# 0-6977: Develop a Generalized Skew Update and Regional Study of Other Measures of Distribution Shape for Texas Flood Frequency Analyses

## Background

Research Project 0-6977, was performed by researchers at Texas Tech University, the University of Texas at Arlington, and the U.S. Geological Survey (USGS) Oklahoma-Texas Water Science Center, to update the Texas generalized skew map and its mean-square error (Chap. 4, Section 9 Figure 4-4) for the Texas Department of Transportation (TxDOT) Hydraulic Design Manual (HDM).  Generalized skew is important because it helps to reliably shape the probability distribution used in flood frequency analyses and particularly improve flood estimation and narrow confidence limits for rare events beyond about the 25-year return period. Additional the research produced training materials using Texas examples for frequency analysis using the updated generalized skew, and to explored emergent concepts in flood hydrology.

## What the Researchers Did

The researchers prepared a dataset of 1,703 streamgages in the study area having at least 6 years of peak streamflow data, along with watershed properties beyond the official  USGS drainage area and contributing drainage area. Data quality filters were implemented that produced a subset of 444 streamgages that had at least 30 years of data from unregulated and undeveloped watershed conditions, which were used for updating generalized skew. A 2-dimensional spatial regression on station-skew values from the streamgages was used to predict generalized skew onto the 1-kilometer USGS National Hydrogeologic Grid. A shared cloud-based training environment was created to provide a pre-configured software environment to demonstrate use of the research products.

## What They Found

While flood distributions are conditionally influenced by climate state (wet and dry classification of annual peak streamflows using the Palmer Drought Severity Index), skew was not sensitive to the classification. Generalized skews modeled using streamgage watershed centroids as the positions in generalized additive
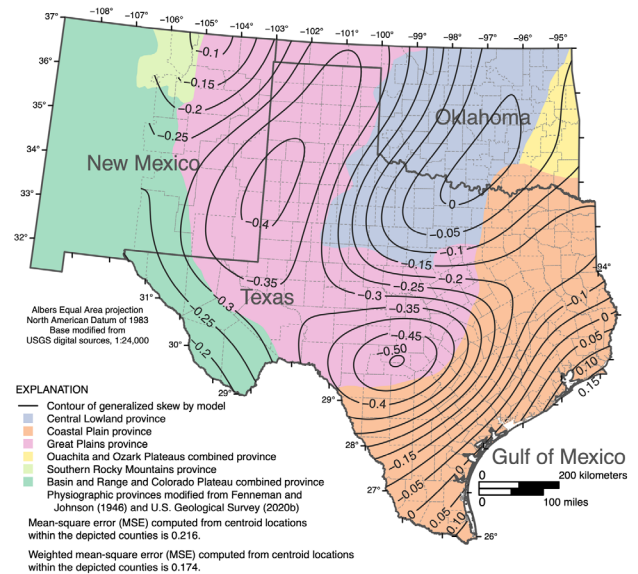


Figure 1. Map of generalized skew coefficients (Suggested as Figure 4-4-2021 next HDM update)

modeling (GAM) produced the replacement for Figure 4-4 in the HDM, shown as Figure 1. The inclusion of records from eastern New Mexico and all of Oklahoma

**Research Performed by:**
Texas Tech Center for Multidisciplinary Research in Transportation (TechMRT), The University of Texas at Arlington (UTA), and USGS Oklahoma-Texas Water Science Center (USGS OTWSC)

**Research Supervisor:**
Theodore G. Cleveland, TechMRT

**Researchers:**
Nick Z. Fang, UTA
William H. Asquith, USGS OTWSC
Monica V. Yesildirek, USGS OTWSC
Jeremy S. McDowell, USGS OTWSC
Jiaqi Zhang, UTA
Raven N. Landers, TechMRT
Lindsay D. Otto, University of Iowa

**Project Completed:**
8-31-2021

help inform the GAM for the more sparsely gaged watersheds in west and northwestern Texas

## What This Means

A designer can use the map to support gage analysis using USGS PeakFQ 7.3 to replace prior methods. The map represents an additional 20 years of information update, and a substantial spatial upgrade. The shared cloud-based training environment facilitates use of special tools built to access an electronic file of the map; the map alone and USGS PeakFQ 7.3 are sufficient to perform gage analysis in Texas.

## The Value of Research

The update captures recent large magnitude peak flows in Texas, keeping the department current with available technology. The training materials are tutorial; designers can self-teach to use the tools employed. The research databases are archived in several persistent locations:

Yesildirek, M.V., McDowell, J.S., Zhang, J., Asquith, W.H., 2021, Geospatial data of watershed characteristics for select U.S. Geological Survey streamgaging stations in New Mexico, Oklahoma, and Texas useful for statistical study of annual peak streamflows in and near Texas: U.S. Geological Survey data release. https://doi.org/10.5066/P9A91W4Z

Asquith, W.H., Cleveland, T.G., Yesildirek, M.V., Zhang, J., Fang, Z.N., and Otto, L.D., 2021, scNIDaregis-Geospatial processing of dams in the United States from the National Inventory of Dams with a state-level aggregation scheme, demonstrated for selected dams in eight states in south-central region of the United States, and post-processing features for basin-specific tabulation: U.S. Geological Survey software release, Reston, Va. https://doi. org/10.5066/P90NJVB9

Asquith, W.H., England, J.F., and Herrmann, G.R., 2020, MGBT-Multiple Grubbs-Beck low outlier test: U.S. Geological Survey software release, R package, Reston, Va., accessed July 27, 2020. https://doi. org/10.5066/P9CW9EF0

The entire research database(s) reports and training materials are housed at the Texas Digital Library. https://doi.org/10.18738/T8/SVLCOQ