PNW Climate Change and Implications for Human Health

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Washington State Health Planning/Adaptation Work Group (Health PAWG)
Overview

This talk:

- Introduces the Climate Impacts Group
- Highlights projected PNW climate change impacts
- Maps key climate change impacts to general PNW human health concerns
- Provides a brief overview on adaptation

This talk does not:

- Provide a definitive list of potential human health impacts
- Provide specific suggestions on adaptive strategies
The Climate Impacts Group

1st of 8 U.S. Regional Integrated Sciences and Assessment (RISA) teams

Areas of study:
• Water resources
• Salmon
• Forests
• Coasts
• [Agriculture, Human Health]

Objectives
• Increase regional resilience to climate variability and change
• Produce science useful to (and used by!) the decision making community
21st Century Global Warming

Projected range of global-scale warming by the 2090s: 3.2°F-7.2°F

Warming expected through 21st century even if CO2 emissions end today due to persistence of greenhouse gases.

Estimated atmospheric lifetime of major greenhouse gas (per molecule):

<table>
<thead>
<tr>
<th>Gas</th>
<th>Estimated contribution from GHG</th>
<th>Lifetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>~60% of warming from GHG</td>
<td>5 to 200 years</td>
</tr>
<tr>
<td>Methane</td>
<td>~20% of warming from GHG</td>
<td>8 to 12 years</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>~6% of warming from GHG</td>
<td>~120 years</td>
</tr>
<tr>
<td>CF4 (Perfluoromethane)</td>
<td></td>
<td>&gt;50,000 years</td>
</tr>
</tbody>
</table>

Data source: IPCC 2001
Projected 21st Century PNW Warming

- Mean change: +2°F (2020s), +3°F (2040s)
- Rate of change expected to be 3x greater
- Warming expected in all seasons

Changes relative to 1970-1999

More detail on the CIG scenarios is available at: http://www.cses.washington.edu/cig/fpt/ccscenarios.shtml
Projected changes in monthly PNW temperature. The lines show changes associated with warm (IPSL-A2), cool (GISS-B1), and “middle-of-the-road” (ECHAM5-A2) climate change scenarios.

All changes are benchmarked to average temperature and precipitation for 1970-1999.

<table>
<thead>
<tr>
<th></th>
<th>Annual</th>
<th>Oct-Mar</th>
<th>Apr-Sept</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2020s</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>+ 0.7°F (0.4°C)</td>
<td>+ 0.4°F (0.2°C)</td>
<td>+ 0.8°F (0.5°C)</td>
</tr>
<tr>
<td>Avg</td>
<td>+ 1.9°F (1.1°C)</td>
<td>+ 1.7°F (0.9°C)</td>
<td>+ 2.1°F (1.2°C)</td>
</tr>
<tr>
<td>High</td>
<td>+ 3.2°F (1.8°C)</td>
<td>+ 2.6°F (1.5°C)</td>
<td>+ 3.8°F (2.1°C)</td>
</tr>
<tr>
<td><strong>2040s</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>+ 1.4°F (0.8°C)</td>
<td>+ 1.1°F (0.6°C)</td>
<td>+ 1.4°F (0.8°C)</td>
</tr>
<tr>
<td>Avg</td>
<td>+ 2.9°F (1.6°C)</td>
<td>+ 2.5°F (1.4°C)</td>
<td>+ 3.3°F (1.8°C)</td>
</tr>
<tr>
<td>High</td>
<td>+ 4.6°F (2.6°C)</td>
<td>+ 4.1°F (2.3°C)</td>
<td>+ 5.4°F (3.0°C)</td>
</tr>
</tbody>
</table>
Figure 2. Change in number of days in 2055-2075 with daily maximum temperature (TMAX) exceeding the 90th percentile TMAX of the present. The number of extreme hot days in Washington State is expected to increase by mid-century relevant to current climate. The increase is likely to be most significant in eastern Washington.

*Figure Source: Leung and Qian (2005)*
• Modest increases (+2%) in annual avg precipitation

• Most of the increase comes in the winter months *but in what intensity?*

• Projected increase in average does not exceed 20th century averages

Note: there is high confidence in projected temp changes, less in precipitation changes
Changes Relative to the 20th Century

**Temperature (°F)**

- Historical variability
- 2020s shift in mean
- 2040s shift in mean
- 2080s shift in mean

**Precipitation (inches)**

Source: Climate Impacts Group, University of Washington
Implications for PNW Resources
Spring snowpack declines as more winter precipitation falls as rain rather than snow, especially in warmer mid-elevation basins.

Warmer temperatures affect the timing and volume of spring and summer streamflow in temperature-sensitive basins.
Overview of PNW Impacts

Water supply
- Increased competition from competing water uses, particularly during summer months
- Increased vulnerability to drought
- Decreased water quality (varies with location and parameter)

Flooding and stormwater management:
- Increased risk of winter flooding and combined sewer overflows in low and mid-elevation basins. Changes in urban flooding less certain.

