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Managing Water in the West

Status Update

U.S. Department of the Interior
Bureau of Reclamation

Overview of Selection Choices

- DHSVM
  - Baseline completed (no more calibration runs)
  - Adjustments to flow will be based on Dee and Tucker gages and populated basin wide
  - Glacier component not checked with recent calibration
    - It will be evaluated. No additional effort to resolve issue. They will be documented for future work and considered in the analysis
- MODSIM
  - MODSIM regulated (with reservoirs) almost complete
  - MODSUN unregulated (without reservoirs) complete (needs review)
  - Demand summaries data from Water Needs report formatted for import to MODSIM
  - Scripting initiated

Overview of Selection Choices

- GW
  - Some issues with irregularity in the steady state model (used as input to Transient) so working to address that now
  - Will use P changes from selected climates to evaluate climate change independently of MODSIM effort (no GW changes will be built into the MODSIM model due to uncertainties in the GW model)
- Climate Change
  - Scripting underway to automate generation of climate change data input
  - Data (T/P) for two future windows (2020s and 2040s) and five climates being generated now
    - Once decision is made by HRC, will move forward with model runs
  - DHSVM and MODSIM models will be run with only one future window (either 2020s OR 2040s) and three climates (MW/W, MW/D, C, LW/W, LW/D)

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Basin Study Goals and Alternative Analysis

U.S. Department of the Interior
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Basin Study Goals

1. **Define current and future basin water supply and demands, with consideration of potential climate change impacts**
   - **Use Water Needs and Water Conservation reports**
   - **Conduct *Existing Conditions* MODSIM modeling to evaluate historical + 1 future window (e.g., 2020s) using 3 climates (MW/W, C, and LW/D)**
   - **This provides the necessary range of uncertainty for results (1 historical + 3 futures = 4 runs)**
   - **Compare results**

Basin Study Goals

2. Determine the potential impacts of climate change on the performance of current water delivery systems (e.g., infrastructure and operations)
   - Complete this effort at the same time as above effort
   - Evaluate all or some of the following (as applicable):
     - Ability to deliver water (will perform)
     - Hydroelectric power generation facilities (will perform)
     - Recreation (N/A)
     - Fish and Wildlife habitat (will perform using instream water rights analysis)
     - ESA (will perform using instream water rights)
     - Water quality (N/A – not enough information for Reclamation – may be part of IFIM work??)
     - Flow and water dependent ecological resiliency (not sufficient information)
     - Flood control management (N/A)

Basin Study Goals

3. Develop options to maintain viable water delivery systems for adequate water supplies in the future
   - Identify structural and non-structural options
     - Structural changes include dam construction simulation and dam raise simulations
     - Non-structural changes include changes in demands (one alterative) and changes in conservation (another alterative)
   - Adaptive Management Strategies (no analysis, just discussion based on what we know at the end of the study)
     - Habitat Restoration Plans
     - Improved models or other DSS
     - Others identified by the County
4. Conduct an analysis and modeling scenarios of the options developed, summarize findings and make recommendations on preferred options.

Alternatives for Evaluation

- **Storage (one alternative, 3 facilities)**
  - **One storage facility in each irrigation district**
  - **EFID, MFID, FID**
- **Irrigation Demand**
  - **One change in future demand – propose across the board increase in each demand summary based on future time period**
- **Conservation**
  - **Assuming conservation data provided in monthly summary form (as we demand data), then assume an across the board increase in conservation efforts.**
- **Any additional variations to these alternatives can be carried out by the County at a later date (the model will be set up already)**

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Selection of Climate Change Information and Decision Process

