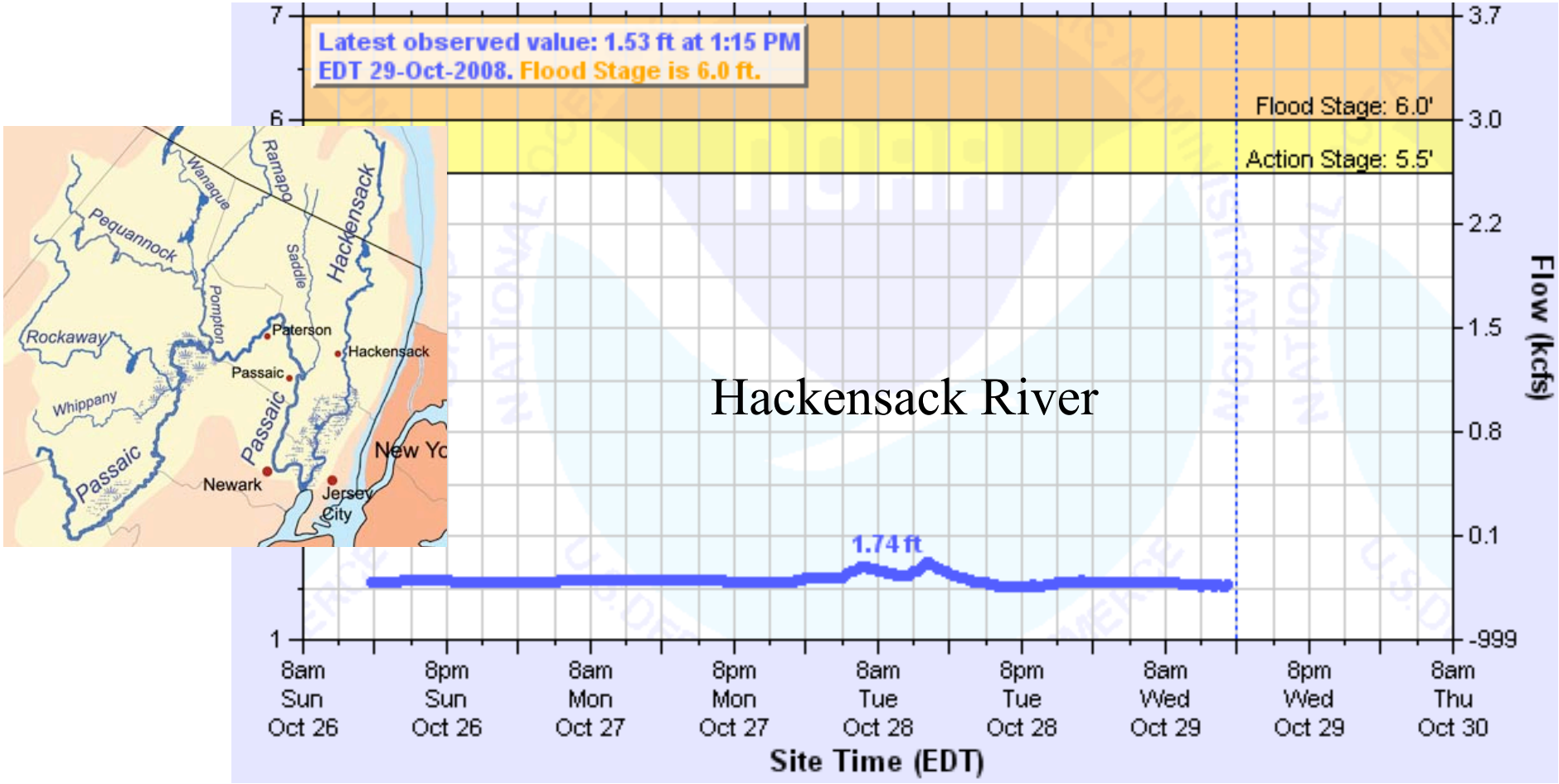
EESC 2200
The Solid Earth System

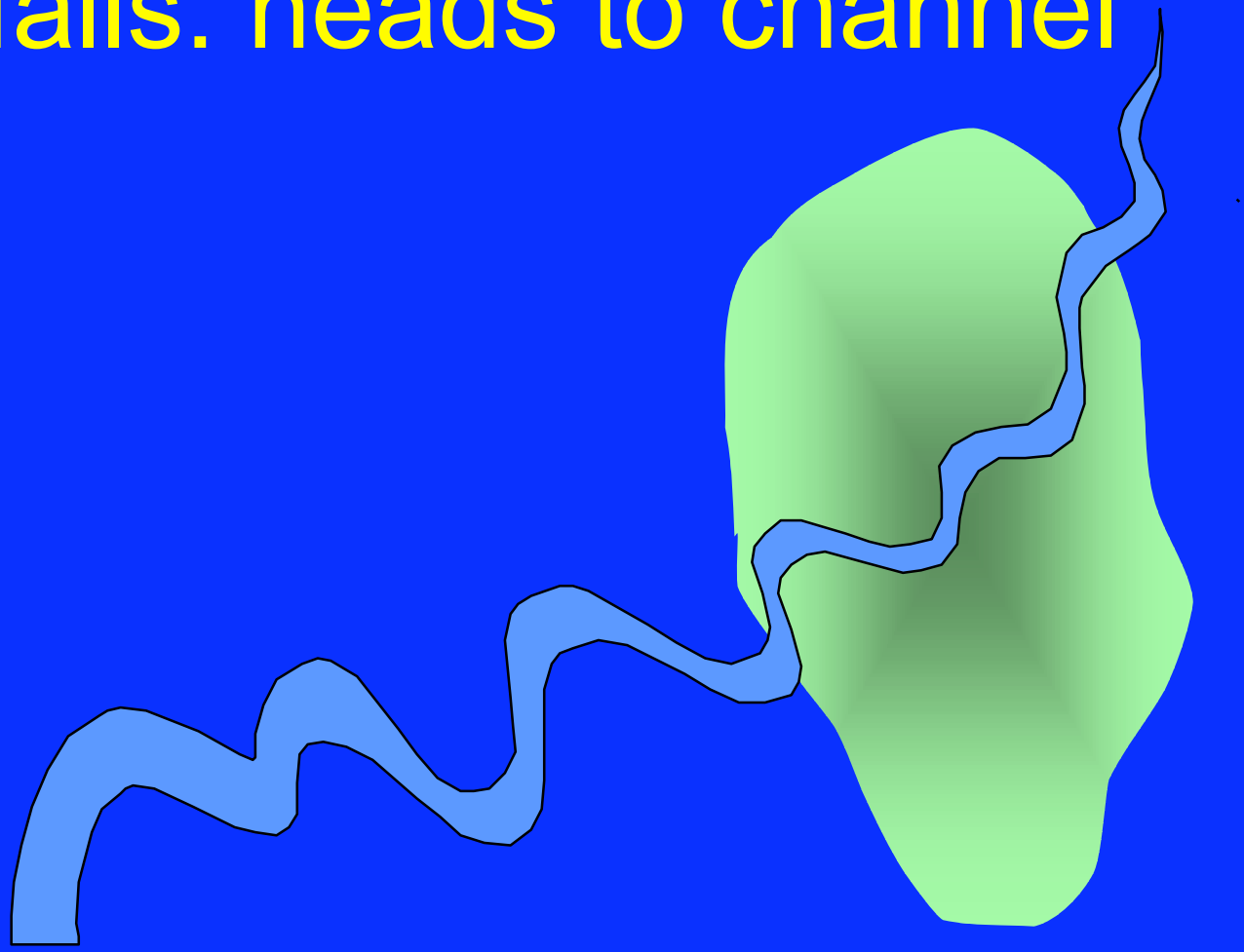
Flood Case Studies

- *HW-4 due Wed*
- *no class Mon*
- *no labs next week*



a Flood

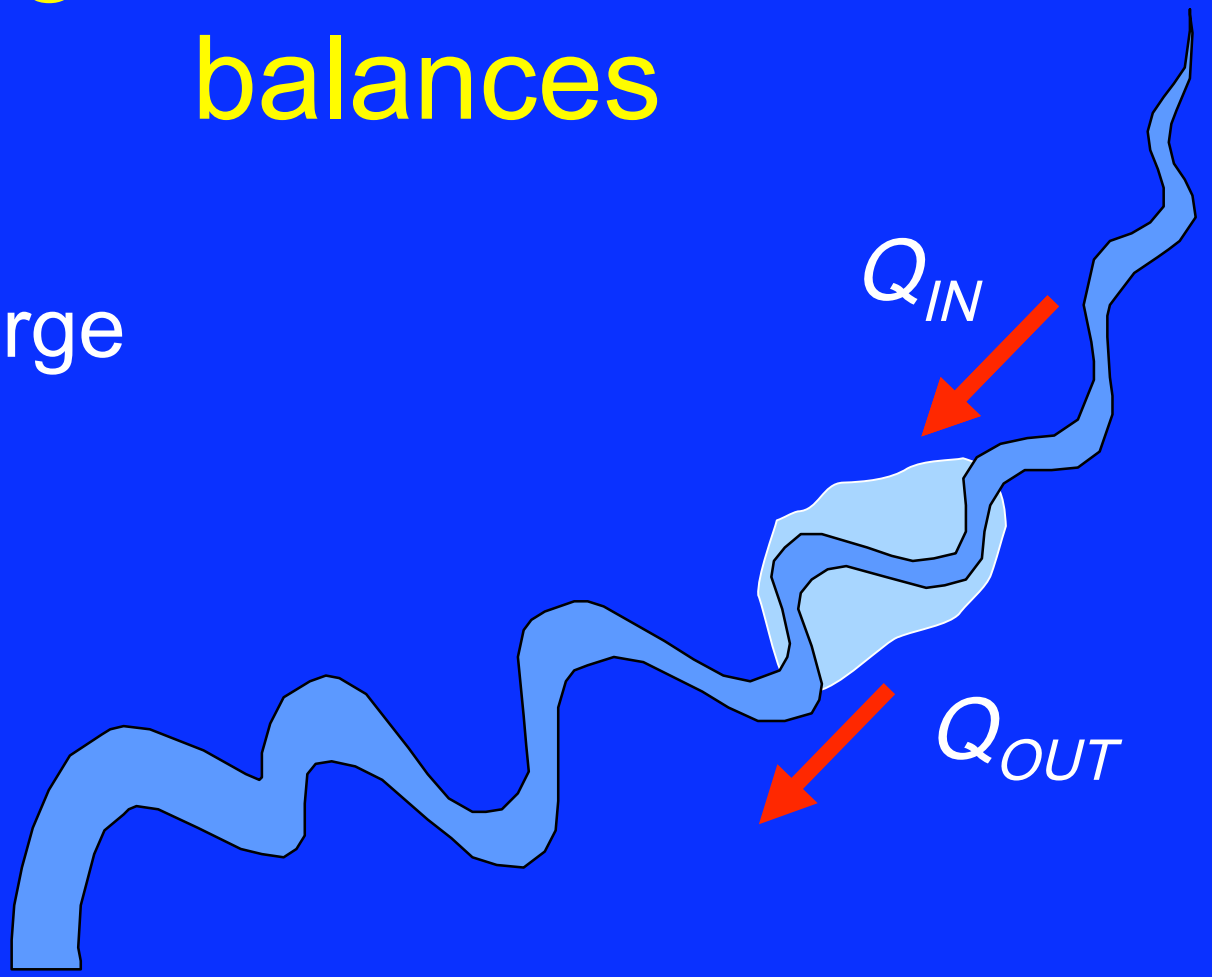
Rain falls: heads to channel



a Flood

propagates downstream: *Q* balances

Q = discharge
cft/sec



a Flood

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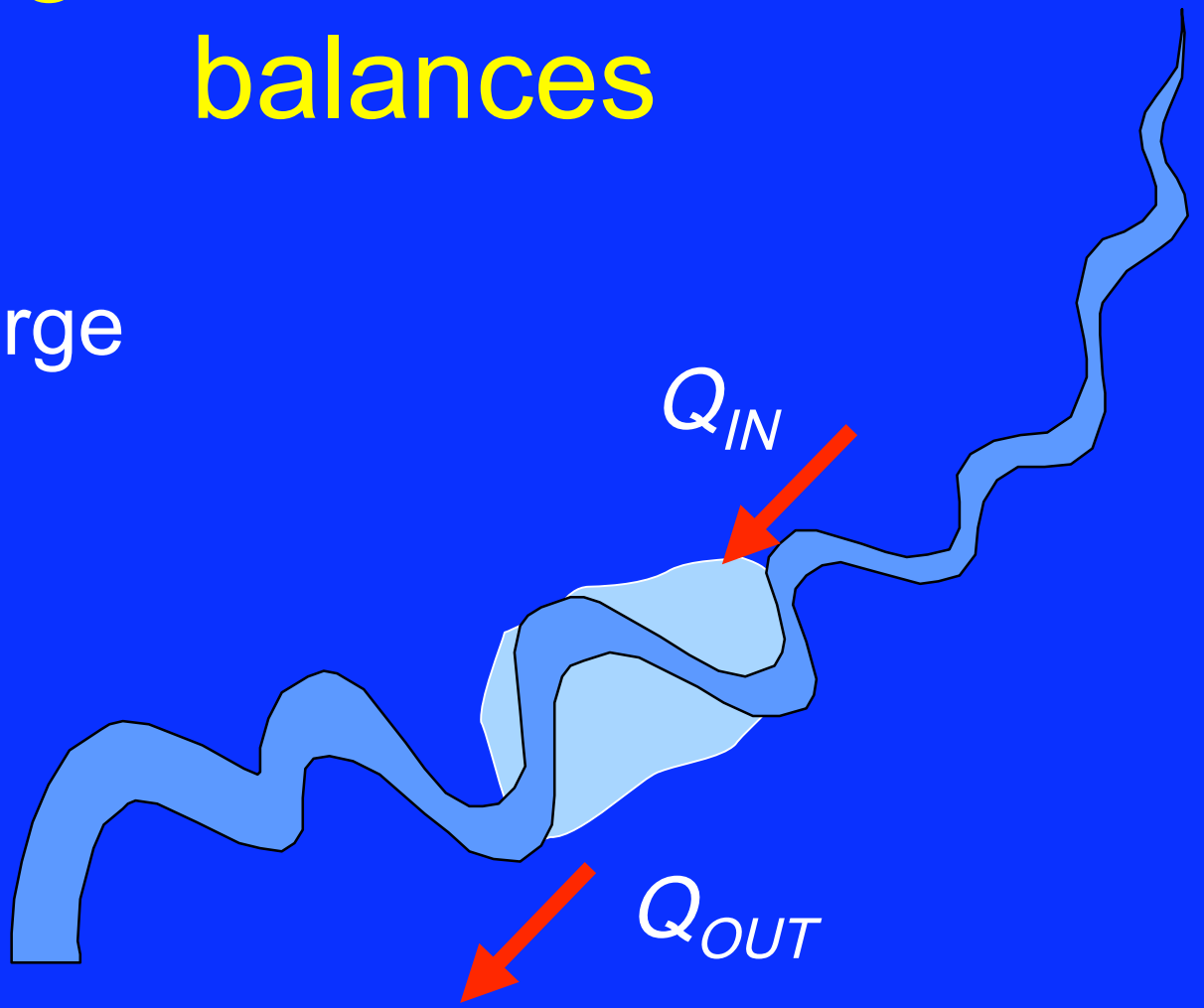

