



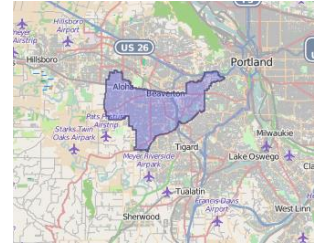
Climate Change in Oregon's 14th Senate District

May 2023



History, Projections, and Consequences

1. The temperature has risen some 1°F during the last half of the 20th Century and may rise 8°F by the end of the 21st Century.
2. While precipitation has been steady and is likely to remain so annually, wetter winters and drier summers.
3. The trend of declining snowfall will continue through the century, possibly dropping to 10% of historic levels by 2100.
4. These precipitation projections, combined with the trend towards increasing heavy rainfall and reducing light rainfall will likely increase flooding and compromise irrigation availability in those months when it is most needed.
5. Several important forest species both commercially and in terms of forest composition will likely be compromised as climate change overtakes the District.
6. The western wildfire season is already 105 days longer than in the 1970s, while reduced snowpack, warmer summers and earlier snowmelt will increase wildfire risk, with 200 – 300% of the area burned by mid-century.
7. Agricultural activities such as wine growing that depend on temperature and water are likely to be threatened through the century.
8. As sea levels rise, increased urban storm damage and destruction will be probable in addition to the loss of beaches and coastal wetlands.
9. Those engaged in agriculture, forestry or fisheries will be most affected by the forthcoming climate trends, will need most to adapt, and probably should be most supportive of mitigation efforts.
10. The main climate impacts to health are likely to be: storms, floods, and sea level rise. The main health concerns will be: disruption in core services, injuries, displacement, landslides, income loss, economic instability, and mental health impacts. Vulnerable communities will be: low-income households, older adults, people living on steep slopes, farmers of fish and shellfish, first responders, and children and pregnant women.
11. To achieve required emissions reduction goals, we need to reduce emissions 45% below 2010 levels by 2030; this requires immediate action!



Compiled by Alan Journet (alanjournet@gmail.com, 541-301-4107) & Brianne Foster (fosterb2@sou.edu, 971-404-6181) April, 2015

Updated by Hogan Sherrow (hogan@you-evolving.com, 541-415-1013) March, 2023

For more information on these points, see the full summary at: <http://socan.eco/oregon-legislative-districts/>

Oregon Senate District 14 Climate Summary

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July, 2017

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Global and Regional Temperature:

Data from NASA and NOAA reveal that the Global and U.S. atmospheric temperatures have increased substantially since 1880 (Figures 1 and 2) with the greatest effect occurring in the last five decades.

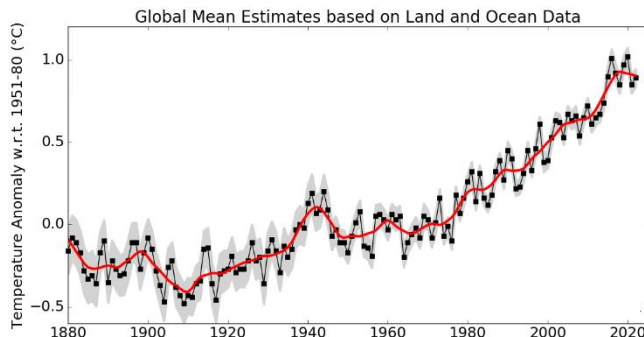


Figure 1. Historic global temperature trend (NASA 2023).

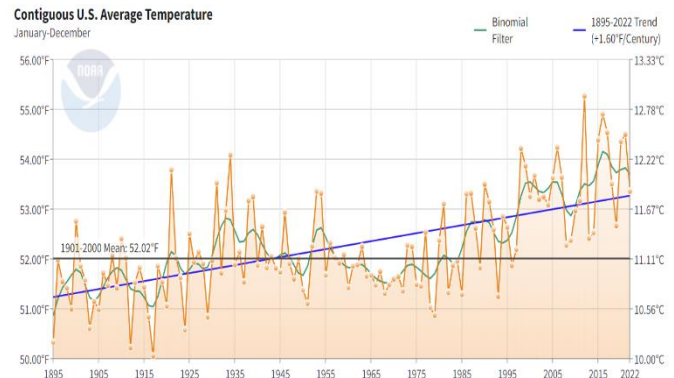


Figure 2. Historic U.S temperature trend. (NOAA 2023).

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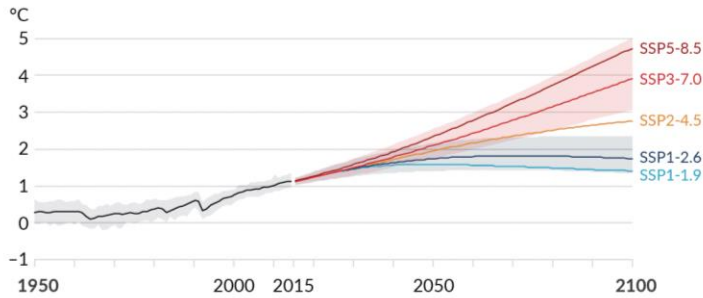


Figure 3. Global temperature projections to 2100 relative to the 1850-1900 average. (IPCC 2021).

Concentration Pathways (RCPs) previously employed by the IPCC in that they include characterization of the human behavior that leads to specific projected atmospheric greenhouse gas concentrations. The SSP5-8.5 pathway incorporates a: “push for economic and social development ... coupled with the exploitation of abundant fossil fuel resources and the adoption of resource and energy intensive lifestyles around the world.” Effectively this seems to echo the RCP8.5 projections employed in the previous IPCC report and is the trajectory we are currently following globally. This scenario would likely result in global temperatures in the range of 3 to 5.1°C (5.4 to 9.18°F) above pre-industrial revolution temperatures by 2100 (Figure 3).

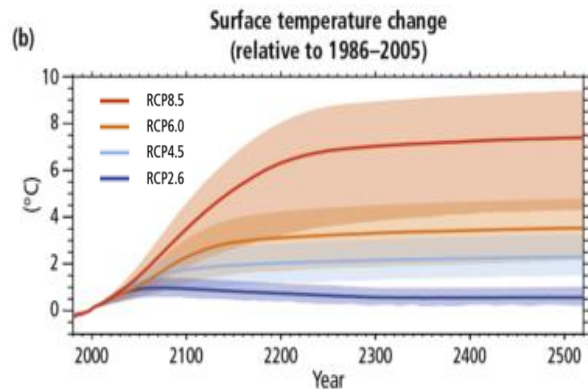


Figure 4. Long term global temperature trends according to RCP values. (Jones 2017).

Meanwhile, projections further into the future have been provided by the Intergovernmental

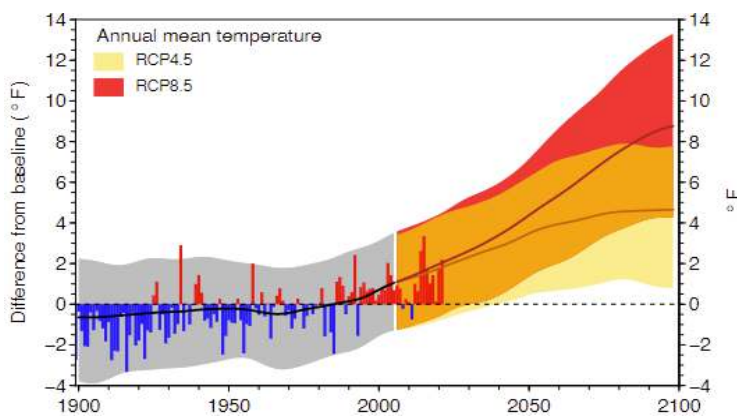


Figure 5. Oregon temperature history and projections through the century; baseline: 1970 – 1999 (Fleishman 2023).

Panel on Climate Change (IPCC) in terms of RCP scenarios (Figure 4) The RCP 2.6 scenario assumes we rapidly eliminate emissions, whereas RCP 8.5 assumes we follow the current trajectory of accelerating emissions. RCP 6.0 and 4.5 assume intermediate trajectories of emissions between the extremes. Note that only the RCP2.6 scenario results in a long-term global temperature increase below 2°C above pre-industrial

conditions - the upper target for the 2015 Paris Agreement. Because the actual temperature trajectory we have experienced follows the RCP 8.5 scenario this has been dubbed the Business-As-Usual (BAU) scenario; we have yet to undertake sufficient actions globally to slow this trend.

Meanwhile, temperature projections for this century in Oregon (Fleishman 2023, Figure 5) suggest a similar range of temperature increases possibly reaching over 13⁰F above the 1970-1999 average by the end of the century under the BAU scenario (RCP 8.5).

Whether we consider the global or Oregon future, the higher range of temperature increase would be unmanageable. It would devastate natural systems (see below:) and simultaneously threaten our climate dependent agricultural, ranching, and forestry activities. Bark beetle and other pest destruction of forests would likely increase as warmer temperatures enhance insect growth and development rates and enable larger overwintering populations. Similarly, invasion of natural and agricultural systems by drought tolerant invasive species and pests will likely be enhanced.

Regional Precipitation:

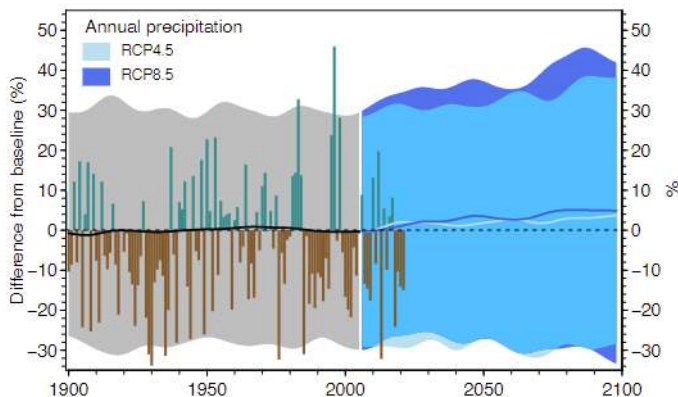


Figure 6. History and projections for precipitation statewide. (Fleishman 2023).

