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

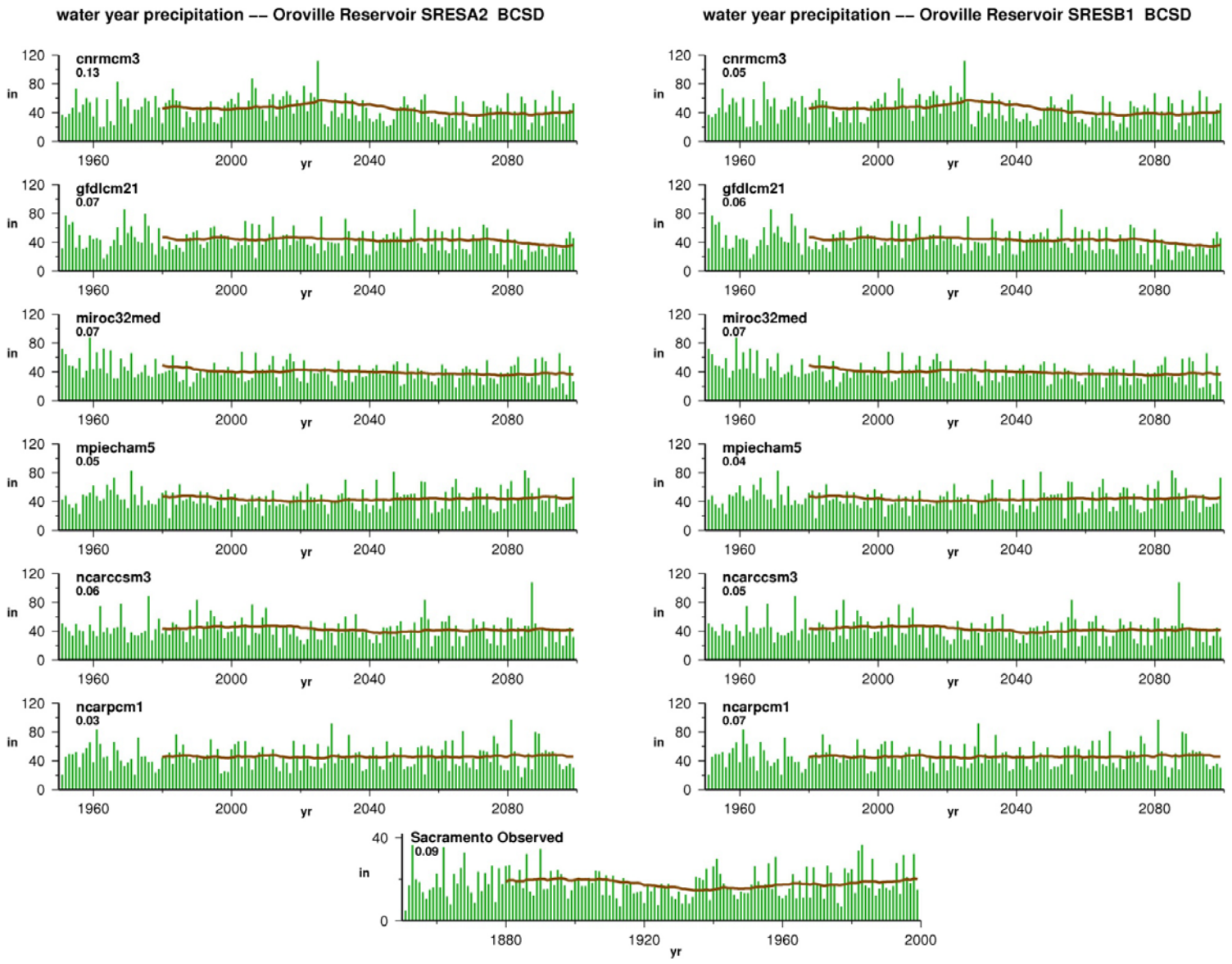
- CVP-IRP (modified BDCP) approach – Andrew
- Strengths/weaknesses of approaches w/ discussion – Mike D