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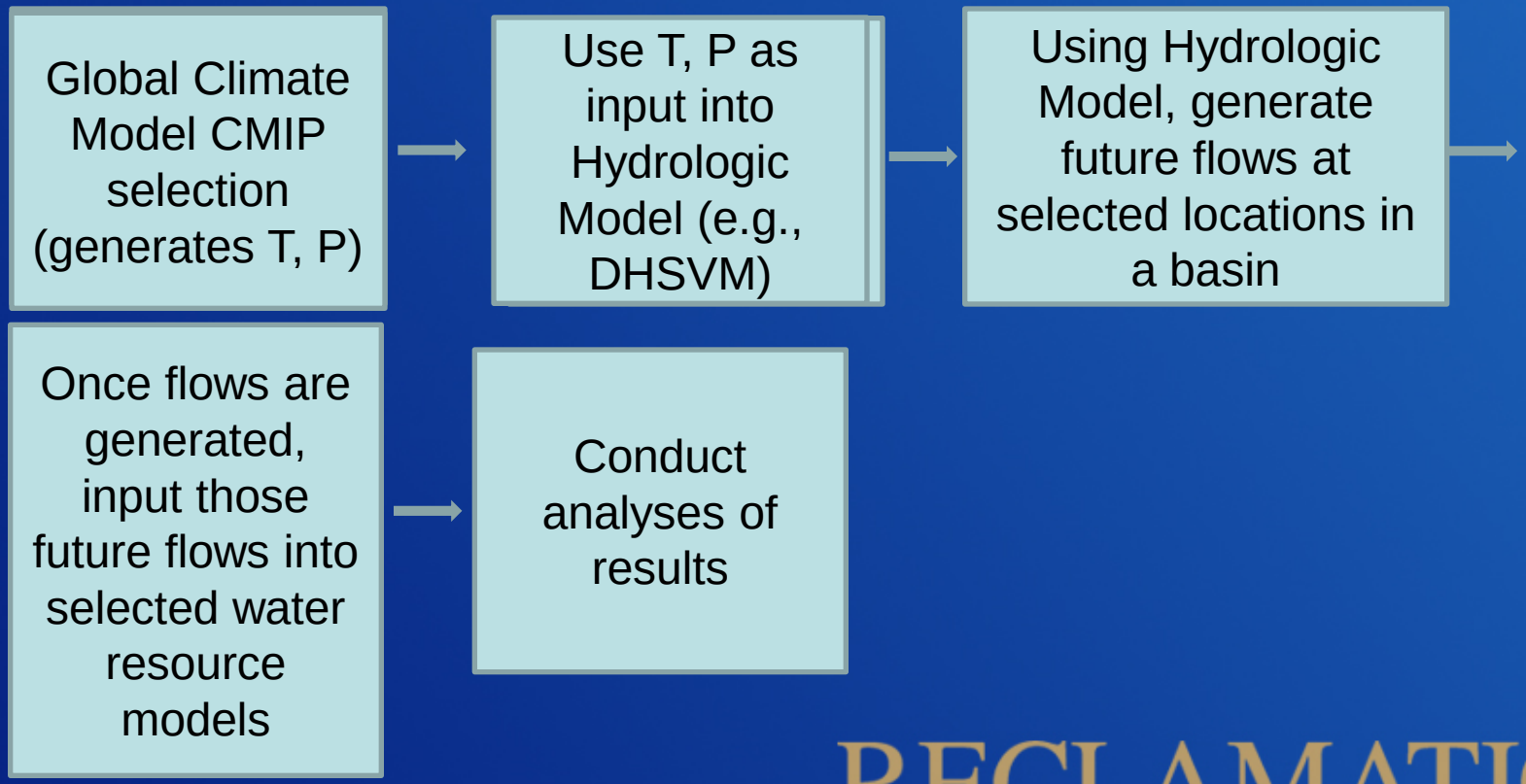
Overview of Selection Choices