Annual precipitation is expected to increase very slightly (if at all) in Oregon through the balance of this century (Figure 6). However, the 2018 US Climate Change Assessment Report (Easterling *et al.* 2017) provides projections for seasonal late century precipitation patterns (Figure 7) according to the 'business as usual' RCP 8.5 scenario.

The region generally is expected to exhibit fall and spring seasons that are little different from historical patterns, with winters possibly a little wetter. Notably, however, accentuating the Mediterranean 'winter wet - summer dry' climate, winters will be wetter, and summers will likely be drier.

This Mediterranean climate exists in just 6 locations across the globe (IUCN undated) and leads to soils and vegetation drying out during summers such that vegetation tends to be fire prone, fire adapted and fire dependent (Safford *et al.* 2021).

Evaporation caused by increasing temperature will likely counter any increase in precipitation such that drought conditions continue. Water resources, already severely compromised in many locations, will become more threatened as snowpack continues to decline. Meanwhile, the current trend of precipitation occurring more frequently as severe storms rather than the light drizzle that replenishes soil moisture will continue. This will likely increase the risk of floods, soil erosion and landslides.

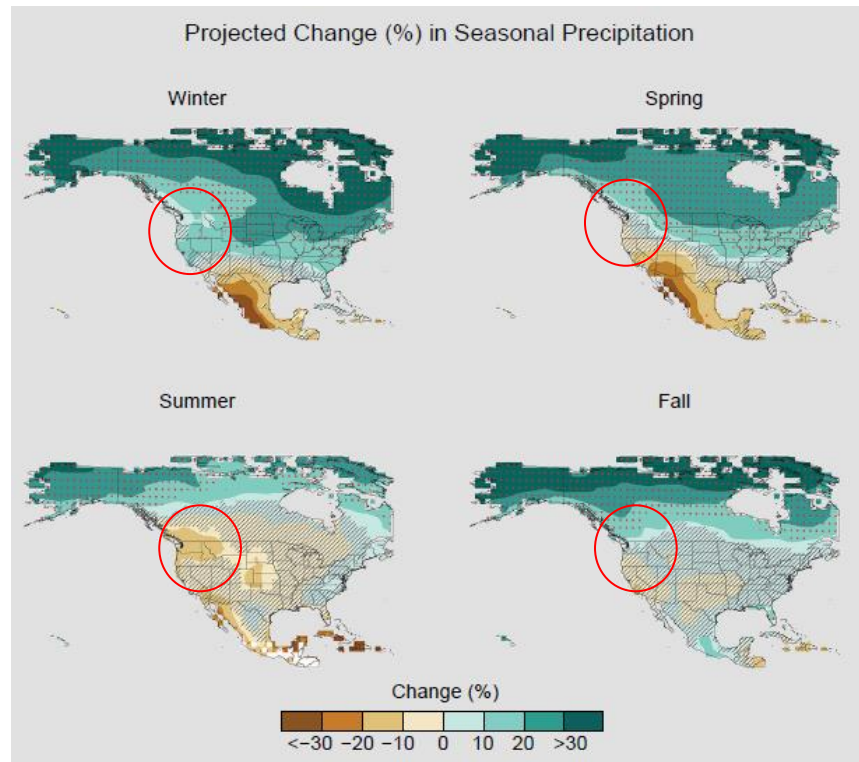


Figure 7. Projected change in precipitation to 2077-2090 compared to 1960-2005 average; stippled areas indicate large change compared to natural variation; hatched areas small change. (Easterling *et al.* 2017).

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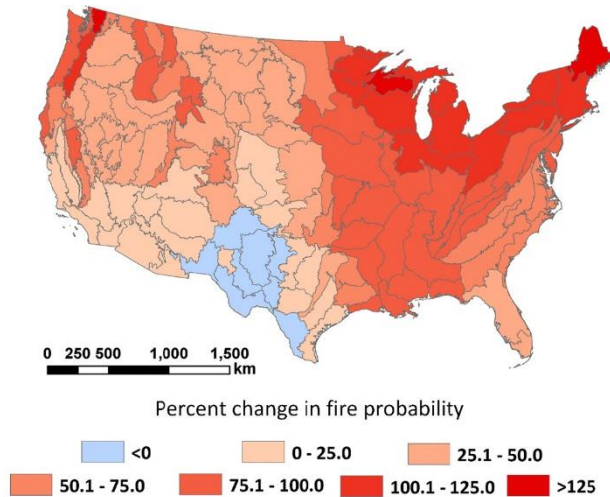


Figure 8. Potential increase in fire risk from the 1971-2000 baseline across the U.S. assuming the RCP 8.5 scenario. (Gao *et al.* 2021).

Stream and river flow occurring during summer/fall will decline and become warmer compromising many iconic Pacific Northwest cold-water aquatic species. Meanwhile, peak river flow will continue to advance earlier in the year, even reaching late fall of the previous year.

Gao *et al.* (2021) depicted the increasing risk of fire across the nation (Figure 8) under the RCP 8.5 scenario indicating that this would likely lead to increased fire probability throughout most of Oregon of at least 50%.

Several years ago, the national climate assessment, (Melillo *et al.* 2014) reported the impact of increasing temperature of just 2.2°F on area burned from wildfire, a condition potentially arriving by mid-century (Figure 9). The range in increase is from 100% meaning a doubling of the area burned to 700% meaning 8-times the current area.

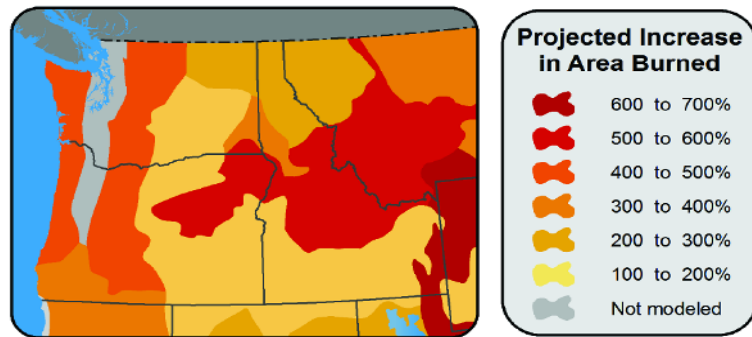


Figure 9. Anticipated wildfire consequences of a 2.2°F warming in area burned (Melillo *et al.* 2014).

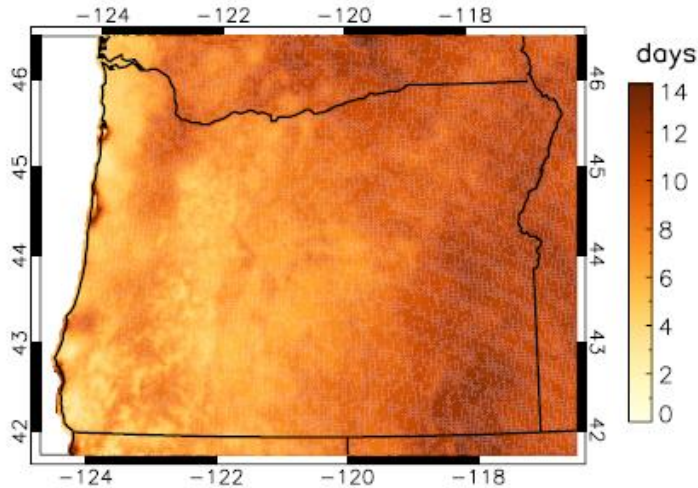


Figure 10. Increase in number of days experiencing high fire risk by mid- century (2040 - 2069) compared to the end of the last century (1971-2000). (Mote *et al.* 2019).

Mote *et al.* (2019) presented a summary of the potential increase in extreme fire risk days by mid-century (2040 - 2069) compared to historical conditions (1971 - 2000) where an increase of up to 14 days in the SE corner of the state is expected (Figure 10).

The fire season, already extended by 105 days since 1970s (Kenward *et al.* 2016), will likely become longer and more severe in Oregon. Even though our natural ecosystems have evolved with fire and are thus fire prone, fire

adapted, and fire dependent, future trends may pose a serious threat to ecosystem ongoing health. In addition, of course, both human safety and human health will likely be threatened. . It was recognized long ago (Westerling *et al.* 2006) that warming and early spring snowmelt correlate with increasing fire risk.

Natural System Consequences

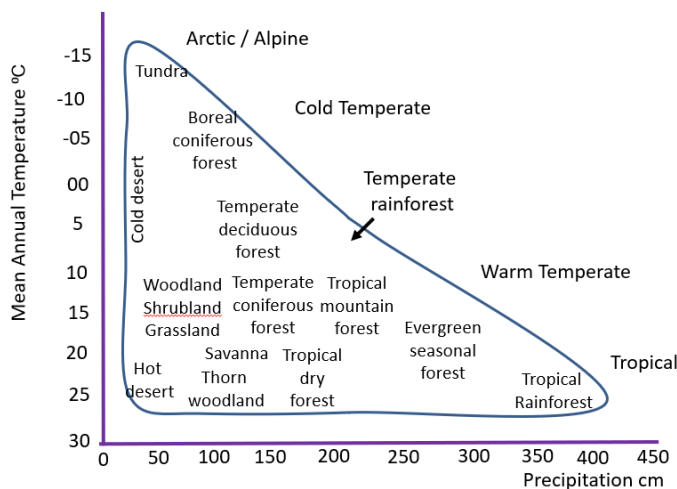


Figure 11. Global distribution of natural ecological systems (biomes) in relation to mean annual temperature and precipitation patterns. (Modified from Whittaker 1975).