Break

- General discussion – Mike A

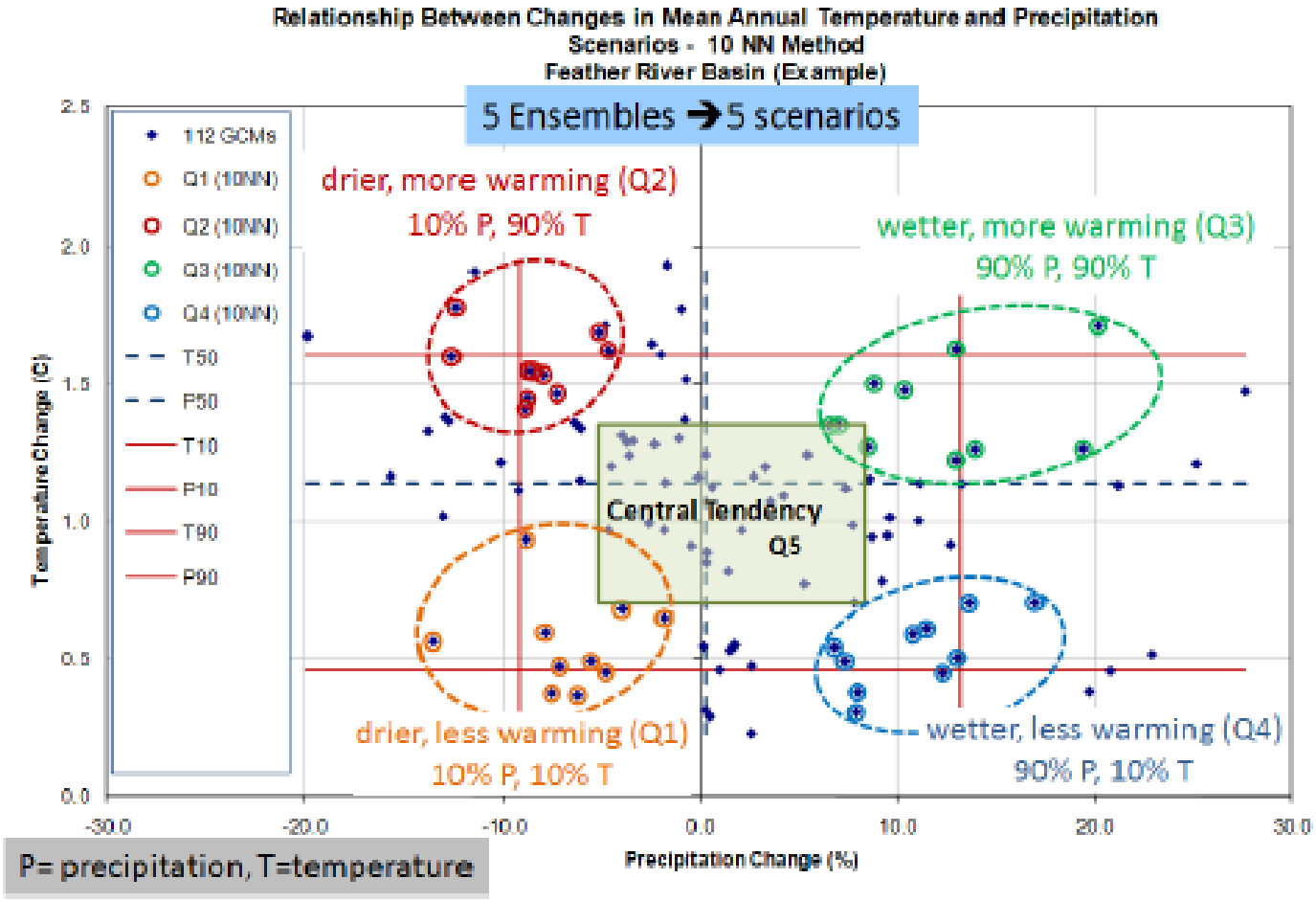
Strengths & Weaknesses

CAT Scenarios (A2)



BDCP example

Example of selection of ensemble members for 5 scenarios:



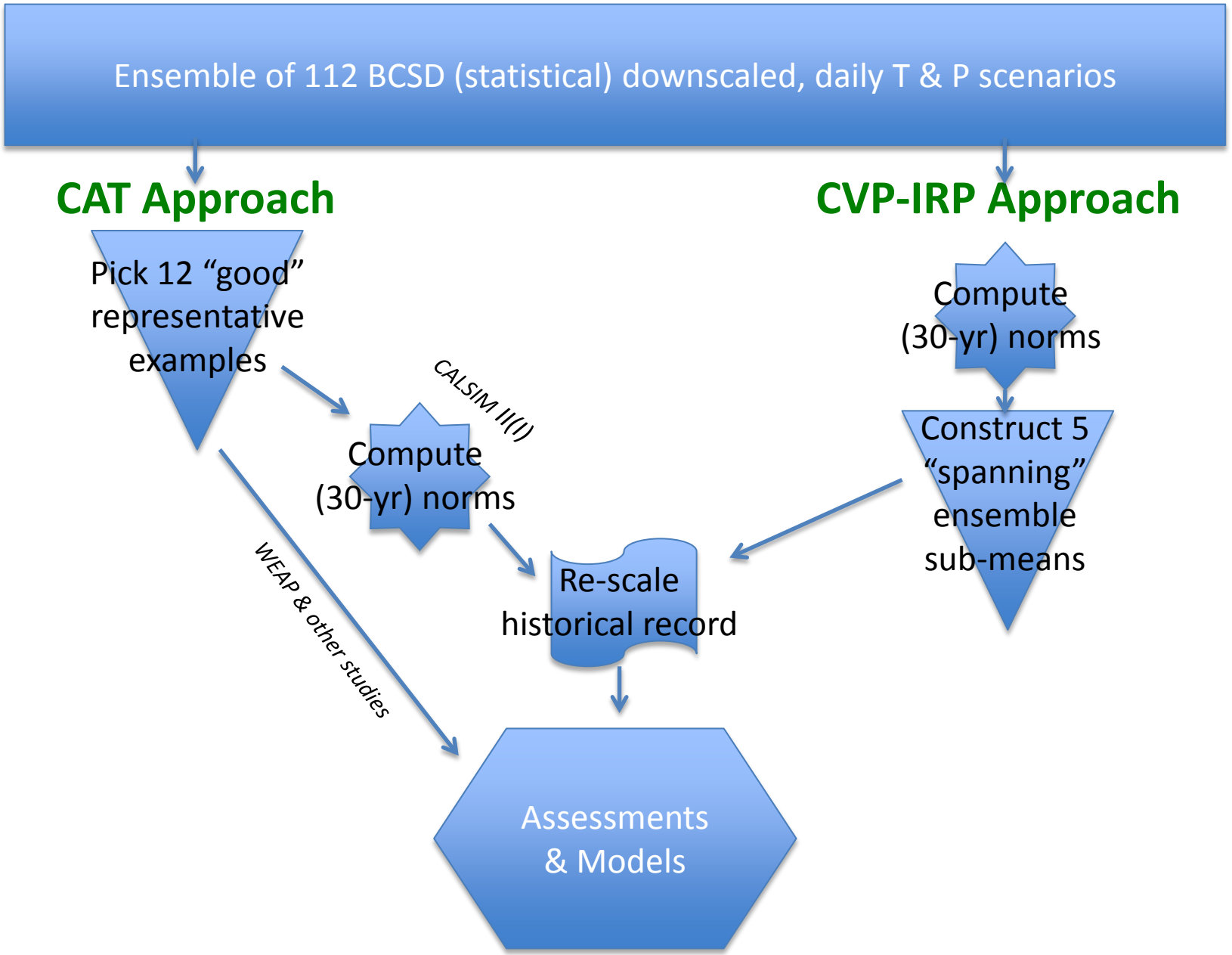
CVP IRP approach

- 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
CVP-IRP Approach
Pick 12 "good" representative examples
CALSIM II(I)
Compute (30-yr) norms
Compute (30-yr) norms
Construct 5 "spanning" ensemble sub-means
WEAP & other studies
Re-scale historical record
Assessments & Models

