

Water Supply Forecasting for California

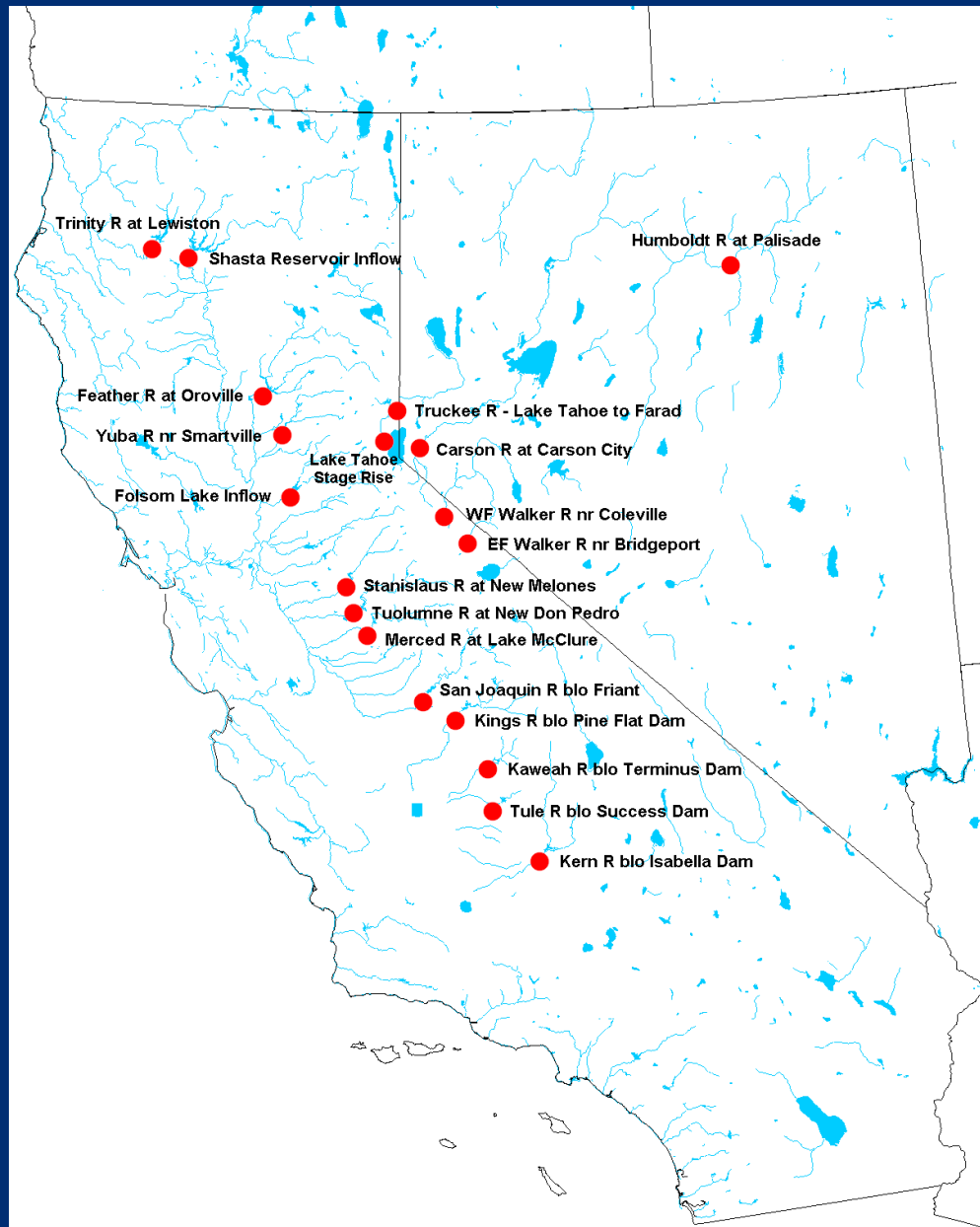
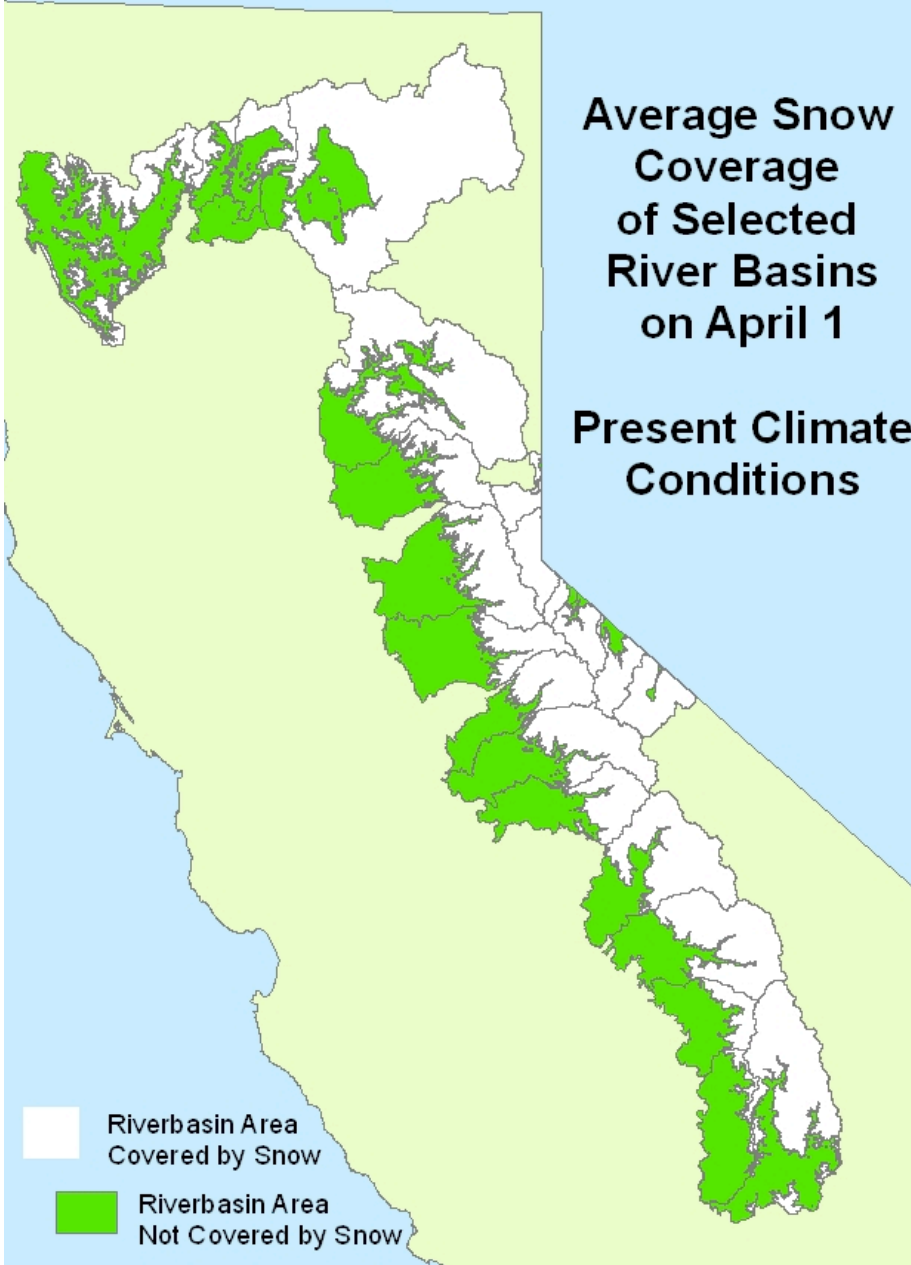
Michael Anderson
State Climatologist
Climate Prediction Applications Workshop
March 2, 2010

