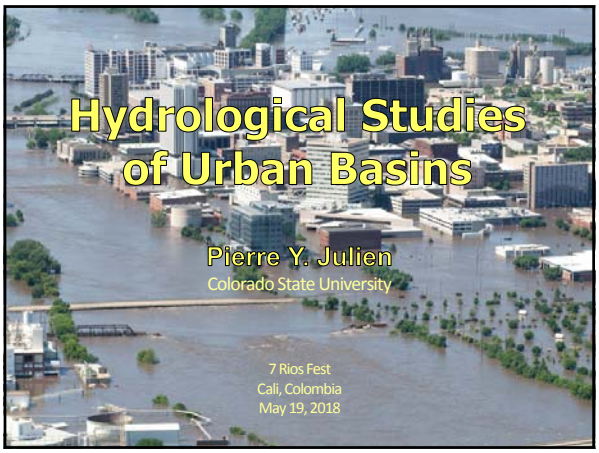

Hydrologic Studies of Urban Basins

1. Hydrologic Modeling
2. Stream Degradation
3. River Protection
4. Extreme Events
5. Other Issues

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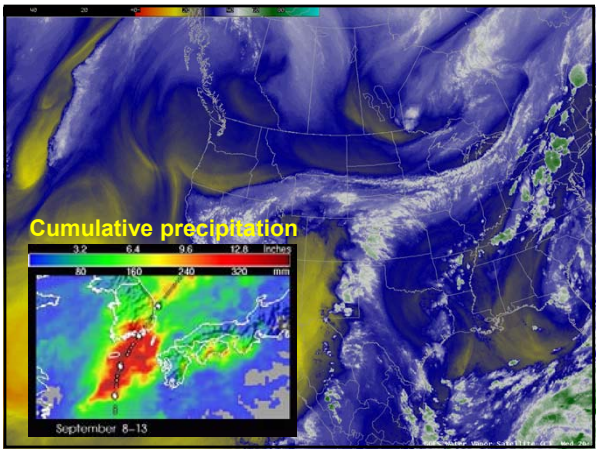
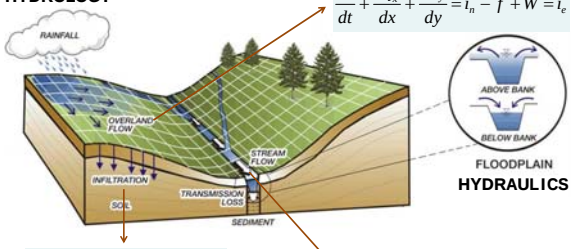


TREX: Two-dimensional Runoff Erosion and eXport

HYDROLOGY

$$\frac{\partial h}{dt} + \frac{\partial q_x}{dx} + \frac{\partial q_y}{dy} = i_n - f + \dot{W} = i_e$$



