

## Updating Flood Frequency in California

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### BIOGRAPHICAL SKETCH

Parrett has worked as a surface-water hydrologist for the USGS for over 30 years, the last three of which have been in California. He has worked on a wide variety of surface-water studies, including flood-frequency studies, flood and debris-flow investigations, methods for estimating mean and low flows, extreme-precipitation studies, water-use, paleoflood investigations, and streamflow modeling studies.

### ABSTRACT

[Not available]

# Updating Flood Frequency in California

By Charles Parrett, California Water Science Center



## Flood Frequency – Associating Stream Discharge with Probability of Exceedance



**Eg., Annual maximum discharge with a 0.01 exceedance probability is expected to be exceeded, on average, once every 100 years.**



## Flood-Frequency Analysis Requires Stationary Data – No Trends

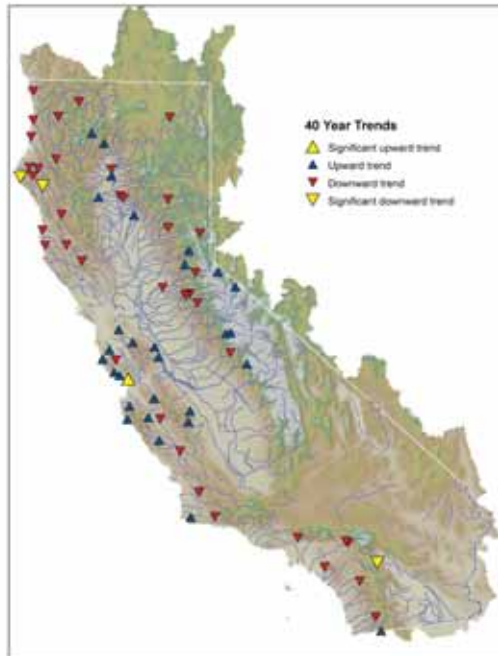


Determination of Flood Frequency assumes that the data are independent and identically distributed in time (i.e., temporally uncorrelated and stationary—no trends).

Are there *climate-change* or *urbanization* related trends?



## Are Peak-Flow Data in California Trendy?



## Assessing Flood Frequency Typically Done by the USGS About Every 10 Years..



Requires cooperative funding from other federal and state agencies

Flood frequency in California last updated in 1977!!!



## Only Limited Interest and USGS Funding for Updating California Flood Frequency Prior to 2006..



Interest increased following Katrina devastation

USGS funding became available through MHDP in Southern California

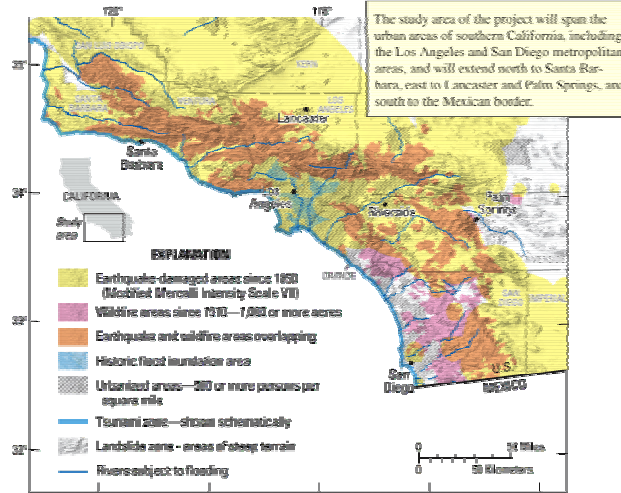


# Multi-Hazard Demonstration Project (MHDP) Mission—Apply the Best Science to Improve Disaster Resiliency...

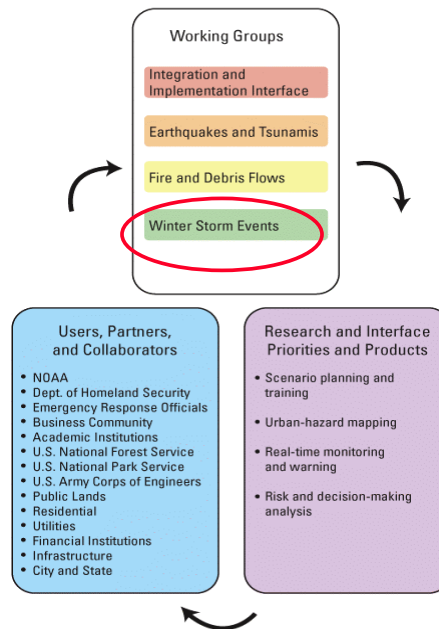
✓ Ensure that our research will be useful to communities.