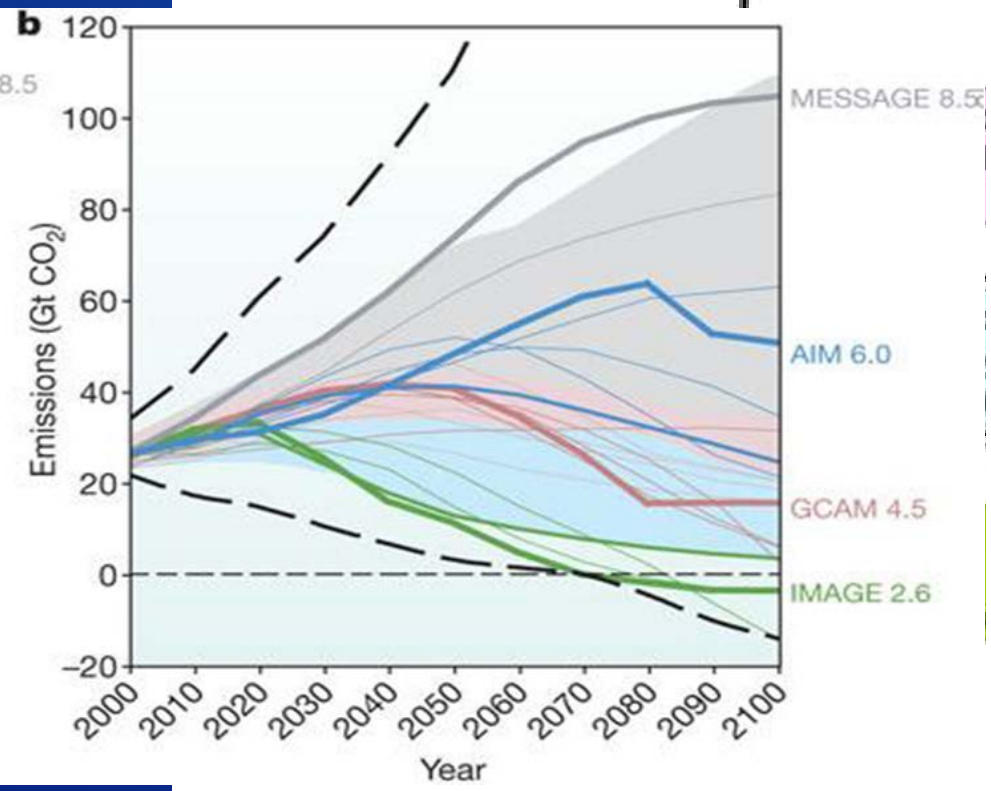
- Overview of Process
- Source of Climate Change Data
  - Climate or Hydrology Data or Both
  - Hydrologic Model Selection
- Global Climate Models (GCMs) from Coupled Model Intercomparison Project (CMIP) Phase 3 or Phase 5 (or both)
  - Emission Scenarios (SRES)
  - Representative Concentration Pathways (RCPs)
- Period Composite (Change) or Transient
  - Bias Correction and Spatial Downscaling Method
  - Historical and Future Reporting Time Periods
  - Quantity of Projections (individual or ensemble)
  - Uncertainty Range

