

RECLAMATION

Managing Water in the West

Extreme Precipitation Frequency for Dam Safety and Nuclear Facilities – A perspective

Workshop on Probabilistic Flood Hazard Assessment

January 29-31, 2013 Rockville, Maryland



**U.S. Department of the Interior
Bureau of Reclamation**

Case Studies



Star Fort Dam, SC



Trapped Rock Dam, NM



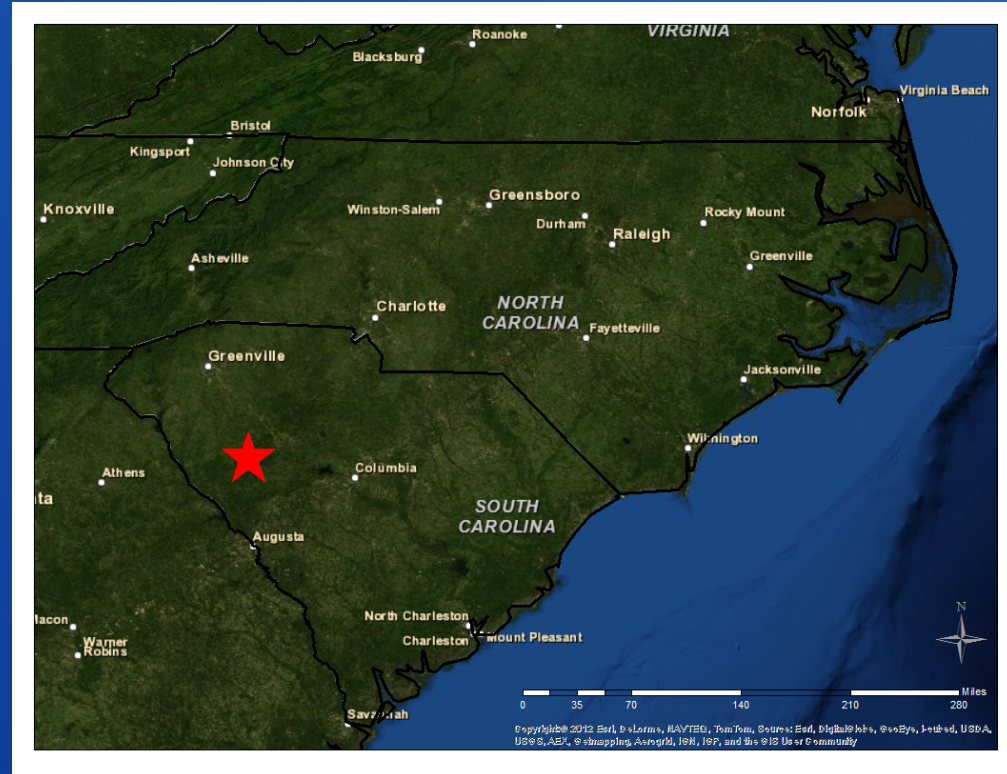
Anderson Ranch Dam, ID



Altus Dam, OK

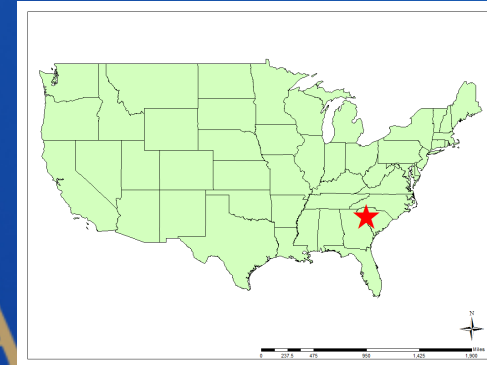
Star Fort Dam

- Owned by the National Parks Service, located in Ninety Six National Historic Site
- Flood control structure
- Built in the 1930s
- Drainage area is 1.15 mi²



Compute the PMF and flood frequency analysis for screening

Requires PMP and precipitation frequency

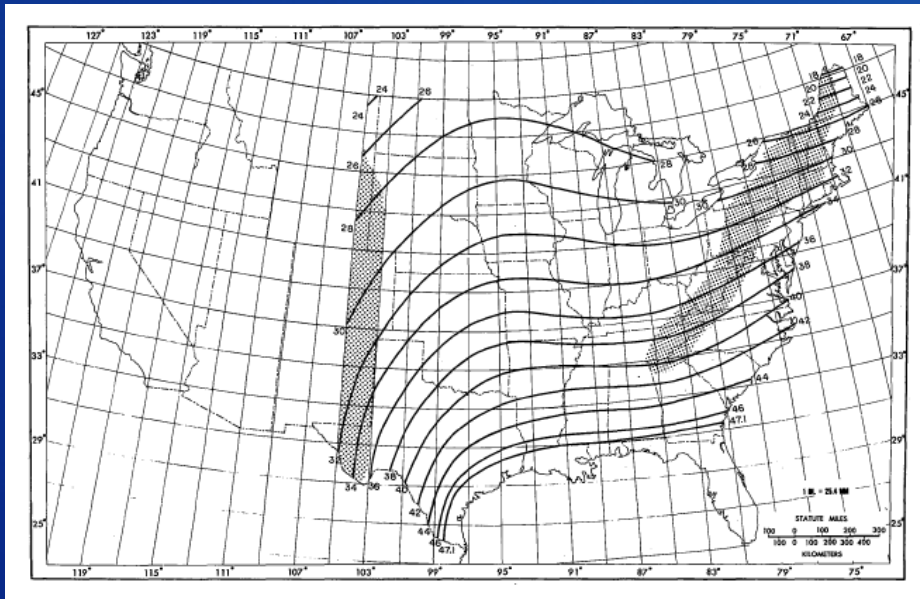


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Star Fort Dam

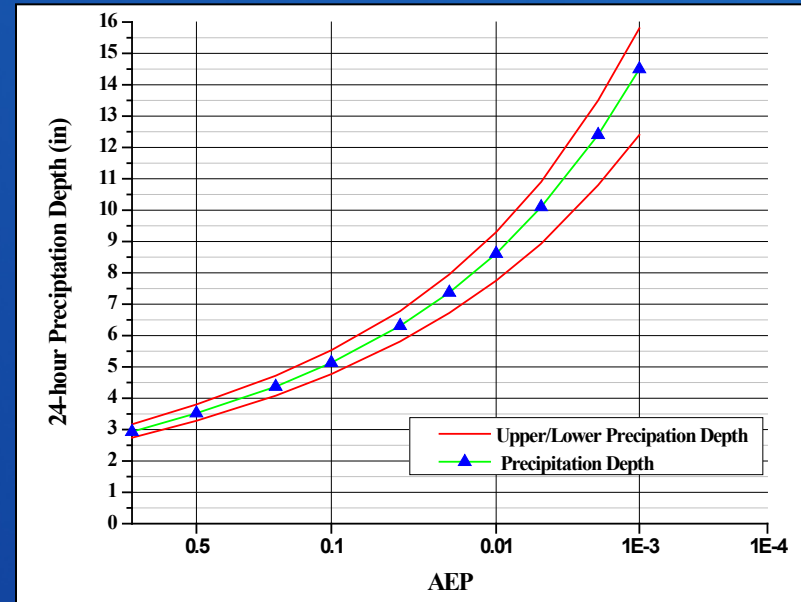
**Compute flood frequency up to 1,000-yr
(upper limit of NOAA Atlas 14)**

