Southern Oregon Climate Action Now

SOCAN

Confronting Climate Change

Climate Change in the Oregon 4th 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, possible 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!

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

Oregon Senate District 4 Climate Summary

For a more complete summary, including sources, from which these points are taken, visit: http://socan.eco/oregon-legislative-districts/

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Climate Change in the Oregon 4th Senate District

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August, 2019

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Global and Regional Temperature:

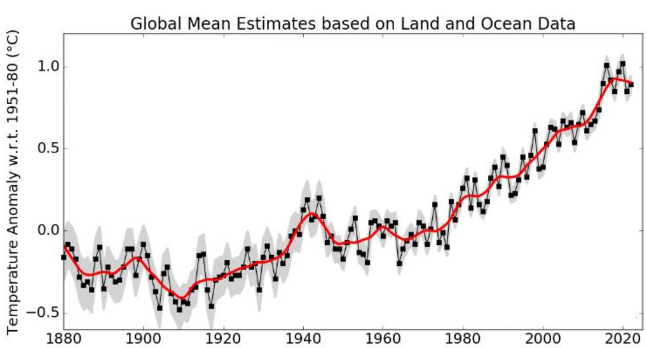


Figure 1. *Historic global temperature trend (NASA 2023).*

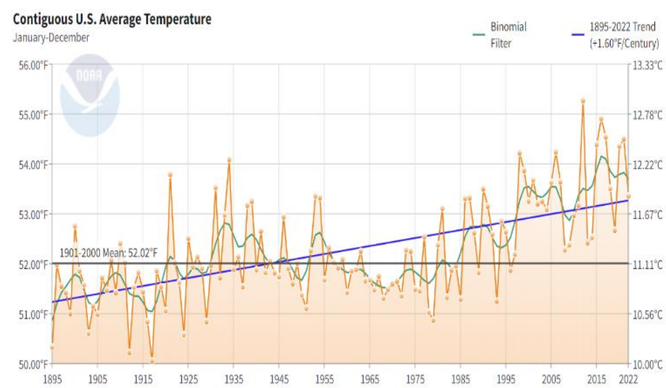
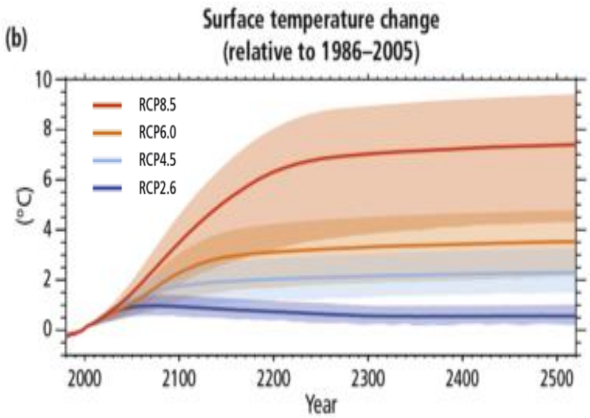


Figure 2. *Historic U.S temperature trend. (NOAA 2023).*

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.



Global temperature projections to 2100 provided by the Intergovernmental Panel on Climate Change Assessment (IPCC) Report 6 (Figure 3) were based on Shared Socioeconomic Pathways (SSPs). Discussed by Hausfather (2018), these pathways represent an advance over the Representative Concentration Pathways (RCPs) previously employed by the IPCC in that they include characterization of the human behavior that leads to specific atmospheric greenhouse gas concentrations. The SSP5-8.5 pathway incorporates (SOS 2022) 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).

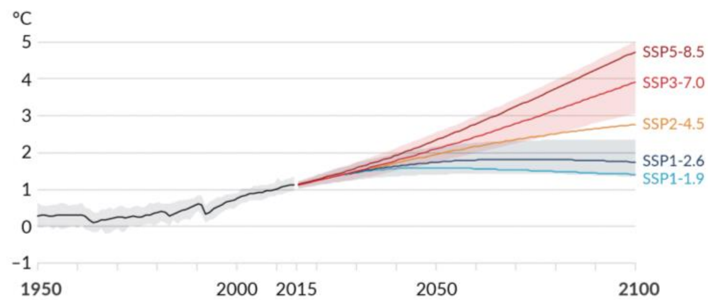


Figure 3. *Global temperature projections to 2100 relative to the 1850-1900 average. (IPCC 2021)*

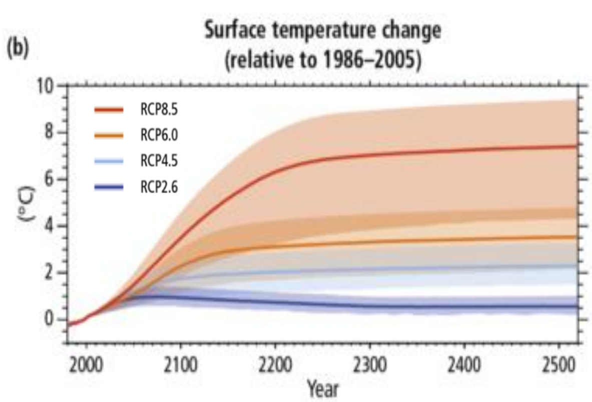


Figure 4. *Long term global temperature trends according to RCP values. (Jones 2017).*

Meanwhile, projections further into the future have been provided by the Intergovernmental 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 13^0F above the 1970-1999 average by the end of the century under the BAU scenario (RCP 8.5).

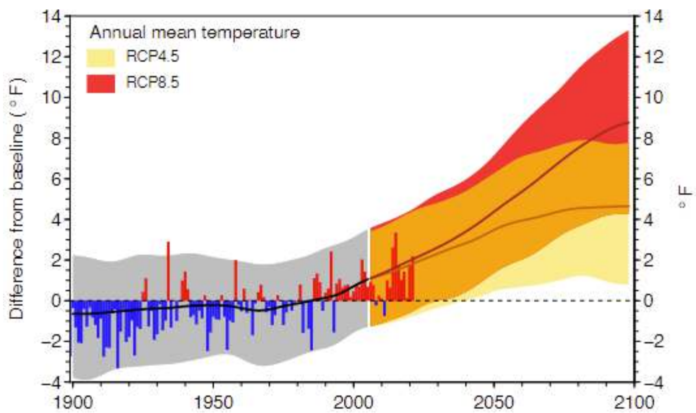


Figure 5. *Oregon temperature history and projections through the century; baseline: 1970 – 1999 (Fleishman 2023)*

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:

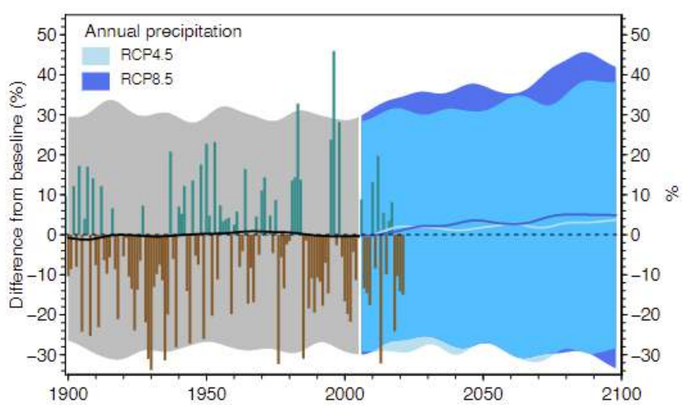


Figure 6. *History and projections for precipitation statewide. Fleishman 2023*

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.

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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.

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.

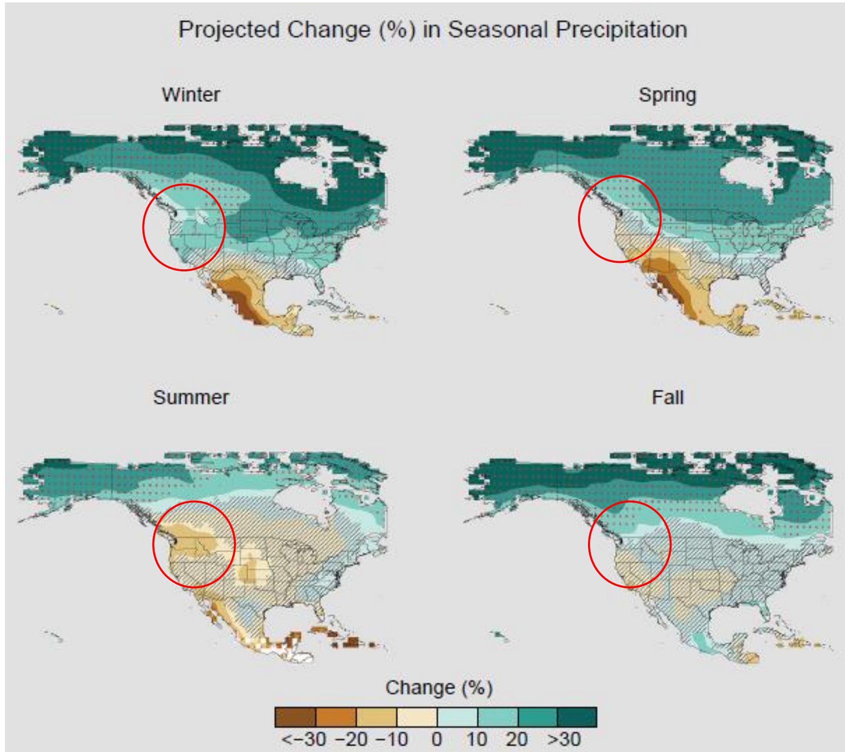

Figure 7. Projected change in precipitation to 2077-2090 compared to 1960-2005 average; stippled areas indicate large change compared to natural variation; hatched areas small change. Easterling *et al.* 2017

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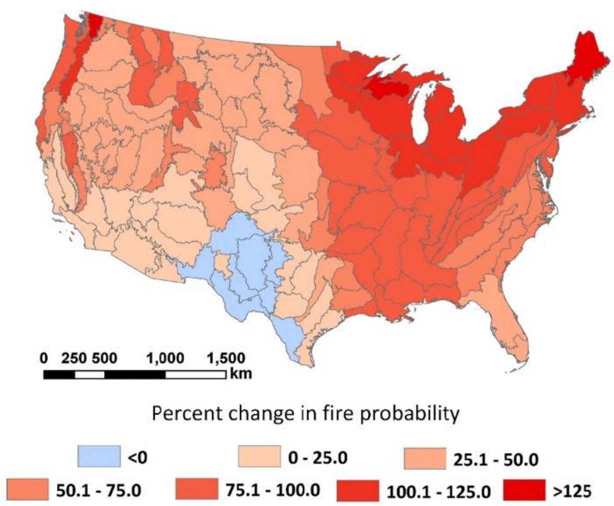

***Figure 8**. Potential increase in fire risk from the 1971-2000 baseline across the U.S. assuming the RCP 8.5 scenario. Gao et al. 2021*

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 into late fall.

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^{o}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.

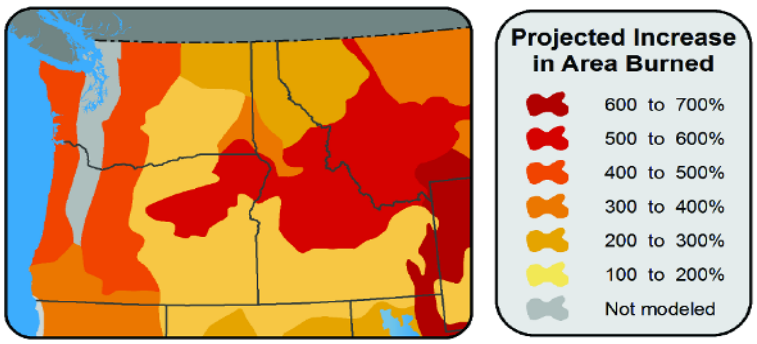

***Figure 9.** Anticipated wildfire consequences of a 2.2^{o}F warming in area burned (Mellilo et al. 2014).*

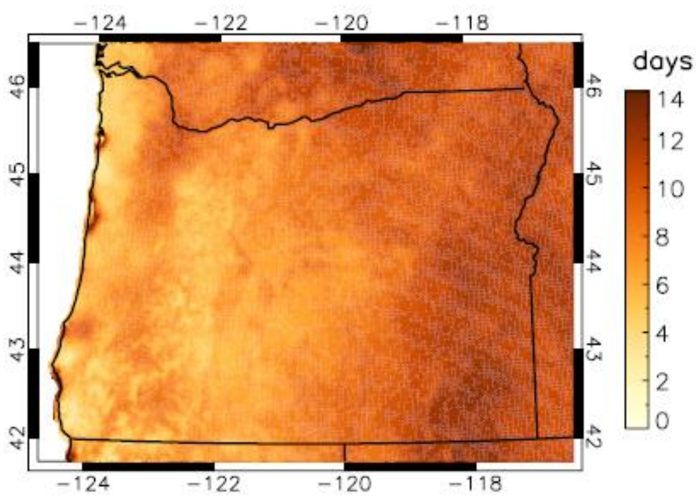

***Figure 10.** Increase in number of days experiencing high fire risk by mid- century (2040 - 2069) compared to the end of the last century (1971-2000). Mote et al. 2019.*

