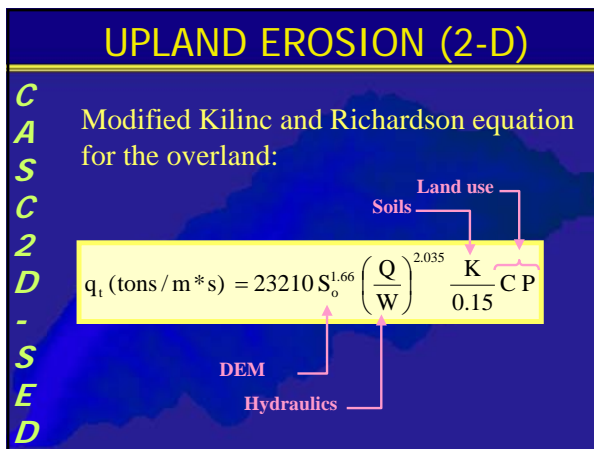
---

---

---

---

---




---

---

---

---

---

---

---

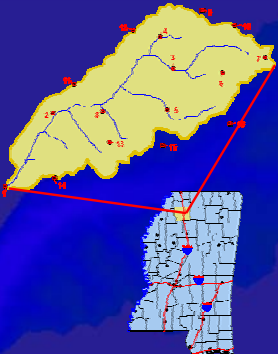
---

---

---

## Goodwin Creek Watershed

A  
p  
p  
l  
i  
c  
a  
t  
i  
o  
n



- Location: Panola County (MS)
- Area: 21Km<sup>2</sup>
- Monitored by ARS-NSL (Oxford, MS)
  - 37 rain gages
  - 14 stream gages (water and sediment)
  - Channel surveys
  - GIS data

---

---

---

---

---

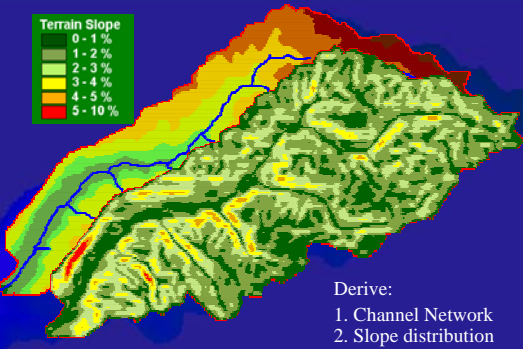
---

---

---

## INPUT DATA (DEM)

A  
p  
p  
l  
i  
c  
a  
t  
i  
o  
n



Derive:

1. Channel Network
2. Slope distribution

---

---

---

---

---

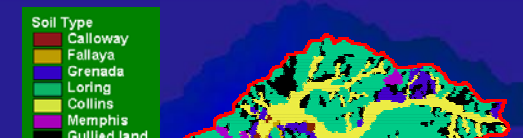
---

---

---

## INPUT DATA (soil type)

A  
p  
p  
l  
i  
c  
a  
t  
i  
o  
n



Soil Parameters		Number of different soil types: 7						
Soil Type	Soil Index	Infiltration			Erosion			
		Hydr. Cond. [cm/h]	Suction Head [cm]	Moisture Deficit [cm <sup>3</sup> /cm <sup>3</sup> ]	Sand [%]	Silt [%]	Clay [%]	K <sub>sed</sub> [-]
Calloway	1	0.350	22	0.34	0.25	0.55	0.20	0.4
Fallaya	2	0.320	14	0.34	0.25	0.55	0.20	0.1
Grenada	3	0.370	17	0.34	0.3	0.6	0.10	0.2
Loring	4	0.380	22	0.34	0.25	0.55	0.20	0.6
Collins	5	0.360	18	0.34	0.3	0.6	0.10	0.2
Memphar	6	0.450	22	0.34	0.3	0.6	0.10	0.5
Gullied Land	7	0.400	15	0.34	0.25	0.55	0.20	0.1