Compute the PMF from the PMP

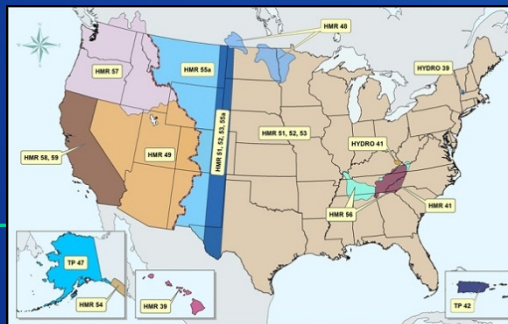


HMR 51 (published 1978)

PMP = 41" in 24-hours



NOAA Atlas 14
14.5" in 24-hours
for 1,000-year event



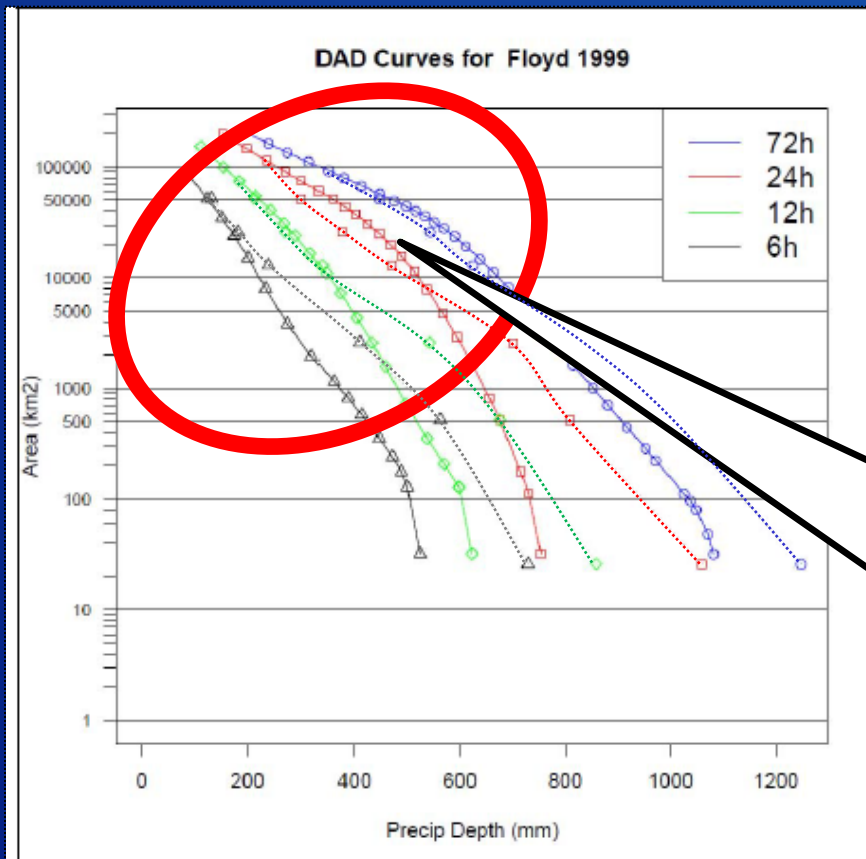
PMP - the theoretically greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of year.

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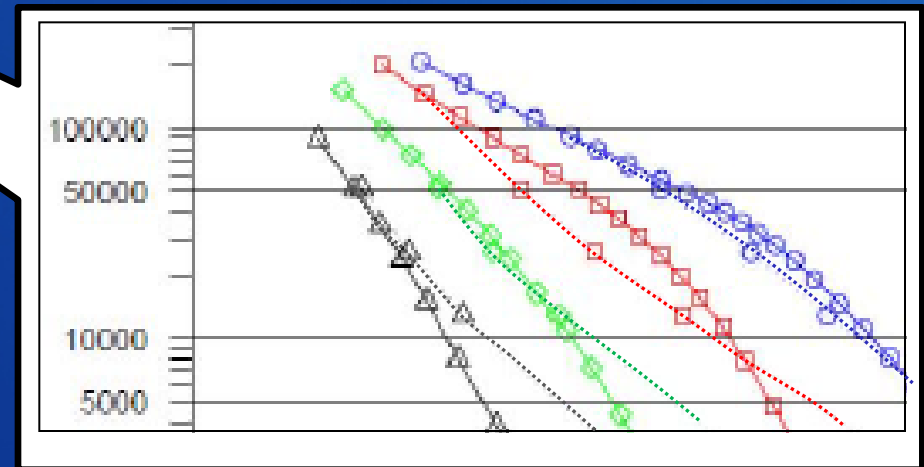
Current Understanding

