New Regional Skew for California- Implications for Flood Frequency Analysis

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Science Center

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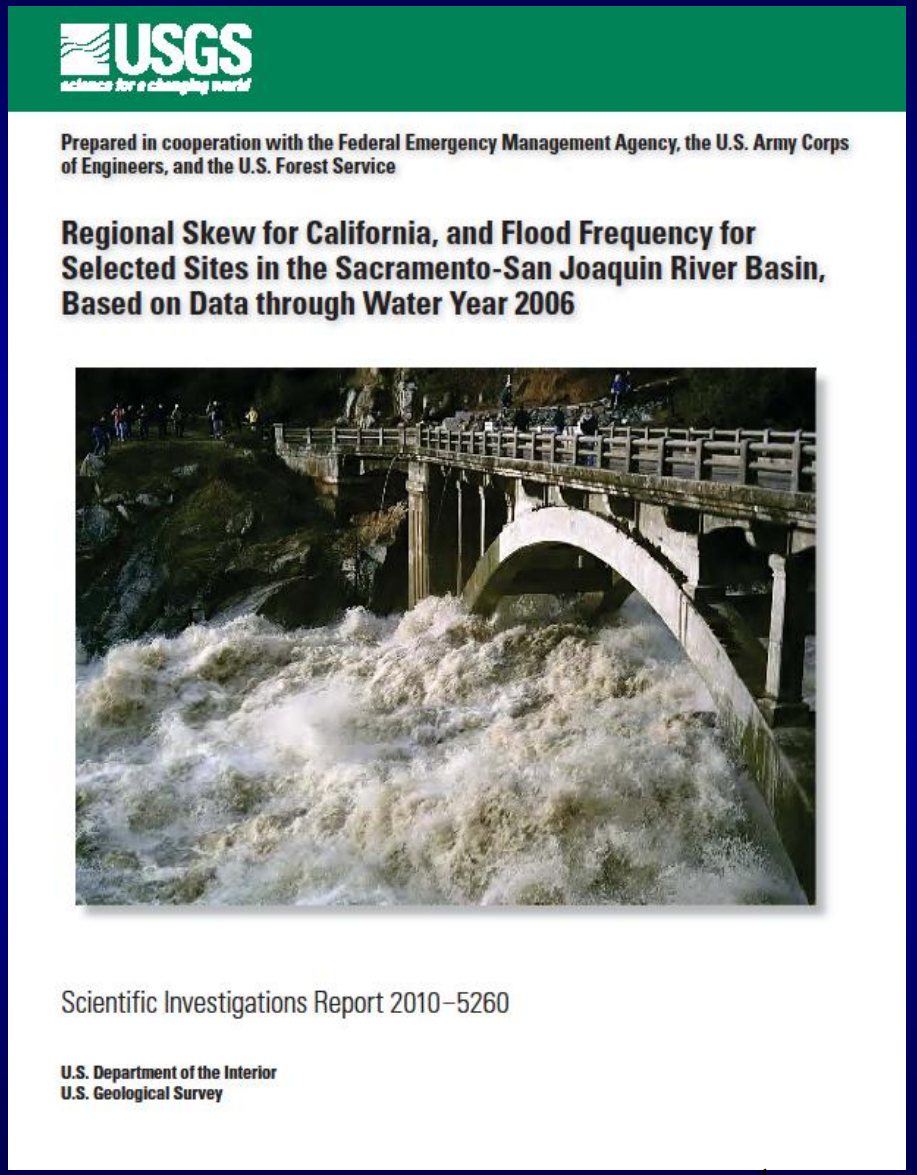
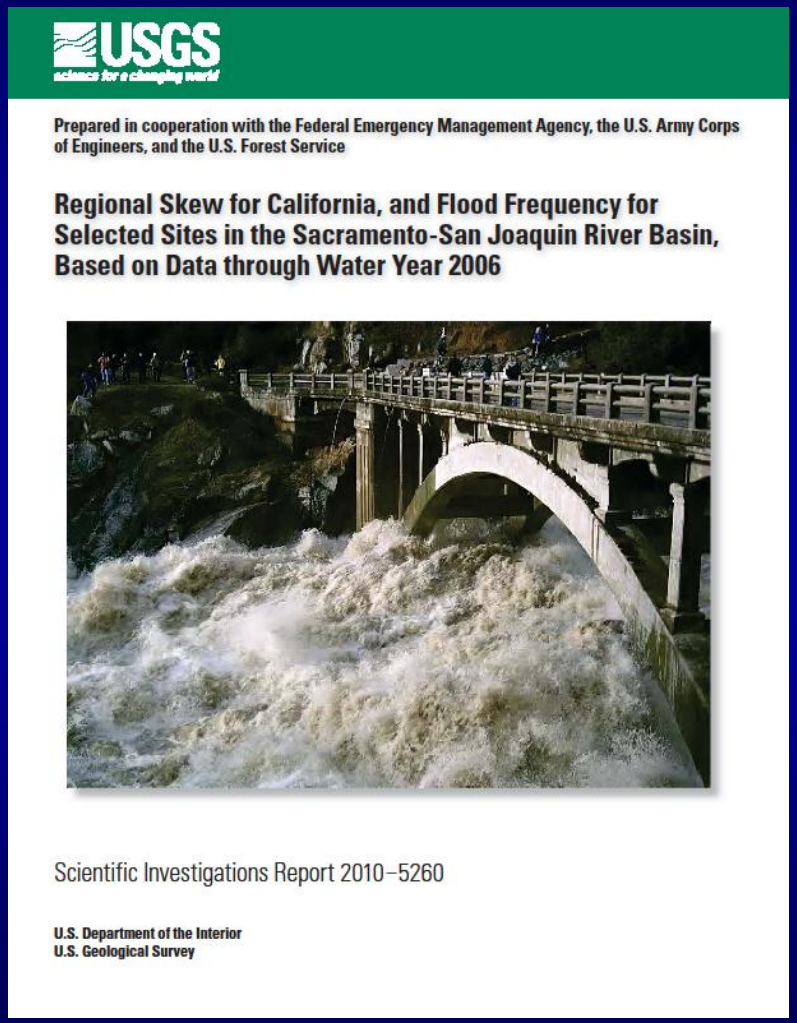


