

RECENT DEVELOPMENTS IN FLOOD FREQUENCY ANALYSIS INCLUDING PLANS TO UPDATE BULLETIN 17B

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INTRODUCTION

Floods cause an average of nearly 140 deaths and cost roughly \$6 billion annually in flood damages. Reducing these losses will require both structural and non-structural approaches which in turn depend on accurately characterizing the frequency of flood flows. *Guidelines For Determining Flood Flow Frequency*, Bulletin 17B, published in 1982, is used by all Federal agencies and many local and state agencies in estimating flood discharges, such as the 1-percent-annual chance flood discharge, for gaged streams. The Hydrologic Frequency Analysis Work Group (HFAWG) of the Subcommittee on Hydrology of the Interagency Advisory Committee on Water Information has developed a plan for revising Bulletin 17B that will evaluate relevant research that has been accomplished since the publication of Bulletin 17B in 1982. A major part of this plan is to evaluate a new statistical procedure, the Expected Moments Algorithm (EMA), that may be an improvement over existing Bulletin 17B procedures, particularly for samples with historical floods, high and low outliers.

PROPOSED IMPROVEMENTS IN BULLETIN 17B

The HFAWG developed a plan for updating Bulletin 17B that includes evaluation of the following major improvements (<http://acwi.gov/hydrology/Frequency/>):

- Evaluate and compare the performance of EMA to the weighted-moments approach of Bulletin 17B for analyzing data sets with historical information,
- Evaluate and compare the performance of EMA to the conditional probability adjustment of Bulletin 17B for analyzing data sets with low outliers and zero flows,
- Describe improved procedures for estimating generalized (regional) skew,
- Implement improved procedures for defining confidence limits,
- Implement an improved plotting position formula for historical data.

The major advance in updating Bulletin 17B is incorporating the EMA technique to estimate the moments of the log-Pearson Type III distribution (Cohn and others, 1997). This is not a major departure from existing Bulletin 17B procedures because it maintains the method of moments approach for fitting the logarithms of the annual peak flows to a Pearson Type III distribution. The use of EMA allows for the use of interval data where only a range of

discharge is known for a given flood or binomial data where it is known that the discharge was either greater than or less than a given value. Also the use of EMA would allow for multiple thresholds for analyzing historical data or high and low outliers.

There have been advances in estimating generalized or regional skew in recent years. Reis and others (2005) describe a Bayesian Generalized Least Squares regression approach for estimating generalized or regional skew and this guidance will be provided in a revised version of Bulletin 17B.

The confidence limits computations in Bulletin 17B do not consider the uncertainty in the skew coefficient and hence the confidence limits are too narrow. Chowdury and Stedinger (1991) and Cohn and others (2001) describe approaches for estimating more accurate confidence limits that do consider the uncertainty in the skew coefficient. These procedures will be incorporated into a revised version of Bulletin 17B.

Hirsh and Stedinger (1987) describe a plotting position formula that is more accurate than existing formulas in Bulletin 17B when there are historical data in the sample. This plotting position formula will be implemented in a revised version of Bulletin 17B.

TESTING OF EMA AND BULLETIN 17B PROCEDURES

The HFAWG is currently comparing and evaluating EMA and Bulletin 17B procedures. This testing is taking two approaches: using observed annual peak data at 82 long-term gaging stations and Monte Carlo simulations of synthetic data. The long-term stations that were selected are rural watersheds unaffected by urbanization, diversions or regulation by major flood control structures. The locations of the 82 stations are shown in Figure 1. The average record length of these stations is 80 years. The intent is to perform split-sampling analyses using shorter periods of record for a subset of these stations and then compare the results to those based on the full period of record. Many of the stations were selected because their records include historical flood data outside of the period of systematic record and low outliers or peaks below a gage base. The 82 stations can be characterized as follows:

- 29 stations with no historical data or low outliers,
- 24 stations with historical data but no low outliers,
- 16 stations with low outliers but no historical data,
- 13 stations with historical data and low outliers.

