

Climate Change in the Oregon 24th Senate District



July 2017

History, Projections, and Consequences

1. The last half of the 20th Century witnessed a temperature increase of about 1°F. Meanwhile, projections suggest a rise of up to 9°F above the average for that period is possible during this century.
2. Snowfall and snowpack accumulation, already dropping are projected to dwindle further, possibly to 10% of historic levels.
3. Annual average precipitation is expected to hold steady but become more variable. Winters are expected to be wetter and summers drier. A higher percentage of rain is expected to occur during intense events impacting summer water needs for humans and irrigation.
4. Wildfires, already exhibiting a 2.5 month longer season than in the 1970's, are expected to become more serious, with a 200% to 300% greater area consumed by mid-century.
5. A likely increase in wildfires will pose a substantially-greater threat to both forest and human health.
6. Agriculture, commercial and human water needs will be compromised as summer and fall availability dwindle.
7. Plant-based production companies will face increased burdens when a changing climate makes raw materials harder to grow, and thus more expensive.
8. With reduced snowpack and summer/fall stream flow, warmer water will likely compromise the ability of streams and rivers to support iconic freshwater species of the region.
9. Portland's parks and gardens will require more water to maintain their health, affecting taxpayers and natural systems.
10. At the current emissions trajectory, we have a 17 year window of opportunity if we wish to maintain the global temperature increase below 2°C (3.6°F) as international agreements dictate.
11. Main health impacts likely will be: heat, allergens, and 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. Vulnerable communities will be: low-income households and neighborhoods, communities of color, older adults, people living on steep slopes, people working in agriculture, first responders, and children and pregnant women.



Compiled by Peter Kleinhenz (kleinhenp@sou.edu) (614-202-5161) & Alan Journet (alanjournet@gmail.com), (541-301-4107) June, 2014

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

We invite copying of these materials, but request that authorship together with the SOCAN logo and attribution be retained.

This Page Intentionally Left Blank



Climate Change in the Oregon 24th Senate District

Compiled by Peter Kleinhenz & Alan Journet

(kleinhenz@sou.edu, 614-202-5161)

(alanjournet@gmail.com, 541-301-4107)

July, 2017

Global and Regional Temperature:

Data from NASA reveal that the Global and U.S. atmospheric temperatures have increased substantially since 1880 (Figures 1 and 2).

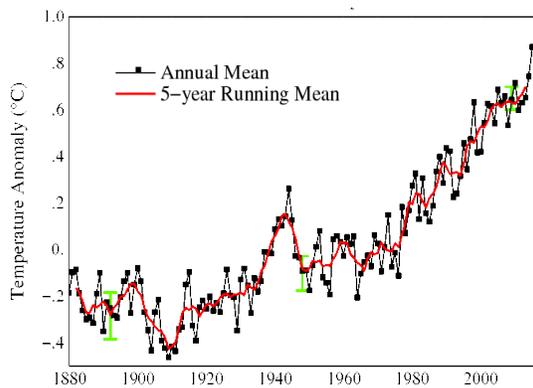


Figure 1. Historic global temperature trend NASA Goddard Institute for Space Studies 2017.

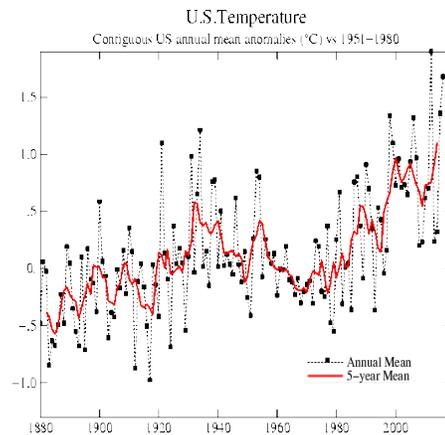


Figure 2. Historic U.S temperature trend. NASA Goddard Institute for Space Studies 2017.

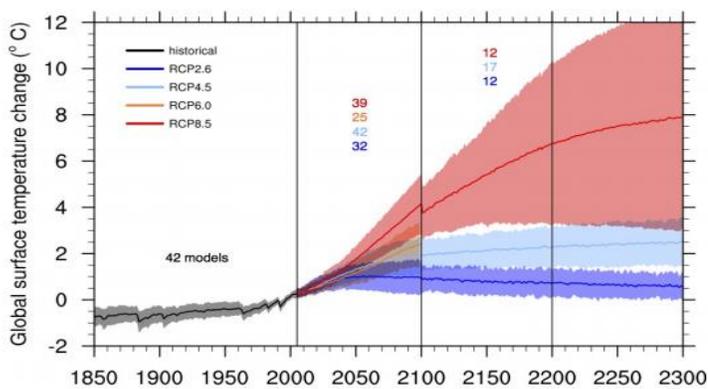


Figure 3. Intergovernmental Panel on Climate Change 2013 global projections.

