http://www.youtube.com/watch?v=MGs2iLoDUYE

1

Notes 11/22

- Activity 2: AZ State Museum dueToday.
- Extra Credit : Due Tues Nov 29.

2

Continuing the Scourges of Mankind

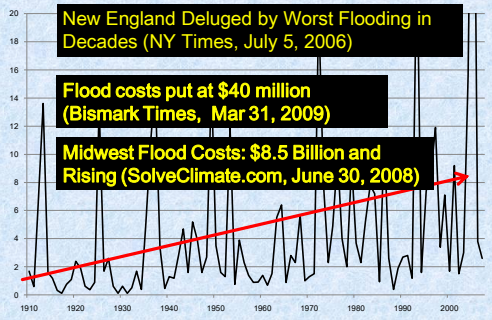
Fires, Pests, Droughts
Today----Floods

Southwest Flooding
--in the desert???

- Rain-stream-flow cycle
- Hydrographs
- Recurrence Interval
- Three Examples from Tucson “washes” as representative of Southwest
- 3 TYPES OF FLOODS

3

Why Care About Floods?



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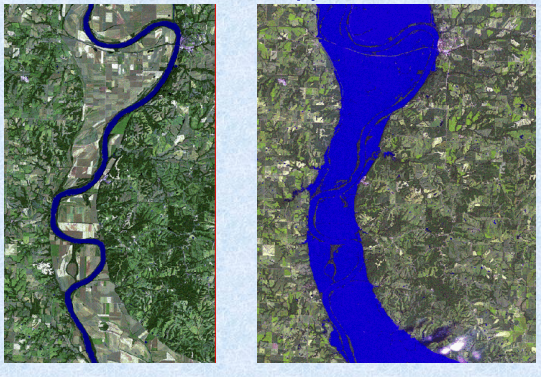
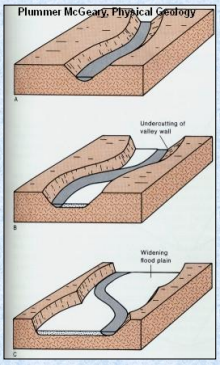
http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/the_cost_of_flooding.jsp

5

1993 Mississippi Flood



Southwest (Arid) Washes



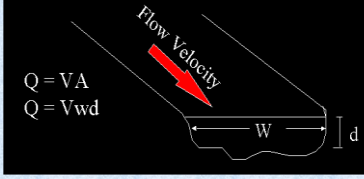
- If entrenched, do not overtop their banks (flood)
- Rather, tend to ……their banks
- Migrate ……. within large “flood plain”
- Re-deposit sediments later, completing cycle.

7

Measuring Streamflow

How much water is flowing in a river?

- Discharge -- volume of water flowing through a river cross section per unit time

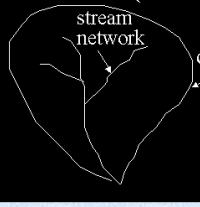


- Volume per time
- Velocity related to slope
- Typical units: cfs
  - Cubic feet per second.

8

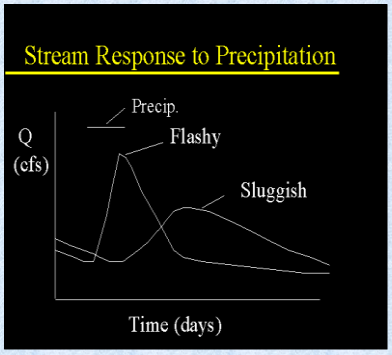
Drainage Basin

- A river’s drainage basin is the area of land that contributes water to the river.
- Boundaries (drainage divides) are high areas.



Watershed and drainage basin are synonymous.