That the geographic distribution of our natural ecological systems (biomes) is largely determined by the variables of temperature and precipitation (water availability) has been understood for decades. Community ecologist Robert Whittaker (1975) developed a classic chart indicating this relationship (modified in Figure 11). The chart depicts the climatic conditions that allow each of the designated biomes to exist. The critical message is that even a small shift in either of these variables from current conditions may threaten the viability of the biomes and the

species of which they are comprised. This will be especially true for biomes currently existing at the edge of the climatic range that they require. It is especially worth comparing these temperature ranges to the potential shifts in Oregon's temperature through the century (Figure

5) from which it is evident that most of our state's precious natural systems will be threatened, and some (especially high-altitude cool climate systems) will likely be eliminated under future conditions. It is worth noting, also, that the same variables control our agricultural productivity, and clearly, our forest viability. Thus, climatic shifts of the dimensions anticipated, absent any adjustment in our collective behavior that thwarts that trajectory, will likely compromise agriculture and forestry throughout the state. Indeed, Dalton *et al.* (2017) indicate not only that "different trees have varying degrees of sensitivity to climate change and adaptive capacity." but also that "suitable climates for many important tree species and vegetation types may change considerably by the end of the 21st century...." Climate envelope projections (Rehfeldt and Crookston 2023), which assess the optimal conditions for tree species on the basis of their current and recent historic range and map these condition into the future, suggest that under the RCP 8.5 scenario, several species will likely suffer range reduction: Douglas fir, Western hemlock, Ponderosa pine, Grand fir, Western larch, Sugar pine, White fir, Pacific madrone, Western juniper, Western redcedar, Tanoak, and California laurel. Meanwhile, by the end of the century, the following species will likely find the Oregon climate completely outside their range (i.e., they will be extirpated from the state): Sitka spruce, Engelmann spruce, Lodgepole pine, Subalpine fir, and Jeffrey pine. Oregonians dependent on commercial timber harvest should be the first to demand climate action in the state.

Coastal Concerns:

Though much of Oregon is land-locked, and will suffer little directly because of ocean consequences, coastal regions and economies will have to contend with warming oceans, sea level rise, and increasing ocean acidification.

Warming Oceans. Although there is considerable seasonal fluctuation in ocean temperature, warming of oceans in the Northwest are already documented with a reported and anticipated increase at the rate of 0.35°C per decade (Alexander *et al.* 2018) off the coast of Oregon over the period 1976 - 2099. Besides influencing species directly, temperature changes impact such events as algal blooms and shellfish poisoning.

Sea Level Rise. Sea levels are rising and will continue to rise for two reasons: First, water expands as it warms from 4°C (approximately 37°F). Thus, as the ocean warms, it inevitably expands, and sea level inevitably rises. Second, as land borne ice enters the ocean, whether as water or ice, it increases the volume of the ocean. Both these phenomena have already caused sea level to rise and are expected to continue this impact. The impact is influenced by the pattern of land adjustment: if land is rising, the impact is reduced, whereas subsiding coastal land will exacerbate the impact. This complication is particularly relevant to the impact of the Cascadia Subduction Zone (CSZ) where a rising or falling land tectonic plate will influence apparent and locally detected sea level rise along the coast. The impact of the oceanic Juan de

Fuca plate sliding under the continental North American plate is a rising continental plate (Lieberman 2012) apparently confounding the ability of a land-based gauge to detect sea level rise. However, should the earthquake occur, there will likely result a drop in the land level of a meter (3 feet) or so. Mote *et al* (2019), however, indicate that by century's end, the actual sea level rise off the coast of Oregon could plausibly reach 8 feet, a value reiterated in Fleishman (2023). During storm surges, a higher sea level will generate conditions that promote far greater storm damage and flooding than would otherwise have been the case. The impact of Hurricane Sandy in 2012 was a perfect illustration of this problem. Not long ago, the suggestion that New York subways could be flooded by a coastal storm would not have been taken seriously – yet it happened! Results of ocean rise, such as increased erosion and compromised coastal habitat integrity for tidal flat, estuary, and marsh natural communities, could become serious.

Ocean Chemistry. Serious as direct climatic consequences are, they do not constitute the sum total of the impacts of our emitting carbon dioxide into the atmosphere.

Because carbon dioxide is absorbed by our oceans, and is transformed into carbonic acid, oceans are becoming more acidic. This is detrimental for marine organisms with carbonate-based shells since either they are unable to form shells in acidic conditions, or they lose shells already established. Bednaršek, *et al.* (2020) demonstrated that ocean acidification off the coast of Oregon is already having a negative effect on Dungeness crab (*Metacarcinus magister*) shell formation and durability. Dungeness crab is one of the most valuable species on the Oregon coast, and the further acidification of our coastal waters could be catastrophic for this population. The losses to the Northwest coast oyster industry, where larvae lose their capacity to form shells, is costing hundreds of thousands of dollars (Ben Achur 2022). Additionally, acidosis, a build-up of acidic conditions in the tissues, threatens many marine life forms. Finally, warming oceans exhibit reduced oxygen levels, potentially critical for marine animals since, like terrestrial animals, they rely on oxygen for basic metabolic respiration.

These consequences of increasing atmospheric greenhouse gases (notably carbon dioxide) pose threats to marine life, and thus to our fisheries, coastal economies, recreation, and tourism.

Rural vs Urban Oregon:

Rural communities are typically characterized by local economies and livelihoods that are reliant on direct interactions with the environment through agriculture, timber, fishing or outdoor based tourism activities. Urban communities, by contrast are typically characterized by local economies and livelihoods that are reliant on activities that do not include direct interactions with the environment. The result is that climate change has a far greater direct effect on rural communities than urban areas, including the direct effects of reduced snowpack,

decreased river levels, rising seas, altered growing seasons, extended drought, increasingly hot summers, and increased wildfire risk. This has led to the misconception that urban communities are not vulnerable to the impacts of climate change.

While rural communities are on the frontlines of the climate crisis and some of the most vulnerable communities across Oregon, urban areas are also vulnerable. The heat related deaths in the Portland-metro area in the summer of 2020 and the Labor Day fires later that year demonstrated that urban areas are under direct threat from the impacts of climate change. Beyond the direct impacts of climate change, urban areas rely on healthy rural regions for their water supply, their agricultural, and forestry products and recreational activities in wild and less developed areas. Indirect effects, therefore, can be substantial. Climatic events that compromise natural systems, and thus urban watersheds, and regional agriculture and forestry will also have a profound impact on life in the urban centers. This impact will not be limited to impacts on prices of food and wood products but will also compromise regional recreational opportunities. Additionally, because the Pacific Northwest is projected to suffer less than most of the country from the warming climate, the region will become the target for climate refugees from across the U.S. These migrants will increase our population and place a greater burden on our natural resources and dwindling water supplies.

The 14th Oregon Senate District Climate History and Projections:

Historic trends and mean minimum and maximum projections temperature for Washington, Clackamas and Multnomah Counties (Figures 12 – 14) indicate warming since the 1970s and a future rise of a further 7- 9°F compared to the 1981-2010 average if the business-as-usual scenario is followed – but less if we reduce emissions.

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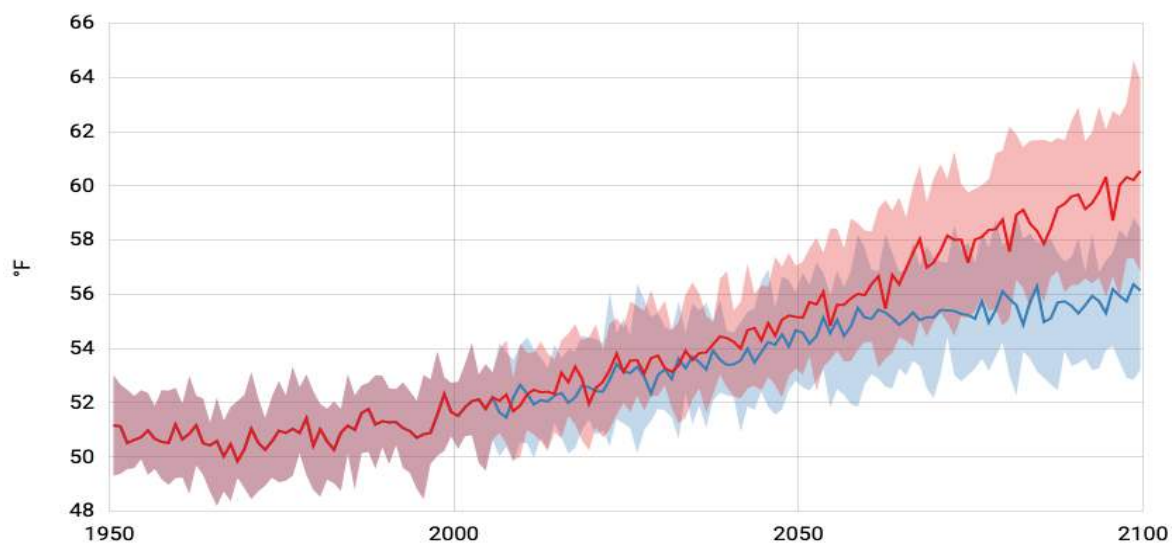


Figure 12. Temperature trends for Washington County, Oregon (USGS 2021).

