

Summary
ASDSO West Region Conference
Engineering for Extremes: Precipitation,
Hydrology, and Hydraulics

for
the Extreme Storm Event Work Group
May 7, 2019



COLORADO
Division of Water Resources
Department of Natural Resources

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Colorado Dam Safety

Conference Background Information

1. Association of State Dam Safety Officials
2. West Region
3. March 25-27, 2019 in Westminster, CO
4. Audience: engineers and hydrologists, dam safety regulators
5. Purpose: Hydrological extremes for dam safety design
6. Presentations available at:
https://drive.google.com/open?id=1tVrE1VbbRIxfMF1cvgahlv_7KIBY19kV
or at ASDSO www.damsafety.org -> collaborate (login req'd)

Conference Presentations Overview

1. Characterizing extreme precipitation and floods in the western U.S.
 - a) "A brief history of extreme rainfall and flooding in the western US", Russ Schumaker, Colorado State Climatologist
 - b) "West Coast Precipitation Extremes in a Warming World: Atmospheric Rivers and Decaying Tropical Storms", Michael Anderson, CA State Climatologist
 - c) "Climate Extremes in the Pacific Northwest", David Curtis, West Consultants
 - d) "Analysis of Extreme Rainfall Forecasts from the HRRR model", Trevor Alcott and others, NOAA

Overview of Conference Presentations

2. Estimation/Prediction of Extremes

a) Precipitation

- i. CO-NM REPS Precipitation Frequency, Tye Parzbok, Mel Shaefer, MetStat & MGS Engineering
- ii. CO-NM REPS PMP, Doug Hulstrand and Geoff Muhlstein, Applied Weather Associates
- iii. NOAA Atlas 14 updates & upgrades, Mark Glaudemans, NOAA HDSC
- iv. Weather Research and Forecast (WRF) model for PMP/PF estimation, Kelly Mahoney, NOAA ESRL PSD

Overview of Conference Presentations

2. Estimation/Prediction of Extremes (cont'd)

b) Floods

- i. Using Paleoflood studies for flood hazard estimation in Western US, Ralph Klinger & others, USBR
- ii. Wildfire impacts on runoff and erosion, Lee MacDonald, Colorado State University
- iii. Flood runoff production mechanisms in Colorado mountains, Doug Woolridge & Jeff Niemann, CSU
- iv. Stochastic simulation for estimating stage-frequency curves with uncertainty bounds for hydrologic risk assessment using USACE RMC-RFA, Haden Smith, USACE RMC
- v. USGS StreamStats, Mike Kohn

Overview of Conference Presentations

3. Climate Change Impacts on Extreme Hydrological events
 - a) Consider climate change in extreme precipitation estimates, Jeff Lukas, Western Water Assessment & Kelly Mahoney, NOAA ESRL

Overview of presentations (cont'd)

4. Tools:

a) USGS StreamStats

b) NOAA Atlas 14

c) Texas PMP Tool

d) CO-NM REPS PMP Evaluation Tool

e) CO-NM REPS Precipitation Frequency MetPortal Tool

f) National Watershed Model: potential uses for reservoir operations, David Gochis & others, NCAR WRF-Hydro & NOAA Office of Weather Prediction

Overview of presentations (cont'd)

5. Applications for dam safety
 - a) Probabilistic Risk Management Program at TVA, Johathan Quebbeman, RTI International
 - b) Risk-based spillway sizing standards in Montana, Michele Lemieux, Montana Dam Safety
 - c) Gross Dam reservoir expansion spillway analysis, Michael Zusi & Frank Lan, AECOM
 - d) Texas PMP application