FLOODPLAIN HYDRAULICS

$$f = K_h \left(1 + \frac{H_c (1 - S_e)\theta_e}{F}\right)$$

$$\frac{\partial A}{dt} + \frac{\partial Q}{dx} = q_l + \hat{W}$$

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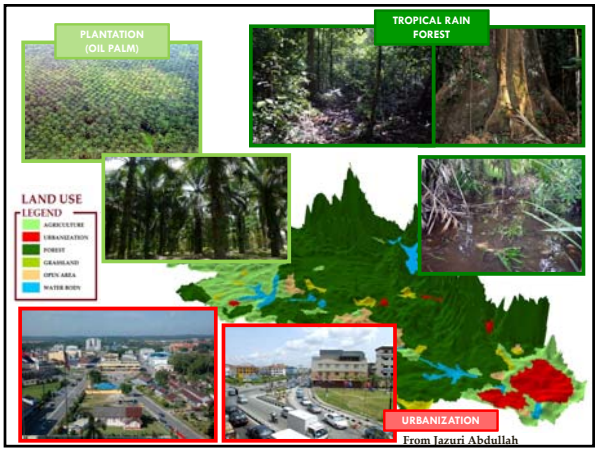
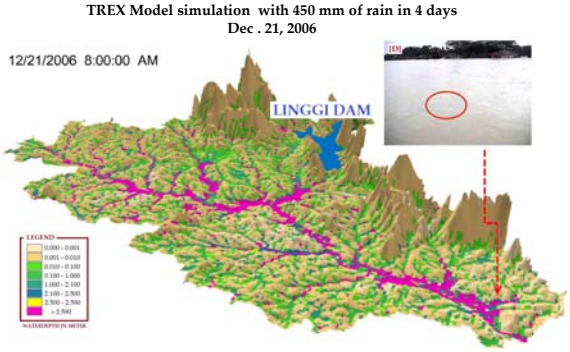


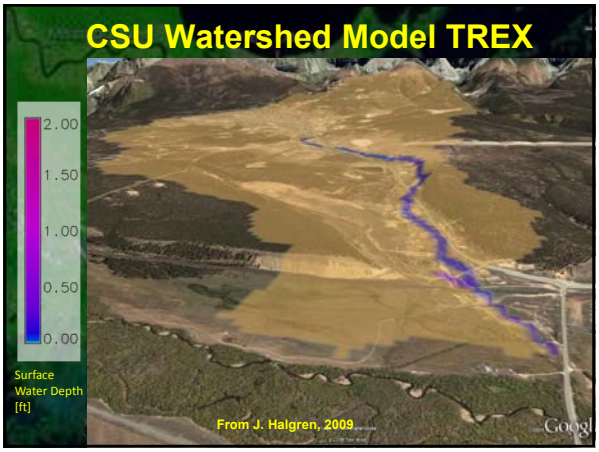
From Jazuri Abdullah

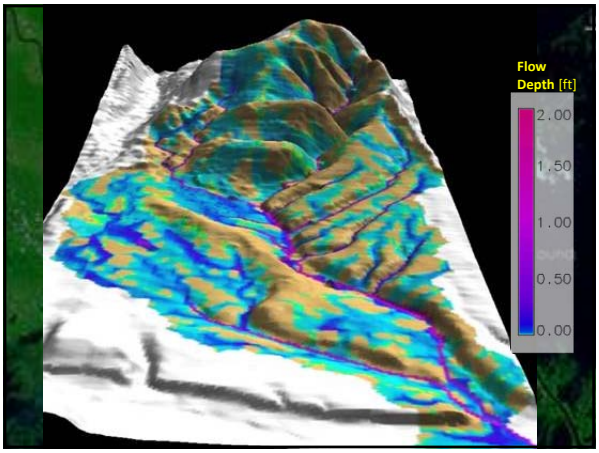
KOTA TINGGI FLOOD

TREX Model simulation with 450 mm of rain in 4 days
Dec . 21, 2006



Kampung Abdullah
New Town Centre
To Labis
Jalan Pee Kang Hai
Second Bridge
Jalan Sultan
Sungai Segamat
Jalan Hassan


CSU Watershed Model TREX
2.00
1.50
1.00
0.50
0.00
Surface Water Depth [ft]
From J. Halgren, 2009