Talk Overview

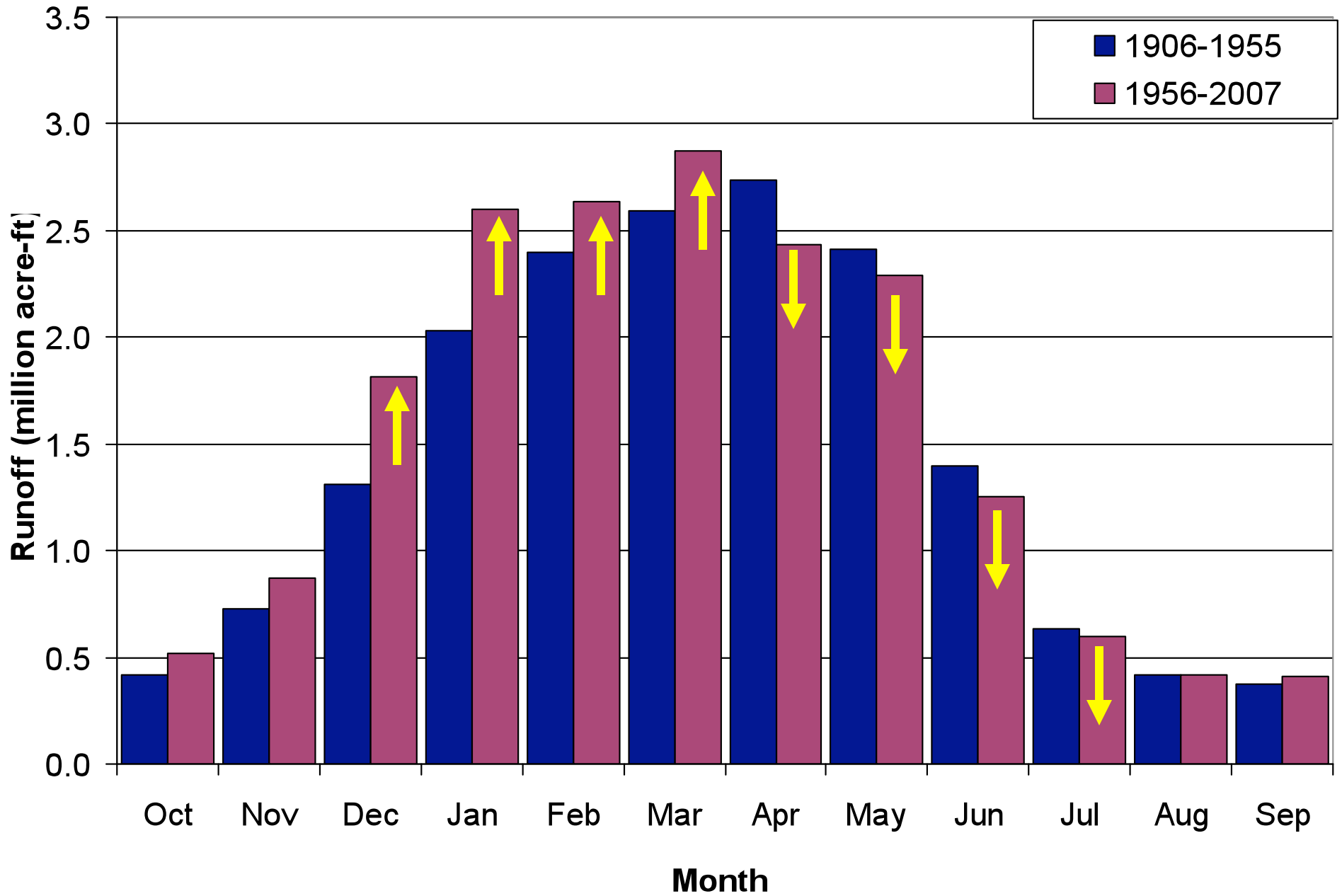
- California Cooperative Snow Surveys Program
- Monitoring
- Forecast Products
- Issues
- Seasonal Forecast/Outlook Information

