Executive Summary

Introduction

The Clackamas River Watershed Resilience project was a multi-year project aimed to provide water resource stakeholders in the Clackamas River Watershed (CW) with guidance for managing resilience in the face of climate change. Phase I of this project was primarily funded by PSU Institute for Sustainable Solution to establish a baseline of historical trends in the Clackamas River watershed relevant to climate change and identify issues pertinent to stakeholders in the context of climate change (e.g., diminished summer water supply, water quality degradation resulting from urban development and intense rainfall, etc.). Phase II of this project sought to continue that research with two objectives: (1) Applied Climate Science, (2) Climate Adaptation Planning.

Uncertainty related to local impacts of climate change present a challenge for regions who are making infrastructure investments and policy decisions today that will remain in place for decades. This project aimed to provide locally specific information, at a finer scale than what is available through global climate models about how climate change may threaten water quality and quantity in the Clackamas River basin. Alongside climate scientists, faculty and students with social science and natural resource management expertise worked with the Clackamas river community and key stakeholders to develop recommended strategies for adapting to climate change. This is a summary of the second phase of work for on this project which began in March 2017. A full report from the first phase of work is also available.

Project Goal

The goal of the Clackamas Watershed Resilience project is to help project partners understand local impacts of climate change on water quality and quantity in the region; and develop strategies to sustain a healthy, reliable water source.

Project Team

Portland State University
Dr. Max Nielsen-Pincus, Environmental Science and Management
Dr. Heejun Chang, Geography
Dr. Andres Holz, Geography
Dr. Paul Loikith, Geography
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Erin Upton, Student, Environmental Science and Management
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Beth Gilden, Project Manager, Institute for Sustainable Solutions

Community Partners
Kim Swan, Clackamas River Water Providers
Matt Glazewski, Water Environment Services

Portland State University Student Interns
Hilary Sueoka North Clackamas Watershed Council
Britany Saeman, Clackamas River Water Providers

Project Team Process and Scope

The purpose of this research was to develop future meteorological projections for temperature and precipitation specific to the Clackamas River watershed:

See detailed findings and other related Clackamas Water Resilience research at: https://sites.google.com/a/pdx.edu/maxnp/research/Clackamas-watershed.

1. To understand predicted changes in 21st century climate related to winter temperature, freezing levels, and precipitation trends, and summer heat waves.
2. To answer questions about how predicted changes in 21st century climate, combined with increased development, may influence flow and sediment loading in the Clackamas River watershed.

From June 2018 -June 2019 the project team took on questions related to the impacts of climate change in the CW and worked with local stakeholders to develop strategies for adaptation and resilience.

The Phase II project team included representatives from CRWP, WES, faculty and graduate students from Portland State University, and a project manager from the Institute for Sustainable Solutions. The project team met monthly to discuss research questions, share research updates and findings, and the implications of the results. Research focused on:

- **Projected Changes in Temperature Rain and Snow**
- **Climate and Land Use Changes on Water Quality and Quantity**
- **Current and Future Wild Fire Risk Assessment**
- **Stakeholder Engagement around Water Quality and Quantity**

The team collaborated on the parameters of their research and their findings. The research team considered the same three scenarios for climate change in their analysis using three widely accepted global climate models. By considering three scenarios they aimed to describe the range of likely possibly futures. Graphs showing the local precipitation and temperature change are below.