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 evident (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

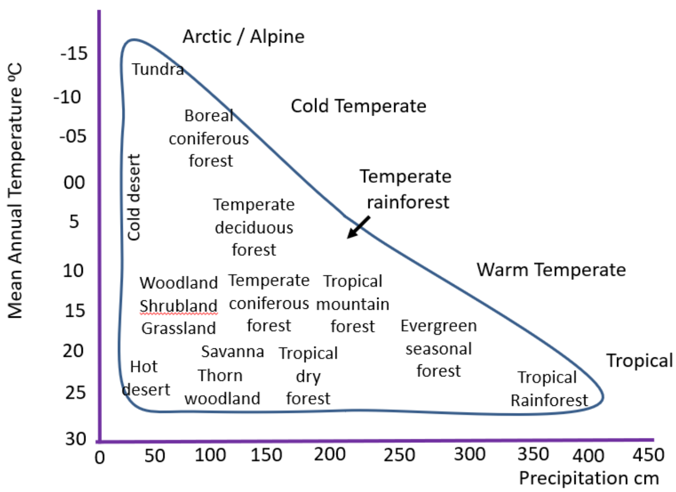

***Figure 11**. Global distribution of natural ecological systems (biomes) in relation to mean annual temperature and precipitation patterns. (Modified from Whittaker 1975.)*

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^{o}C (approximately 37^{o}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 consequence 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 carbon-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. Additionally, acidosis, a build-up of acidic conditions in the tissues, threatens many marine life forms.

In addition, 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. The 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 4th Oregon Senate District Climate History and Projections:

Although climate change is a complex issue, current models indicate several important trends in weather and climate that Oregon's 4th senate district is likely to experience if carbon emissions continue to increase. These trends include an increase in mean annual temperature but a trend of no change in overall precipitation (including both rain and snowfall). For Douglas County (Figure 12), the temperature trend for the last half of the 20th century showed about a 1°F increase. By the end of this Century, the increase could be as high as 9°F above the late 20th century mean. The trends for Lane County (USGS 2021) are almost identical. Both counties are likely to experience warmer conditions inland than towards the coast.

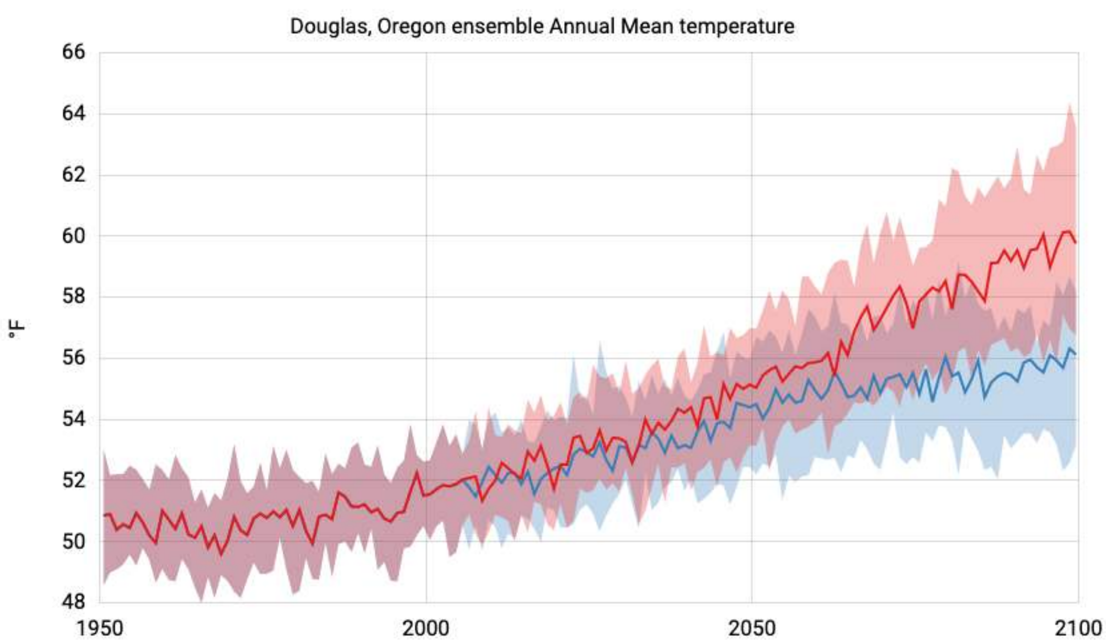

***Figure 12**. The historical and projected annual temperatures for Douglas County under the Business as Usual Scenario of accelerating fossil fuel use and greenhouse gas emissions (red line) and a reduced emission trajectory (blue line). (USGS 2021).*

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The historic trend in precipitation for Douglas County (Figure 13) indicates a flat trend which is expected to continue through this century but with greater variability, meaning more extreme wet and dry years (USGS 2021). Again, Lane County is almost identical (USGS 2021). Both counties are likely to experience wetter conditions towards the coast than inland.