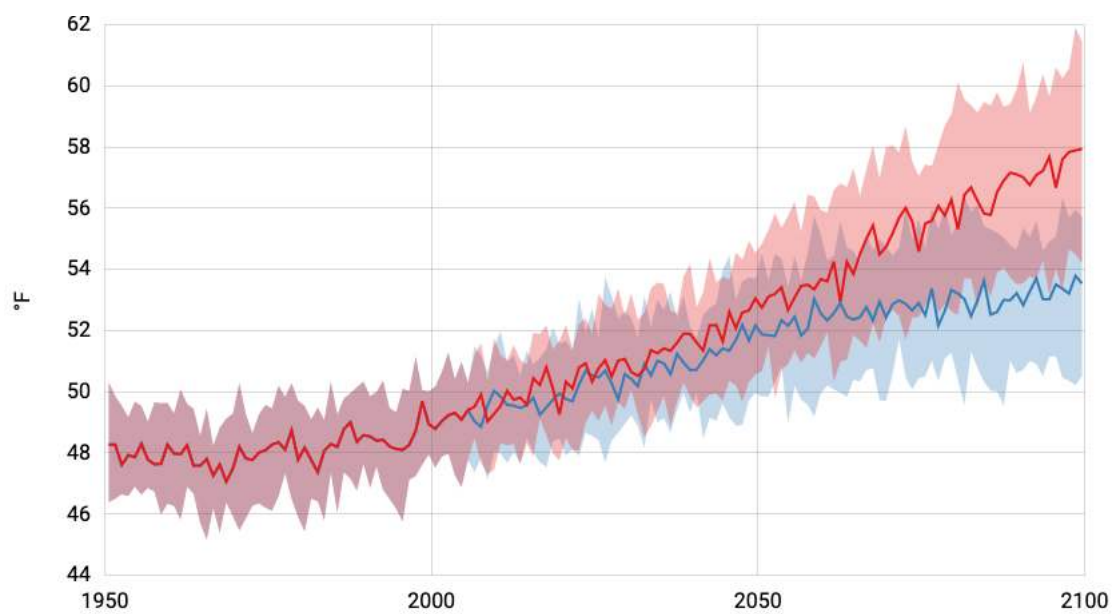


Figure 13. Temperature trends for Clackamas County, Oregon (USGS 2021).

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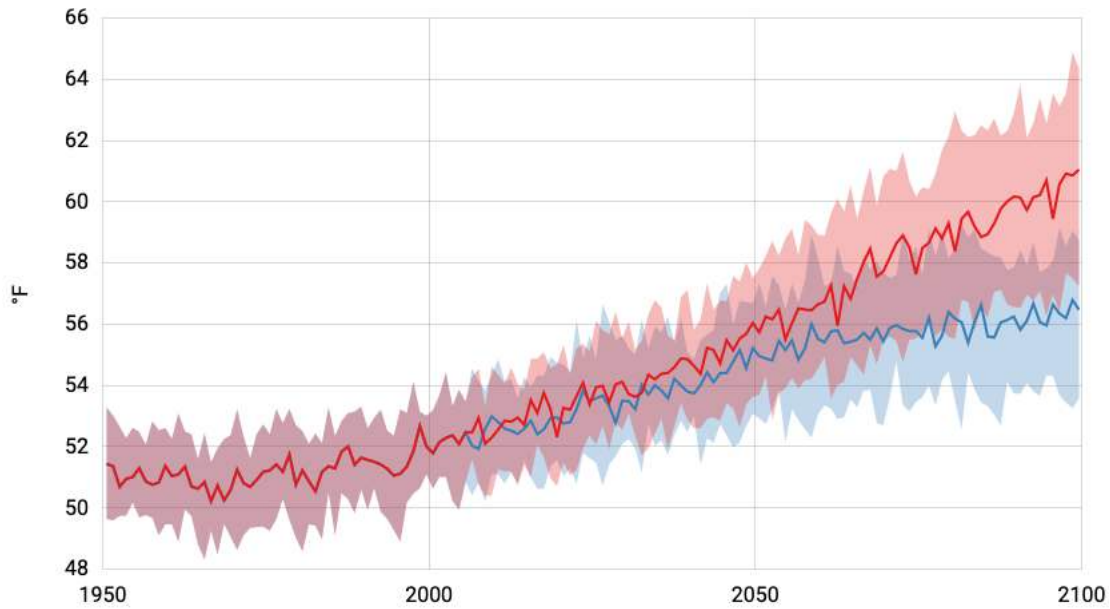


Figure 14. Temperature trends for Multnomah County, Oregon (USGS 2021).

Precipitation history and trends for Clackamas and Washington County (Figures 15 and 16), resemble Multnomah County in indicating a historical trend of steady precipitation that is likely to continue. The current trend towards precipitation falling in more frequent downpours as opposed to the light rainfalls that rejuvenate soil moisture is also expected to continue. This means that the rain that falls will more likely induce floods and soil erosion than replenish dry soils (Vynne *et al.* 2011).

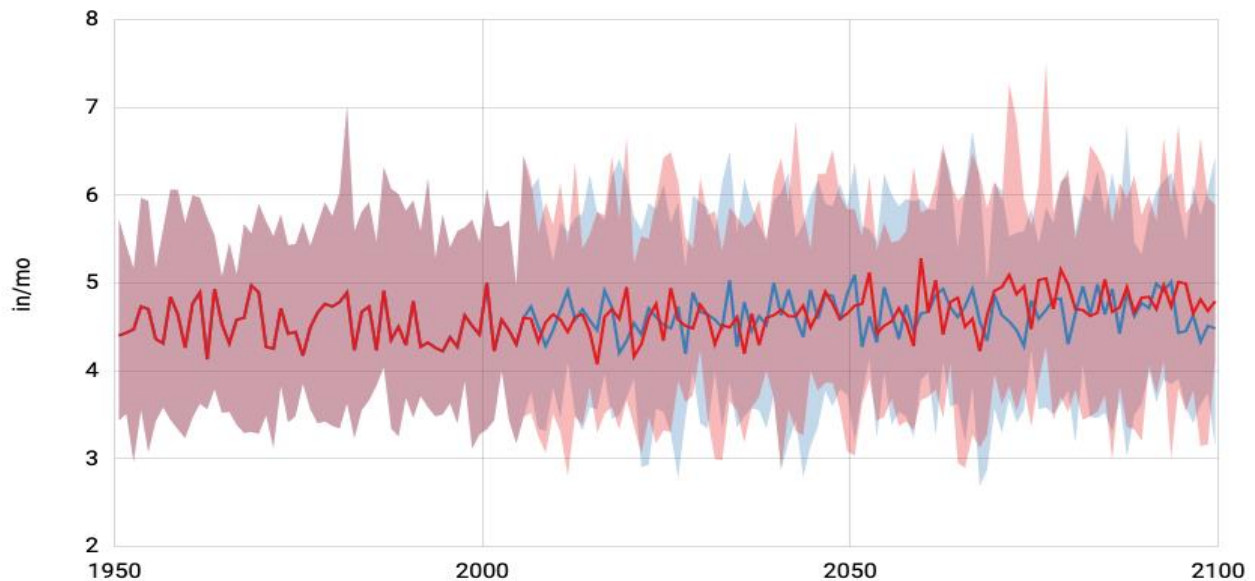


Figure 15. Precipitation trends in Washington County, Oregon (USGS 2021).

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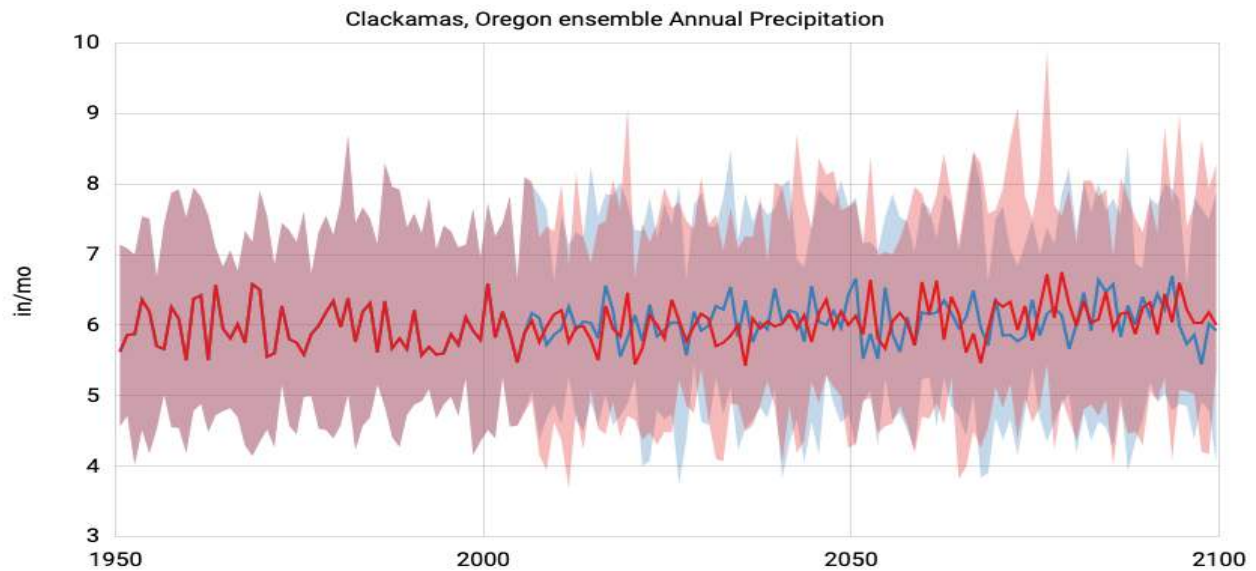


Figure 16. Precipitation trends for Clackamas County (USGS 2021).

