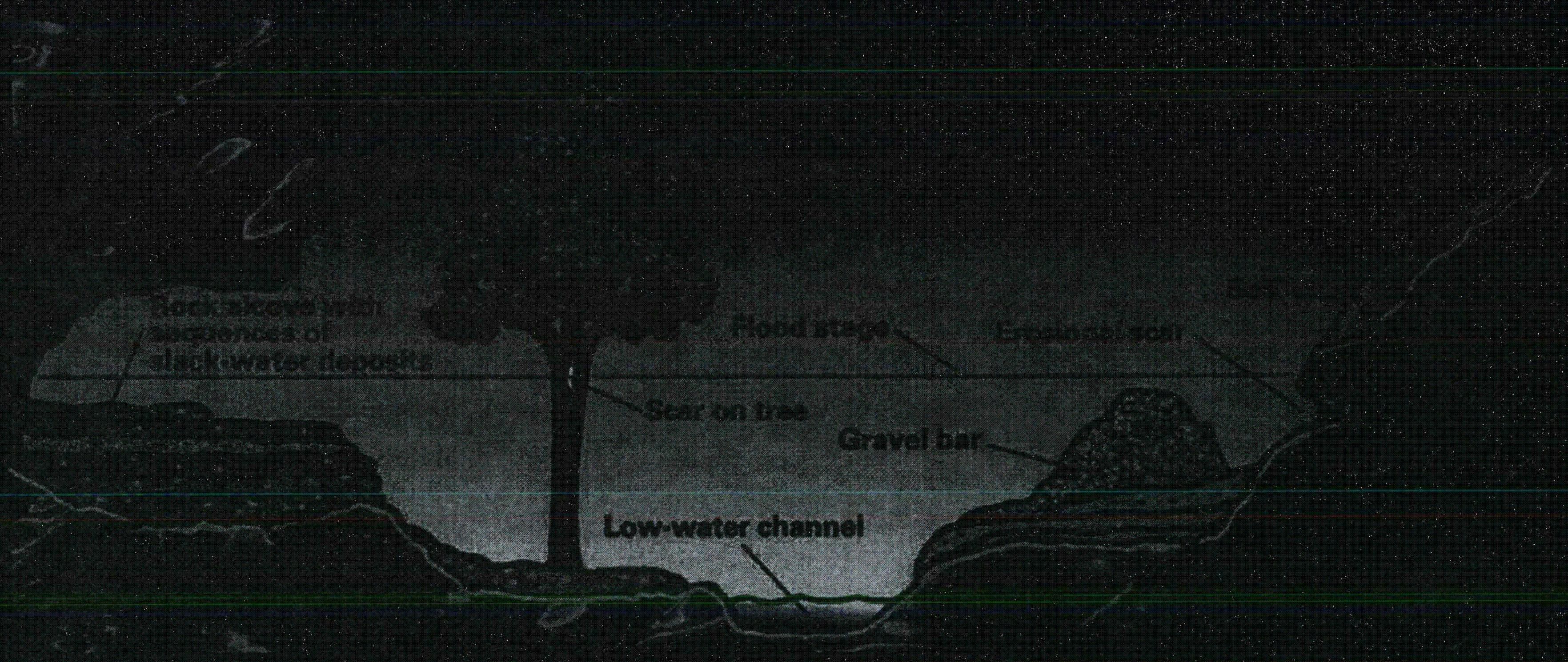
Paleofloods -Paleostage indicators (PSIs)



Jarrett (1991) USGS Water-Supply Paper 2375
House et al. (2002) AGU Paleoflood Monograph

USGS

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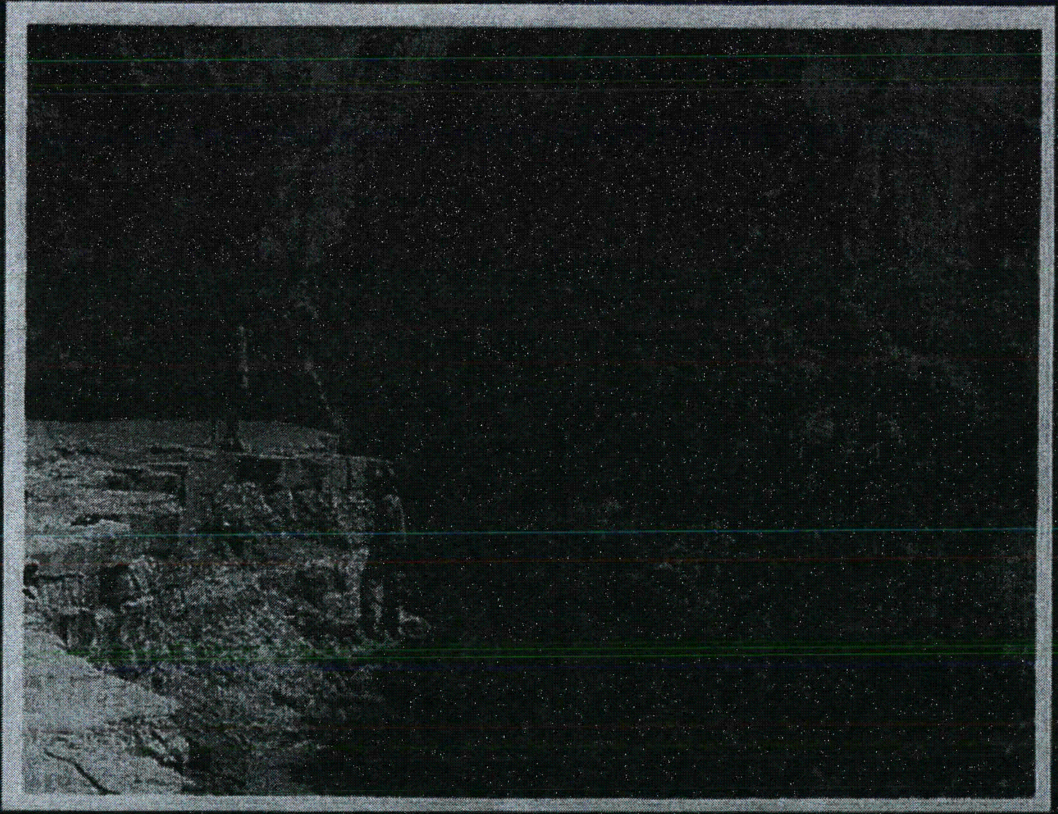
Slackwater Deposits



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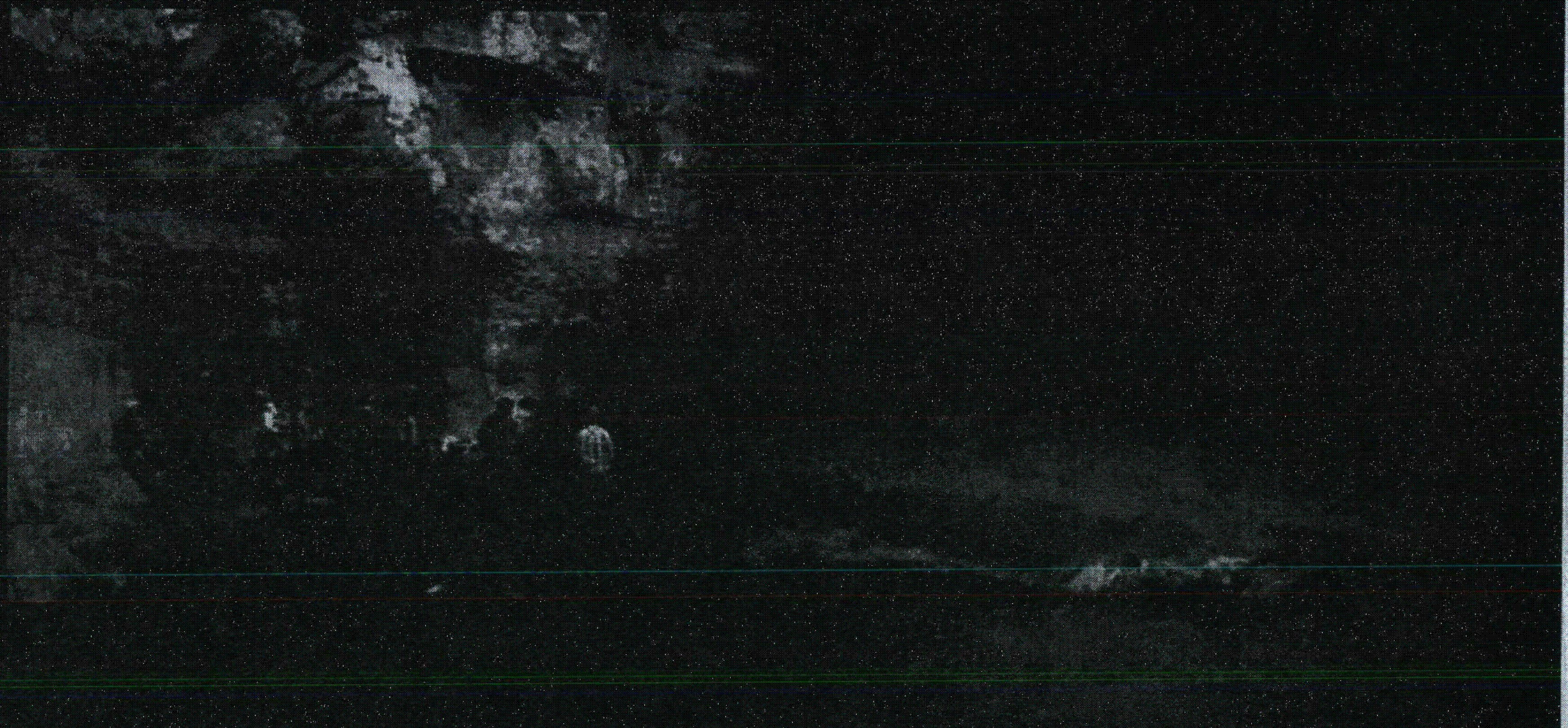
Searching for Paleoflood Evidence