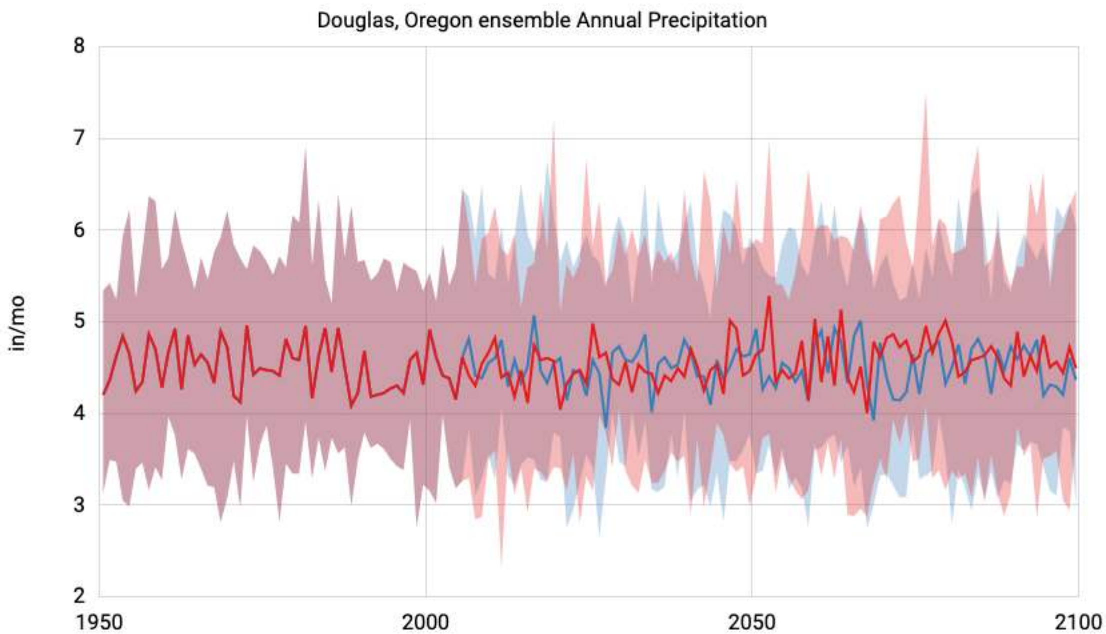

***Figure 13**. Historic and projected precipitation trends for Douglas County, Oregon (USGS 2021).*

Meanwhile, snowfall (Figure 14) in Douglas County has been declining since the 1900's, a trend that has many adverse impacts on the valley such as reduced water for natural communities, crop irrigation, and human consumption. The lack of high elevation snowpack also suggests a more severe wildfire season. The projected trend in snowpack is for a continued decline, possibly to only 10% of historical levels by late century. Combined with the trend towards precipitation falling in heavy downpours on more days rather than light rain on many days as seen historically, this will likely result in earlier and decreased stream flow, a consequence that poses a serious threat to those agricultural activities dependent on late summer and early fall snowmelt as an irrigation source.

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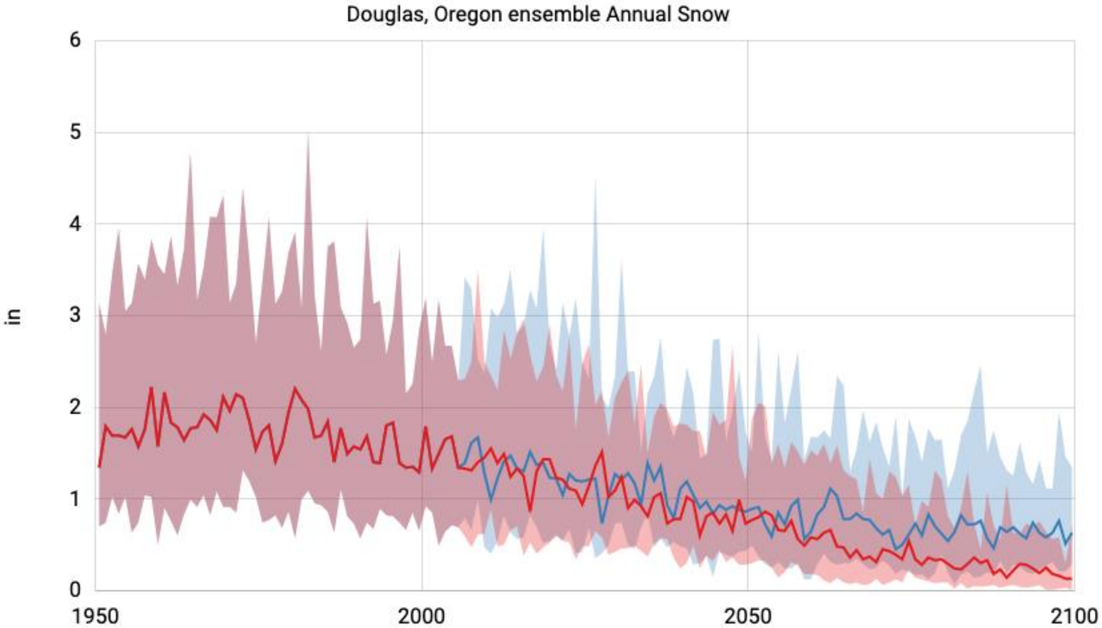

Figure 14. *Historical and projected snowfall patterns for Douglas County (USGS 2021).*

Federal Congressional District 4

Oregon State Senate District 4 falls entirely within Federal Congressional District 4. The historic temperature trend for this Congressional District (Figure 15) shows an increase of app 2.1ºF per century since 1895 (a value comparable with this State Senate District) but note that the rate of increase itself has increased to 3.8ºF since 1960.

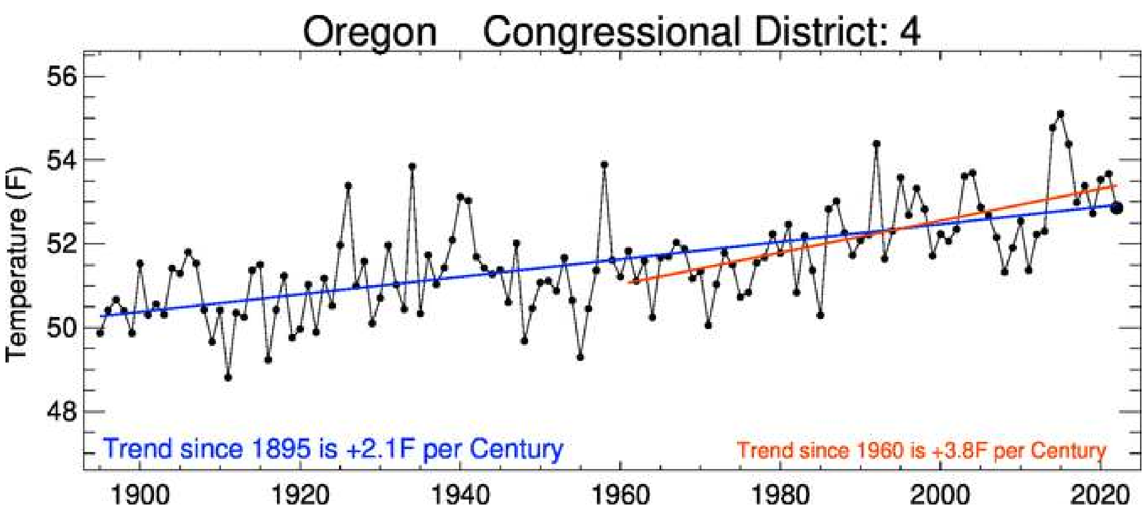

Figure 15. *Temperature trend for Federal Congressional District 2 (CCT 2021).*

Oregon 4th Senate District Economy:

Although the forestry industry in Oregon's 4thSenate District is not what it once was, Ponderosa pine, Douglas fir, Incense cedar, Sugar pine, White fir, Western hemlock, and Lodgepole pine continue to be processed in the region. If levels of carbon dioxide in our atmosphere continue to increase, the range of these species will also be affected. Current projections for the appropriate climate for these species (Figures 16 – 22) through the 21st century as climate change progresses indicate remarkable reductions in the range of appropriate growing conditions for most species. High tree viability is indicated in red, low viability in green and absence in areas without color.