http://www.climatechange2013.org/images/uploads/WGIA_R5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

Depending on the RCP (Representative [Carbon] Concentration Pathway) we follow globally (Fig. 3), this century may result in from a 2⁰F increase, assuming immediate action, to a high of over a 9⁰F increase. The trajectory beyond the century offers an even more challenging high extreme with an extreme 20⁰F hotter. Meanwhile, temperature projections for the Pacific Northwest (Figure 4) suggest a similar range of temperature increases are possible, reaching – as an average – nearly a 12⁰F increase by the end of the century

under the Business as Usual scenario (RCP 8.5) in which we continue the current trajectory of accelerating emissions.

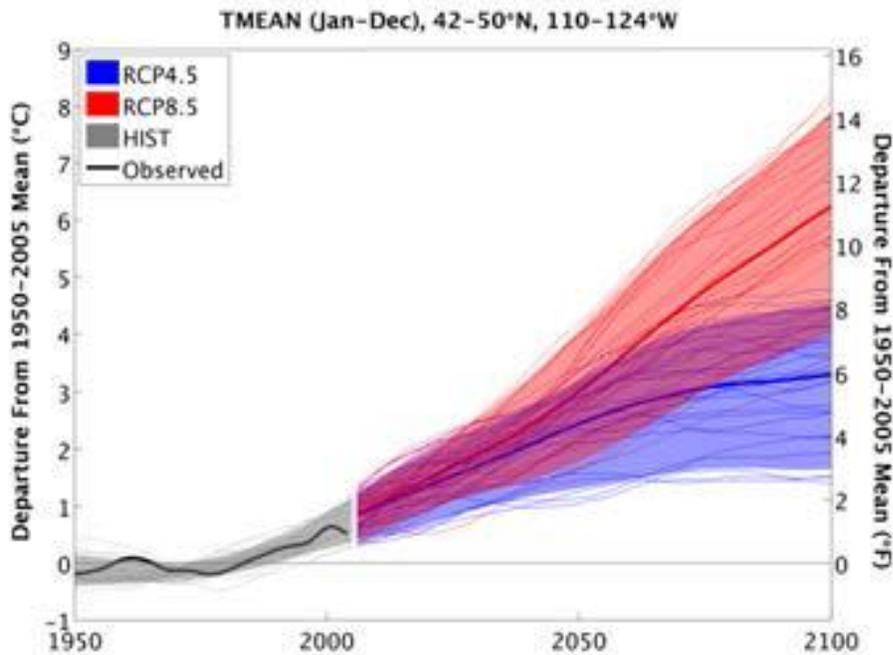


Figure 4. Oregon temperature history and projections through the century (Dalton *et al.* 2013).

<http://library.state.or.us/repository/2010/201012011104133/summaries.pdf>

The higher range of temperature increase would be unmanageable. It would devastate natural systems (forests, woodlands, shrub lands and the species they support) 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 greater overwintering populations. Similarly, invasion of natural and agricultural systems by drought tolerant invasive species and pests will likely be enhanced.

The lower range for continued temperature increase resulting from the greenhouse gases already released is inevitable; for this we will simply have to prepare and adapt.

Regional Precipitation:

The 2013 US Climate Change Assessment (Melillo *et al.* 2014) provides projections for future precipitation (Figure 5) according to the ‘business as usual’ 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, summers will likely be considerably drier.