	12 CAT Scenarios	5 BDCP Scenarios	CVP-IRP Modified BDCP Scenarios
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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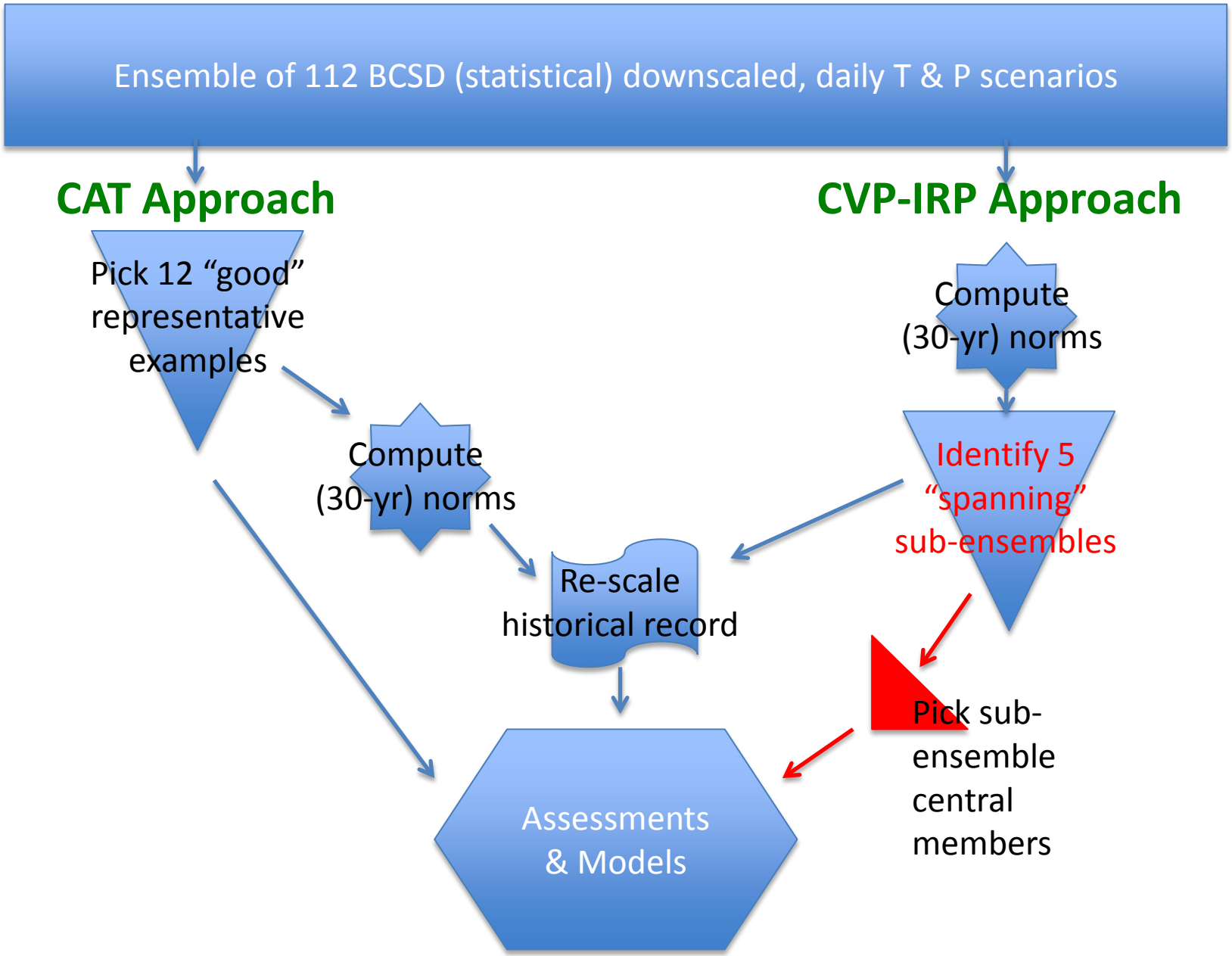
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Identify 5 "spanning" sub-ensembles
