

# Precipitation-Frequency and Prior Distributions for Quantiles

## DLS-114, Module 1.21



**U.S. ARMY**



**US Army Corps  
of Engineers®**

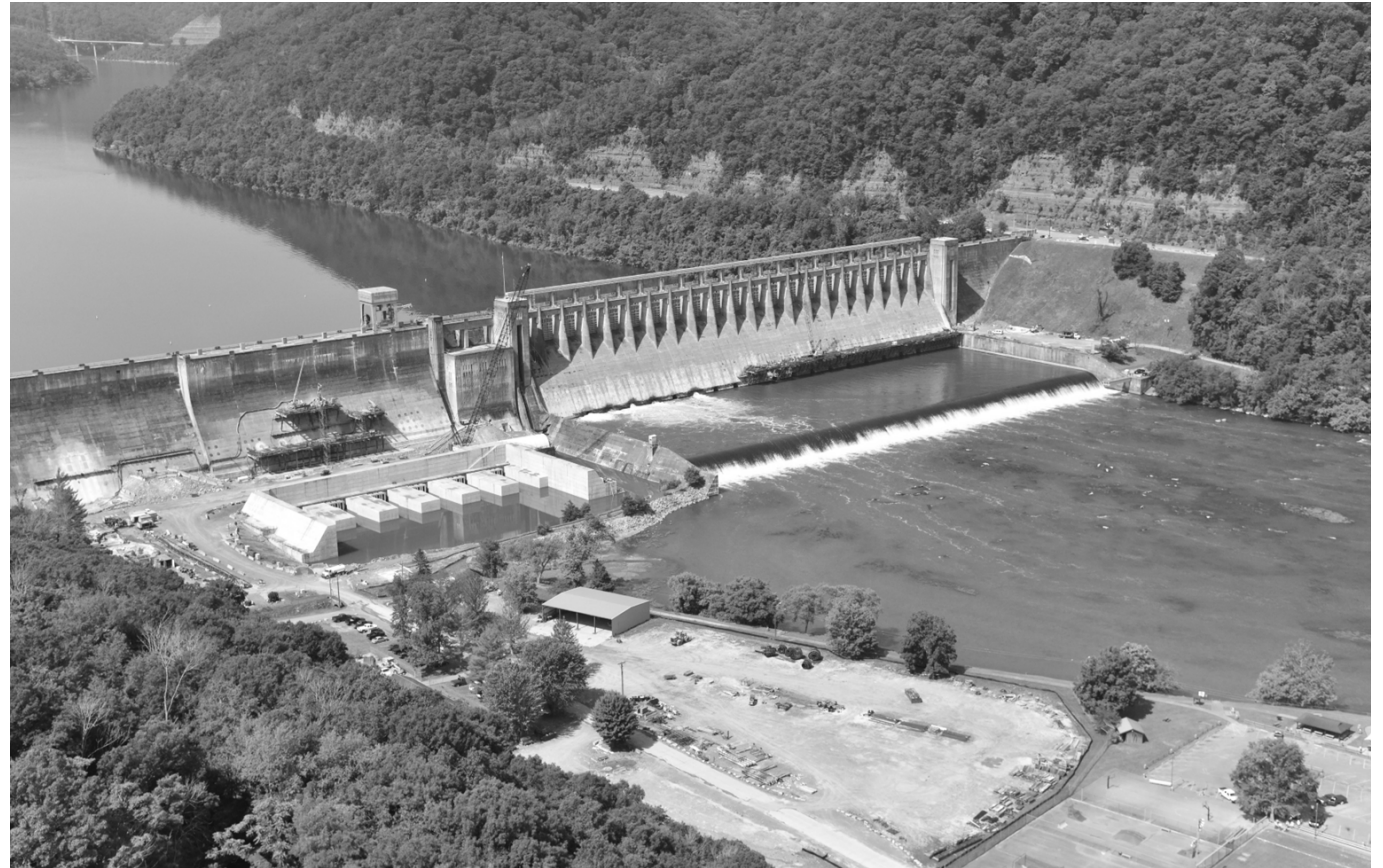
Dam and Levee  
Safety Programs

March 2026 / Version 1

BLUESTONE DAM, WV (SOURCE: USACE)

# Learning Objectives

- Summarize a process for precipitation-frequency analysis
- Describe prior distributions for quantiles
- Demonstrate how to enter quantile priors in RMC-BestFit



**Bluestone Dam**



# Precipitation-Frequency Information

**NATIONAL WEATHER SERVICE**  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOMEFORECASTPAST WEATHERSAFETYINFORMATIONEDUCATIONNEWSSEARCHABOUT

## Hydrometeorological Design Studies Center

[Weather.gov](#) > [Office of Water Prediction](#) > Hydrometeorological Design Studies Center