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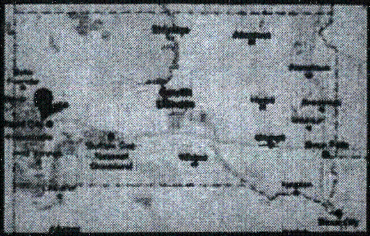
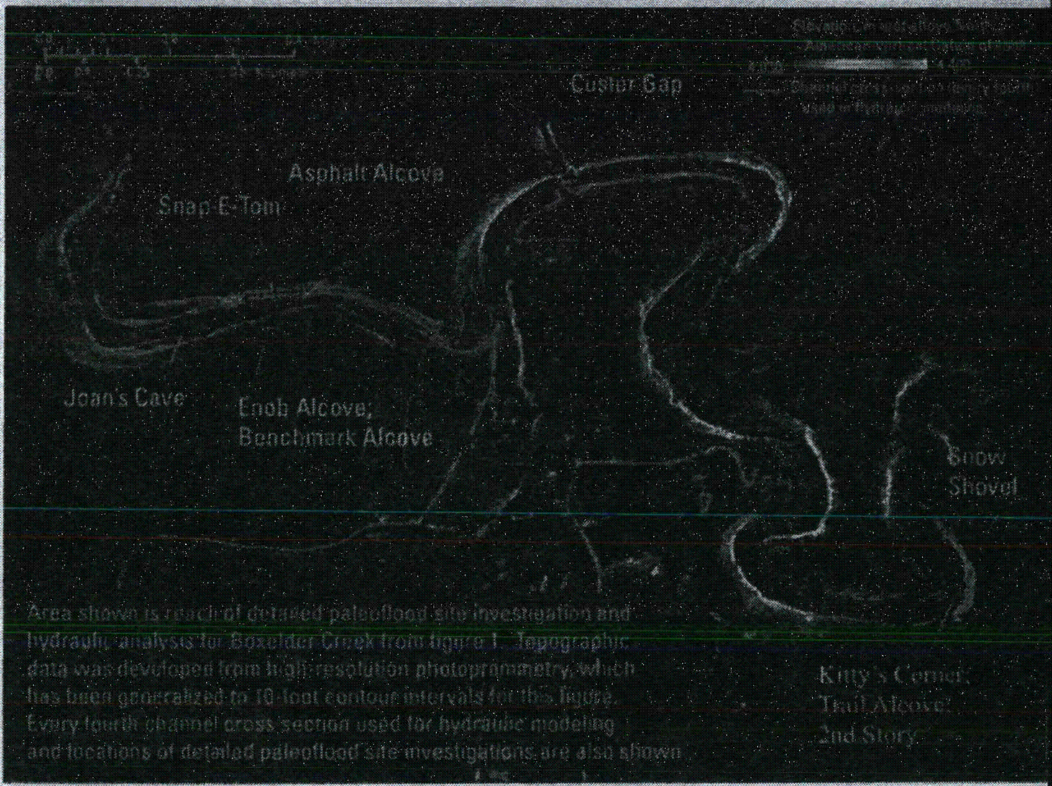
Paleoflood Sites





Base modified from ESRI digital data. Projection: Lambert Conformal Conic, State Plane, South Dakota. North American Datum 1983, 1:9,600, False easting = 1968500, False northing = 0.

Figure Boxelder Reach. Topographic information and selected details of hydraulic analysis for Boxelder Creek reach.

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Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

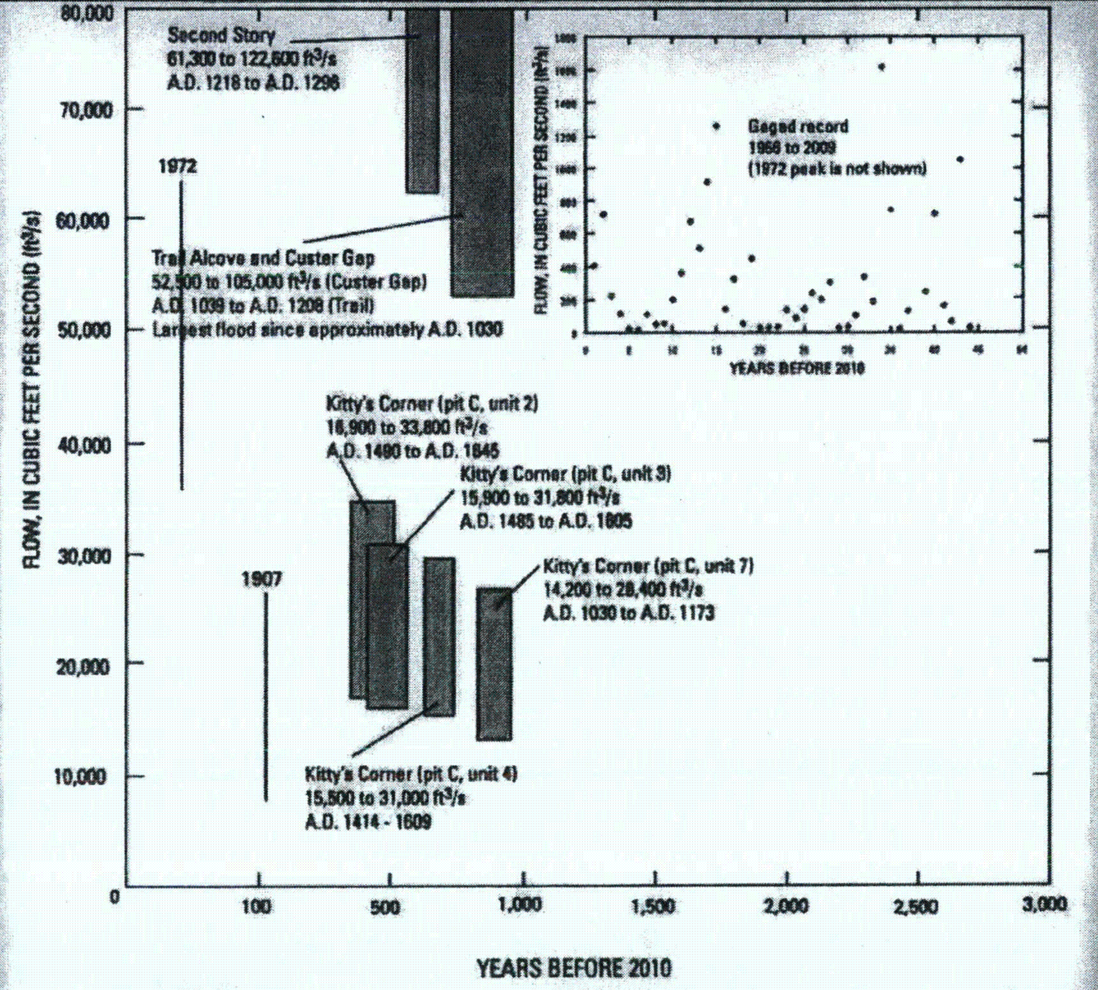

Figure Lower Boxelder Chronology. Graphical representation of the long-term flood chronology for lower Boxelder Creek.