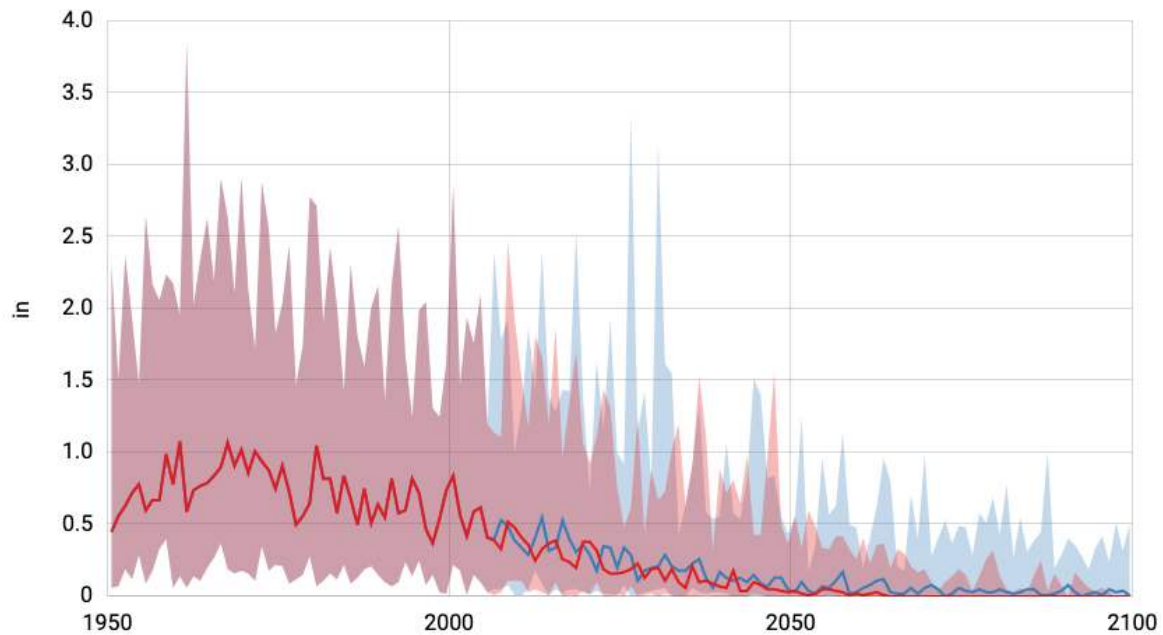


Figure 17. Snowfall history and projections for Washington County, Oregon (USGS 2021).

The historic trend and projections for snowfall in Washington County (Figure 17) indicates declining snowpack from the 1970s and into the future regardless of emissions scenario. During this century alone, snowfall in the region has dropped to less than 15% of historical records. This, combined with a consistent decrease of snowpack throughout the Cascade

Mountains (Figure 18) have negative effects on the valley since the snowpack has been the historical reservoir for summer water supplies. Reduced snowpack, accompanied by earlier snowmelt will likely increase the threat of spring floods followed by drought and wildfire in summer and fall (KTVZ News, 2012; Mote & Snover, 2014).

Federal 1st and 6th Congressional District Historic Temperature Trends

Oregon Senate 14th District falls in the 1st and 6th Federal Congressional Districts. This is how historic patterns have fared across those districts. The data (Figures 18 & 19) indicate that the 1st Congressional District has been warming at a rate of 2.4⁰F per century since 1960, while

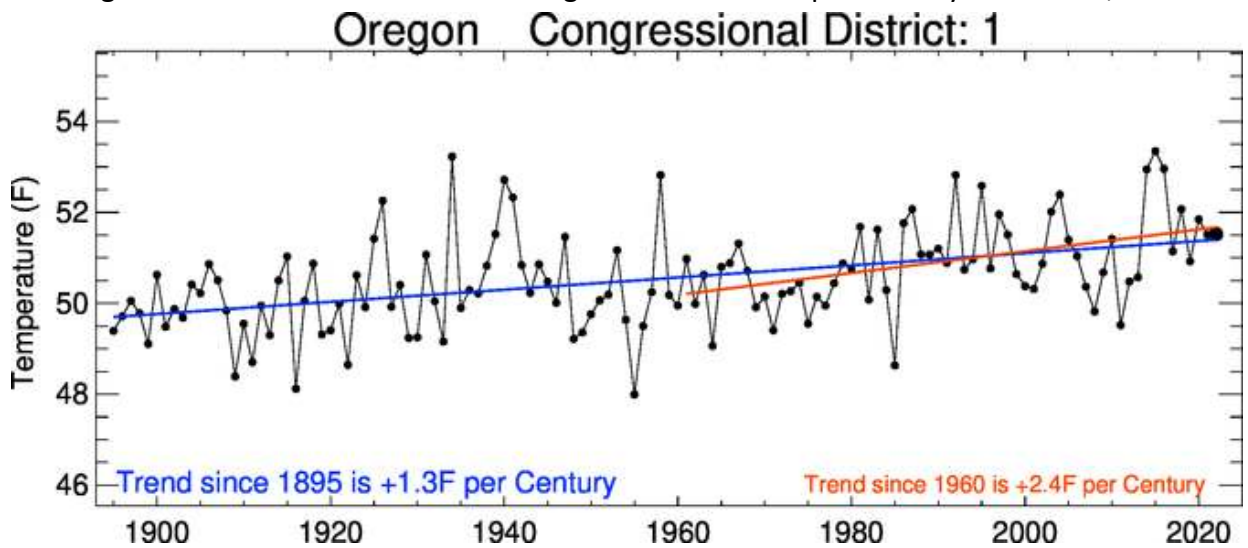


Figure 18. Temperature trend for Federal Congressional District 1 (CCT 2021).

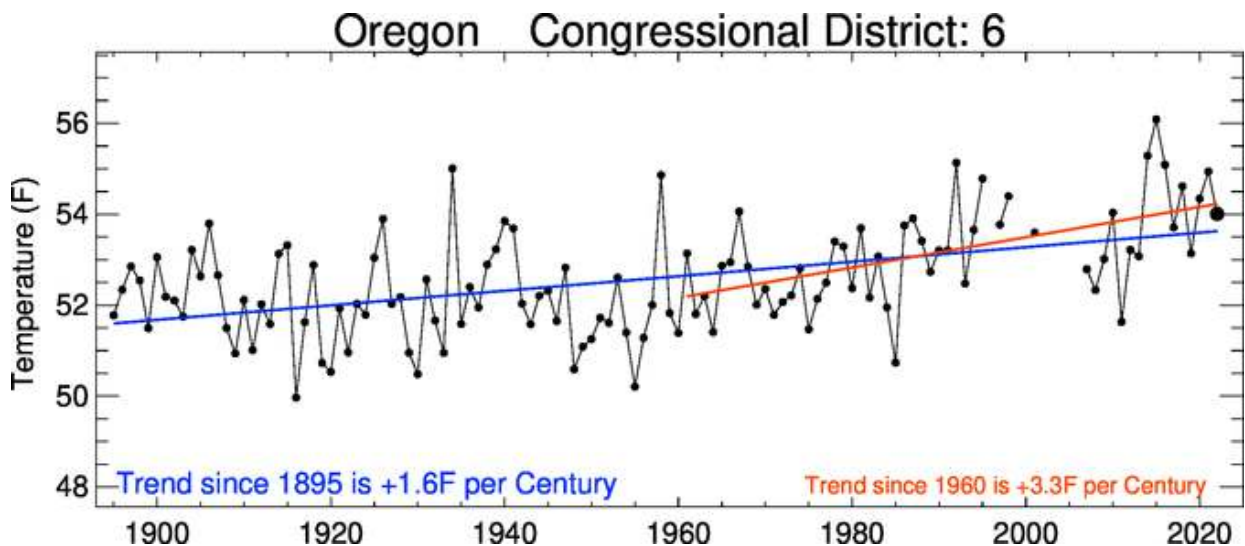


Figure 19. Temperature trend for Federal Congressional District 6 (CCT 2021).

District 6 has been warming at a rate of 3.3⁰F. Although CD1 is buffered somewhat by its western edge along the Pacific Ocean, both districts are being impacted by climate change.

Oregon 14th Senate District Economy:

The principal economic drivers of Washington County economy are industries such as Nike and technology companies such as Intel plus agriculture, including wineries (Compiled from various sources). Although predominantly an urban area, agriculture, wineries, forest products, and tourism are relevant economic activities that are likely to feel the impact of a changing climate.

Among the tree species of most concern is Douglas fir, projections for which are presented in Figure 20.

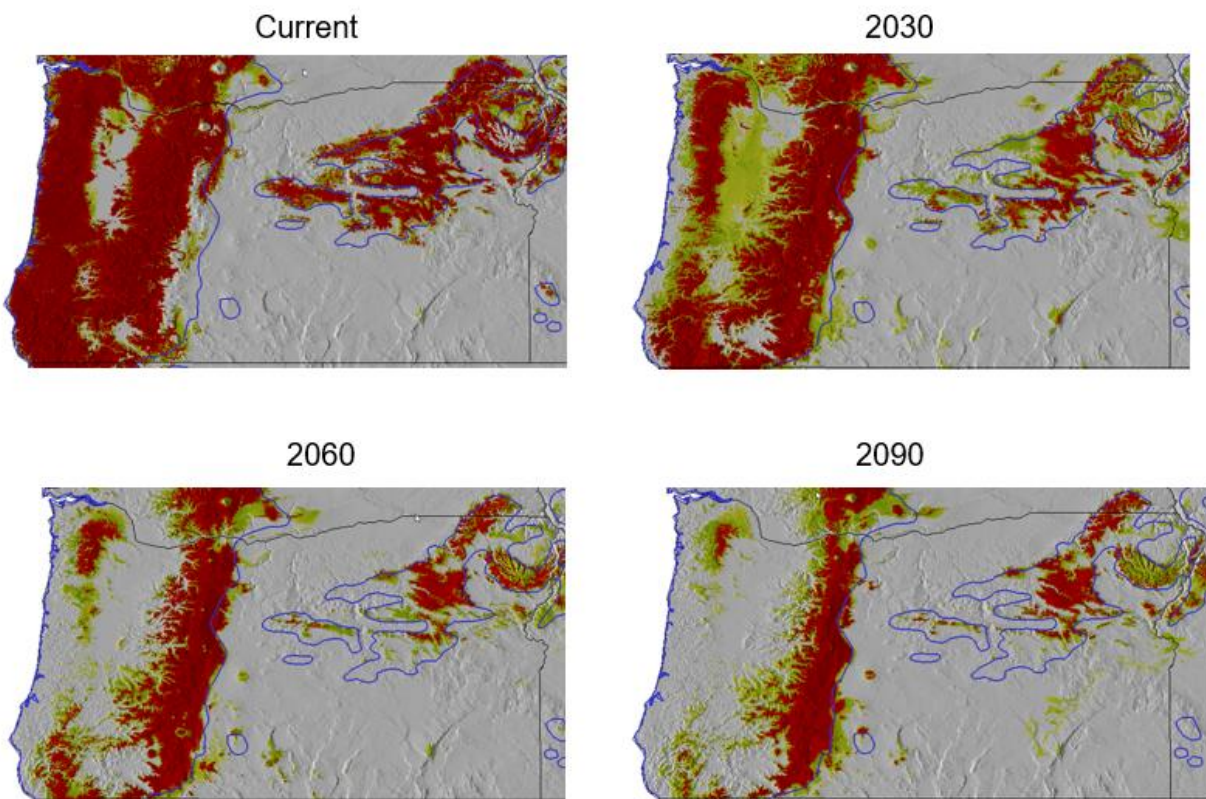


Figure 20. Douglas fir (*Pseudotsuga menziesii*) current and projected distribution through the 21st Century (Crookston and Radtke 2019).