A draft report has been prepared comparing EMA and Bulletin 17B procedures for the full period of record for the 82 stations. Testing to date has verified that EMA and Bulletin 17B procedures give the same flood frequency estimates when there are no historical data or low outliers. This was expected as the EMA procedures and Bulletin 17B procedures are the same if there are no outliers or adjustments for historical data and all annual peak flows are characterized by point values (as is the standard practice in flood frequency analysis). There were significant differences for some samples with historical data and low outliers. The HFAWG is still evaluating and understanding these differences.

FUTURE ACTIVITIES

The split-sampling analyses for the observed data and the Monte Carlo simulations of synthetic data are still ongoing. These analyses will likely be completed in the summer of 2010. A report will be completed in 2010 that describes the EMA and Bulletin 17B procedures and results of all testing. This report will be a basis for the HFAWG to determine if the EMA procedure should be incorporated into a revised Bulletin 17B.

The HFAWG will prepare recommendations on revisions to Bulletin 17B for approval by the Subcommittee on Hydrology and the Advisory Committee on Water Information. Once these recommendations are approved, the HFAWG will develop a revised version of Bulletin 17B. Given the progress to date and the needed approval process, any update of Bulletin 17B will likely occur in 2011.

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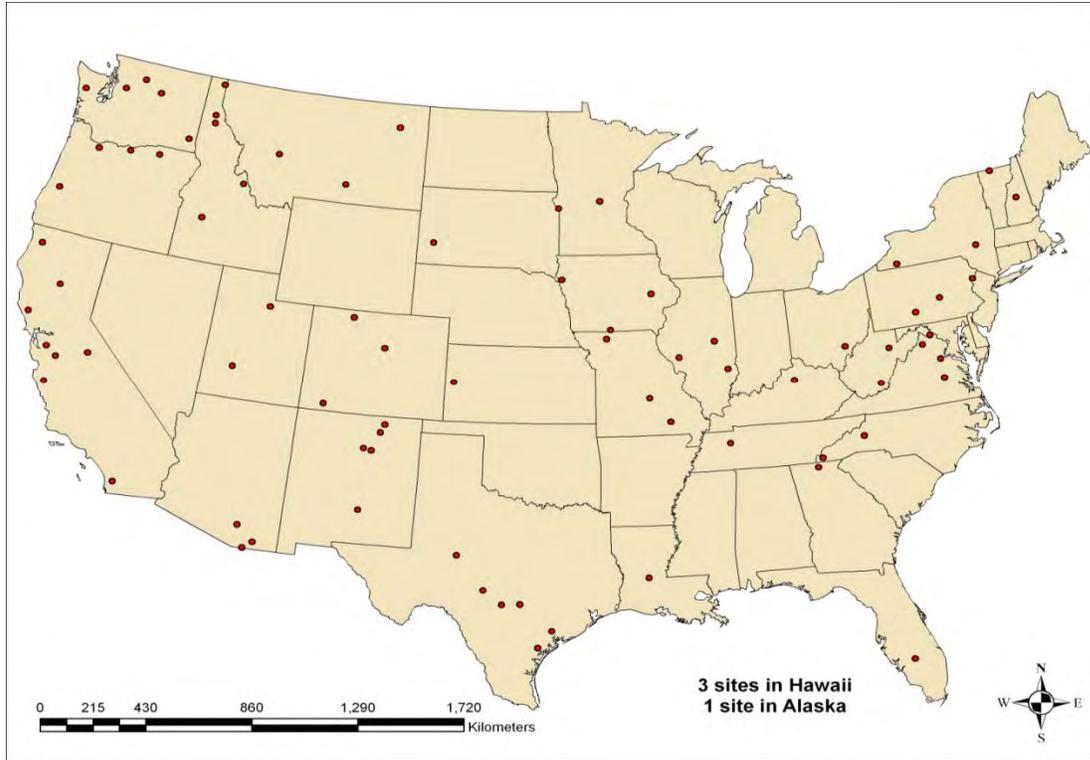


Figure 1. Locations of long-term gaging stations where EMA and Bulletin 17B procedures are being tested.