CLIMATE CHANGE TRENDS IN THE SIERRA NEVADA

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AVERAGE GLOBAL TEMPERATURE

Change in degrees C

Business-as-usual scenario (A2)

Best case scenario

Average temperature in 1990

Year

Change in degrees F
GLOBAL TRENDS

- Increase in avg. temp
- Increase in sea level
- Melting of ice/snow
- Fewer frost days
- More severe heat
- More wildfire
- More frequent floods, severe storms
MODELS/EMISSIONS SCENARIOS

- PCM (NCAR)
- GFDL (Geophysical Fluid Dynamics Lab)
- A2 emissions scenario
SIERRA NEVADA PROJECTIONS

- Temperature (annual, seasonal)
- Precipitation (annual, seasonal)
- Hydrology – runoff, snowpack, water deficit
- Vegetation – MC1 projections
- Wildfire – particulate matter and area burned
HISTORIC TRENDS IN CALIFORNIA

- Temperature increase (air and water)
- Shifts from snow to rain
- Declines in streamflow
- Increased frequency of heavy precip and flood
- Earlier spring runoff
- Change in vegetation (not always upslope)
- Longer fire season
## Temperature

<table>
<thead>
<tr>
<th></th>
<th>Historic</th>
<th>2030-49</th>
<th>2060-79</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>47.4° F</td>
<td>+3° F</td>
<td>+5° – +5.5° F</td>
</tr>
<tr>
<td>Central</td>
<td>51.3° F</td>
<td>+3° F</td>
<td>+5° – +5.5° F</td>
</tr>
<tr>
<td>South</td>
<td>48.4° F</td>
<td>+3° F</td>
<td>+5° – +6° F</td>
</tr>
</tbody>
</table>

### Summer

<table>
<thead>
<tr>
<th></th>
<th>2030-49</th>
<th>2060-79</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>63.2° F</td>
<td>+3° – +4° F</td>
</tr>
<tr>
<td>Central</td>
<td>66.1° F</td>
<td>+3° – +4° F</td>
</tr>
<tr>
<td>South</td>
<td>64.3° F</td>
<td>+3° – +4° F</td>
</tr>
</tbody>
</table>

### Winter

<table>
<thead>
<tr>
<th></th>
<th>2030-49</th>
<th>2060-79</th>
</tr>
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<tbody>
<tr>
<td>North</td>
<td>33.2° F</td>
<td>+2° – +3° F</td>
</tr>
<tr>
<td>Central</td>
<td>38.4° F</td>
<td>+2° – +3° F</td>
</tr>
<tr>
<td>South</td>
<td>34.6° F</td>
<td>+2° – +3° F</td>
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## Precipitation

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>770mm</td>
<td>+3° F</td>
<td>+5° - 5.5° F</td>
</tr>
<tr>
<td>Central</td>
<td>1119mm</td>
<td>+3° F</td>
<td>+5° - 5.5° F</td>
</tr>
<tr>
<td>South</td>
<td>528mm</td>
<td>+3° F</td>
<td>+5° - 6° F</td>
</tr>
</tbody>
</table>

### Spring

<table>
<thead>
<tr>
<th></th>
<th>Historic</th>
<th>Spring</th>
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<th>2060-79</th>
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</thead>
<tbody>
<tr>
<td>North</td>
<td>65mm</td>
<td>-10% - +19%</td>
<td>+4% - +24%</td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>98mm</td>
<td>-15% - +16%</td>
<td>0% - +20%</td>
<td></td>
</tr>
<tr>
<td>South</td>
<td>47mm</td>
<td>-16% - +15%</td>
<td>-5% - +21%</td>
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</table>

### Fall

<table>
<thead>
<tr>
<th></th>
<th>Historic</th>
<th>Fall</th>
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<th>2060-79</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>61mm</td>
<td>0% - +2%</td>
<td>-14% - -27%</td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>86mm</td>
<td>+3% - 9%</td>
<td>-5% - -25%</td>
<td></td>
</tr>
<tr>
<td>South</td>
<td>33mm</td>
<td>+9%</td>
<td>-1% - -13%</td>
<td></td>
</tr>
</tbody>
</table>
WHAT CAN WE EXPECT?

- Higher temperatures
- Drier conditions
- More wildfire
- More drought
- More floods
- Shift from snow to rain
- Longer, hotter summers
- Lower late summer streamflow
- Higher, earlier peak flow
- Species redistribution
EXPOSURE
EXPOSURE

- Direct
EXPOSURE

- Indirect
Human response to climate change
Human response to climate change
General Circulation Models (GCMs)
Interpolated values to each cell
Annual Average Temperature
Southern Region
Sierra Nevada

Data Sources:
Historic PRISM data (Gibson et al. 2002)\(^5\)
GFDL (Stouffer et al. 2006, Delworth et al. 2006)\(^6\),
PCM (Washington et al. 2000)\(^7\),
Downscaled following Flint and Flint (2012)\(^8\)

Rev: 2/22/2013
Climate: temperature and precipitation

Grazing management

Vegetation management

Wildfire management

Agriculture practices

Urban/rural development

Beaver

Groundwater

Snowpack

Evapotranspiration

Distribution and density of upland trees

Riparian vegetation

Bank destabilization

Number and intensity of floods

Wildfire frequency and severity

Sedimentation

Upper Yellowstone River hydrograph, water quality, temperature

Domestic and agricultural water withdrawals