What these projections suggest is that as the climate changes Oregon's 4th Senate District will become less favorable for these species. If we do nothing to mitigate climate change, the forestry industry in Oregon's 4th Senate District will face continuing challenges as these species become less and less productive and even abundant. However, given the ability of many Oregon forests to store carbon (Hudiburg *et al.* 2009), it is critical that climatic conditions not diverge such that these important species are compromised.

Figure 16. *Incense cedar (Calocedrus decurrens) Current and Projected distribution (Rehfeldt and Crookston 2023). 2030 and 2090 are not available*

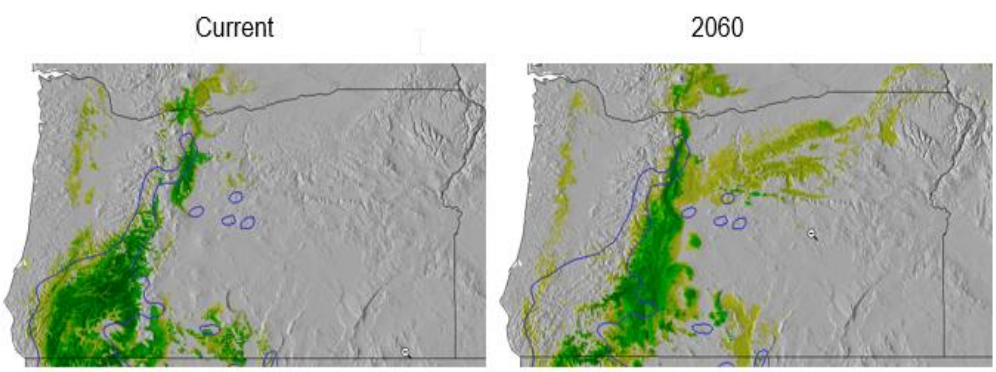

Figure 17. *Douglas fir (Psuedotsuga menzeisii) current and projected distribution through the 21st Century (Crookston and Radtke 2023).*

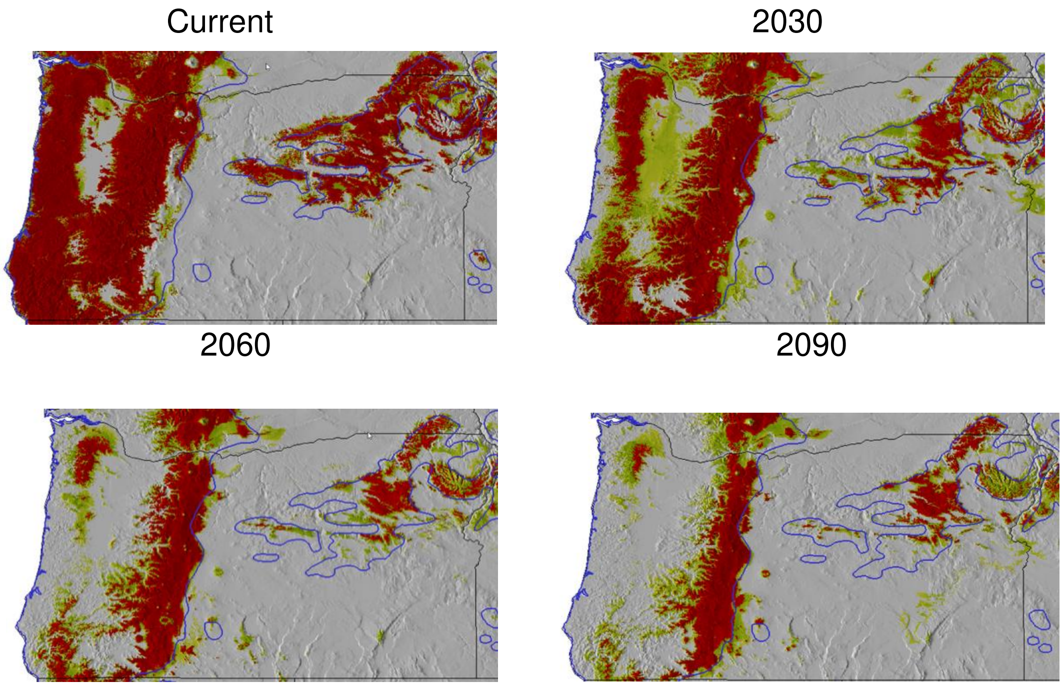

Figure 18. *White fir, Abies concolor appropriate climate conditions now and into the future (Crookston and Radkte 2023).*