a Flood

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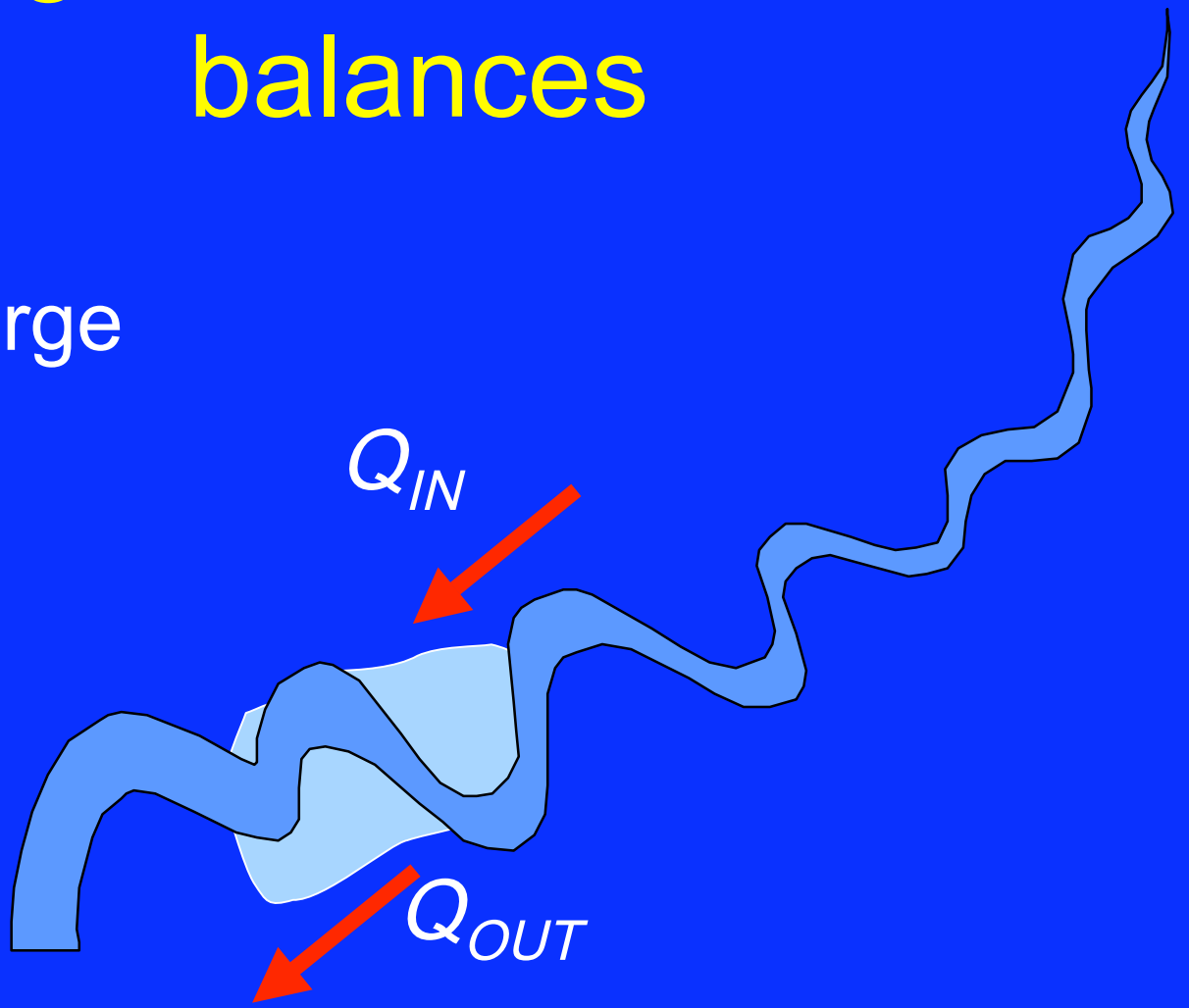
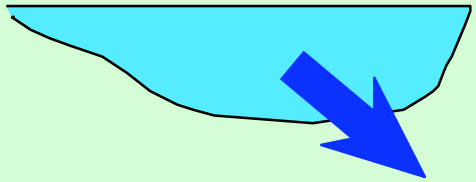


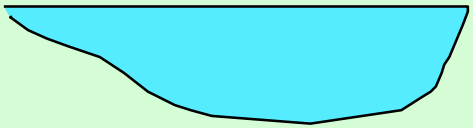
Discharge

(= water under bridge)

Discharge = cross-sectional area × velocity

$Q = A \times V$





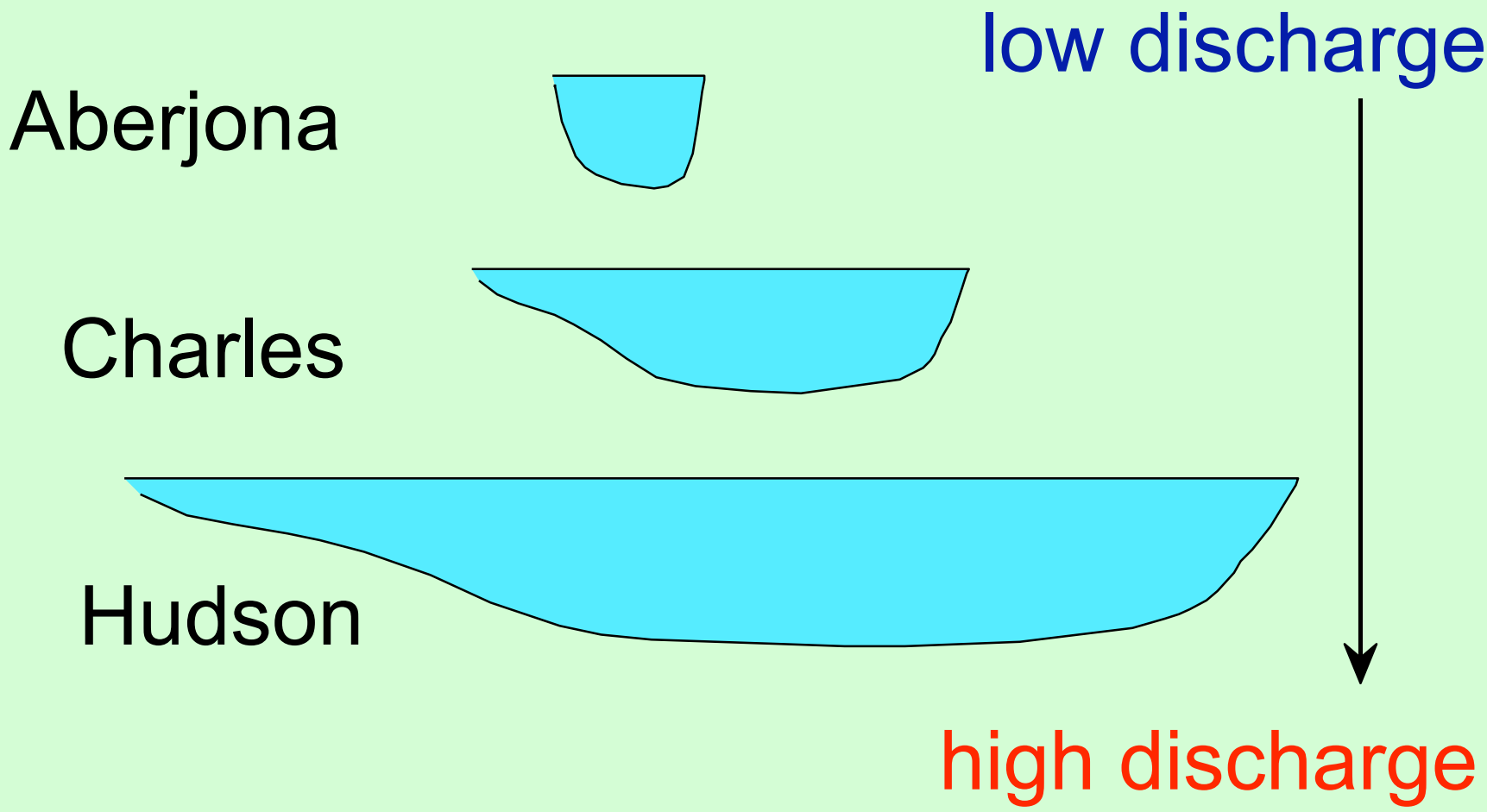
(more water under bridge)

(bigger bridge)

(faster river)

Area = Width × Depth

Some channel shapes.....