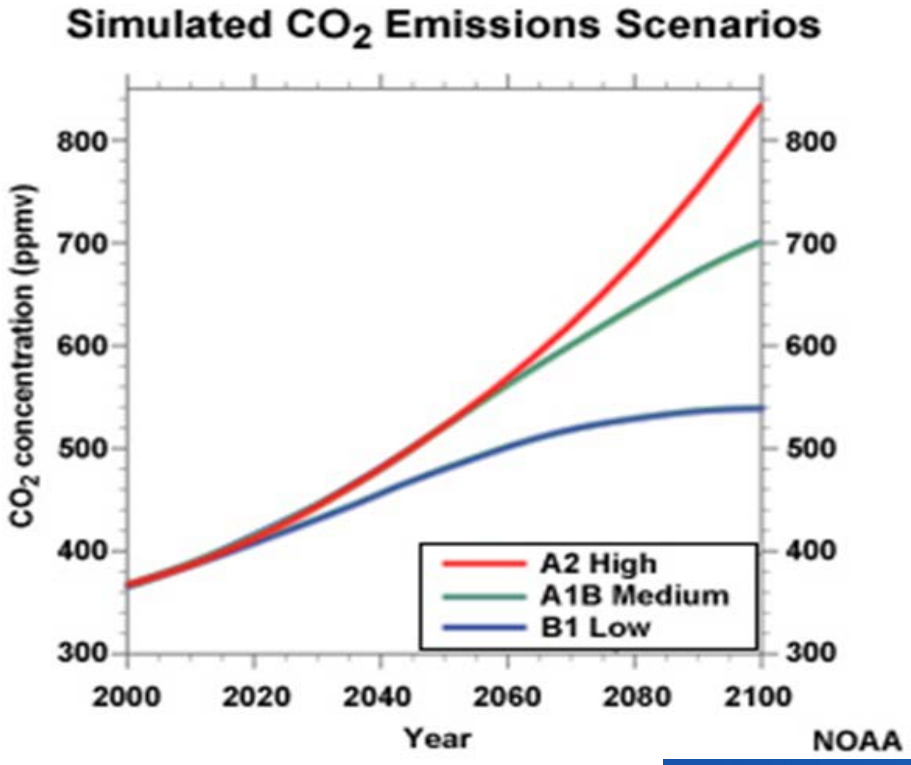
Overview of Process

- **CMIP3 or CMIP5 => T and P generation => Hydrologic Model => Future flow generation => water resource model analyses => results reporting**



CMIP3 vs. CMIP5





IPCC 2008: Towards New Scenarios for Analysis of Emissions, Climate