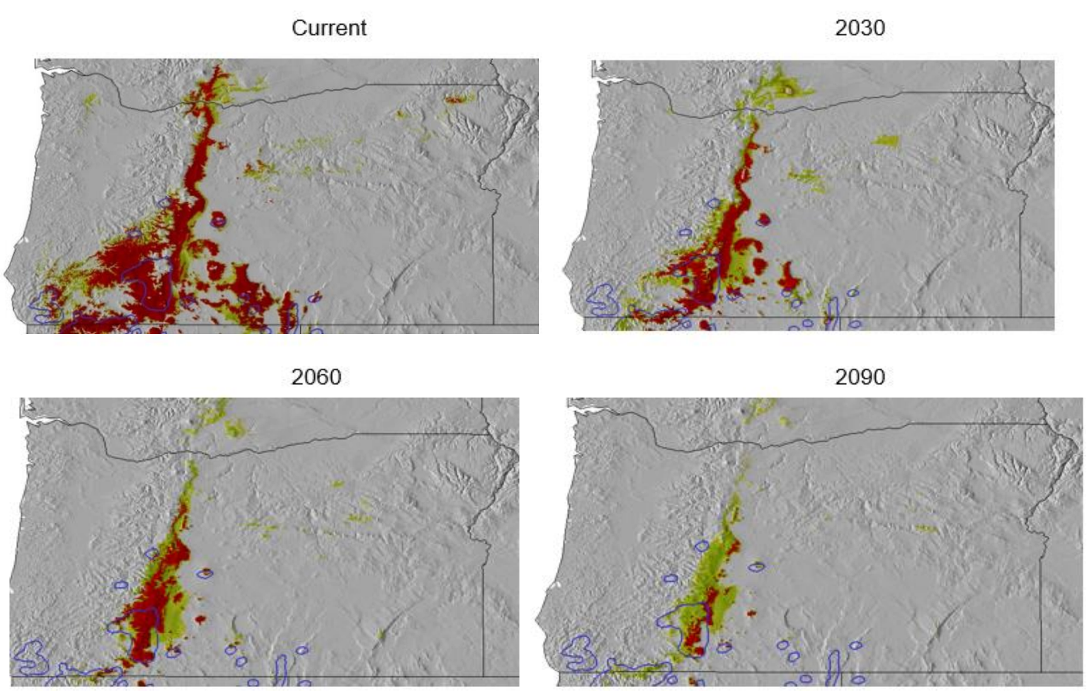

Figure 19. *Ponderosa pine, Pinus ponderosa appropriate climate conditions now and into the future (Crookston and Radtke 2023).*

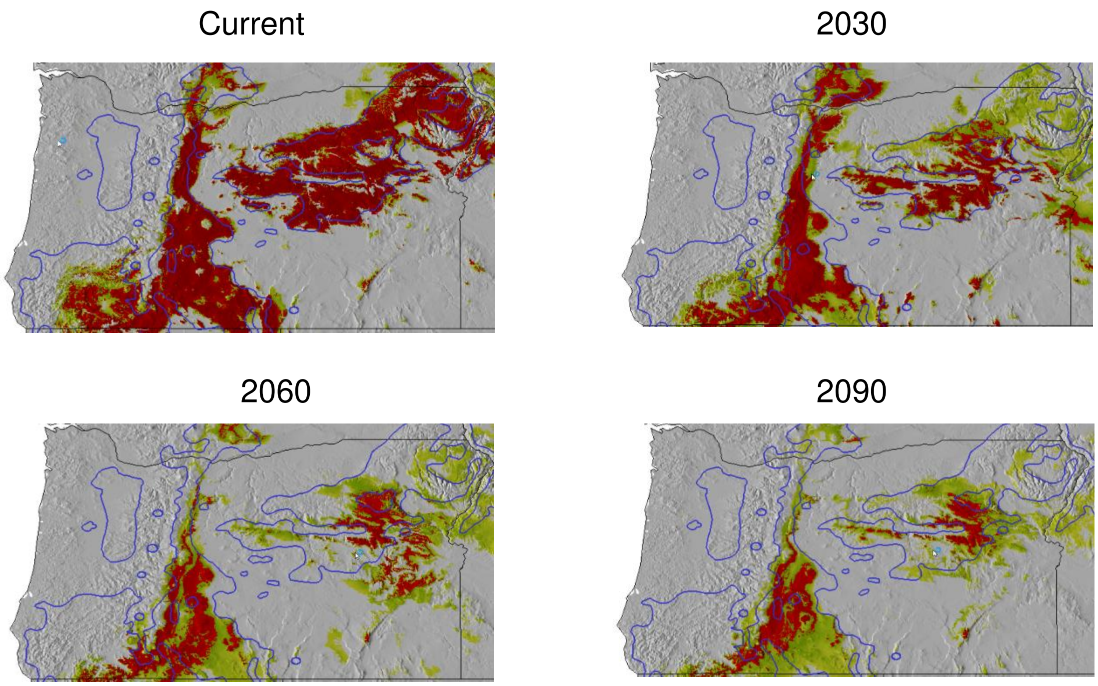

Figure 20. *Western hemlock, Tsuga heterophylla appropriate climate conditions now and into the future (Crookston and Radtke 2023).*

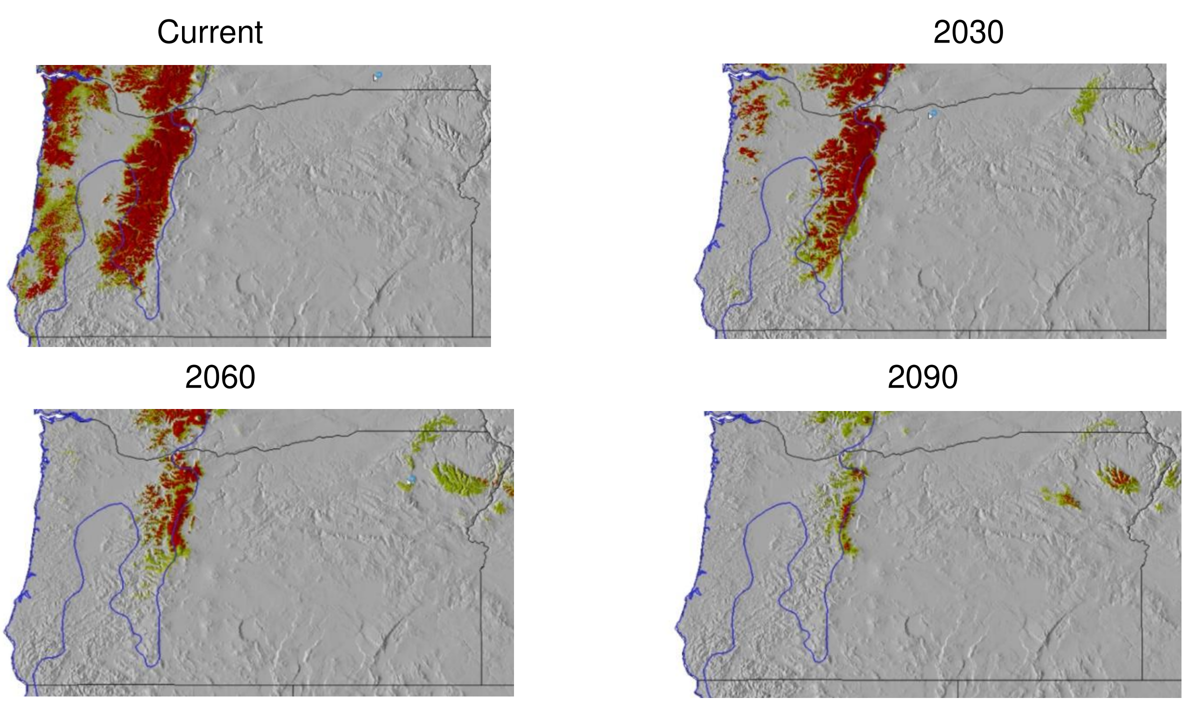

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Figure 21. *Sugar pine, Pinus lamertiana appropriate climate conditions now and into the future (Crookston and Radtke 2023).*