✓ Conduct the best possible multidisciplinary scientific research.

✓ Work in partnership with communities to support them in using the research results.



## MHDP Established Four Working Groups..



## **FEMA, CalTrans, and Forest Service Expressed Interest in Helping Fund State-Wide Flood-Frequency Analysis in 2008..**



- 1. Update USGS gage data**
- 2. Develop equations for predicting flood frequency at ungaged sites**
- 3. Place results on GIS-based Web page that enables quick, easy solution**



## **Now Working With the COE and DWR to Merge USGS Study With Large Central Valley Flood Study..**



- 1. Include gage data on regulated streams (after accounting for regulation effects)**
- 2. Include flood volume statistics as well as annual peaks**



### 3 Key Steps....

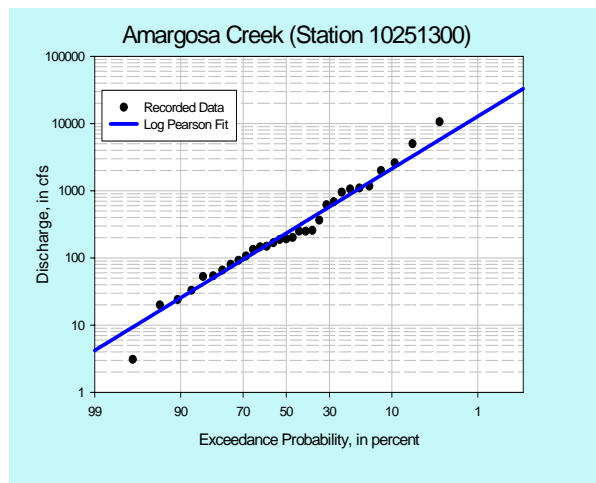


1. Update flood-frequency at gaged sites
2. Use gaged data to develop equations for estimating flood frequency at ungaged sites
3. Make the equations GIS and web based so solutions are quick and easy for local users



### Step 1-- Fitting a Probability Distribution to Recorded Data Determines Flow Frequency...

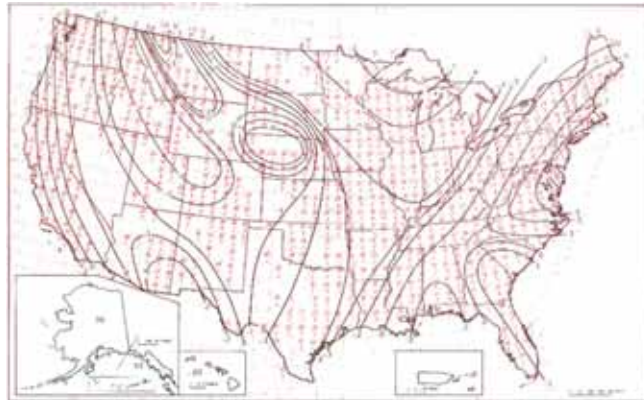
**Bulletin 17B** requires federal agencies to fit **Log-Pearson 3** distribution to the logs of data using method of moments (MM)



## Two New Wrinkles to Bulletin 17B..

Use of new Method for fitting LP3 distribution (EMA)

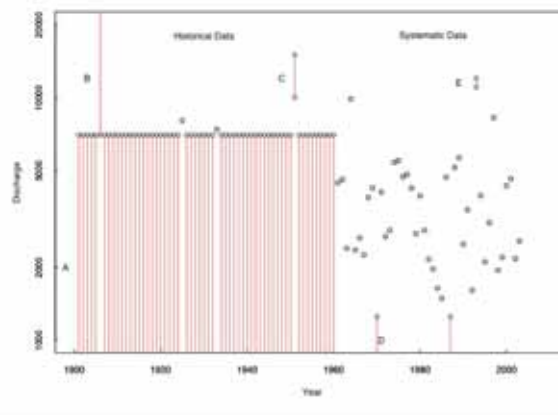
New robust method for determining regional skew (Bayesian GLS)



