Avances en la modelacion de avenidas subitas, transporte de sedimentos y contaminantes con TREX

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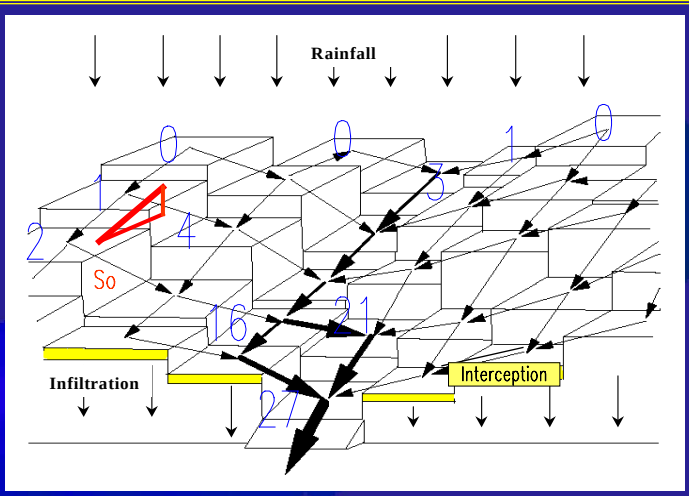
PROBLEM: Upland Erosion

Introduction

PROBLEM: ... and Deposition

Introduction

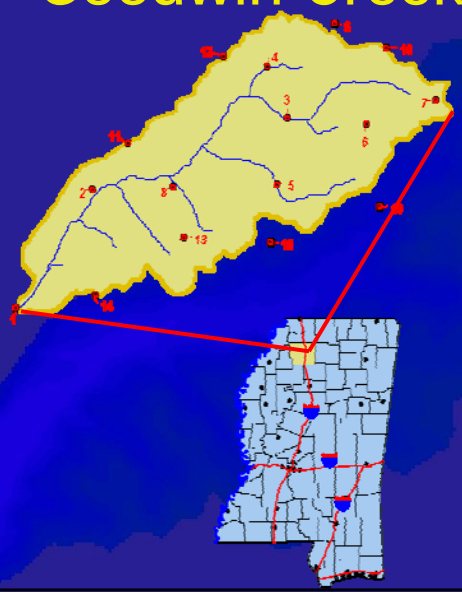
CASC2D-SED



CASC2D- Julien et al. (1995)
CASC2D-SED – Johnson et al. (2000), Rojas (2002)

Goodwin Creek Watershed

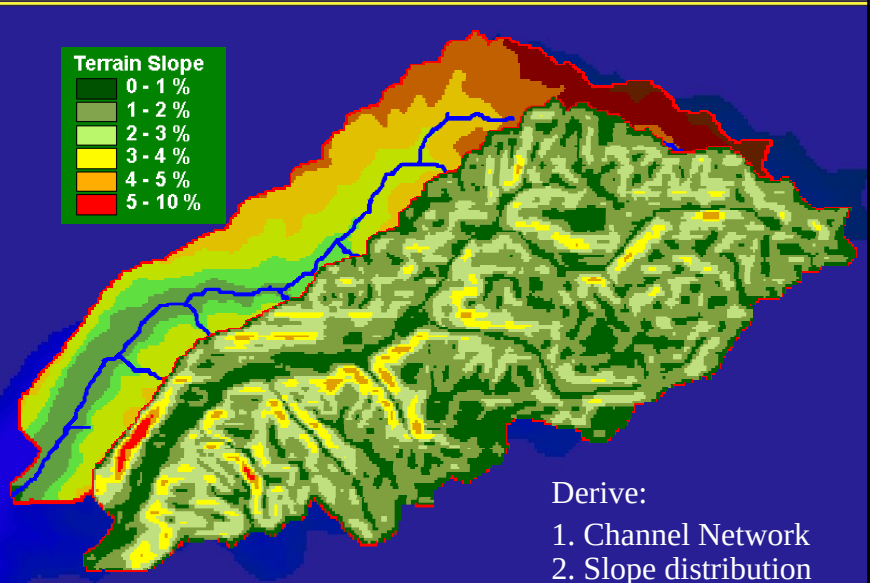
Application



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

INPUT DATA (DEM)

Application

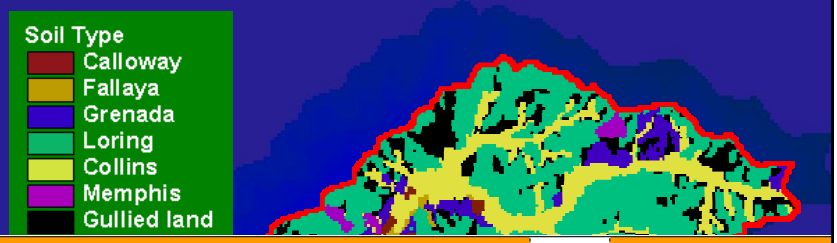


Derive:

1. Channel Network
2. Slope distribution

INPUT DATA (soil type)

Application

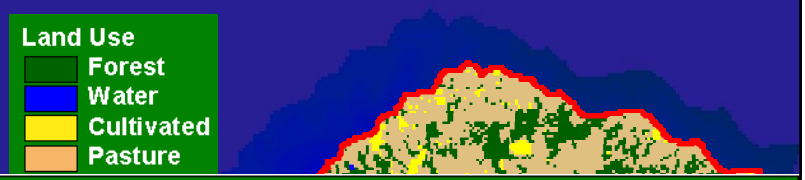


Soil Parameters — Number of different soil types: 7

		Infiltration			Erosion			
Soil Type	*Soil Index*	*Hydr. Cond.* [cm/h]	*Suction Head* [cm]	*Moisture Deficit* [cm3/cm3]	*Sand* [%]	*Silt* [%]	*Clay* [%]	K_{USLE} [--]
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
Memphis	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

INPUT DATA (land use)