New Report is First of Three..



First report describes new regional skew and provides updated peak flood frequency for 364 sites. http://pubs.usgs.gov/sir/2010/5260/

Second report will provide new regional skew for various high-flow durations (eg. 1-day max, 3-day max, etc)

Third report will provide new regional estimation equations and updated peak flood frequency for another +300 sites.

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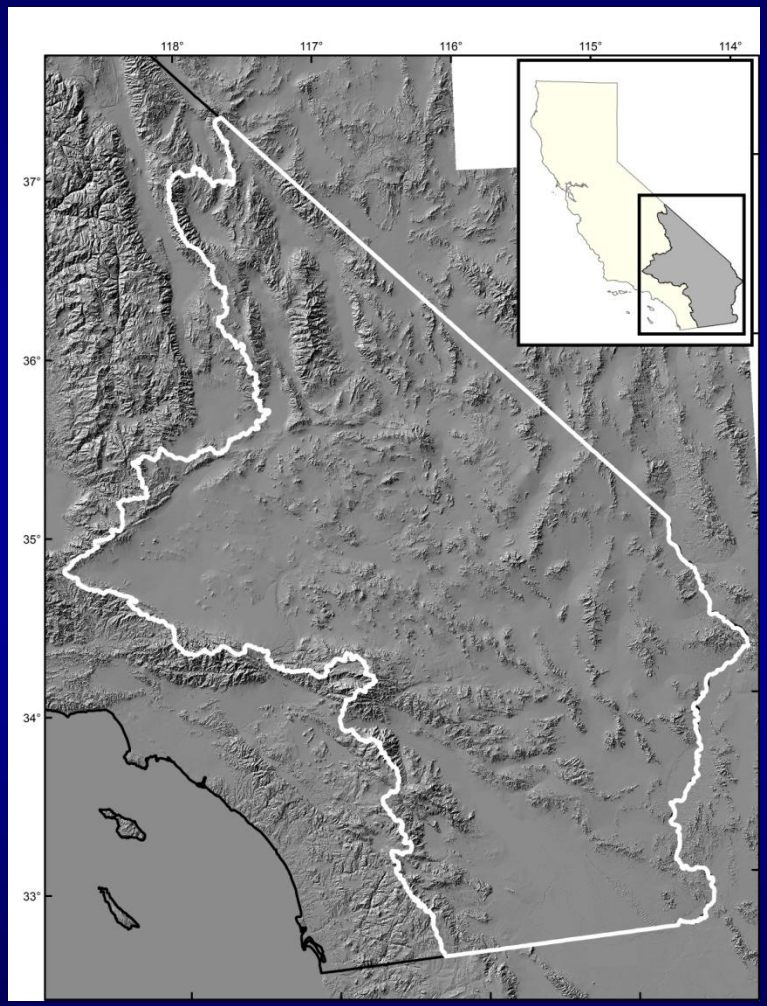
New Regional Skew Not Determined for California Desert..



Few sites in California desert with long-term (+30 yrs) record..

Flood-frequency complicated by numerous zero flows

Third report will provide updated flood frequency for desert sites

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Flood Frequency – Associating Stream Discharge with Probability of Exceedance

Eg., Annual maximum discharge with a 0.01 (1-percent) exceedance probability is expected to be exceeded, on average, once every 100 years.