## EMA Can Use Interval Data In Addition to Point Data..

Systematic data are point data that are recorded

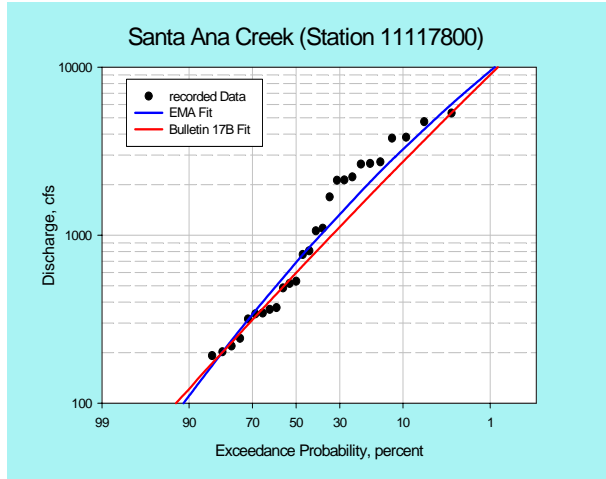
Historical data are often known only as interval data (eg. The flood of 1955 was between 10,000 and 15,000)



## Comparison of New EMA Curve Fit With Bulletin 17B Method of Moments Fit...

**Bulletin 17B MM  
Fit Cannot Accept  
Interval Discharges  
Eg. Q is between 100  
And 1,000 cfs**

**EMA Makes Better  
Use of Historic  
Flood Information**



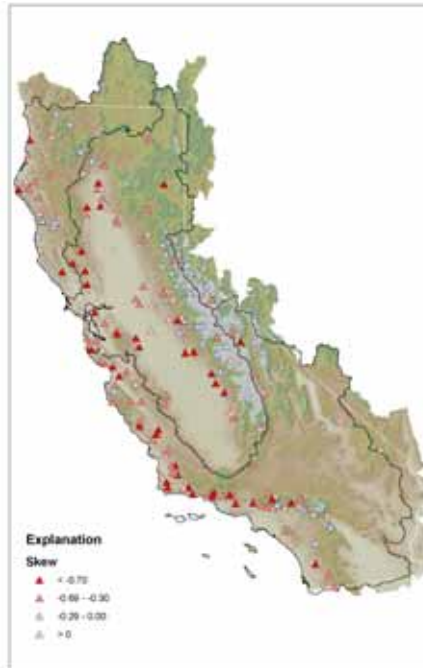
## Bayesian GLS Regional Skew..



1. Pilot application in southeast US found that regional skew was constant and near zero
2. Also found that regional skew had much smaller Mean Square Error (MSE) than old bulletin 17B map



## Provisional Skew Results for California..



## Second Step is to Develop Equations for Estimating Flood/Debris Flow Magnitude or Stage at Ungaged Sites.....

- Flood-frequency data are estimated from regression equations that relate flows to basin characteristics
- Examples of basin characteristics: Basin area, slope, shape, climate, vegetation cover, degree of urbanization, geology, . . .



## Example Regression Equation

- Regression equations take the form:

$$Q_{100} = 0.471A^{0.715}E^{0.827}SH^{0.472}$$

- where:

**Q<sub>100</sub>** is the 100-year flood flow, cubic feet per second

**A** is drainage area, in square miles

**E** is mean basin elevation, in feet

**SH** is a shape factor, dimensionless



## Problems with Regression Approach

- Delineating basin boundaries and computing basin characteristics using manual method can take several hours or more
- GIS methods require substantial investments of time, money, and data development
- Equations are often not used because of large efforts needed to determine basin characteristics



### **Third Step is to Make the Determination of Basin Characteristics and Solution of Regression Equations Web Based..**



**StreamStats is a current USGS program being implemented on a state-by-state basis**



### **StreamStats Web Application**

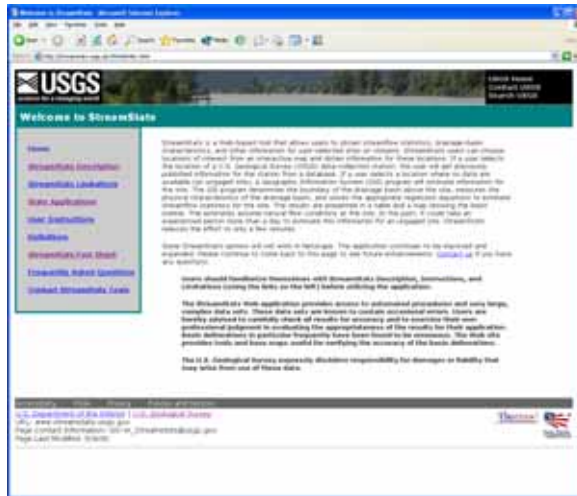
- **Automatically measures basin and climatic characteristics for user-selected sites on streams using GIS tools**
- **Solves regression equations for estimation of streamflow statistics for user-selected points on ungaged streams**