Projected Precipitation Change by Season

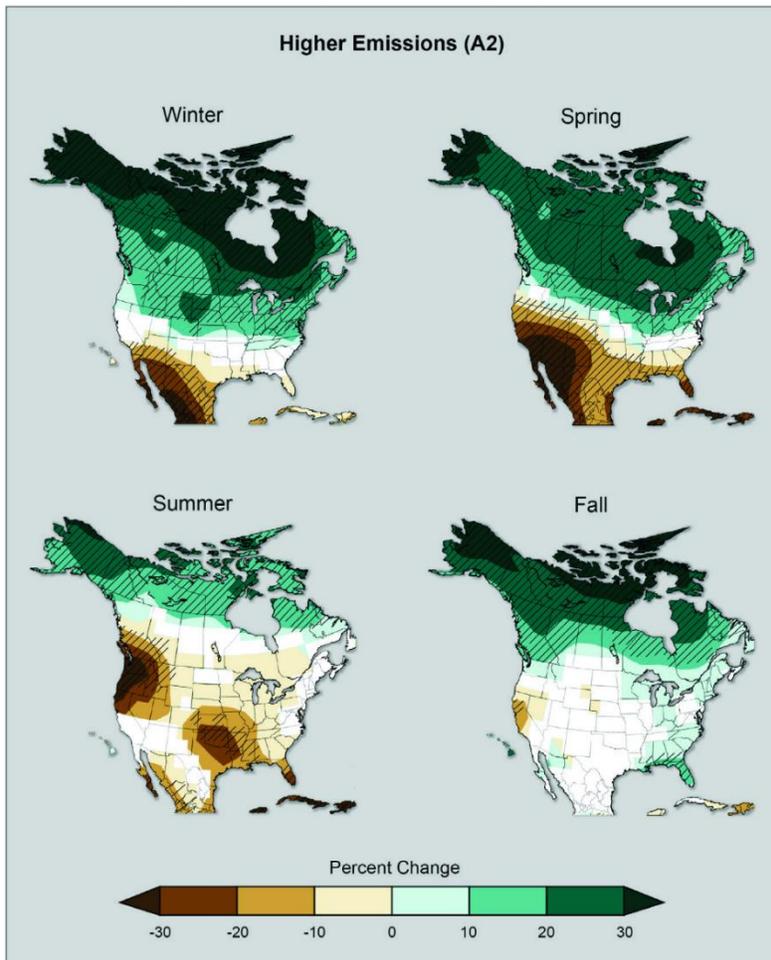


Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average (Melillo *et al.* 2014).
<http://www.globalchange.gov/what-we-do/assessment>

Water resources, already severely compromised in many locations, will become more threatened as snowpack declines and precipitation occurs as severe storms rather than the typical light drizzle that rejuvenates soil moisture. This trend will likely enhance floods, soil erosion and potentially landslides.

The reduced stream and river flow occurring during summer/fall will be warmer compromising many iconic Pacific Northwest cold-water aquatic species.

Melillo *et al.* (2013) also offered wildfire projections accompanying just a 2.2⁰F warming, a condition potentially evident by mid-century (Figure 6).

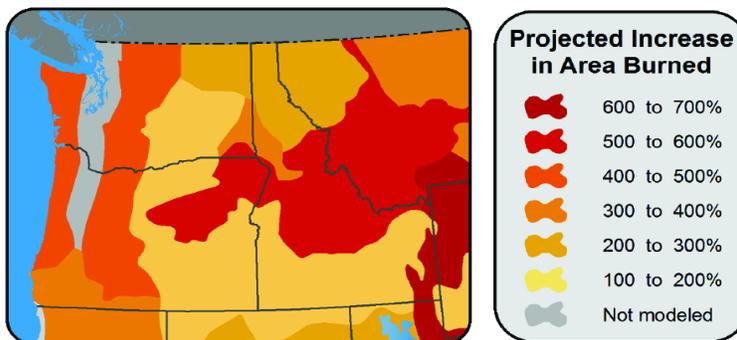


Figure 6. Anticipated wildfire consequences of a 2.2⁰F warming in area burned (Melillo *et al.* 2014).
<http://www.globalchange.gov/what-we-do/assessment>

The fire season, already extended by 2.5 months since 1970 (Westerling *et al.* 2006), will likely become longer and more severe in Oregon, with two to six times as many acres burned. Both human safety and human health will likely be threatened.

Coastal Concerns:

Though much of Oregon is land-locked, and will suffer little directly as a result 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 between 1900 and this century are already documented with further increases to 2.0 °F by mid-century expected. 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). As the ocean warms, it expands and sea level 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 a subsiding coastal plate will exacerbate the impact. Projections for Newport suggest a potential century rise of between 6” and nearly five feet. Higher sea level poses a greater threat than merely its impact on tidal level. 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 is a perfect illustration of this problem. Not long ago, the suggestion that New York subways could be flooded by a coastal storm would have not received any serious consideration – yet it happened! Consequences of ocean rise such as increased erosion and compromised coastal habitat integrity for tidal flat, estuary, and marsh natural communities could become serious.

Ocean Acidification. Serious as 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, our oceans are increasing in acidity. This is detrimental for marine organisms with carbon-based shells since they are unable to form shells in acid conditions, or they lose shells already established. Oysters suffering directly, and salmon indirectly, have been noted as particularly threatened by acidification. Acidosis, a build-up of acidic conditions in the tissues, threatens many marine life forms.

The 24th Oregon Senate District Climate History and Projections:

The average temperature history and projections for (Figure 7) show the Clackamas County rose 1°F during the second half of the last Century and might rise some 9°F above the mean for that period by the end of the century if we fail to lower our emissions trajectory.