Hydrographs

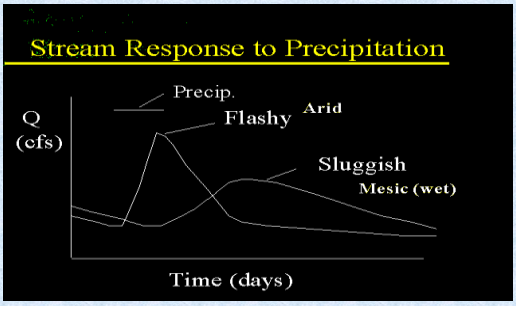


- Time series of discharge (cfs) through time (day, hour)
- River's response to …….

10

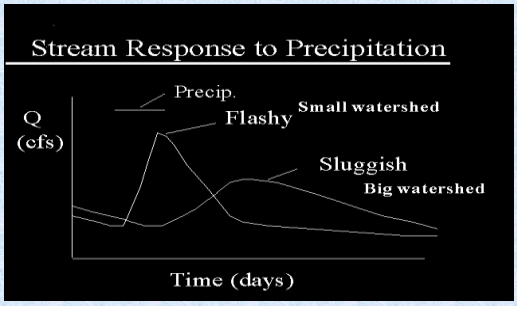
SW Streams tend to be flashy: Why?

1: In arid environments: Vegetation and soils are weak ➔ ……..strong



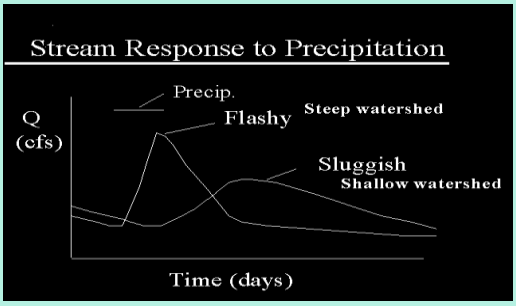
SW Streams tend to be flashy: Why?

2: Watershed is …….: water has little space to travel



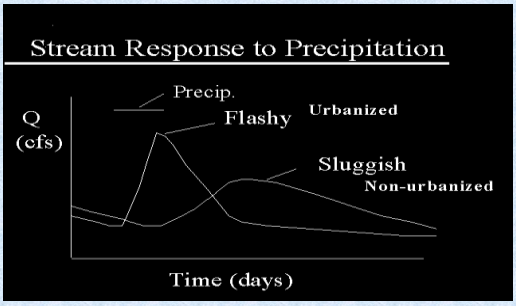
SW Streams tend to be flashy: Why?

3: ……. watersheds: surface flow moves quickly to streams



SW Streams tend to be flashy: Why?

4: Watershed is ……: paved over



Tropical Storm Octave

A tropical disturbance formed south of the Gulf of Tehuantepec on September 23. Steered by a deep layer high over Mexico, the disturbance moved west for four days before becoming a tropical depression. The system was situated over warm sea surface temperatures of 28–29°C, although wind shear prevented significant development. Late on September 28, the depression strengthened into Tropical Storm Octave, and early the next day reached its peak intensity of 50 mph (80 km/h). While strengthening, Octave turned to the north and northeast. On September 30, Octave began

accelerating over an area of cooler waters and increasing vertical wind shear. Consequently, Octave weakened back to tropical depression status during the afternoon. On October 2, the Eastern Pacific Hurricane Center issued their last advisory on the storm, as the surface circulation had dissipated. [3]While a tropical cyclone, Octave never threatened land. However, the interaction between its remnants and an upper-level low off of California produced a week-long rainfall event in Arizona. Damage was extreme, and several cities were entire flooded. Fourteen people were killed and hundreds were injured. The flooding left 10,000 Arizonans homeless. Damage in the state totaled $500 million (1983, $1.1 billion 2011 USD).

Of note: The 28-mile (45 km) long Santa Fe Railway 'Prescott Branch' that served the City of Prescott, AZ was washed out in multiple locations between Chino Valley and downtown Prescott due to Octave floodwaters. Railroad service was never reinstituted and the line was formally abandoned in 1984, leaving Prescott as Arizona's largest city ever to lose its rail service

Flood of 1983

- "It seemed like a flood of **biblical** proportions"
- The numbers tell the story:
  - 14 killed
  - 10,000 people temporarily homeless
  - more than 800 structures destroyed or damaged
  - nine counties (of 15) declared federal disaster areas
  - area road and bridge damage $54 million
  - a statewide price tag of a half-billion dollars.