Select presentation details

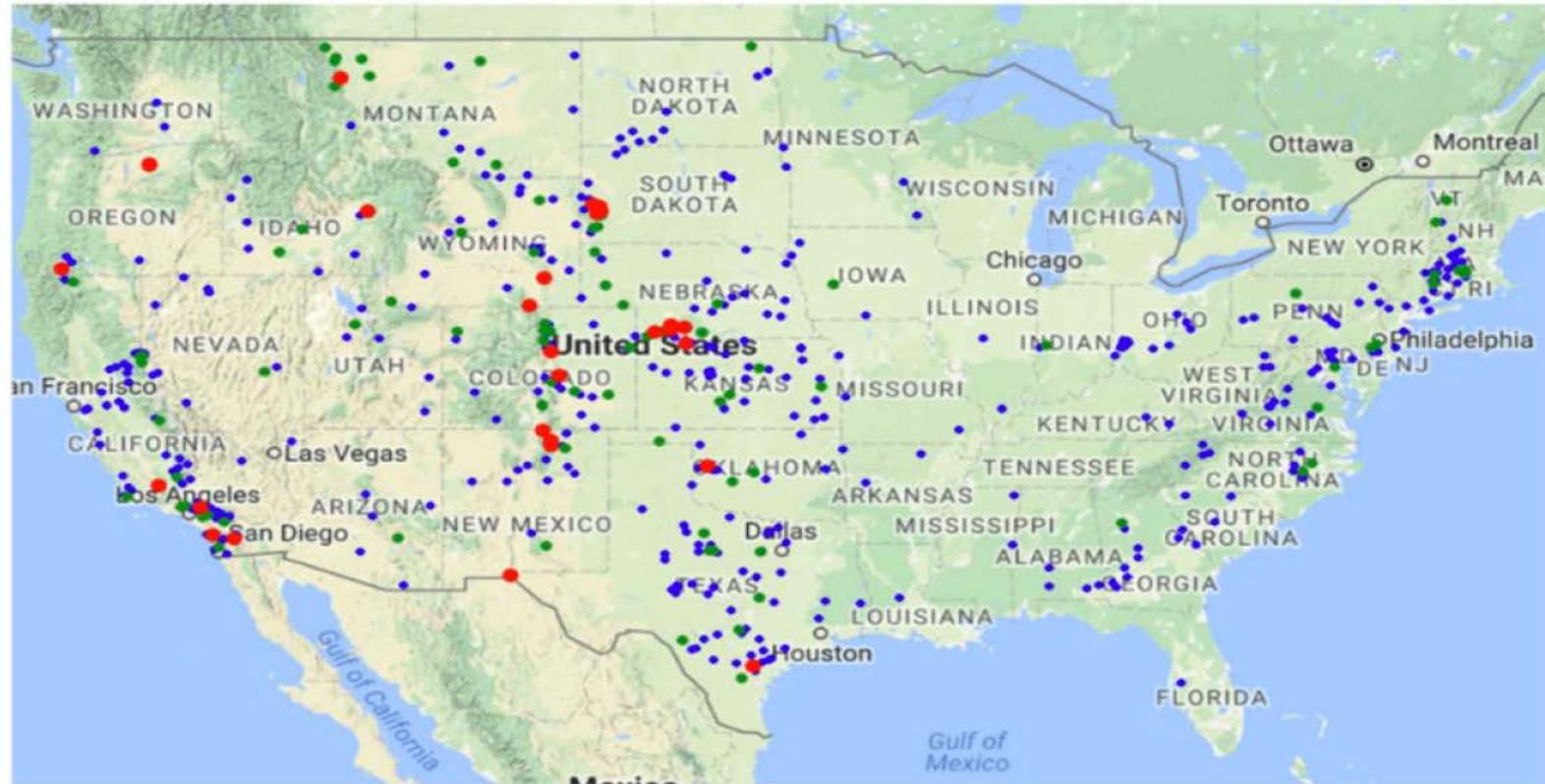


Figure 2. Locations of U.S. Geological Survey gaging stations with upper tail ratios exceeding 5 and less than 10 (blue), between 10 and 20 (green), and greater than 20 (red).

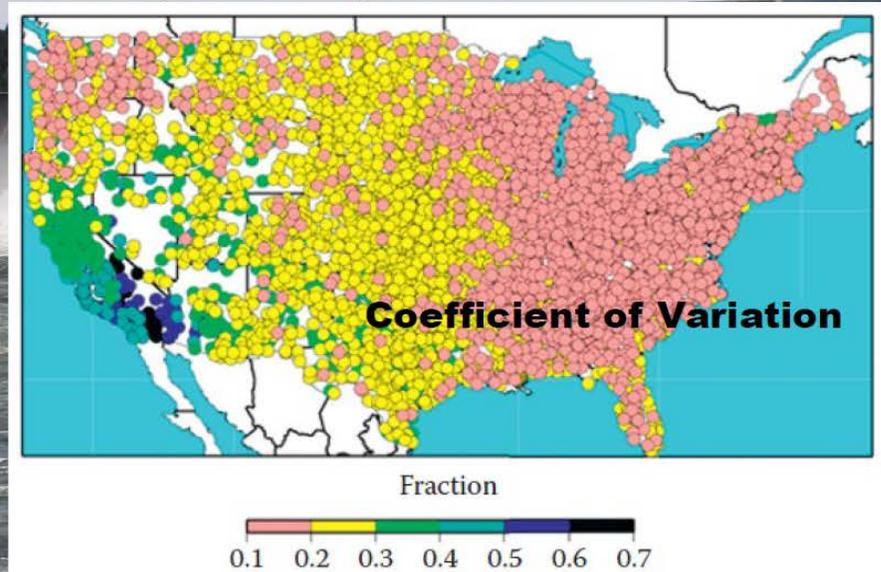
R. Schumacher, "A brief history of extreme rainfall and flooding..."

- Smith et al, Water Resources Research, August 2018, <https://doi.org/10.1029/2018WR022539>
- Q_{peak}/Q_{10} of 200 for 1903 Heppner, OR storm.