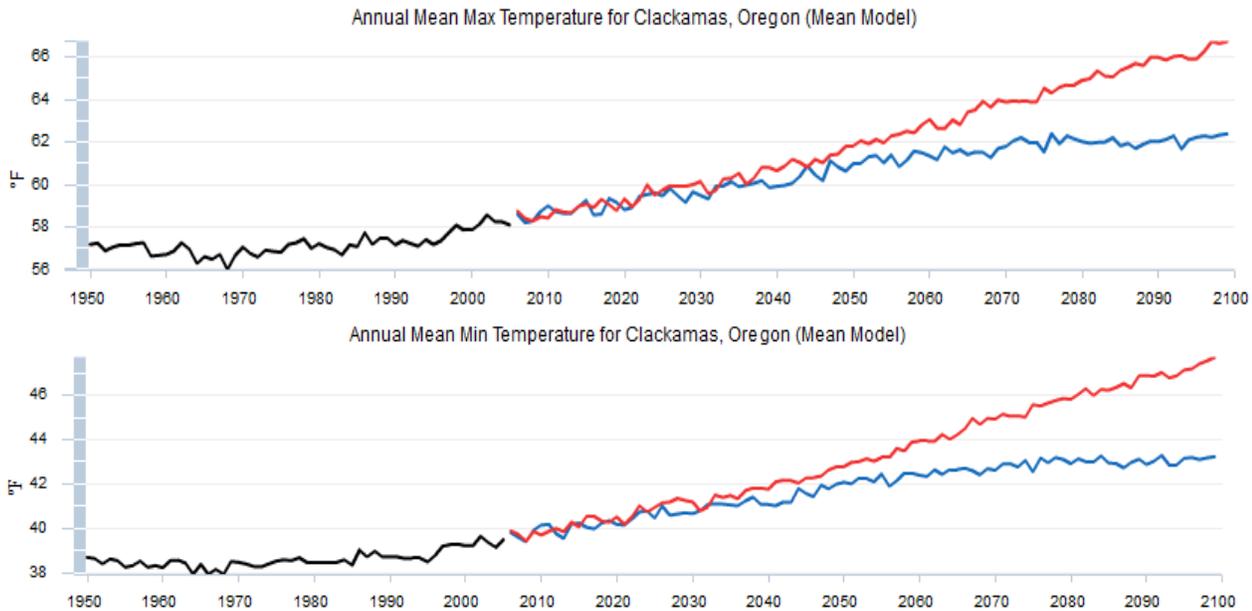


Figure 7. Mean Maximum and Minimum temperature trends and projections for Clackamas County. Red represents the business as usual scenario of accelerating fossil fuel use and emissions while blue assumes some emissions reduction occurs (USGS 2017).

Precipitation trends for Clackamas County show a reasonably flat history and projected future (Figure 8). However, variability will likely increase producing wetter and drier years. Additionally, the seasonal precipitation projection (Figure 5) combined with rising temperature, suggest the likelihood of summer drought will increase

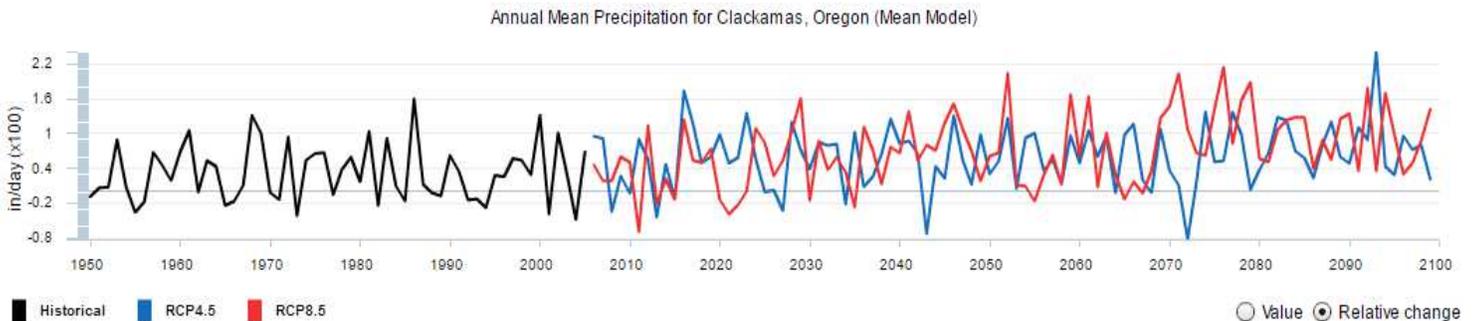


Figure 8. Precipitation trend and projections for Clackamas County (USGS 2017)