$$Q = A \times V$$

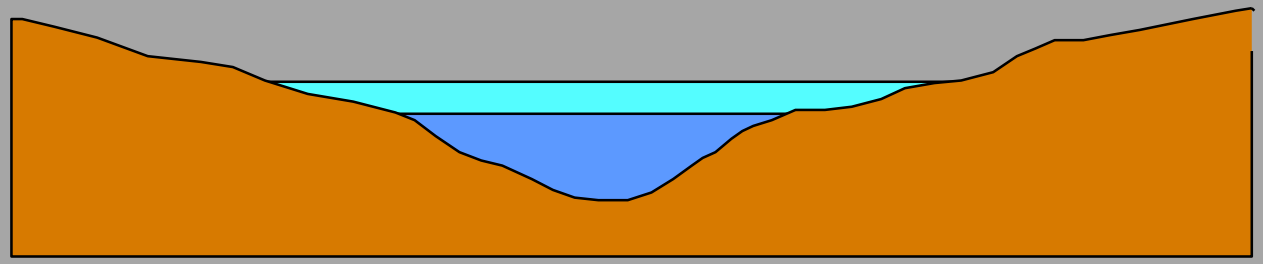
If discharge increases, then have to

- Increase *V*
- Increase *A*

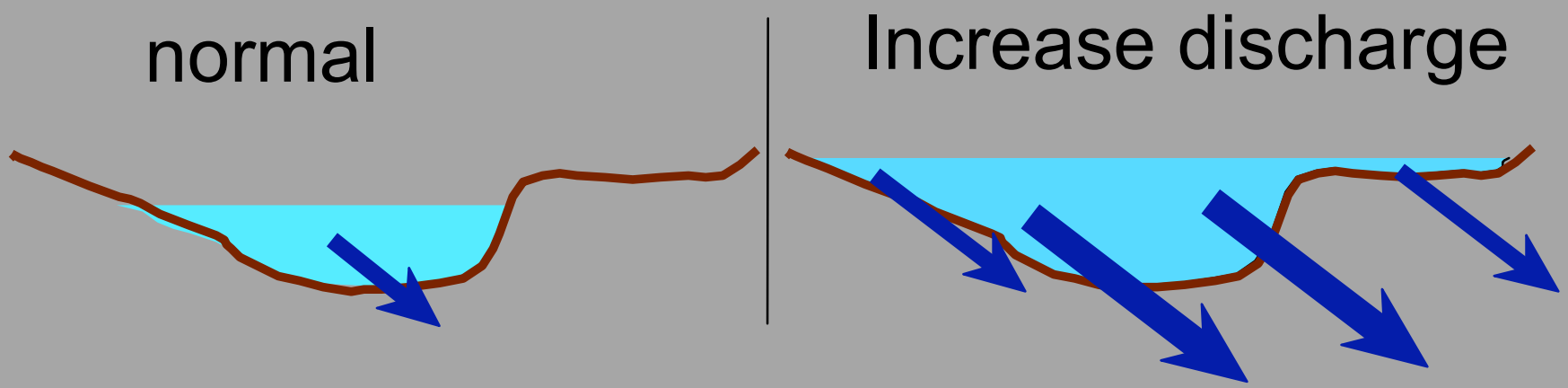
--> FLOODS

Discharge varies in 2 ways: Q = A x V

natural



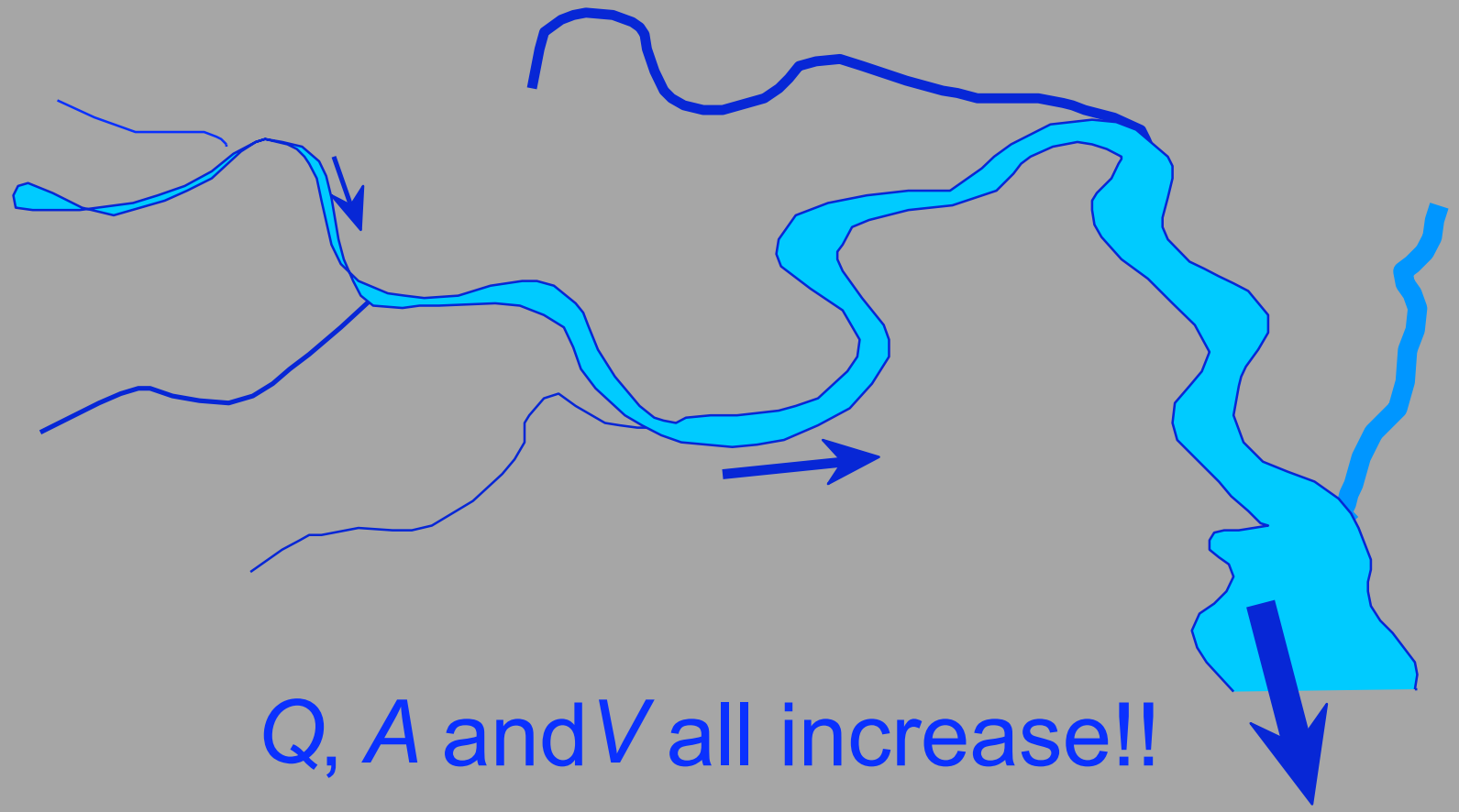
$Q = A \times V$ and floods



A increases by river rise, flooding banks

V increases too...

On big stream systems, discharge increases as **tributaries** bring in more water

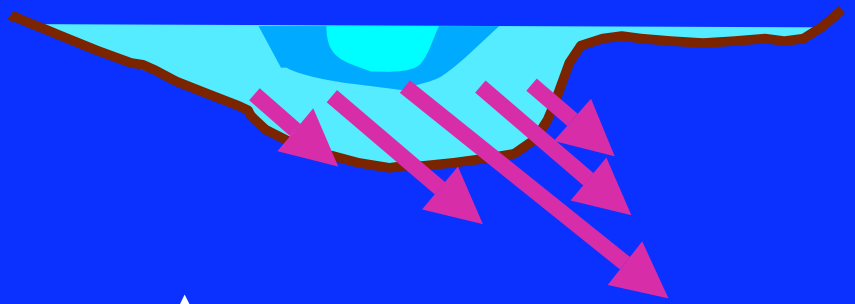


Q, *A* and *V* all increase!!

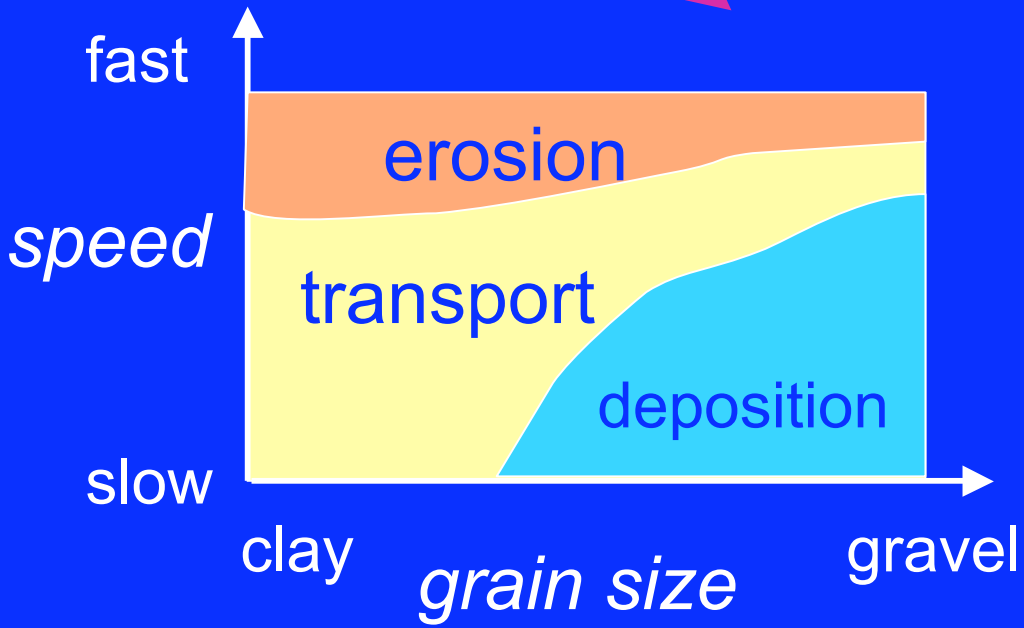
Modern flood plain

Natural systems have floodplains, why?

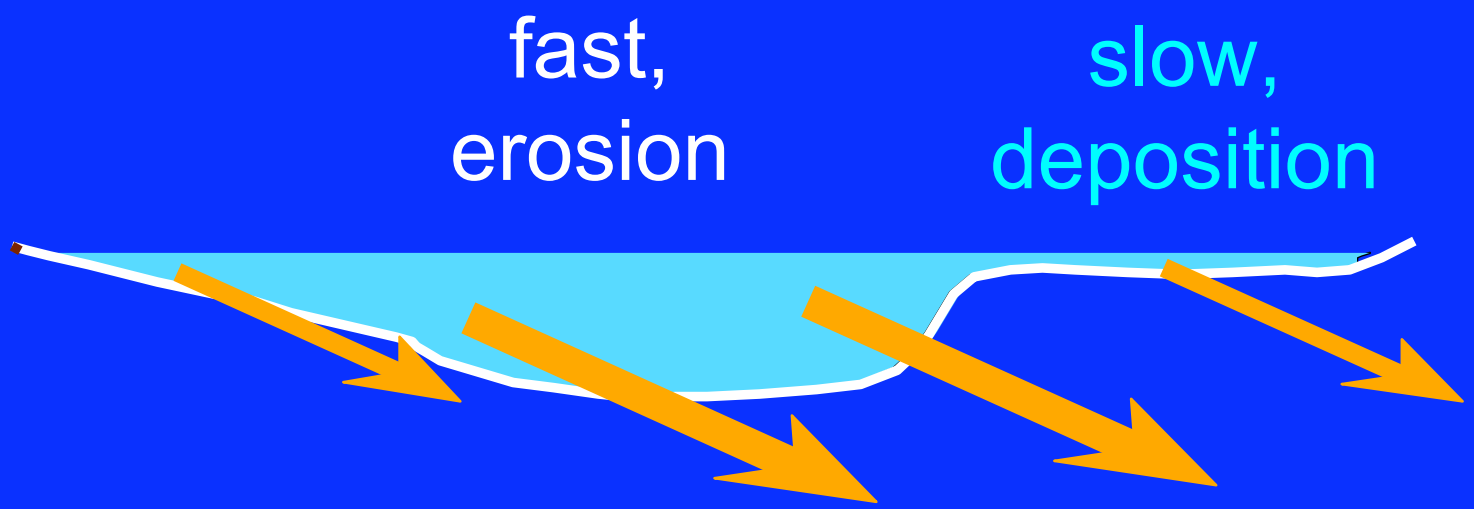
1. Water speed faster farther from bottom



2. Faster water carries bigger load



Why: stream erodes channel, fills floodplain



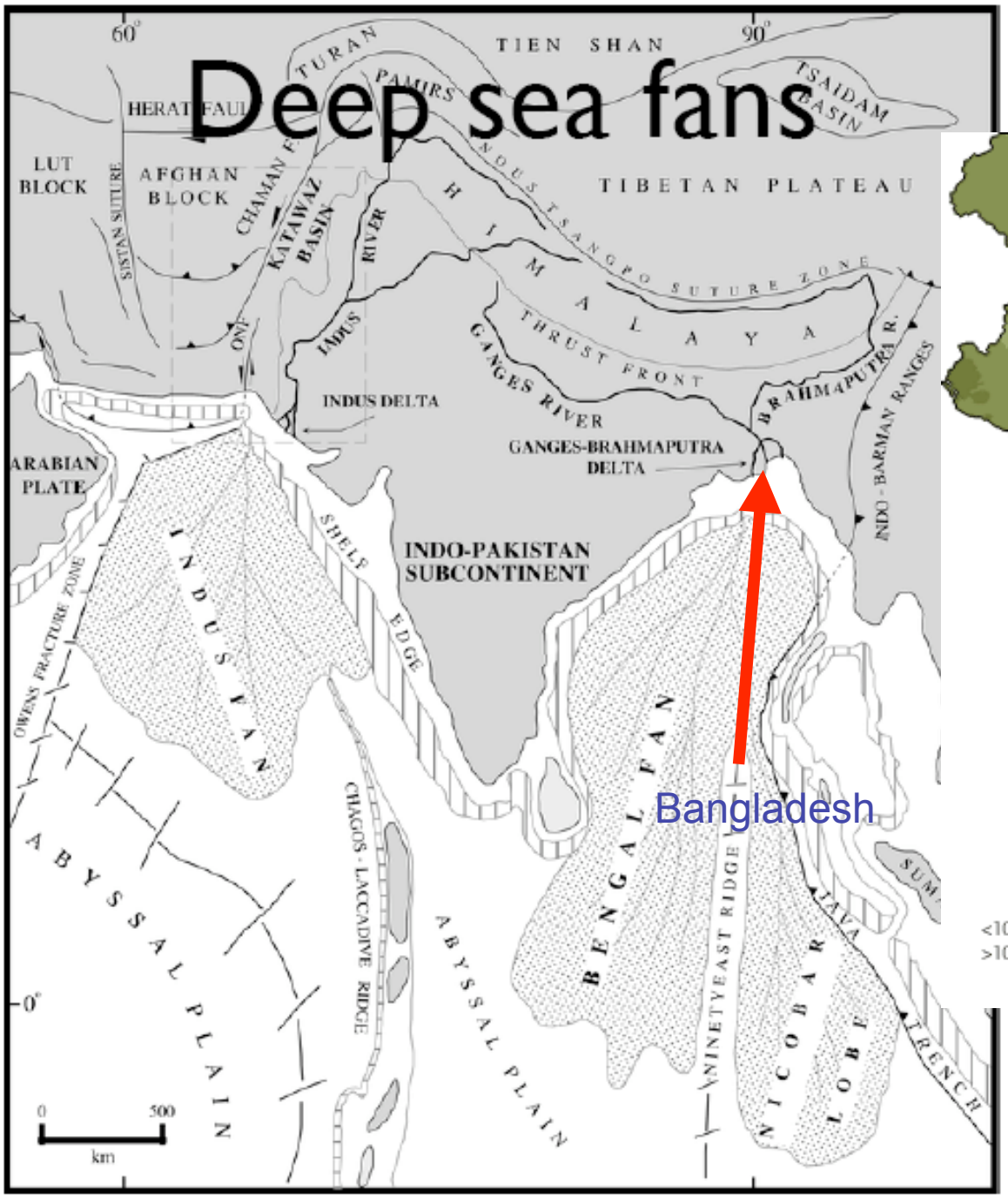
Flood Case Studies

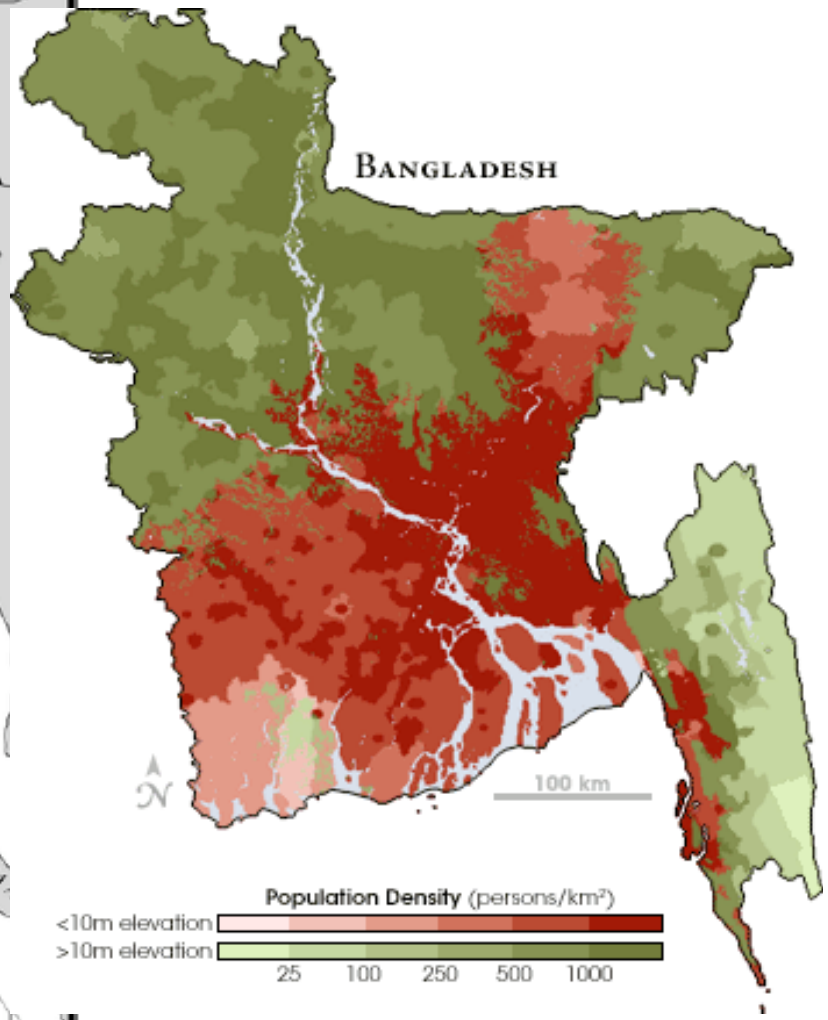
1. Hurricanes and Deltas
2. Big Thompson Canyon
3. 1993 Midwestern Flood
4. 100 yr floods
5. Ancient tales of floods
6. Channel scablands

- When
- Where
- Deaths
- $$ Damage
- How Big?
- Problems
- Mitigation?