California Cooperative Snow Surveys Program

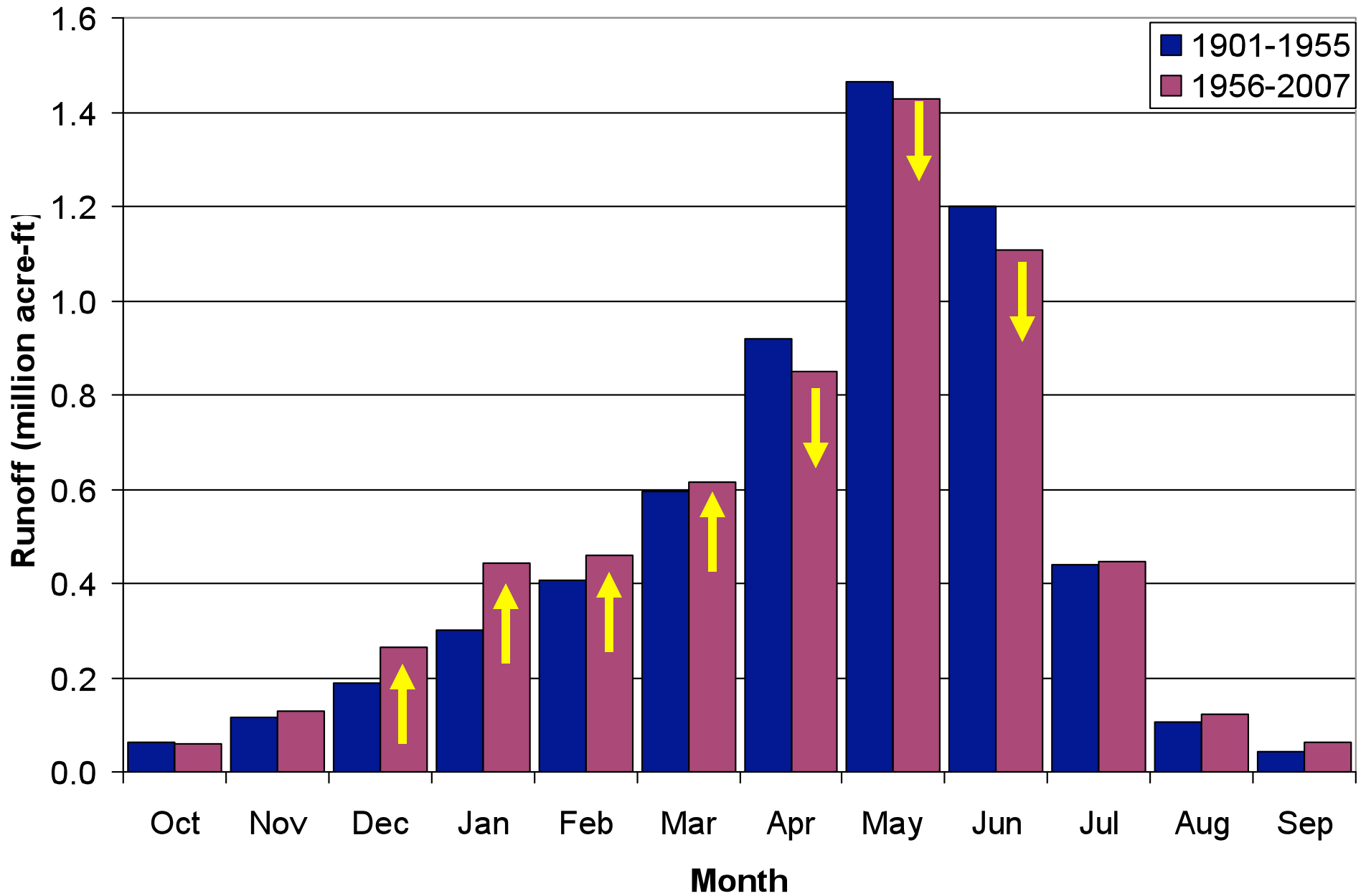
- ❖ Program established in 1929
- ❖ Using snow sampling methods first developed by Dr. James Church (Univ. of Nevada – Reno) at the Mt. Rose (Nevada) Snow Course
- ❖ Over 240 courses
- ❖ Over 50 agencies help collect snow data
- ❖ Dozens more agencies contribute other data (precipitation or runoff data)
- ❖ Most of these agencies contribute financial support to the program
- ❖ Calif. Coop. Snow Surveys program has operating budget in excess of \$1.5 million annually (primary expense is data collection and data network maintenance)