Oregon Senate District 24 Climate Summary

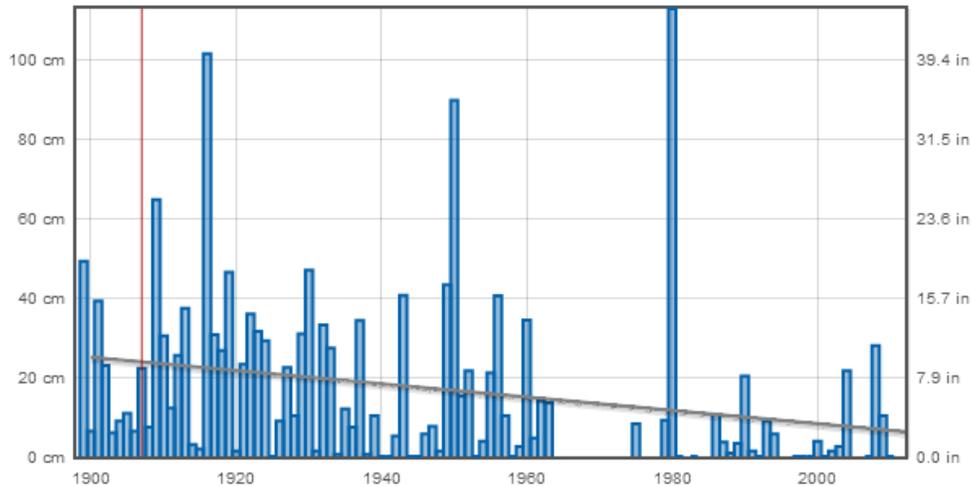


Figure 9. Snowfall trend for Portland, Oregon.

<http://www.wunderground.com/climate/local.html?id=USC00458773&var=SNOW&MR=1>

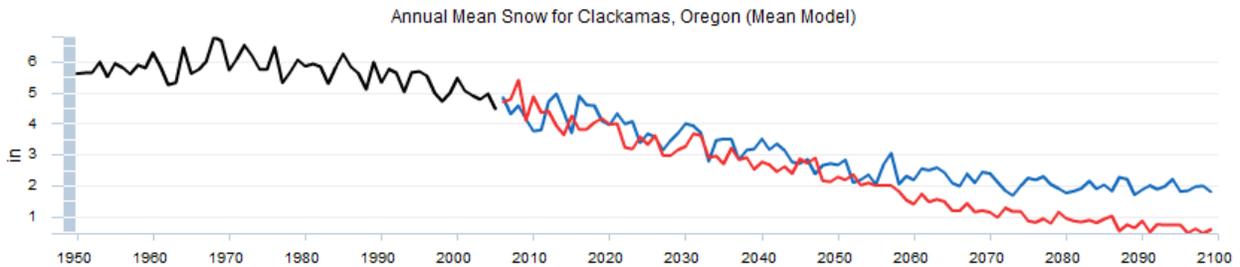


Figure 10. Snowfall history and projections for Clackamas County, Oregon (USGS 2017)

Snowfall is decreasing rapidly in Senate District 24 as depicted in Figure 9 and 10. This decrease is projected to continue regardless of future emissions scenarios, though the 'business usual scenario' (red) will likely lead to greater reductions than if we reduce emissions (blue). As snow melts, streams and aquifers get replenished. Senate District 24 will face water scarcity if climate change continues unabated. The social, economic, and environmental consequences of snowfall scarcity are varied and require careful consideration

The synergistic effects of higher temperatures, lower precipitation, and snowfall should not be underestimated. Evaporation will increase with higher temperatures and less surface water will be available. Droughts can be expected to lengthen, which will increase the cost of water resources and drive up costs for businesses and homeowners alike.

Federal Congressional District Historic Temperature Trend

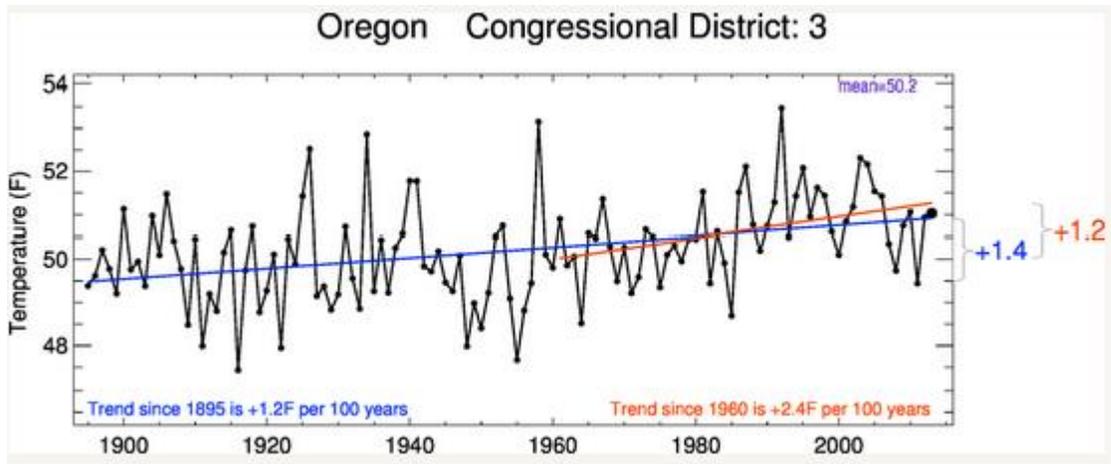


Figure 11. Congressional District 3 historic temperature trends.