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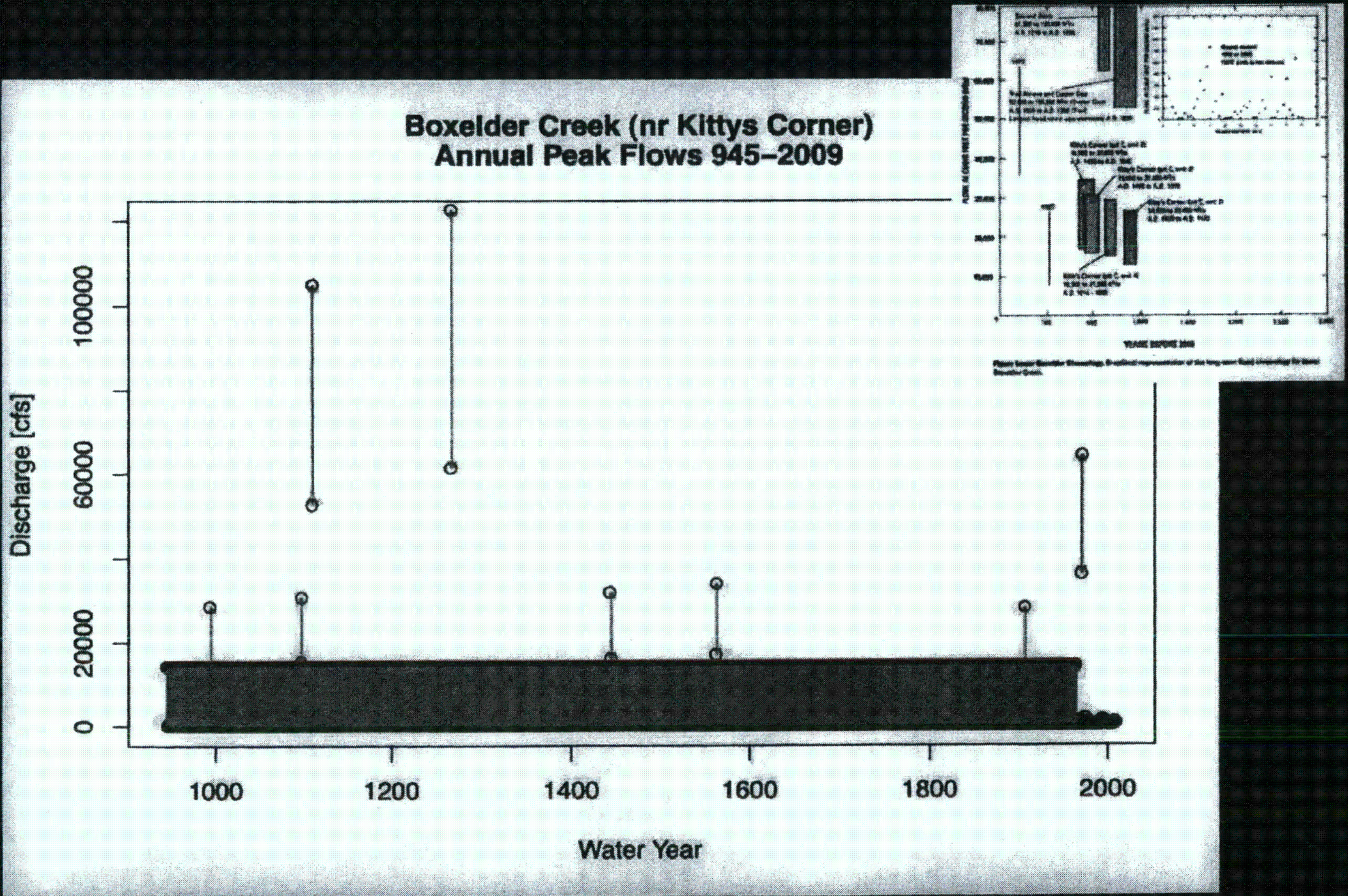

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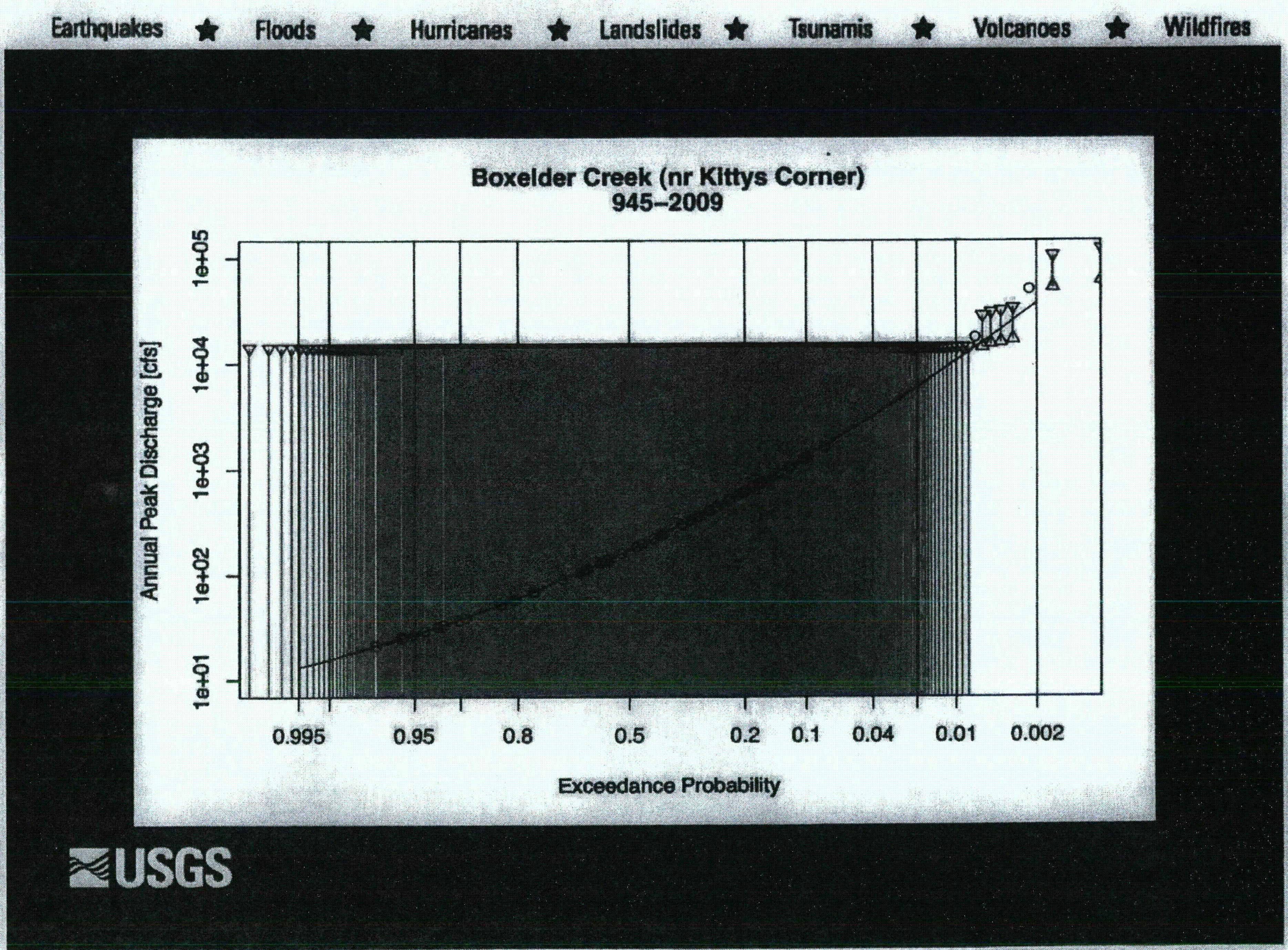
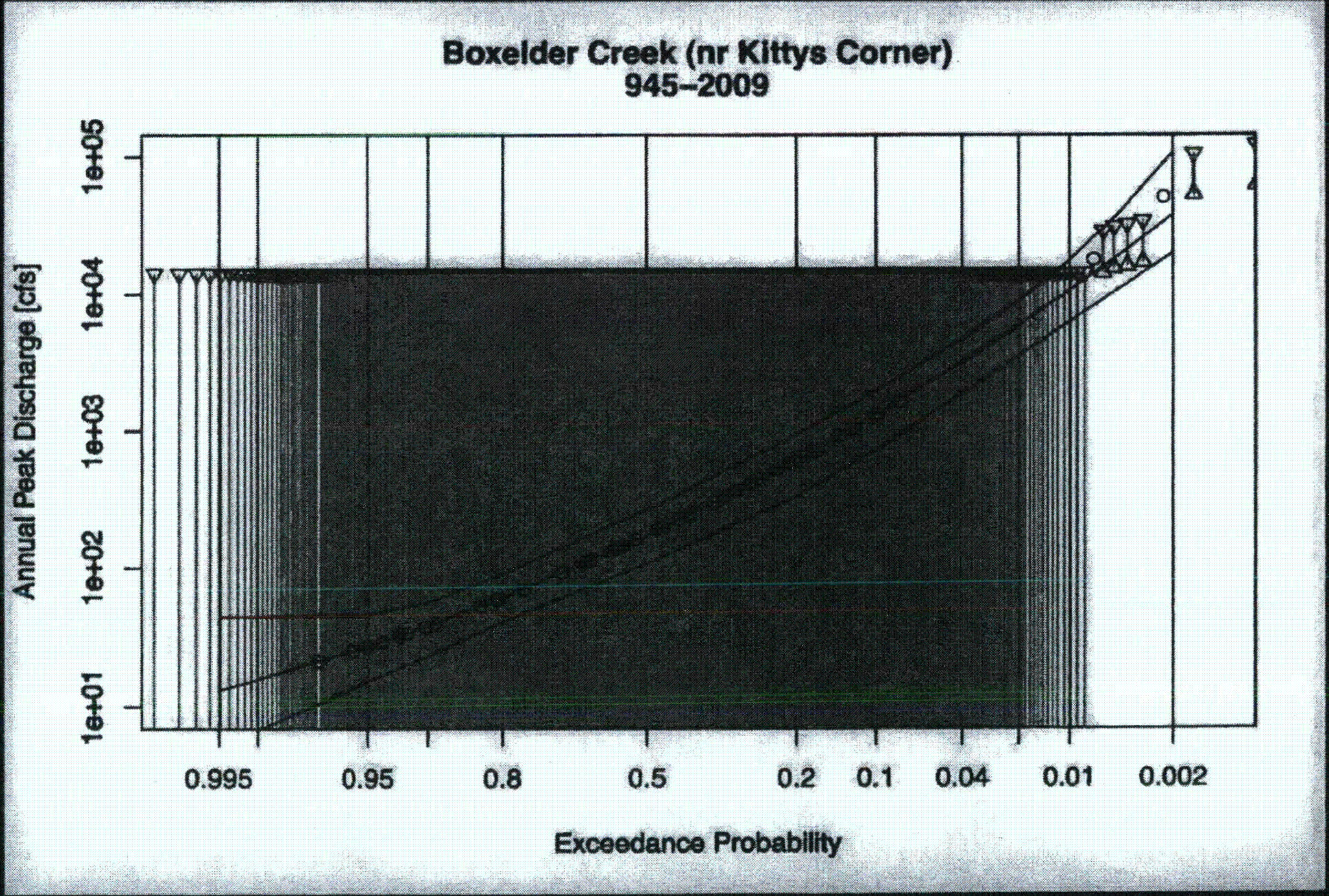