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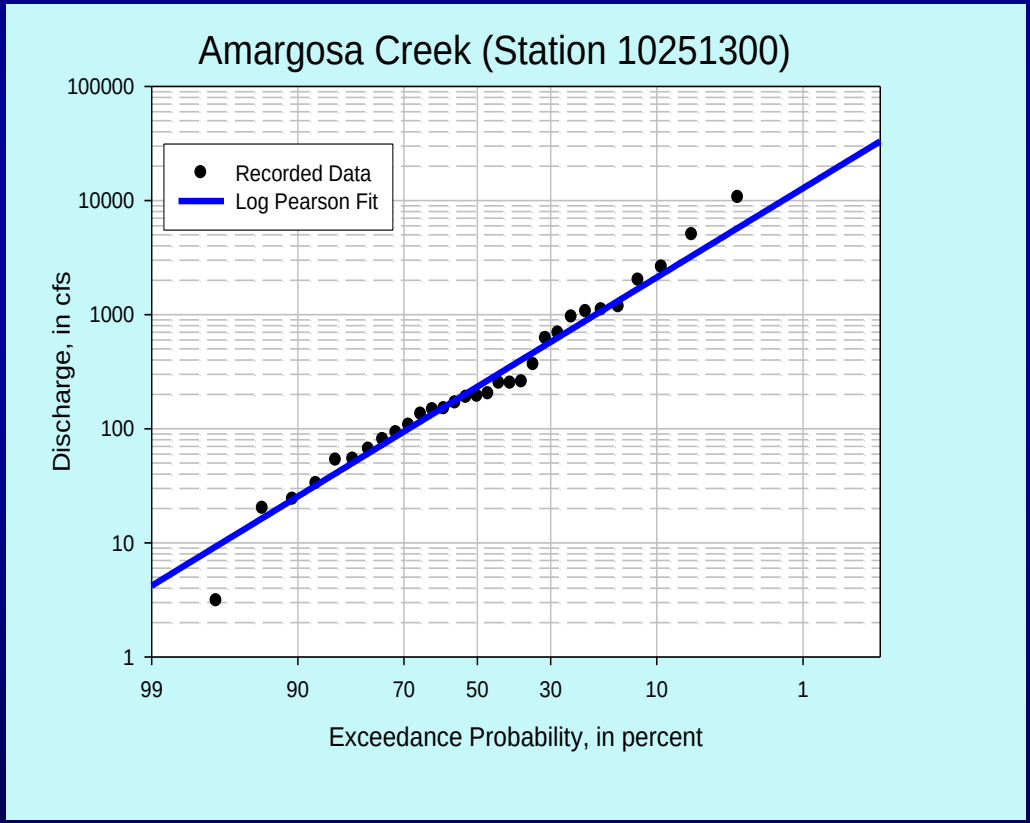
Flood Frequency at Gaged Sites– Statistical Analysis of Recorded Annual Peak Discharges

Fit a probability distribution to the sample (recorded) data

Distribution used in the U.S. is the log Pearson 3 (described in Bulletin 17B)



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Steps in Fitting the Log Pearson 3 (LP3) Distribution…

- Convert annual peak discharges to logs

- Compute Mean (M), Standard Deviation (S), and Skew (G) of the logs

- Use the basic equation described in Bulletin 17B

$$\text{Log } Qp = M + kS,$$

where Qp is the peak discharge for some probability p, and k is a function of G and the probability

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Complications to the Simple Application of Basic Equation…

- Skew (G), computed by cubing the data, is notoriously sensitive to large values and is unreliable for small samples.

- Accurate fitting of LP3 also is complicated by outliers (especially zero flow), short records, historical flood information, mixed flood populations, data trends, etc. A new fitting method, (EMA) was used in the USGS study.

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Bulletin 17B Recommends Weighting the Station (Sample) Skew (G) with a Regional Skew (Gr)

- Determine the regional skew from an analysis of long-term gages in the area.

- Weight the Station and Regional skews with weights that are inversely proportional to the variances of the values.

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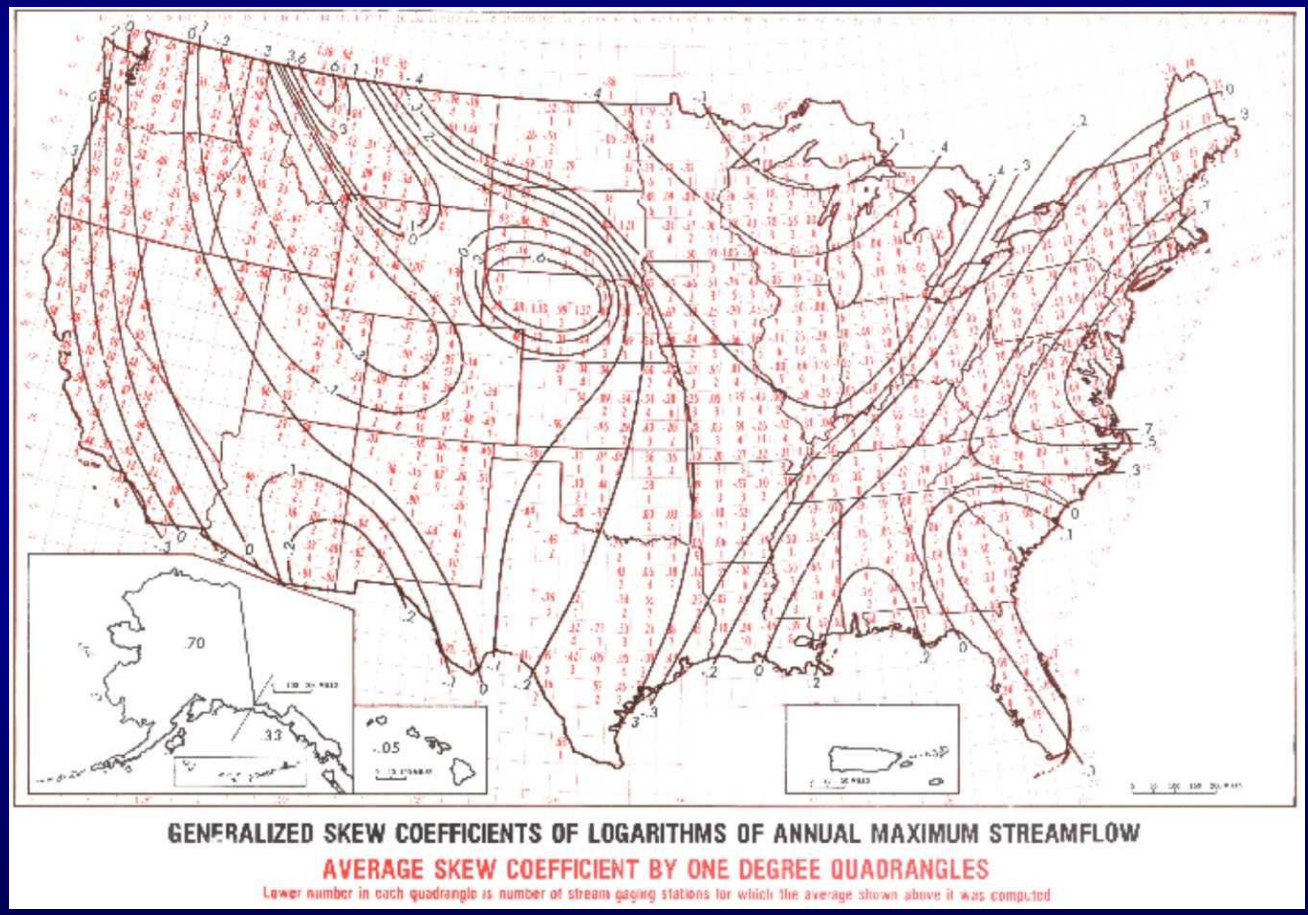
Bulletin 17B Also Provided a National Map...