<http://temperaturetrends.org/district.php?district=3&state=OR>

A large portion of Senate District 24 lies within Oregon’s 3rd Federal Congressional District. Temperature trends from that district (Figure 11) show that the temperature, on average, has risen 1.2 degrees Fahrenheit since 1895. Meanwhile, since 1960 the temperature has been rising at twice that rate.

Oregon 24th Senate District Economy:

Climate change would significantly impact the economy of Multnomah County, which the majority of Senate District 24 is contained within. The economy of Multnomah County centers on agriculture, timber, manufacturing, and tourism.

Much of Senate District 24 consists of urban Portland. Portland is known as the “City of Roses” due to the large number of these spectacular flowers growing in the moderate, moist climate there. The gardens and greenness of the city are well-known and help to support a booming tourism industry. As the climate changes, the green character of Portland will be harder to maintain. To do so will require larger draws from available water resources, affecting taxpayers and natural systems.

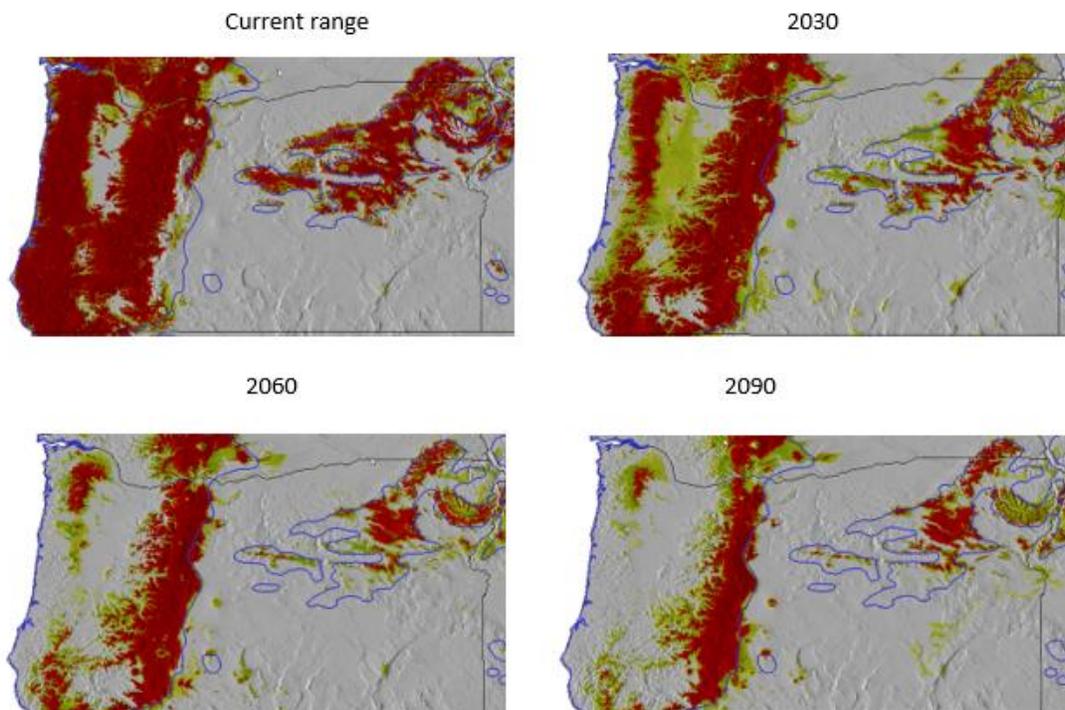
Large companies based in or near Senate District 24 will be affected by climate change as well, and in ways that may not be obvious at first. Take Adidas for example. Several studies (Abdlatif *et al.* 2012; Zomer *et al.* 2014) show that rubber production could be severely impacted by climate change and Adidas would likely incur far greater production costs for its shoes. This would have a negative ripple effect on the economy of Senate District 21.

Stumptown Coffee and Portland Brewing Company will have to pay more for their basic ingredients as climate change makes less land suitable for coffee and hops production, respectively. And those are just a few examples out of the several production-based companies with headquarters in or near Senate District 24.