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires
Boxelder Creek (nr Kittys Corner)
945–2009
Annual Peak Discharge [cfs]
1e+01
1e+02
1e+03
1e+04
1e+05
0.995
0.95
0.8
0.5
0.2
0.1
0.04
0.01
0.002
Exceedance Probability
USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

Uncertainty and Confidence Intervals



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Quantile Estimates and Confidence Intervals for 1% Flood

Period of Record	$Q_{0.99}$	95% Confidence Interval	
1966-2009	18,800	4,800	4,640,000
1946-2009	14,100	4,300	820,000
1904-2009	15,300	5,200	273,000
945-2009	10,600	6,300	18,100
1966-2009*	2,760	1,390	19,100

* 1972 flood omitted

USGS

Quantile Estimates and Confidence Intervals for 0.2% Flood

Period of Record	$Q_{0.99}$	95% Confidence Interval	
1966-2009	104,000	15,100	429,000,000
1946-2009	63,400	12,100	28,100,000
1904-2009	64,500	14,800	7,320,000
945-2009	37,400	19,800	108,000
1966-2009*	5,460	2,150	91,400

* 1972 flood omitted

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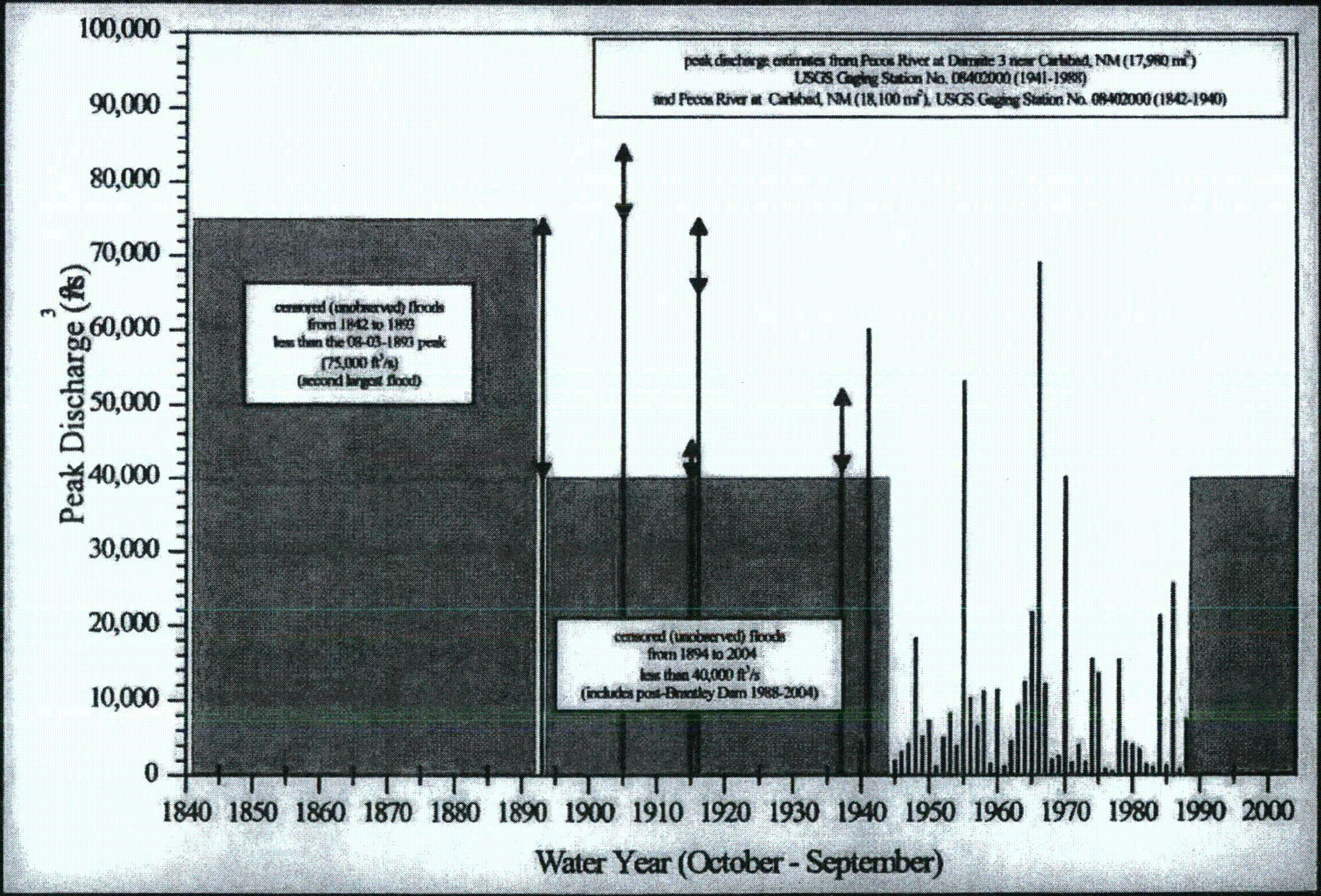
Why Paleoflood Data Are Useful

- Reveal character of right-hand tail of flood frequency distribution
- Inexpensive
- Available now (maybe)