Compute the PMF from the PMP

New Storm Data for Eastern North Carolina



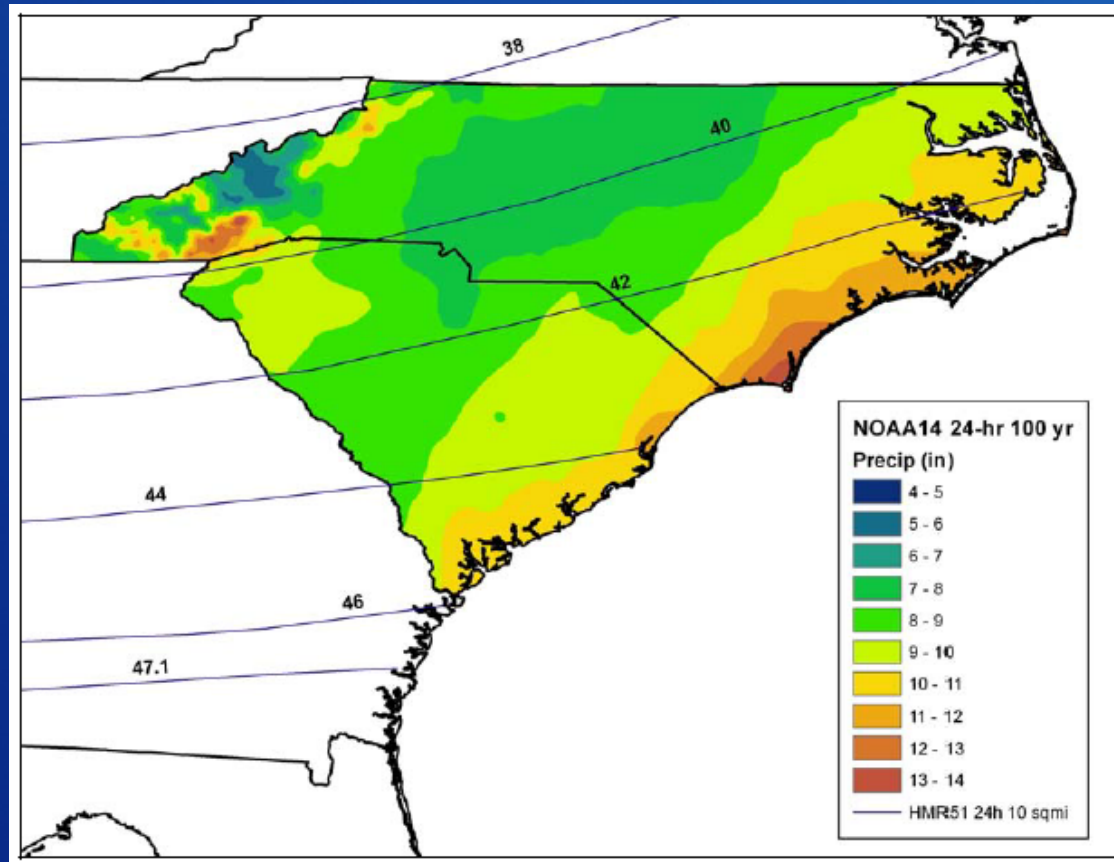
Hurricane Floyd, upon moisture maximization, exceeds PMP at 24-hr and 72-hr at large area sizes.



Current Understanding

Compute flood frequency

Resolution of NOAA Atlas 14 vs HMR 51



Trapped Rock Dam

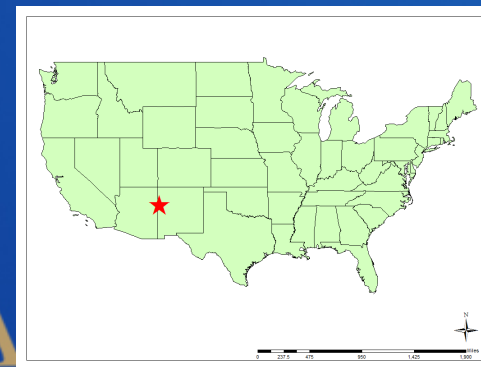
- Owned by the Zuni Pueblo Indian Reservation, Bureau of Indian Affairs
- Flood control structure
- Drainage area is 2.88 mi²



Flood Frequency Analysis

Requires Precipitation Frequency Analysis

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Trapped Rock Dam

Australian Rainfall-Runoff method (ARR):

1. Assigns a probability to the PMP
2. Extrapolates between the credible limit of extrapolation and PMP using a 2-parameter parabolic function in log-log space

