

# Effective Record Length

## DLS-114, Module 1.24



**U.S. ARMY**



**US Army Corps  
of Engineers®**

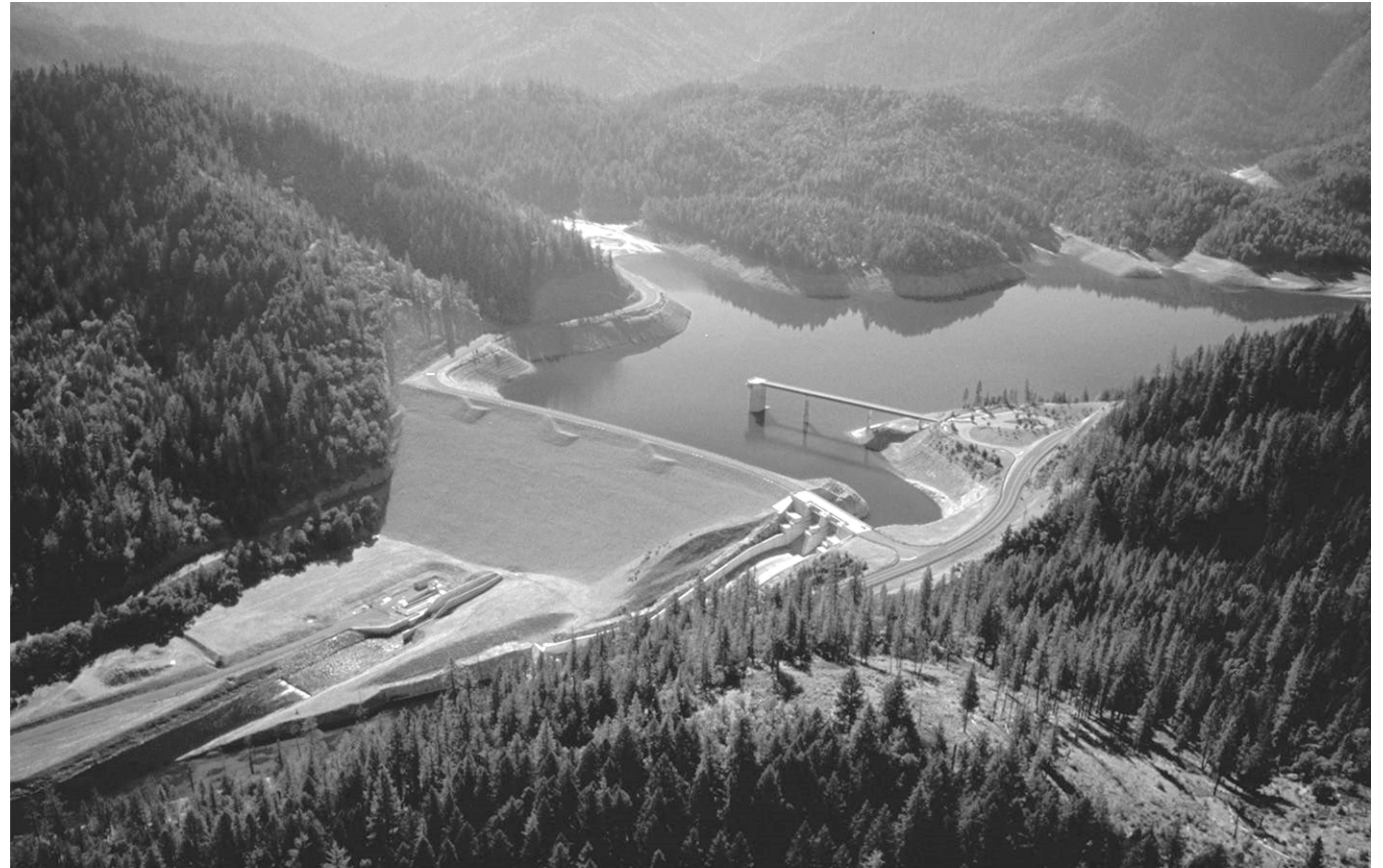
Dam and Levee  
Safety Programs

**March 2026 / Version 1**

APPLEGATE, OR (SOURCE: USACE)

# Learning Objectives

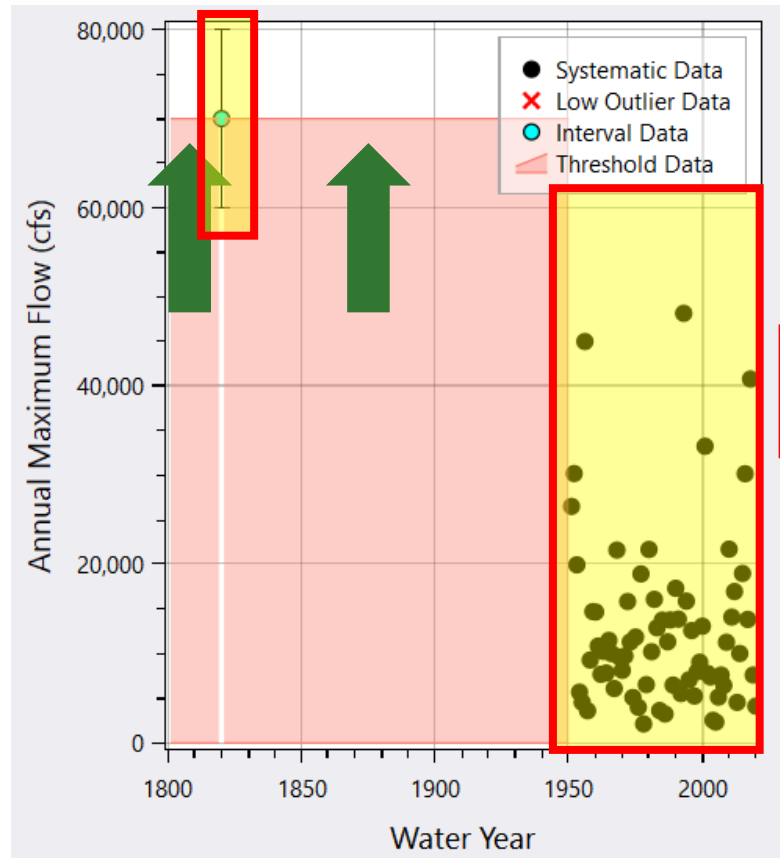
- Define effective record length (ERL)
- Describe how effective record length can be used
- Demonstrate how to estimate effective record length
- Describe how to estimate pseudo-ERL