Application



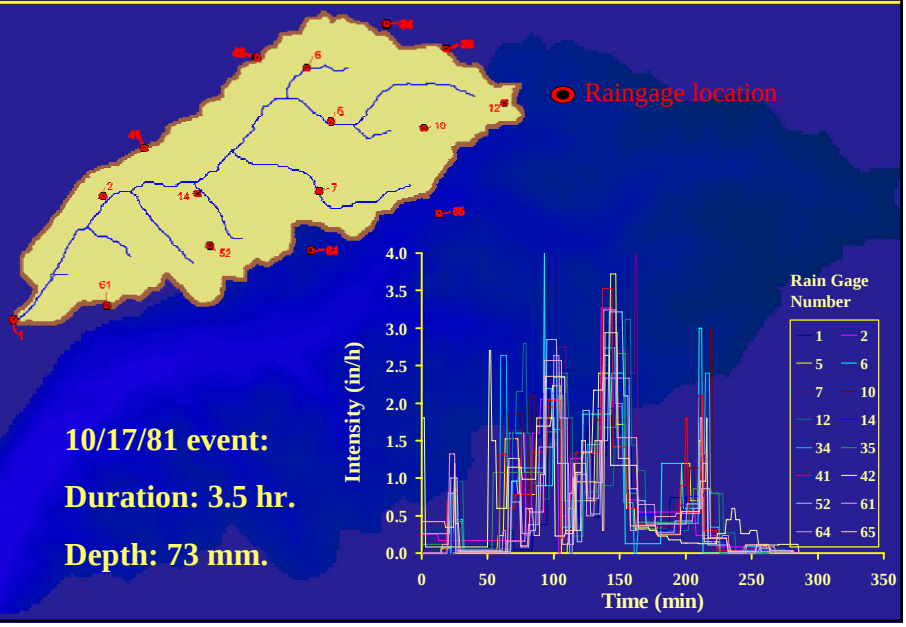
Land Use Parameters

Number of different land use classes: 4

Land Use Type	*Land Use Index*	*Manning n* [--]	*Interception* [mm]	C_{USLE} [--]	P_{USLE} [--]
Forest	1	0.25	1.5	0.005	1
Water	2	0.01	0	0	1
Cultivated	3	0.1	0.8	0.1	1
Pasture	4	0.2	1	0.09	1

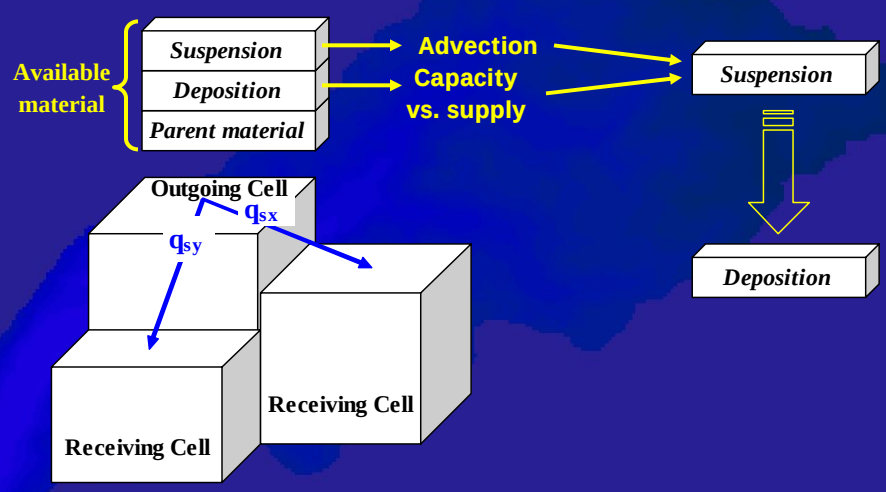
INPUT DATA (rainfall)

Application



SEDIMENT ROUTING

CASC2D-SED



CASC2D-SED

UPLAND EROSION (2-D)

Modified Kilinc and Richardson equation for the overland:

Land use

Soils

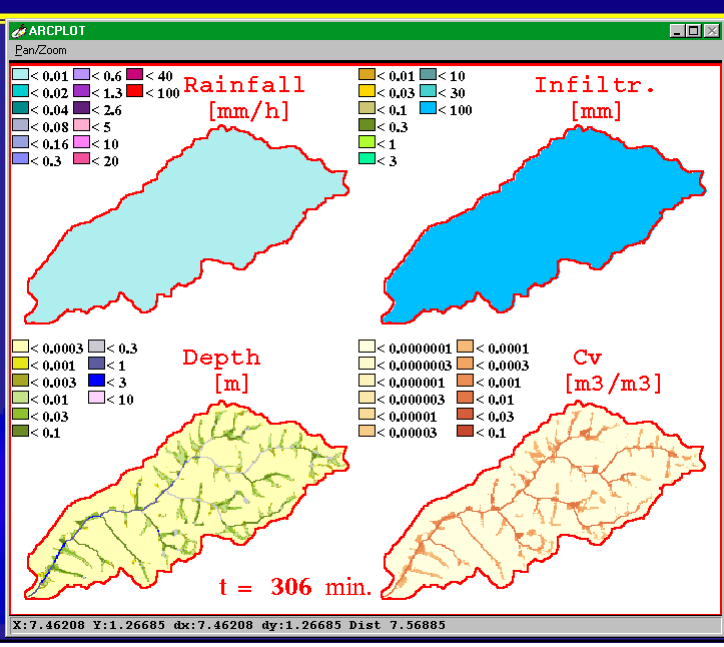
$$q_t\,(\text{tons}/\text{m}*\text{s}) = 23210\, S_o^{1.66} \left(\frac{Q}{W}\right)^{2.035} \frac{K}{0.15}\, C\, P$$