Re-scale historical record
Pick sub-ensemble central members
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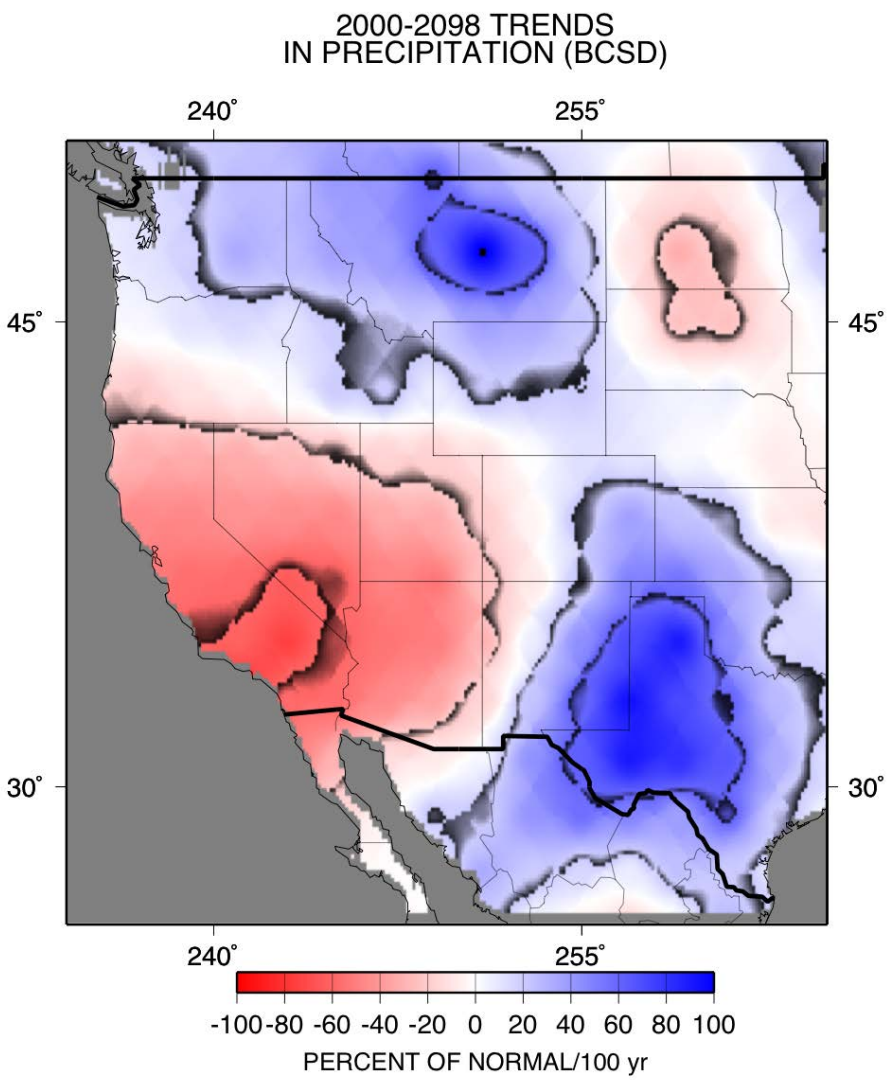
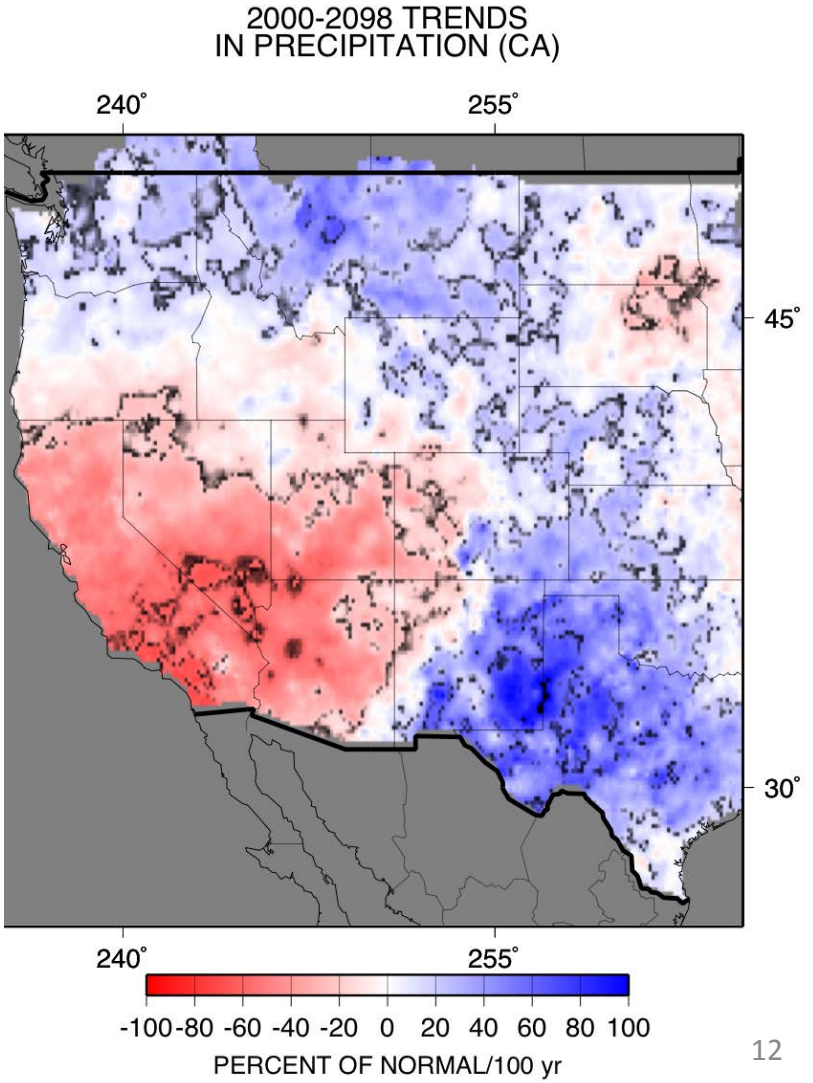
Downscaled Projected Trends in December Precipitation
(GFDL CM2.1, A2 emissions, 21st Century)