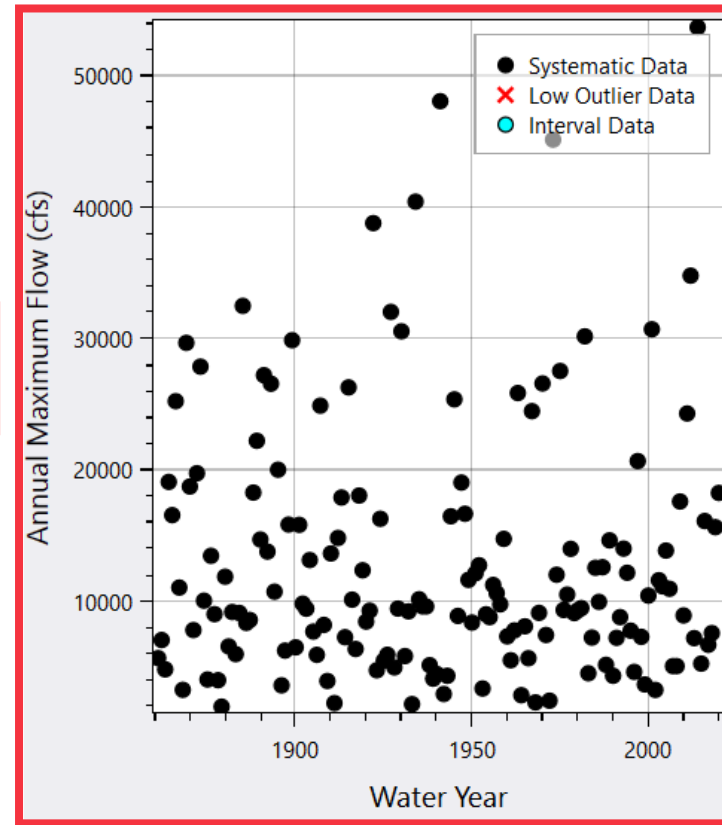
**Applegate Dam**

# What is Effective Record Length?

## Our data



## Equivalent systematic data



- Same
  - Parameters
  - Uncertainty
  - Mean hazard

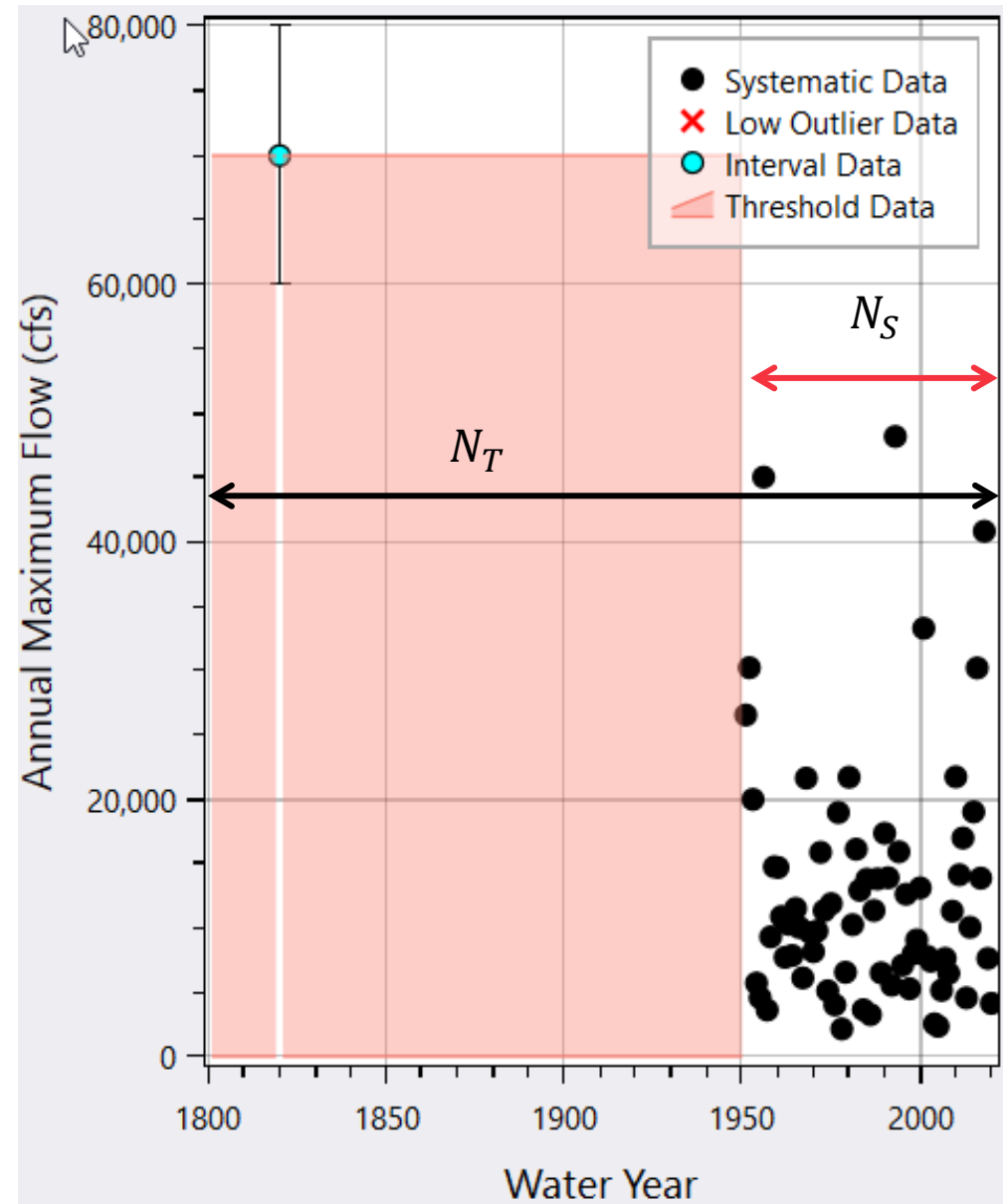
## Definitions

$N_S$  = Systematic record length

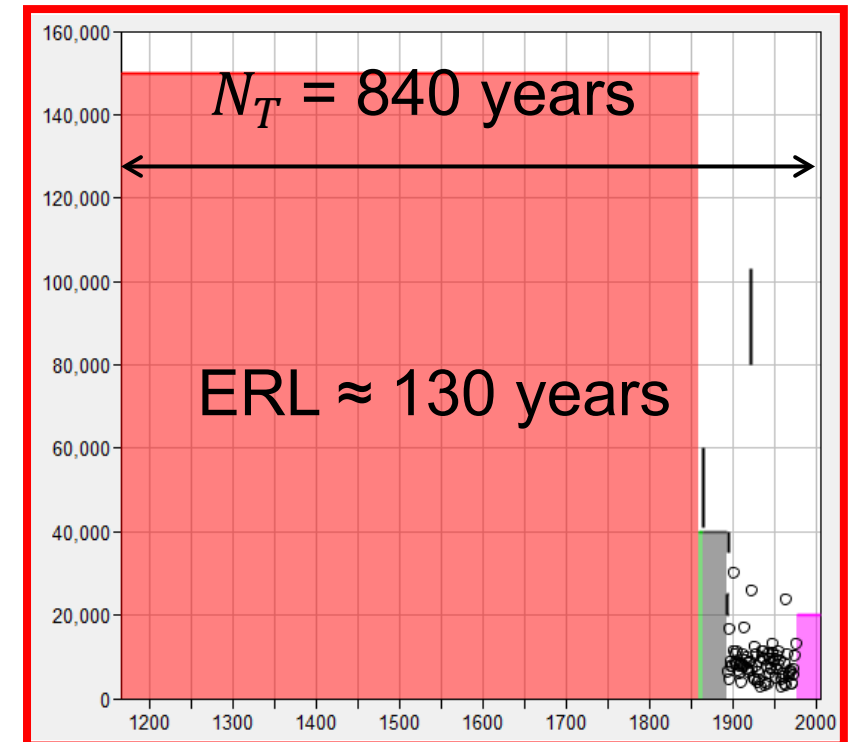
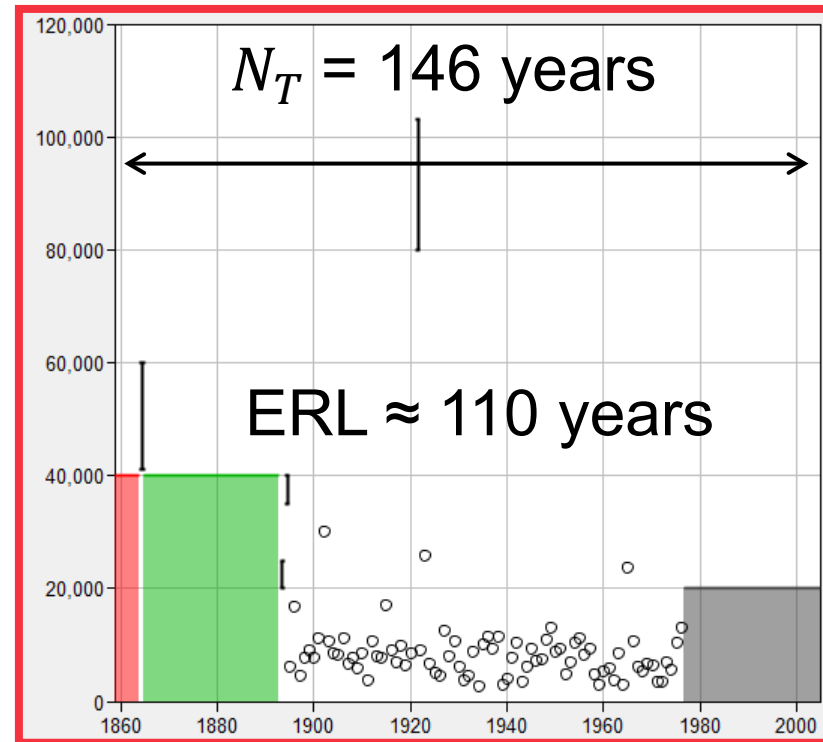
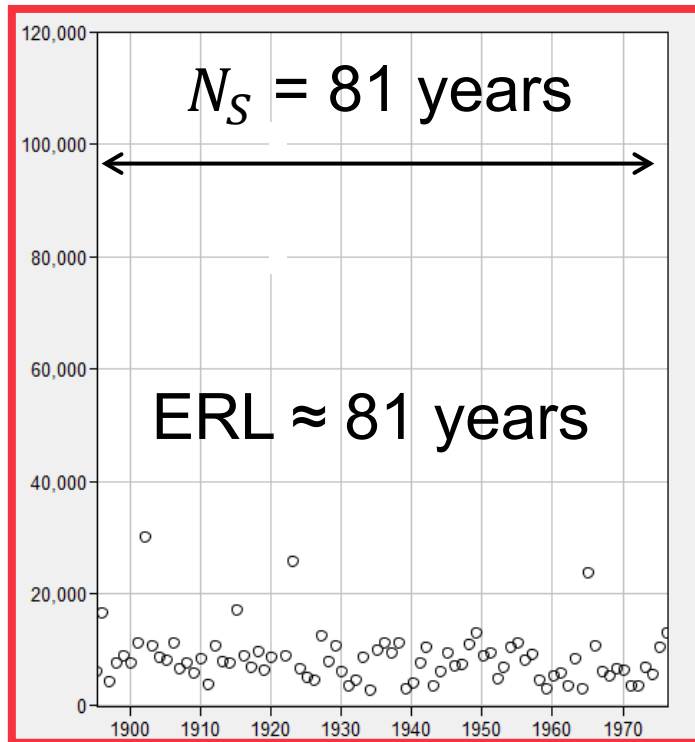
$N_T$  = Total record length