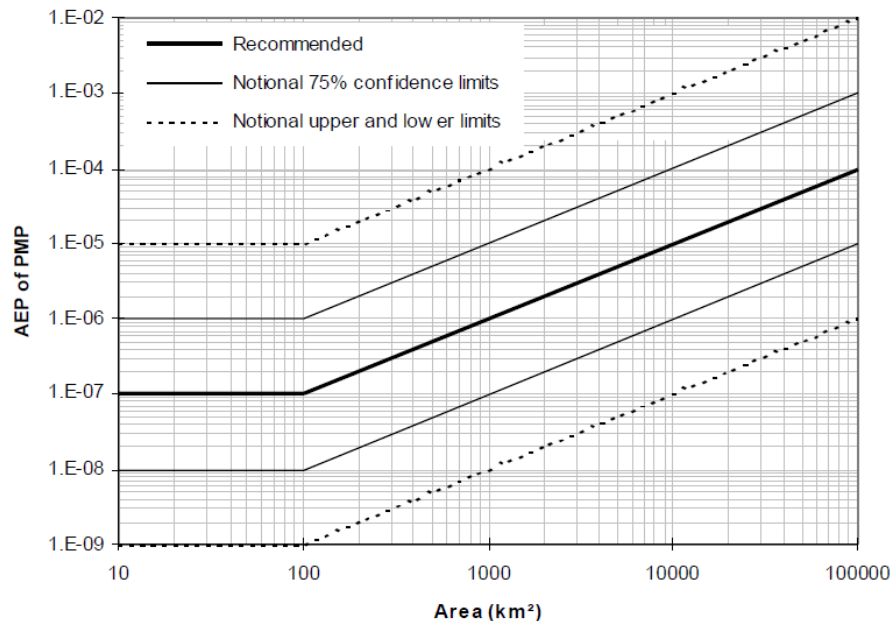
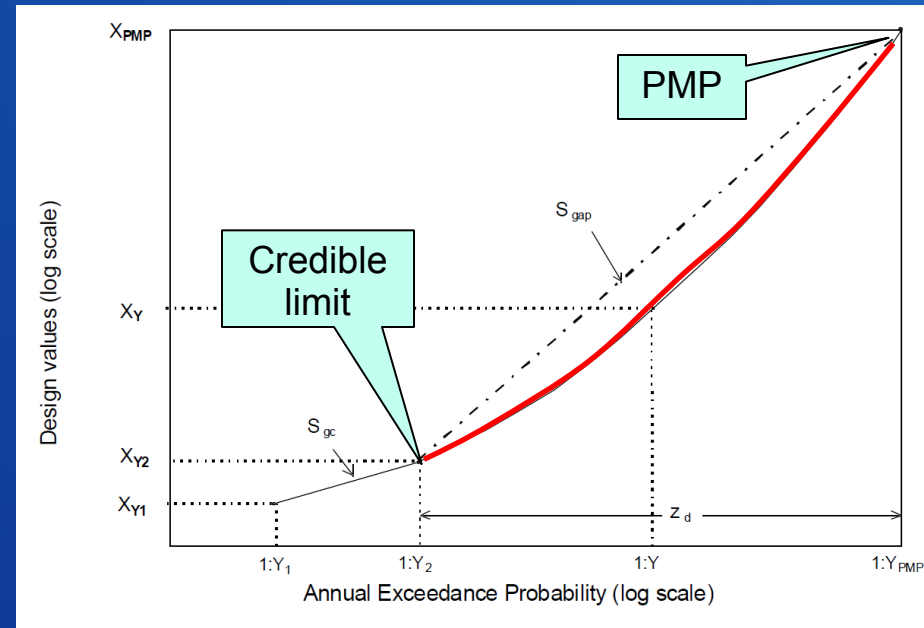
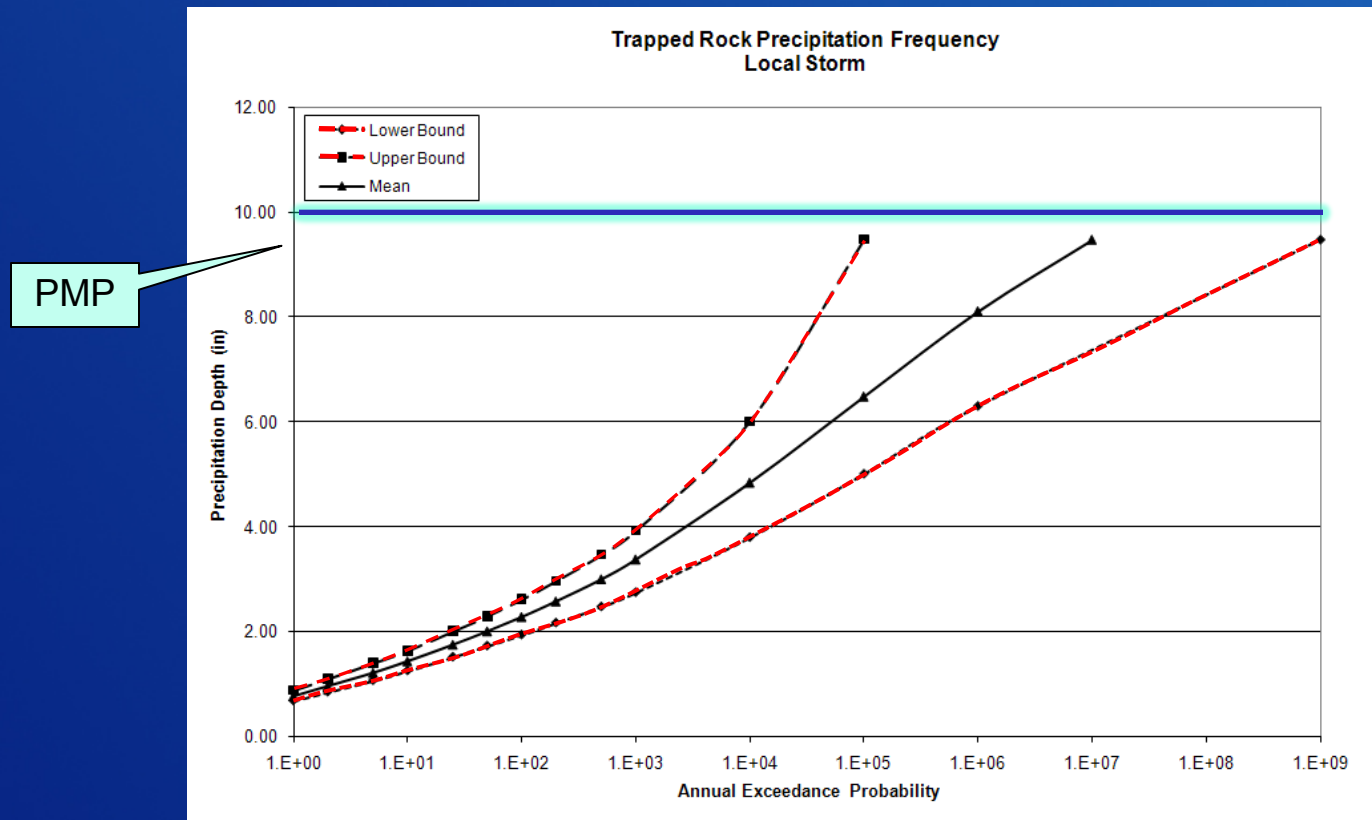


Figure 6 Recommended values of AEP of PMP



Current Understanding

Uncertainty on PMP

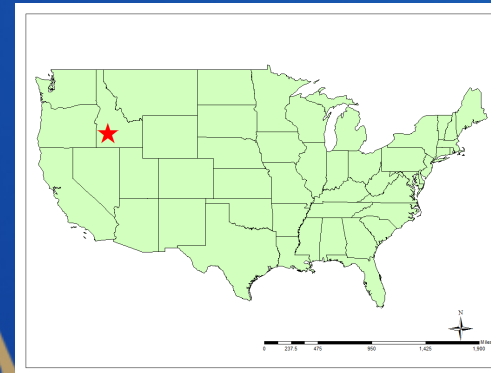
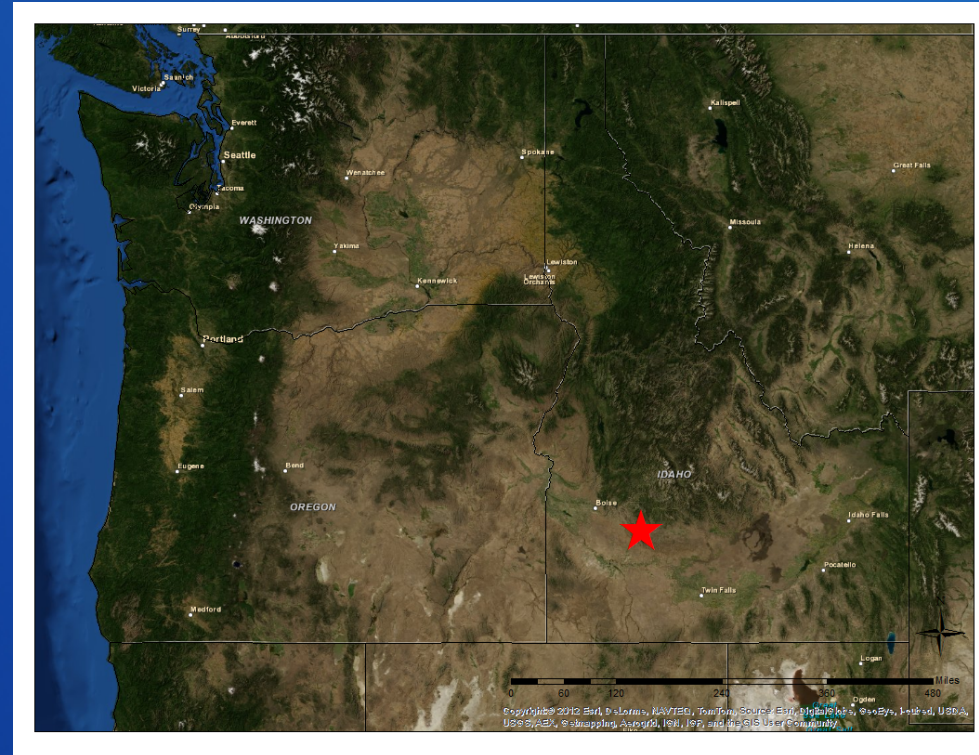