Salmon:
- Increased stress from winter floods, warmer water temperature, lower summer streamflows
Forests:
- Increased risk of wildfire
- Increased vulnerability to insects
- Decreased growth & regeneration in drier low elevations (with opposite at high elevations)

Coasts
- Increased inundation, erosion, habitat loss, and flooding from sea level rise

Agriculture:
- Increased production from CO2 fertilization effect and warmer spring temps?
- Opportunities for new crops, decreased irrigation supply, increased heat stress/insects
...and Human Health?
Mapping Changes to Potential Health Impacts

<table>
<thead>
<tr>
<th>Projected Change</th>
<th>Potential Human Health Impact</th>
<th>+ or - impact?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warmer summer air temperatures</td>
<td>Increased heat-related morbidity and mortality</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Reduced air quality in urban areas (e.g., ground-level ozone, increased pollen production)</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Reduced air quality in rural areas (via increased risk of forest fires; increased particulates from dust due to drier soils?)</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Reduced water quality (warmer water temperatures expected, less dissolved oxygen at depth likely; overall changes vary with parameter and location)</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Increase in toxin-causing algae that may encourage growth of Harmful Algal Blooms at the surface (via increased winter stratification and warmer temperatures)</td>
<td>Negative</td>
</tr>
<tr>
<td>Projected Change</td>
<td>Potential Human Health Impact</td>
<td>+ or - impact?</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Warmer winter temperatures</td>
<td>Reduced cold-related deaths</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>Reduced polluted runoff from chemical deicing solvents and salt? (due to reduced winter road maintenance [a current problem?])</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>More favorable over-wintering conditions for pests and insects</td>
<td>Positive or negative (depending on the pest or insect)</td>
</tr>
<tr>
<td>Higher winter streamflows</td>
<td>Increased risk of displacement from flooding and erosion</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Reduced water quality (via increased non-point source pollution; overall changes vary with parameter and location)</td>
<td>Negative</td>
</tr>
<tr>
<td>Projected Change</td>
<td>Potential Human Health Impact</td>
<td>+ or - impact?</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Warmer spring temperatures and lower snowpack</td>
<td>Increased risk of vector-born disease from mosquitoes (re: earlier emergence)</td>
<td>Negative</td>
</tr>
<tr>
<td>Lower summer streamflows</td>
<td>Reduced summer water quality (via increased water temperature, concentration of contaminants; overall changes vary with parameter and location)</td>
<td>Negative</td>
</tr>
<tr>
<td>Rising sea level</td>
<td>Increased risk of displacement from flooding, erosion, and/or permanent inundation</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Increased risk of contamination from inundated coastal hazardous waste sites</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Potential for salt water intrusion into coastal aquifers</td>
<td>Negative</td>
</tr>
</tbody>
</table>
Other PNW Human Health Impact Considerations

- Psychological stress from loss of cultural identity in Native cultures (e.g., from decline or loss of key species, loss of reservation land, cultural sites to sea level rise).

- Changes in global disease transmission rates and geographic distribution in the era of planes.

- Some unknowns:
  - Will wind patterns change and alter the distribution of air pollutants locally? Regionally? Internationally?
  - Will precipitation events become more intense, increasing the risk for more combined sewer overflows and other non-point source pollution?
What Is Adaptive Planning?

“Adaptation is not one activity or decision, but rather a continuous set of activities, actions, decisions, and attitudes undertaken by individuals, groups, and governments.”

-- Adger et al. 2005

…with the objective of increasing community and ecosystem resilience to climate change impacts
A climate resilient community is one that has taken proactive steps to reduce the risks associated with known climate change impacts while increasing its capacity to quickly recover from or adapt to those impacts it cannot avoid or anticipate at this time.
Why Adaptive Planning?

- Significant climate change impacts are projected, and the impacts expected within the next few decades are largely unavoidable.

- Decisions with long-term impacts are being made every day. Today’s choices will shape tomorrow’s vulnerabilities.

- Significant time is required to motivate and develop adaptive capacity, and to implement changes.

- Increasing evidence that it will cost more to retrofit for climate resilience than to build it in in the first place.
General Goals in Planning for Climate Change

• Improve community awareness of and preparedness for global warming impacts.

• Build in recognition of a changing climate.

• Reverse trends that increase vulnerability to climate.

• Increase the robustness of long term climate-sensitive decisions and investments.

• Increase the flexibility and adaptability of vulnerable managed systems.

• Enhance the adaptability of vulnerable natural systems.
Summary

- Global and regional climate is already changing.

- These changes are expected to accelerate in the coming decades.

- Potential human health impacts are tied to changes in global health, warmer air temperature, declining snowpack, changes in water quality, sea level rise...others? E.g., changes in the intensity of precipitation?

- The specific magnitude of these potential impacts has yet to be explored for the PNW.
More information on PNW climate impacts and planning for climate change is available from

The Climate Impacts Group
www.cses.washington.edu/cig

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