DEM

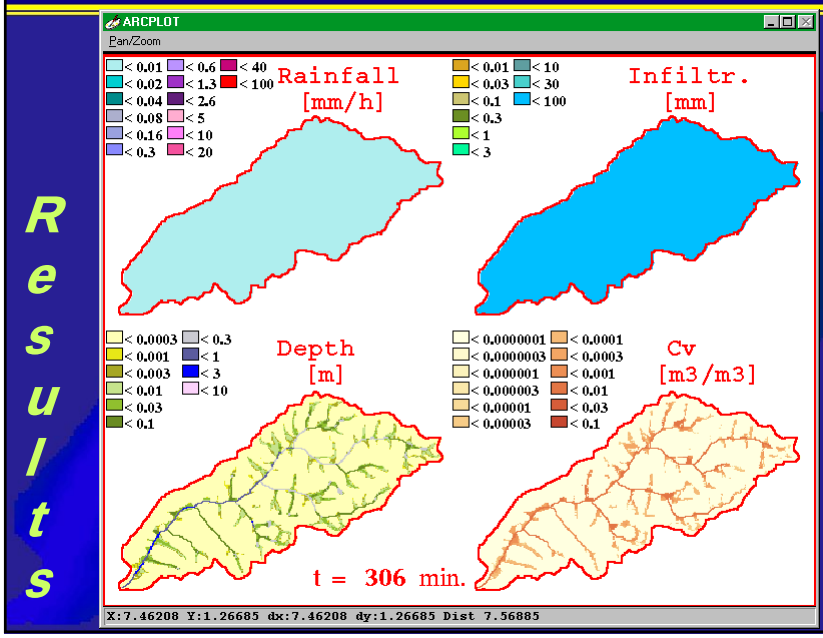
Hydraulics

GEOVISUALIZATION rainfall-runoff

Results

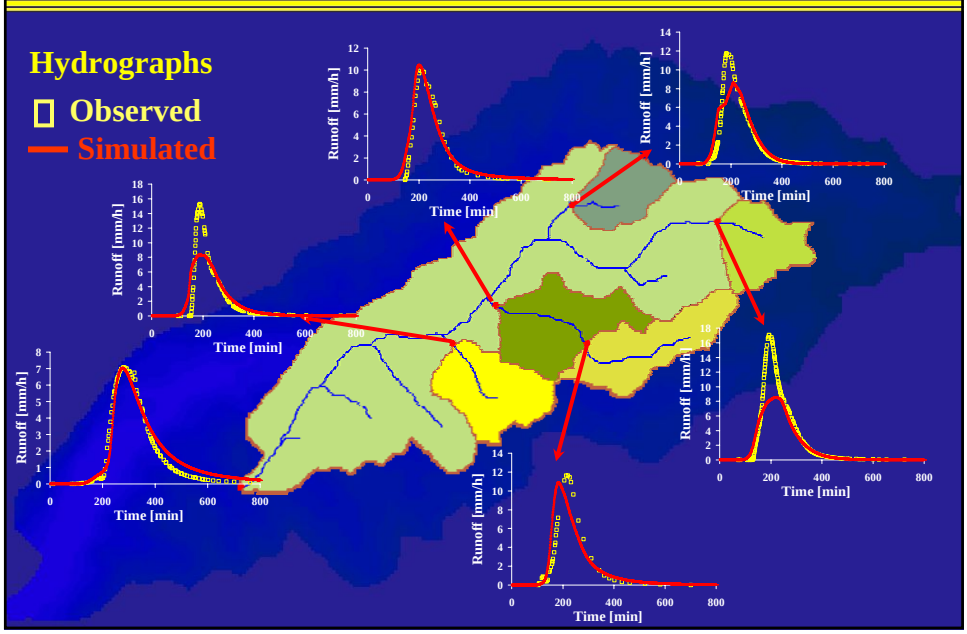


GEOVISUALIZATION rainfall-runoff

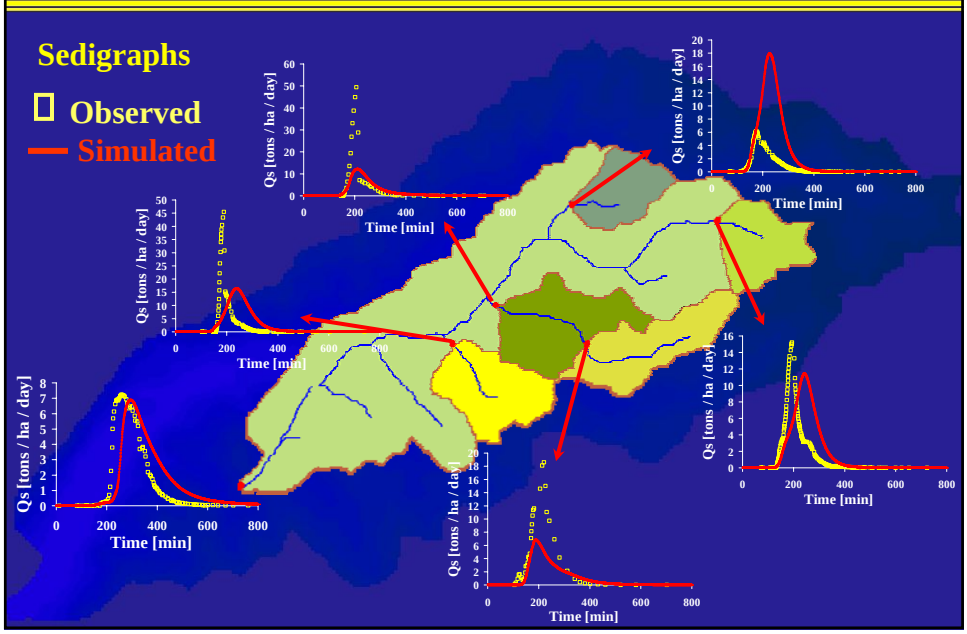


Results

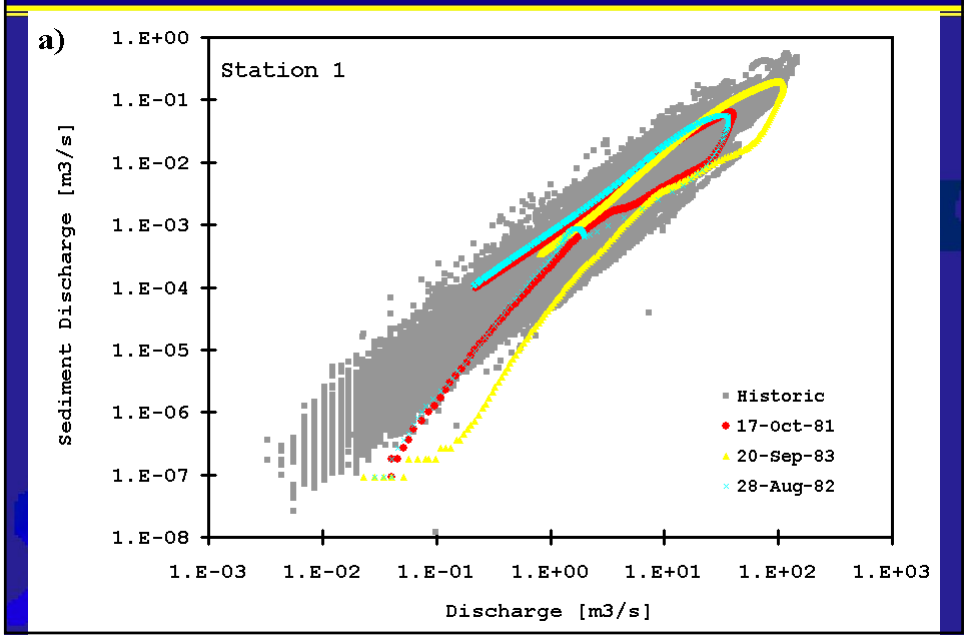
INTERNAL VALIDATION



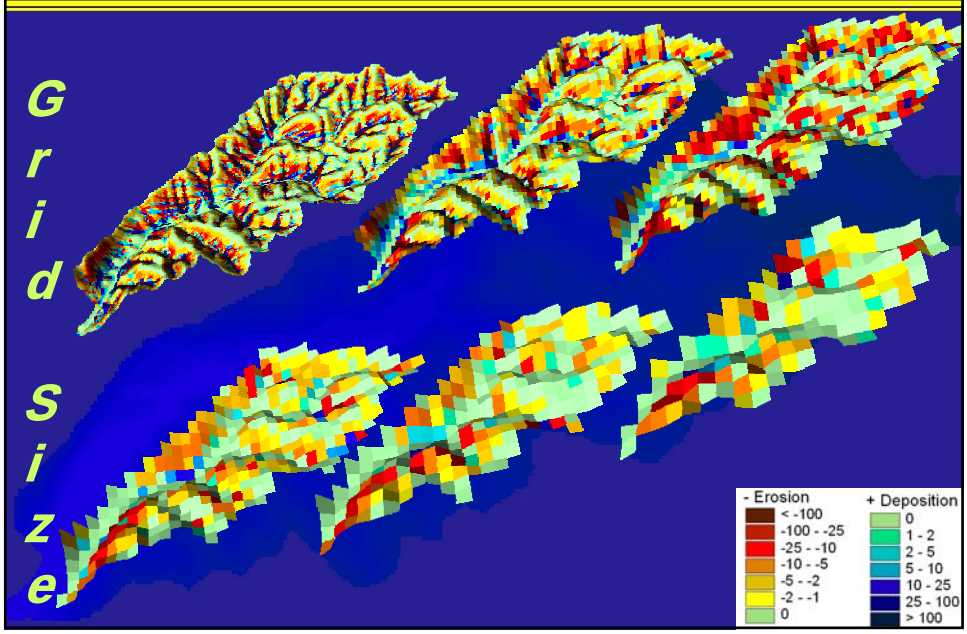
