How to Use *Climate Mapping for a Resilient Washington*: a Web Application for Climate Resilience Planning in Washington

Climate Mapping for a Resilient Washington (CMRW) is a resource for your jurisdiction to explore climate impacts that can inform local vulnerability assessment and resilience planning. The interactive web application displays and summarizes changes in Washington's climate at the state and county level. Users have options to download data, tables, and figures that depict changes for the county in which they are located. This scientific information can inform your local vulnerability assessment, and when combined with current local conditions that affect vulnerability, it can also inform policies and actions to increase climate resilience.

For users who are using *CMRW* along with the *Climate Element Planning Guidance* developed by Washington State Department of Commerce, this users' guide is linked to Section 3, Step 1 of the guidance document.

This users' guide describes the steps a local jurisdiction can take to use CMRW to explore local climate impacts for multiple sectors and planning areas. CMRW includes 11 sectors: Agriculture, Buildings and Energy, Cultural Resources and Practices, Economic Development, Ecosystems, Emergency Management, Human Health, Transportation, Waste Management, Water Resources, and Zoning and Development. Information is provided for seven climate hazards: Drought, Extreme Heat, Extreme Precipitation, Flooding, Reduced Snowpack, Sea Level Rise, Wildfire.

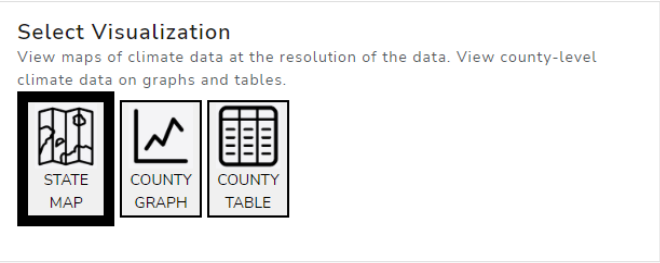
This guide explains how to:

1. View climate hazards by planning sector on a state map and by county;
2. View climate indicators for scenarios and time periods in the future;
3. Find information on how to explore local climate impacts and other factors that can affect exposure and sensitivity to changes in the climate at the local level;
4. Download maps, tables, graphs, and data by county.

This users' guide focuses on how to use the CMRW web application and the steps to follow to explore local impacts in your area. More information and sources for climate data contained within the web application are available through the web application by selecting options from the menu bar at the top of the screen.

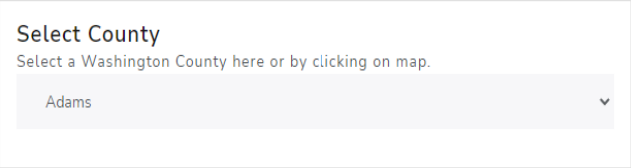
Questions about this guide or data and information contained within the web application can be directed to Matt Rogers at rawrgers@uw.edu at the Climate Impacts Group.

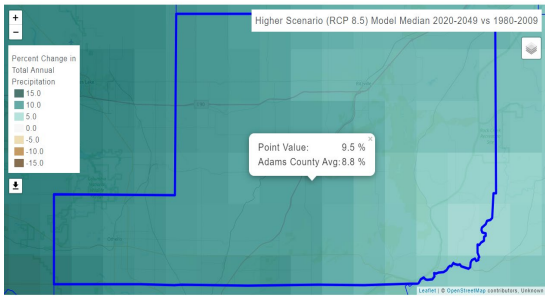
1. Select Visualization. Climate impacts can be viewed at the state level or for the county in which you are located. Selecting "County Graph" or "County Table" displays a summary of the climate impacts in your county (see steps 8 and 9).



Note: *The map is most useful for initial exploration of climate changes in your area. County-specific graphs and tables (see steps 8 and 9) are most useful for viewing detailed changes expected for your area.*

2. **Select County**. Selecting your county from the drop-down list will focus the map on that county. You can also select a county by clicking on the county in the state map. Clicking on the county in the map will also produce a pop-up box with the county average value of a climate indicator, as well as the point value for the location of the cursor.





