**Motivation**

Create climate change scenarios for water operations and restoration planning that

- Reflect the range of available downscaled climate projections for precipitation and air temperature
- Provide a manageable number of scenarios for alternatives evaluation

**Ensemble-Informed Climate Change Scenario Selection**

An ensemble is a group of climate change projections from several different models. Individual scenarios are created by using information from the ensemble. Ensembles have been shown to better reflect historical conditions than single model runs (e.g. Gleckler 2008, Pierce 2009).

For each future analysis period, 5 climate change scenarios are created by sampling from projection ensembles.

- 112 climate change projections are evaluated to create 5 ensembles (Q1-Q5) with a spatial resolution of 12 km over California.
- For each ensemble (Q1-Q5), a climate change scenario is created for projected changes in precipitation and air temperature.

**Precipitation and temperature changes relative to historical conditions**

<table>
<thead>
<tr>
<th>Precipitation Change (%)</th>
<th>Temperature Change (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>drier, more warming (Q2)</td>
<td>Q1 (10NN)</td>
</tr>
<tr>
<td>wetter, more warming (Q3)</td>
<td>Q2 (10NN)</td>
</tr>
<tr>
<td>drier, less warming (Q1)</td>
<td>Q3 (10NN)</td>
</tr>
<tr>
<td>wetter, less warming (Q4)</td>
<td>Q4 (10NN)</td>
</tr>
</tbody>
</table>

**Feather River Basin Example for 2011-2040 Projections**

**Ensemble-Informed Scenario Selection using 10 Nearest Neighbors**

Change over 2011-2040 period as compared to 1971-2000 base period

Q3 (wetter, more warming)

Q1 (drier, less warming)

Q4 (wetter, less warming)

**Using Climate Change Information in Analyses of Proposed Alternatives**

For each future analysis period (2015, 2025, and 2060):

**Climate Projections**

- 112 projections from Global Climate Models
- Changes in precipitation and air temperature
  - Downscaled every 12 km (1/8° lat/long) in California

**Climate Change Scenarios**

- 5 scenarios of changes in precipitation (P) and air temperature (T) are created by sampling from projection ensembles
  - Central tendency (Q5 25%-75%)
  - 10 nearest neighbors used for
    - drier, less warming (Q1 10%P, 10%T)
    - drier, more warming (Q2 10%P, 90%T)
    - wetter, more warming (Q3 90%P, 10%T)
    - wetter, less warming (Q4 90%P, 10%T)

**Streamflow Changes**

For each of the 5 scenarios, changes in precipitation and temperature are used as input to the hydrologic model VIC (Variable Infiltration Capacity model)

Changes in streamflow are estimated for 18 streams in California

**Impacts Analysis**

Changes in precipitation, temperature and streamflow are used for water resources and ecological impacts analyses of proposed alternatives for

- Habitat restoration
- Channel changes
- Operations changes
- Water quality improvement

**Links for More Information**

- Ensemble Method Summary in DWR Climate Change Methods Review Paper (pages 58-64)
- Bay Delta Conservation Plan Website: [http://baydeltaconservationplan.com](http://baydeltaconservationplan.com)