Select presentation details

Extreme Variability in the West

Water year Precipitation – 1951-2008



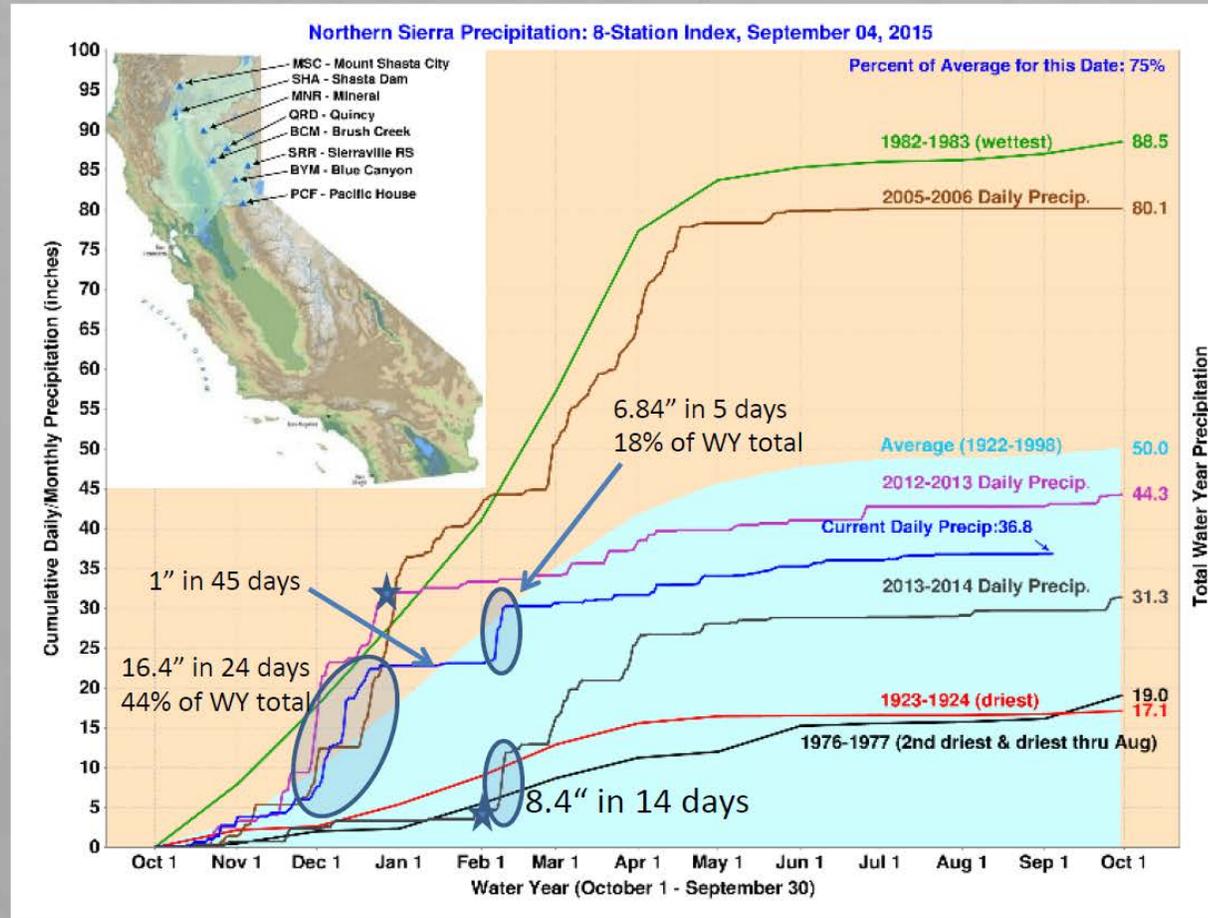
From Dettlinger, M.D. et al.,
Water, 3(2), 445-478, 2011.

Bonneville Dam

D. Curtis, "Climate Extremes in the Pacific Northwest"

Select presentation details

Atmospheric Rivers and Precipitation Accumulation – Variability on Multiple Scales