These are based on models that assume a continuation of the current trend of increasing atmospheric carbon dioxide emissions with high tree viability indicated in red, low viability in green and absence in areas without color. These projections suggest conditions for this species may be less favorable than currently - meaning timber activities in the district relying on this species could be severely challenged as the century unfolds, especially if we do nothing to mitigate the climate trends already evident. Additionally, large fires could become more common in Western Oregon forests. Estimates increase in regional forest area burned ranges between 180% and 300% by the end of the century, depending on the climate scenario and estimation method examined (Dello and Mote 2010).

Furthermore, given the ability of many Oregon forests to store carbon (Hudiburg *et al.* 2009; Law *et al.* 2018), it is critical that climatic conditions not diverge such that these important species are compromised. Halofsky *et al.* (2016) discuss the potential and disturbing impacts of climate change on SW Oregon's forests.

Potential Agricultural Impacts:

The main impacts on agriculture will involve temperature change and water scarcity. While warmer weather and earlier spring seems positive, late summer and fall water shortages will likely pose severe problems. In addition, chilling hours during winter have declined by as much as 30% since 1950 in areas of the Central Valley to the point of not making some crops viable. However, as climates continue to change, similar winter dormancy issues could mean trouble for Oregon's perennial crops (Dello and Mote 2010). Additionally, as snowpack decreases in the Cascades, availability of irrigation water could become more restricted as summer heat waves and droughts become more commonplace. The most consistent changes in global climate models show a regional warming and drying in the summer. The multi-model average decrease for summer precipitation is 14% by the 2080s. Over two decades ago, the EPA (2002) reported that as a result of water use "an estimated 130 kilometers [80 miles] of 2nd to 4th order streams go dry in a moderately dry summer. For a 1.8°F rise in temperature, irrigation demands are projected to increase by 10% (Dello and Mote 2010). Even in urban areas where little forestry is practiced, the detrimental impact of climate change on the commercial forest species of Oregon and the Pacific Northwest will have a negative impact on timber local availability and thus elevate the price of construction.

Climate change is expected to enhance invasion risk from many crop diseases, pests, and weeds. Rising temperatures allow both insects and pathogens to expand their ranges to regions where they were once not found. In addition, warmer winter temperatures allow more insects to survive in regions where colder winters once controlled populations. Changes in climate have

the potential to disrupt beneficial insects that serve as the natural enemies of some crop pests, ultimately producing greater overall crop exposure to herbivores. Warmer temperatures may also allow for additional generations of insect pests within a single growing season. Models of codling moth populations, for example, under baseline conditions and four Global Climate Model (GCM) projections find earlier emergence of adults in spring. Coupled with warmer temperatures in summer this could result in most apple-growing locations experiencing a

AVERAGE GROWING SEASON TEMPERATURES

THE RANGE IN THE ABILITY TO RIPEN VARIETIES

Northern Hemisphere (Apr-Oct), Southern Hemisphere (Oct-Apr)

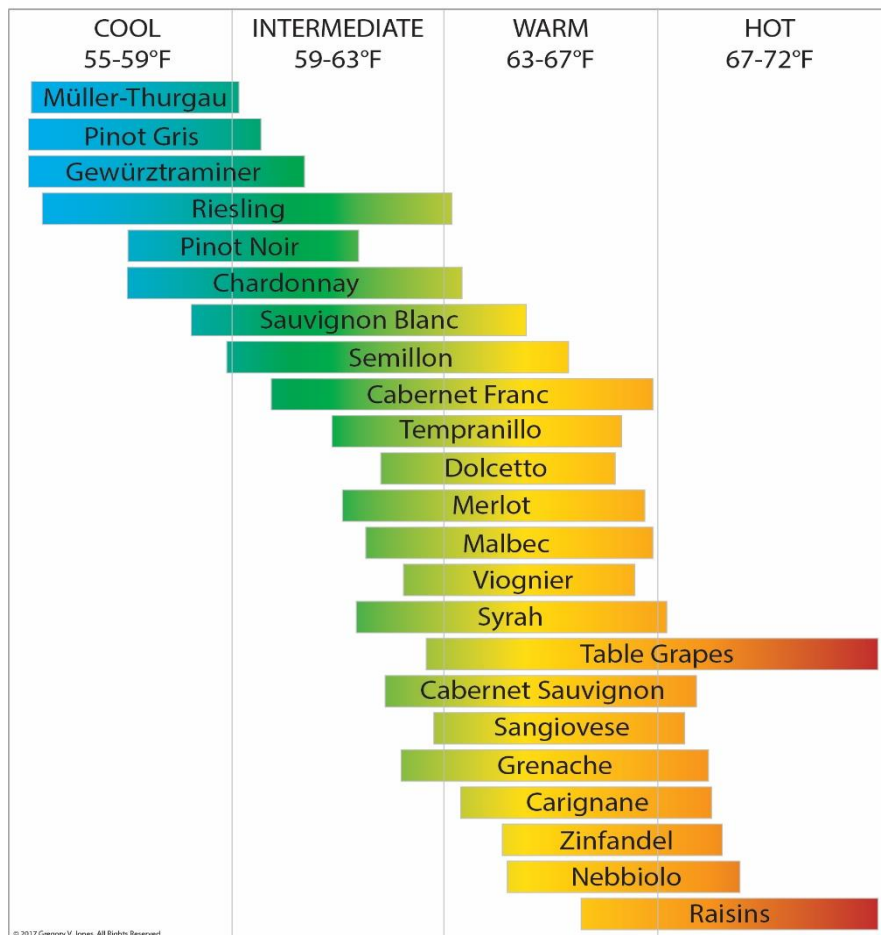


Figure 21. Grape varietal optimum growing season temperature (Jones 2015).

include Pinot Noir, Chardonnay Pinot Gris, and Riesling (Wine Enthusiast 2023). Figure 21 indicates the preferred growing temperature ranges for each major grape varietal. All these varieties will be affected by projected temperature changes, but over the course of this century, they are likely to remain viable. Of the varieties, Pinot Noir, due to its narrow niche for optimum quality, is the most vulnerable. If there are further increases in temperature, vineyards will likely need move much of current acreage planted in the Willamette Valley

complete third generation hatch. These results suggest additional costs to apple growers from additional pheromone and sprays per season (Dello and Mote 2010).

Much of the tourism is connected to the North Willamette Valley's thriving wine industry, which is home to more than two-thirds of the state's vineyards (Morris undated, Willamette 2014). State-wide, the wine industry was the 11th largest agricultural sector, valued at more than \$71 million in 2008 (Dello and Mote 2010). The predominant wine varieties in the Willamette Valley

outside of what is considered suitable for Pinot Noir. This would necessitate costly adaptation processes of replanting to different, warmer climate grape varieties, or moving to higher elevations or further north in latitude. Additional risks come from the marketing side, where changes in varieties or wine styles would require a substantial effort to inform consumers and maintain market viability (Dello and Mote 2010). Many vineyards in the area that contribute to the local economy will likely be directly affected.

As with the agricultural sector, water may become a constraining factor for local residences, industry, and business. Many Oregonians depend on water pumped from the ground to provide much of their water supply. These below-ground aquifers are out of sight and may seem limitless, but in a number of areas within the Willamette Basin, aquifers are declining or becoming contaminated from salts, septic systems, and industrial pollution (Sinclair 2005). Many municipalities rely on rivers sourced from snow melt which will become only more limited as snowpack decreases. As much of the region also sources its electrical power from hydroelectric sources, lower river flows could reduce reliability of power generation within the region (Oregon 2012). At the same time, efficiency and reliability of power transmission and delivery is likely to decline as power lines are stressed by higher ambient temperatures and increased risk from wildfires. As a result, more brownouts and blackouts are possible. Expansion of biomass-based energy production may also be limited due to loss of supply from forests and agriculture from increased wildfire (Dello and Mote 2010).

Potential Health Risk:

According to the Oregon Health Authority (2014), the main climate impacts to health are likely to be: heat, allergens, storms, and floods. The top health concerns will be: poor air quality, respiratory illness, heat-related illness, harmful algal blooms, recreational hazards, increased allergens, displacement, landslides, economic instability, and mental health impacts. Communities that will be especially vulnerable will be: low-income households and neighborhoods, communities of color, older adults, people living on steep slopes, people working in agriculture, first responders, Native Americans, young children, and pregnant women.

Climate change is likely to have an impact on public health issues in Oregon including the spread of communicable diseases as well as an increase in water-, food-, and air-borne infections. Predicted average increases in summer temperatures will make heat waves a greater likelihood, causing heat-related morbidity and mortality, especially among vulnerable populations, such as the elderly, low income populations, pregnant women and those who work in outdoor occupations. Increasing temperatures in Oregon could raise the threat of

vector-borne diseases and emerging infections. Respiratory insults, especially among persons with pre-existing lung health problems would be exacerbated by exposure to smoke from forest fires, as well as from the projected increases in air pollution levels in our region. Air pollution and increases in pollen counts (and a prolonged pollen producing season) may increase cases of allergies, asthma, and other respiratory conditions among susceptible populations (Dello and Mote 2010). Climate change and its consequences target the most vulnerable - such as the young and the old. The consequences depicted here could have a severe impact on the health of the elderly. Many of the health consequences involve respiratory problems for this vulnerable segment of the population. Not only will the projected climate change be negative for our economy, it will also change the lives of people in the 15th District.