National map Commonly gets Used

National map Developed in 1974

Variance equal To about 17 Years of data



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New Method for Determining Regional Skew Developed by Researchers at Cornell

- Uses Generalized Least Squares (GLS) regression to relate Regional skew to some measurable basin characteristic.

- The model error for the regression typically is small compared to sampling error of at-site skew.

- Considerably more weight is given to Regional skew, even if the GLS equation is poor.

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New Method for Determining Regional Skew Developed by Researchers at Cornell

- Previous USGS/Cornell study in the Southeastern U.S. found that regional skew was a constant (near zero), but the variance (based on model error) was equivalent to 39 years of data.

- USGS and Cornell researchers jointly worked on the new California regional skew analysis.

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California Regional Skew Analysis Was More Complicated than The Analysis in Southeastern U.S.

More interstation correlation of annual peak discharge.

GLS regression found a significant relation between basin elevation and skew—reflects a complex interaction of rain and snow on flood peaks.

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Relation Between Skew and Elevation is Non-linear..

$$G = 0.68 - 1.3e^{-(ELEV/6500)^2}$$

- Regional Skew varies from -0.62 to +0.62.
- Variance ranges from 52 to 65 equivalent years of record (EYR).

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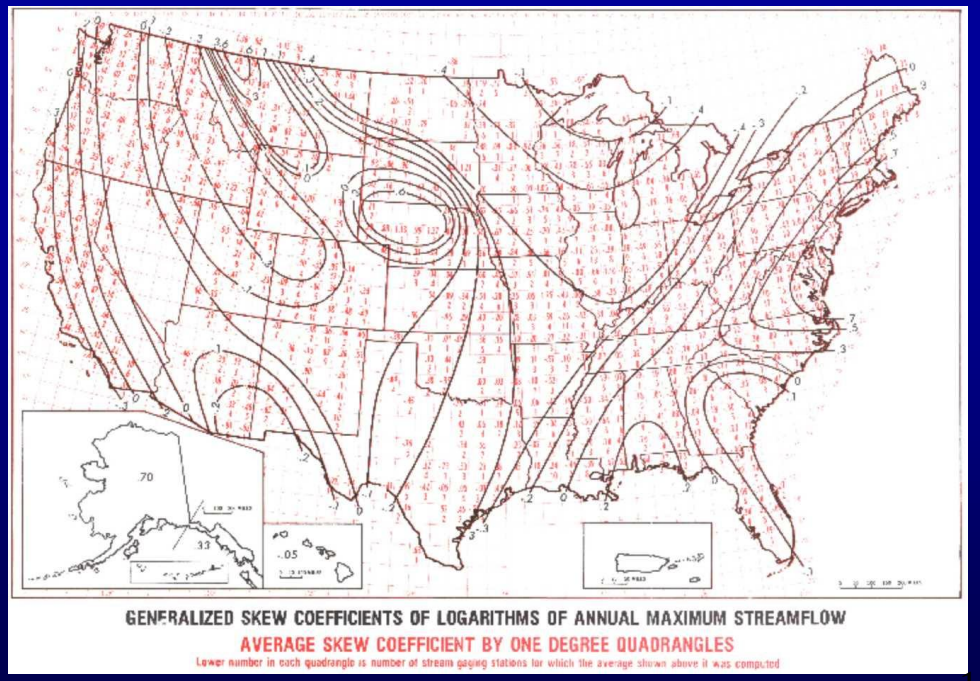
Conceptually, How Does New Regional Skew Compare to Bulletin 17B Regional Skew ?

New regional skew is physically based (snow/rain interaction)

$$G = 0.68 - 1.3e^{-(ELEV/6500)^2}$$

VS



Error of new regional skew correctly distinguishes model error from sampling error.