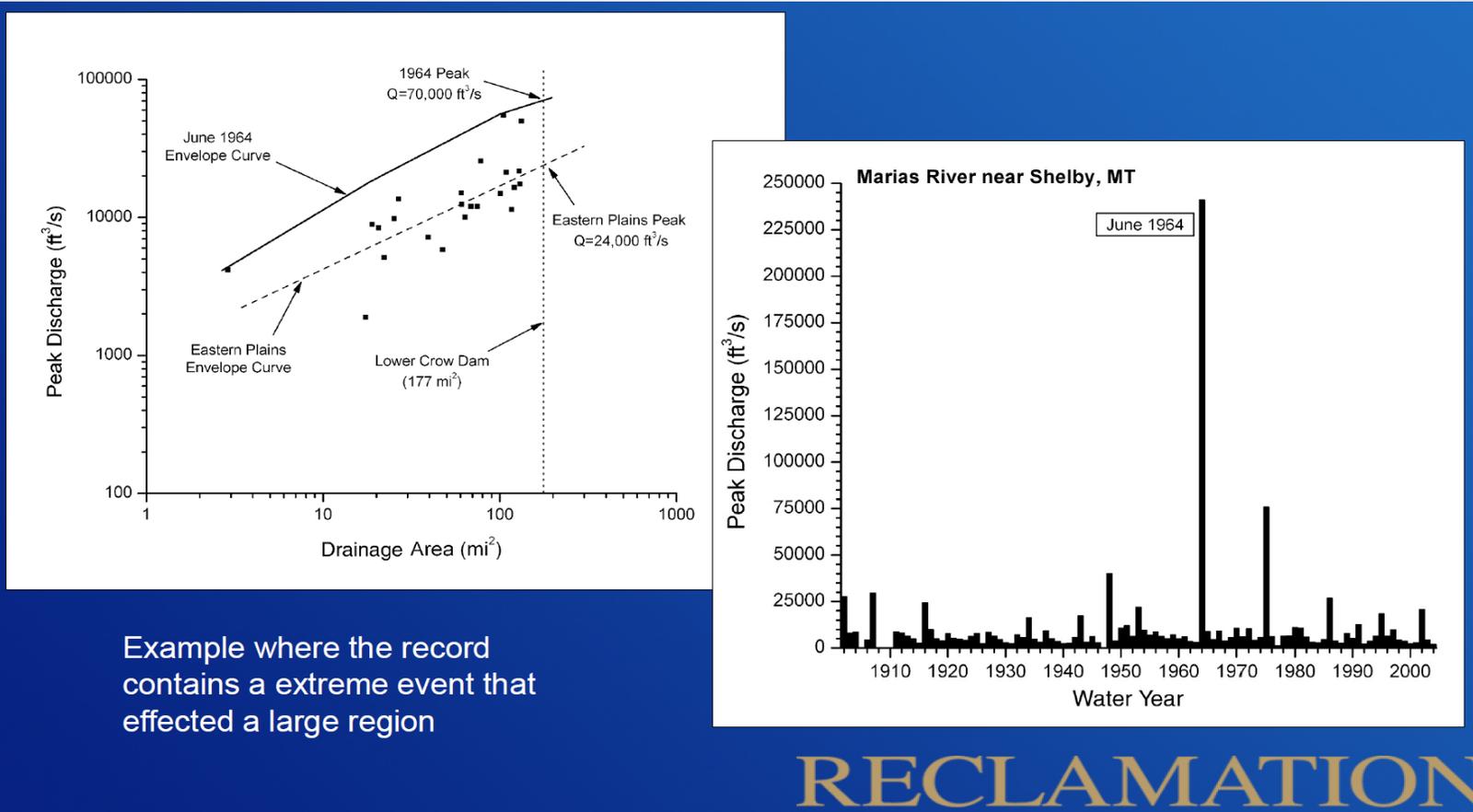


WY2015:
121 days
37.24"