ERL = Effective record length

Average gain:  $\lambda = \frac{ERL - N_S}{N_T - N_S}$



# Example



**Average gain:**

$$\lambda = \frac{(110 - 81) = 29}{(146 - 81) = 65} = 0.45$$

$$\lambda = \frac{(130 - 81) = 29}{(840 - 81) = 65} = 0.06$$

# Modeling Uncertainty

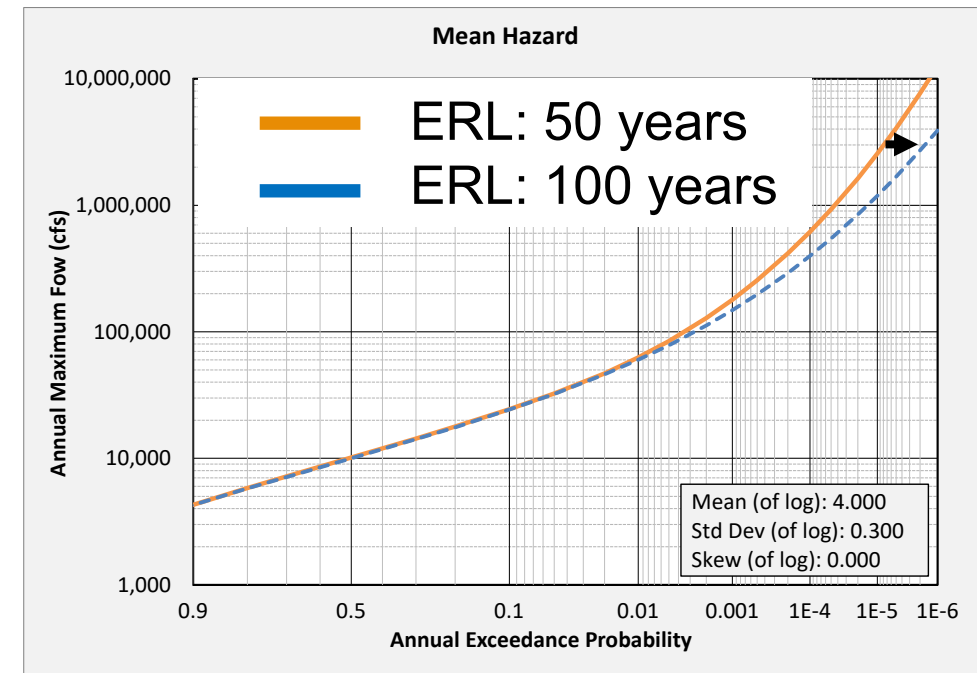
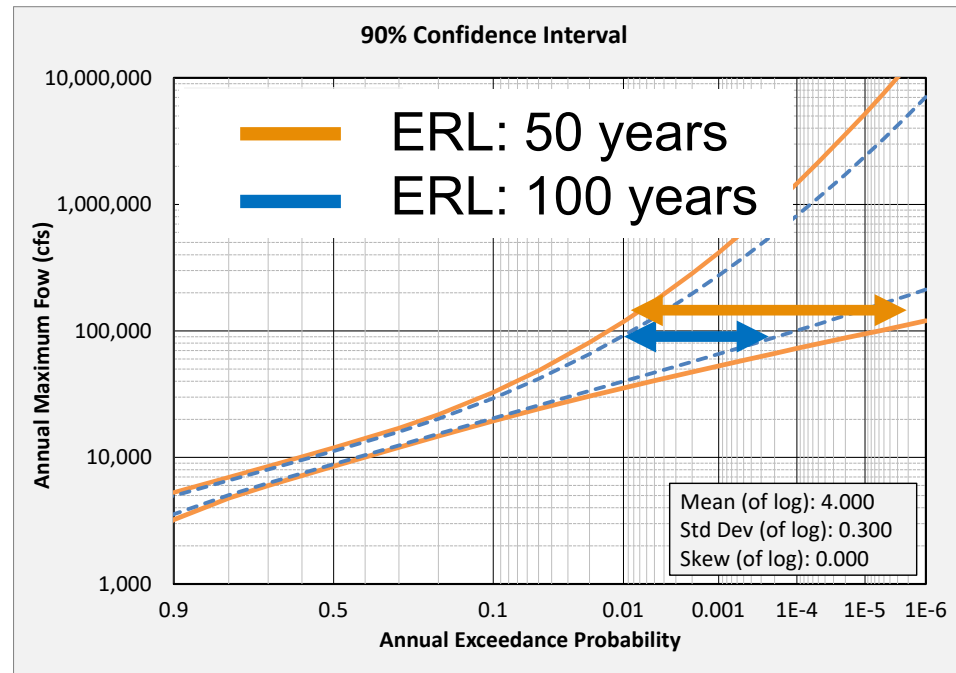
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- Knowledge uncertainty
- Width of uncertainty bounds and mean hazard curve
- Greater ERL = Less uncertainty