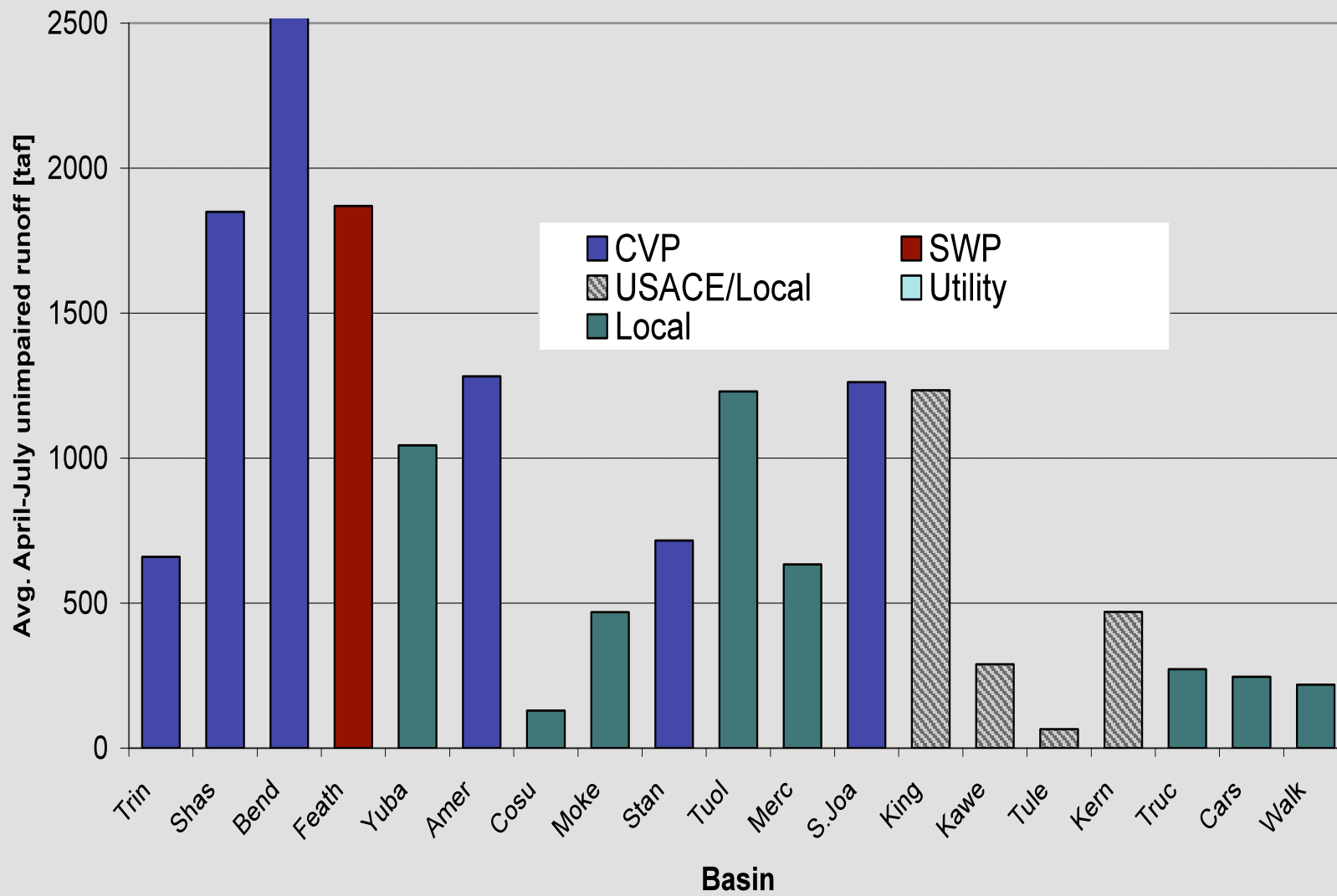


Monthly Average Runoff of Sacramento River System



Monthly Average Runoff in San Joaquin River System





How is data collected?