Construction and the transportation of materials are responsible for nearly ten percent of Portland’s economy. One of the anticipated impacts of climate change is a rising sea level as ice caps melt. The costs involved with altering docks, shipping routes, and ship designs would have trickle-down effects on anyone working in the shipping industry. As mentioned before, raw materials (such as wood) could become scarcer as a result of climate change. The materials will, naturally, become more expensive as they get harder to procure. Currently, the most important timber resource in Clackamas County is Douglas fir-dominated forest. The climate envelope projections (Rehfeldt *et al.* 2006) presented for Douglas fir in Figure 12 indicate that conditions for this species may be severely compromised through the century. This poses a major threat to the regional timber industry, as well as the manufacturing and construction jobs that depend on that industry.

Figure 12 Douglas fir (*Pseudotsuga menzeisii*) current and projected distribution through the 21st Century

<http://charcoal.cnre.vt.edu/climate/species/>



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.

Manufacturing comprises a large portion of the economy in Multnomah County. Interestingly, it too is tied to climate change. As the federal government increases restrictions on fossil fuel use (a leading cause of climate change) in this country, Clackamas County's manufacturing sector could benefit. Opportunities will increasingly exist to develop the parts needed to run the abundant wind turbines, and other renewable energy projects, in and around Portland. Multnomah County could lessen the emissions that are driving climate change while growing their economy in preparation for the emphasis on alternative energy projects that are sure to come. In June of 2014, the Obama Administration required states to limit their carbon dioxide emissions substantially by 2030. Additionally, Oregon plans to source twenty percent of its energy from clean, renewable sources by 2020. Multnomah County could be a leader in the manufacturing of alternative energy materials and, as a result, also be a leader in the fight against climate change.

If climatic changes continue unabated, the nature and economic activity contained within Senate District 24 will suffer. Senate District 24 is a prosperous district. If the district is to stay that way, it should recognize its role in preventing the worst potential climate change impacts. Policies made in the next few years should reflect a commitment to addressing the impacts of climate change. Policies made in as little as a decade should reflect adaptation to the changes certain to happen within Senate District 21 unless serious action is taken soon. There will be times in the future when those living in Senate District 24 will have to adapt to inevitable changes. But, for now, we have a moral choice to make about how much we want to reduce the extent of climate change impacts. The choice is yours.

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, in fact 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.

Even though an urban district may not encompass agricultural areas, individuals living in the district assuredly rely on agricultural productivity from neighboring districts. If productivity in such areas is compromised, the price of food will respond accordingly.

Potential Health Risks:

According to the Oregon Health Authority (2014), the main climate impacts to health are likely to be: heat, allergens, and 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, and children and pregnant women.

A Timeline for Action:

Based on the projected consequences of a warming climate, International agreements (e.g. UN 2009) have established 2°C as a limit beyond which we should not allow the global temperature to climb. This limit is echoed by the World Bank (2012, 2013, and 2014) and the International Energy Agency (IEA 2009).

Table 1 Carbon Dioxide Emissions and Temperature Consequences		
Emissions	Gigatons CO₂ added to atmosphere	Temperature increase
1850 – 2000	1035	0.8°C
2000 – Now	440	1.5°C
Allowed	825	2°C
Fossil Fuel Reserves	725	3 - 4°C
Accessible Reserves	780	5 - 6°C
Additional Reserves	1280	??

The trends and consequences discussed here are based on readily available data. An overall summary of our global temperature trajectory is depicted in Table 1 (from Quick M 2014) This shows that emissions of greenhouse gases to date have induced a temperature rise and inevitable continued rise totaling 1.5°C to 1.6°C (2.7 - 2.9°F) (Dixon 2001). If we wish to avoid an increase over 2°C the math tells us that we can only allow another 825 gigatons (billions of tones) of Carbon dioxide and equivalent emissions. Given that the current annual rate of global emissions is 37 gigatons (Le Quéré *et al.* 2014) and assuming the ‘business as usual’ scenario of accelerating emissions is followed into the future as it has been to date, we will exhaust this budget in about 17 years. Unfortunately, if known and suspected fossil fuel reserves were extracted and burned, the temperature impact would be far in excess of that agreed 2°C upper limit. In relation to shooting beyond 2°C, the World Bank (2012) acknowledged there is: “no certainty that adaptation to a 4°C world is possible.”

There can be little doubt that substantial urgency must be attached to addressing this issue.

Contact Senator Rod Monroe:

Capitol Phone: 503-986-1724

Capitol Address: 900 Court St NE, S-409, Salem, OR, 97301

Email: Sen.RodMonroe@state.or.us

Website: <http://www.oregonlegislature.gov/monroe>

House District 47: Representative Diego Hernandez:

Capitol Phone: 503-986-1447

Capitol Address: 900 Court St NE, H-373, Salem, OR 97301

Email: Rep.DiegoHernandez@oregonlegislature.gov

Website: <http://www.oregonlegislature.gov/hernandez>

House District 48: Representative Jeff Reardon:

Capitol Phone: 503-986-1448

Capitol Address: 900 Court St NE, H-473, Salem, OR 97301

Email: Rep.JeffReardon@state.or.us

Website: <http://www.oregonlegislature.gov/reardon>

Literature:

Abdlatif, Ismail, Zainal Mohamed, and Parthajyoti Borkotoky. 2012. *Climate Change and Malaysian Rubber Production*. Saarbrucken, Germany: Lambert Academic.