What about data for my city or town?

Climate Mapping for a Resilient Washington provides climate information summaries at the county level because in many cases the precision of the modeled climate data is not sufficient to provide projections at the scale of individual cities or towns. In most cases, the county-level summaries also apply to the cities and towns in those counties. For some indicators of climate change that vary substantially with elevation, such as changes in snowpack or streamflow, cities and towns can consider the variation within the county as shown on the map. For most climate indicators, within county and local variation in climate impacts will depend more on existing local conditions that affect exposure and sensitivity to climate change **(See Step 7)**.

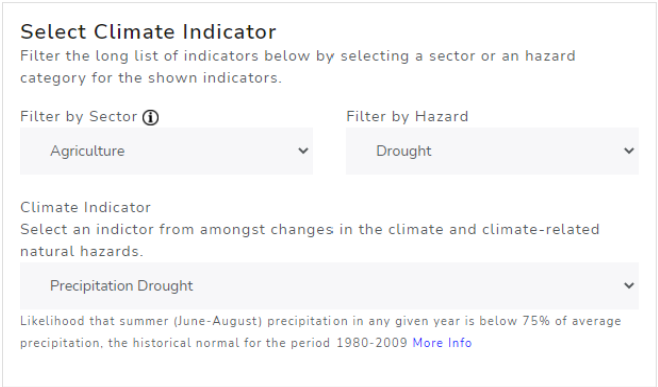
Data on climate exposure in the web application should be used in combination with local data and expertise on current conditions.

3. Select a Climate Indicator. After selecting your county, you can select indicators of changes in the climate for your area on the map. The indicators you use for your assessment and planning depend on which sectors and hazards you are planning for or are concerned about. A short list (1-6) of indicators is provided for each sector-hazard combination.

3a. Filter by Sector. To view climate indicators that are relevant for a planning sector, use the "Filter by Sector" drop-down menu to see climate indicators for a specific sector. For example, by selecting “Agriculture,” the list of climate indicators will be filtered to those that are relevant to agriculture. CMRW includes 11 sectors: Agriculture, Buildings and Energy, Cultural Resources and Practices, Economic Development, Ecosystems, Emergency Management, Human Health, Transportation, Waste Management, Water Resources, and Zoning and Development.

3b. Filter by Hazard. To view climate indicators that are relevant for each climate-related hazard, use the "Filter by Hazard" drop-down menu to see climate indicators for a specific hazard. For example, by selecting “Drought”, the list of climate indicators will be filtered to those that are relevant to drought. CMRW includes information on seven climate hazards: Drought, Extreme Heat, Extreme Precipitation, Flooding, Reduced Snowpack, Sea Level Rise, and Wildfire.

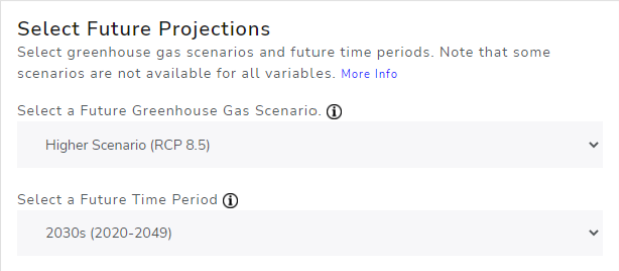
3c. Select Climate indicator. For each sector-hazard combination, a filtered list of climate indicators will be available that depicts changes in the climate relevant for that sector and hazard. For example, a climate indicator for the agriculture sector and the hazard of drought is “Precipitation Drought.” A definition is displayed below the selected indicator. Precipitation drought is the likelihood that summer precipitation in any year is below 75% of average precipitation. Clicking on “More Info” provides more information about the display. Multiple indicators are available for some sector-hazard combinations. Which indicators you use depends on what you are planning for. For example, if you are concerned about dry-land agriculture you may select “Precipitation Drought”, but if you are concerned about irrigated agriculture, you would select warm season streamflow.



These steps can be repeated for all sector-hazard combinations that are relevant to your climate assessment or resilience plan.