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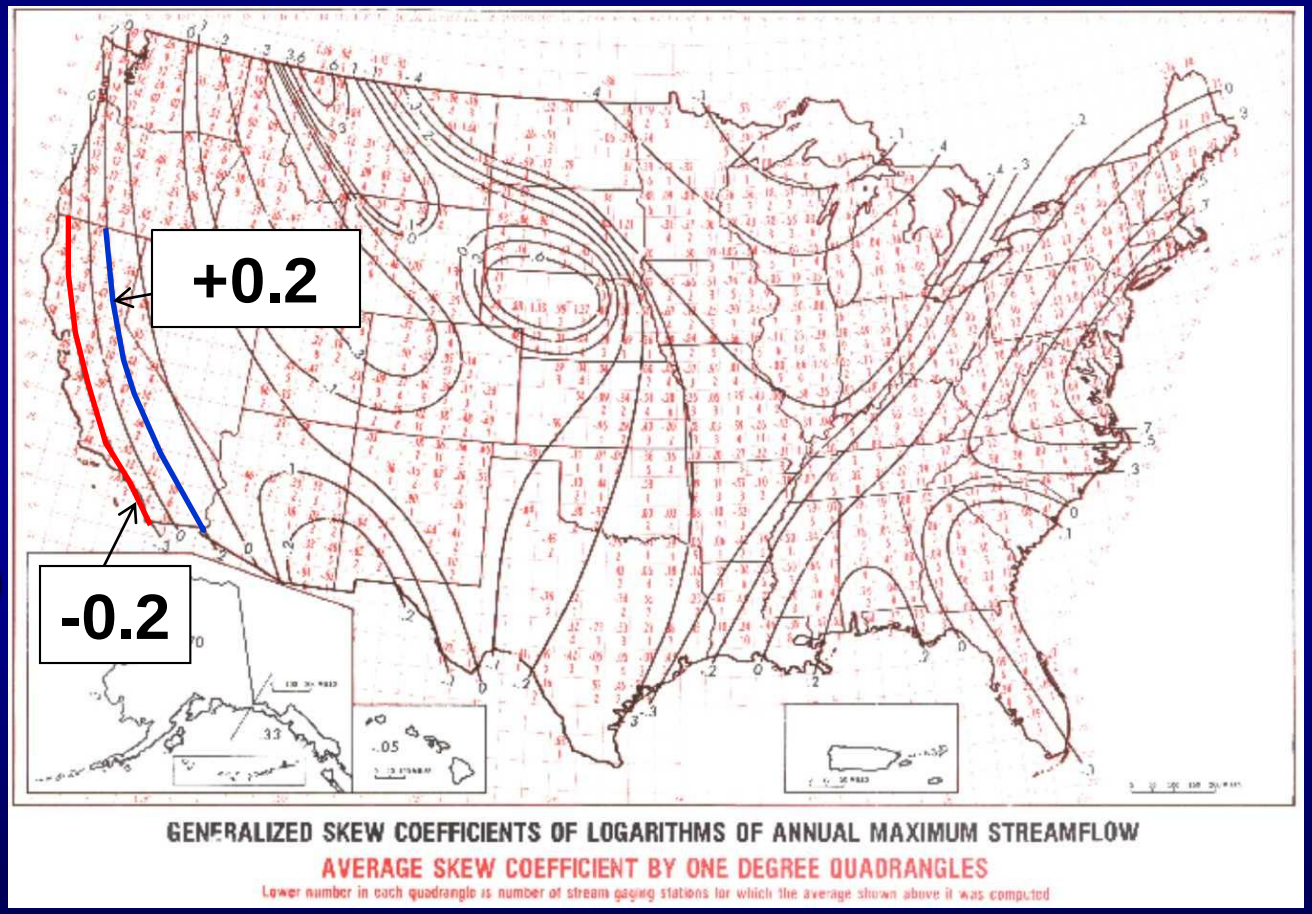
Practically, How Does New Regional Skew Compare to Bulletin 17B Regional Skew ?

Less variability In Bulletin 17B Map

Less Weight Given To Bulletin 17B Skew (EYR = 17)



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Summary of Differences Between Bulletin 17B Skew and New Regional Skew …

- Bulletin 17B skew ranges from -0.2 to +0.2.
- New regional skew ranges from -0.62 to +0.62
- Largest Bulletin 17B skew occurs in roughly the same location as new skew (along the Sierra crest)
- Smallest Bulletin 17B skew occurs about where the new skew is smallest (along the coast line)
- Significantly more weight given to new regional skew (EYR is 52 to 65 yrs vs 17 yrs for Bulletin 17B skew)