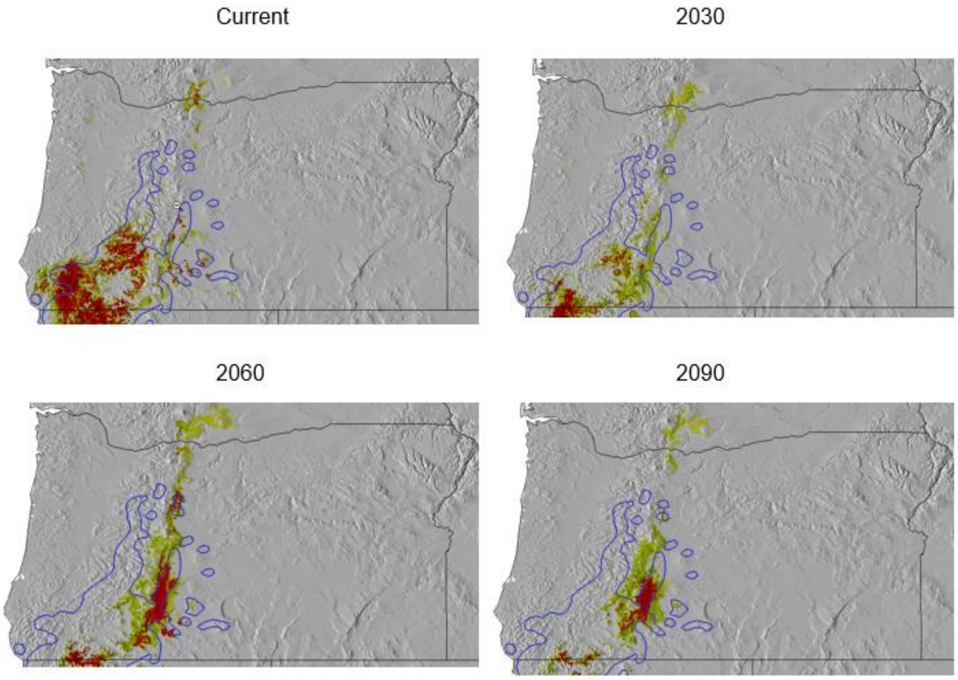
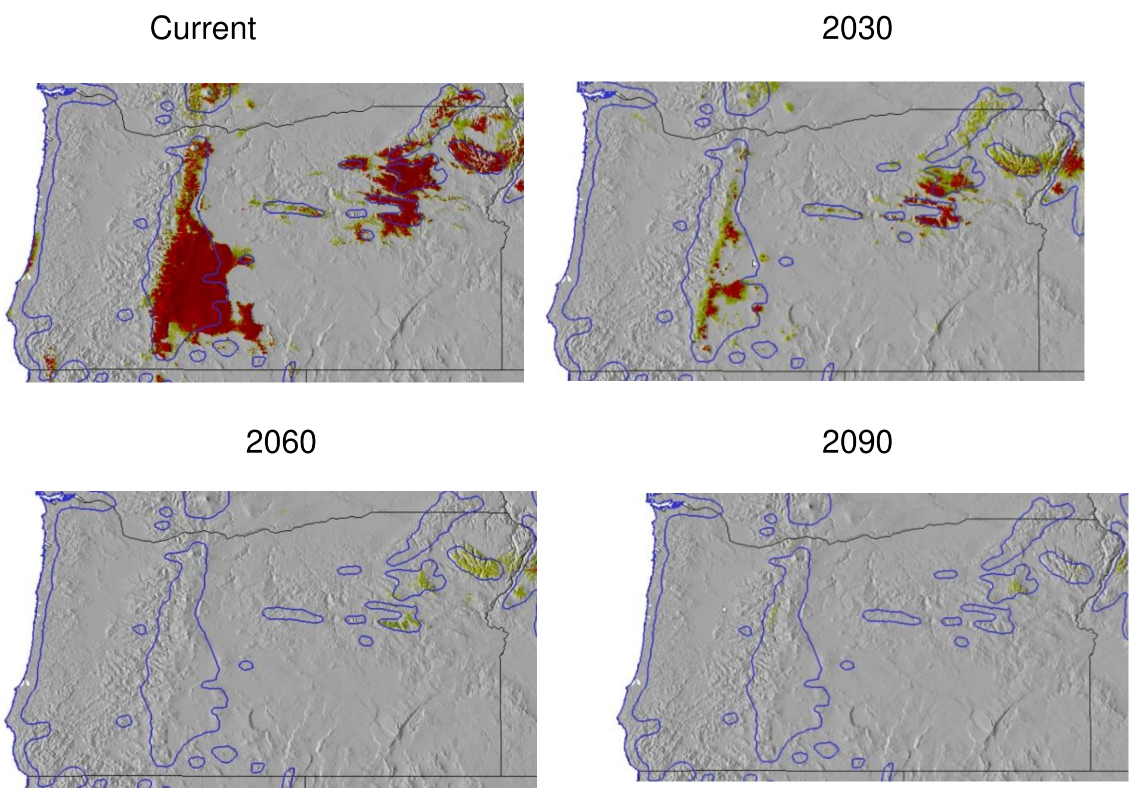


Figure 22. *Lodgepole pine, Pinus contorta appropriate climate conditions now and into the future (Crookston and Radtke 2023).*



Just as climate change is likely to affect tree species in Oregon's 4th senate district, it is likely to affect agriculture, another main staple of this district's economy. Livestock production and crop yields will undoubtedly be affected by the consequences of climate change: a longer period of summer drought, a higher likelihood for fires to occur, and a shorter winter "chill" period (which pear growers know is key to the success of the crop). An increase in temperature over the next century is also likely to affect the success of raising livestock and growing field crops. Providing adequate water for livestock through irrigation may become more of a challenge as the summer drought period lengthens and temperature increases. Likewise, many field crops grow at an "ideal" temperature. While Oregon's 4th senate district may be ideal for many now, that may change by the end of the century if we do nothing to mitigate climate change.

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 of SW Oregon's forests.