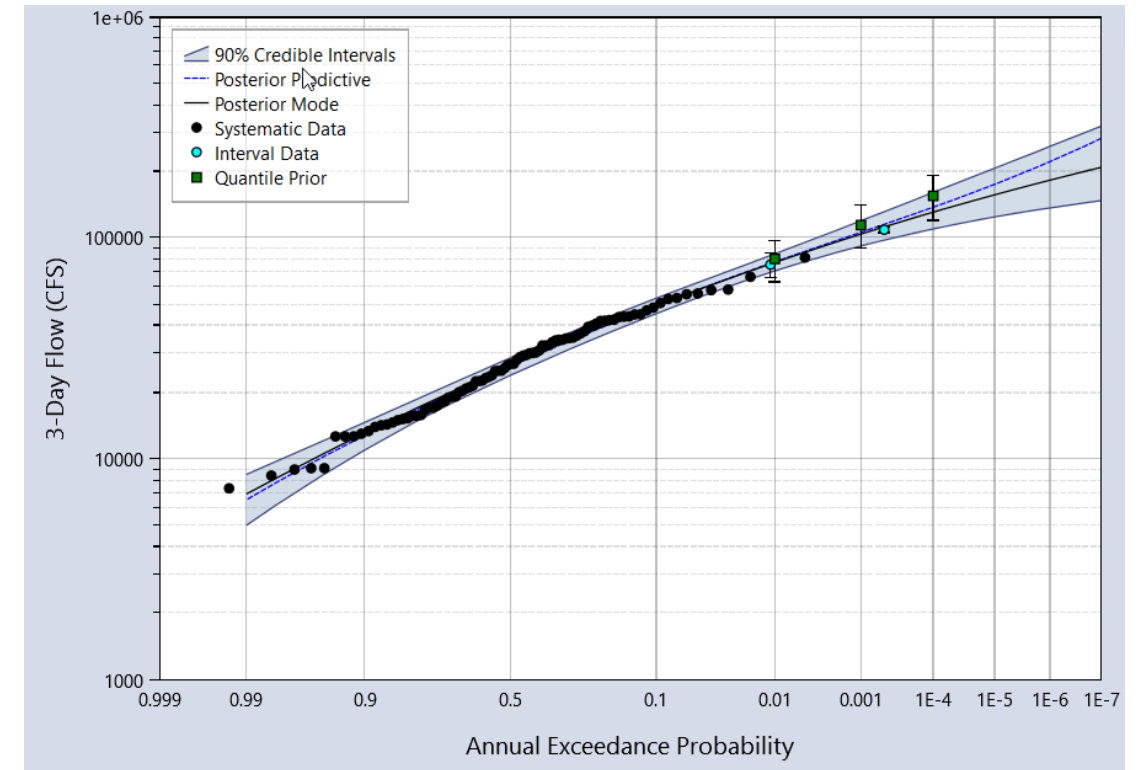
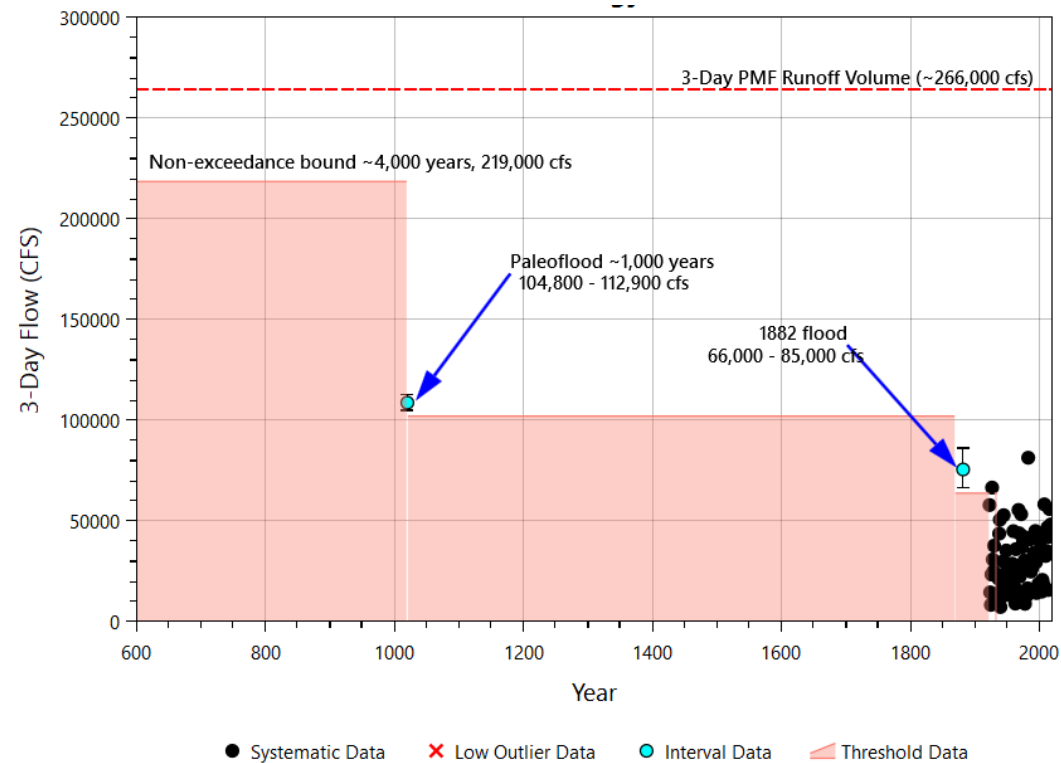