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Flood of 1983

- Summer of 1983--, ~50 percent more rainfall than normal,
- Ground was saturated.
- Late September, hurricane Octave
- Six inches or more fell across a huge swath of Southern Arizona, with widespread and catastrophic results.

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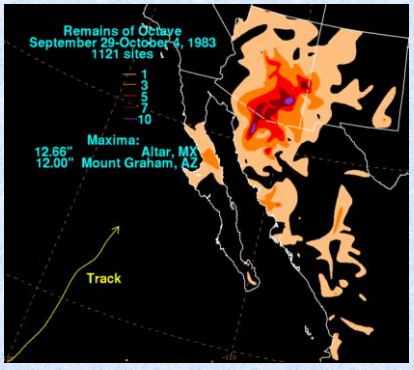

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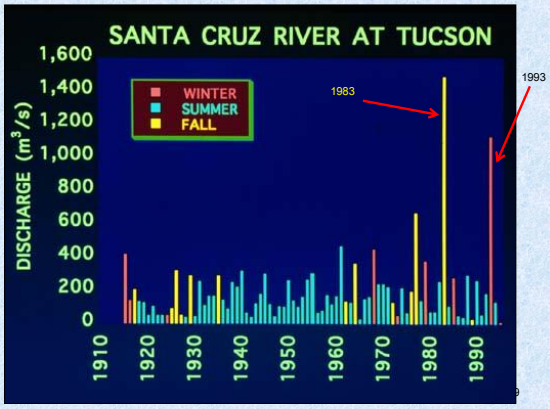


1983 Flood

Looking S from St Mary's Bridge. L Oct 2, 1983; R pre-flood

20

Dodge at Rillito

Ina at Stana Cruz

21

1983 Flood

- North of Tucson
- After Rillito joins it, Santa Cruz is not entrenched

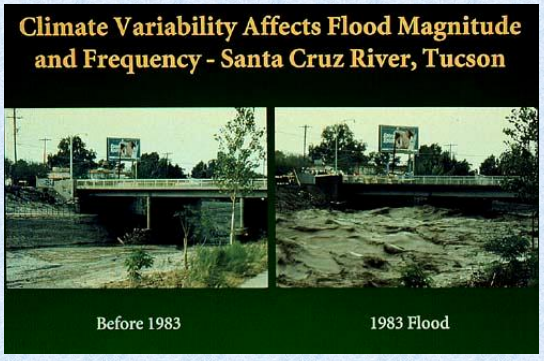
22

1983 Flood

- What happens to structures?

23

How Much in 1983 Flood?



1983 flood: 884,900 af

- How many years does that "water" Tucson?

$$884{,}900\,af \bullet \frac{325{,}851\,gal}{1\,af} \bullet \frac{1\,person \bullet day}{160\,gal} \bullet \frac{1\,yr}{365\,day} \bullet \frac{1\,Tucson}{500{,}000\,peo.} =$$

= ~…… Tucson years

25

After 1983:

- "The rivers themselves moved."
- The real problem wasn't flooding, but erosion.
- "If we're going to have flooding rivers, we have got to have something to protect the banks."
- In the last 30 years at a cost of **$**.....
  - Pima County 78 **miles** of soil cement bank protection, including 28 miles along the Santa Cruz River
  - 24 miles on the Rillito
  - 2 miles on Pantano Wash.
  - 10 miles of levees,
  - Purchased 12,000 acres of flood control property and are looking at environmental restoration projects on the Santa Cruz and Rillito.