Office of Water Prediction  
National Program

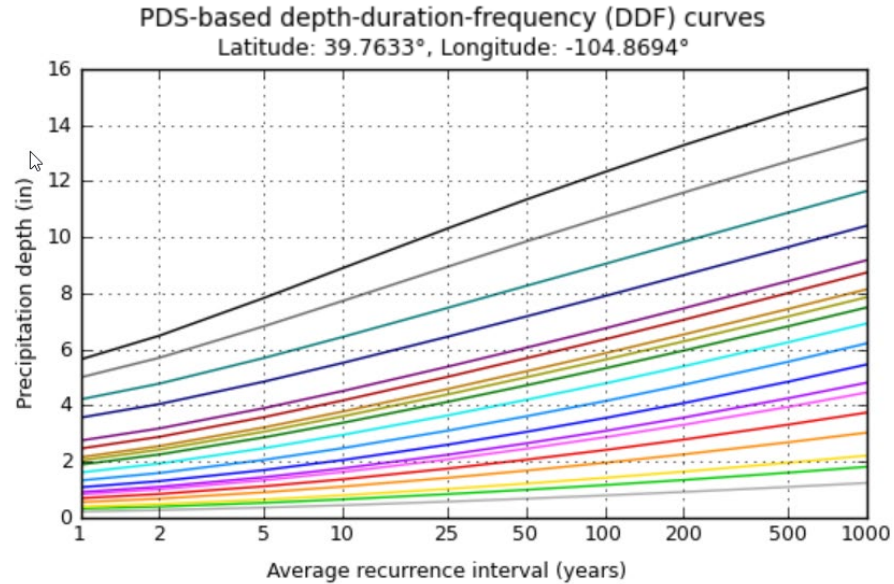
HOMEGENERAL INFOPRECIPITATION FREQUENCYPROBABLE MAX PRECIPITATIONMISCELLANEOUSCONTACT USSITE MAPORGANIZATION



**NOAA Atlas 14  
project area**

- Volumes 1 to 11  
(published)
- Volume 12 (2023)

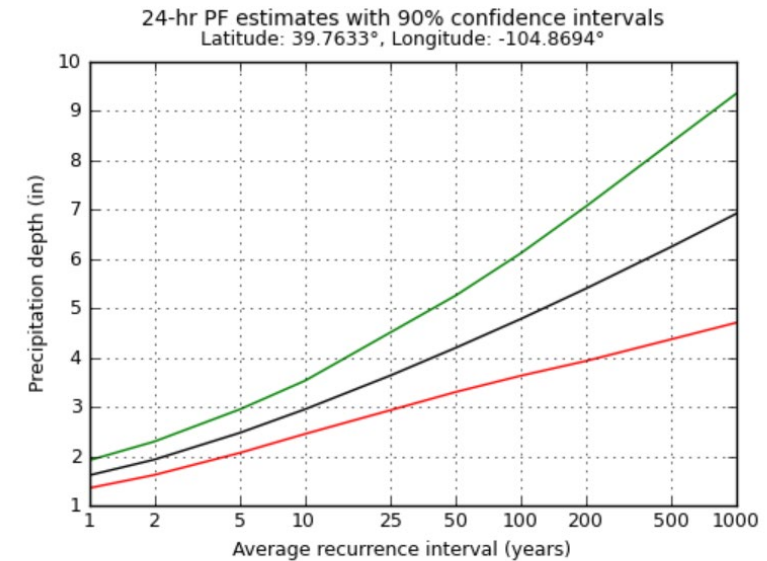
# Point Precipitation



NOAA Atlas 14, Volume 8, Version 2

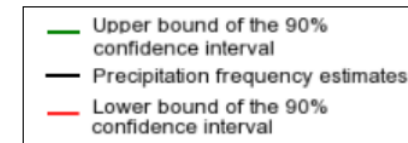
Created (GMT): Mon Mar 7 14:46:33 2022

Duration	
— 5-min	— 2-day
— 10-min	— 3-day
— 15-min	— 4-day
— 30-min	— 7-day
— 60-min	— 10-day
— 2-hr	— 20-day
— 3-hr	— 30-day
— 6-hr	— 45-day
— 12-hr	— 60-day
— 24-hr	

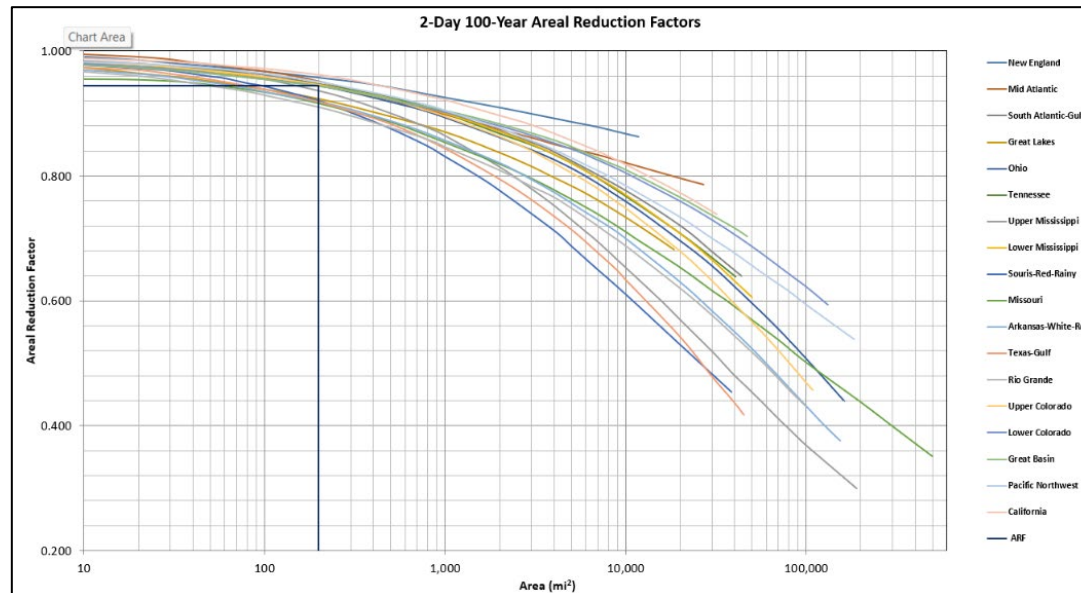
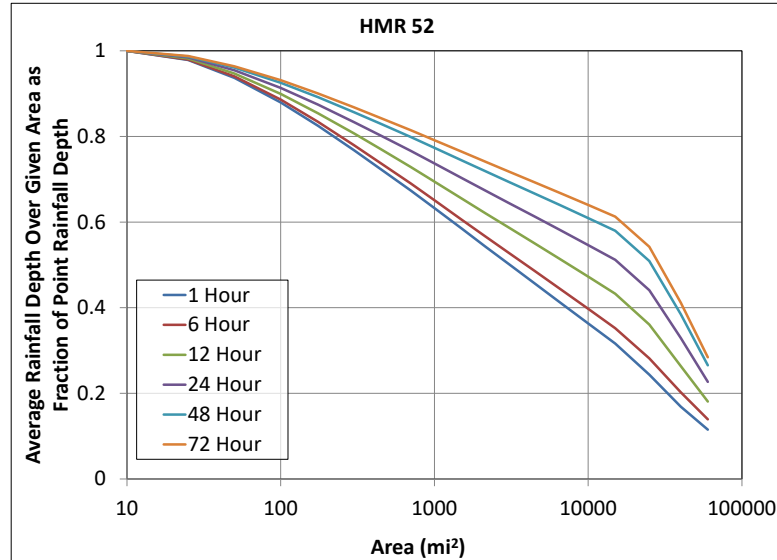