Potential Agricultural Impacts:

Our field crops are planted in soil and climatic conditions to which they are well adapted. This means adjustments from current climate can be detrimental. The agricultural 'one-degree problem' occurs because increasing temperature generally reduces crop yield. For each degree C temperature rise crop yield drops some 5 - 10% (Brown 2006). Meanwhile, the 'business as usual' scenario of increasing greenhouse gas emissions suggests that throughout Oregon the temperature will likely increase 5 or more degrees C with decreasing soil moisture (USGS 2014) posing a great risk of extended drought. Farmers and home gardeners in Oregon should be concerned about a compromised future.

Future climate patterns as projected would negatively impact the economy through a reduction in crop yields since increasing temperature consistently reduces crop productivity and a potential for lost tourism due to wildfire. The blossoming wine industry and the pears produced by and for Harry and David would also be affected by the altered growing season. A potential problem for pear growers is the need for a solid winter chill period. This is decreasing. While not immediately a problem, if the trend of decreasing chill hours continues the consequences for pear production could become relevant. Legally grown marijuana and hemp have also become important components of the economy in Senate District 4. Both are water intensive practices and will, therefore be severely impacted by reduced precipitation and stream flows.

The predominant wine varietals in this area are Pinot Gris, Syrah, Merlot, Cabernet Sauvignon, Pinot Noir, and Chardonnay. Figure 23 depicts the growing season optimal temperatures for varietals grown in the region including the impact climate change will likely have on wine growing. While many of the grape varietals grown in this area seem reasonably well-adapted to mid-century growing season temperatures, even some of the warm climate varietals could be compromised by late century. However, of particular note are the cooler growing season varietals of the region (especially Illinois Valley wines) such as Pinot gris, and Gewürtstraminer, which could be severely compromised even by mid-century.

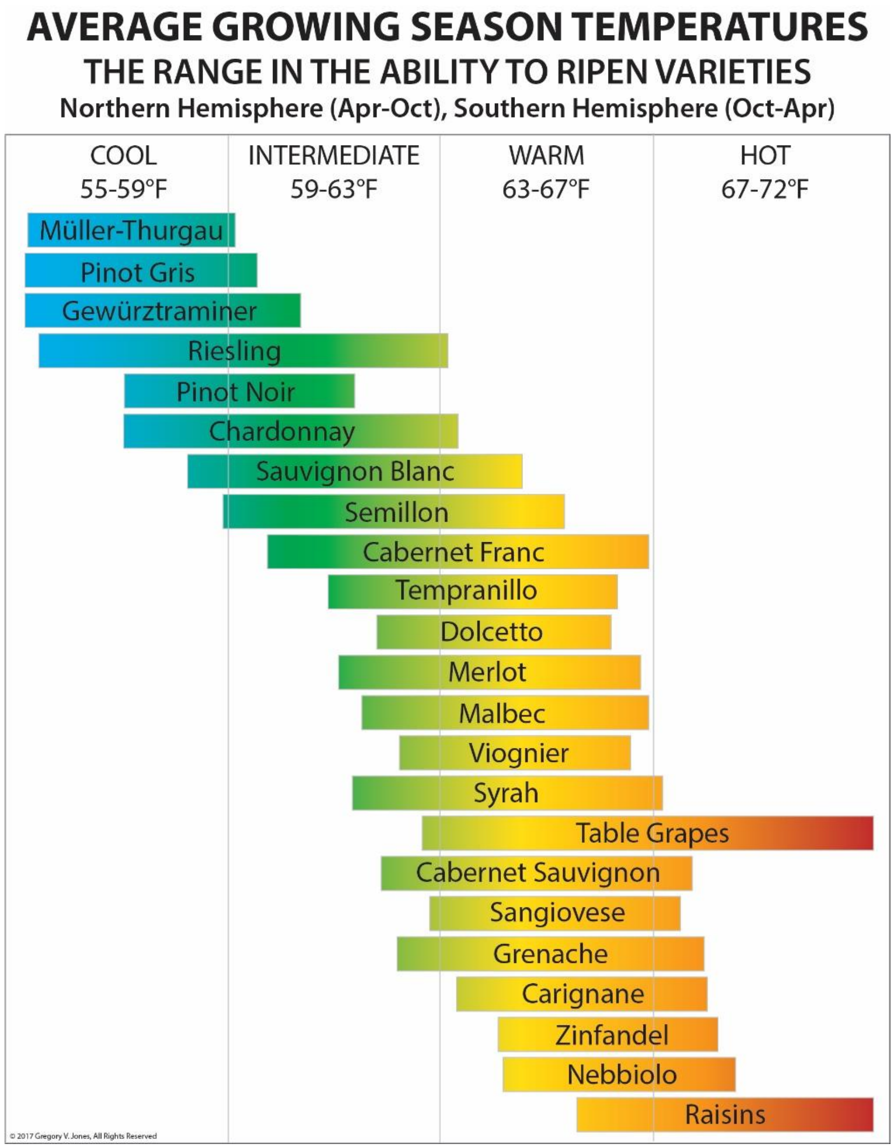


Figure 23. *Grape varietal optimum growing season temperature (Jones 2015).*

If climate trends continue as projected, Oregon's 4th Senate District will experience considerable natural and economic disruption. In order to sustain a vibrant economy, the region will find it necessary to adapt. Avoiding the worst-case scenario depicted in these projections will require the concerted effort of elected leaders at all levels of government, regional, national, and international.

Potential Health Risks:

Not only will climate change be negative for our economy, it will also change the lives of people in the 4th Senate district. Oregon Senate District 4 and surrounding areas have become increasingly popular as retirement locations; 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. Heat waves and particulates emitted by wildfires can be particularly hazardous to those with respiratory problems.

According to the Oregon Health Authority (2020), the impacts of climate change on health are likely to be numerous: poor air quality, poor water quality, respiratory illness, occupational and recreational hazards, heat-related illness, residential displacement, contaminated drinking water, water insecurity, food insecurity, vector-borne disease, income loss, economic instability, and mental health issues are all forecasted. Communities that will be especially vulnerable will be: rural and low-income communities, BIPOC communities, private well users, agricultural and outdoor recreation workers, firefighters and other first responders, and children and pregnant women.

A Timeline for Action:

Based on the projected consequences of the warming global climate, international agreements (e.g. UNFCCC 2015) some years ago established 2ºC (preferably 1.5ºC) 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 2ºC 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 1.5ºC 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 1.5ºC 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 2ºC. 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 CO_2, while for a 66% chance, the remaining emissions budget is 420 GT CO_2. 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 greenhouse gas 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 is based on the assumption 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 of 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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