Flow Depth [ft]
2.00
1.50
1.00
0.50
0.00

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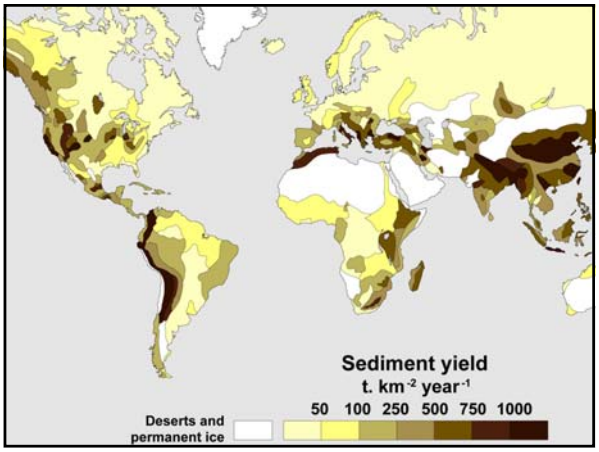
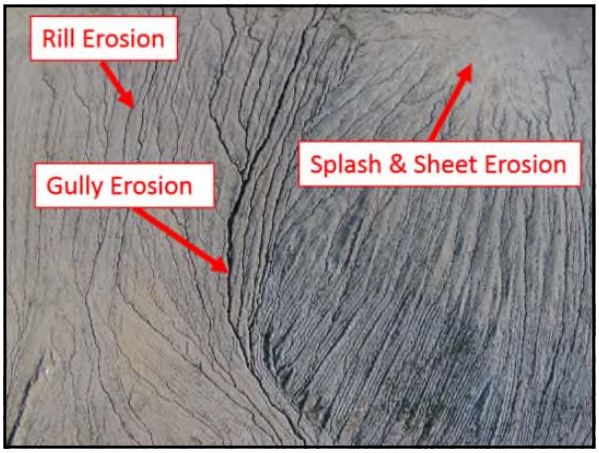
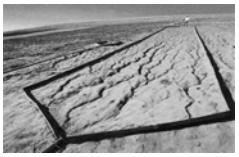




Revised Universal Soil-Loss Equation (RUSLE)



$$E = R\,K\,L\,S\,C\,P$$

- E: mean annual soil loss
- R : rainfall erosivity
- K : soil erodibility
- L : slope length
- S : slope steepness
- C : cropping management
- P : conservation practice

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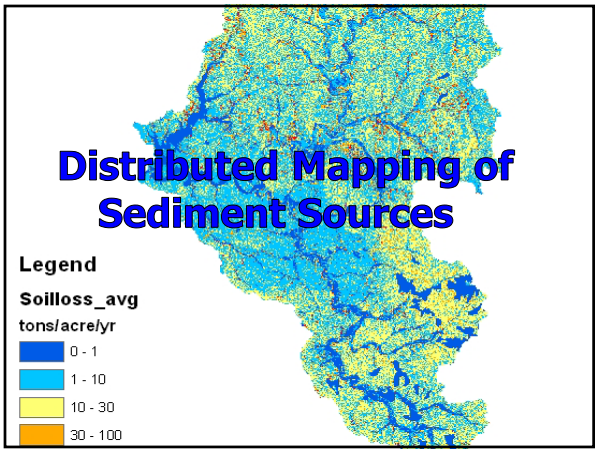
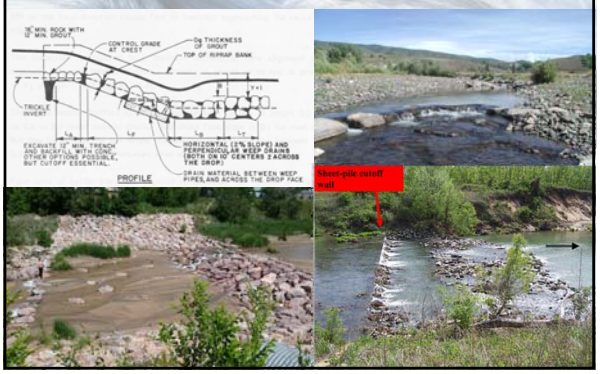