Hurricanes and Deltas

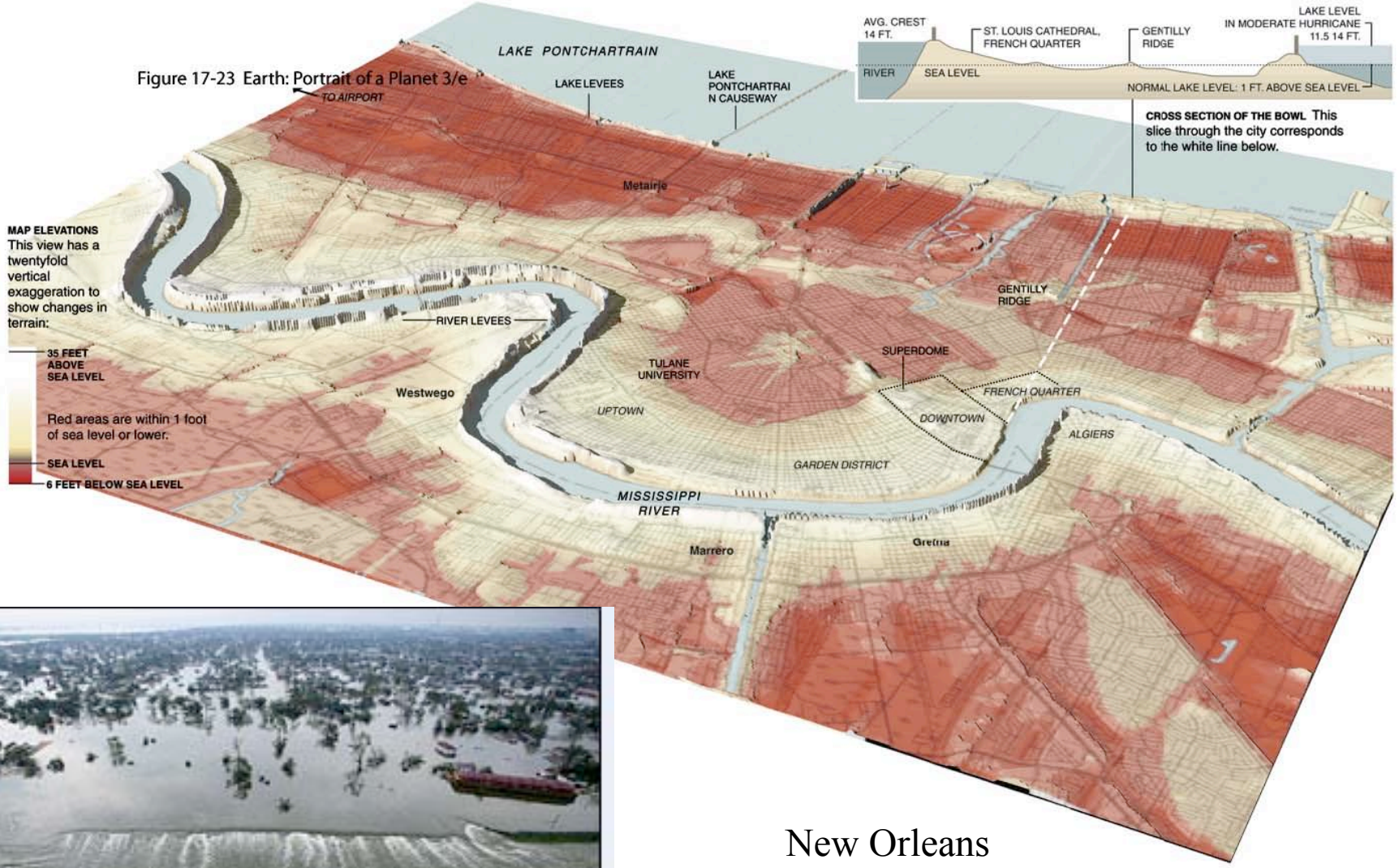
Deep sea fans





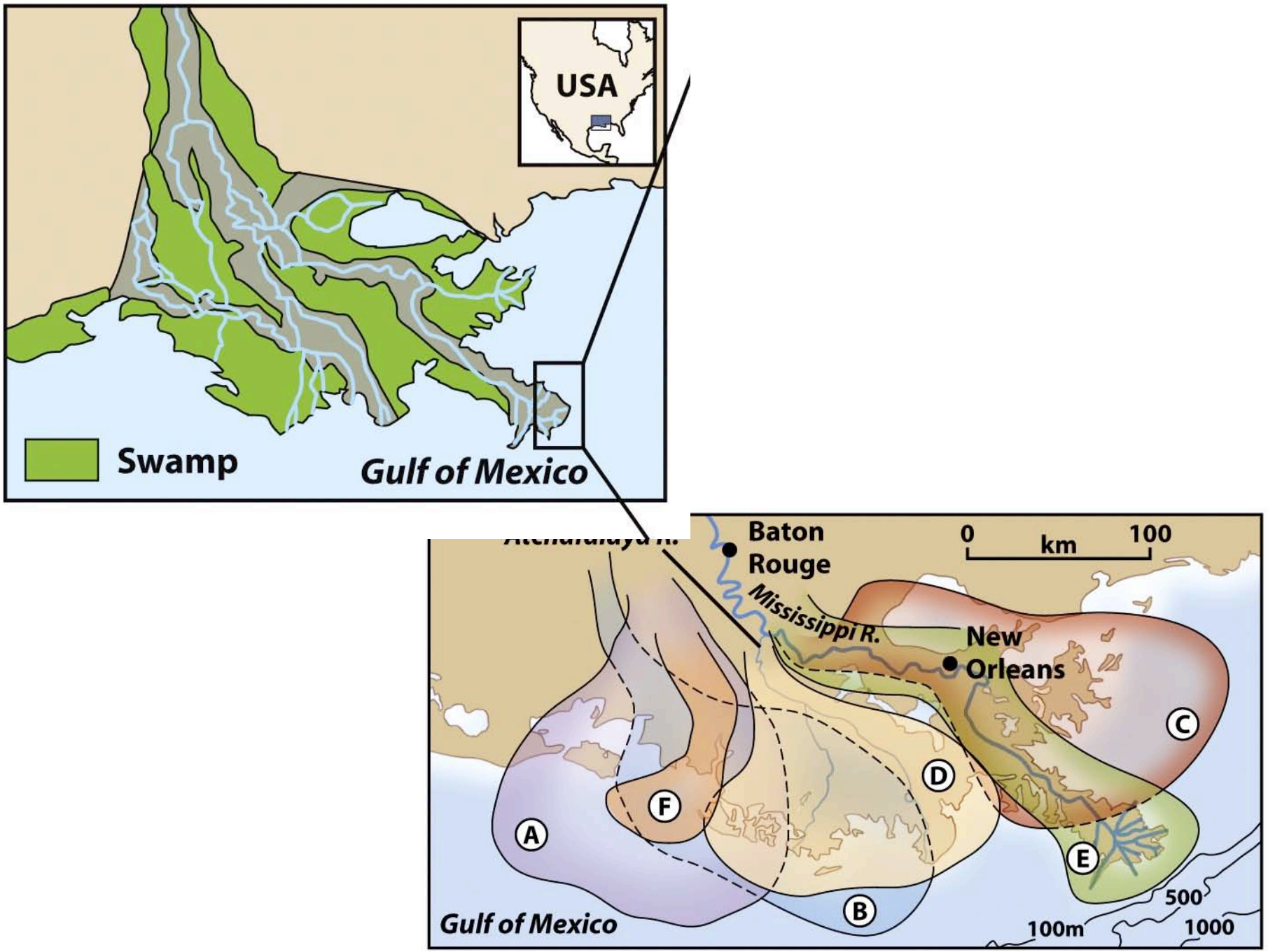
Living in Bangladesh

Figure 17-23 Earth: Portrait of a Planet 3/e

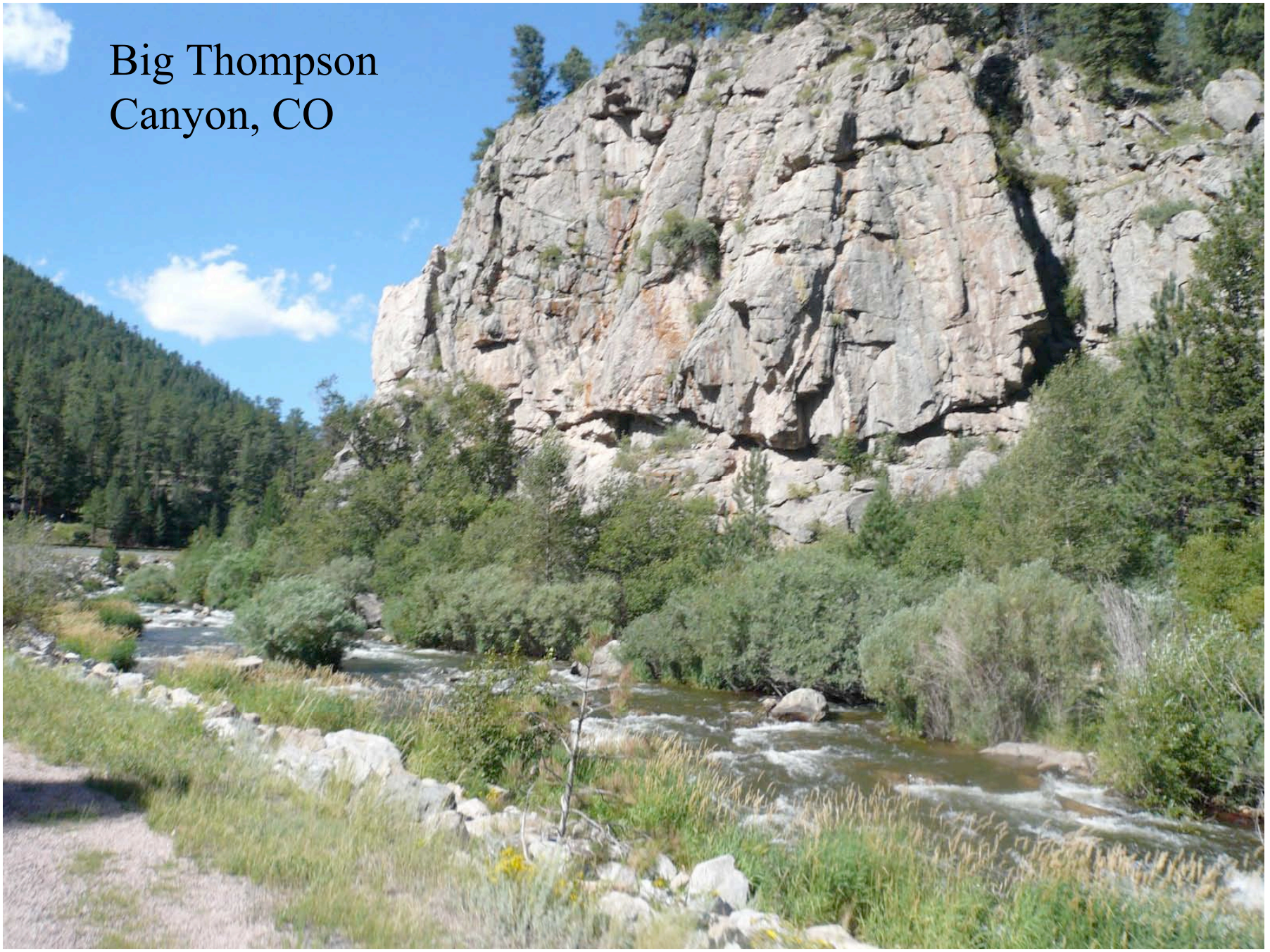


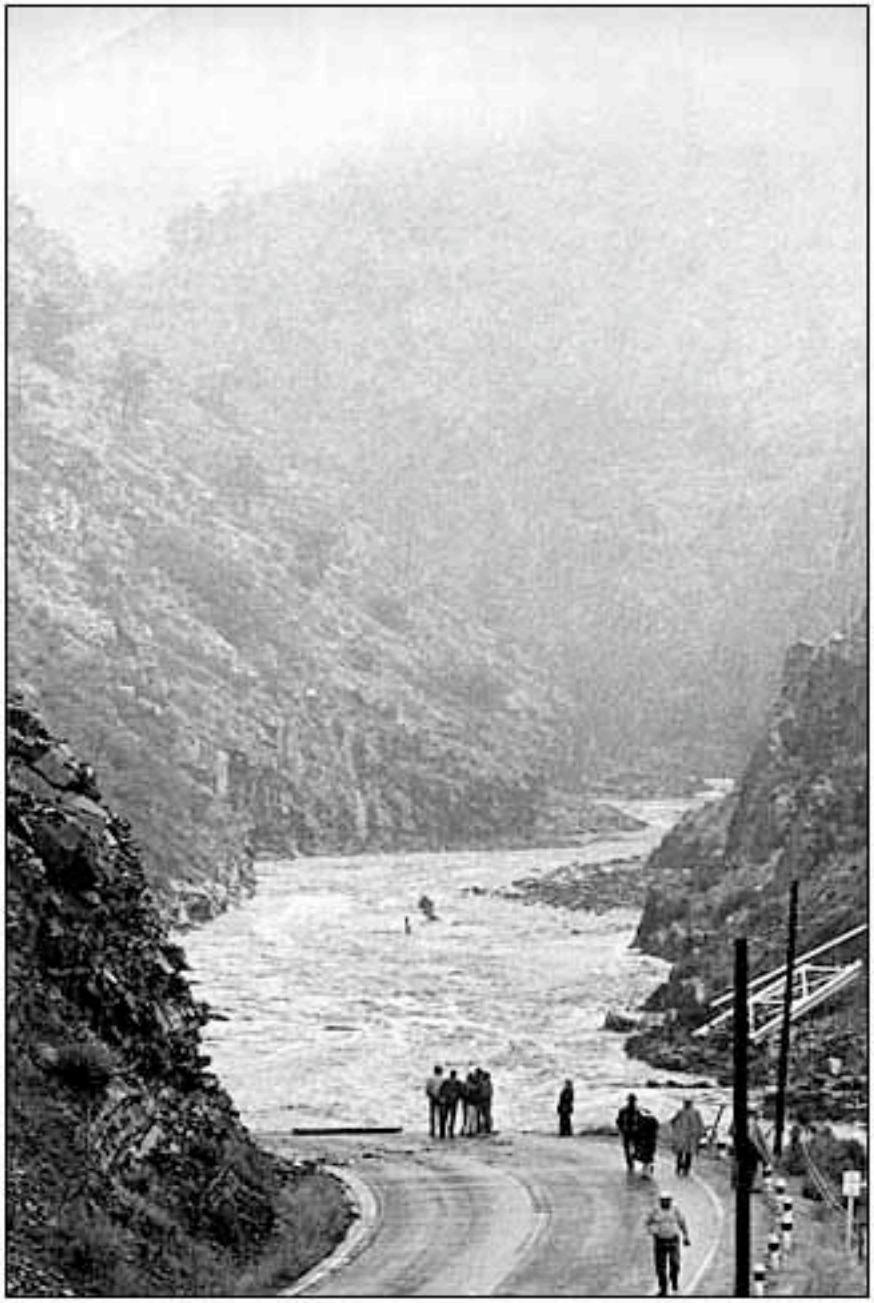
Vincent Laforet, Pool / Getty Images

New Orleans


USA
Swamp
Gulf of Mexico
Baton
Rouge
Mississippi R.