Pecos River near Carlsbad (Brantley Dam), NM



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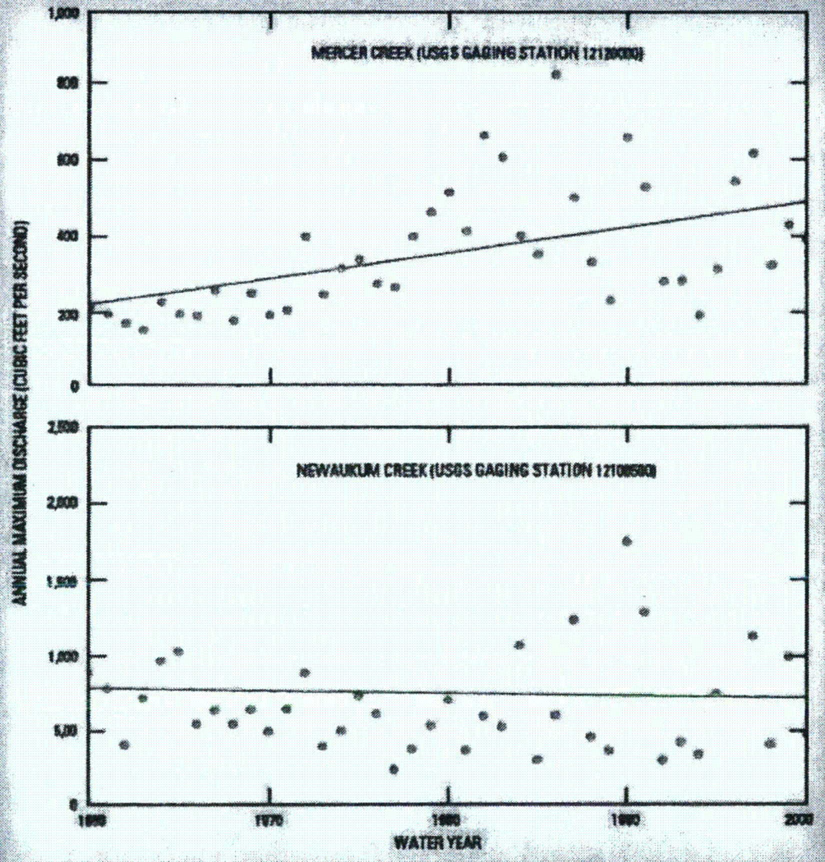
…But There Are Some Issues:

- Dependence on site characteristics
- QA/QC of data
  - Indirect measurements
  - Reconstructing channel geometry and hydraulic conditions
- Nonstationarity
  - Changes in land use in basin
  - Regulation such as dams and levees
  - Climate change

Impact of Development



Annual maximum discharge increased with urban development in Mercer Creek from 1960 to 2000, but remained essentially the same in nearby rural Newaukum Creek during that period.

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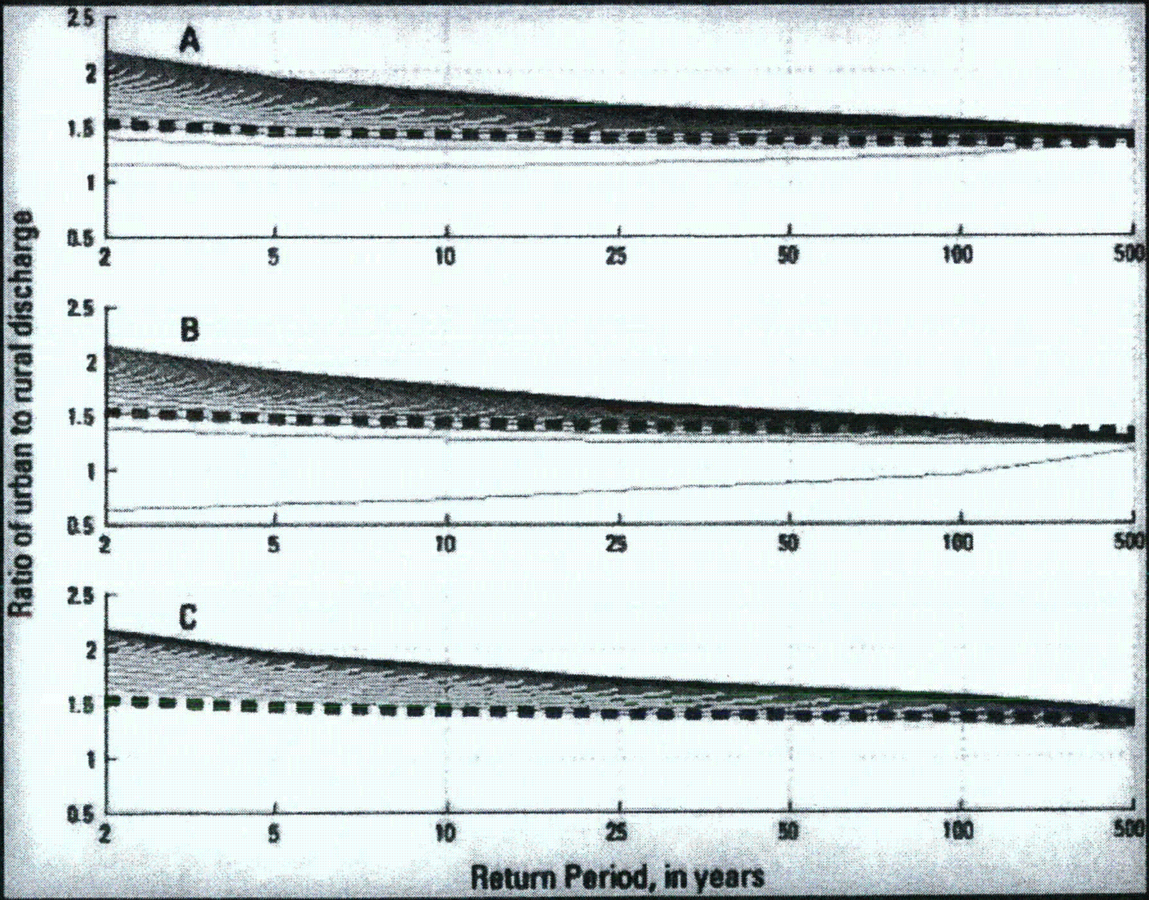
Ratio of Urban to Rural Discharge

West Branch Herring Run at Idlewylde, MD (01585200)



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Stationarity of Climate

IV. Data Assumptions

Necessary assumptions for a statistical analysis are that the array of flood information is a reliable and representative time sample of random homogeneous events. Assessment of the adequacy and applicability of flood records is therefore a necessary first step in flood frequency analysis. This section discusses the effect of climatic trends, randomnes of events, watershed changes, mixed populations, and reliability of flow estimates on flood frequency analysis.

A. Climatic Trends

There is much speculation about climatic changes. Available evidence indicates that major changes occur in time scales involving thousands of years. In hydrologic analysis it is conventional to assume flood flows are not affected by climatic trends or cycles. Climatic time invariance was assumed when developing this guide.

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Milly et al. [2008]

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Climate Change and Stationarity of Floods

- What data show now
- What models predict

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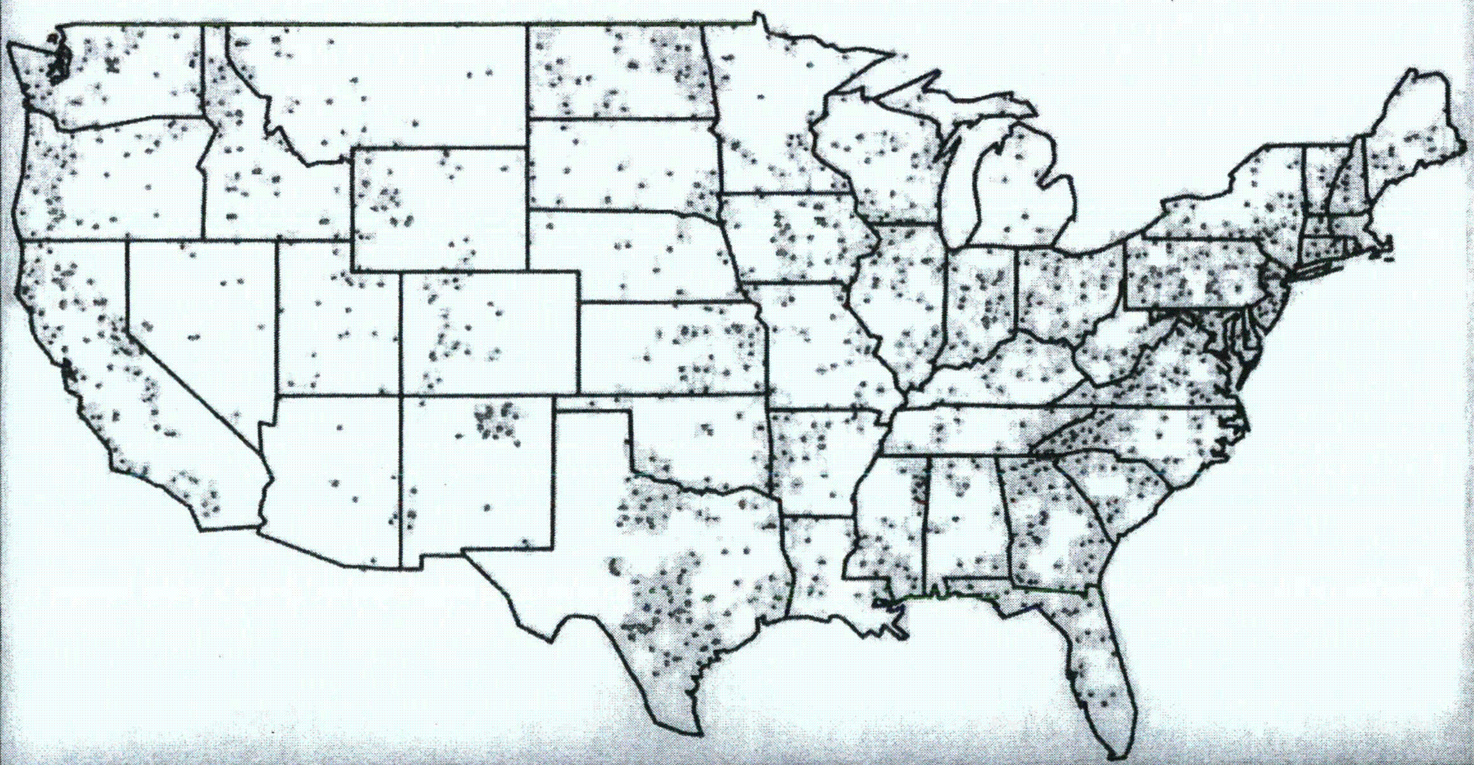
HCDN Sites