★ 16.8"
404 Days

M. Anderson, "West Coast Precipitation Extremes in a warming world..."

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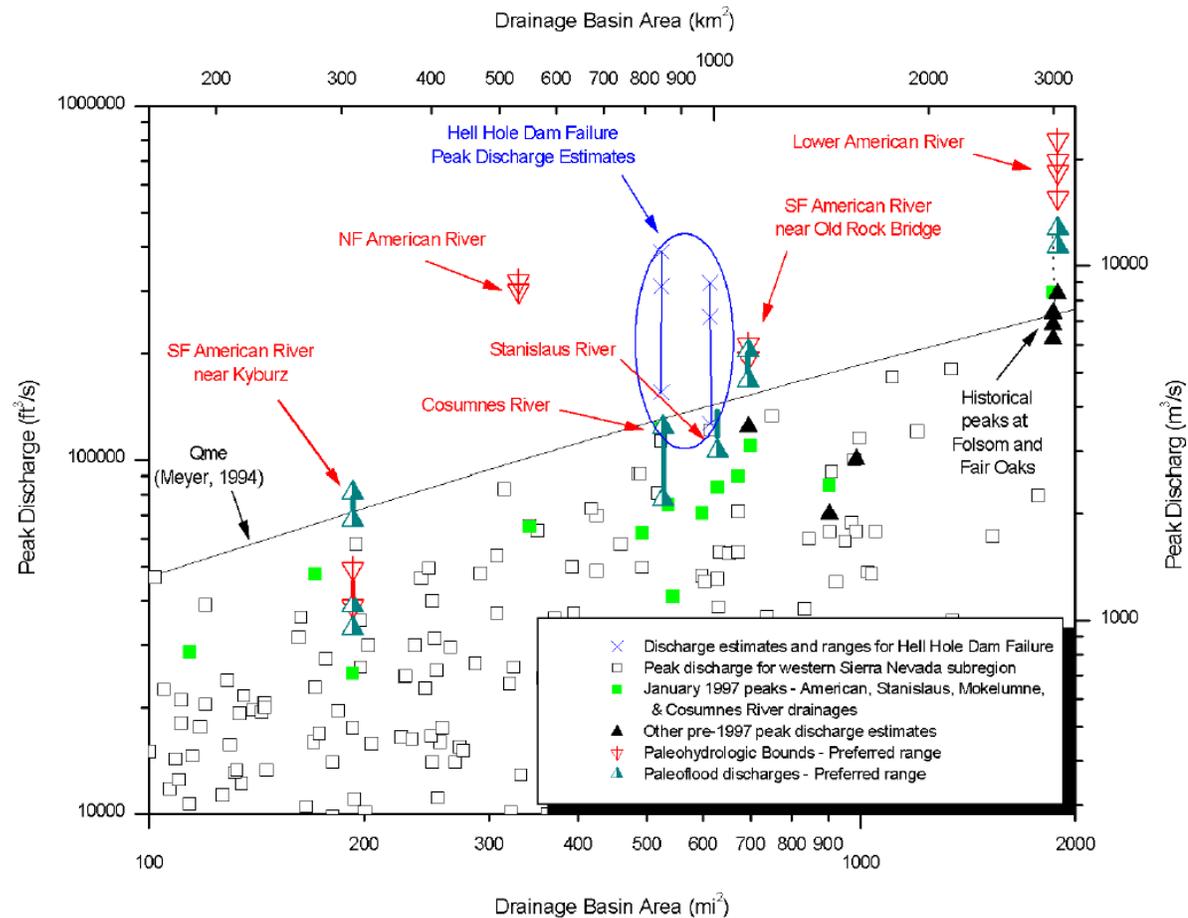
Example where the record contains an extreme event that effected a large region

RECLAMATION

R. Klinger, "Utility of paleoflood Data in estimating flood hazard..."

- Can extend stream flow record to encompass past 1000-10,000 years
- Non-exceedance bounds – feature sensitive to flood modification that can place limit on flood magnitude over a known time period (ex. Stable terraces, trees, etc)

Select presentation details



Peak Discharge Envelope Curves

Plotting paleoflood and NEB data on envelope curves can help in understanding the extreme events in the historical record

RECLAMATION

R. Klinger, "Utility of paleoflood Data in estimating flood hazard..."

Colorado - New Mexico Regional Extreme Precipitation Study

Summary Report

Volume I

Project Background and Overview

November 30, 2018



CO-NM REPS Report

<http://water.state.co.us/damsafety/dams.asp>

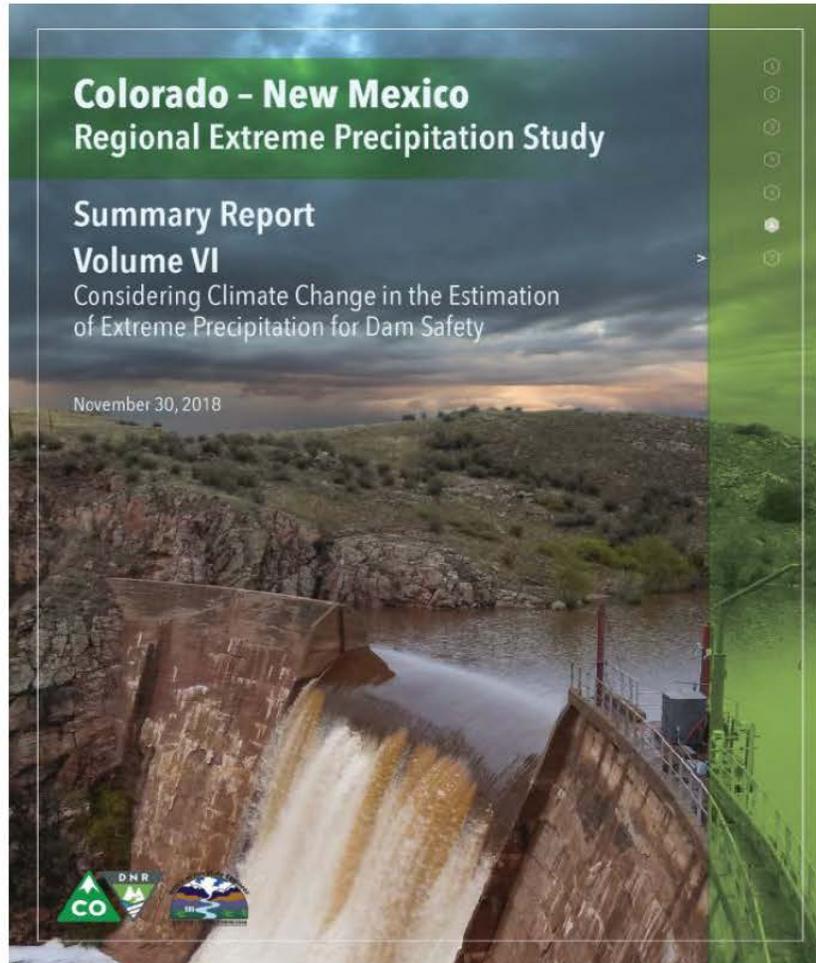
Or Google "Colorado DWR"