New
Orleans
0
km
100
A
B
C
D
E
F
Gulf of Mexico
100m
500
1000

Big Thompson Canyon

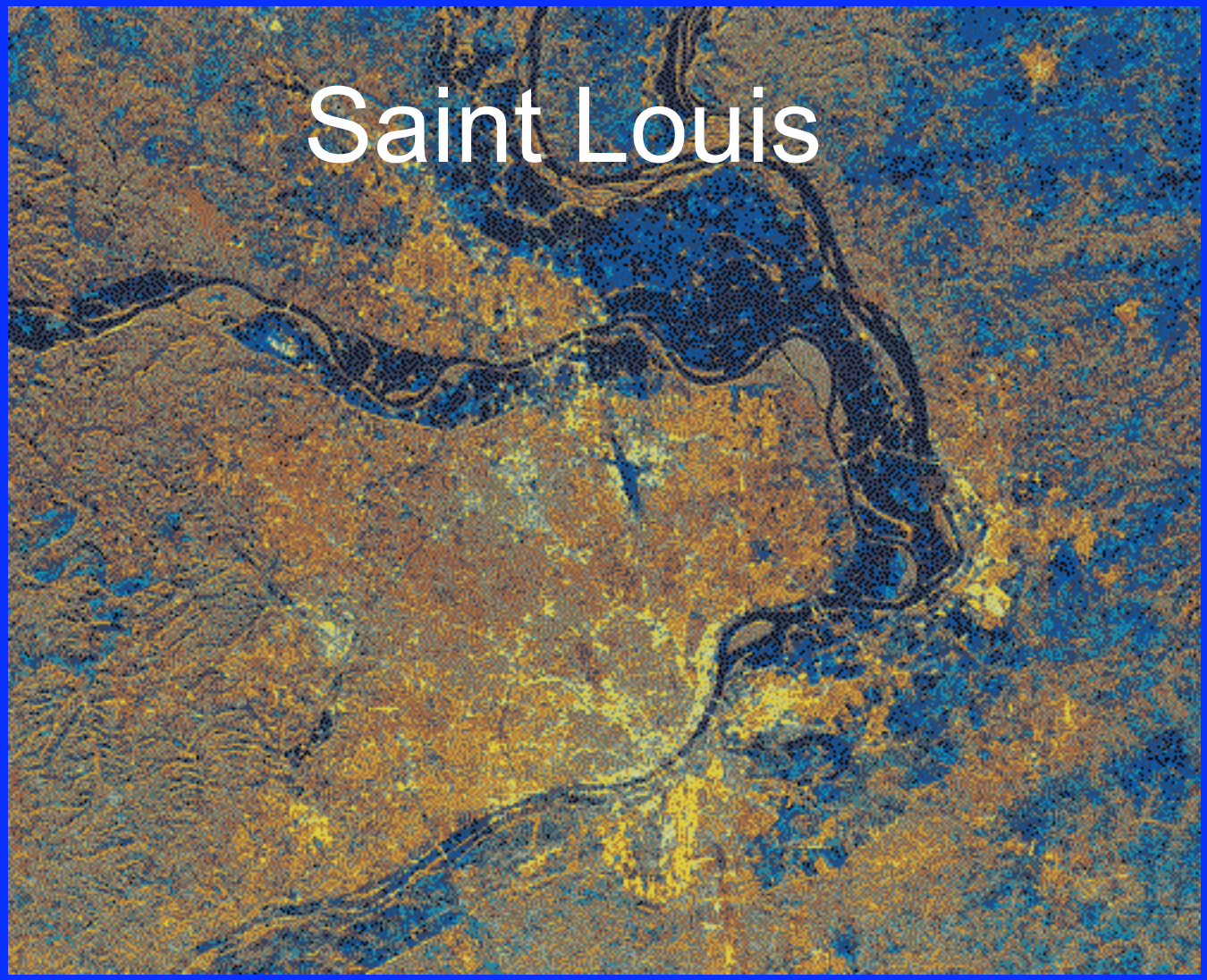

Big Thompson
Canyon, CO



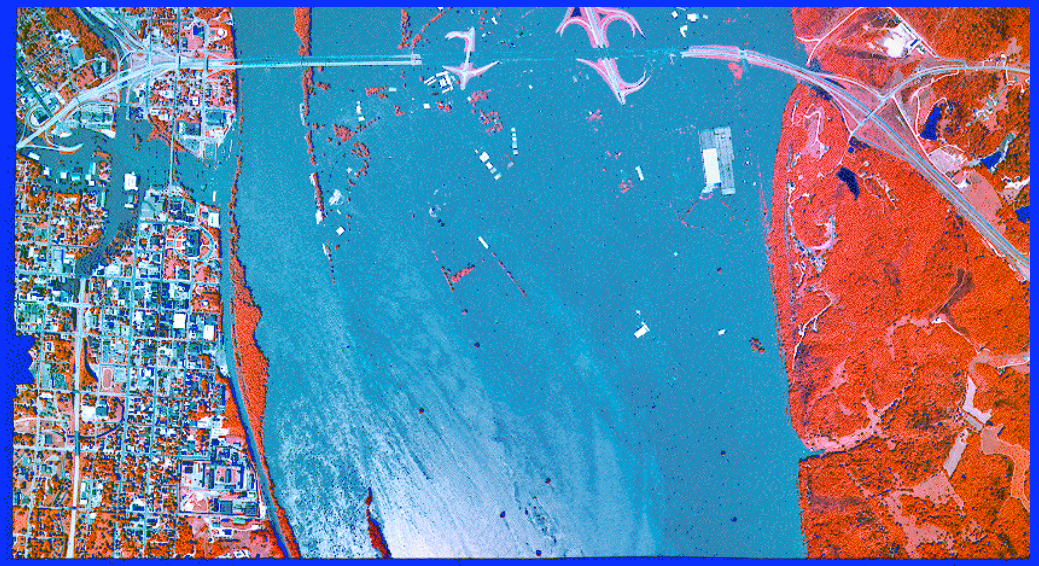
Rescuers stand near a washed-out section of U.S. 34 just west of The Dam Store, looking west into The Narrows of the Big Thompson Canyon following the Big Thompson flood of July 31, 1976.