Note: *Not all hazards will be relevant to all sectors in your area. Some sector-hazard combinations have more indicators than others.*

4. **Select Future Projections.** For each climate indicator, the webtool displays different future climate conditions, or projections, based on different climate scenarios and time periods. The default display in the map view is for a higher climate scenario (RCP 8.5) and changes that are expected for 2020–2049.



4a. Select a Future Greenhouse Gas Scenario. Compare how the selected climate indicator is expected to change for a higher or lower climate scenario. Scenarios represent a standardized set of assumptions about humanity's trajectory that lead to different concentrations of greenhouse gases in the atmosphere. The higher scenario (RCP 8.5) causes more warming by 2100 compared to the moderate (A1B) and lower (RCP 4.5) scenarios, but all scenarios are similar before 2050 and only differ thereafter. For near-future (before 2050) applications, the choice of scenario is less important than for late-century applications.

Key Point: For late-century applications (after 2050), we recommend that you explore multiple scenarios to determine if the differences matter for your climate assessment or planning.

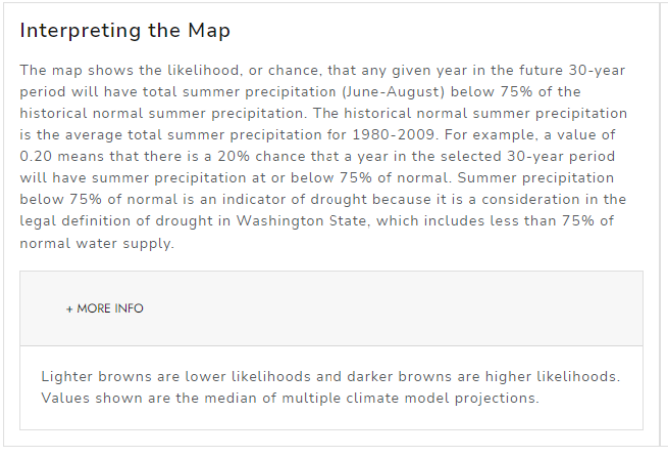
Note: *Data are not available for all greenhouse gas scenarios for all climate indicators.*

4b. Select a Future Time Period. Compare how the selected climate indicator is expected to change through the 21st century. Changes in the climate are summarized as the average over 30-year periods. The drop-down menu lists the years that are the center decade for each 30-year period. For example, 2030s is the period 2020–2049. For the purpose of climate assessment and planning, we recommend that you use a time period that is consistent with your planning horizon. However, later time periods may also be important to consider because some climate resilience actions will require years to decades of planning before implementation. Also, because some assets and infrastructure last for decades to centuries once built, these assets will be exposed to changes in the climate well beyond the initial planning horizon**.**

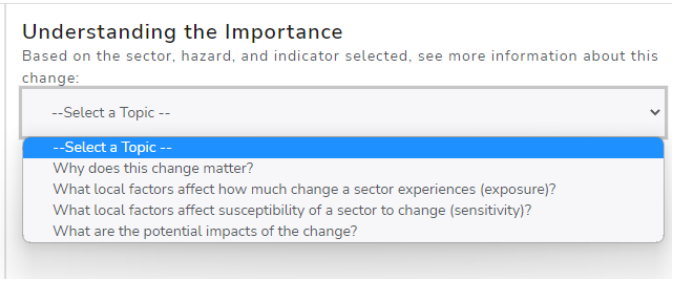
Key Point: Comparing multiple scenarios and time periods will help your jurisdiction to align your periodic climate impacts analysis with your plan horizon and update cycle.