# StreamStats Web Page

■ <http://streamstats.usgs.gov>

- ◆ Under construction
- ◆ Description of application
- ◆ Links to state applications
- ◆ Links to documentation



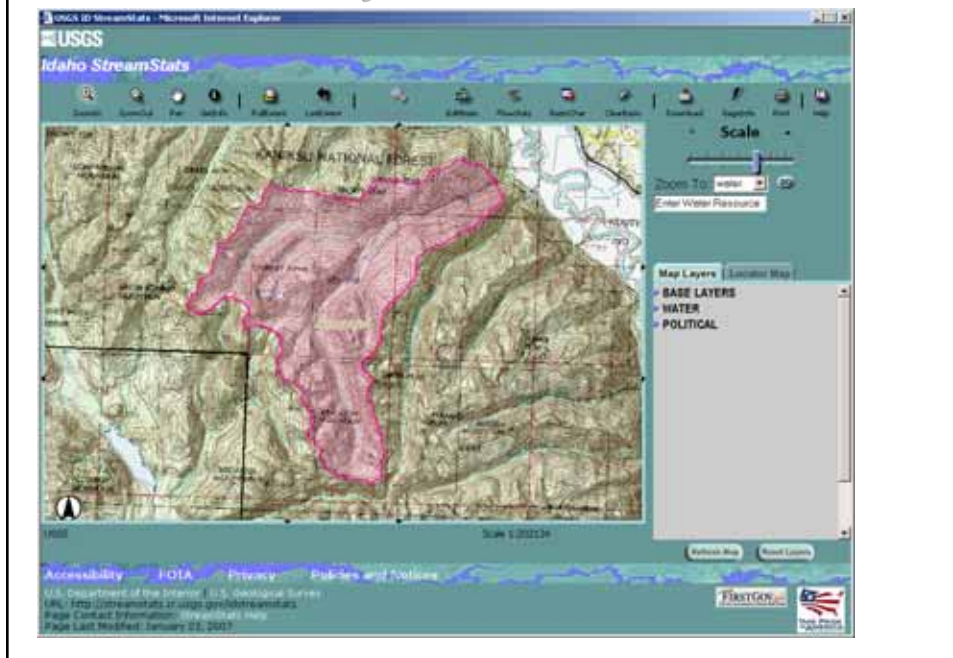
# User Interface at Startup



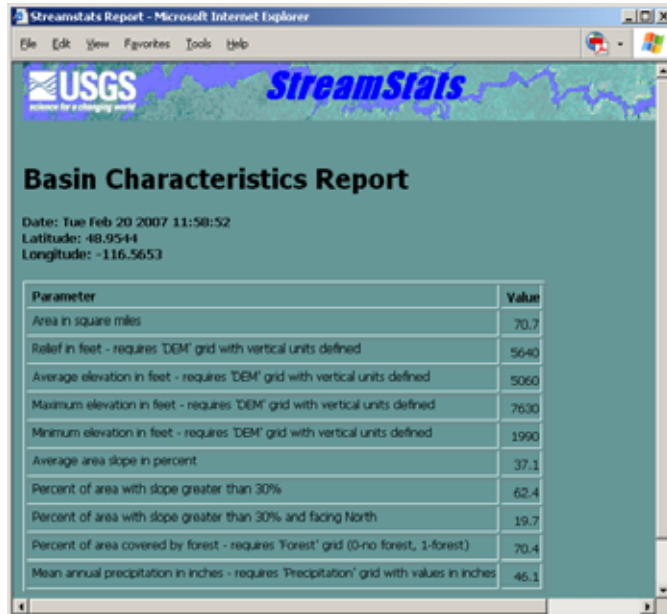
## Ungaged Site Selection



## Basin Boundary..



## Basin Characteristics Report..



## Streamflow Characteristics...