---

---

---

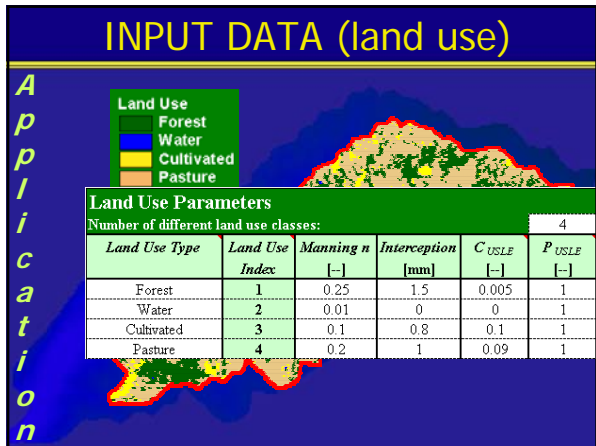
---

---

---

---

---




---

---

---

---

---

---

---

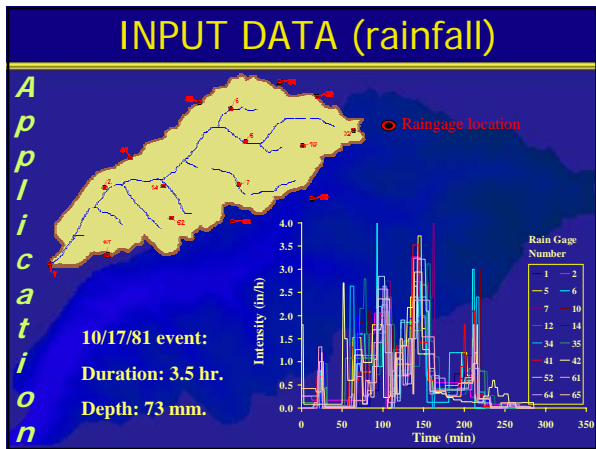
---

---

---

---

---




---

---

---

---

---

---

---

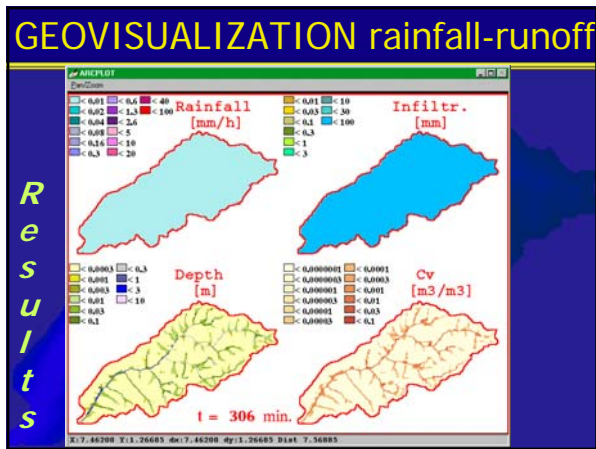
---

---

---

---

---




---

---

---

---

---

---

---

---

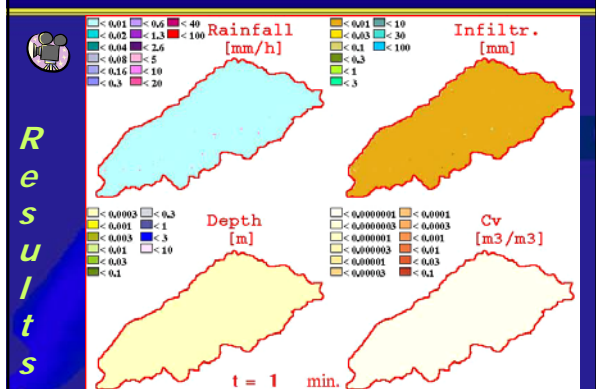
---

---

---

---

# GEOVISUALIZATION rainfall-runoff




---

---

---

---

---

---

---

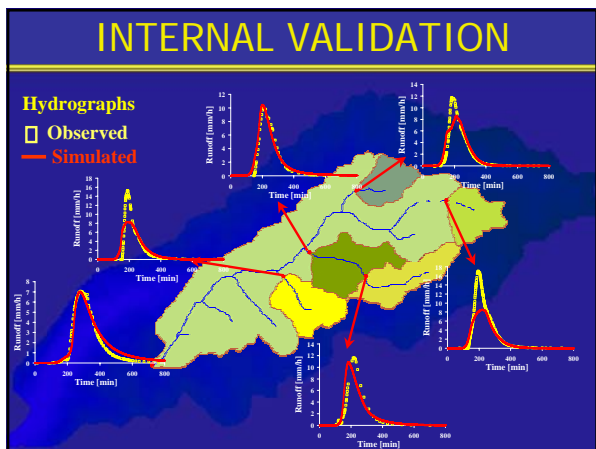
---

---

---

---

---




---

---

---

---

---

---

---

---