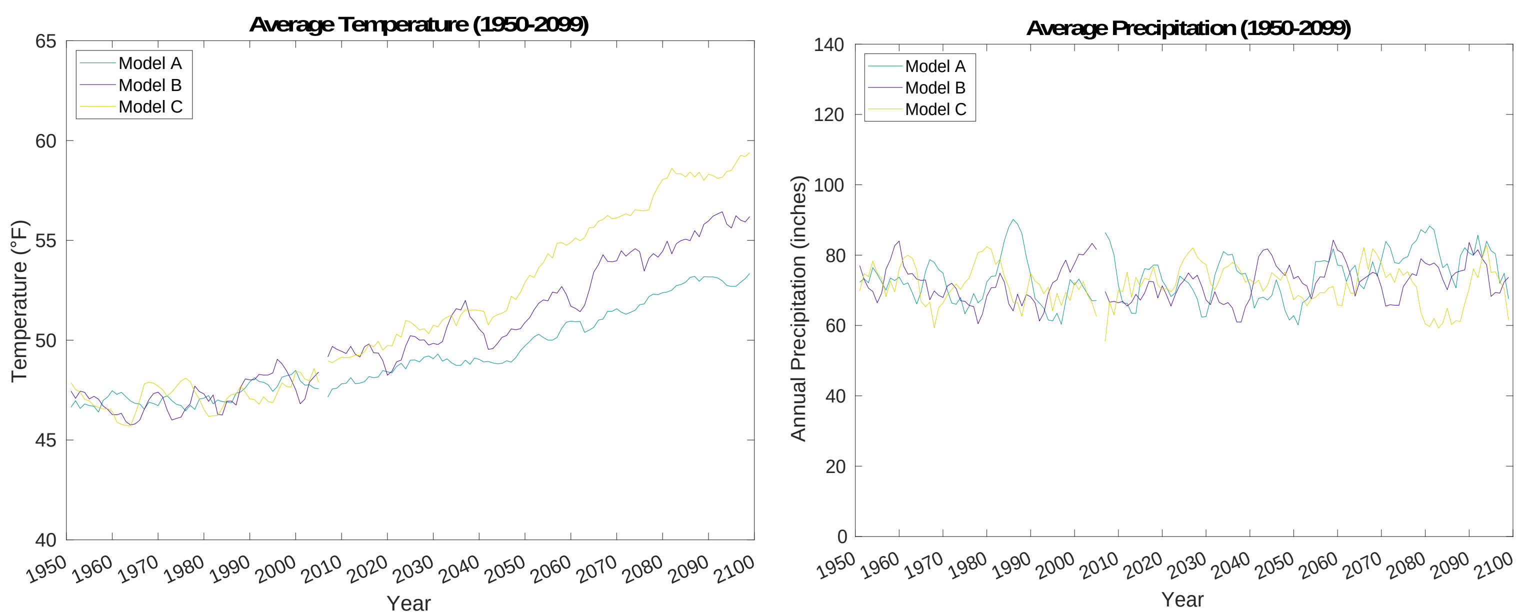

Figure 1. Average annual surface temperature (left) and average annual precipitation (right) simulated under historical (1950 – 2005) and Business-as-usual (2006 – 2099) emissions pathways for three climate models: Mdl A (inmcm4), Mdl B (CNRM-CM5), and Mdl C (HadGEM2-ES36). Temperatures are a five-year mean.

Additional parameters like land use and the influence of other climatological changes were considered for each area of inquiry. The preliminary results were presented to water resource managers and other stakeholders in the Clackamas River Watershed.

Clackamas River Watershed Resilience Project Key Findings

Following are some of the key findings from the phase II work. A more detailed explanation of these findings is in individual reports for each research area which can be found at: https://sites.google.com/a/pdx.edu/maxnp/research/Clackamas-watershed

Key Findings about Temperature, Rain and Snow

1. Average temperatures over CRW increase by 5°F – 8.4°F compared with current climate.
2. Average number of days below freezing (32°F) decreases by 53% – 74% compared with current climate.
3. Average number of days above 90°F increases by 8x – 20x compared with current climate.
4. There are no discernible trends or changes in average precipitation by 2100.
5. The average percentage of days receiving precipitation that are snow decreases from 42.5% to 18.3% by 2 100.
6. At Clackamas Lake, less than 25% of days with precipitation will be snow days by 2040 while less than 10% of days with precipitation will be snow days by 2082. This means that by the end of the century, over 90% of precipitation days at Clackamas Lake will be rain days.

Key Findings about Hydrology Changes

1. Low impact climate change scenario showed streamflow increased significantly during winter months; high impact scenario showed decreasing spring and summer streamflow
2. Average annual top 5% flow increased the most (29.3%) during distant future low impact scenario, while the highest increased flow during the near future period will likely occur under moderate impact scenario
3. Summer flow during August is expected to decrease below 6 cms (200 cfs) for low and high impact climate scenario
4. Annual sediment load trend is similar to streamflow, but low impact climate scenario showed the most significant increase in CRW in the 2050s and 2080s compared to historical data.
5. The magnitude of extreme sediment loading events is increasing in the low impact climate scenario, suggesting near future water quality may diminish

Key Findings about Fire Risk (Preliminary results)

1. Currently there is less than 1% chance of a fire growing larger than 50,000 acres; projections indicate that by mid-century that probability will be 5%, nearly 7x greater than today.
2. Conservatively, we estimate that the average annual area burned inside the watershed will increase 4x to over 13,000 acres.
3. Fire season length is not predicted to change significantly, but within each fire season we predict more days of high and extremely high fire danger.

Key Findings from Stakeholder Engagement

1. Participants noted the importance of translating scientific data to interpretable narratives for stakeholders and broader audiences to help communicate the potential impacts from climate change and relevant adaptation options.
2. Existing activities and future opportunities focused around the themes of infrastructure considerations, environmental conservation efforts, planning and management initiatives, community and professional engagement, and investment in science and research.
3. Discussion about priorities for the future focused on (1) maintaining ecosystem health for the CRW (including the river, tributaries and forested areas), (2) focusing on education and outreach efforts, (3) increasing organizational collaboration and program efficiency, and (4) establishing management and research priorities.
4. Adaptation strategies will likely fall into one of four categories: (1) Alternative, bigger, or new green and grey infrastructure for drinking, storm, and wastewater management. (2) Alternative sources of drinking water. (3) Alternative land management strategies that impact watershed health and function. (4) More robust water conservation strategies implemented by water consumers.

Next Steps

There are significant opportunities to build on the work completed in the second phase of the Clackamas Watershed Resilience project. In order to fully understand the impacts of the climatological changes described by these researchers, we need to investigate how these changes would impact existing ecosystems, ground water availability, and infrastructure—tying the predicted changes to the real built and natural resources in the county. Investigating the impacts on local assets in more detail would allow decision makers in the region to choose appropriate adaptation strategies, policies and investments.

The research also reveals the immense opportunity for climate change mitigation work in the region that should be considered alongside the predicted growth. From the initial work with the stakeholders, the project team specifically recommends incorporating climate impact research into current and near future projects and initiatives in the watershed, such as the Clackamas County Climate Action Plan and the Clackamas County Watershed Health Plan, local cities' climate action plans, and US Forest Service climate vulnerability assessments.