Anderson Ranch Dam

- Owned by Reclamation
- Storage structure
- World's highest earthfill dam at the time of construction
- Drainage area is $\sim 975 \text{ mi}^2$

Detailed flood hydrology study for the Dam Safety Office

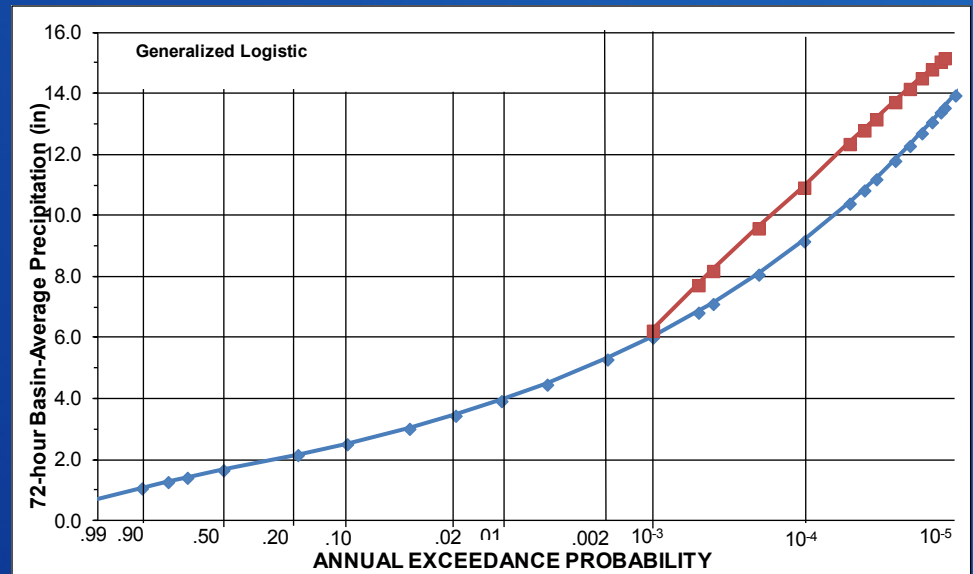
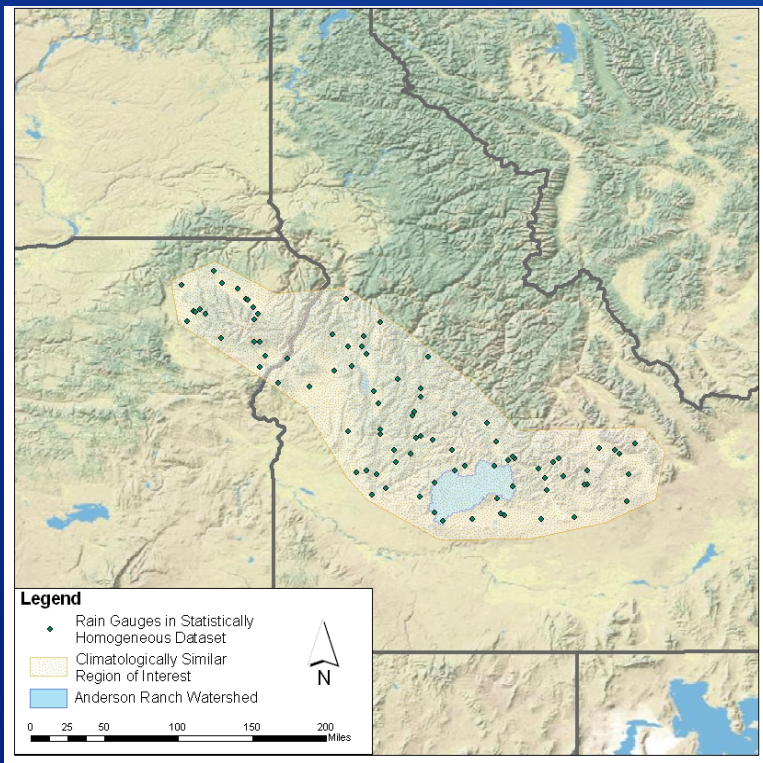
Requires precipitation frequency + storm patterns