INTERNAL VALIDATION



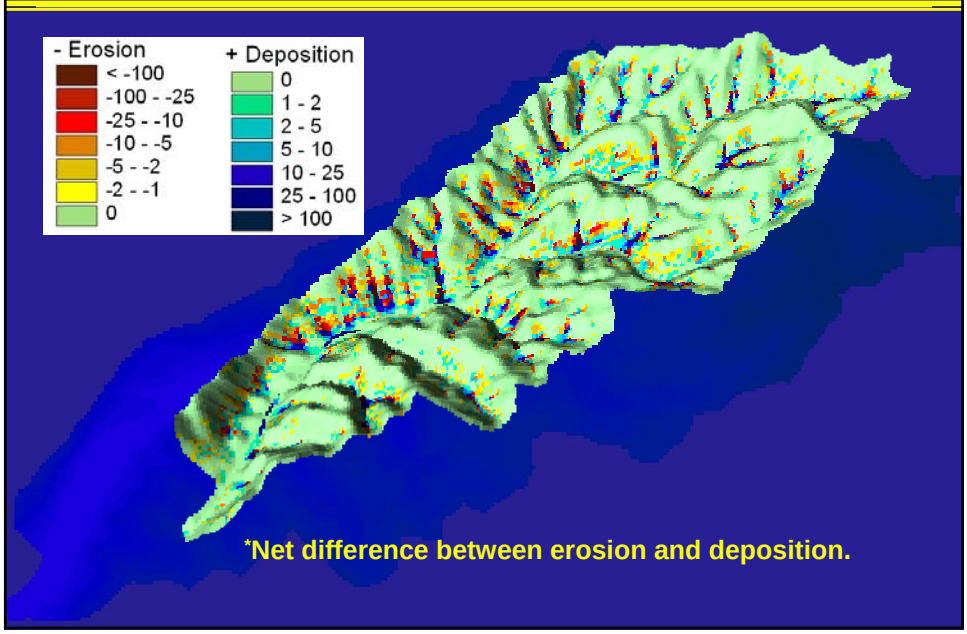
SEDIMENT RATING CURVES



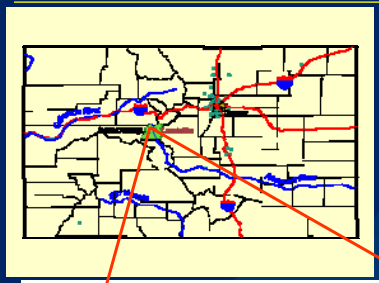
NET EROSION (Uniform)



Net Erosion and Deposition*

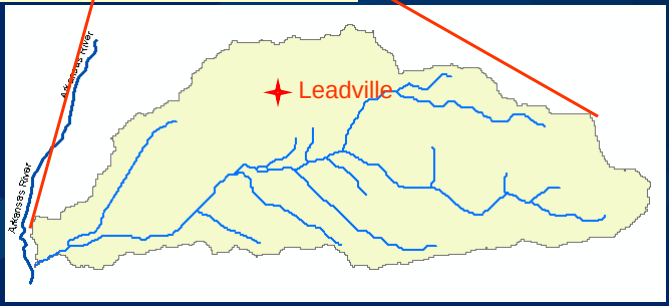


California Gulch Watershed

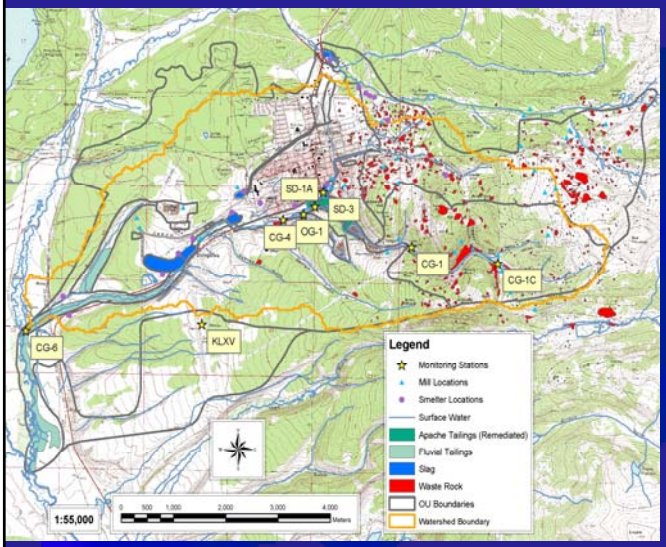


- EPA Superfund Site
- Location: Lake County (CO)