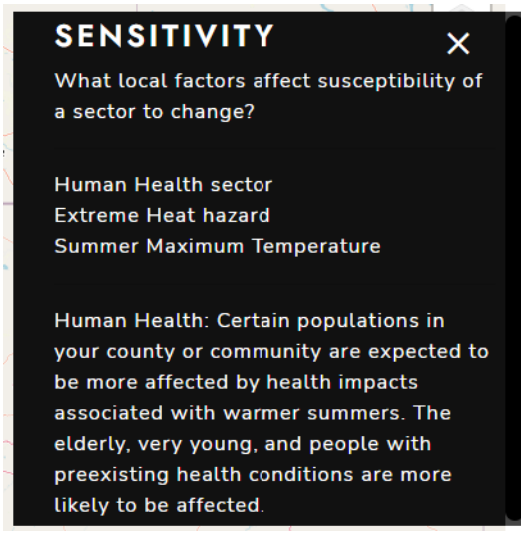
Note: *Data are not available for all time periods for all climate indicators.*

5. Interpret the Map. Once you have made the selections described in steps 3 and 4, the "Interpreting the Map" box below the map describes the selected climate indicator and provides an example.



6. Understand the Importance. CMRW provides information with the climate indicator to help you put the climate indicator in the context of local factors that affect local exposure and vulnerability to the change. For each sector-hazard combination, CMRW provides information to help ask questions about local exposure, sensitivity, and impacts. Select a question from the drop-down menu under "Understanding the Importance" and a pop-up box will appear that describes the types of local conditions to explore for that sector-hazard combination.



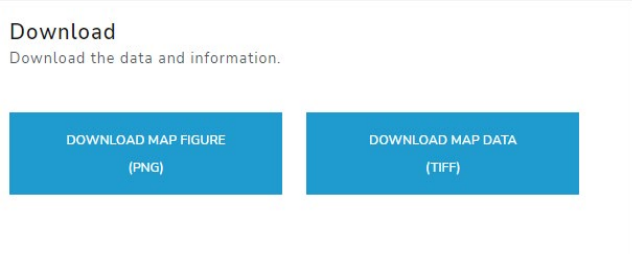


Key Point: It is important to consider the climate indicator along with local information because it is this information that will produce within jurisdiction granularity in future climate impacts. For example, indicators of changes in extreme heat should be considered with information about land use that can affect local heat exposure (such as paved areas vs. parks and open space) and the density of vulnerable populations (such as low income, elderly, or very young) that will be more susceptible to heat extremes.

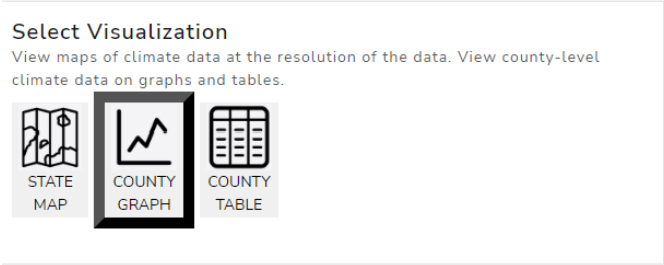
Related Resource: Climate Element Planning Guidance

The Washington Department of Commerce's **Climate Element Planning Guidance** provides a model process and resources to help local jurisdictions integrate CMRW data and local information into a vulnerability and risk assessment that considers local assets' sensitivity, exposure, and other attributes. Conducting such an assessment can help local jurisdictions to identify their highest relative climate risks and to develop tailored planning goals, policies, and implementation strategies and actions.

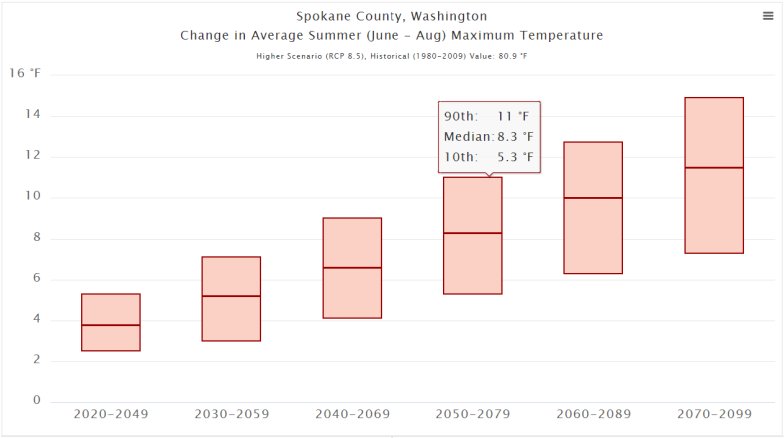
7. Download the map image or data. Once you have explored projected indicators of climate change, you can download the map as an image (.png file) or data displayed in the map (.tiff file meant for use in Geographic Information Systems) to be used in your local climate assessment or plan.