Locations of 1491 HCDN Stations



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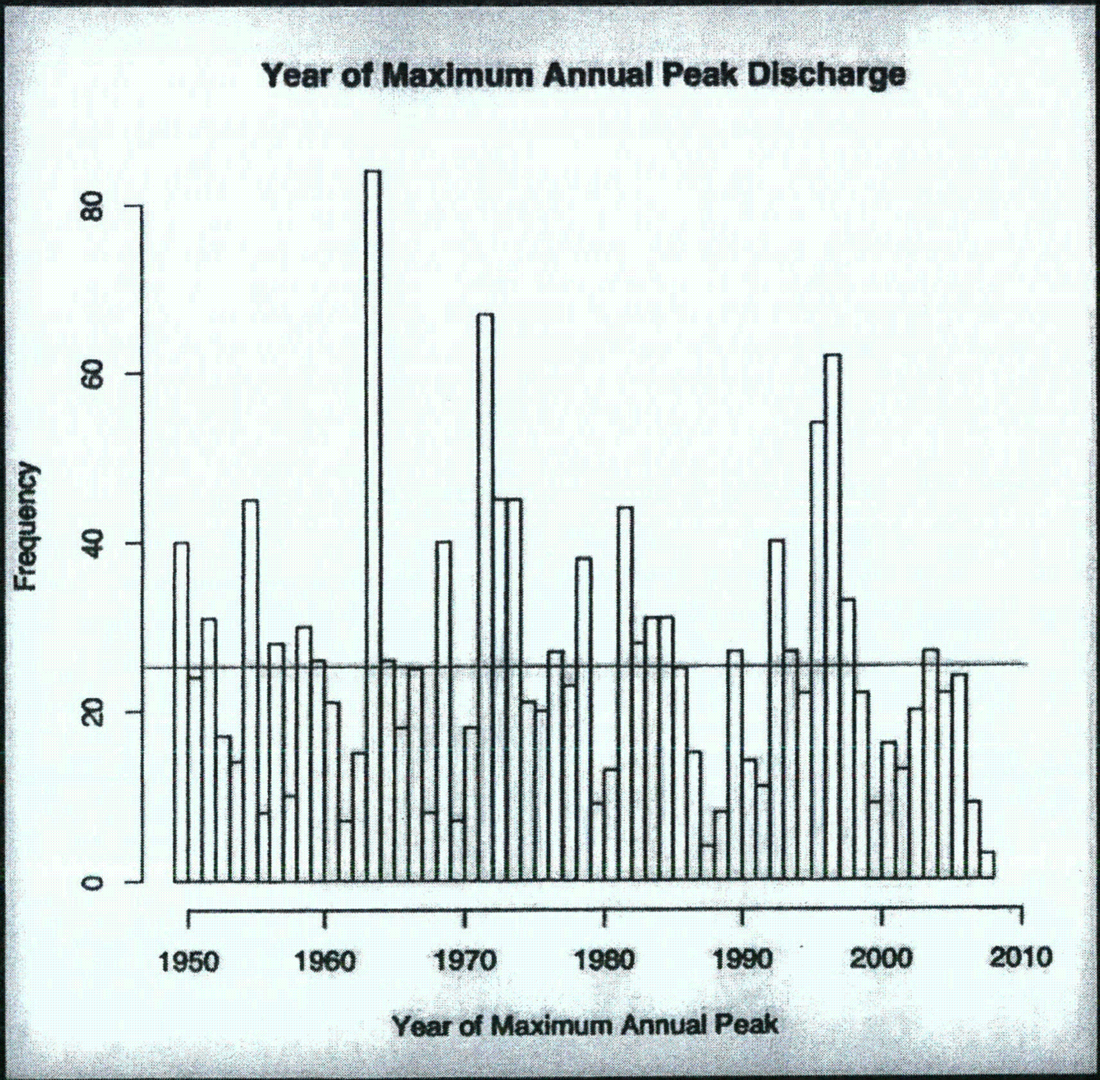
Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires



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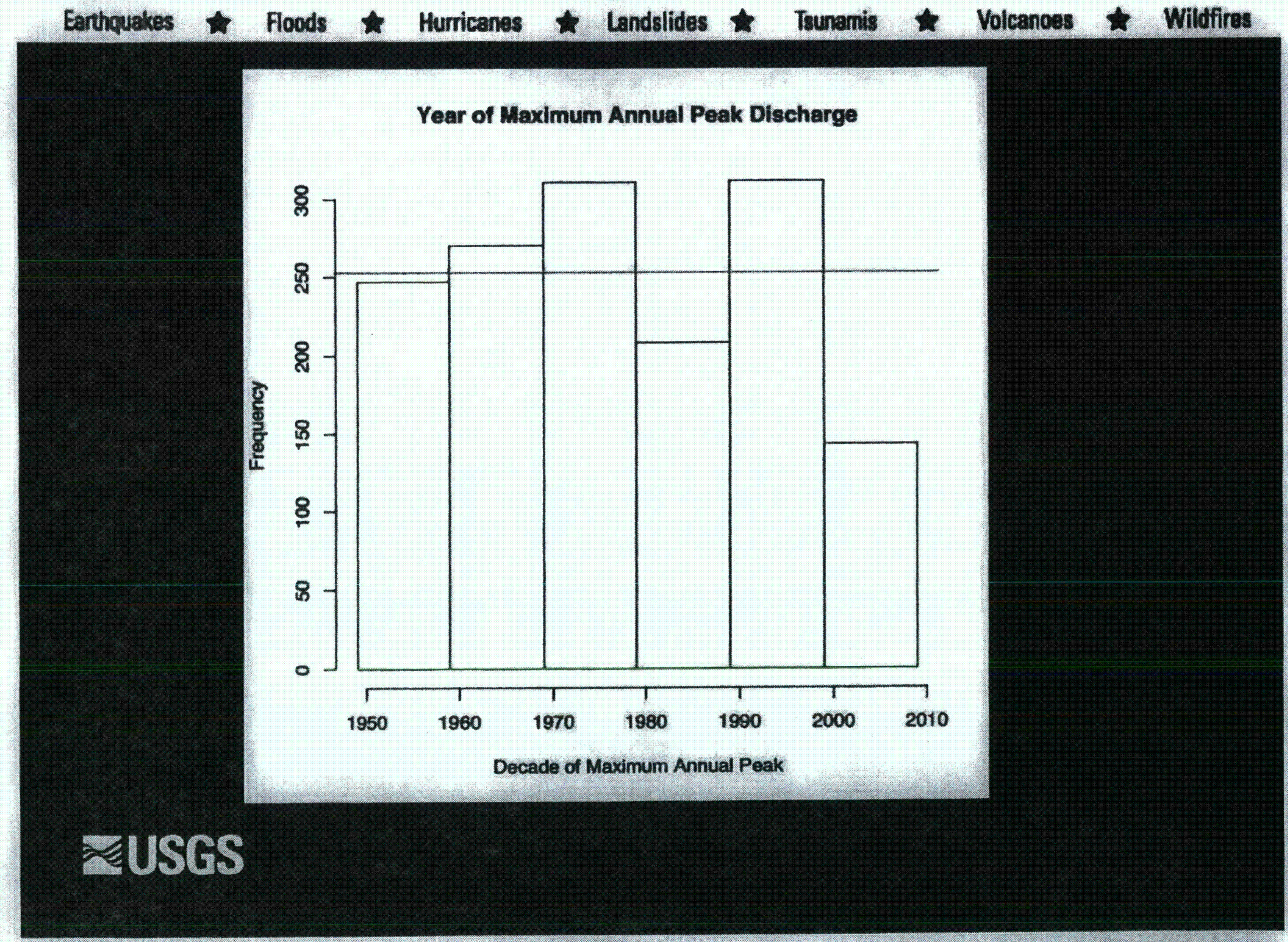
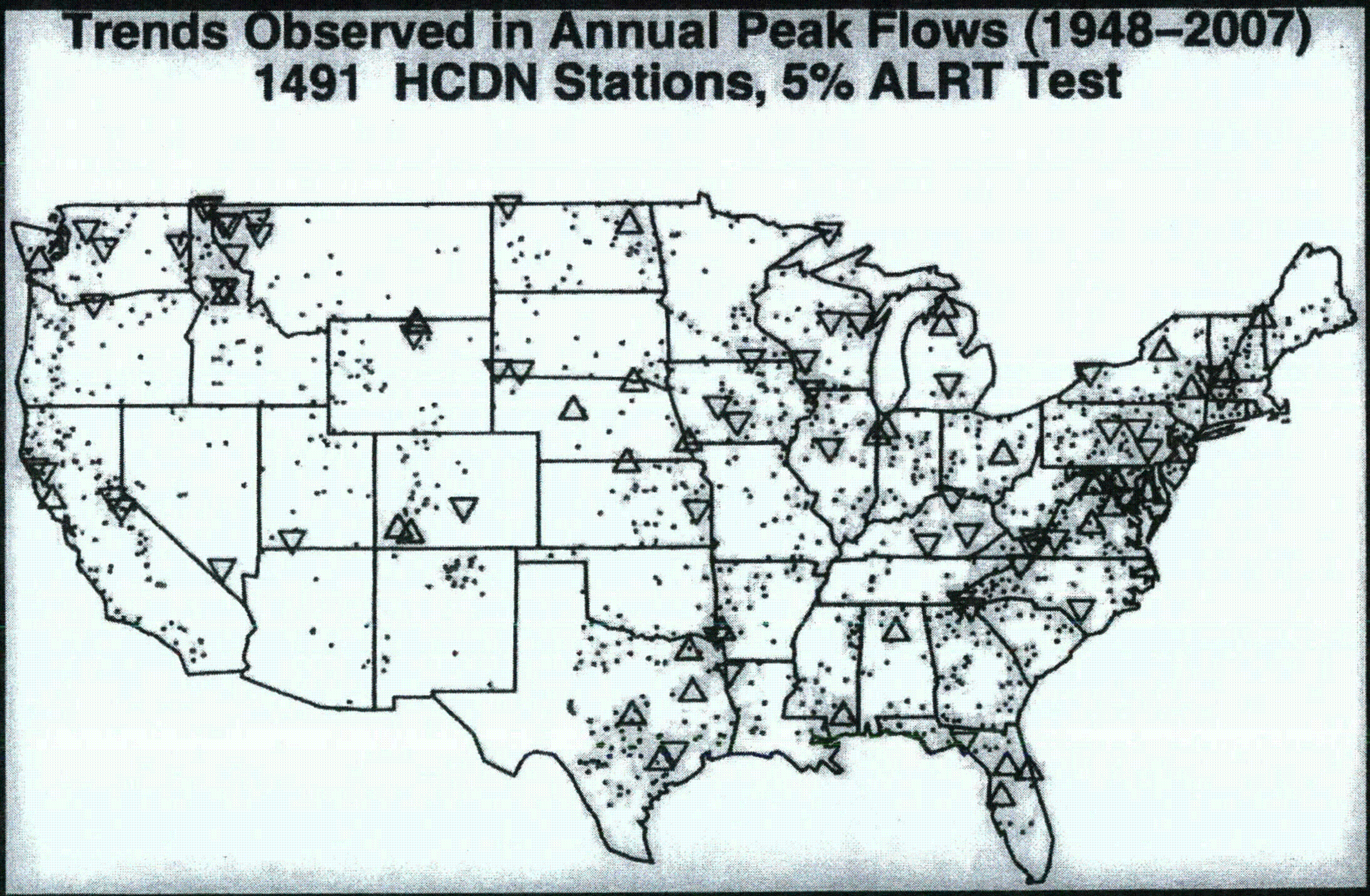

Earthquakes
Floods
Hurricanes
Landslides
Tsunamis
Volcanoes
Wildfires
Year of Maximum Annual Peak Discharge
Frequency
0
50
100
150
200
250
300
1950
1960
1970
1980
1990
2000
2010
Decade of Maximum Annual Peak
USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires



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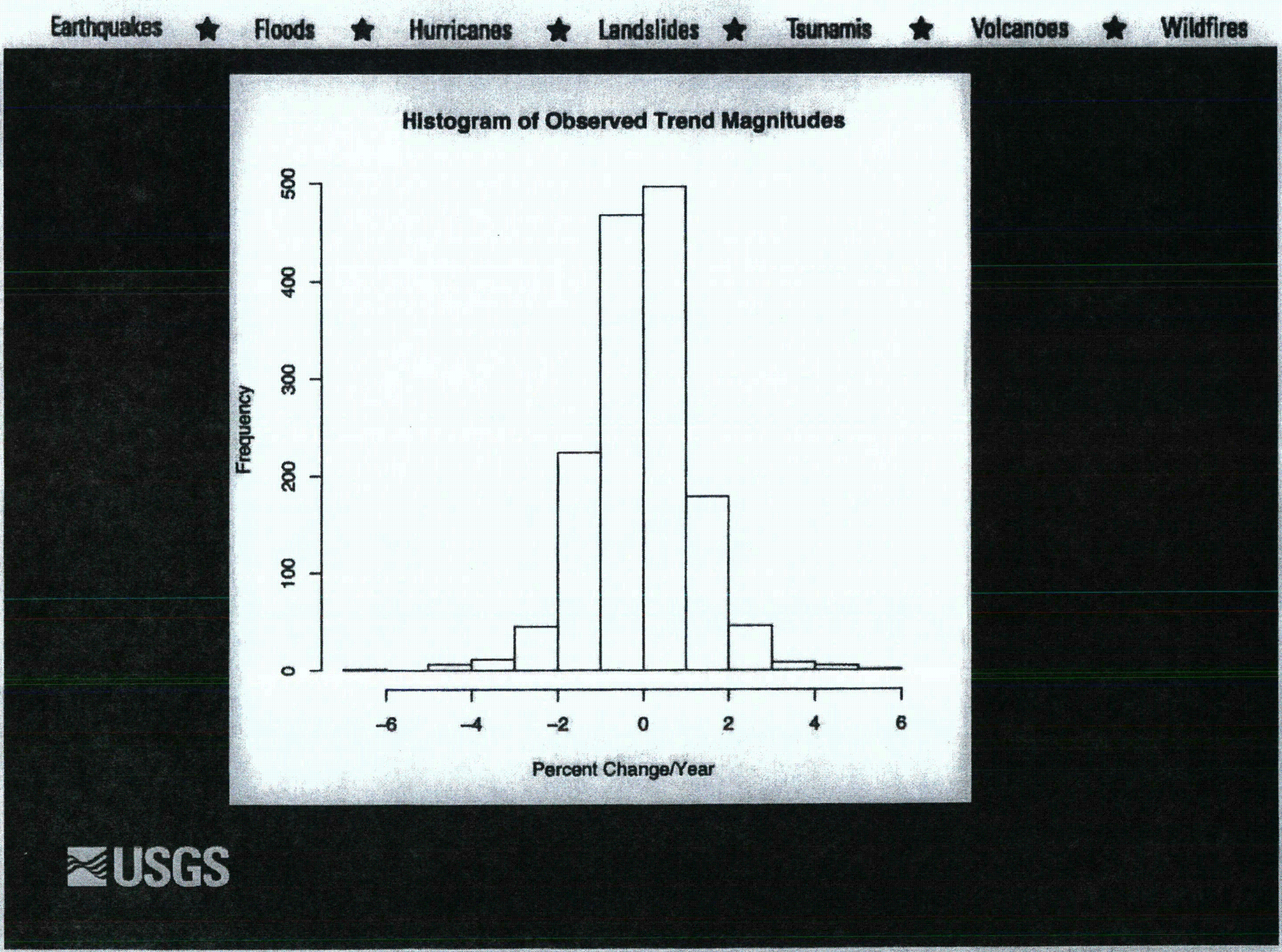
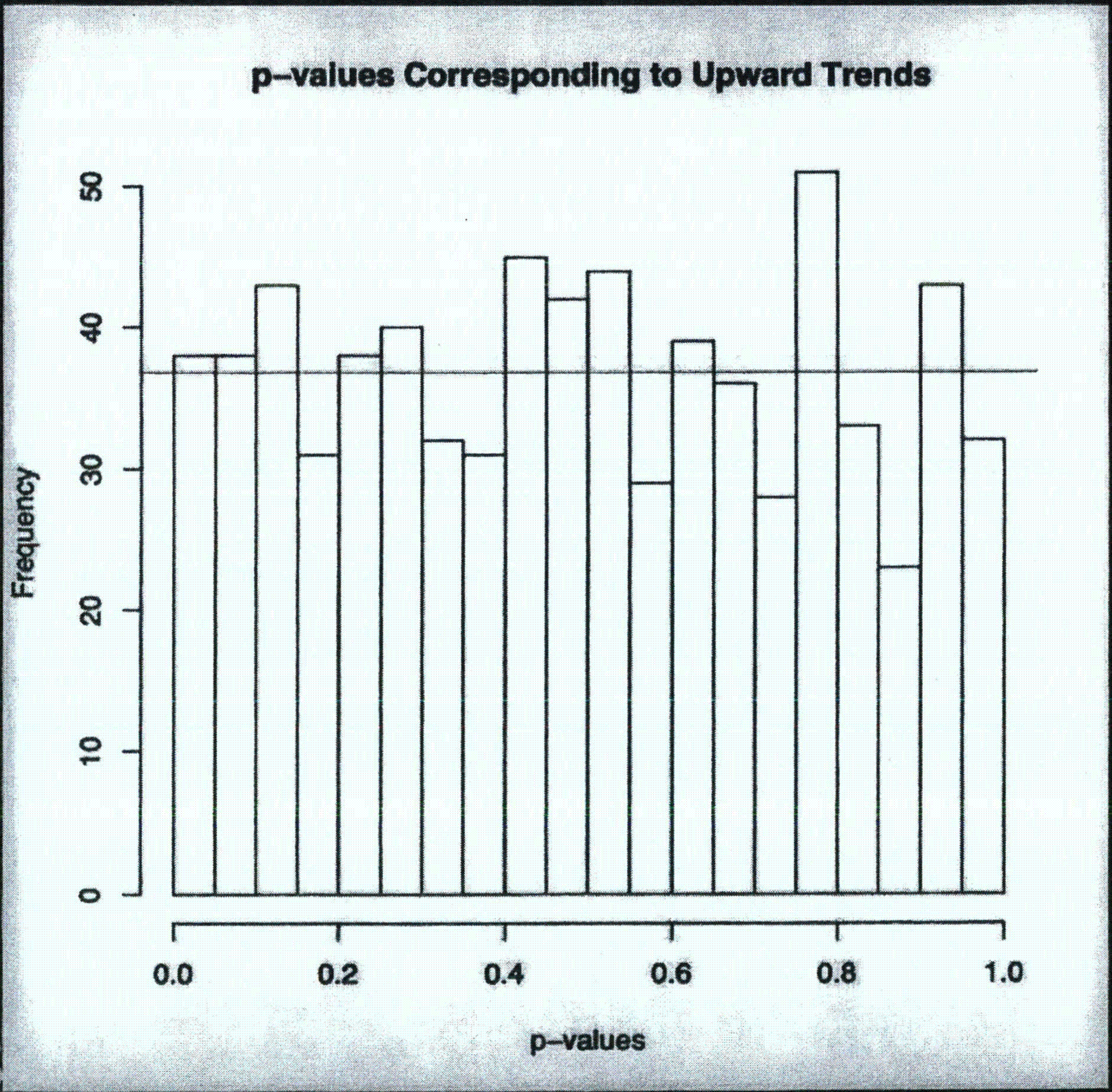

Earthquakes
Floods
Hurricanes
Landslides
Tsunamis
Volcanoes
Wildfires
Histogram of Observed Trend Magnitudes
Frequency
0
100
200
300
400
500
-6
-4
-2
0
2
4
6
Percent Change/Year
USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires



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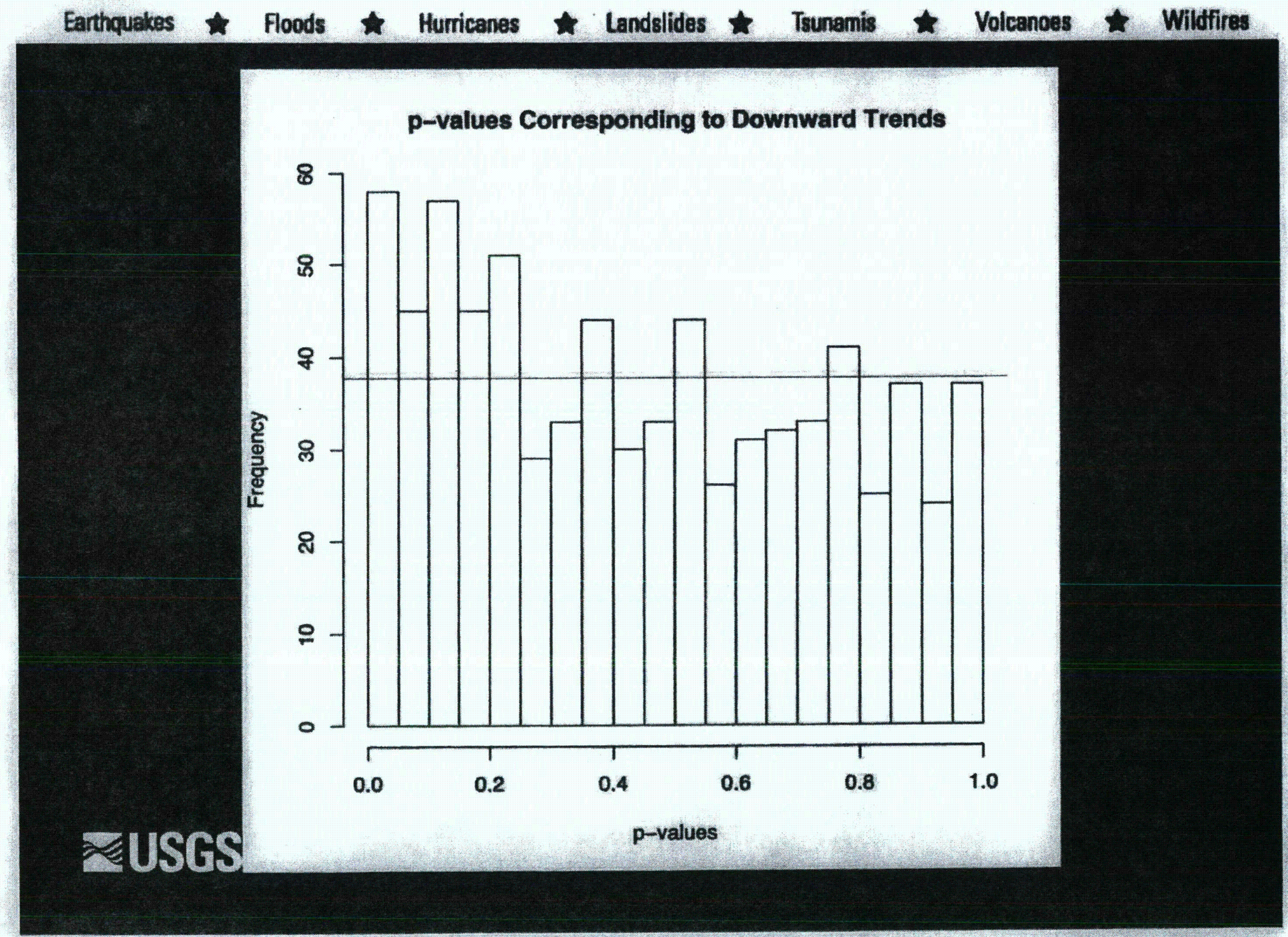
Earthquakes
Floods
Hurricanes
Landslides
Tsunamis
Volcanoes
Wildfires
p–values Corresponding to Downward Trends
Frequency
0
10
20
30
40
50
60
0.0
0.2
0.4
0.6
0.8
1.0
p–values
USGS