100-year flood: 2-h: 1.73 in



Model Application to California Gulch



Elevation Range:
2909 - 3654 m

Mean Slope: 12.6 %

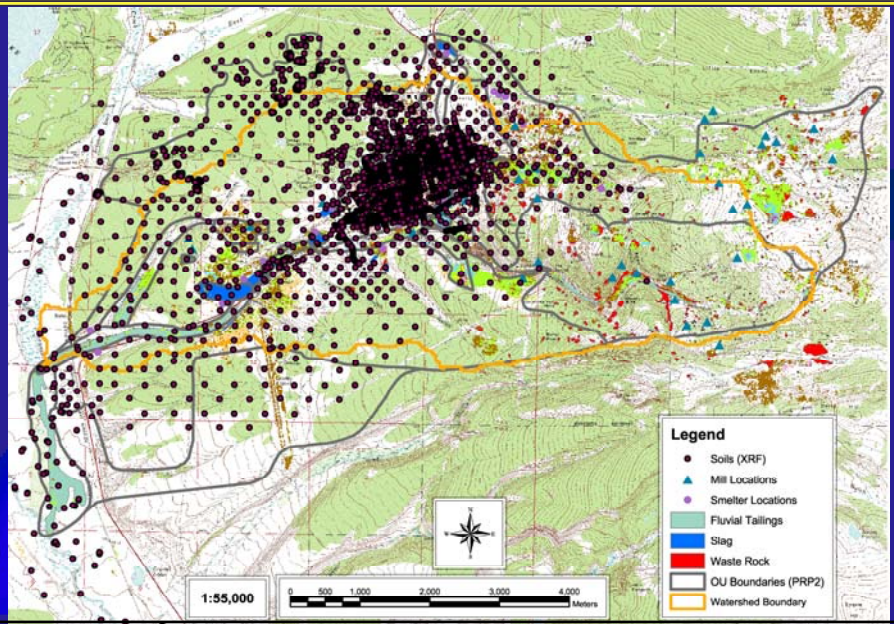
Topography:
Basin is 30.6 km²

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

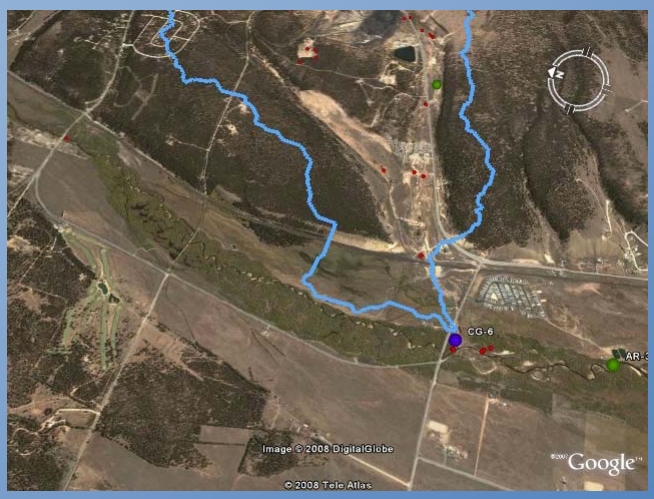
Metals: Cd, Cu, Zn

Toxicity to fish and benthos downstream

Contaminant Characterization: Soils



California Gulch, Colorado

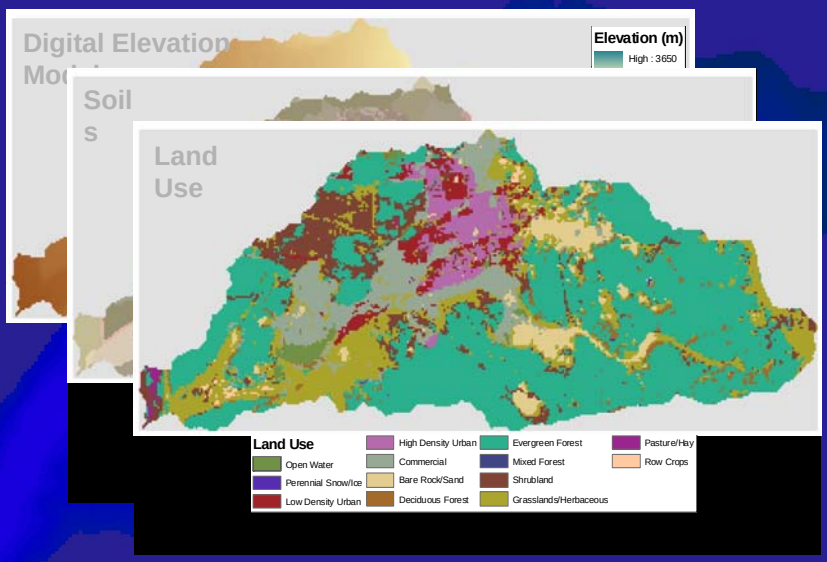


Data Locations:

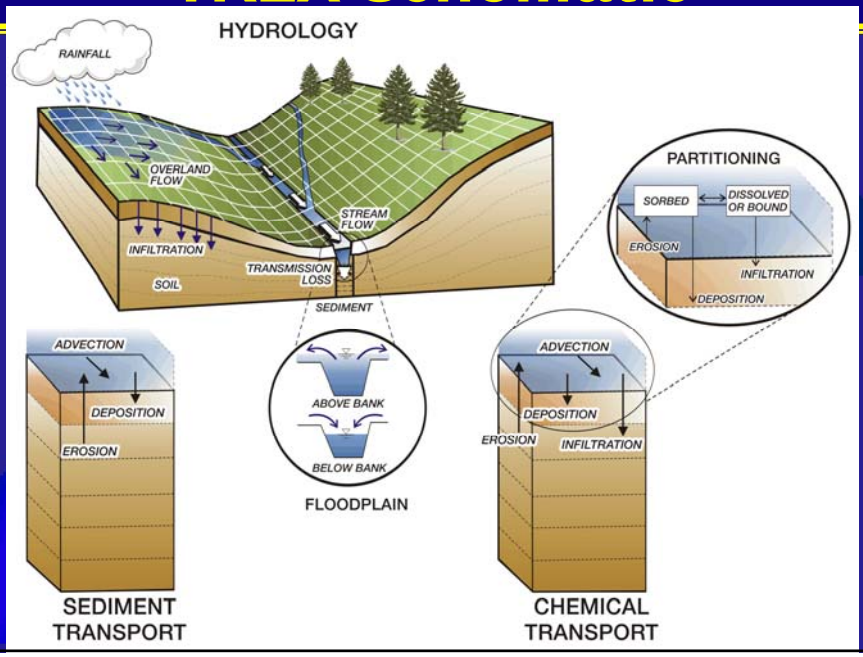
- Real-Time Fluvial
- Other
- Real-Time Precip. and Fluvial
- Airport Precip.