NOAA Atlas 14, Volume 8, Version 2

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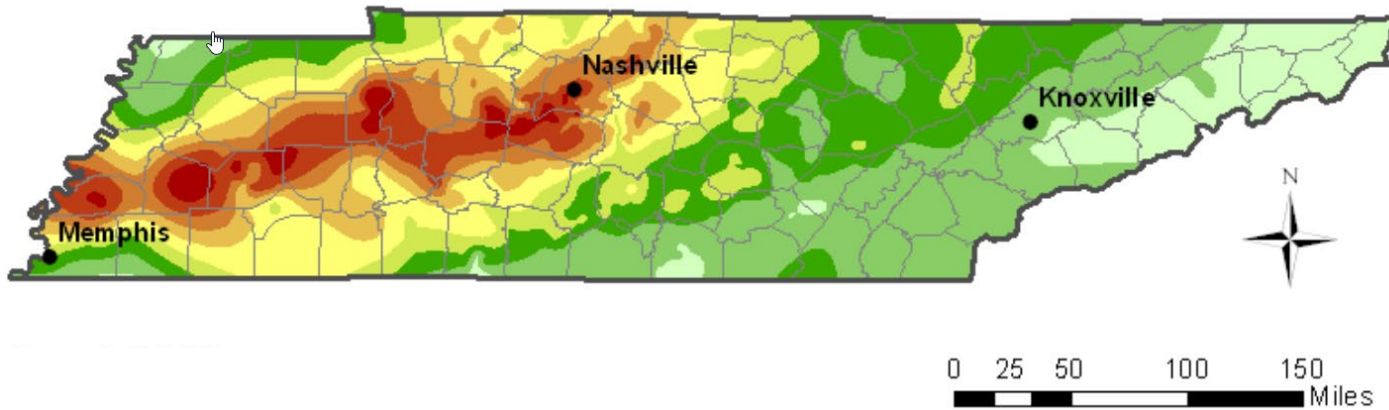
# Basin Average Precipitation



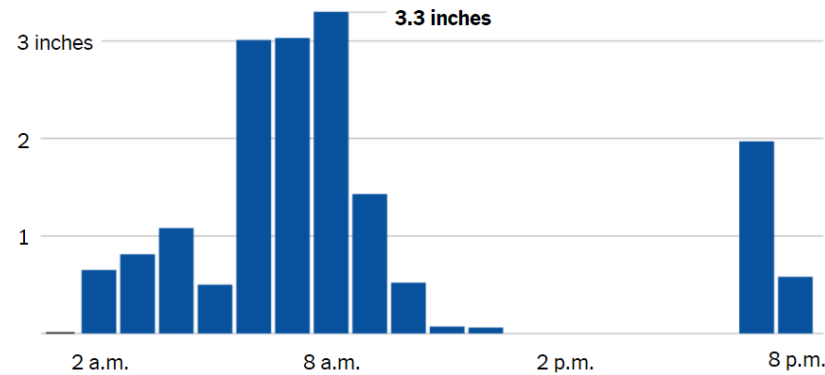
- Areal reduction factor
  - ARF
  - Range (0, 1)
- Average precipitation depth over a basin
  - Always less than point