# Value of Additional Data (1 of 2)

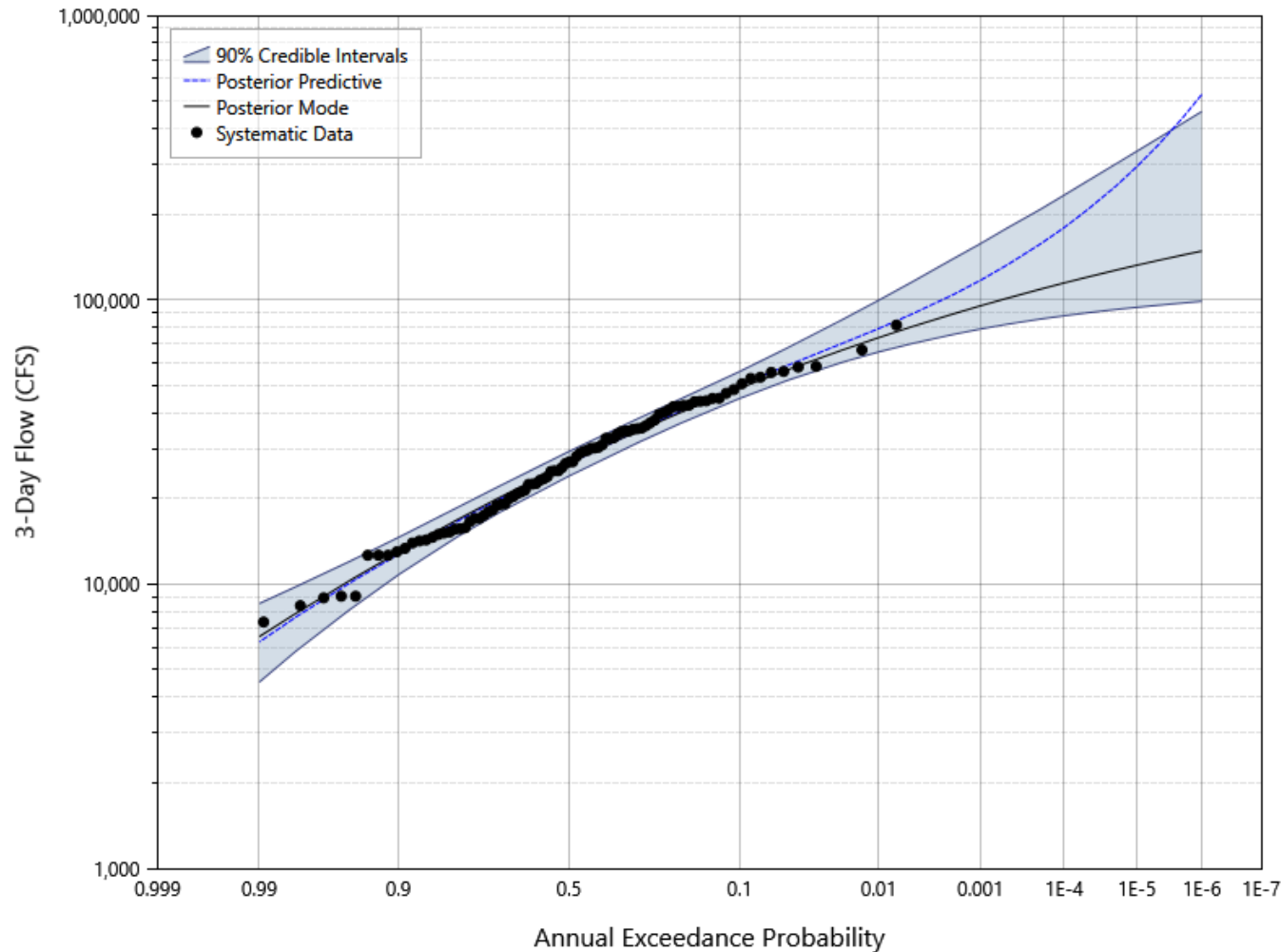
- Greater ERL ... less uncertainty



# Value of Additional Data (2 of 2)

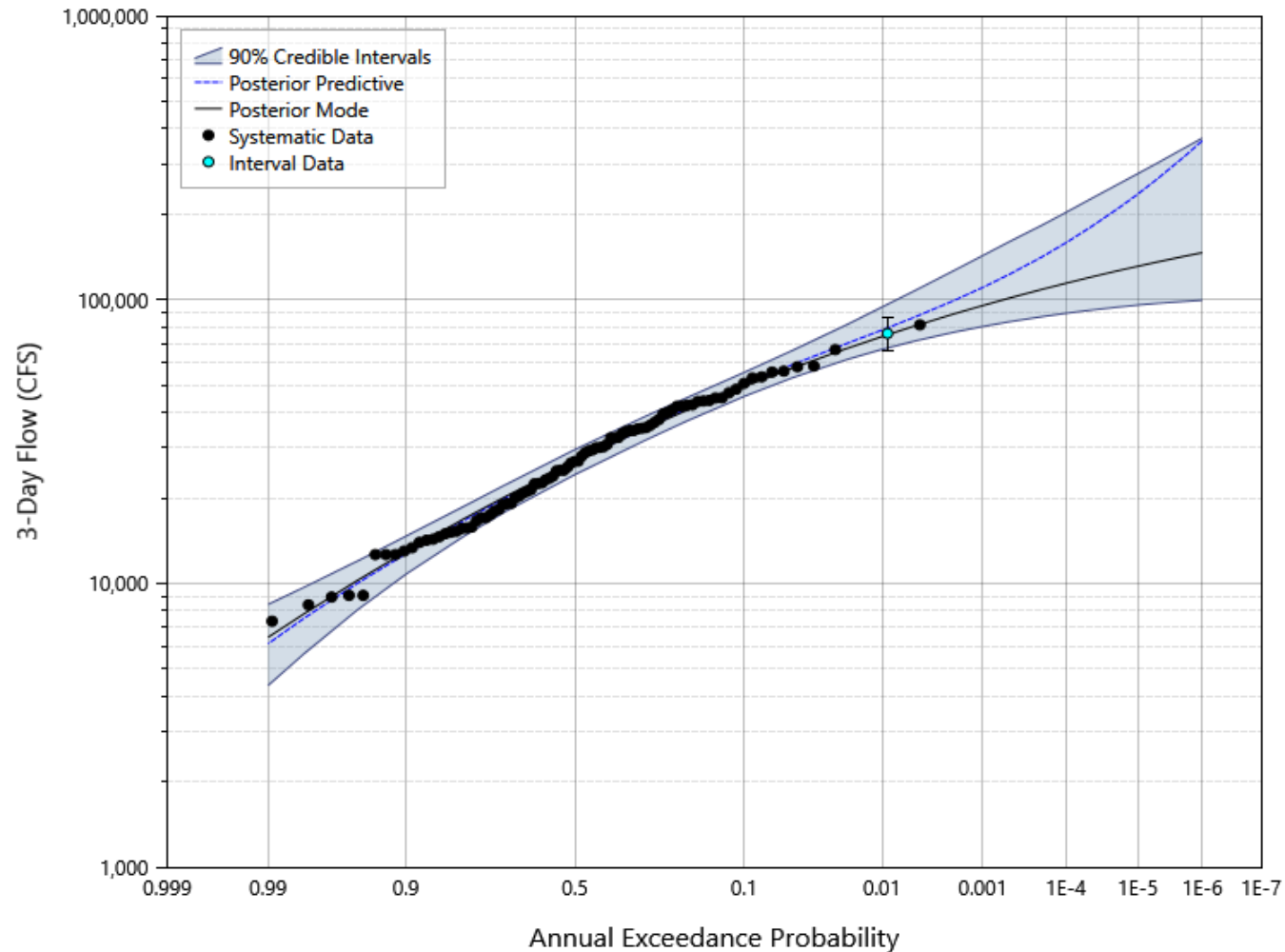


# Systematic Data



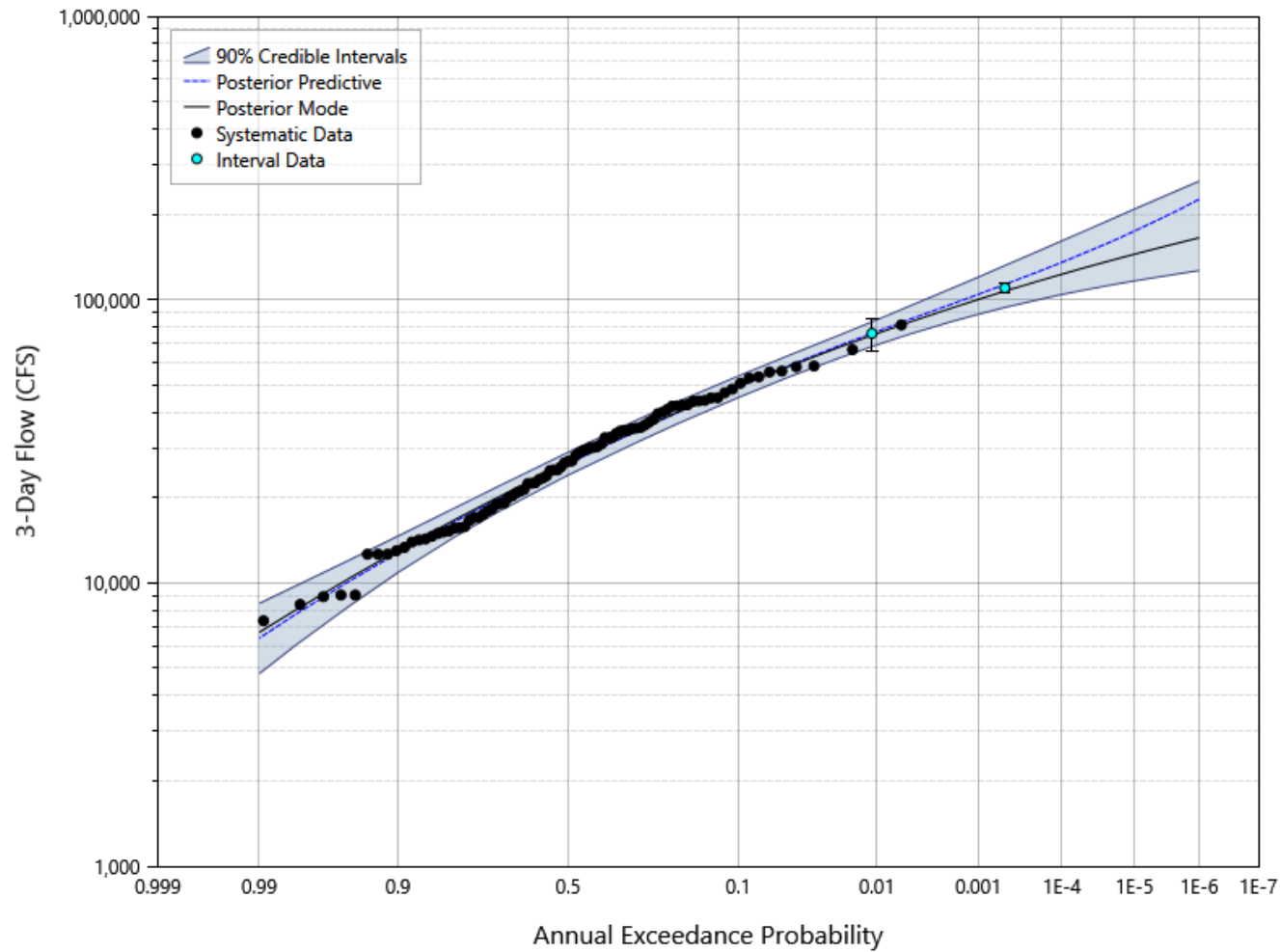
| Data       | ERL | Marginal gain |
|------------|-----|---------------|
| Systematic | 95  | -             |
|            |     |               |
|            |     |               |
|            |     |               |
|            |     |               |