Erosion and Sediment Transport

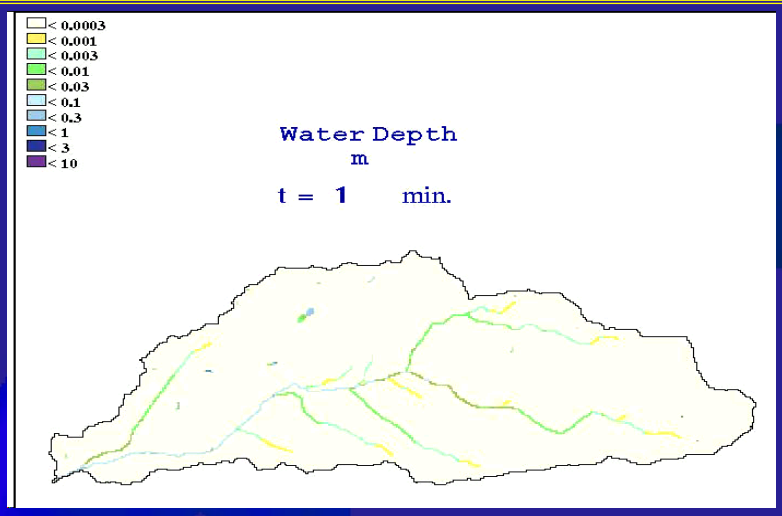
Spatially Distributed Model Inputs



TREX Schematic

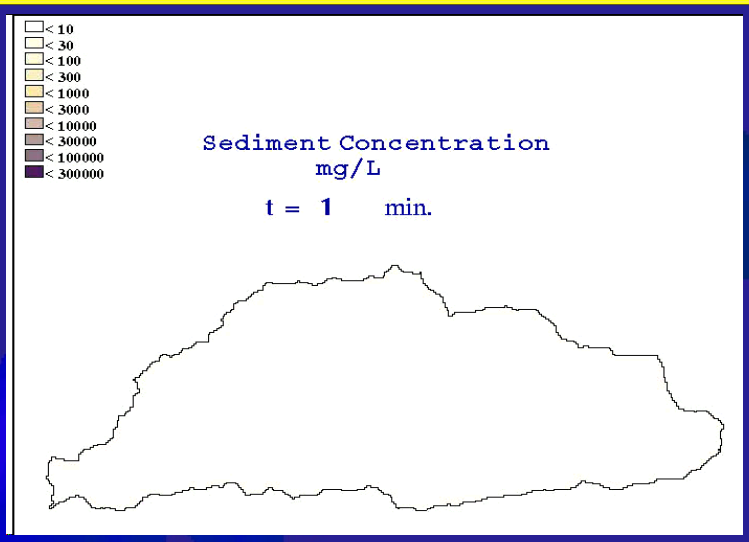


Water depths from a rainfall event*



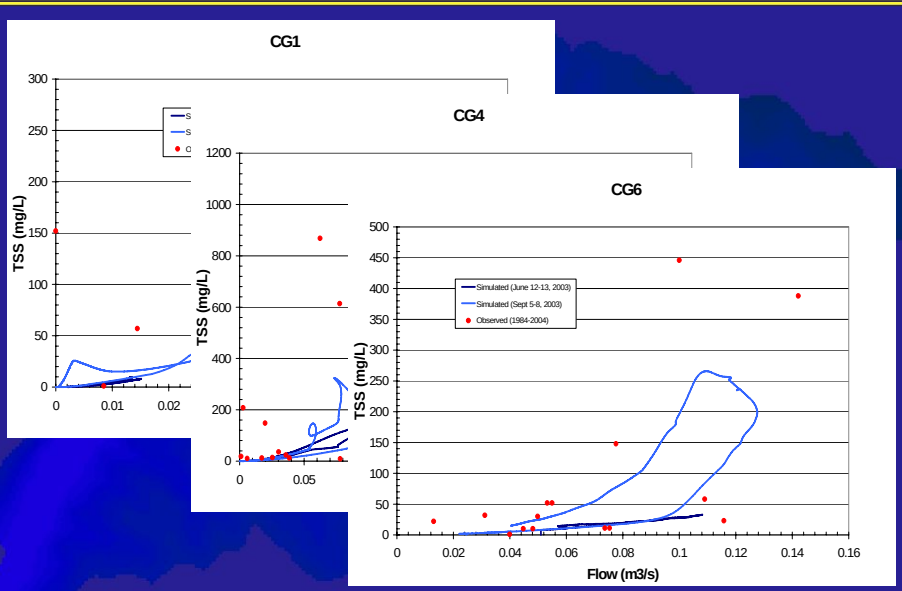
*1-in-100 year intensity, 2 hour duration uniform rainfall event.

Event transport of sediment (TSS)*

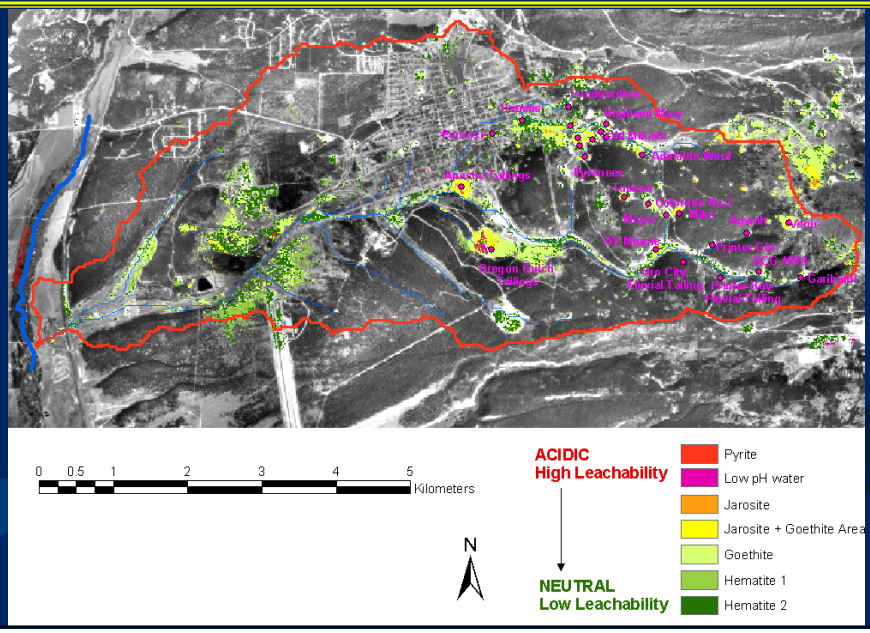


*Transport is computed by grain size. Total solids shown.