$$P_{Avg} = P_{Point} * ARF$$

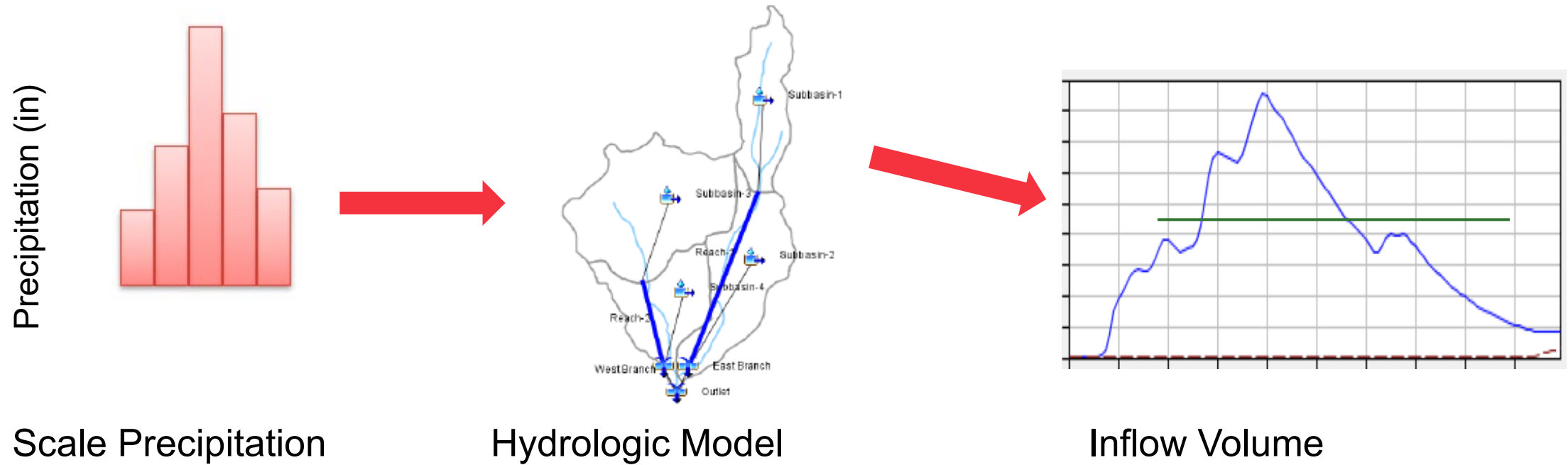
# Spatial and Temporal Pattern



- Observed storms
- Hypothetical storms

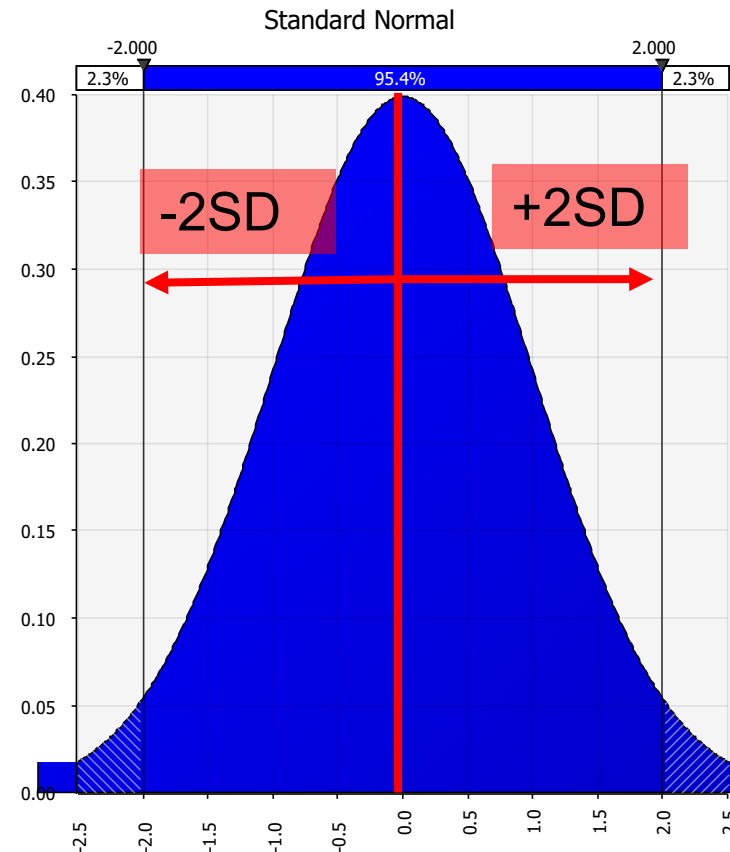


# Precipitation-Frequency Procedure



# Precipitation-Frequency Results Uncertainty

- Simple
  - Range between reasonable low and reasonable high is equal to +/- 2 standard deviations
- Advanced
  - Quantitative analysis using Monte Carlo method