Other Methods

SNOW PILLOWS



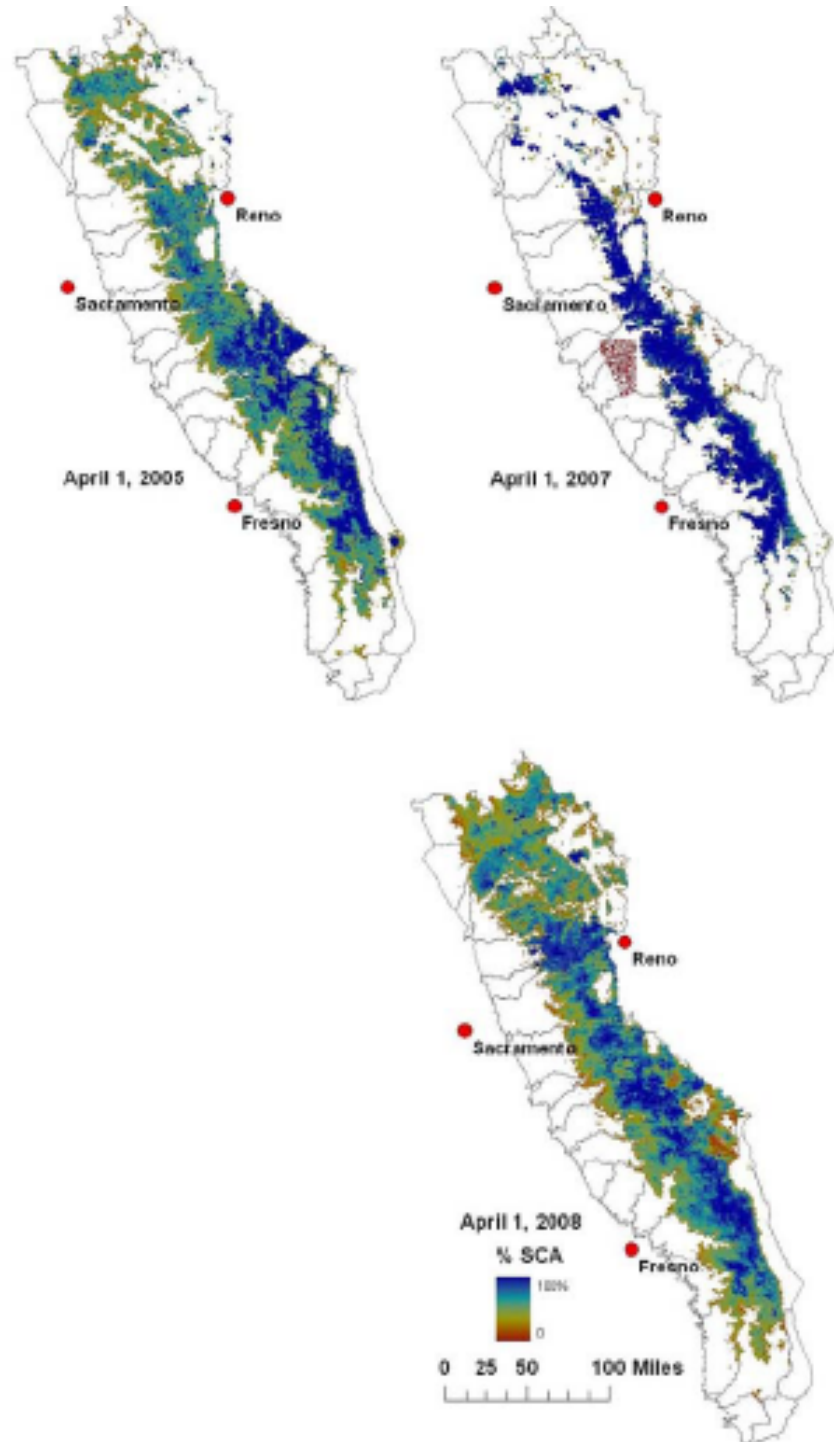
Snow
Depth Gage



Rain Gage

SCA Reports

- Provided by UC Merced/UCSB
- Based on MODIS data
- Reports published February through May



Snow Surveys Water Supply Forecast

Seasonal

Products

Monthly Bulletin 120 A-J Runoff Forecasts (Feb – May)

Weekly Bulletin 120 Updates (Feb – June)

Spring Snow Melt Forecasts (April – June)

Sacramento River Accretions (Oct – May)

... .. **Water Year**

Sacramento River Water Supply Index
(SRR and SVI) (Oct-May)

San Joaquin River Water Supply Index
(SJI) (Oct-May)

BULLETIN 120 (B120)

- Regression Formula variables include:
 - October – March Precipitation Index
 - April – July Precipitation Index
 - High and Low Snow Indices
 - Previous fall and spring runoff
 - 50 year historic database (1956-2005)

April-July Forecasts

“Like Solving a ‘Multi-Dimensional Puzzle’ Each Week”

- ❖ Regression Equations
 - ❖ Based on water years 1956-2005
- ❖ “Year-Type” Equations
 - ❖ Interactive tool creates regression equations based upon years that fall under desired specifications
 - ❖ Based on water years 1931-2007
- ❖ Cross-Basin Equations
 - ❖ Uses historical relationships to forecast April-July runoff for a given basin as a function of forecasted runoff at surrounding basins
- ❖ Exceedence Tables
- ❖ “Physical” Models
 - ❖ Feather River PRMS, for example

Other Information in the Bulletin 120

- Historical max., min., and averages for each forecast point
- 80% probability spread
- Water year unimpaired runoff forecasts for main valley streams
- Regional hydrologic summaries
- Statewide precipitation and snowpack conditions
- Major water project reservoir storage conditions
- Contact information for Snow Surveys staff

Water Supply Index (WSI)

- **Monthly Updates published October thru May**
- **Regional forecasts are made for:**
 - **Sacramento River Basin Runoff (SRR):** Sum of unimpaired flows for Sacramento River at Bend Bridge, Feather, Yuba, and American Rivers
 - **Sacramento Valley Index (SVI):** Water year type index determined with 40% current A-J runoff, 30% Oct-Mar runoff, 30% previous year's index (where runoff is SRR sum as above)
 - **San Joaquin Valley Index (SJI):** Water Year type index for Stanislaus, Tuolumne, Merced, and San Joaquin Rivers but with 60-20-20 breakdown

Runoff Data Issues

Full Natural Flow (FNF)

- ❖ 146 terms needed to complete FNF calculations
- ❖ 25 sources of FNF data
- ❖ Some flow values are estimated based on historical records
- ❖ FNF calculations need to be done by third business day in order to have Water Supply Forecast products available as promised.
- ❖ Timeliness of data is crucial