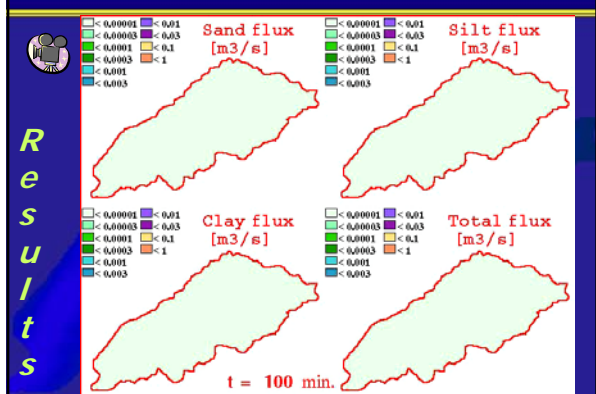
---

---

---

---

# GEOVISUALIZATION sed. flux




---

---

---

---

---

---

---

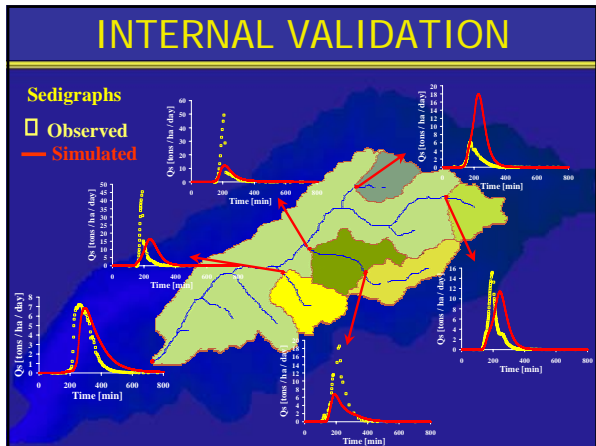
---

---

---

---

---




---

---

---

---

---

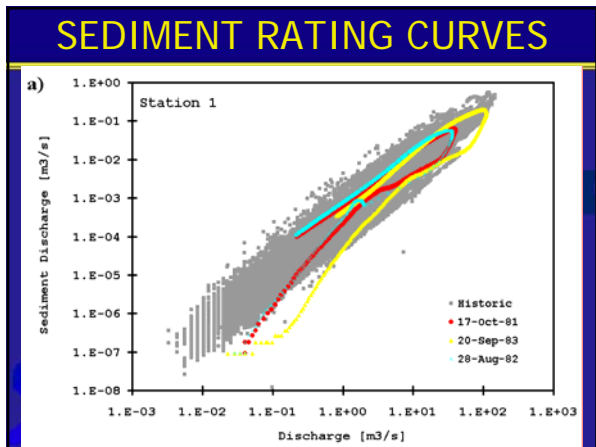
---

---

---

---

---




---

---

---

---

---

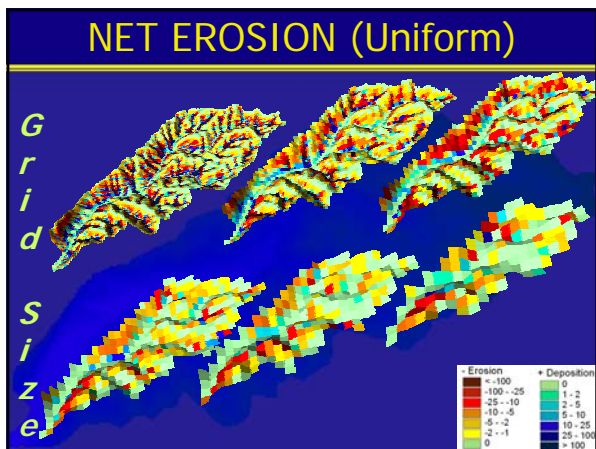
---

---

---

---

---




---

---

---

---

---

---

---

---

---

---

## CASC2D-SED Web Page

- At Colorado State University
- Under direction of Dr. Pierre Julien

• [pierre@enqr.colostate.edu](mailto:pierre@enqr.colostate.edu)