Reporter-Herald file photo

1993 Midwestern Flood



dark blue -- flooded in 1993

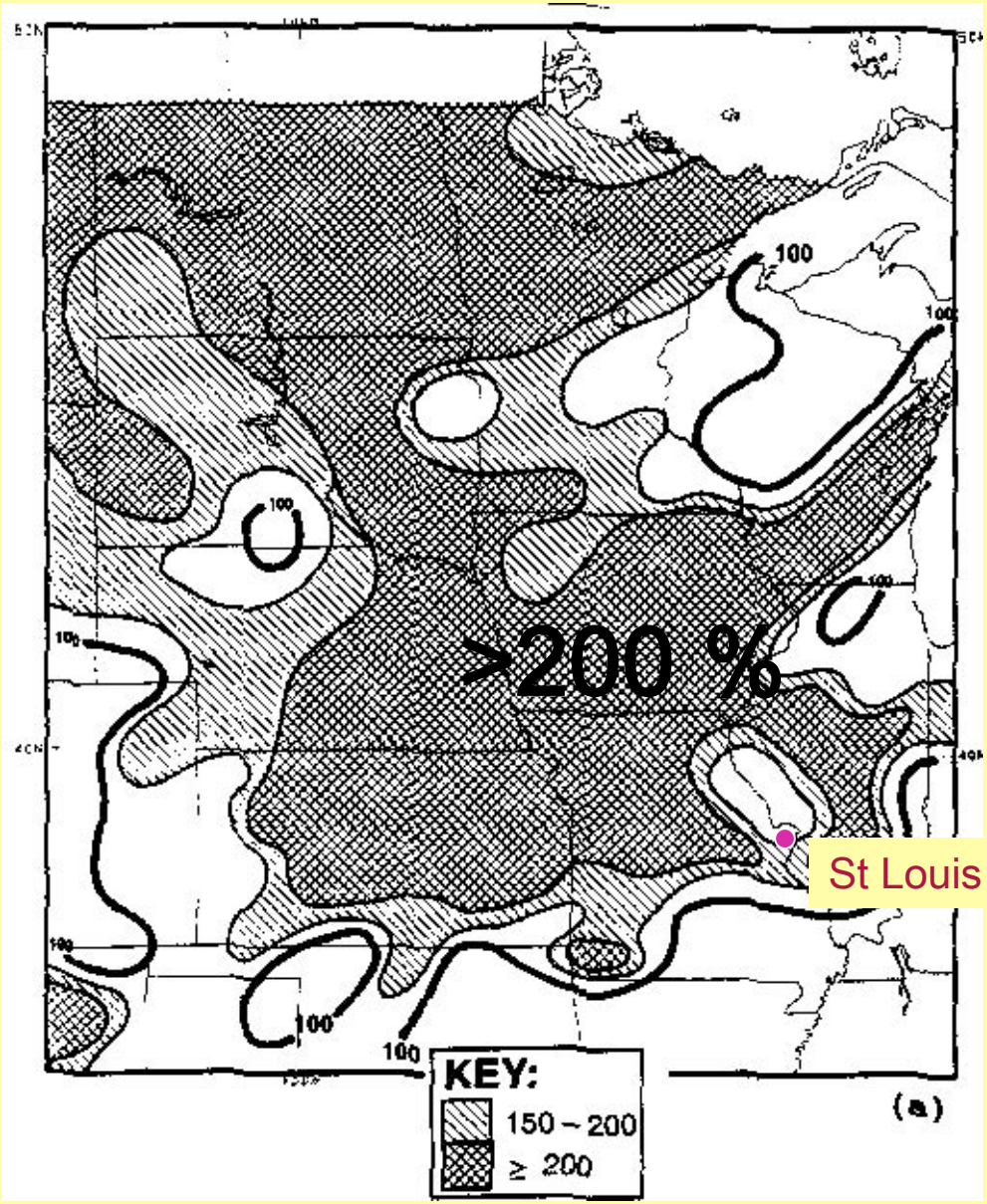


Jefferson City MO


Tuttle Ck spillway, KS: 24 Jul 93, 35000 cfs

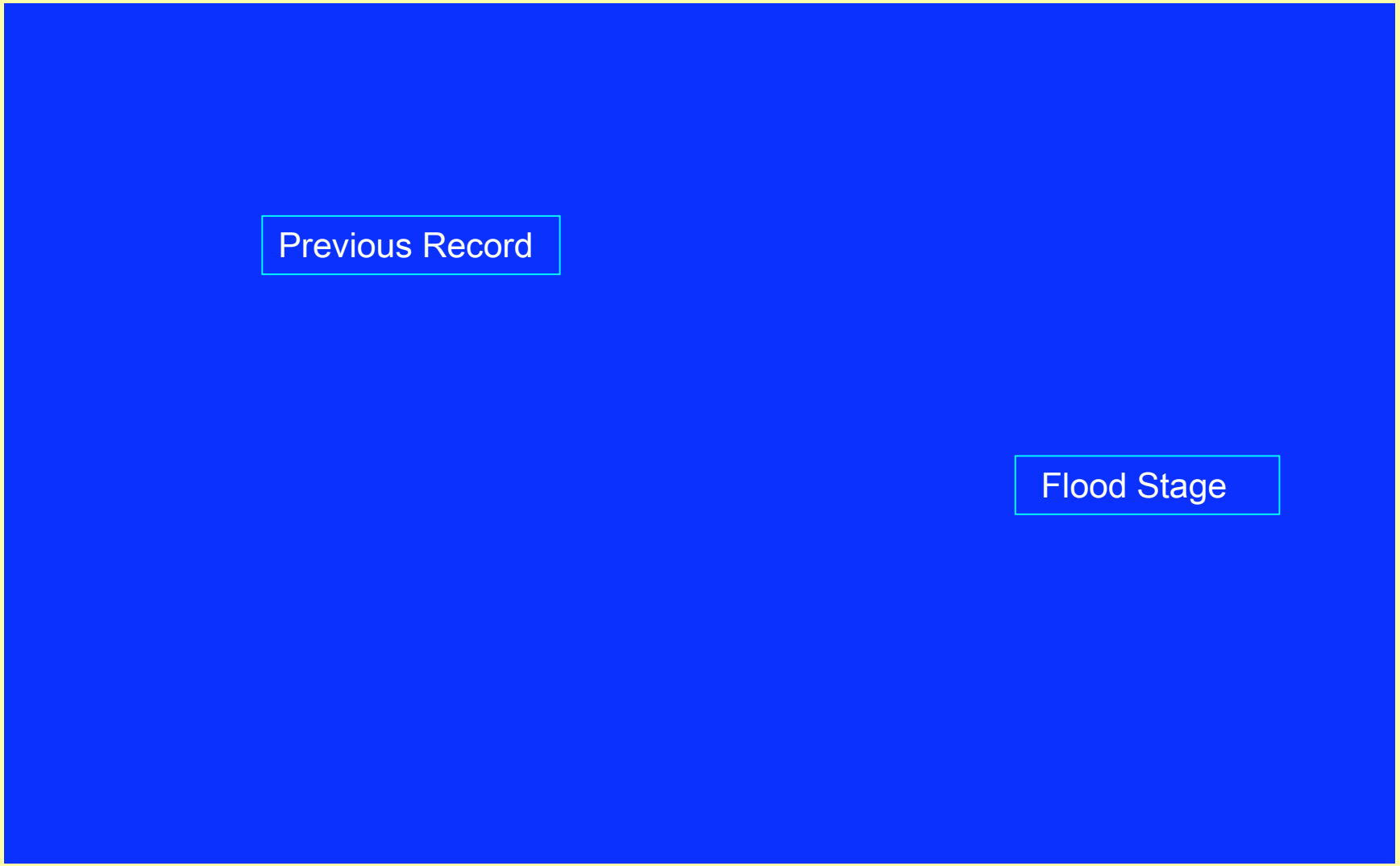
The 1993 Flood

Excess Rainfall



Rainfall causes flooding in “streams”

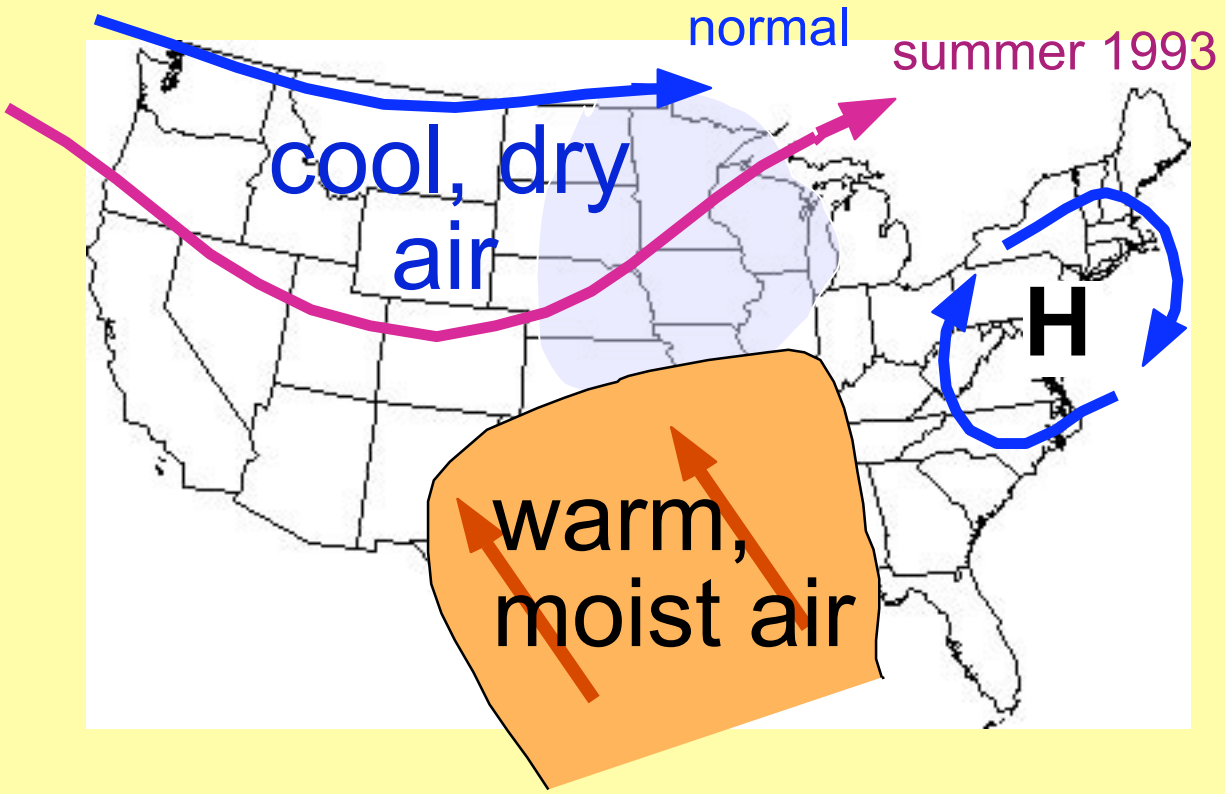
St. Louis Gauge



What happened?

1. Fall before, heavy rains saturated soils

2. Unusual summer jet stream



p. 386

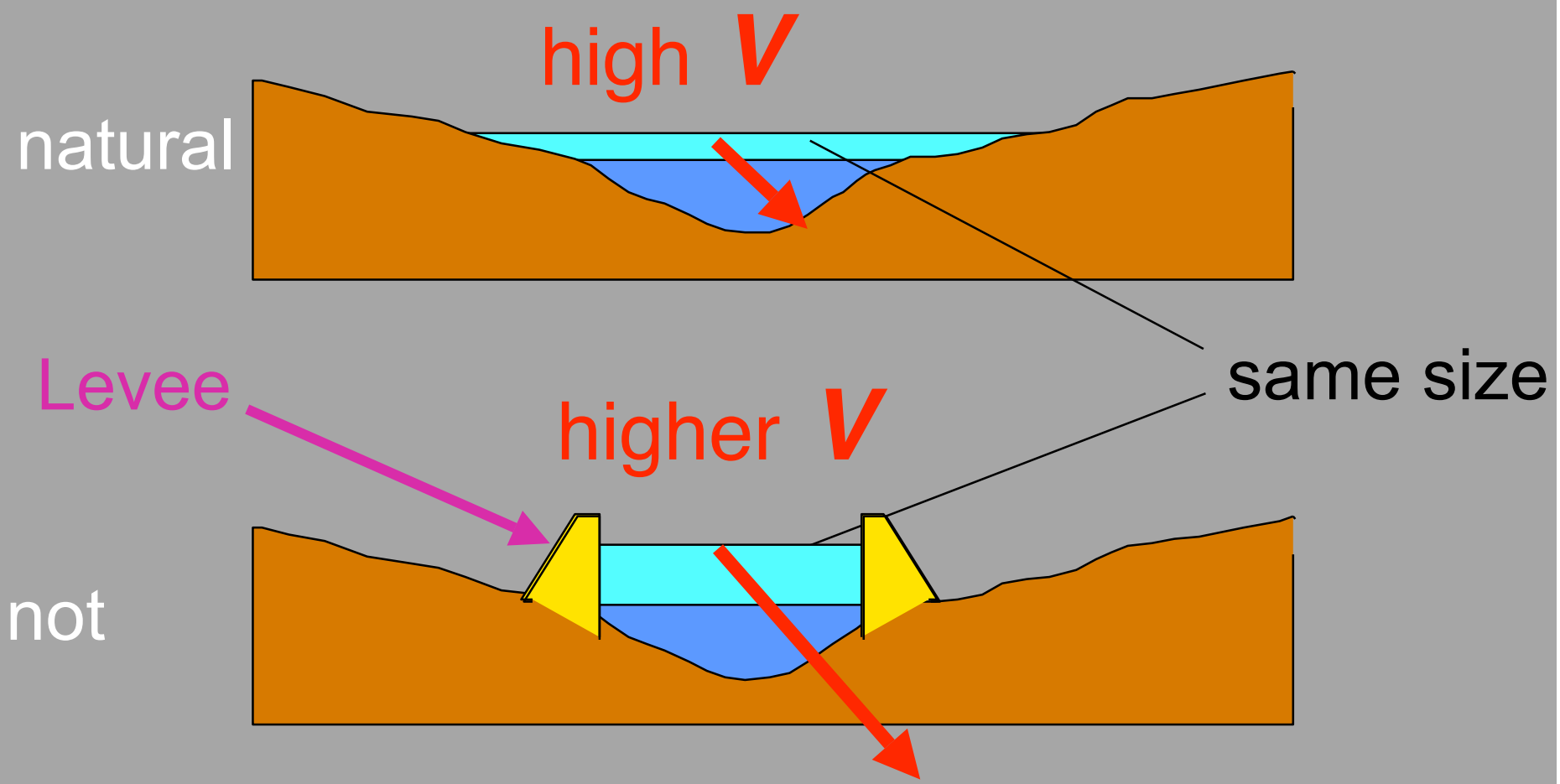
1993 Overall: Worst flood in US history

peak discharge = 1,030,000 cft/s at St Louis

$20 billion damage
50,000 homes damaged
75 towns submerged
48 fatalities

18 Jul 93

Discharge varies in 2 ways: Q = A x V

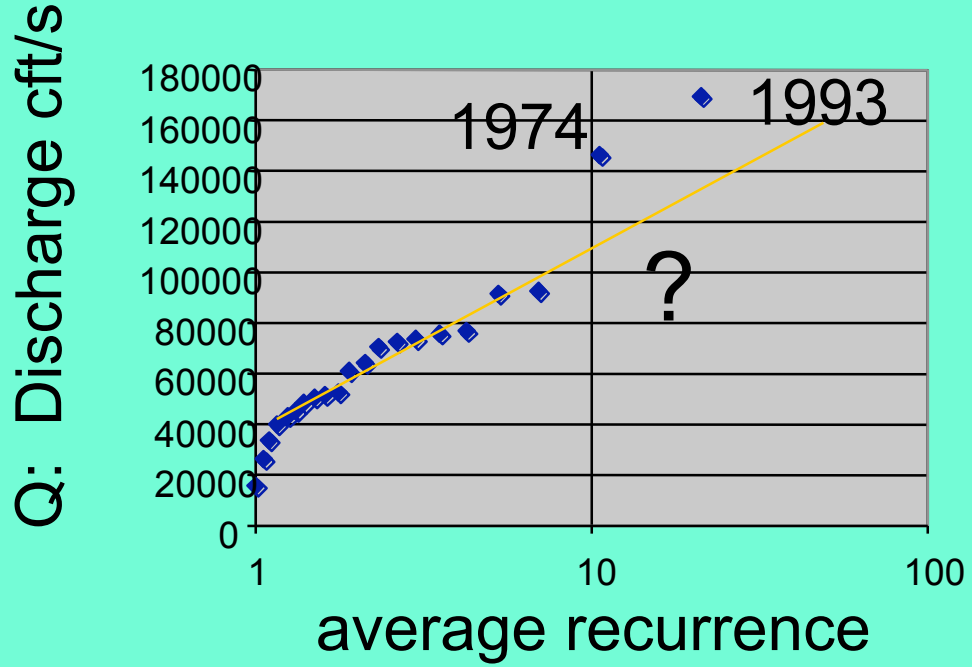


100 yr floods

Flood recurence intervals: Q vs rate

Data: # peak floods > Q
in last (10, 50, 100) years?