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

Dalton, MM., PW. Mote, and A.K. Snover [Eds.] 2013. *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities*. Washington, DC: Island Press, 230 pp.

Dixon 2001 *Global Warming Commitment: Temperatures Would Rise Even with No Further Additional Greenhouse Gas Increases*. NOAA. http://www.gfdl.noaa.gov/cms-filessystem-action?file=/user_files/kd/pdf/onepageb01.pdf

Hudiburg T, Law B, Turner D, Campbell J, Donato D, Duane M. 2009. Carbon dynamics of Oregon and Northern California forests and potential land-based carbon storage. *Ecological Applications* 19: 163 – 180.

IEA 2009, *World Energy Outlook*, International Energy Agency, Paris, France, 691 pp

IPCC 2013. *Climate Change 2013: The Physical Science Basis; Summary for Policymakers* WGI IPCC Switzerland.

Le Quéré C, Moriarty R, Andrews R, Peters G, Ciais P, Friedlingstein P, Jones S, Sitch S, Tans P, Arneeth A, Boden T, Bopp L, Bozec Y, Canadell J, Chevallier F, Cosca C, Harris I, Hoppema M, Houghton R, House I, Johannessen T, Kato E, Keeling R, Kitidis V, Klein Goldewijk K, Koven C, Landa C, Landschützer, Lenton A, Lima I, Marland G, Mathis J, Letzl N, Nojiri Y, Olsen A, Ono T, Peters W, Pfeil B, Poulter B, Raupach M, Regnier P, Rödenbeck C, Saito S, Salisbury J, Schuster U, Schwinger J, Séférian R, Segschneider J, Steinhoff T, Stocker B, Sutton A, Takahashi T,

Tilbrook B, van der Werf G, Viovy N, Wang Y 2014 *Global Carbon Budget 2014* Earth System Science Data 7: 521-610.

Melillo, JM., TC. Richmond, and GW Yohe, [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.

Miller SM, Wofsy SC, Michalak AM, Kort EA, Andrews AE, Biraud SC, Dlugokencky EJ, Eluskiewicz J, Fischer ML, Janssens-Maenhout G, Miller BR, Miller, JB, Montzka SA, Nehkorn T, Sweeney C. 2013, Anthropogenic emissions of methane in the United States. *Proceedings of the National Academy of Science*. 110 (50) <http://calgem.lbl.gov/Miller-2013-PNAS-US-CH4-Emissions-9J5D3GH72.pdf>

NASA Goddard Institute for Space Studies July 2017 *GISS Surface Temperature Analysis*.

Retrieved from NASA Goddard Institute for Space Studies:

https://data.giss.nasa.gov/gistemp/graphs_v3/Fig.A2.gif and

http://data.giss.nasa.gov/gistemp/graphs_v3/Fig.D.gif

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>

Quick M, 2014 *How Many Gigatons of Carbon Dioxide...?*

<http://www.informationisbeautiful.net/visualizations/how-many-gigatons-of-co2/>

Rehfeldt G, Crookston N, Warwell M, Evans J 2006 Empirical Analyses of Plant-climate Relationships for the Western United States, *International Journal of Plant Science* 167 (6): 1123 – 1150.

UN 2009 *United Nations Framework Convention on Climate Change: Copenhagen Accord*.

United Nations, Stockholm, Sweden.

<http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf>

USGS 2017 National Climate Change Viewer (NCCV) United States Geological Survey

https://www2.usgs.gov/climate_landuse/clu_rd/nccv/viewer.asp

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.

World Bank 2012, *Turn Down the Heat: Why a 4°C Warmer World Must be Avoided*. The World Bank, Washington DC. 84pp

World Bank 2013, *Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience*. The World Bank, Washington DC. 213pp

World Bank 2014, *Turn Down the Heat: Confronting the New Climate Normal*. The World Bank, Washington DC. 275pp

Zomer, RJ, Trabucco A, Wang M, Lang R, Chen H, Metzger, MJ, Smajgl, A, Beckschäfer P, Xu J 2014 Environmental stratification to model climate change impacts on biodiversity and rubber production in Xishuangbanna, Yunnan, China. *Biological Conservation* 170: 264-273

We invite copying of these materials, but request that authorship together with the SOCAN logo and attribution be retained <http://socan.eco/oregon-legislative-districts/>