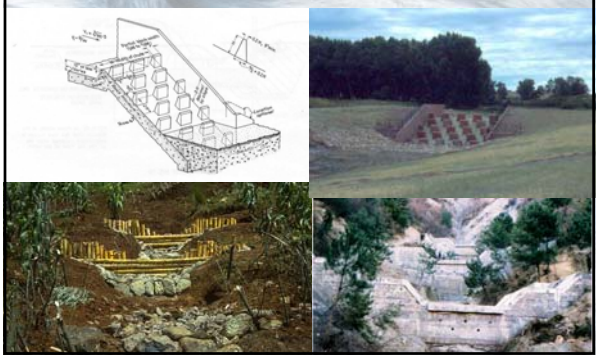
Upland Degradation Problems

Grade-control structures



Drop structures

Baffle drop structures



Steel and concrete

Hydrologic Studies of Urban Basins

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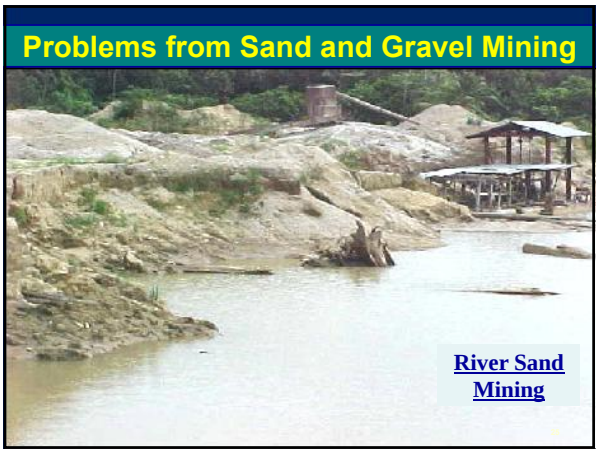
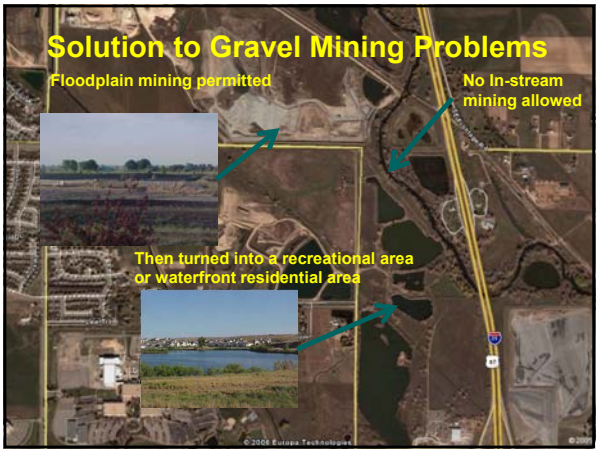
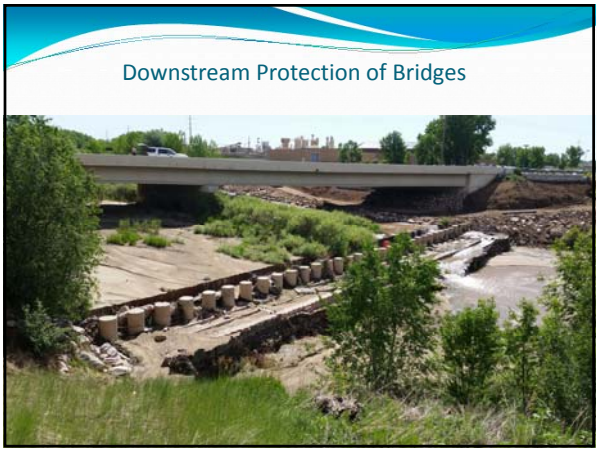

Problems from Sand and Gravel Mining
River Sand Mining

PLUS Highway
KG. BUKIT LALANG
PEKULA
Merdeka Bridge
KG. BUMBUNG LIMA


Solution to Gravel Mining Problems
Floodplain mining permitted
No In-stream mining allowed
Then turned into a recreational area or waterfront residential area



Hydrologic Studies of Urban Basins

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New Orleans in August 2005
after Hurricane Katrina
Damage $108 billions