- Current manual, source code, example, MPEG movies

• [http://www.enqr.colostate.edu/%7epierre/ce\\_old/projects/casc2d-Rosalia/index.htm](http://www.enqr.colostate.edu/%7epierre/ce_old/projects/casc2d-Rosalia/index.htm)

---

---

---

---

---

---

---

---



---

---

---

---

---

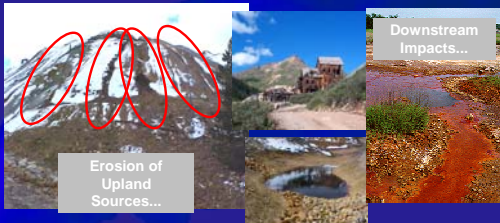
---

---

---

## Current Research

- Tool to quantify metal transport from upland sources to downstream channels



---

---

---

---

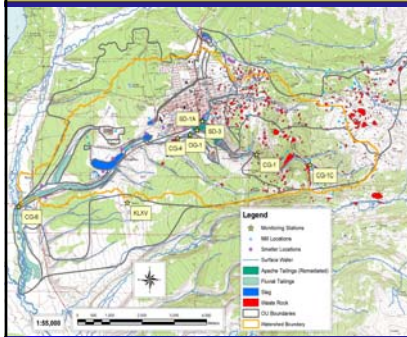
---

---

---

---

## Model Application to California Gulch



**Elevation Range:**  
2909 - 3654 m

**Mean Slope:** 12.6 %

**Topography:**  
Basin is 30.6 km<sup>2</sup>

**Transport Issue:**  
Contaminant sources distributed across site (~2000 sources)

**Metals:** Cd, Cu, Zn

**Toxicity to fish and benthos downstream**

---

---

---

---

---

---

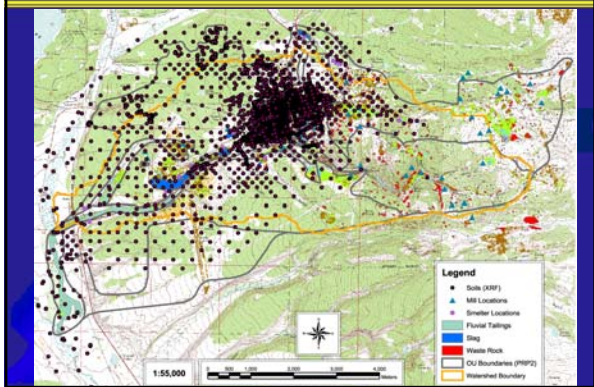
---

---

---

---

## Contaminant Characterization: Soils



---

---

---

---

---

---

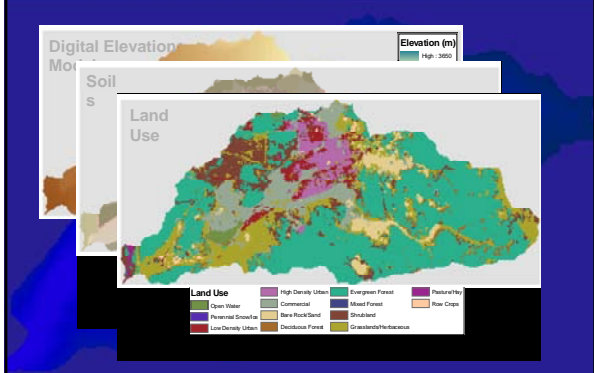
---

---

---

---

## Spatially Distributed Model Inputs



---

---

---

---

---

---

---

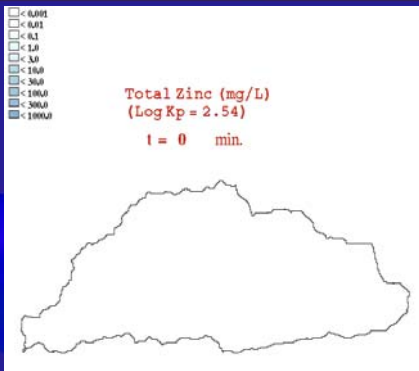
---