The Willamette Valley contains Oregon's five largest cities and 70% of its populations (Haven 2022) The population in the North Willamette Valley grew more than 14% between 2000 and 2010 and is projected to continue growing (Oregon 2012). By 2050, an additional 1.5 million people are expected to live within the Willamette Valley, with more than 63% of them having migrated from outside of the state (Sinclair 2005). As a result, any natural disaster in the Willamette Valley region will have a significant effect on Oregon's population and economy. The area is already at relatively high risk from floods, landslides, wildfires, and winter storms. It also faces moderate to high risk from earthquakes and volcanic activity. The extensive urban infrastructure in parts of the region means natural hazard events can lead to power outages, building collapse, dam failures and HAZMAT operations. (Oregon 2012) Projected climate changes in precipitation rates and temperatures are likely to threaten the integrity of the built environment, including buildings, roads, highways and railroads, water and sewage systems, and energy facilities throughout Oregon (Dello and Mote 2010).

A Timeline for Action:

Based on the projected consequences of the warming global climate, international agreements (e.g. UNFCCC 2015) some years ago established 2°C (preferably 1.5°C) above pre-industrial conditions as the limit beyond which we should not allow the global temperature to climb. This limit was echoed by the World Bank (2014). Meanwhile, the Intergovernmental Panel on Climate Change (IPCC 2018a) indicated that the 2°C limit pushes us too close to many global tipping points beyond which recovery becomes a reducing possibility. Thus, they recommend that we absolutely should target 1.5°C if we wish a reasonable chance of retaining a livable planet. Unfortunately, underlining the urgency, emissions to date may have already committed us to the 1.5°C increase (Mauritsen and Pincus 2017).

Global greenhouse gas emissions during 2017 totaled 53.7 Gigatonnes (GT) of carbon dioxide equivalent (IPCC 2018b) which includes between 32.5 (IEA 2019) and 36.5 GT of carbon dioxide (WRI 2018). This implies that between 30% and 40% of the global warming emissions are due to gases other than carbon dioxide. The trends and consequences discussed here are based on readily available data. This underlines the urgency for immediate action across the globe to curtail greenhouse gas emissions if we wish to avoid an increase over 2°C. Considerable variability exists among estimates of the emissions budget remaining if we are to restrict warming to the 1.5°C increase targets (Levin 2018, Carbon Brief 2018). Indeed, the latter source identifies a large range in estimates for a 66% chance of keeping warming to below 1.5°C of between 28 GT and 779 GT. Meanwhile, the IPCC (2018a) indicated that the rate of carbon dioxide emissions alone is currently 42 ± 3 Gigatonnes annually suggesting that, for a 50% chance at a rise below 1.5°C, the remaining budget for emissions is 580 GT CO₂, while for a 66% chance, the remaining emissions budget is 420 GT CO₂. Considering the current accelerating rate of emissions, the IPCC (2018a) concluded that by 2030 we must impose a reduction in emissions of 45% below the 2010 level and by 2050 we must reach net zero emissions. Considering the increasing impact of greenhouse gases other than carbon dioxide, that seems both conservative and reasonable. Underlining the urgency and imperative of limiting warming to 1.5°C, long ago the World Bank (2014) acknowledged there is: “no certainty that adaptation to a 4°C world is possible.”

Representing the People at the 24th United Nations Framework Convention on Climate Change Conference of the Parties in Poland (COP24), British naturalist and broadcaster Sir David Attenborough argued that in climate change “we are facing a man-made disaster of global scale, our greatest threat in thousands of years...” and “If we don't take action, the collapse of our civilizations and the extinction of much of the natural world is on the horizon.” (Domonoske 2018). The choice is ours!

From the trends and consequences discussed here, all based on readily available data, there should be little doubt that substantial urgency must be attached to addressing this issue.

Solutions:

In addition to individual action wherein we evaluate our actions and adjust our behavior to reduce activities that result in greenhouse gas emissions or increase those that result in atmospheric greenhouse gas sequestration (capture and storage), we can promote local, state and federal actions that do the same on a larger scale. Local communities can develop Climate Action Plans that promote emissions reductions and capture/sequestration activities.

Meanwhile, at the state and federal level, similar such programs can be instituted. The predominant proposals to achieve this involve either:

- a) imposing a jurisdictional cap on emissions which declines over time to establish a trajectory of emissions reductions that meet long term reductions goals. This approach involves the issuance of allowances to emit that reduce over time. Allowances may be sold/auctioned, or allocated free, or involve some combination.
- b) imposing a fee or tax on emissions that rises over time to achieve reductions that are consistent with a desired trajectory and long-term goals.

The cap approach is direct since it involves assessing emissions from target polluters and requiring that reductions occur while the tax/fee approach is indirect since it assumes that a rising tax will result in reduced emissions.

Both approaches usually involve the generation of funds either via sold/auctioned allowance in the case of the cap, or a fee in the case of the tax/fee approach. The second question associated with either approach involves a decision as to what will be done with the funds raised. One approach is to return these to residents or taxpayers (the individuals who ultimately pay the cost of the pollution reduction); hence the concept of a Dividend. Alternatively, the funds raised can be used to offset allow reductions in other taxes, whether individual or corporate. Finally, these funds may be used for investments that (a) promote activities that themselves lead to reductions in atmospheric greenhouse gas concentrations, either by reducing emissions or promoting sequestration and/or (b) serve the goals of promoting environmental / social justice by assisting communities historically disadvantaged by pollution or likely to suffer disproportionately from the transition to a clean energy economy.

Since the state legislature has declined to implement a comprehensive policy, if Oregon is to contribute its share to addressing the climate crisis and wishes to appear credible when seeking action elsewhere, it will be necessary to take smaller targeted steps that reduce emissions in designated sectors or activities and/or promote the sequestration of carbon from our atmosphere in our natural and working lands.

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Literature:

Alexander M, Scott J, Friedland K, Mills K, Nye J, Pershing A, Thomas A, 2018. Projected sea surface temperatures over the 21st century: Changes in the mean, variability and extremes for large marine ecosystem regions of Northern Oceans. Elem Sci Anth, 6(1), p.9. DOI:

<http://doi.org/10.1525/elementa.191>

Bednaršek N, Feely R, Beck M, Alin S, Siedlecki S, Calosi P, Norton E, Caenger C, Strus J, Greeley D, Nezlin N, Roethler M, Spicer J. 2020 Exoskeleton dissolution with mechanoreceptor damage in larval Dungeness crab related to severity of present-day ocean acidification vertical gradients. Science of the Total Environment. 716, 10 136610

<https://doi.org/10.1016/j.scitotenv.2020.136610>

Ben Achur S. 2022 Ocean acidification raises economic concerns for shellfish hatcheries. Market Place Minnesota Public Radio July 5 2022. <https://www.marketplace.org/2022/07/05/ocean-acidification-raises-economic-concerns-shellfish-hatcheries/>

Brown L 2006 *Plan B 2.0: Rescuing a Planet Under Stress and a Civilization in Trouble*. W.W. Norton, & Co. N.Y. London 365 pp.

Carbon Brief 2018 Analysis: How much 'carbon budget' is left to limit global warming to 1.5°C?
<https://www.carbonbrief.org/analysis-how-much-carbon-budget-is-left-to-limit-global-warming-to-1-5c>

Crookston N, Radtke P. 2023 Plant Species and Climate Profile Predictions, Climate Estimates, Climate Change and Plant Climate Relationships.
<https://charcoal2.cnre.vt.edu//climate/species/index.php> (A discussion of the site can be found at: <https://www.fs.usda.gov/ccrc/tool/plant-species-and-climate-profile-predictions> though the site has been relocated from the USDA so the links on that page are dead ends).

CTT 2021 Congressional Temperature Trends: Thermometer Records from Weather Stations
<http://temperaturerends.org/district.php?district=4&state=OR>

Dalton M, Mote P, Snover A [Eds.]. 2013. *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities*. Washington, DC: Island Press.
<http://cses.washington.edu/db/pdf/daltonetal678.pdf>

Dalton M, Dello K, Hawkins L, Mote P, and Rupp D (2017) *The Third Oregon Climate Assessment Report*, Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR.
http://www.occri.net/media/1055/ocar3_final_all_01-30-2017_compressed.pdf

Domonoske C, 2018 David Attenborough Warns Of 'Collapse Of Civilizations' At U.N. Climate Meeting. npr news. <https://www.npr.org/2018/12/03/672893695/david-attenborough-warns-of-collapse-of-civilizations-at-u-n-climate-meeting>

Easterling, D, Kunkel K, Arnold J, Knutson T, LeGrande A, Leung L, Vose R, Waliser D, Wehner M, 2017: Precipitation change in the United States. In: *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D, Fahey D, Hibbard K, Dokken D, Stewart B, Maycock T. (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC.
https://science2017.globalchange.gov/downloads/CSSR_Ch7_Precipitation.pdf

EPA 2000. Chapter 13: Willamette River Case Study, *Progress in Water Quality: An Evaluation of the National Investment in Municipal Wastewater Treatment*. Retrieved from *Progress in Water Quality* Environmental Protection Agency. *An Evaluation of the National Investment in Municipal Wastewater Treatment*: http://water.epa.gov/polwaste/wastewater/treatment/upload/2002_06_28_wquality_chap13.pdf

EPA 2002 Willamette Basin Alternative Futures Analysis. Environmental Assessment Approach that Facilitates Consensus Building United States Environmental Protection Agency.

https://www.fsl.orst.edu/pnwer/wrb/proj_summary.pdf

Fleishman, E., editor. 2023. Sixth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon.