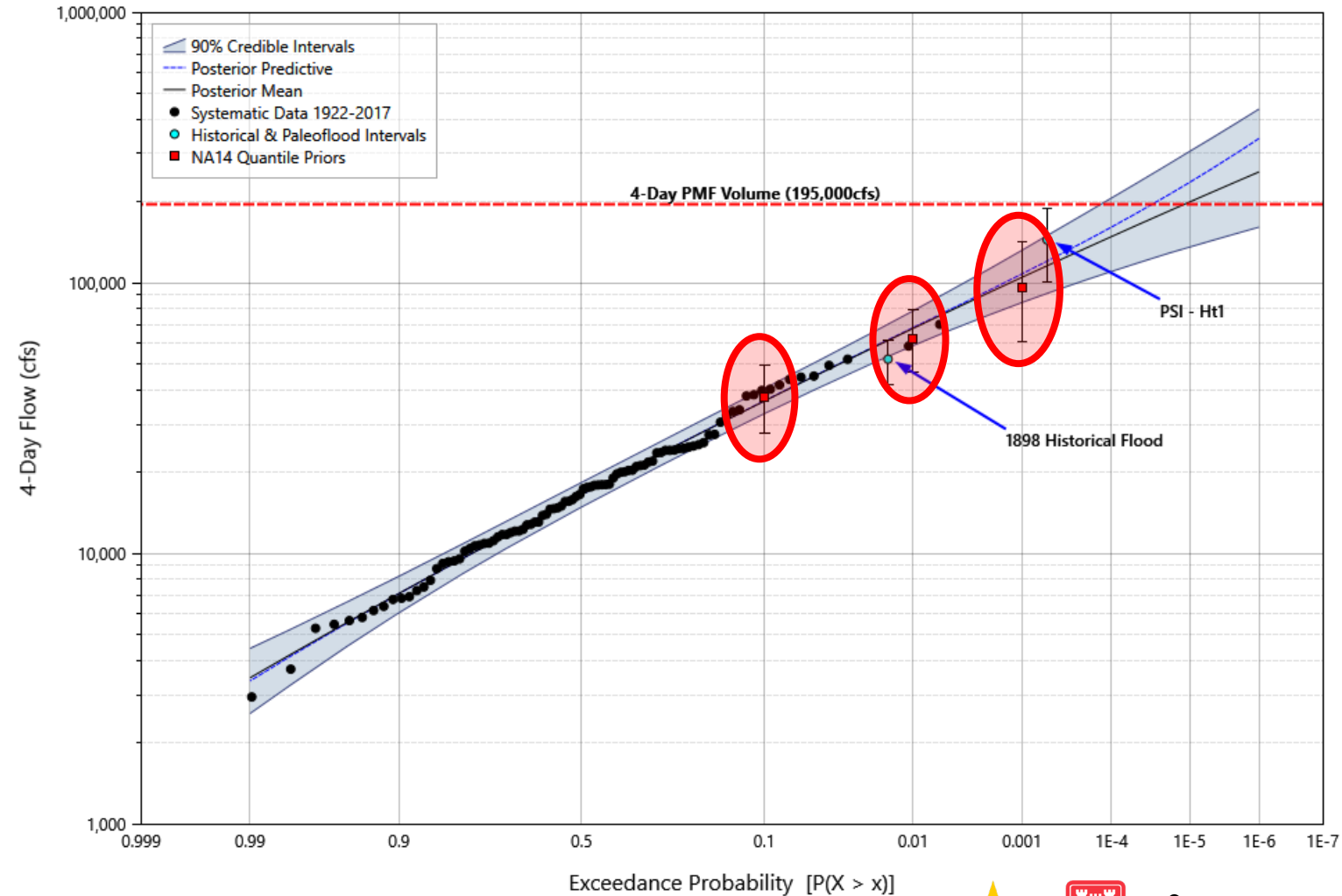
$$\sigma = \frac{High - Low}{4}$$



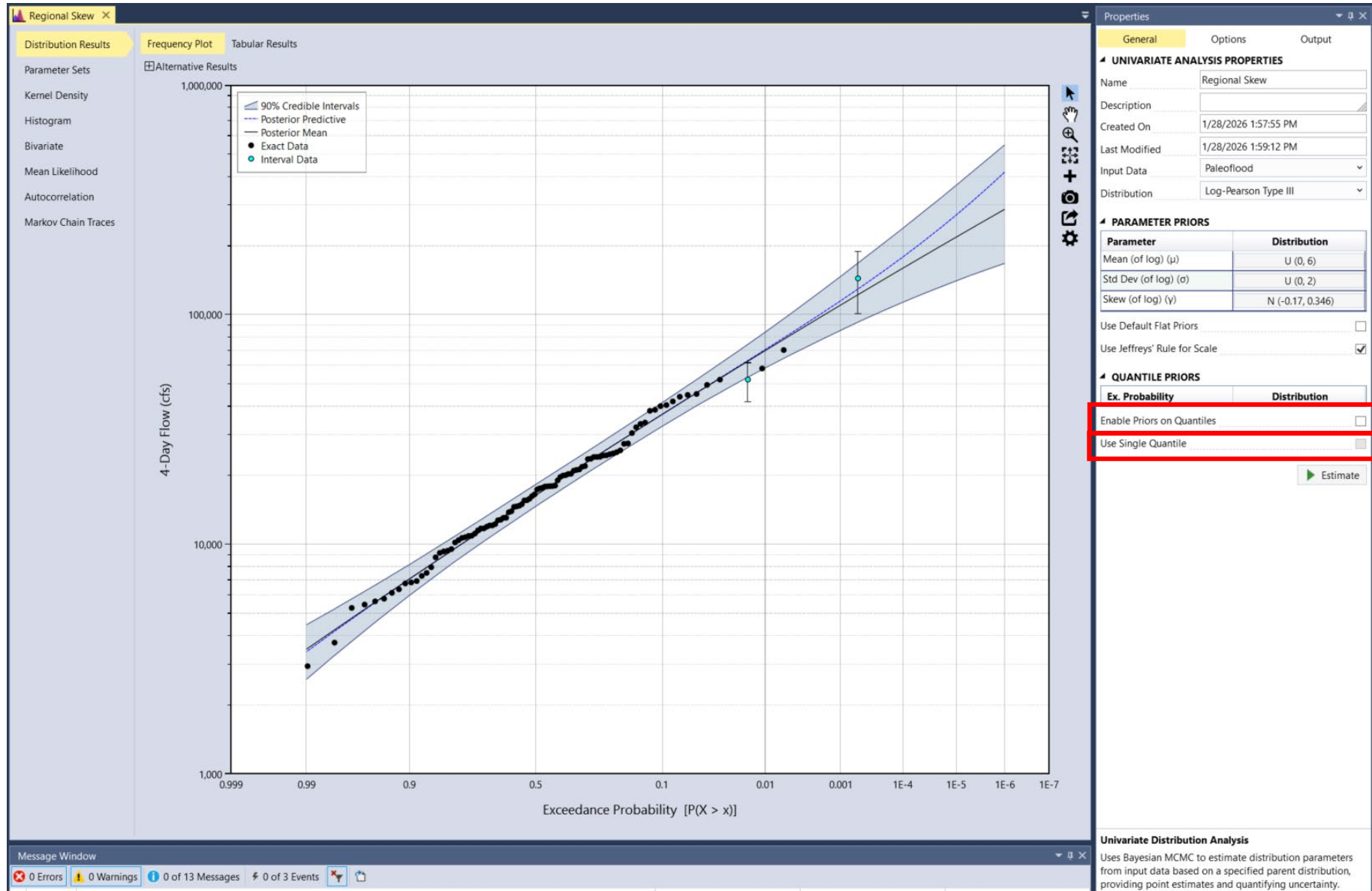
# Precipitation-Frequency Results

## RMC-BestFit

- Prior distribution for a quantile
  - Volume at a given AEP
- Improves frequency curve
- Reduces uncertainty