Select presentation details



University of Colorado Boulder

<http://wwa.colorado.edu>



Volume VI: Considering climate change in the estimation of extreme precipitation for dam safety

57 pp.

Available through

Colorado Dam Safety Office

<http://water.state.co.us/damsafety/dams.asp>

Along with other CO-NM REPS materials

J. Lucas & K. Mahoney, “Considering climate change in the estimation of extreme precipitation...”

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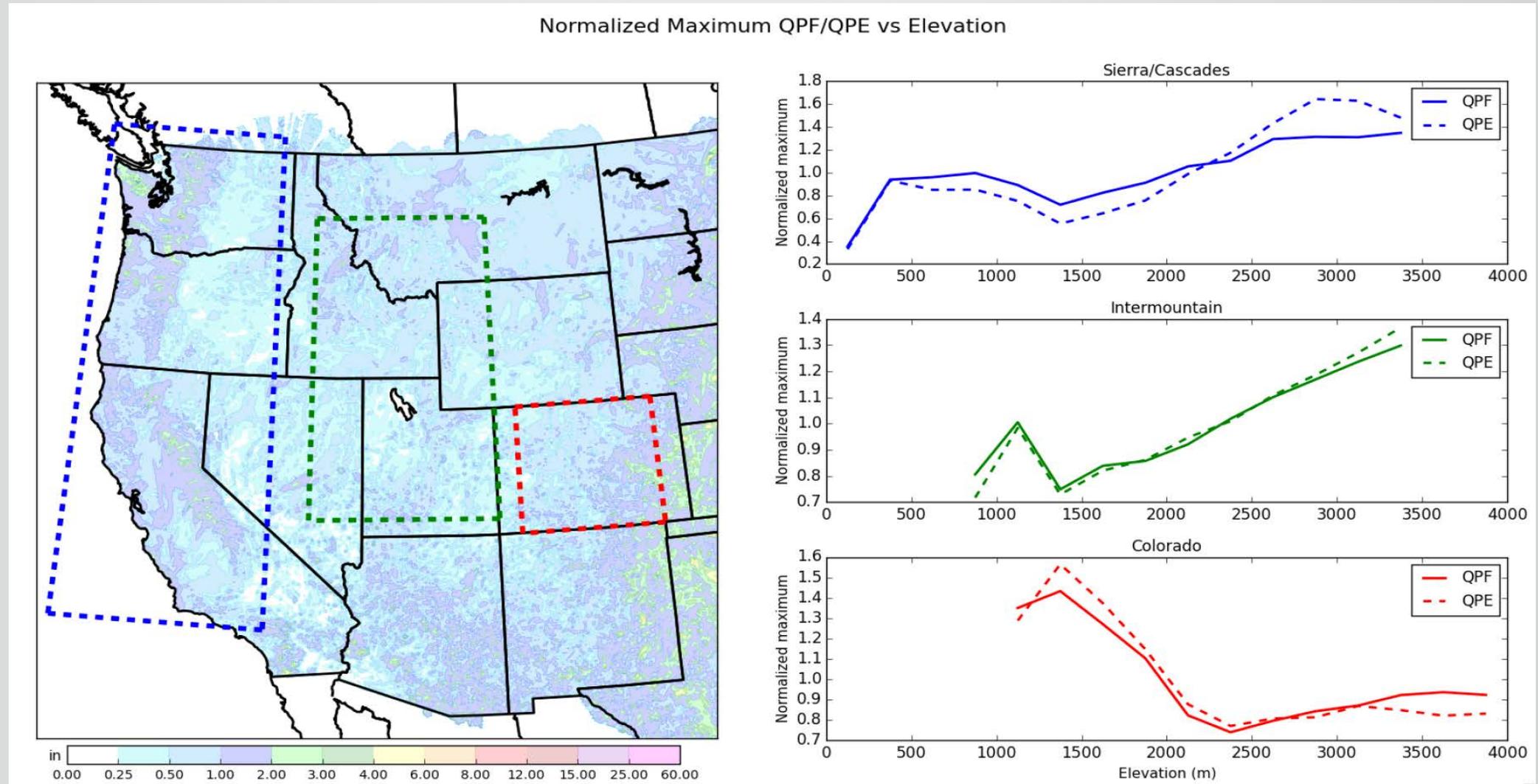
Mechanisms by which climate change may impact PMP (and extreme precipitation more broadly)

