Stress Test/Extreme Scenario Development for Floods and Droughts Considering Climate Change

David C. Curtis, Ph.D.
WEST Consultants, Inc.

Michael Anderson
California Department of Water Resources
California mandates consideration of climate change.
Extreme Variability
Massive Water Infrastructure
Water Supply
Massive Water Infrastructure

Flood Control
How resilient is the system?
Drought Management

Three driest years in a row
Epic drought now in 4\textsuperscript{th} year

Oops!
Limited data
Annual Precipitation - Sacramento, CA
1850-2014

Sacramento 30-Year Trailing Average
Trees tell a climate story.
Sacramento River Reconstructed Annual Flow Volume

Sacramento River Annual Volume (Ac-Ft)
Millions

Annual Volume
Sacramento River Reconstructed Annual Flow Volume

Sacramento River Annual Volume (Ac-Ft) in Millions

Annual Volume

30-Year Average

Graph showing the annual volume of the Sacramento River from 1900 to 2000, with a line indicating the 30-year average.
Constructed Data Sets Drive Analysis
Climate Change Analysis

Model Features

T42

T85

T170

T340
Flood Control
California spans entire weather systems
ARkStorm: Really big yet plausible

- Weather models
- 500-1000 year rainfall
- Up to 10 feet of rain
- Wind gusts to 125 mph
- Widespread flooding
- Hundreds of land slides
- $400 billion in damage
Climate Change Signal

- Temperature
  - Strong signal for warming
  - Change rain/snow ratio

- Precipitation
  - Weak
    - Annual Averages
    - Extremes
  - Form
Takeaway thoughts

- Extreme Variability
- Rapid Transitions
- Infrastructure Planning
- Framework for Stress Test
- Another downward trend?
Questions?
Average Elevations from 25m DEM (grey) and on 2.5° model-grid line, 40°N

- Sierra Nevada
- NV-UT border
- Denver

meters above sea level

Degrees west longitude

130 125 120 115 110 105
But, it’s only Sacramento.
The Pineapple Express That Has Been Bringing Lots of Moisture From The Subtropics/Hawaii!
Questions?
Northern Sierra 8 Sta. Index vs Sacramento Annual Precip.
1921-2013

R² = 0.77
Extreme Variability.
Atmospheric Rivers
Tree Ring-Width Analysis

Period of accelerated tree ring growth.

Upper forest border Pinus Longaeva from three sites in western North America
Salzar, M. W. et al., PNAS 2009:106:20348-20353