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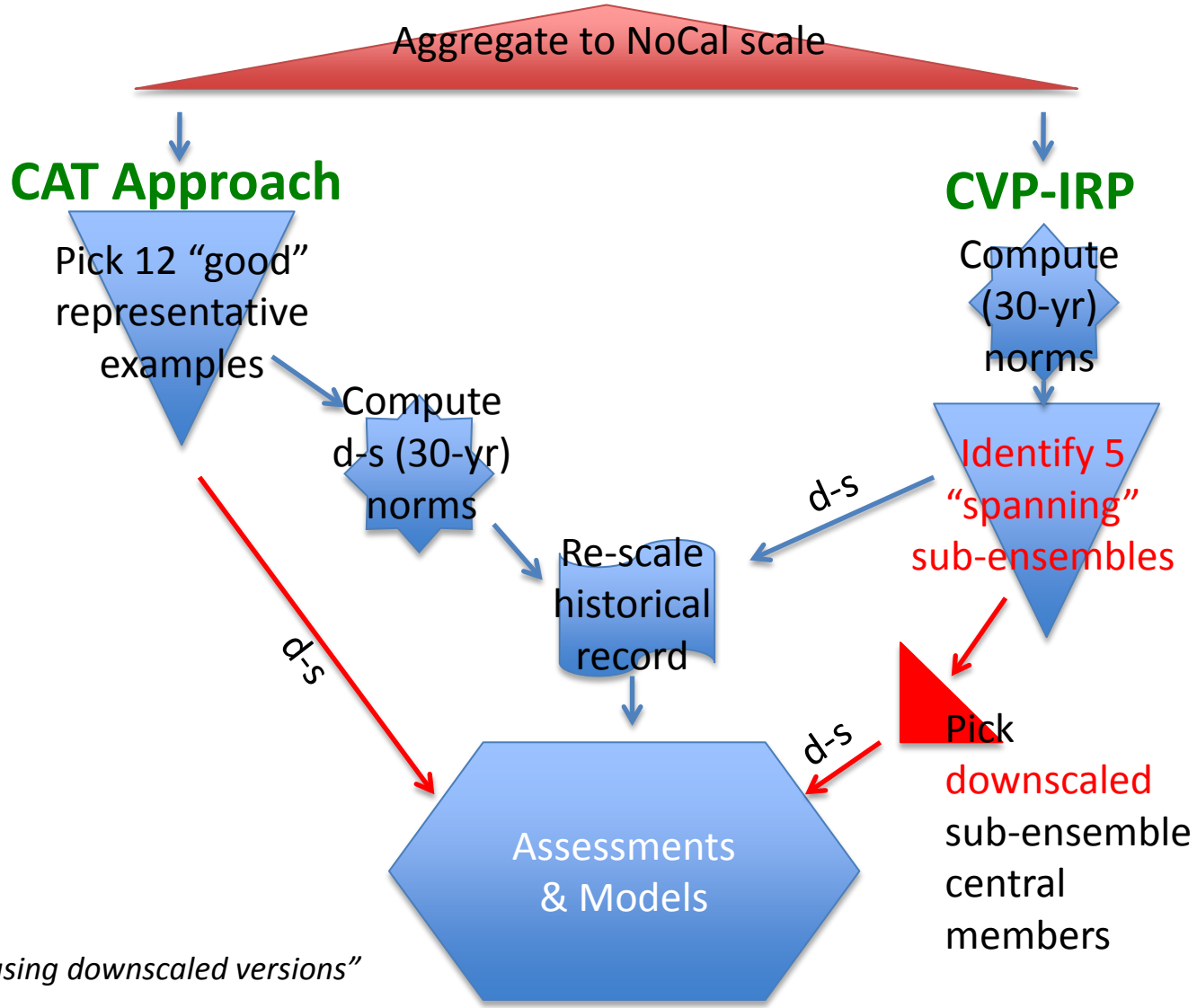
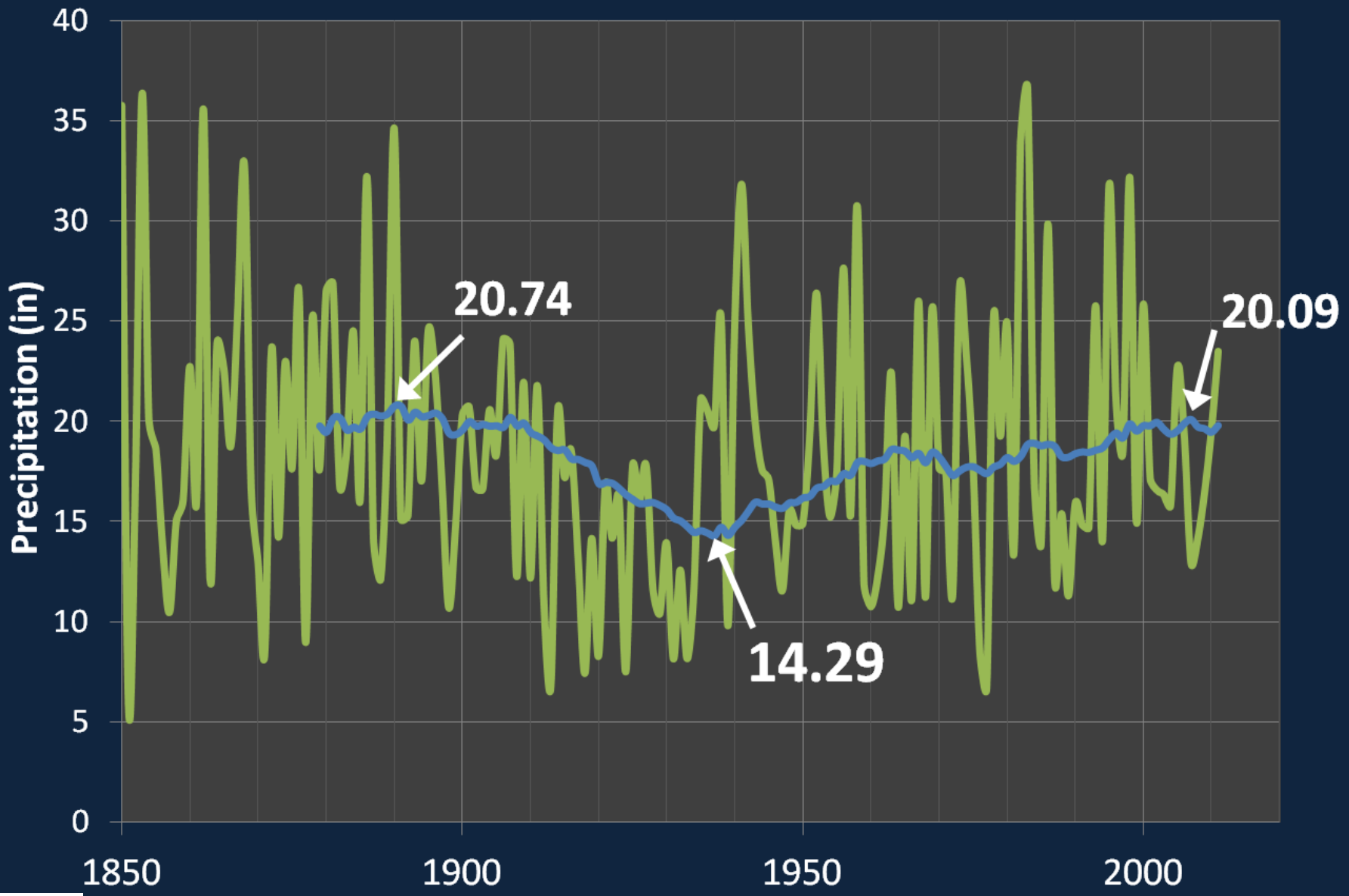