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Anderson Ranch Dam

Precipitation frequency using multiple methods: ARR and L-moments



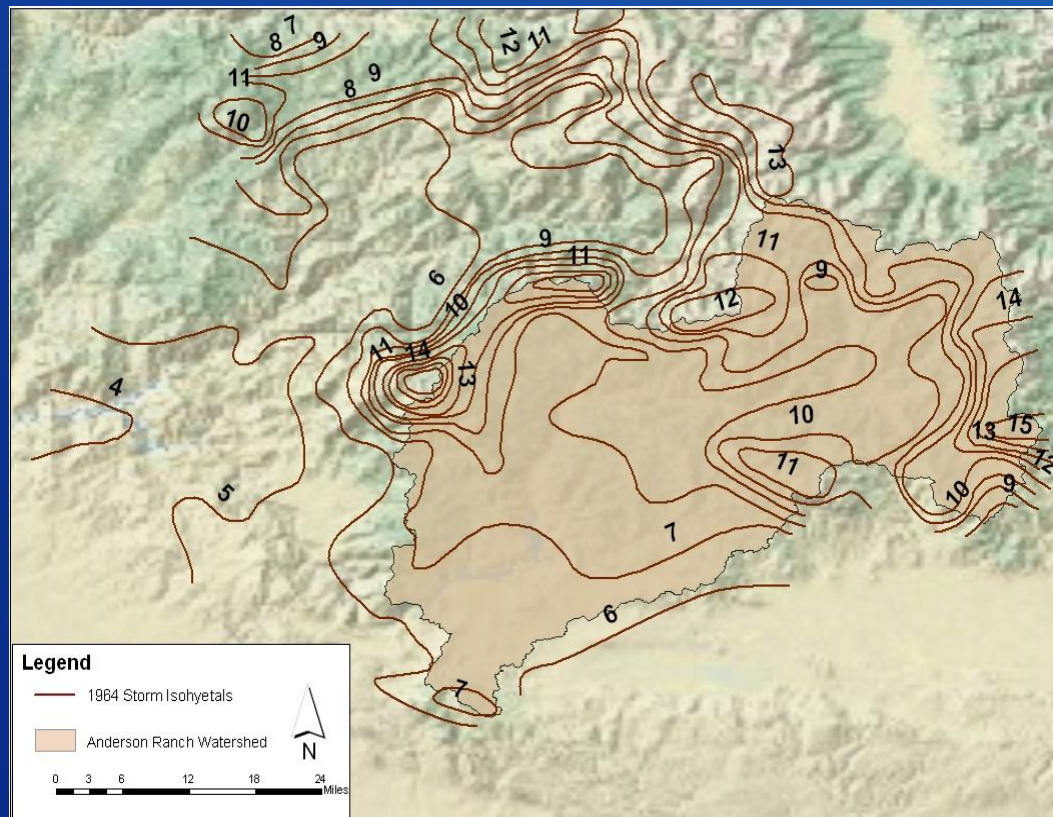
ARR = red curve

L-moments = blue curve

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Anderson Ranch Dam

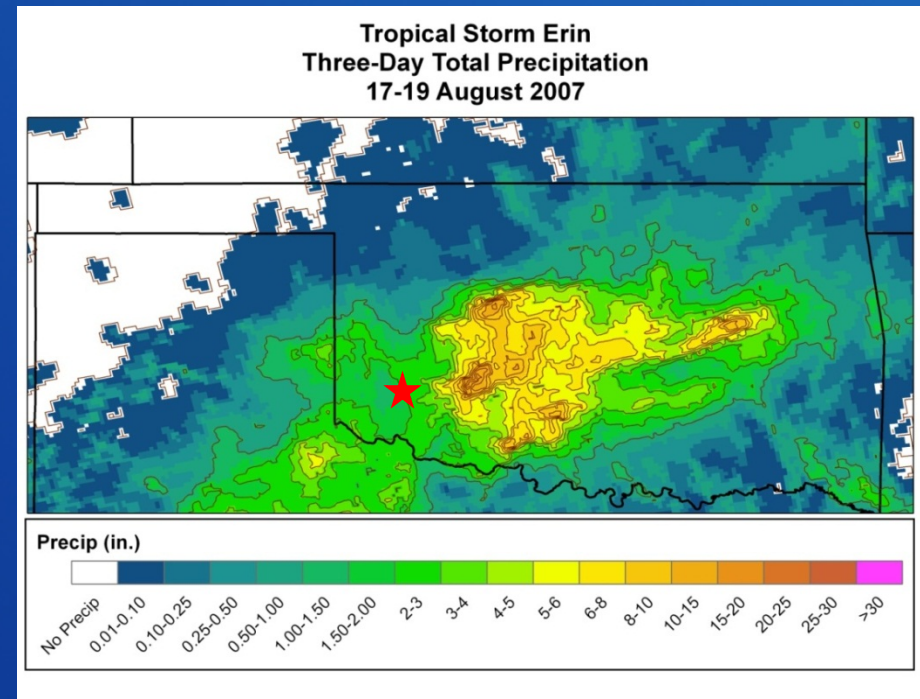
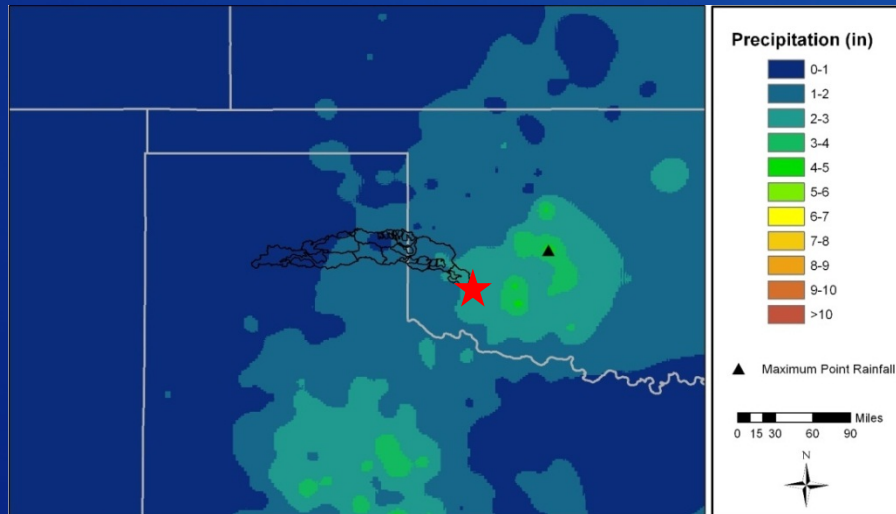
Storm spatial patterns



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Evolving Ideas

Radar derived rainfall for spatial pattern



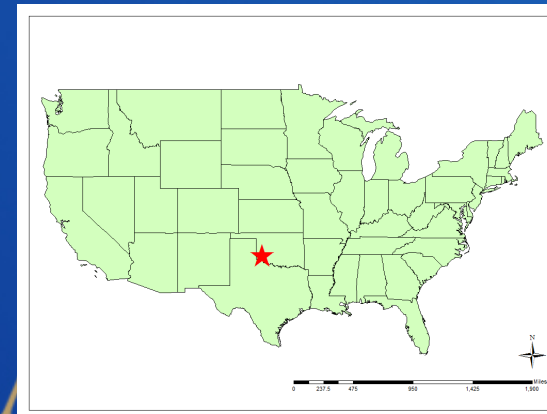
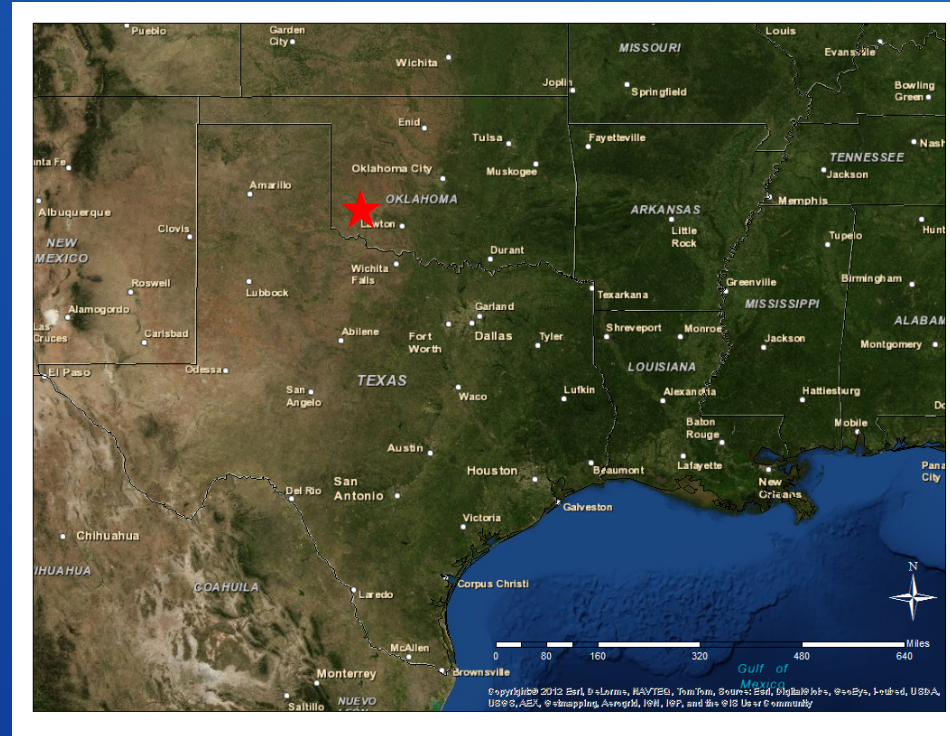
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Altus Dam