- **Moisture availability**
- Convective intensity
- Storm efficiency (horiz. convergence + ascent)
- Storm duration
- Storm tracks
- Precipitation type

} Very likely to increase, high confidence

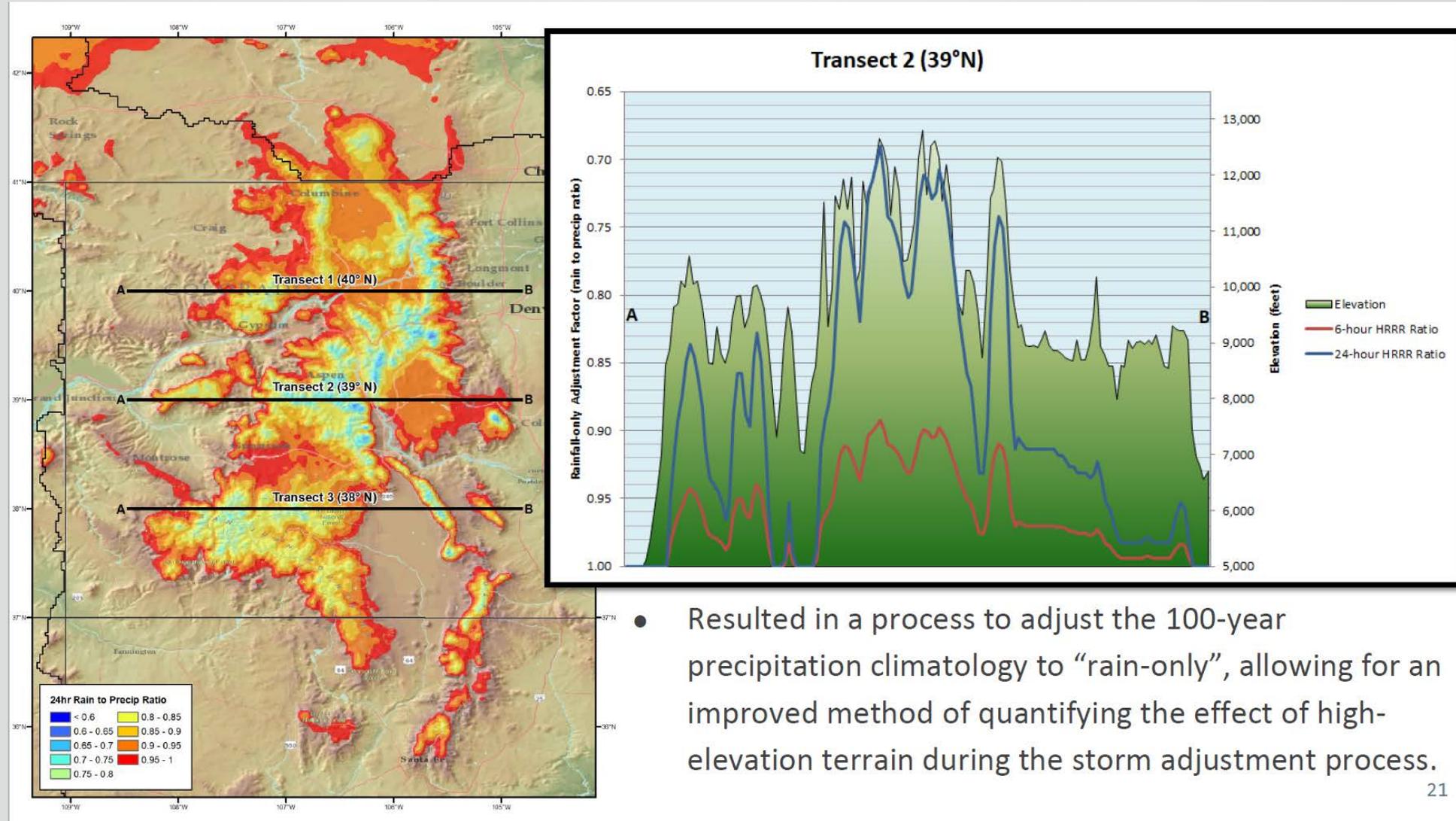
} Future trends less certain

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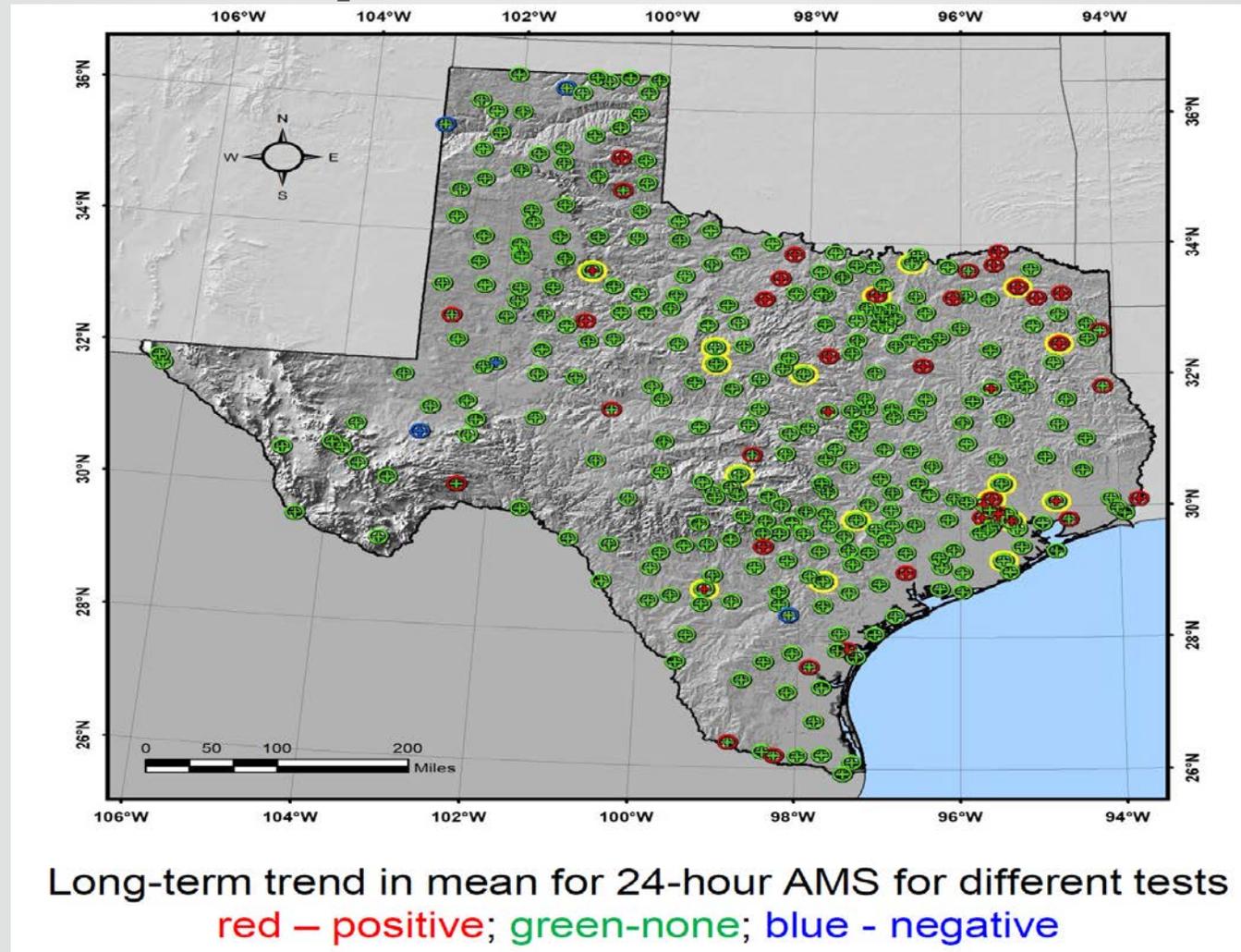
“Analysis of Extreme Rainfall forecasts from the HRRR Model”, Trevor Alcott & Eric James, NOAA ESRL

Select presentation details



Doug Hulstrand & Geoff Mulhstein, “Development of Deterministic Probable Maximum Precipitation for the Colorado-New Mexico ...”

Select presentation details



Mark Glaudemans, “NOAA Atlas 14: Activities, Needs and Plans”

- Good discussion on HDSC efforts to address non-stationarity and uncertainty

Select presentation details

Extreme Storm Events Work Group - Proposal

“Extreme Rainfall Product Needs” Proposal

October 10, 2018

https://acwi.gov/hydrology/extreme-storm/product_needs_proposal_20181010.pdf

Recommendations for National Strategy [excerpts][NOAA focus]:

- 1) Atlas 14 Development:
 - a) extend Atlas 14 coverage to the five northwestern States
 - b) develop enhanced suite of products for whole country simultaneously
 - c) using improved methodology accounting for the non-stationary climate
- 2) Create archive of extreme precipitation events ... for use in the creation of Probable Maximum Precipitation (PMP) studies. ... data... would be available for use in the updating of the HMRs....
- 3) Create new and updated versions of the HMRs which include updated methodology ...
prepare a National Guidance Document for State-wide/Regional and Site-Specific PMP Studies.
[NOAA partnership on guidance document, pending national study of current needs and methods]