d-s *means "using downscaled versions"*

Technical Criteria for Selecting Climate Scenarios

- Select among CAT, BDCP, or GCM scenarios using 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



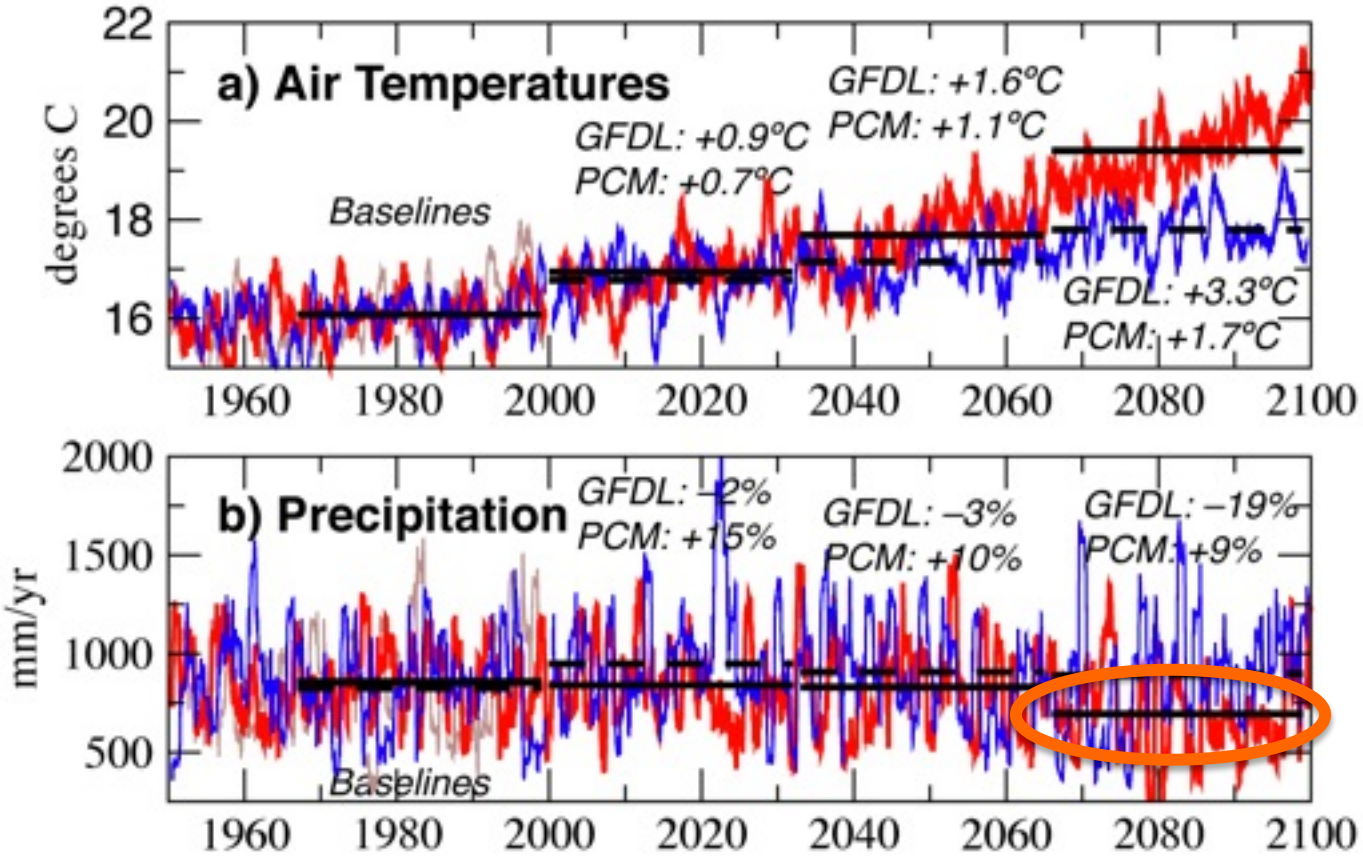


Fig. 1.--Observations and downscaled projections of (a) air temperatures over the Delta and (b) precipitation over the entire Delta watershed; all variables plotted as 365-day moving averages, with red curves representing GFDL climate model projections under historical and A2 (accelerating emissions) scenario, blue curves representing PCM historical and B1 (slowing emissions) scenario, and brown curves as historical observations, solid black bars are 33-yr averages of GFDL projections, and dashed black bars are 33-yr averages of PCM projections.

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)*?