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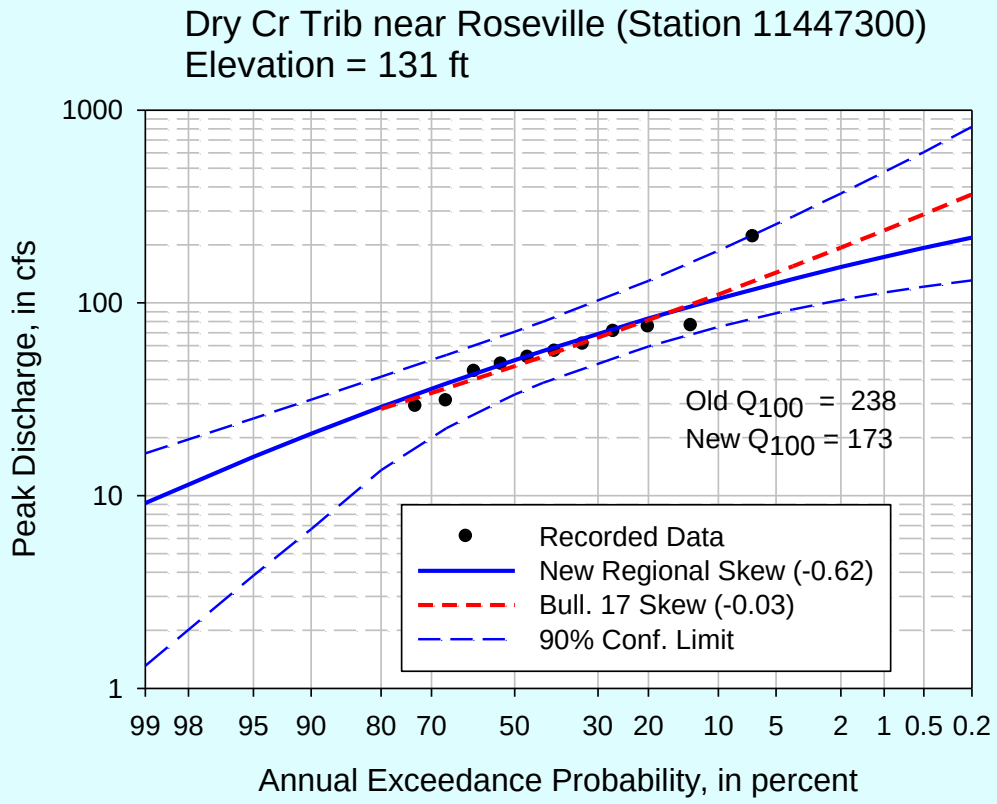
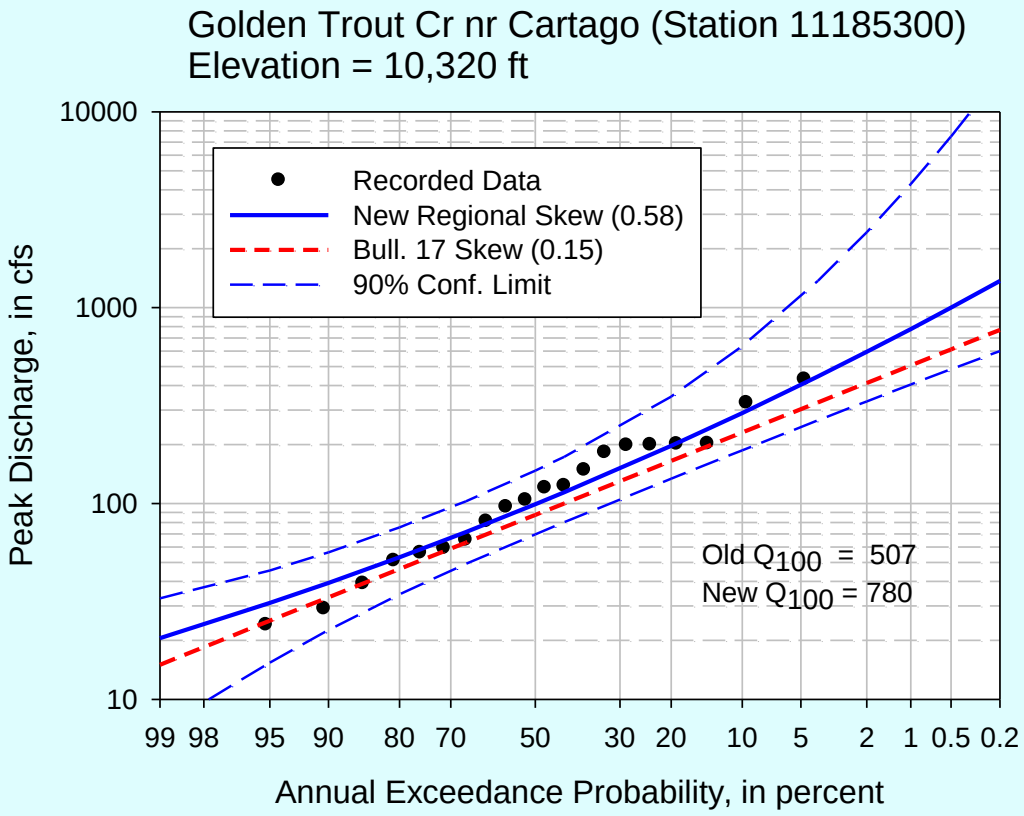
Some Real Examples