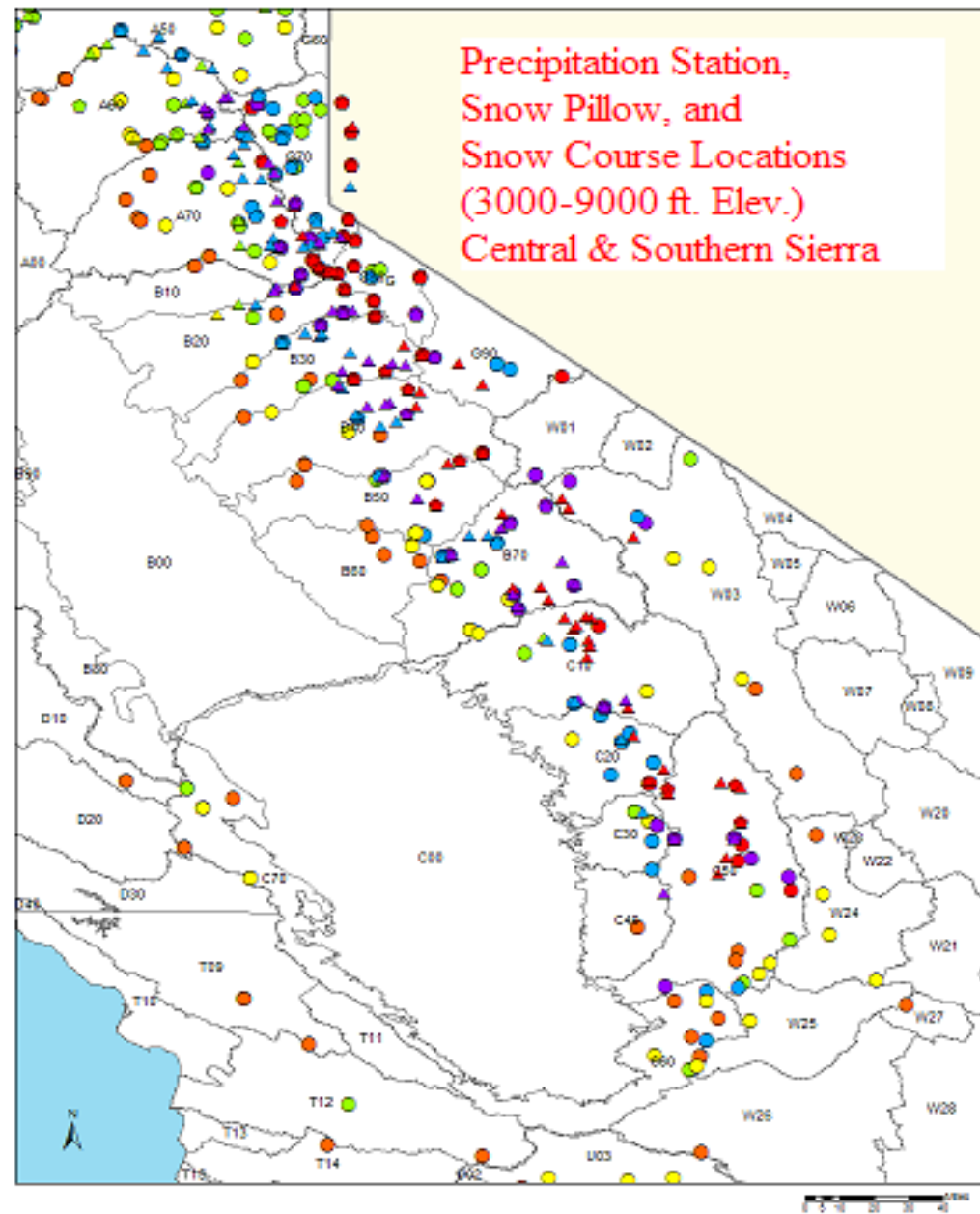
Precipitation and Snow Data Issues

- May have elevation or east-west bias
- May have out of basin station bias
- Budget cuts have worsened these concerns
- Missing stations cause unintentional biases
- Lack of quality snow course measurements requires alternate source data or re-measurement
- IRONICALLY, harsh weather will often delay or prohibit data collection
- Relying on snow pillows is not as good as manual snow course measurements
- Gage data (precip. or snow) can be suspect
- Precipitation Observers' methods are inconsistent