- Owned by Reclamation
- Irrigation storage structure
- Contributing area is ~1951 mi²

**Detailed flood hydrology study for
the Dam Safety Office**

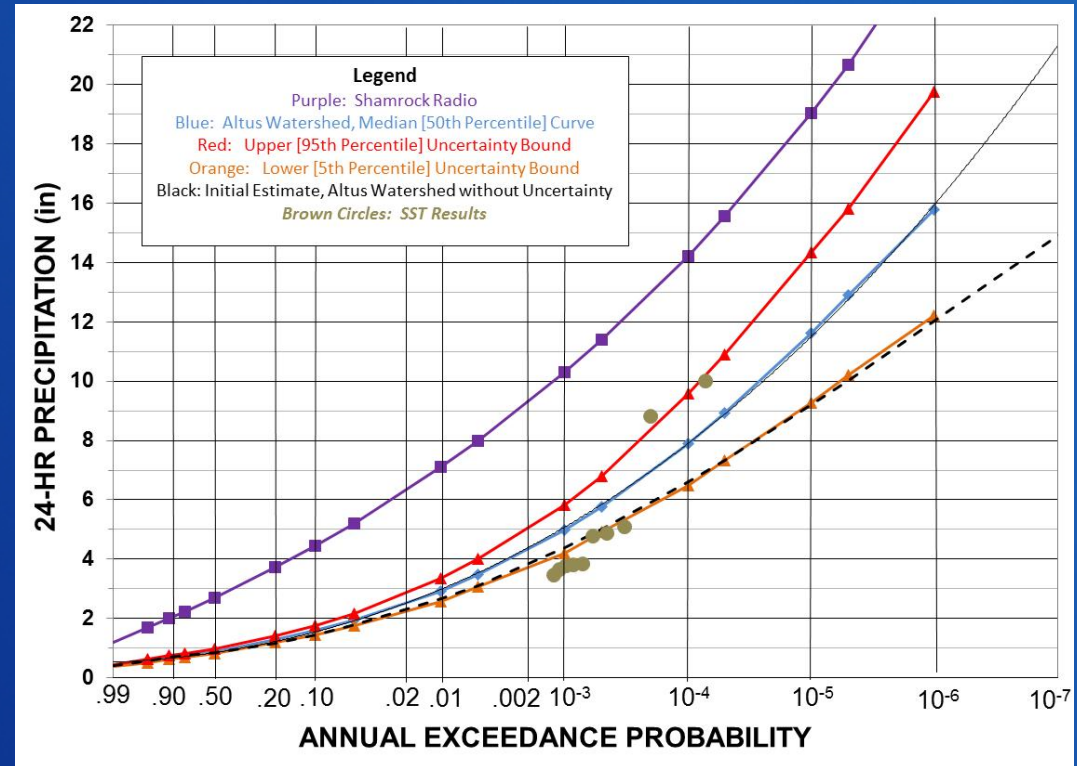
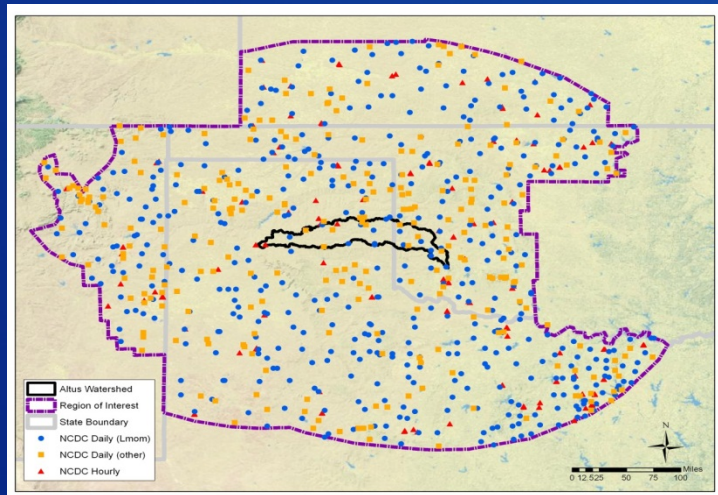
**Requires precipitation frequency +
storm patterns to run SEFM**