26

1983 Flood

- Bank gouging
- Not overtopping

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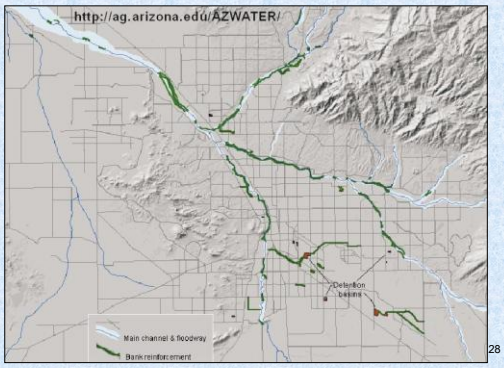
Bank Reinforcement



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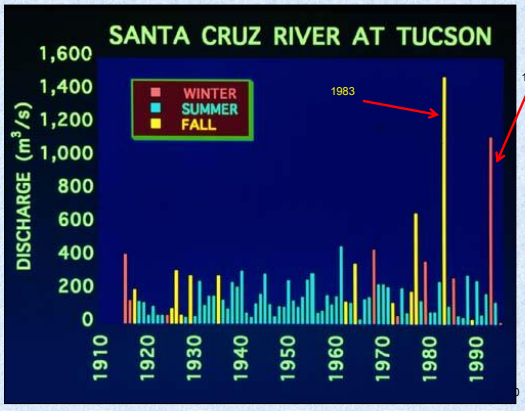
……..the Rivers

- Even the grade
- Cement the walls
- Helps move water out fast
- But:
  - Reduces …….
  - Marana?

Doug Shakel, geology professor at Pima Community College calls the county's soil cement project a "channelization effort" and labels what the county has implemented as a "flood guarantee program" that will prevent erosion but aggravate flooding." (Devine 2003, Tucson Weekly)

29



Flood of 1993

Rated #2 Weather event of 20th century by Tucson Weather Service

January 1993 – …….. week duration

- several Pacific storm systems produced the wettest January on record
- ……." rain fell across the metro area between the 5th and 19th.
- Runoff from snow melt from the Santa Catalina Mountains added to the flood.
- $..... million in damages

31

Sabino Canyon is 'forever changed'

Record flood that swept through July 31 left the treasured site 'a different place'
Doug Kreutz, *Arizona Daily Star* Tucson, Arizona | Published: 08.12.2006

July 31/Aug1, 2006

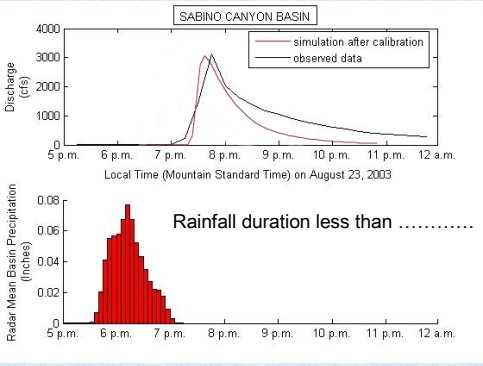
Rainfall totals:
Upper Sabino– 8-10"
Molino Basin– 5-6"
Lower Sabio—2"

Sabion Stream Gauge peak:
…….. cfs

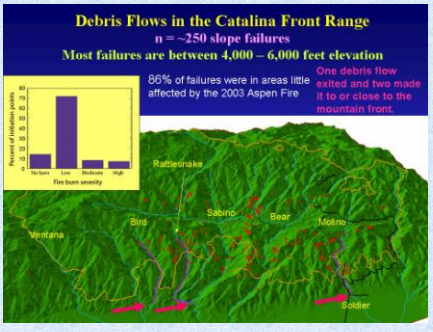
http://www.sabinocanyon.arizona.edu/
http://www.fs.fed.us/r3/coronado/forest/districts/scrd/2006sabinoflood.shtml
http://www.tucsonweekly.com/gbase/Currents/Content?oid=oid%3A97514
http://wwwpaztcn.wr.usgs.gov/Santa_Catalina_Debris_Flows.pdf

33

Rainfall & runoff in Sabino



Sabino 2006– Damage by?