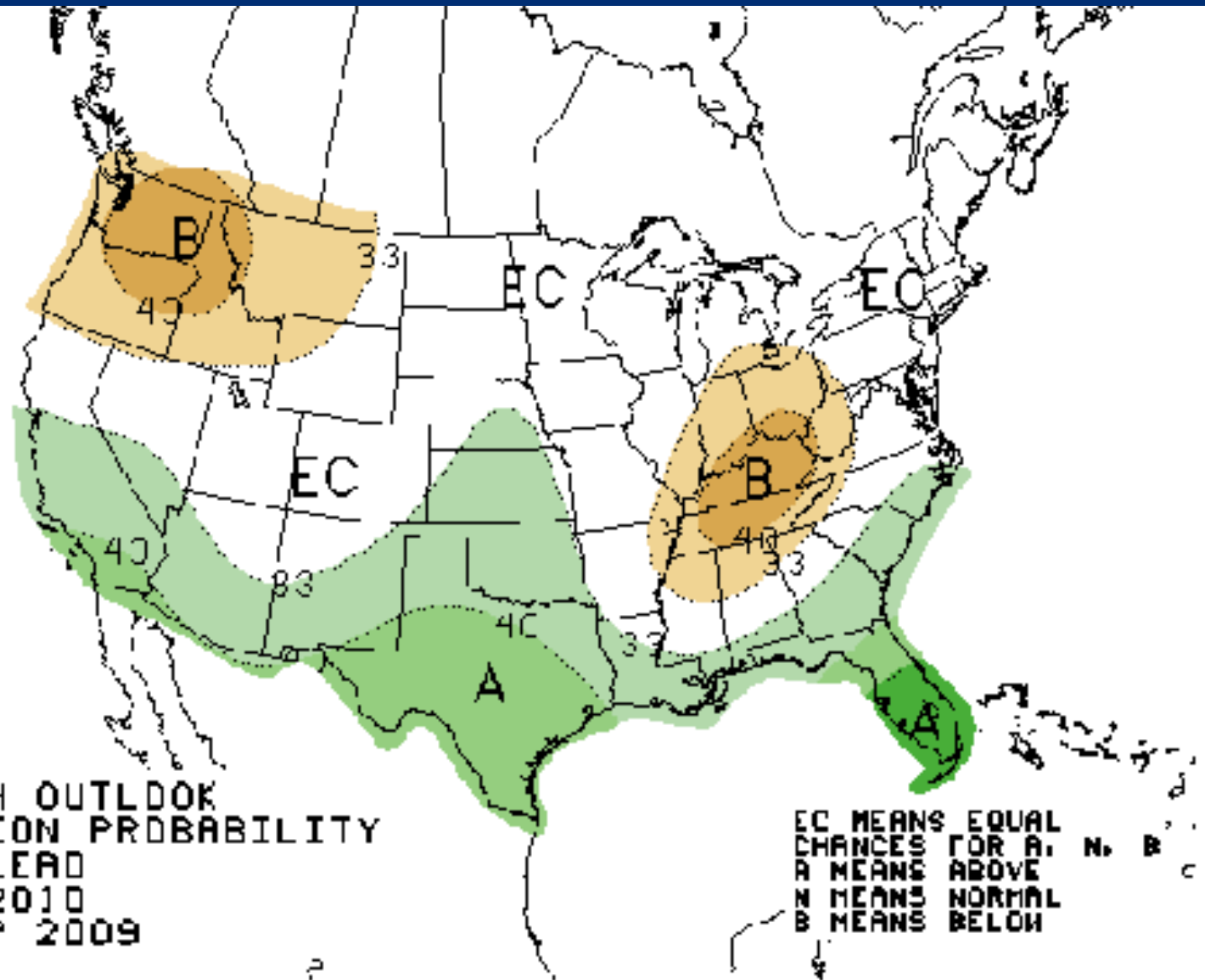
Forecasting: Science versus Feel

- ❖ Regression Equations Generally Work well...
- ❖ But...
- ❖ We rely also on feel because ...
- ❖ Data is not always perfect
- ❖ Average Snow pack \neq Average Runoff
- ❖ Average Precipitation \neq Average Runoff
- ❖ Average Runoff \neq Full Reservoirs
- ❖ Members of Calif. Cooperative Snow Surveys have many years of experience

Snow or Rain? Climate Change Effects on Forecasts



Seasonal Forecast/Outlook Info



El Niño Climatology

- Of the 18 El Niño events since 1950, rainfall has been above normal $\frac{1}{2}$ of the time and below normal $\frac{1}{2}$ of the time in central California.
- The six strong El Niños: 4 of 6 had above normal rainfall (3 of which $>140\%$ of normal).
- Weak and moderate El Niños: 6 of 9 years had below normal rainfall in central California.

El Niño Climatology

- The 1976-1977 drought was during a weak El Niño.
- Only 4 of 10 of the costliest floods in California occurred when there was an El Niño.
- 'Pineapple connections' and MJO's are more prevalent during non-El Niño years.
- El Niño is not the only thing happening in the atmosphere! Other oscillations and patterns can enhance or detract from overall impact.



Questions?

manderso@water.ca.gov