# Historical Data



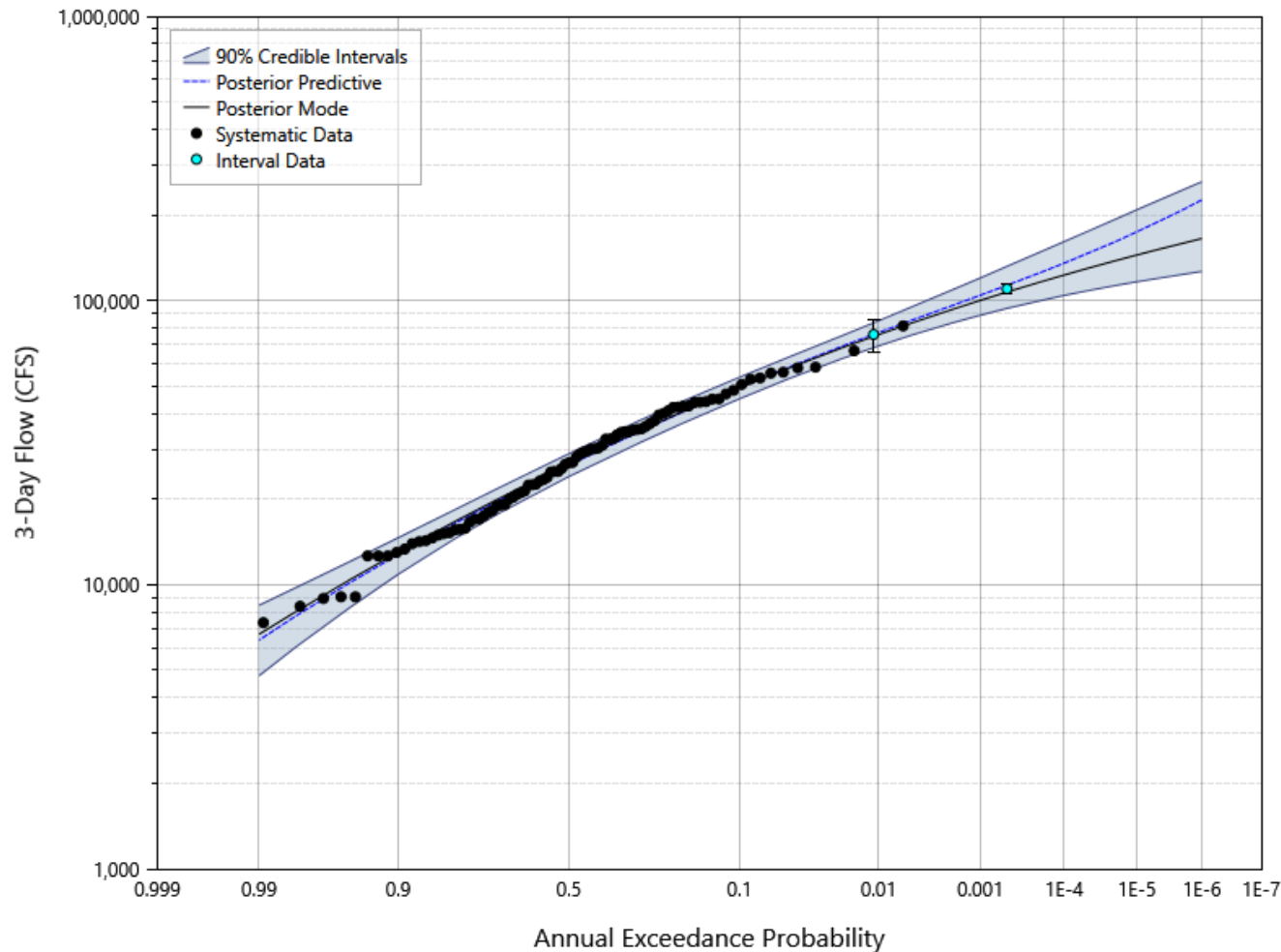
| Data        | ERL | Marginal gain |
|-------------|-----|---------------|
| Systematic  | 95  | -             |
| +Historical | 115 | +20           |
|             |     |               |
|             |     |               |
|             |     |               |

# Paleoflood Data



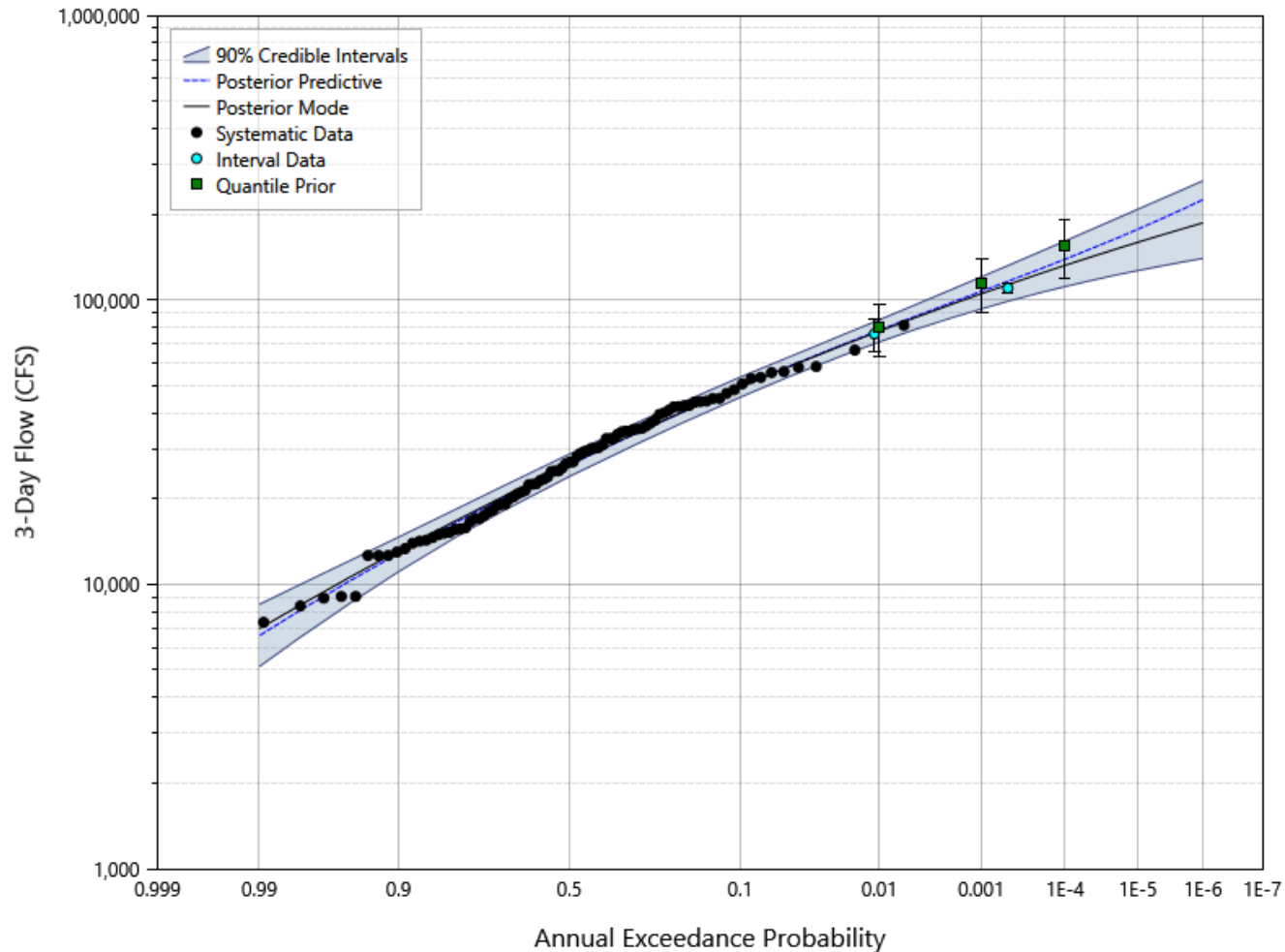
| Data        | ERL | Marginal gain |
|-------------|-----|---------------|
| Systematic  | 95  | -             |
| +Historical | 115 | +20           |
| +Paleo      | 275 | +160          |
|             |     |               |
|             |     |               |