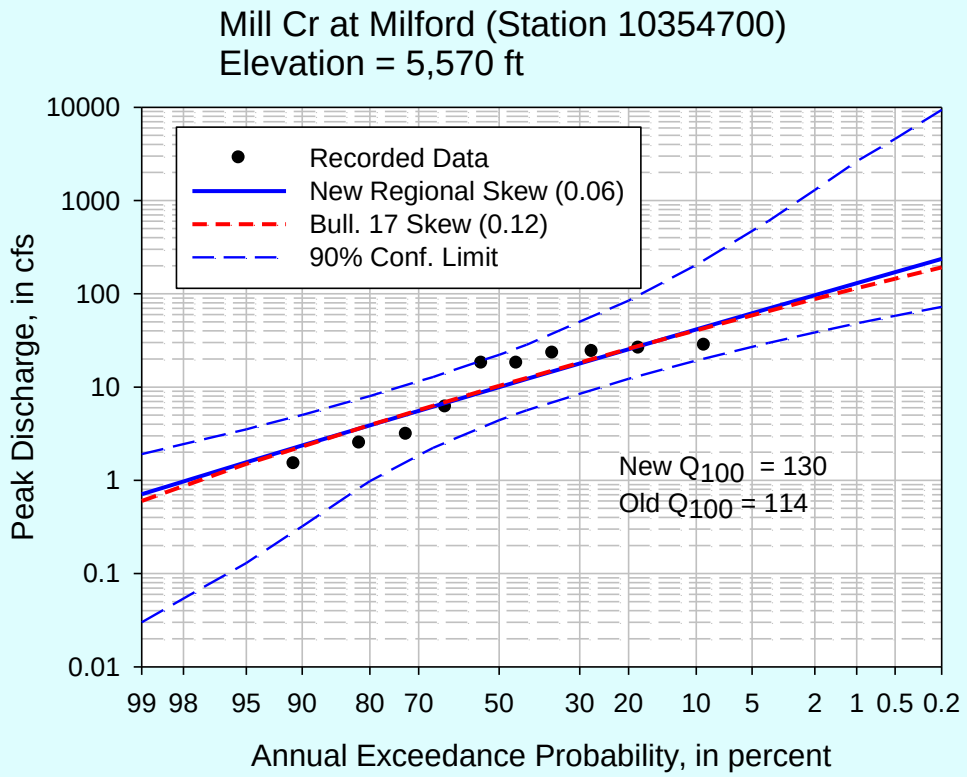
Very low elevation AND very short record

Some Real Examples



Very high elevation AND relatively short record

Some Real Examples



Moderately high elevation AND relatively short record

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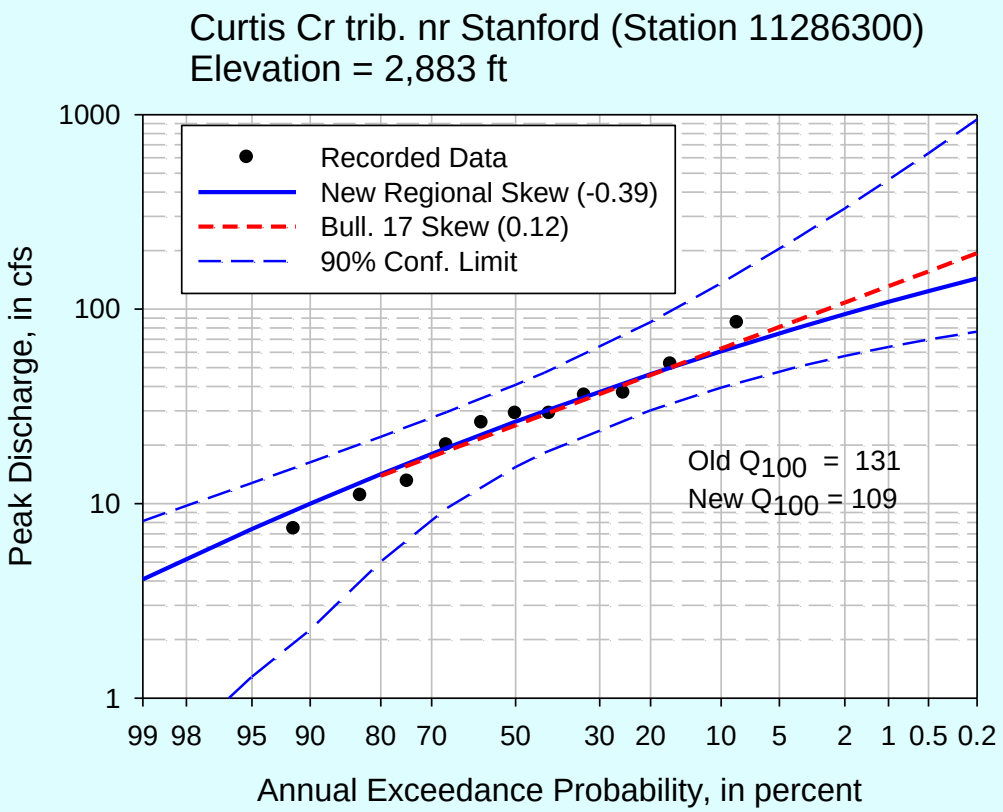
Some Real Examples