Change, Impacts, and Response Strategies, IPCC Expert Meeting Report, Figure I.1. Intergovernmental Panel on Climate Change, Geneva, Switzerland.

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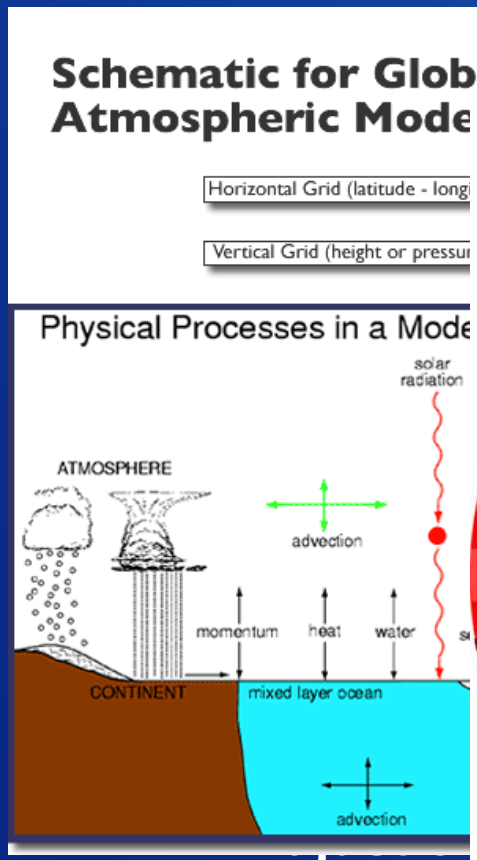
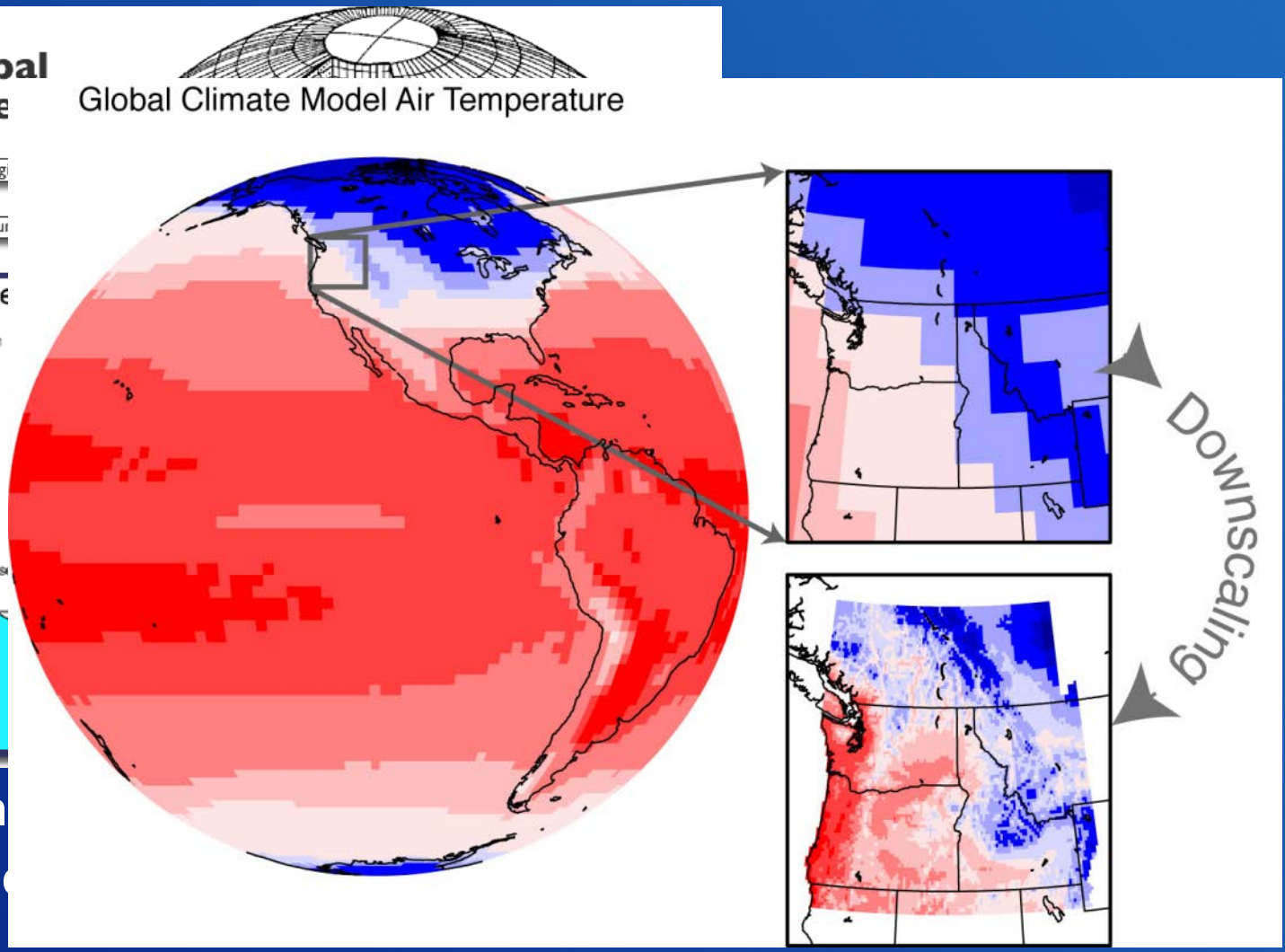
Source Selection