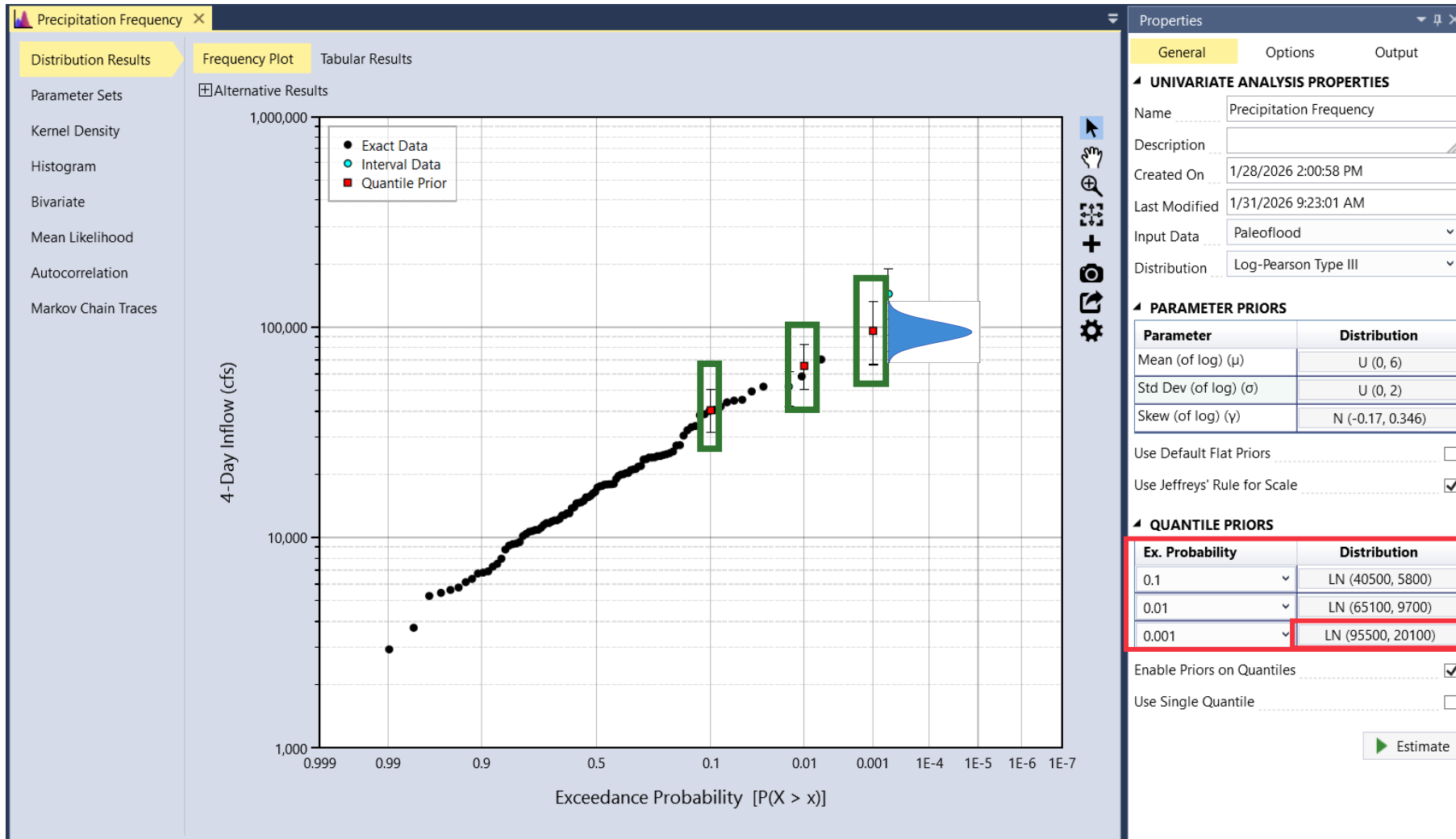


# Precipitation-Frequency Results Quantile Prior



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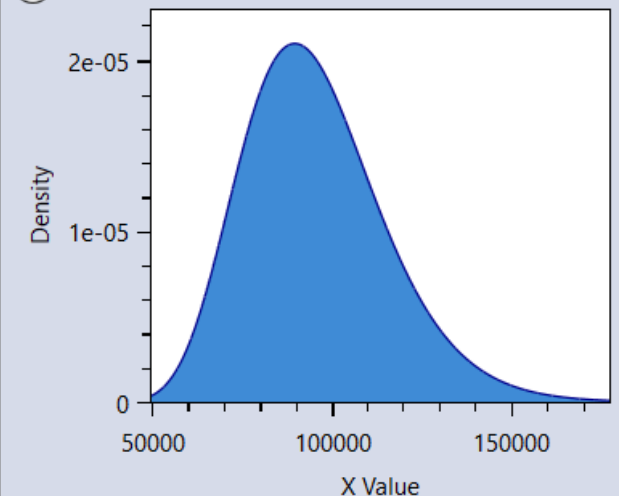
# Entering Quantile Priors in RMC-BestFit