# Regional Skew Prior



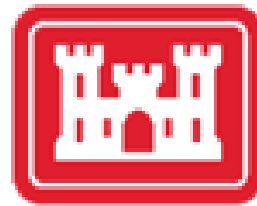
| Data        | ERL | Marginal gain |
|-------------|-----|---------------|
| Systematic  | 95  | -             |
| +Historical | 115 | +20           |
| +Paleo      | 275 | +160          |
| +Skew prior | 290 | +15           |
|             |     |               |

# Quantile Priors



| Data             | ERL | Marginal gain |
|------------------|-----|---------------|
| Systematic       | 95  | -             |
| +Historical      | 115 | +20           |
| +Paleo           | 275 | +160          |
| +Skew prior      | 290 | +15           |
| +Quantile priors | 350 | +60           |

# RMC Toolbox (1 of 3)



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**RMC Flood Hazard Suite**  
**RMC Expected Probability and Uncertainty Toolbox**  
**Version 1.0.0**

# RMC Toolbox (2 of 3)

|              |   |         |     |       |          |
|--------------|---|---------|-----|-------|----------|
| Prepared by: | David Margo   | Office: | RMC | Date: | 1/8/2021 |
| Checked by:  |   | Office: |     | Date: |          |
| Title:       | Example 4 from Bulletin 17C; Arkansas River near Pueblo, CO |         |     |       |          |

## RMC Flood Hazard Suite RMC Expected Probability and Uncertainty Toolbox, Version 1.0.0 Log Pearson Type 3 Distribution

◀ Macros must be enabled to use this toolbox

### Step 1: Enter the input parameters for the analysis

◀ When copying and pasting data, use "Paste Special" with the "Values (V)", "Keep Text Only (T)", or "Match Destination Formatting (M)" option. This prevents unintentional changes to the spreadsheet formatting.

| Input Parameter                                 | Value  |
|---|--------|
| Mean of $\text{Log}_{10}(\mu)$                  | 3.6406 |
| Standard Deviation of $\text{Log}_{10}(\sigma)$ | 0.1961 |
| Skew of $\text{Log}_{10}(\gamma)$               | 0.2284 |
| Effective Record Length (Years)                 | 84     |

### Step 2: Enter the output parameters for the analysis

| Output Parameter  | Value           |
|---|-----------------|
| Label for Tabulating and Plotting Results                   | Peak Flow (cfs) |
| Maximum AEP Value for Tabulating and Plotting Results       | 0.9             |
| Minimum AEP Value for Tabulating and Plotting Results       | 1.E-06          |
| Confidence Interval for Tabulating and Plotting Results (%) | 90%             |
| Number of Decimal Places for Displaying Input Quantiles     | 0               |
| Number of Significant Figures for Tabulating Results        | 3               |

◀ Label is displayed in the output table heading and as the y-axis label in the output plot

### Step 3: Enter the simulation parameters for the analysis

| Simulation Parameter                | Value  |
|-------------------------------------|--------|
| Number of Realizations (R)          | 10000  |
| Pseudo Random Number Generator Seed | Random |


◀ Simulation time is proportional to  $\text{ERL} \times R$

◀ Uses parametric percentile bootstrap without bias correction to generate samples and uses method of moments to estimate parameter sets for each sample

# RMC Toolbox (3 of 3)

## Step 4: Enter data for comparison plot (Optional)

Enter and plot comparison data ☐ Yes

| Z      | Return Period | AEP  | BestFit Upper | BestFit Lower | BestFit Predictiv | BestFit Mode |
|--------|---------------|---|---------------|---------------|-------------------|--------------|
| 4.753  | 1000000       | 1.0E-06   | 124,514.      | 31,065.       | 95,766.           | 54,767.      |
| 4.611  | 500000        | 2.0E-06   | 109,215.      | 29,346.       | 82,444.           | 50,143.      |
| 4.417  | 200000        | 5.0E-06   | 91,388.       | 27,164.       | 67,780.           | 44,501.      |
| 4.265  | 100000        | 1.0E-05   | 79,737.       | 25,554.       | 58,556.           | 40,566.      |
| 4.107  | 50000         | 2.0E-05   | 69,504.       | 23,969.       | 50,665.           | 36,898.      |
| 3.891  | 20000         | 5.0E-05   | 57,793.       | 21,930.       | 41,939.           | 32,431.      |
| 3.719  | 10000         | 1.0E-04   | 50,102.       | 20,439.       | 36,404.           | 29,321.      |
| 3.540  | 5000          | 2.0E-04   | 43,301.       | 18,989.       | 31,628.           | 26,426.      |
| 3.291  | 2000          | 5.0E-04   | 35,523.       | 17,107.       | 26,280.           | 22,904.      |
| 3.090  | 1000          | 0.001   | 30,501.       | 15,757.       | 22,840.           | 20,455.      |
| 2.878  | 500           | 0.002   | 26,009.       | 14,393.       | 19,829.           | 18,176.      |
| 2.576  | 200           | 0.005   | 20,868.       | 12,630.       | 16,392.           | 15,403.      |
| 2.326  | 100           | 0.01  | 17,549.       | 11,317.       | 14,128.           | 13,471.      |
| 2.054  | 50            | 0.02  | 14,592.       | 10,035.       | 12,087.           | 11,666.      |
| 1.645  | 20            | 0.05  | 11,262.       | 8,337.        | 9,678.            | 9,449.       |
| 1.282  | 10            | 0.1   | 9,084.        | 7,065.        | 8,008.            | 7,874.       |
| 0.842  | 5.0           | 0.2   | 7,140.        | 5,770.        | 6,415.            | 6,355.       |
| 0.524  | 3.3           | 0.3   | 6,068.        | 4,975.        | 5,497.            | 5,468.       |
| 0.000  | 2.0           | 0.5   | 4,710.        | 3,898.        | 4,288.            | 4,297.       |
| -0.524 | 1.4           | 0.7   | 3,711.        | 3,058.        | 3,376.            | 3,409.       |
| -0.842 | 1.3           | 0.8   | 3,241.        | 2,642.        | 2,934.            | 2,977.       |
| -1.282 | 1.1           | 0.9   | 2,711.        | 2,150.        | 2,427.            | 2,481.       |
| -1.645 | 1.1           | 0.95  | 2,366.        | 1,808.        | 2,081.            | 2,145.       |
| -2.054 | 1.0           | 0.98  | 2,052.        | 1,478.        | 1,753.            | 1,830.       |
| -2.326 | 1.0           | 0.99  | 1,880.        | 1,290.        | 1,560.            | 1,651.       |

- ◀ If column heading is blank, value will be "ColumnX" and any values in the table will not be plotted
- ◀ Filter on AEP column by selecting or unselecting "(Blanks)" to show blank rows for additional data entry or to hide unused blank rows. Unused rows will be hidden automatically