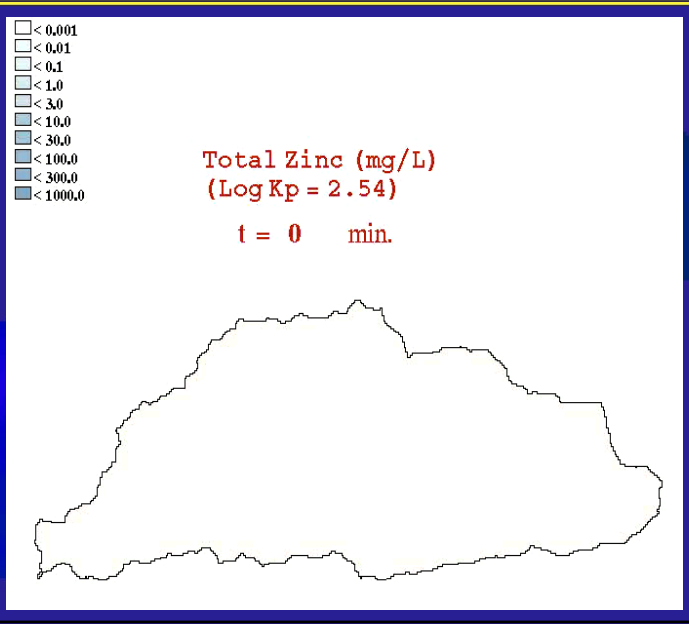
Simulated vs. Observed TSS



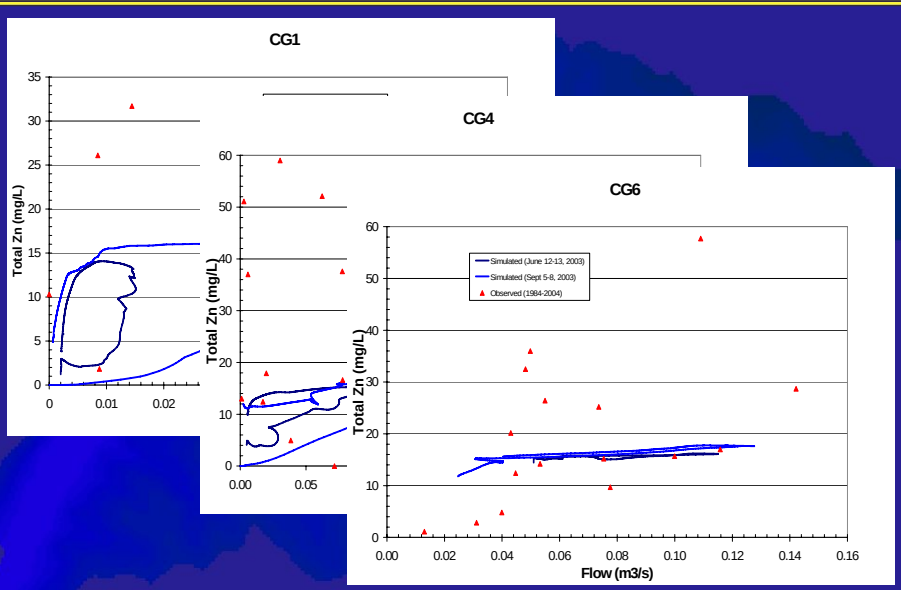
California Gulch Watershed



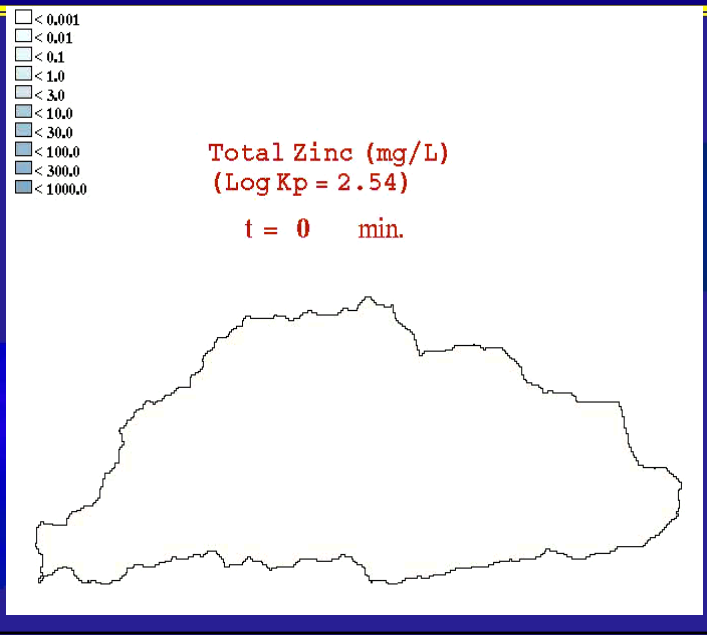
Total Zinc Transport: June 12-13, 2005



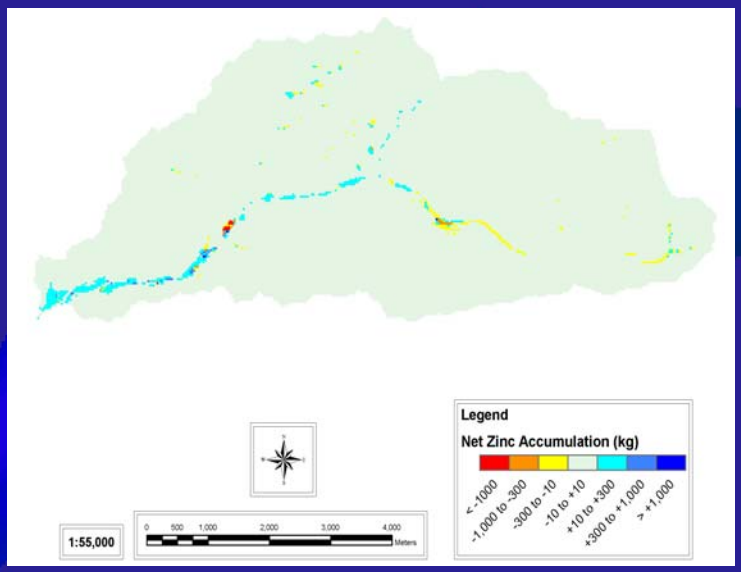
Simulated vs. Observed Zinc



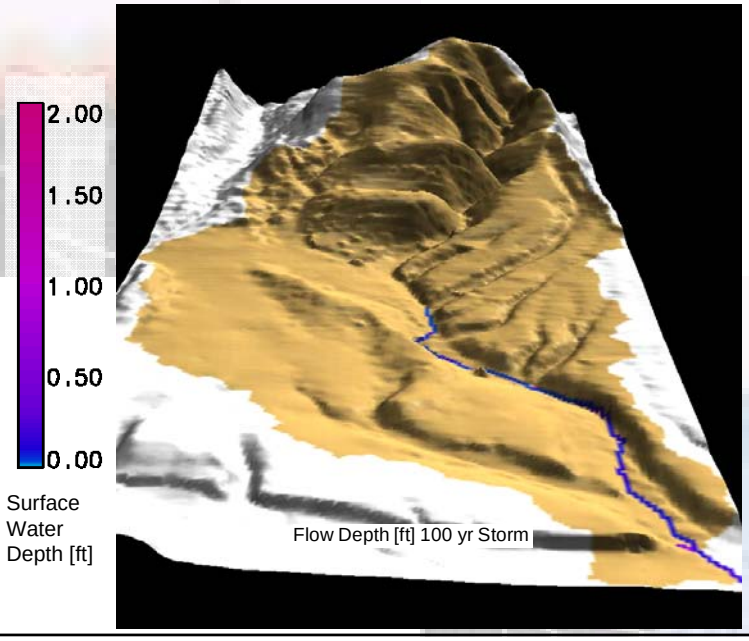
Total Zinc Transport: 1-in-100-yr Event



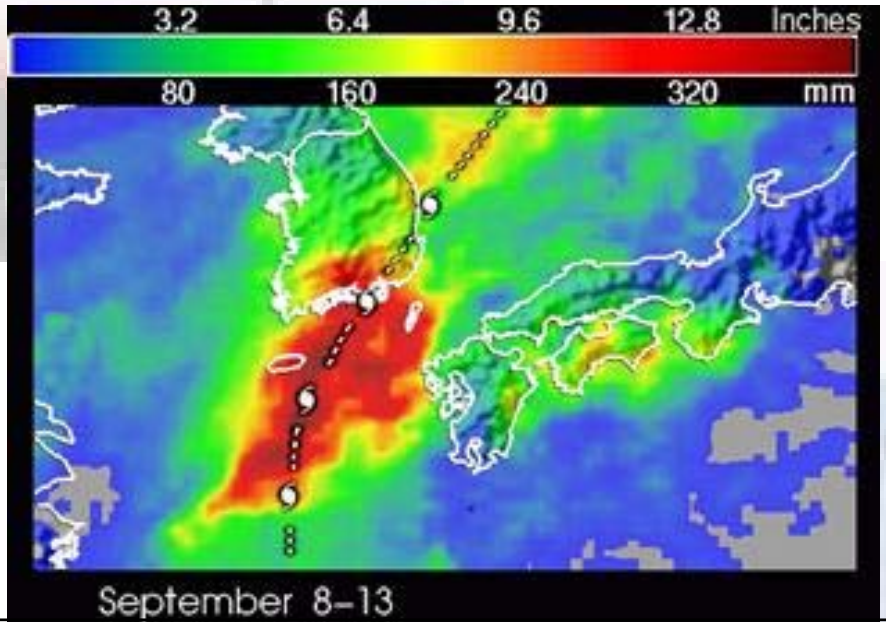
Zinc Accumulation: 1-in-100-yr Event



CSU Watershed Model TREX



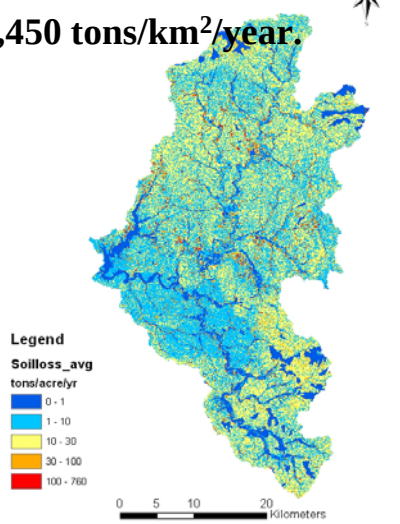
Total rainfall of Typhoon Maemi from 9/8/2003 to 9/13/2003)



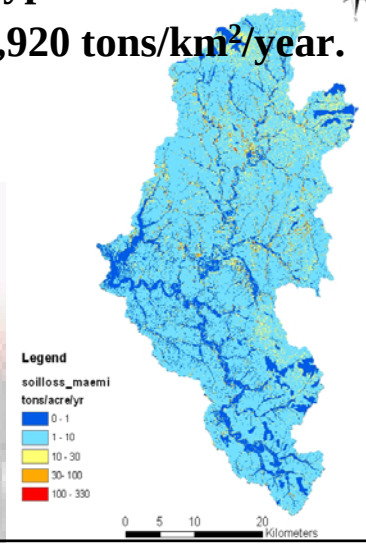
Mangun mountain, South Korea

Soil loss maps

