Water Plan Update
Scenarios Subgroup

- Dan Cayan
- Dave Curtis
- Mike Dettinger
- Kosta Georgakakos
- Sarah Young
- Elissa Lynn
- Rich Juricich
- Andrew Schwartz
- Jamie Anderson
- Mike Anderson

Two webex meetings (one more in the works); lots of emails & sharing
Today: Report out & discussion

- Problem statement – Rich
- California Climate Action Team approach – Dan

**Lunch & mini-doc**
- CVP-IRP (modified BDCP) approach – Andrew
- Strengths/weaknesses of approaches w/ discussion – Mike D

**Break**
- General discussion – Mike A
Strengths & Weaknesses
CAT Scenarios (A2)
BDCP example

5 Ensembles \rightarrow 5 scenarios

drier, more warming (Q2)
10% P, 90% T

drier, less warming (Q1)
10% P, 10% T

wetter, more warming (Q3)
90% P, 90% T

wetter, less warming (Q4)
90% P, 10% T

P = precipitation, T = temperature
CVP IRP approach

• Use info from 112 downscaled GCMs to select members of 5 ensembles (same process as BDCP, Q1-Q5))
  • Central tendency
  • Drier/wetter and less warming/more warming (4 combos)
for 4 projection points in time (new for CVP IRP)
  • 2010, 2025, 2055, 2085

• For a given ensemble (Q1-Q5)
  – computer change statistics for each projection period
  – Shift historical time series from 1915-2003 (Mauer) to 2011-2099
  – Adjust the historical series by INTERPOLATING between 2010, 2025, 2055, 2085 “projection pt” values

The resulting scenarios preserves historical inter-annual variations while evolving the amount of climate change over time
Ensemble of 112 BCSD (statistical) downscaled, daily T & P scenarios

**CAT Approach**
- Pick 12 “good” representative examples
- Compute (30-yr) norms
- Re-scale historical record
- Assessments & Models

**CVP-IRP Approach**
- Compute (30-yr) norms
- Construct 5 “spanning” ensemble sub-means
- Assessments & Models

**CALSIM III)**
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| **Strengths** | • Scenario selection based on GCMs using criteria developed by CAT  
• Climate evolves; dynamic future  
• Thoroughly peer reviewed in published literature.  
• Used extensively in past statewide impact evaluations.  
• Preserves variability displayed in projections, doesn’t rely on historical observations to incorporate inter-annual/inter-decadal variability.  
• Provides individual realizations of the future projection distribution. | • May capture wider range of possible potential future climate using a smaller set of scenarios  
• Climate is static, then mapped onto historic  
• Includes 3 emissions scenarios  
• Includes information from the available 112 CMIP3 projections  
• Aggregation method de-emphasizes technical inconsistencies associated with individual climate projections | • Climate dynamically evolves through time.  
• Same strengths as BDCP |
| **Weaknesses** | • Bias toward drier side of projections  
• 30 year running averages don’t appear to represent historic variability.  
• Does not capture full range of uncertainty as described by the full CMIP3 archive of projections.  
• Has not been reevaluated since completion in 2008—new methods, research are available.  
• Does not provide a single central tendency or most likely outcome that can be used for detailed/project level decision making  
• Unsure if selection of models provides the appropriate sampling needed for given DWR studies. | • Does not capture extreme temp and precip unless mapped to a historical pattern  
• Computationally complex—requires considerable resources and expertise to modify in any way.  
• Scenarios are currently only available at two time periods; 2025, 2060  
• Not thoroughly peer reviewed.  
• Collapses variability of multiple projections into ensemble average, potentially masking a more realistic representation of hydrologic variability.  
• Difficult to maintain spatial continuity of the desired projection distribution realization that is run. | • All scenarios follow same sequence of wet and dry years as historical record (i.e. driest years on record are followed by very wet- 1976-79)  
• Provides relatively limited representation of extreme precipitation/drought years when compared to GCMs.  
• Most of the same weaknesses as BDCP. |
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- Re-scale historical record

**CVP-IRP Approach**
- Compute (30-yr) norms
- Identify 5 “spanning” sub-ensembles
- Pick sub-ensemble central members

**Assessments & Models**
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Downscaled Projected Trends in December Precipitation
(*GFDL CM2.1, A2 emissions, 21st Century*)
Ensemble of 112 BCSD (statistically) downscaled, daily T & P scenarios

CAT Approach

Pick 12 “good” representative examples

Compute d-s (30-yr) norms

Identify 5 “spanning” sub-ensembles

CVP-IRP

Compute (30-yr) norms

Pick downscaled sub-ensemble central members

Re-scale historical record

Aggregate to NoCal scale

Assessments & Models

d-s means “using downscaled versions”
Technical Criteria for Selecting Climate Scenarios

- Select among CAT, BDCP, or GCM scenarios using an approach that represent the types of climate changes most important to water management
- Capturing precipitation variability is important
- Want to capture extremes, including extended dry periods, with particular attention (on our part) to observed 30 year running averages of precipitation
- Historical record is not a good model of the future, but
- Historical variations are our best “model” of future variability
- Select scenarios that can be used for multiple planning purposes; that are inter-comparable with what other agencies and institutions are doing
Sacramento Annual Precipitation

Precipitation (in)

- 20.74
- 14.29
- 20.09

1850 1900 1950 2000

Sacramento Annual Rainfall
30-Yr Ave
Should we be looking for prolonged droughts (like this GFDL examples) in scenarios, to require that some be included?
So where are we now?

• 5 \(^{(CVP \ IRP)}\) or 12 \(^{(CAT)}\) or 17 \(^{(both)}\) scenarios?
• Span ensemble range \(^{(CVP \ IRP)}\) or sample ensemble range \(^{(CAT)}\)?
• Maintain historical time variations \(^{(either)}\), or use GCMs to explore new examples of variability \(^{(either)}\)?
• Specifically target long-term supply declines or droughts \(^{(?)}\), or stick to what the historical/GCM selections give?
• Maintain spatial coherence/internal consistency \(^{(either)}\), or maximize changes at each pixel \(^{(CVP \ IRP)}\)?