Select Distribution for 0.001:

Log-Normal (base e)	
Mean ( $\mu$ )	95500
Std Dev ( $\sigma$ )	20100

Probability Density Plot

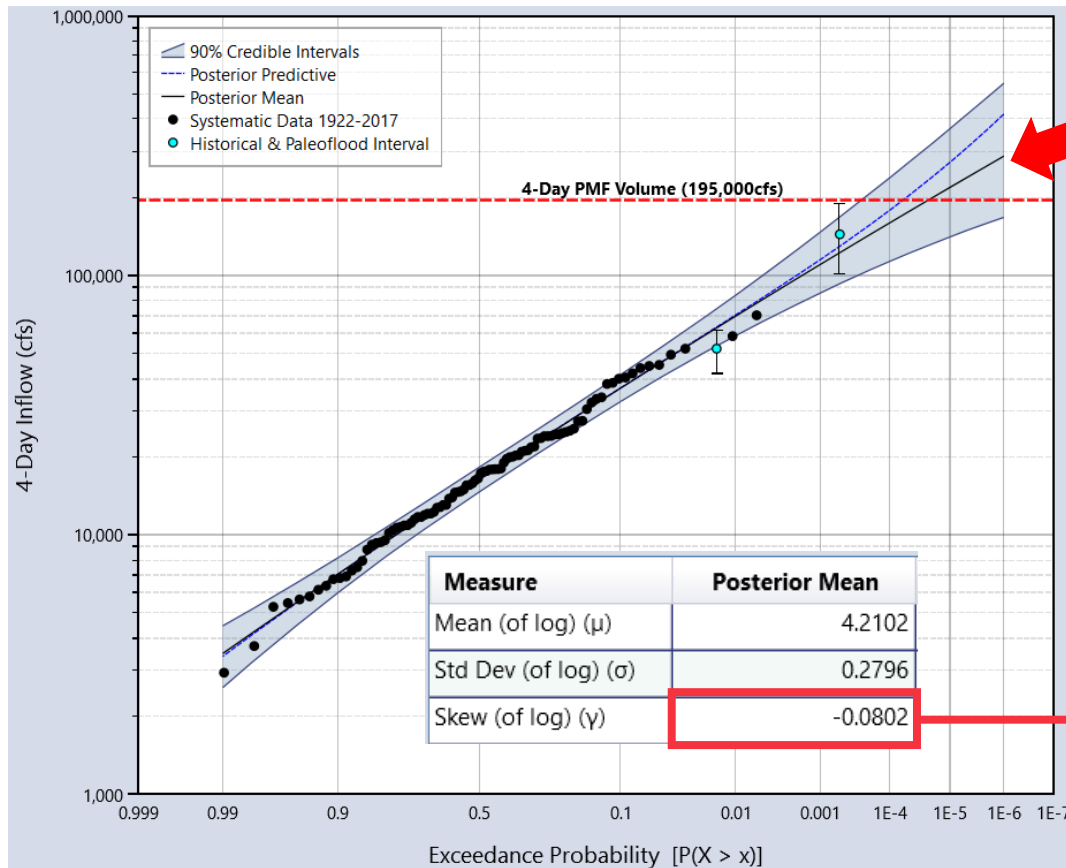


Statistics

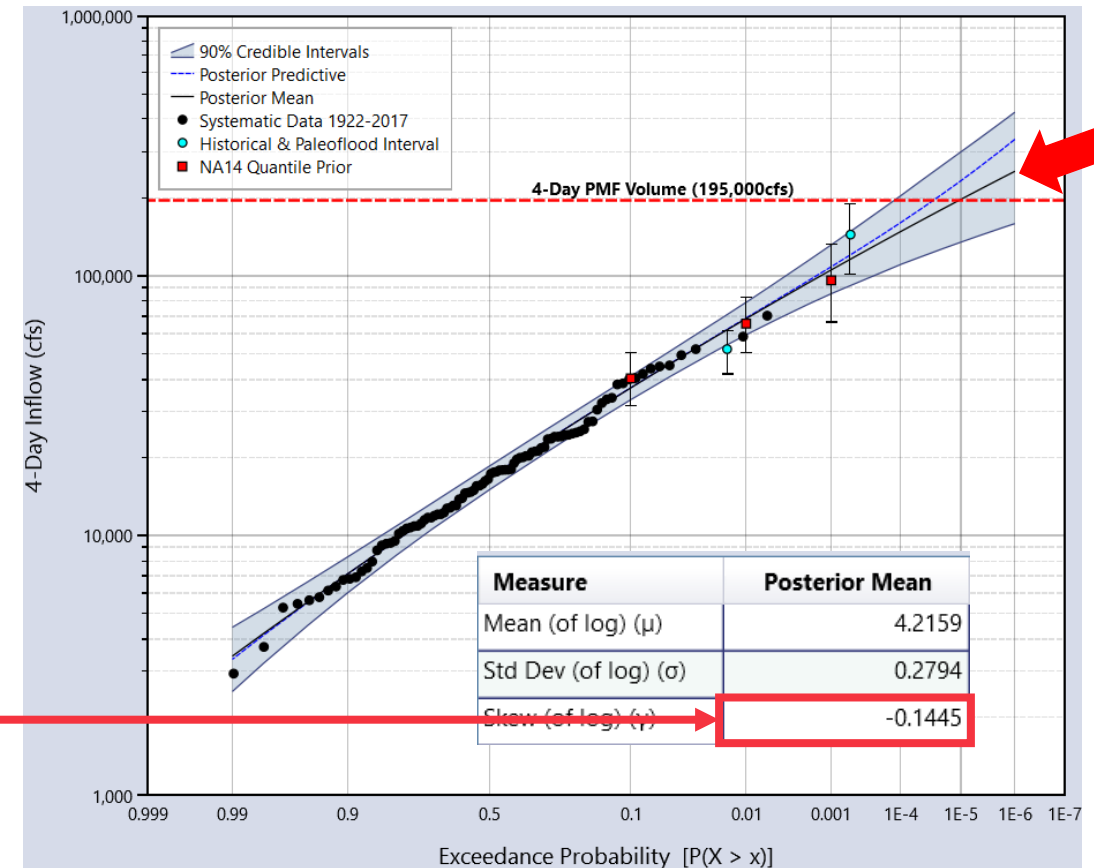