Los Corales, Venezuela, 1999

Mt. Umyon, Seoul, South Korea

Hydrologic Studies of Urban Basins

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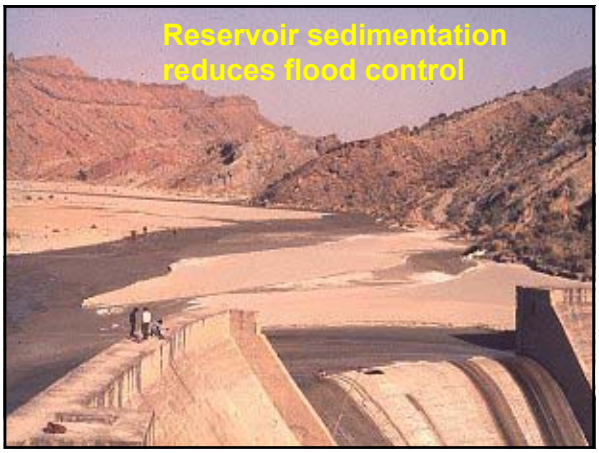
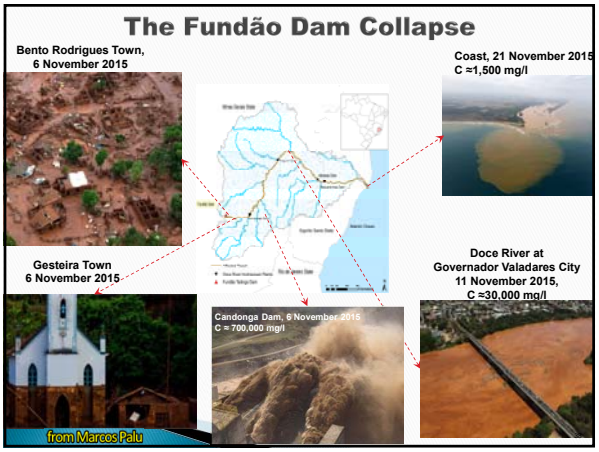

Reservoir sedimentation
reduces flood control


The Fundão Dam Collapse
Bento Rodrigues Town,
6 November 2015
Coast, 21 November 2015
C ≈1,500 mg/l
Gesteira Town
6 November 2015
Doce River at
Governador Valadares City
11 November 2015,
C ≈30,000 mg/l
Candonga Dam, 6 November 2015
C ≈ 700,000 mg/l
from Marcos Palu

Waldo Fire
Colorado June 2012

Summary and Conclusions

1. Hydrologic Modeling

Distributed models like TREX can simulate extreme floods

2. Stream Degradation

Urban streams usually require grade-control structures

3. River Protection

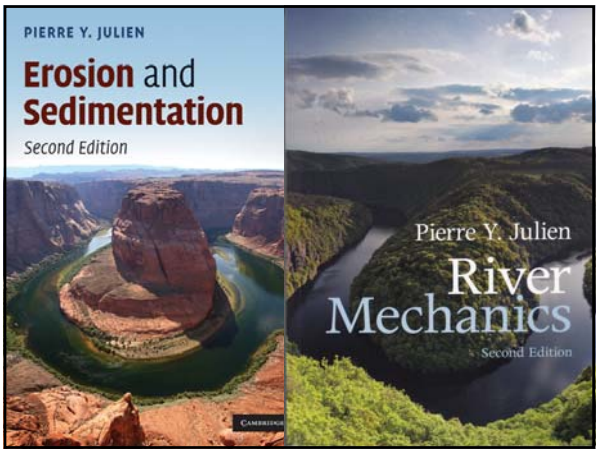
Protect bridges against degradation and gravel mining

4. Extreme Events

Extreme events can have devastating consequences

5. Other Issues

Beware of droughts, dam safety and water quality


PIERRE Y. JULIEN
Erosion and Sedimentation
Second Edition
Pierre Y. Julien
River Mechanics
Second Edition

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Pierre Julien