## Step 5: Run the simulation

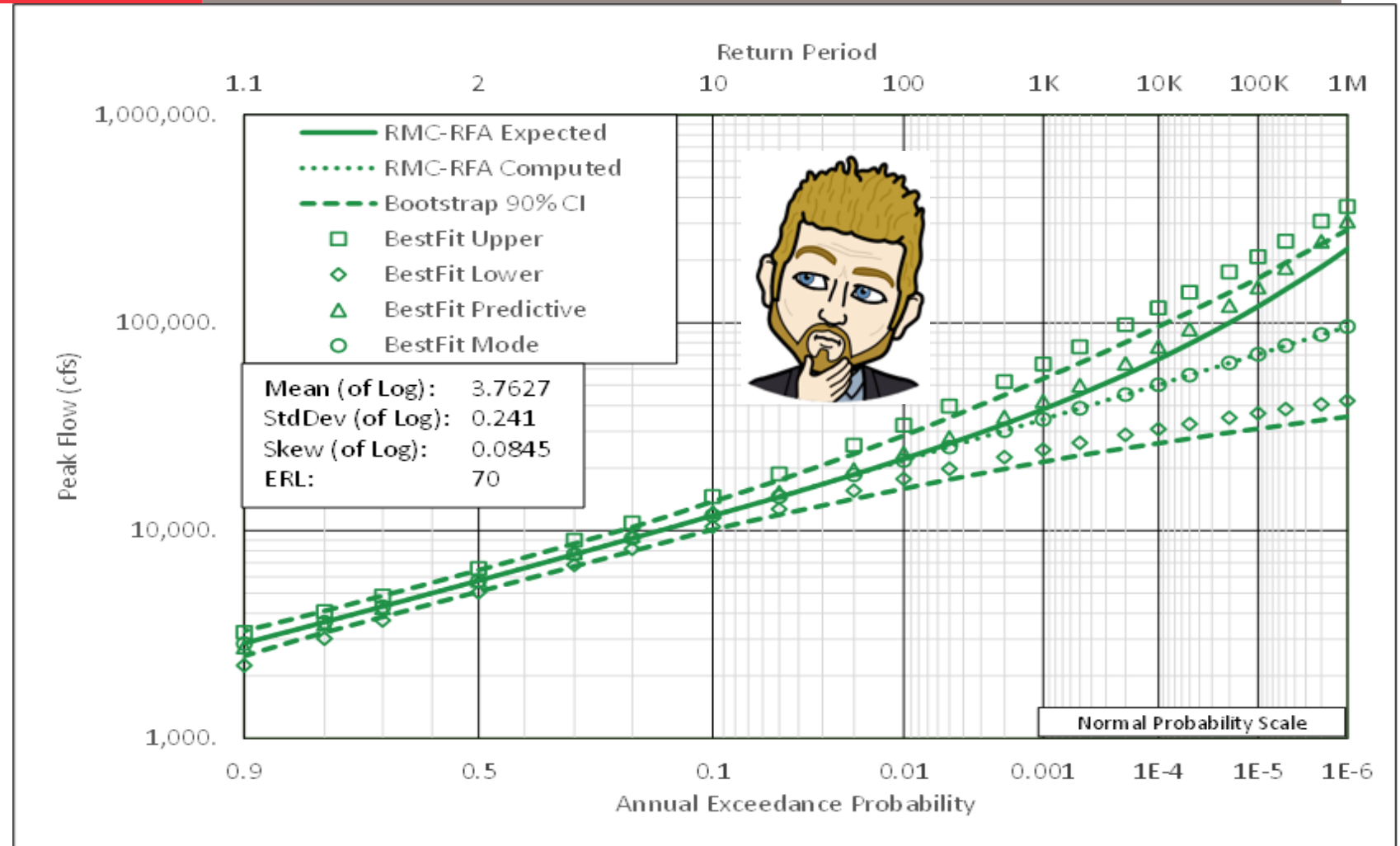
Click Here to  
RUN SIMULATION

- ◀ Progress is displayed on the application status bar in the lower left corner



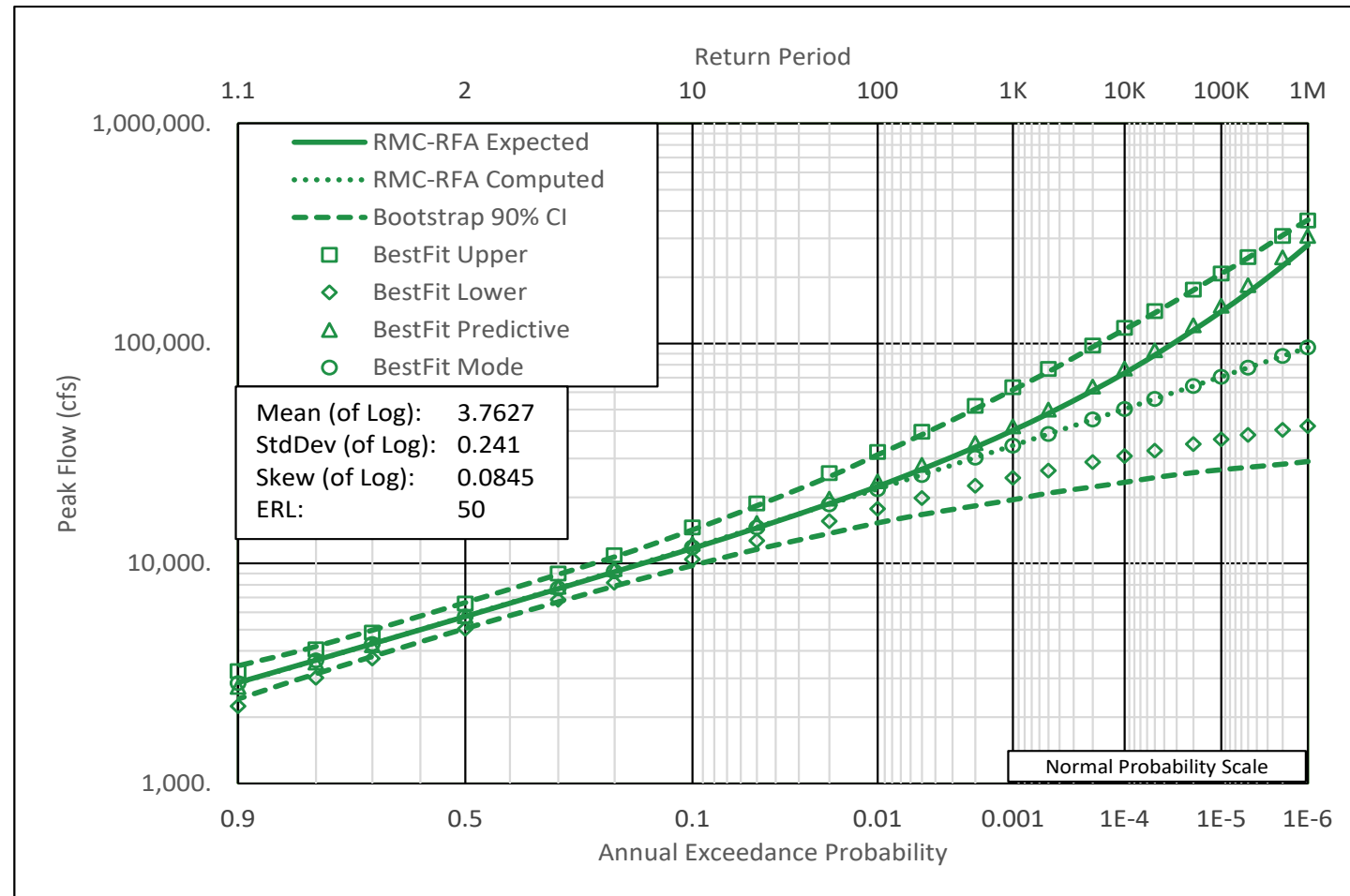
# Manually Adjusting ERL (Pseudo-ERL) (1 of 2)

- ERL = 70



# Manually Adjusting ERL (Pseudo-ERL) (2 of 2)

- Adjust to match predictive curve
- Pseudo-ERL:  
50 years



# Limitations

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1. Frequentist vs. Bayesian Statistics
2. What are the ERL limitations?
3. Why do we compute ERL?

# Summary

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- Effective record length is used to model uncertainty
- Greater effective record length = less uncertainty
- RMC toolbox is available to estimate the pseudo effective record length
- Uncertainty in RMC-RFA model should reasonably match uncertainty from RMC-BestFit analysis
- If ERL needs manual adjustment, contact RMC for guidance

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# ? Questions