8. View County Graph. In addition to viewing the selected climate indicator on a map, you can also view county summaries of the climate indicator for all scenarios and time periods. This option is most useful if you want to explore in more detail an important climate change indicator for your area. You can repeat this step for all relevant climate indicators.

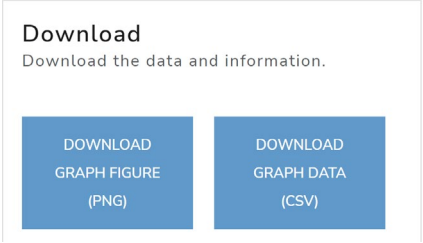


8a. View County Graphs. Graphs of the indicator depict the expected changes for your county for all future time periods through 2100, as well as the expected range among models for each time period. By hovering your cursor over the graph, you can see the high (90th percentile), low (10th percentile), and median values for each time period. We recommend considering a range of possible changes rather than only a single value because the exact future condition cannot be known with certainty. Values can be displayed for all available climate scenarios by selecting the future greenhouse gas scenario.



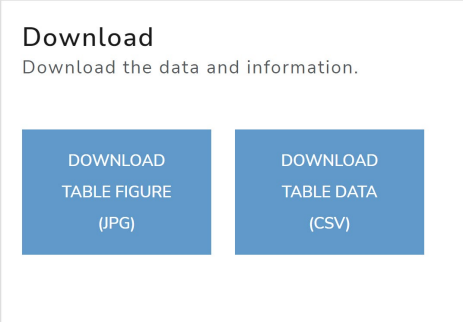
8c. Interpret County Graph. As with the map view, the "Interpreting the Graph" box below the graph describes how to read the graph for the selected climate indicator.

8d. Download County Graph. You can download an image (.png file) of the graph or a file (.csv) containing data shown in the graph.



9. View County Table. In addition to graphs, county-specific values for the selected climate indicator are provided in a table that shows the values for all climate scenarios and time periods through 2100. Values include the median and range of the future values, as well as the historical baseline.

9a. Download County Table. You can download an image of the table (.png file) or the data in the table (.csv file), which can be used to develop your own custom tables for plans, reports, or presentations.



SPOKANE COUNTY
CHANGE IN AVERAGE SUMMER (JUNE - AUG) MAXIMUM TEMPERATURE

	MODEL MEDIAN	MODEL RANGE (10TH TO 90TH PERCENTILE)
1980-2009		
Historical Baseline	81 °F	80 to 81 °F
2020-2049		
Higher Scenario (RCP 8.5)	3.8 °F	2.5 to 5.3 °F
Lower Scenario (RCP 4.5)	3.1 °F	1.4 to 4.4 °F

What if I want more specific climate data to support implementation?

Climate Mapping for a Resilient Washington is designed to provide state agencies, local governments and communities across the state with data and information on the expected changes in the climate and related natural hazards. These data and information are intended to inform education, awareness, assessment, planning, and prioritization of climate resilience strategies and actions. Because CMRW covers many climate hazards, sectors, and indicators at a high-level, these data and information may not be insufficient to inform specific project designs or engineering needs for implementation. For some changes in the climate, other resources and tools are available that provide more detailed information for climate impacts and sectors, such as the resources listed below, which were also developed by the Climate Impacts Group.

Projected Changes in Extreme Precipitation is designed to provide data and visualizations of projections of heavy precipitation for use in stormwater planning.

Interactive Sea Level Rise Data Visualizations provide more detailed site-specific projections of sea level rise for a more scenarios and time periods.