Extrapolate to get rate of “100 yr” flood

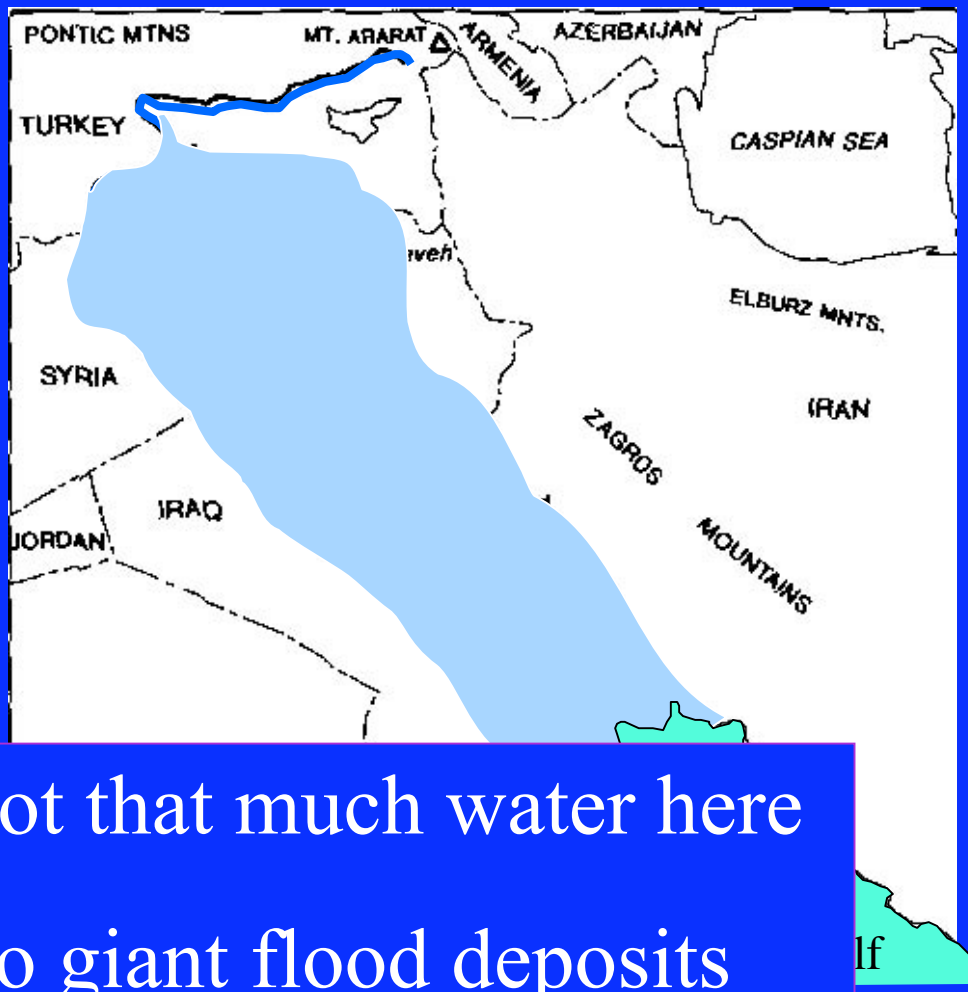


Ancient tales of floods

John Martin. *The Deluge*. 1834. Oil on canvas. 66 x 102 inches.

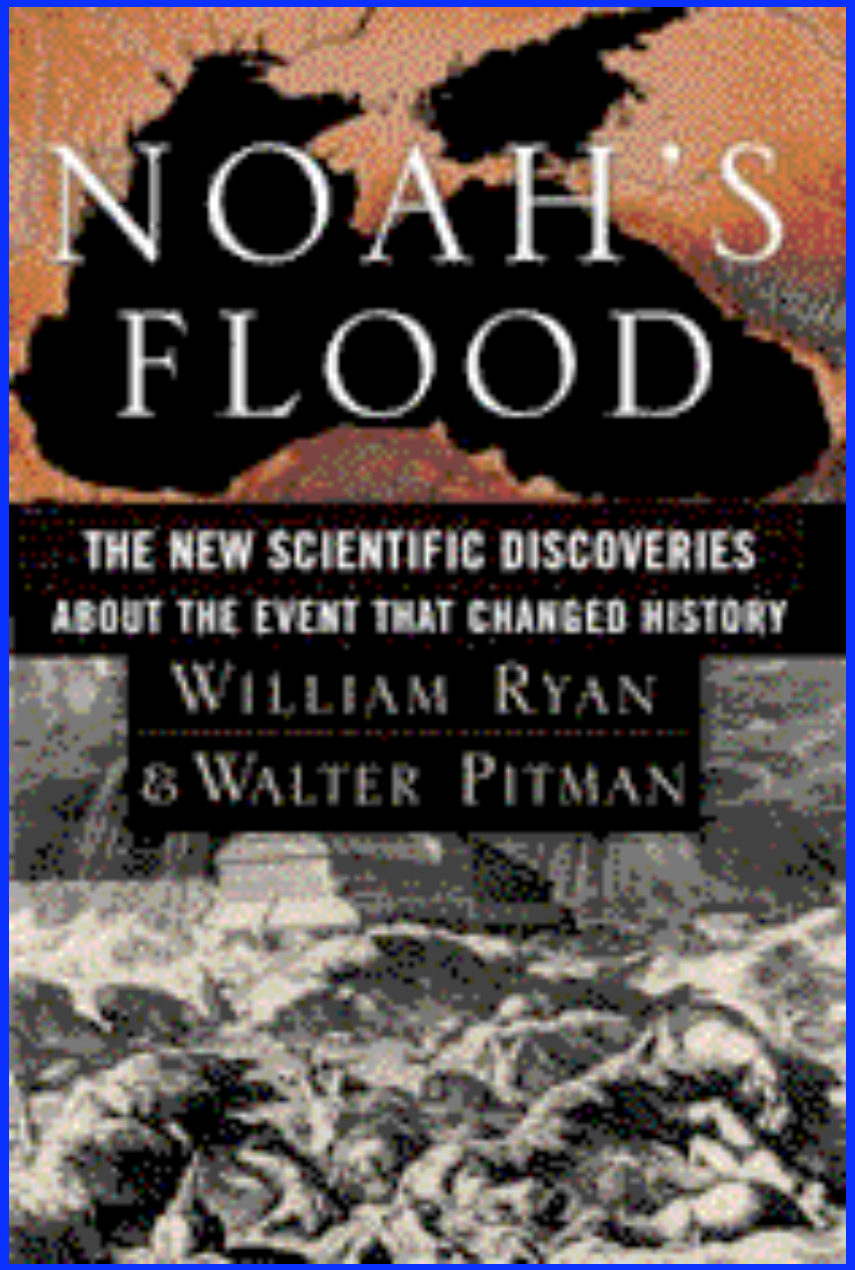
Same story in many mid-eastern cultures
Oldest: Gilgamesh, 1st epic literature
(Sumeria, 2000 - 3000 BCE)
Did something actually happen?

Traditional Idea: flood Tigris, Euphrates ("1000 yr flood")