Annual average:
3,450 tons/km^2/year.



Typhoon Maemi:
2,920 tons/km^2/year.



Imha reservoir

CONCLUSIONS

- TREX 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 … for free!

TREX and CASC2D-SED Web Pages

At Colorado State University
Under direction of Dr. Pierre Julien

pierre@engr.colostate.edu

Current manual, source code, example, MPEG movies

Acknowledgments

Dr. Mark Velleux, CSU, now Hydroqual

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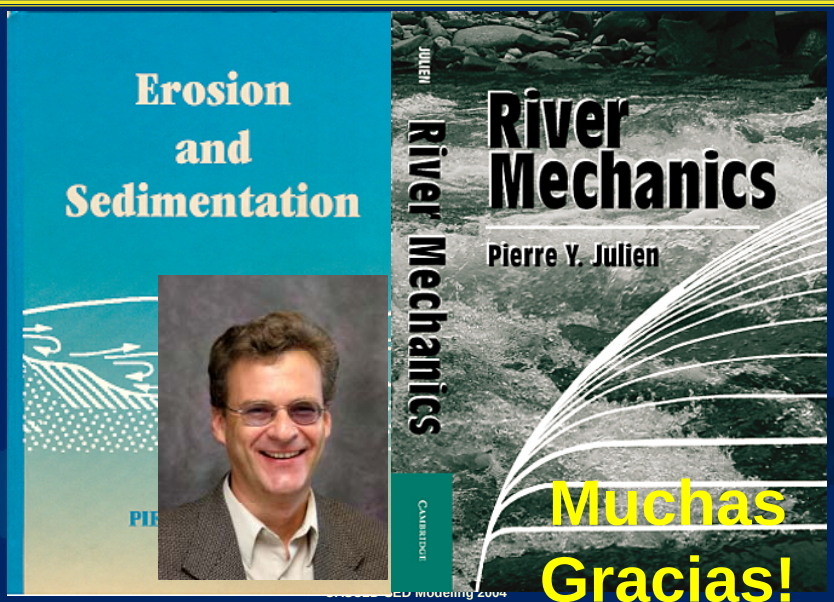
Dr. Rosalia Rojas, CSU

Hyeon Sik Kim, CSU, also KOWACO

James Halgren, PhD candidate at CSU

Seema Shah-Fairbank, PhD candidate at CSU

pierre@engr.colostate.edu



Muchas Gracias!