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Sabino 2006– debris flows

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Sabino 2006 Damage by?

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Sabino Canyon 2006

$>……..damage

Long-term stream rehab?

What about houses?

More than 20 deaths in last 20 years

Memorial services planned for hikers killed in Sabino Canyon 09:35 PM MST on Tuesday, August 7, 2007

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Watch this video on your computer—with sound!!

http://www.youtube.com/watch?v=LRVUVBAfiTo

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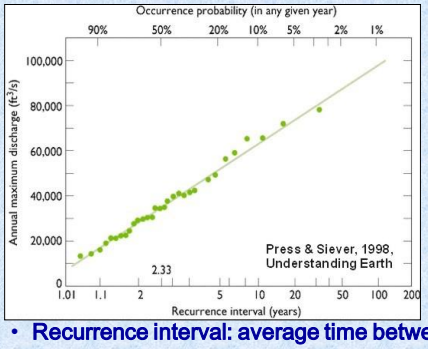
Not All Floods Alike

	Season	Storm Type	Antecedent Conditions	Storm Duration	Total discharge	Cost
1983	Oct 1-3 (……)	Hurricane + Pacific	……	……	85,000cfs	$500m
1993	Jan 3-20 (winter)	Pacific	Dry	…….	55,000cfs	$100m
Sabino	July 31 (……)	……	….	…	15,000cfs	$1+m

Total volume: 1983= 884,900 acre feet

40



- High-magnitude events: rare
- Low-magnitude events: common

- Recurrence interval: average time between events of a certain discharge
- 10-year flood: discharge that has a 10-yr RI

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PUBLIC PERCEPTION OF FLOOD FREQUENCY

The 100-year flood has come and gone, so, by all rights, Tucsonans should enjoy another century of great Southwest weather.

Message sent to national media by Metropolitan Tucson Convention and Visitor's Bureau after the floods of October 1983 caused damage in excess of half a billion dollars throughout southern Arizona.

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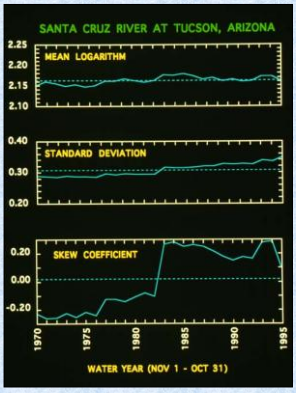

Recent Changes

- Mean about the same
- Variance increasing somewhat
- ……off the charts!

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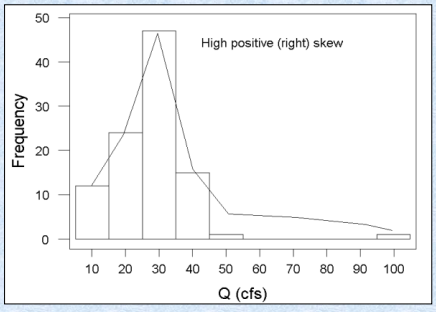
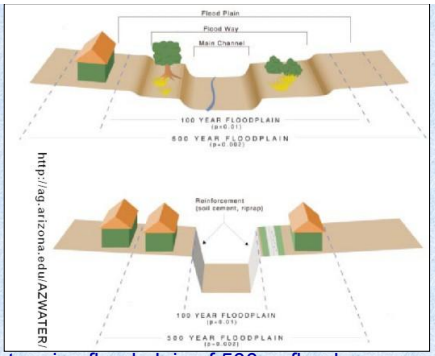


- High skew: an extreme event

44



- Determine flood plain of 500-yr flood
- Don't build there

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Flood Management

- Floods happen, frequently lately
- Soil cementing is a debatable strategy, but we're doing it
- Have ample setbacks, at least 500 feet, to avoid flood damage.

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How to Know About Paleofloods?

Consider Intro. to Dendro (geos 464/564 48