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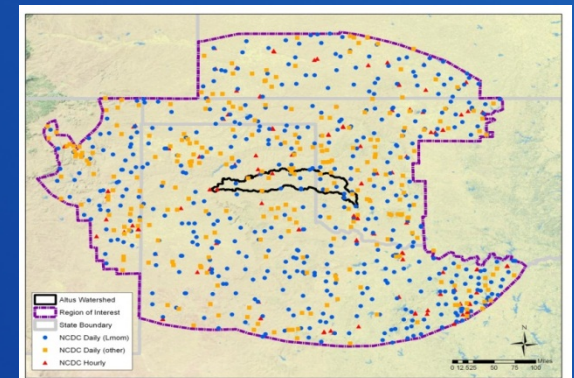
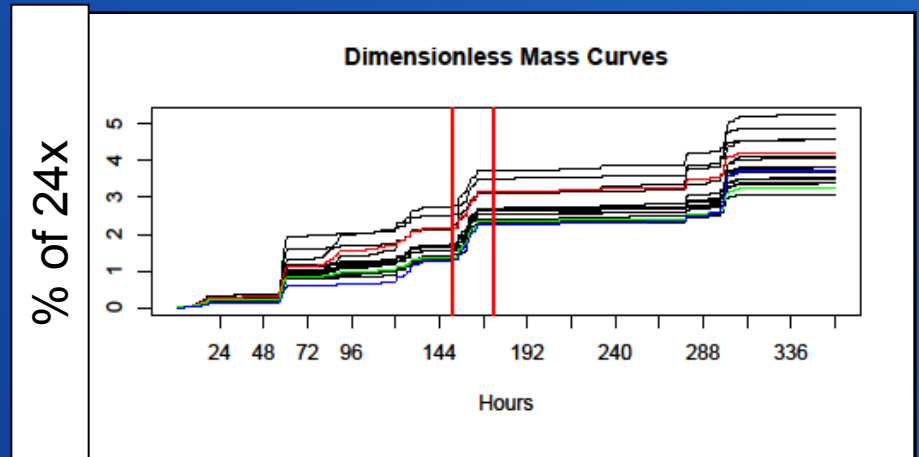
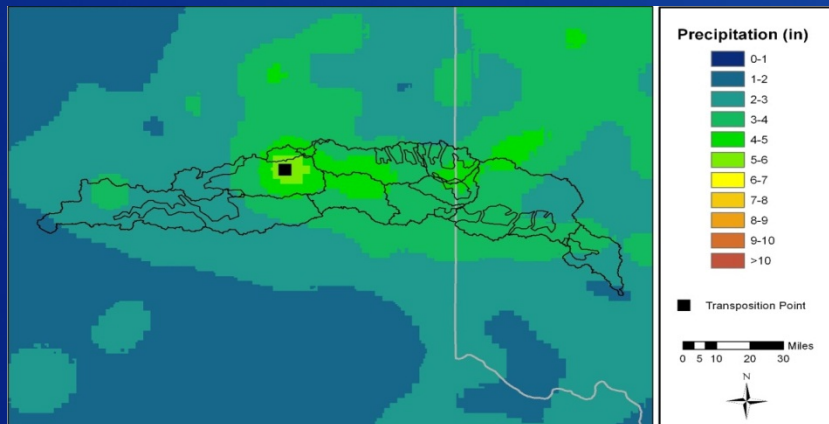
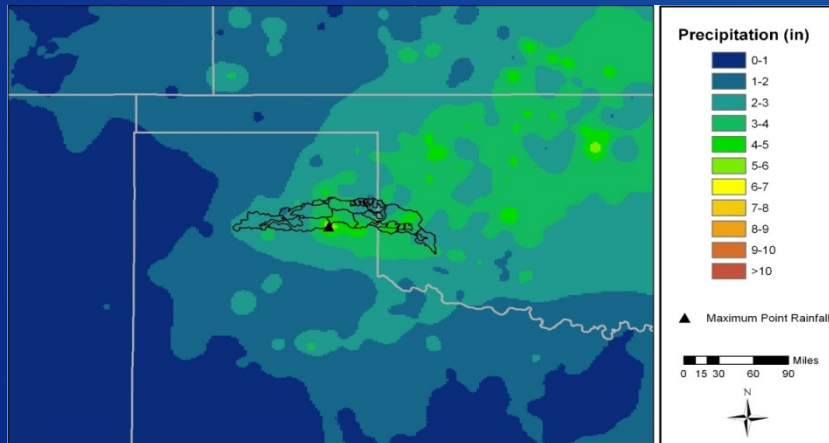
Altus Dam

Precipitation frequency from L-moments



Altus Dam

Storm spatial patterns

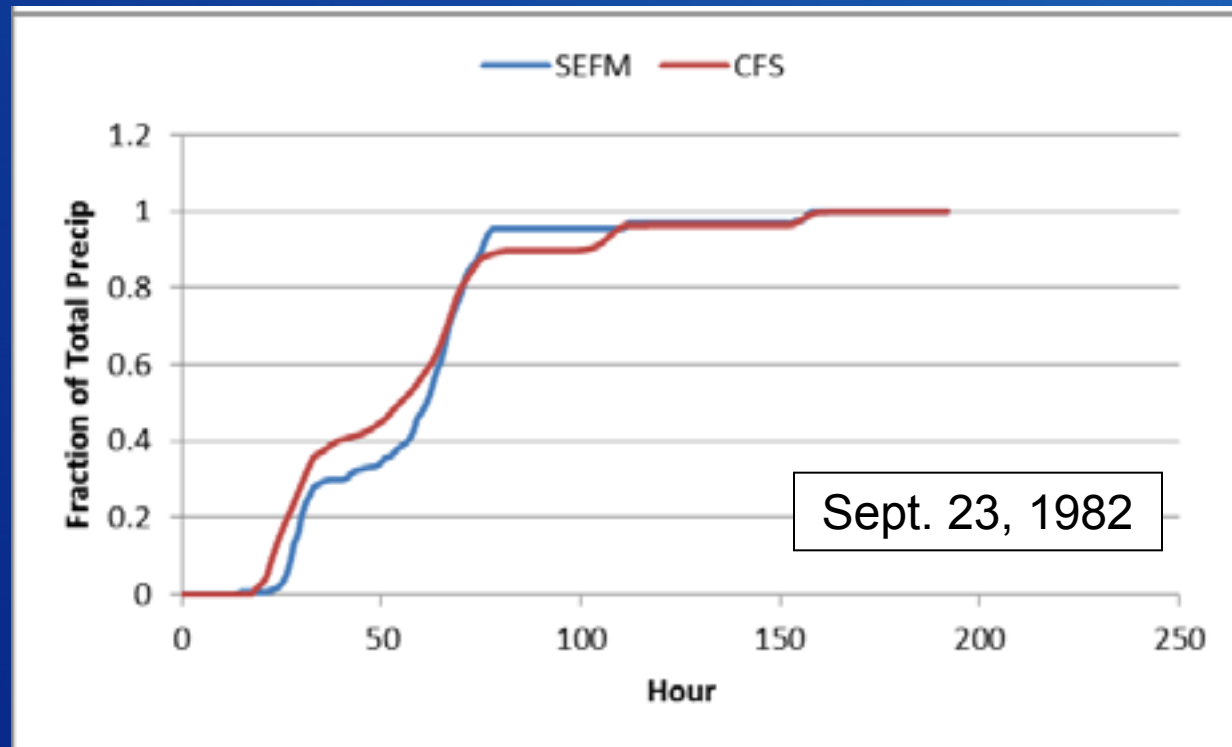


May 22, 1972

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Evolving Ideas

Temporal pattern (mass curves) from model data (CFS-R)



Summary

- Scaled approach (based on size of dam and consequences)
- In-house, site-specific work
- Precipitation frequency curves
- PMP is used as a consideration
- Uncertainty
- Methods are evolving



Case Studies



Star Fort Dam, SC



Trapped Rock Dam, NM



Anderson Ranch Dam, ID



Altus Dam, OK