- Data from Reclamation's Archive (LLNL)
  - CMIP3
    - 19 of 23 GCMs available, 3 emission scenarios (A1, A1b, B1), total of 112 projections
    - Flow generated at 1/8th degree (~12KM)
    - Period of coverage is 1950-2099 at a monthly time step
  - CMIP5
    - 100+ GCMs, 4 representative concentration pathways, total of 234 projections
- Data from UW Climate Impacts Group
  - CMIP3
    - 19 of 23 GCMs, 3 emission scenarios, total of 57 projections
    - Flow generated at 297 locations in CRB
- Others

Spatial Downscaling





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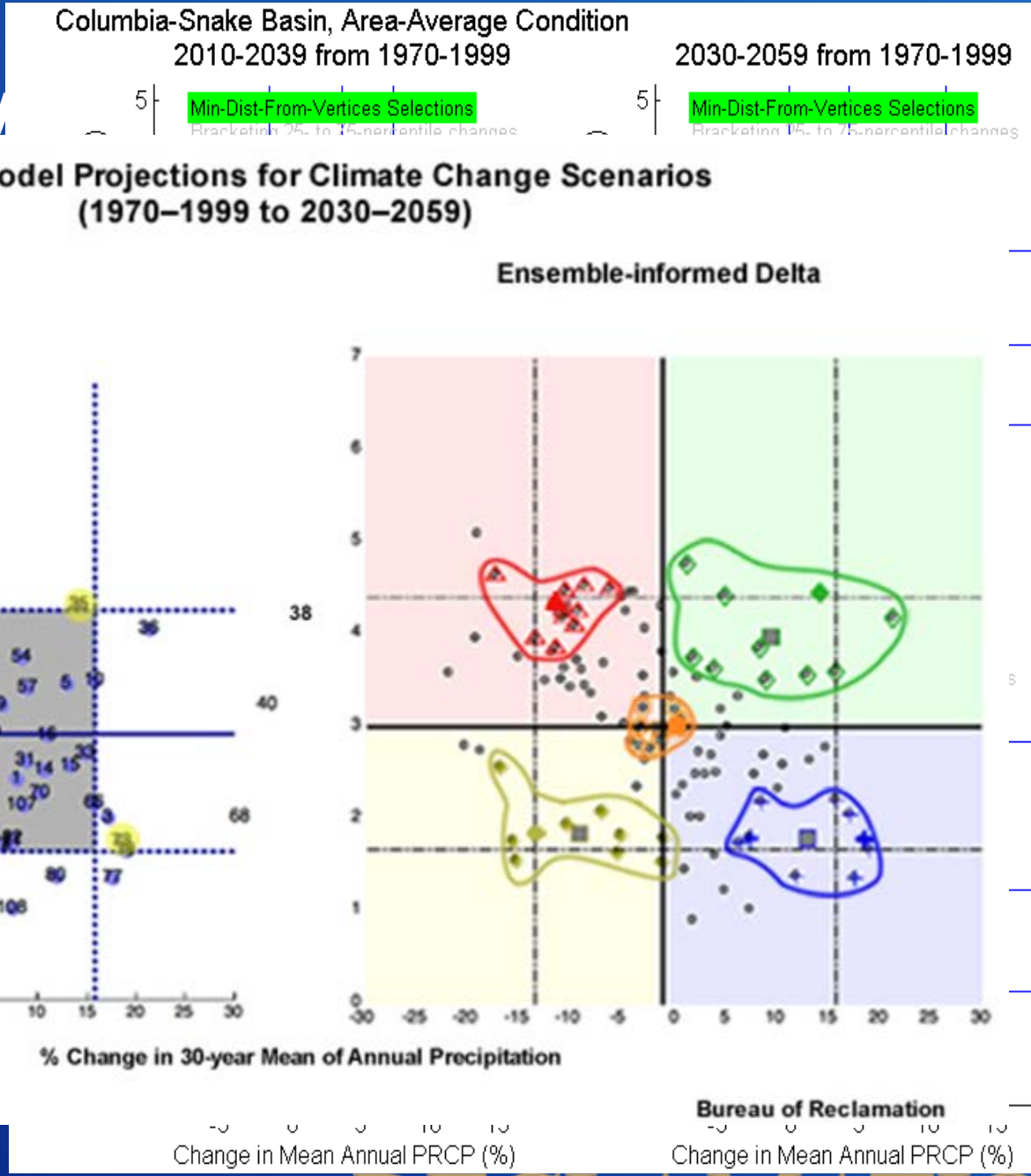
– Use sam

Period Composite or Transient

- **Period Composite (e.g., Delta or Hybrid Delta or HD)**
  - **2 projections compared – one future and one historical**
  - **Delta is a shift in T/P statistics; HD is a shift in the "distribution" of the T/P**
  - **Usually timeframes are 30yrs (e.g., 1970 – 1999 compared to some future 1930 – 1959)**
  - **Report change in the metric (e.g., metric can % change in flow, storage volume)**
  - **Distribution of wet/dry patterns representative of historical record**
- **Transient**
  - **1 projection used; one pair of historical and future periods to define the change**
  - **Timeframes are spans 150 years**
  - **Distribution of patterns not related to historical patterns**
  - **Great for threshold evaluation**

Uncertainty



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Decision looks something like this…

- Source and Model Phase
  - GCMs from CMIP3 from LLNL site (get Phase 3 GCM data, downscaled over the CRB at a 1/8th degree scale)
- Technique
  - Hybrid-Delta ensemble method (compare 1970-1999 to 1930 to 1959) using more than one projection
- Uncertainty Characterization
  - 20%/50%/80%
- Climate Characterization
  - MW/W, C, and LW/D
- Hydrologic Model
  - Use VIC hydrologic model to evaluate T/P output from GCM

…and finally…

- Route flows to some determined number of locations
- Import into water supply model (e.g., ModSim)
- Determine metrics to analyze (end-of-month storage)
- Conduct comparisons and report