# Comparing Results

## Without quantile priors

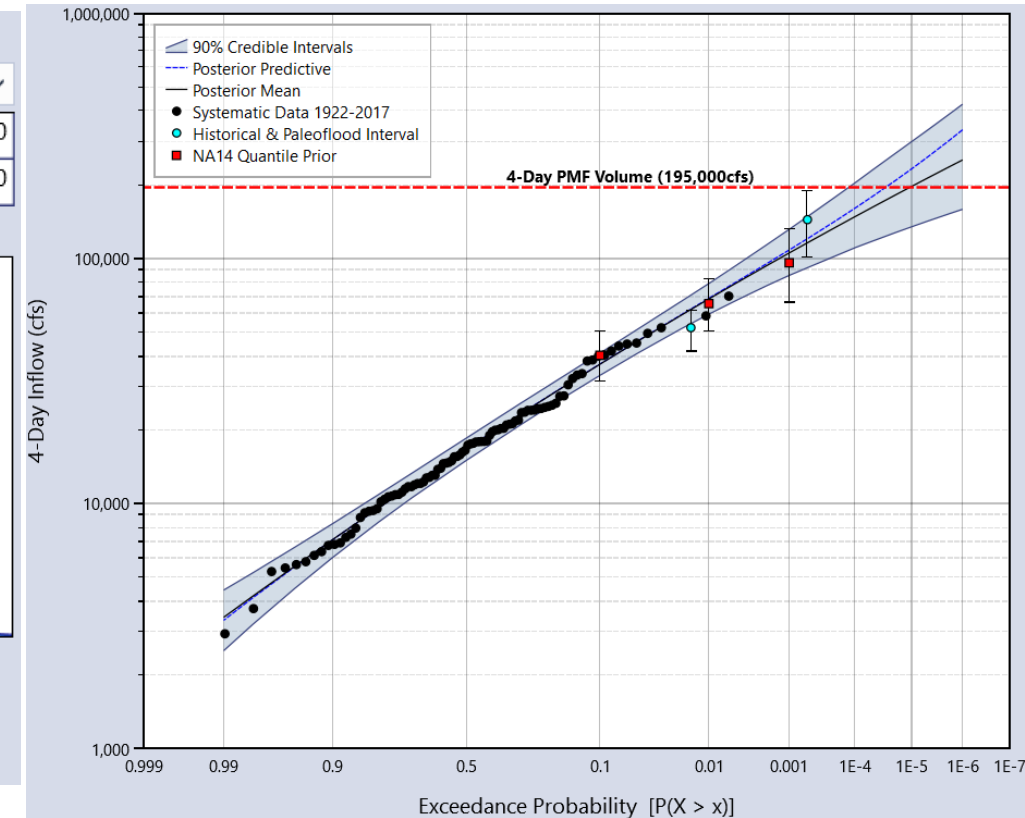
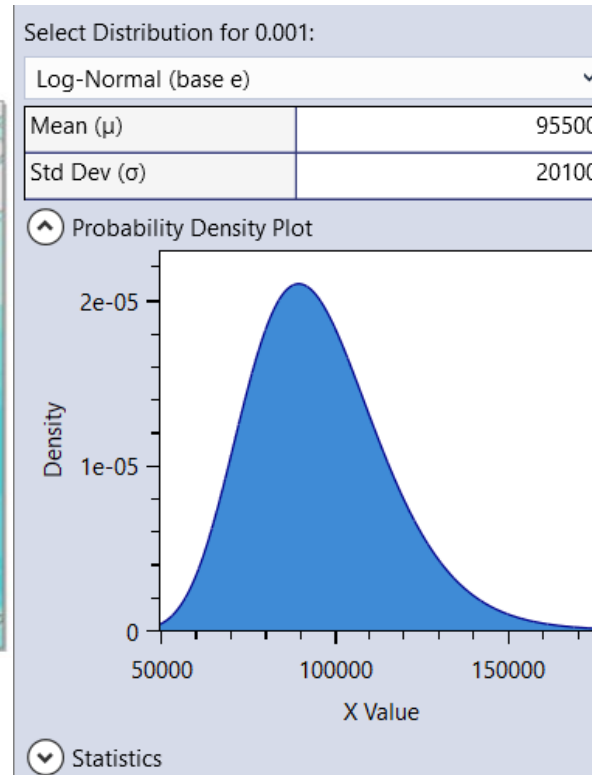


## With quantile priors





# Precipitation-Frequency Prior Distributions for Quantiles



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# Questions