---

---



### Total Zinc Transport: June 12-13, 2005



---

---

---

---

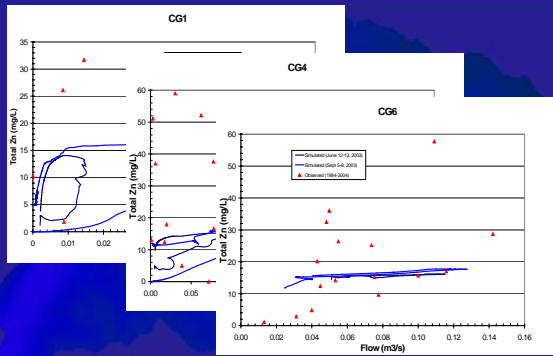
---

---

---

---

### Simulated vs. Observed Zinc



---

---

---

---

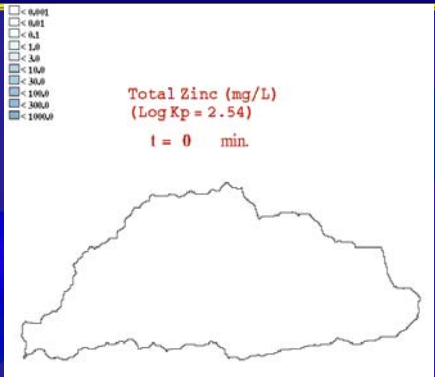
---

---

---

---

### Total Zinc Transport: 1-in-100-yr Event



---

---

---

---

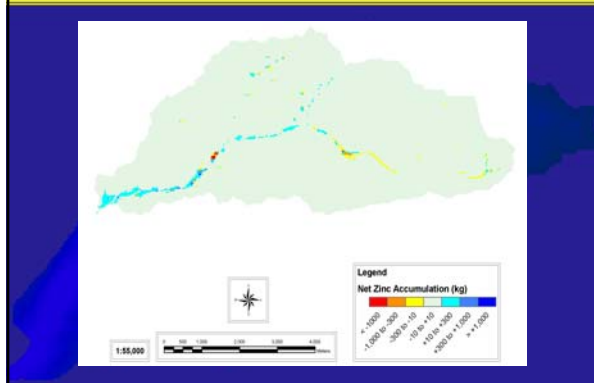
---

---

---

---

## Zinc Accumulation: 1-in-100-yr Event



---

---

---

---

---

---

---

---

## CONCLUSIONS

- CASC2D simulates the hydrologic response of watershed at resolutions of 30m.
- The model has been calibrated on several watersheds for water, sediment and metal fluxes.
- MPEG movies enhance the visualization of hydrologic processes including sediment and metals.
- The model is available on the web.

---

---

---

---

---

---

---

---

## ASCE Journal of Hydraulic Engineering



---

---

---

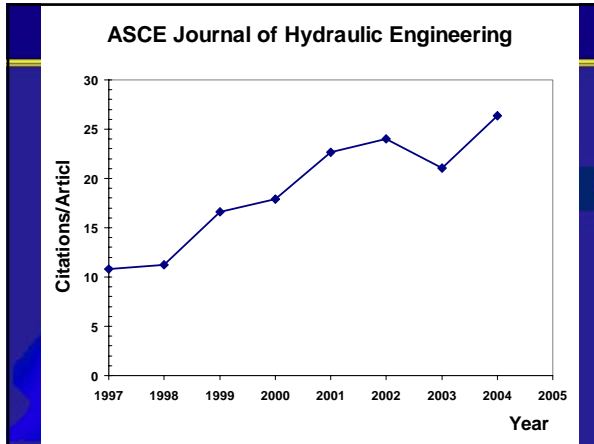
---

---

---

---

---




---

---

---

---

---

---

---

---

[pierre@engr.colostate.edu](mailto:pierre@engr.colostate.edu)

**Erosion and Sedimentation**

**River Mechanics**  
Pierre Y. Julien

**THANK YOU!**

---

---

---

---

---

---

---

---