<https://blogs.oregonstate.edu/occri/oregon-climate-assessments>

Gao P, Terando A, Kupfer J, Varner J, Stambaugh M, Lei T, Hiers J. 2021 Robust projections of future fire probability for the conterminous United States. *Science of the Total Environment*

789: 147872. <https://www.sciencedirect.com/science/article/pii/S0048969721029430>

Halofsky J, Peterson D, Metlen K, Myer G, Sample V. 2016 Developing and Implementing Climate Change Adaptation Options in Forest Ecosystems: A Case Study in Southwestern Oregon, USA forests 7: (268) 1 - 18.

<file:///F:/Alan/Documents/KACONJOUR/Climate%20%20Change%20Literature/Forests,%20Fire%20&%20BLM%20RMP/Halofsky,%20Peterson,%20%20Metlen,%20Myer,%20Sample%202016%20climate%20change%20and%20adaptation%20in%20the%20Rogue%20Basin%20Oregon.pdf>

Hausfather Z. 2018 Explainer: How ‘Shared Socioeconomic Pathways’ explore future climate change. Climate Modeling. Carbon Brief. <https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change/>

Haven 2022 The Endless Appeal Of Life In The Willamette Valley. The Haven Team.

<https://havenlifestyles.com/the-endless-appeal-of-life-in-the-willamette-valley/#:~:text=The%20Willamette%20Valley%20is%20a,around%2070%25%20of%20Oregon's%20population.>

Howat I, Tulascyk S. 2005 Trends in spring snowpack over a half-century of climate warming in California, USA *Annals of Glaciology* 40: 151-156.

<https://www.cambridge.org/core/journals/annals-of-glaciology/article/trends-in-spring-snowpack-over-a-halfcentury-of-climate-warming-in-california-usa/E7153C040C54C29DFC9EDB92678C02FD>

Hudiburg T, Law B, Turner D, Campbell J, Donata D, Duane M. 2009 Carbon dynamics of Oregon and Northern California forests and potential land-based carbon storage. *Ecological Applications*. <https://doi.org/10.1890/07-2006.1>

IPCC 2013. Climate Change 2013: The Physical Science Basis; Summary for Policymakers WGI IPCC Switzerland. <https://www.ipcc.ch/report/ar5/wg1/>

IPCC 2018a. Global Warming of 1.5°C, (An IPCC Special Report) Intergovernmental Panel on Climate Change Summary for Policymakers -

https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

Full Report - <https://www.ipcc.ch/sr15/>

IPCC 2018b. Emissions Gap Report United Nations Environment Programme

<https://www.ipcc.ch/site/assets/uploads/2018/12/UNEP-1.pdf>

IUCN undated. Overview and description. IUCN CEM Mediterranean Type Ecosystems Specialist Group. International Union for the Conservation of Nature. [https://www.iucn.org/our-union/commissions/group/iucn-cem-mediterranean-type-ecosystems-specialist-group#:~:text=Mediterranean%2Dtype%20ecosystems%20\(MTEs\),and%20Southwestern%20and%20South%20Australia.](https://www.iucn.org/our-union/commissions/group/iucn-cem-mediterranean-type-ecosystems-specialist-group#:~:text=Mediterranean%2Dtype%20ecosystems%20(MTEs),and%20Southwestern%20and%20South%20Australia.)

Jones G 2015 Climate, Grapes and Wine: Terroir and the Importance of Climate to Winegrape Production. GuildSomm

https://www.guildsomm.com/public_content/features/articles/b/gregory_jones/posts/climate-grapes-and-wine

Jones N 2017 How the World Passed a Carbon Threshold and Why It Matters. Yale Environment 360 <https://e360.yale.edu/features/how-the-world-passed-a-carbon-threshold-400ppm-and-why-it-matters>

Karl T, Melillo J, Peterson T 2009 Global Climate Change Impacts in the United States, Cambridge University Press <https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>

Kenward A, Sanford T, Bronzan J 2016 Western Wildfires: A Fiery Future. Climate Central: <file:///H:/Alan/Documents/KACONJOUR/Climate%20Change%20literature/Forests,%20Fire%20&%20BLM%20RMP/Kenward%20et%20al%20westernwildfires2016vfinal.pdf>

Law B, Hudiburg T, Berner L, Harmon M 2018 Land use strategies to mitigate climate change in carbon dense temperate forests. Proceedings of the National Academy of Sciences. 115 (14) 3663-3668. <https://www.pnas.org/doi/10.1073/pnas.1720064115>

Levin K 2018 According to New IPCC Report, the World Is on Track to Exceed its “Carbon Budget” in 12 Years, World resources Institute. <https://www.wri.org/blog/2018/10/according-new-ipcc-report-world-track-exceed-its-carbon-budget-12-years>

Lieberman B 2012 'CSZ' — A Key Factor for Pacific Northwest Sea-Level Rise. Yale Climate Connections. <https://www.yaleclimateconnections.org/2012/07/cascadia-subduction-zone-a-key-factor-for-pacific-nw-sea-level-rise/>

Maycock, and B.C. Stewart (eds.). U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018 <https://nca2018.globalchange.gov/>

Melillo, J, Richmond T, Yohe G, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2. http://s3.amazonaws.com/nca2014/low/NCA3_Climate_Change_Impacts_in_the_United%20States_LowRes.pdf?download=1

Morris, D. undated. *Agritourism Thrives in Oregon*. Retrieved from Leisure Group Travel: <http://leisuregrouptravel.com/agritourism-thrives-in-oregon/>

Mote, P.W., J. Abatzoglou, K.D. Dello, K. Hegewisch, and D.E. Rupp, 2019: Fourth Oregon Climate Assessment Report. Oregon Climate Change Research Institute. occri.net/ocar4. <http://www.occri.net/media/1095/ocar4full.pdf>

NASA GISS 2023 Annual Mean Temperature Change Over Land and Over Ocean. GISS Surface Temperature Analysis (v4). National Aeronautics and Space Administration Goddard Institute for Space Studies. https://data.giss.nasa.gov/gistemp/graphs_v4/

NOAA 2023 Climate At A Glance National Time Series. National Oceanographic and Atmospheric Administration. https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/national/time-series/110/tavg/12/12/1895-2022?base_prd=true&begbaseyear=1901&endbaseyear=2000&trend=true&trend_base=100&begtrendyear=1895&endtrendyear=2023&filter=true&filterType=binomial

Oregon. 2012. Region 2: Northern Willamette Valley/Portland Metro Regional Profile. www.oregon.gov/LCD/HAZ/docs/2.A.ORNHMP12-Reg2Profile.pdf

Oregon Health Authority 2014, Oregon Climate and Health Profile Report, Climate and Health Program, Public Health Division, Oregon Health Authority: Summary provided by Emily York MPH, Climate & Health Program Coordinator, Oregon Public Health Division, Oregon Health Authority. <http://public.health.oregon.gov/HealthyEnvironments/climatechange/Documents/oregon-climate-and-health-profile-report.pdf>

Parks B 2022. Oregon Public Broadcasting. <https://www.opb.org/article/2022/04/27/offshore-wind-oregon-coast-coos-bay-brookings/>

Poet 2023 Pacific Coast Advantage. Pacific Ocean Energy Trust:
<https://pacificoceanenergy.org/information/pac-coast-advantage/>.

Safford H, Butz R, Bohlman G, Coppoletta M, Estes B, Gross S, Merriam K, Meyer M, Molinari N, Wuenschel A. 2021 Fire Ecology of the North American Mediterranean-Climate Zone. Chapter 9 https://www.fs.usda.gov/psw/publications/srs/srs_2021_safford001.pdf [In] Greenberg C, Collins B (eds.), Fire Ecology and Management: Past, Present, and Future of US Forested Ecosystems, Managing Forest Ecosystems 39, https://doi.org/10.1007/978-3-030-73267-7_9.

Sinclair M. 2005. Willamette River Basin: Challenge of Change. Willamette Partnership.
https://defenders.org/sites/default/files/publications/challenge_of_change.pdf

UNFCCC 2015. The Paris Agreement Unites Nations Climate Change. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

USDA 2011. *Vineyard and Winery*. USDA National Agriculture Statistics Service.
http://www.nass.usda.gov/Statistics_by_State/Oregon/Publications/Vineyard_and_Winery/v_2011_final.pdf

USGCRP, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles D, Fahey D, Hibbard K, Dokken D, Stewart B, and Maycock T (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp
<https://science2017.globalchange.gov/downloads/>

USGS 2021 National Climate Change Viewer, U.S. Geological Survey Land Change Science Program. https://apps.usgs.gov/nccv/mac2/mac2_counties.html

Westerling A, Hidalgo H, Cayan D, Swetnam D. 2006 Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. *Science* 313 no. 5789 pp. 940-943.
Whittaker RH 1975 *Communities and Ecosystems* Macmillan Publishing CO., New York
<https://www.science.org/doi/10.1126/science.1128834>

Whittaker RH 1975 *Communities and Ecosystems* Macmillan Publishing CO., New York

Willamette 2014. *About the Valley*. Retrieved from Willamette Valley Wineries Association:
<http://willamettewines.com/about-the-valley/>

Wine Enthusiast 2023 Willamette Valley. Wine Enthusiast.

<https://www.wineenthusiast.com/region/willamette-valley/>

World bank 2014, *Turn Down the Heat: Confronting the New Climate Normal*. The World Bank, Washington DC. 275pp [https://openknowledge.worldbank.org/entities/publication/98508814-](https://openknowledge.worldbank.org/entities/publication/98508814-21c5-53e6-b36c-912a4ecf9da7)

[21c5-53e6-b36c-912a4ecf9da7](https://openknowledge.worldbank.org/entities/publication/98508814-21c5-53e6-b36c-912a4ecf9da7)

WRI 2018 New Global CO2 Emissions Numbers Are In. They're Not Good. Word Resources

Institute. <https://www.wri.org/blog/2018/12/new-global-co2-emissions-numbers-are-they-re-not-good>

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