Moderately low elevation AND very short record

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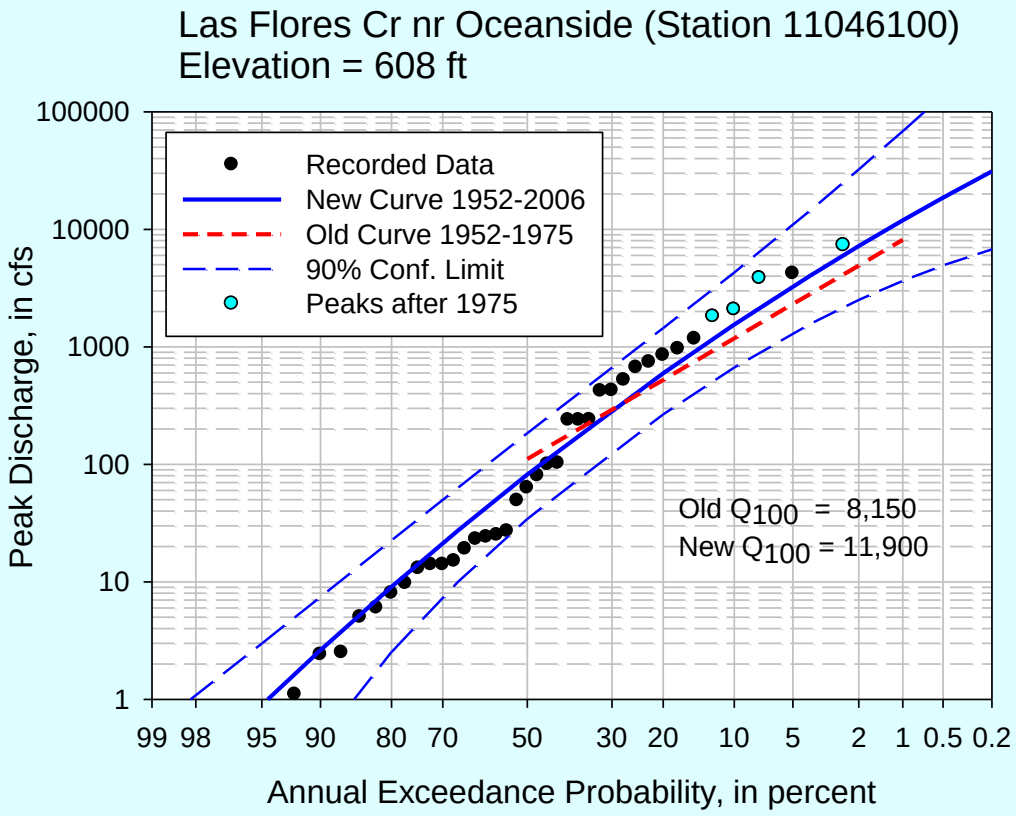
Some Real Examples



Old USGS report (1977) Vs new report

Differences due to additional flood record

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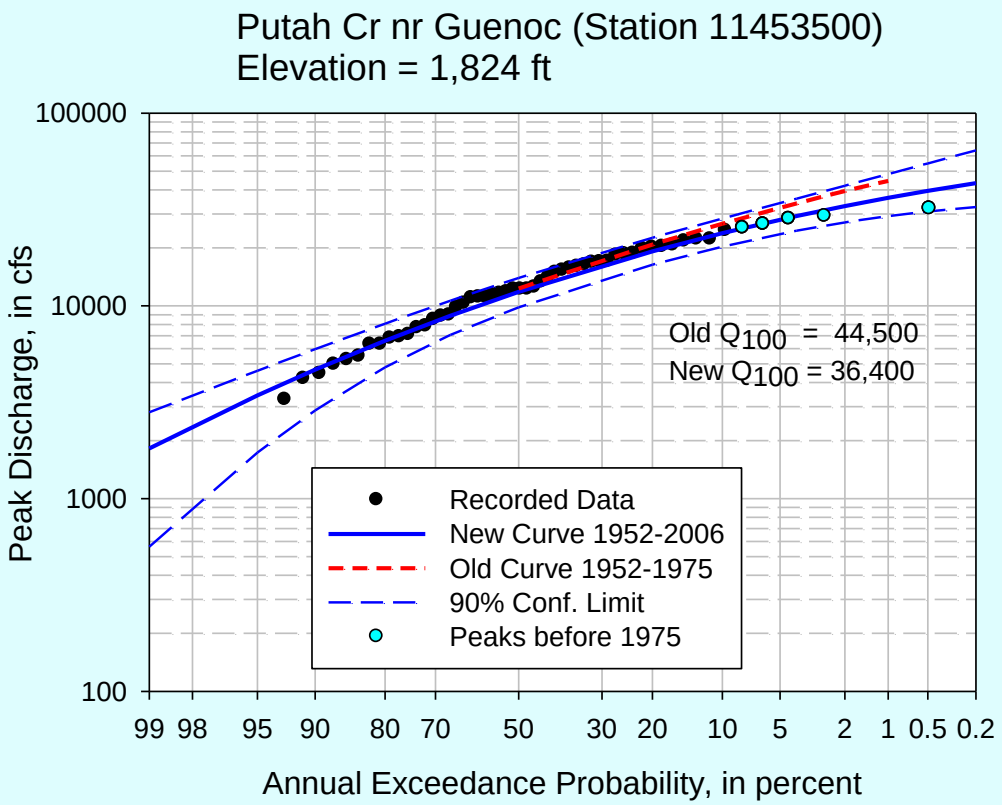
Some Real Examples



Old USGS report (1977) Vs new report

Differences due to additional flood record

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Summary of Flood-Frequency Effects of New Regional Skew..

- Depending upon record length and effects of historical information and outliers, Q_{100} tends to be larger at higher elevations
- Depending upon record length and effects of historical information and outliers, Q_{100} tends to be smaller at lower elevations
- Overall, changes to flood frequency are modest

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What's Coming Next (Over the Next 6 mos.)?

- Completion of new regional skew for various flow durations
- Flood-frequency results for +300 more sites (including the desert region).
- Regression equations for estimating flood frequency at ungaged sites (including the desert region).
- StreamStats web page available for calculating flood frequency at the click of a mouse . . . http://water.usgs.gov/osw/streamstats/california.html

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Thank you!

Questions?

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