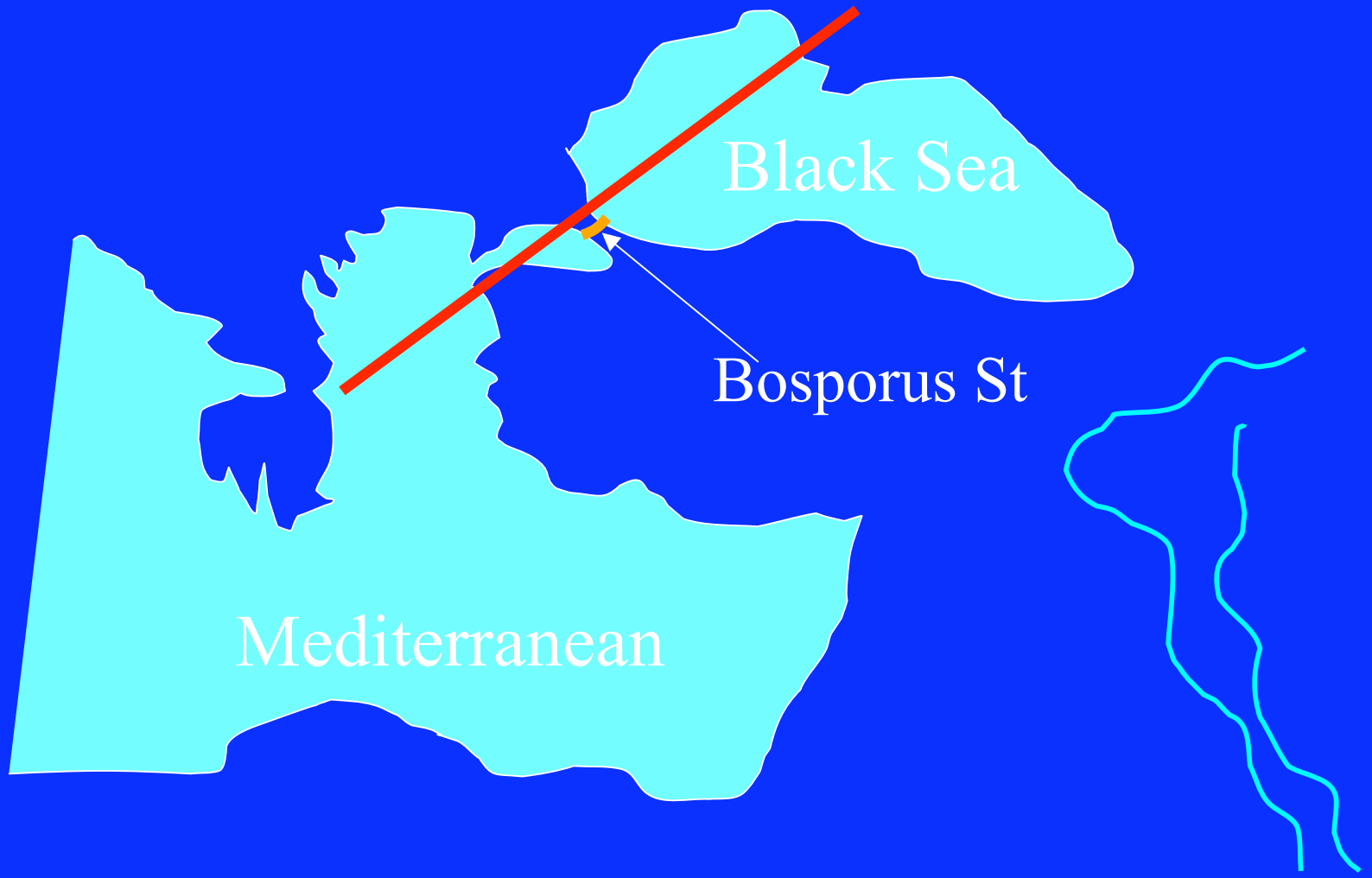


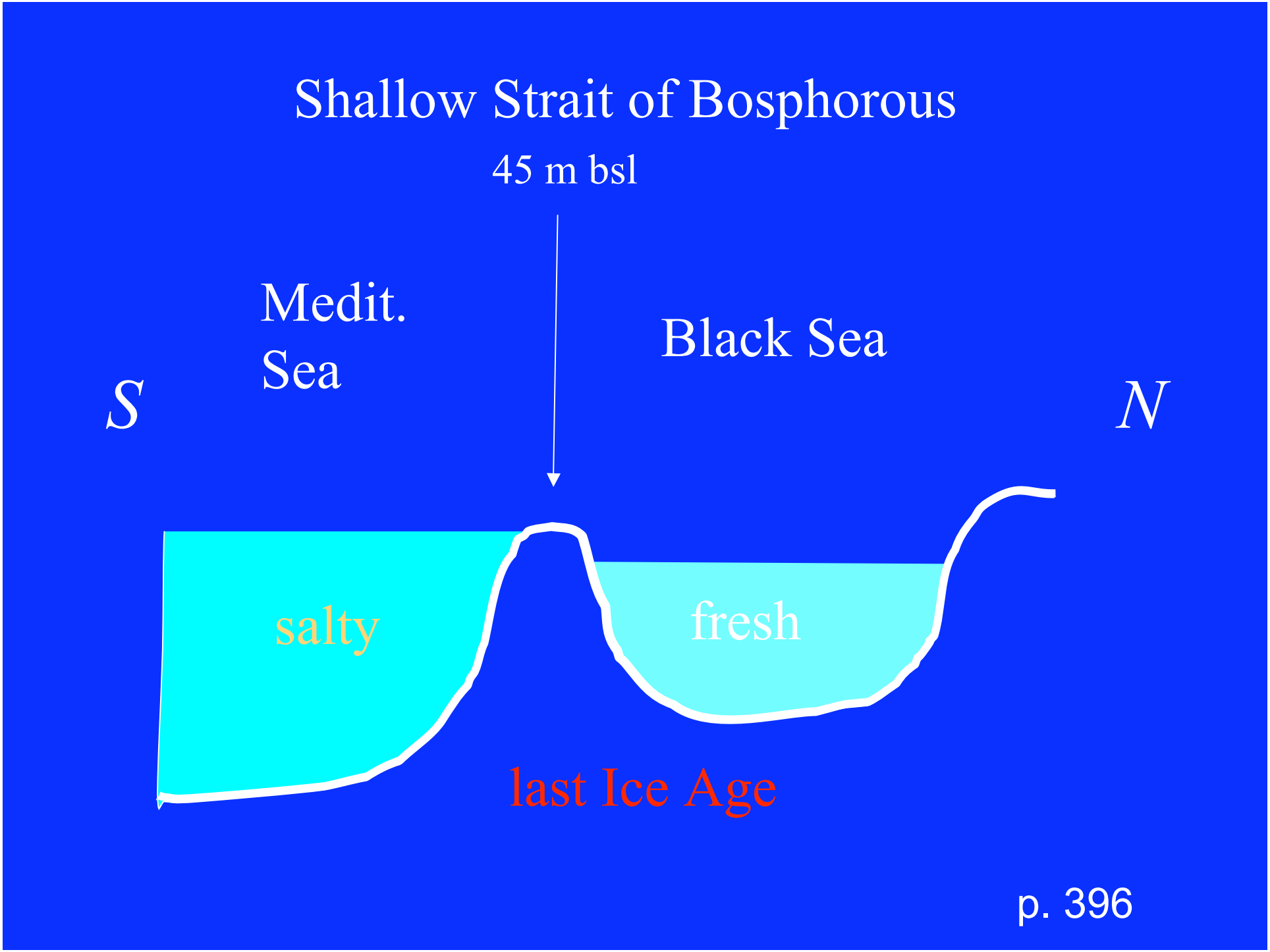
Problems: not that much water here

no giant flood deposits

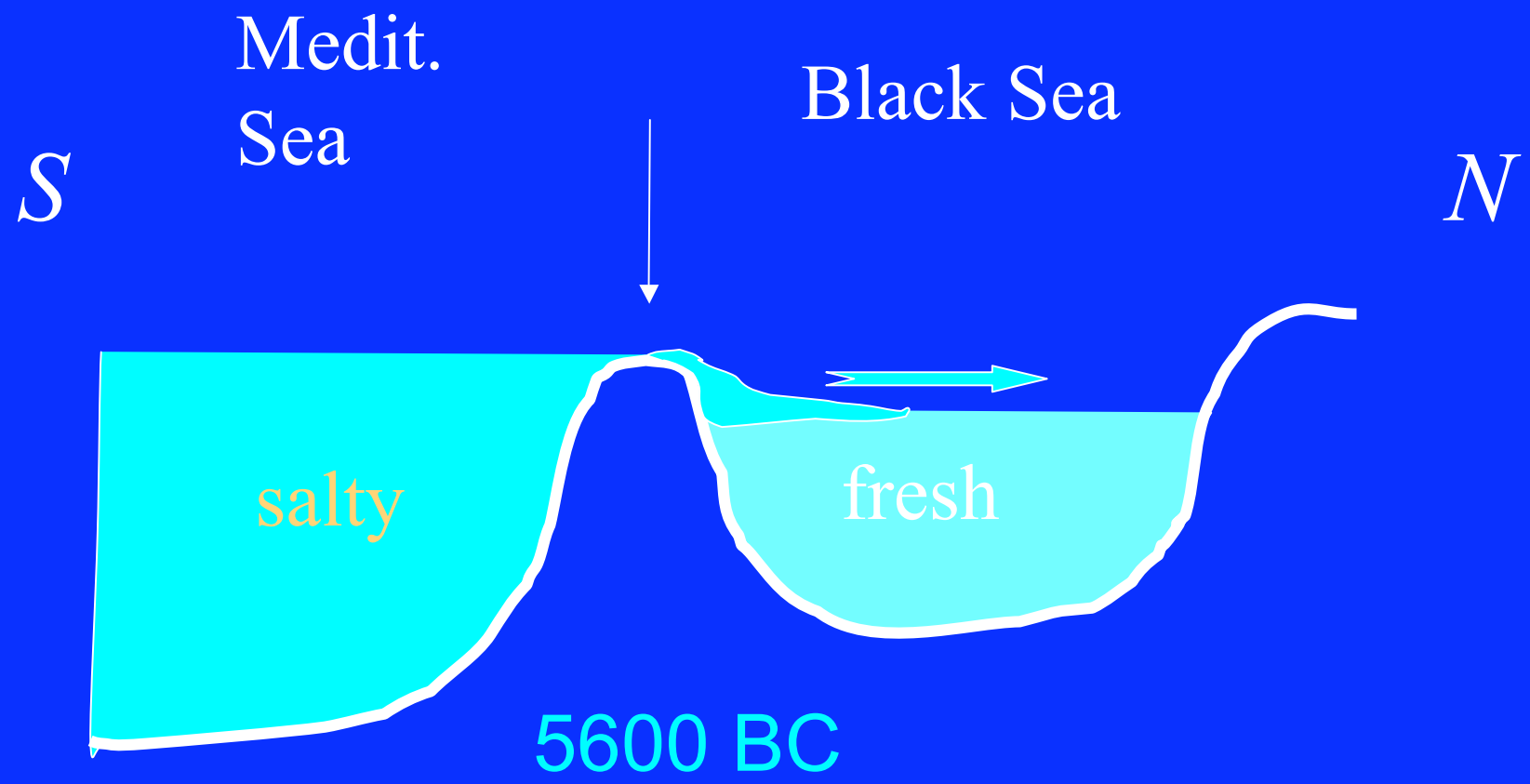

NOAH'S FLOOD
THE NEW SCIENTIFIC DISCOVERIES
ABOUT THE EVENT THAT CHANGED HISTORY
WILLIAM RYAN
& WALTER PITMAN

Black Sea...




Shallow Strait of Bosphorous
45 m bsl
Medit.
Sea
Black Sea
S
N
salty
fresh
last Ice Age

Shallow Strait of Bosphorous



In Black Sea...

- 5600 BCE: sudden deluge
- change from fresh -> saline
- scouring of Bosporous channel
  - 80 - 100 km/hr flows?
  - Black Sea level rises 100 m in 1 year?
  - Major flood of Black Sea shorelines...

Conclusion

Catastrophic flooding at 5600 BCE
also, 4 Ma flooding of Medittteranean

Displaced humans: probably

The Great Deluge?

Channel scablands

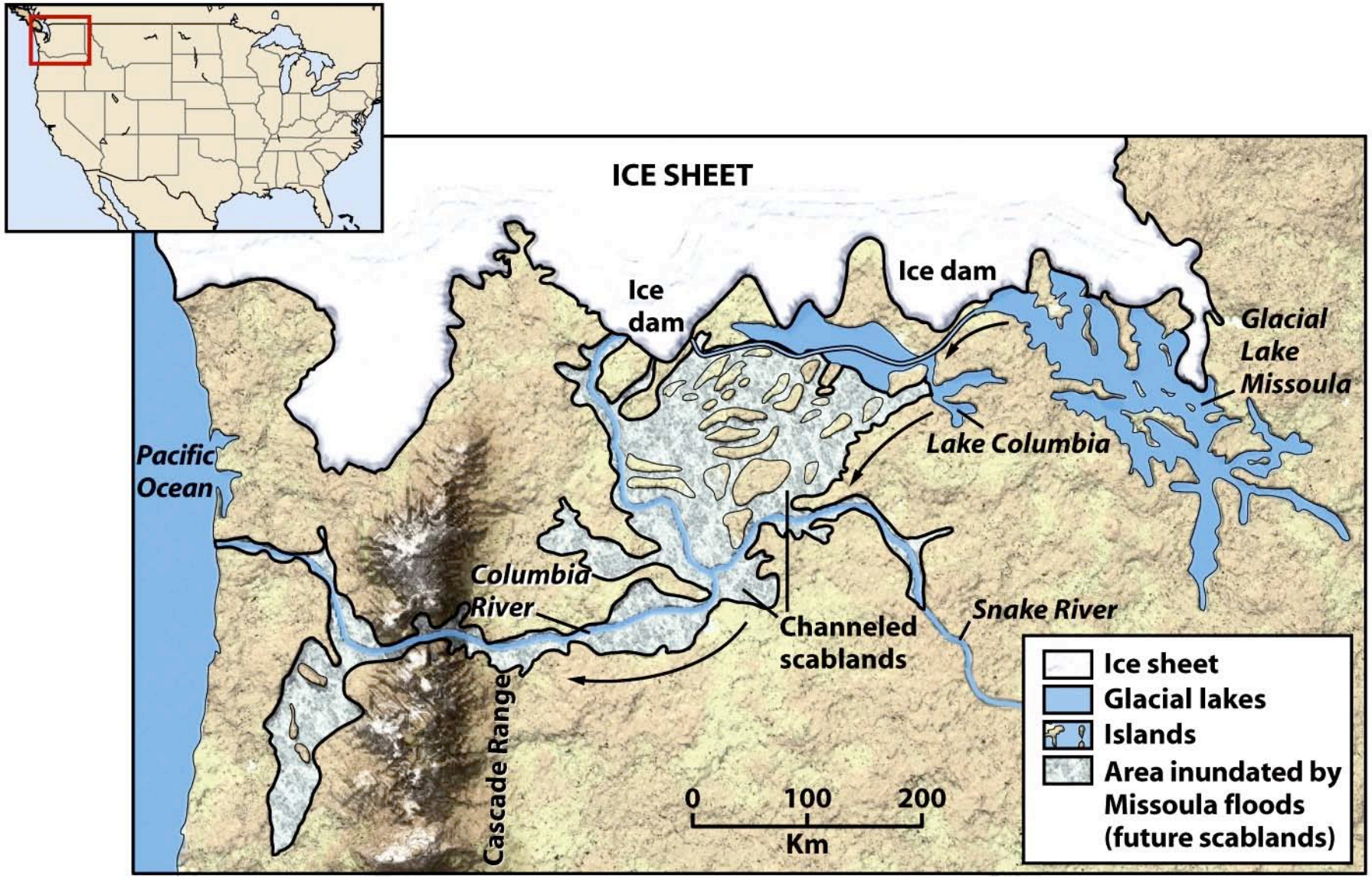
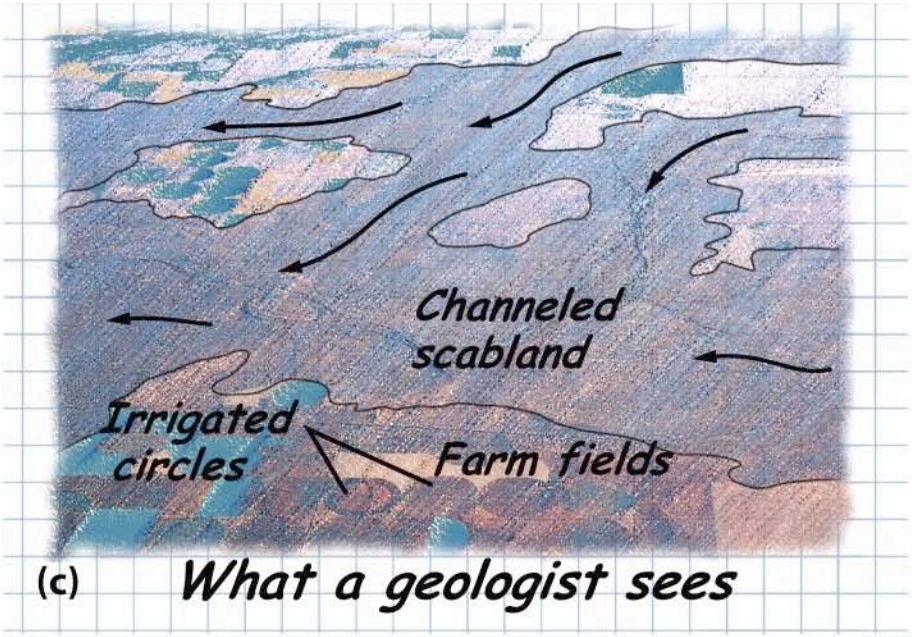


Figure 17-34a Earth: Portrait of a Planet 3/e

(b)



(c) What a geologist sees

Figure 17-34bc Earth: Portrait of a Planet 3/e

Flood Forecasting

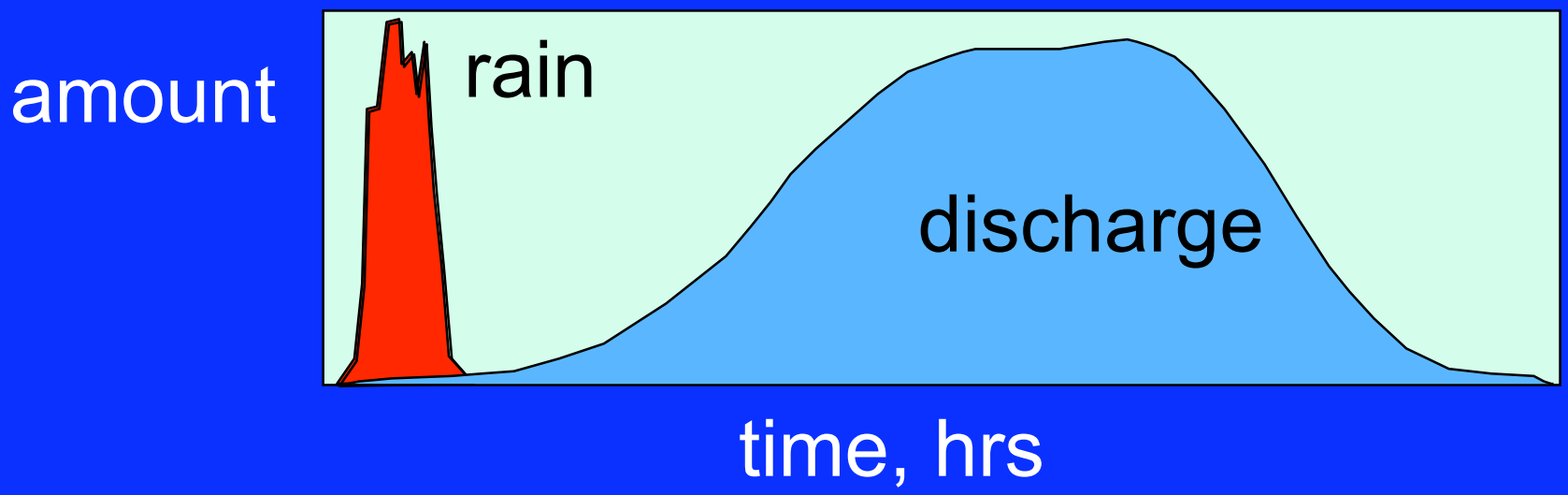
- rainfall
- saturation

Flood Factors

1. available water =
   watershed area × rainfall

-> big watersheds (Mississippi) more potential

2. Time Lag between rain and flood



Summary

- **Flood** = high Q over banks
- Causes: rainfall, ground saturation
- Lag and duration: Drainage Basin size
- Urbanization, levees intensify floods