

Southern Oregon Climate Action Now

**SOCAN**

Confronting Climate Change

## Climate Change in Oregon's 19th Senate District

July 2017



### History, Projections, and Consequences

1. The last half of the 20<sup>th</sup> century witnessed a temperature increase of about 1°F. Meanwhile, projections suggest a possible further rise of up to 8°F from the average over that period is possible during this century.
2. Snowfall and snowpack accumulation, already dropping is projected to dwindle further, possibly to 10% of historic levels.
3. Annual average precipitation is expected to hold steady but, seasonally, winters are expected to be wetter and summers drier with rain occurring in more heavy downpours promoting flooding and erosion.
4. Wildfires, already exhibiting a 2.5 month longer season that in the 1970's, are expected to become more serious, with a 200% to 300% increase in area consumed by mid-century.
5. An increase in wildfires will likely pose a substantially-greater problem for forest and human health.
6. Climatic shifts themselves will likely compromise the viability of important forest and timber species in the district, especially Douglas fir posing a threat to timber activities.
7. Agriculture will be compromised as summer and fall water availability dwindles.
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. Tourism will be negatively affected if lakes, rivers, and waterfalls receive less flow due to reduced precipitation and snowpack.
10. Main Health impacts 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. 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, young children, and pregnant women.

Compiled by Peter Kleinhenz ([kleinhenz@sou.edu](mailto:kleinhenz@sou.edu), 614-202-5161) & Alan Journet ([alanjournet@gmail.com](mailto:alanjournet@gmail.com), 541-301-4107) May, 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 19th Senate District

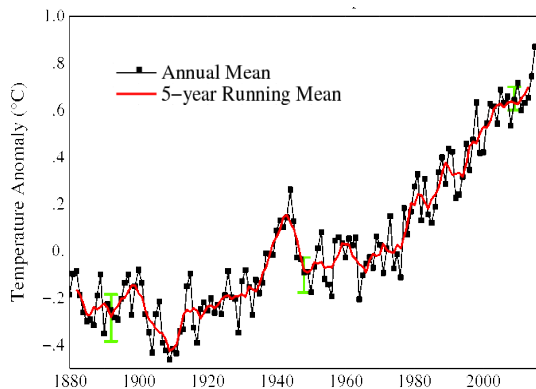
Compiled by Alan Journet

([alanjournet@gmail.com](mailto:alanjournet@gmail.com), 541-301-4107)

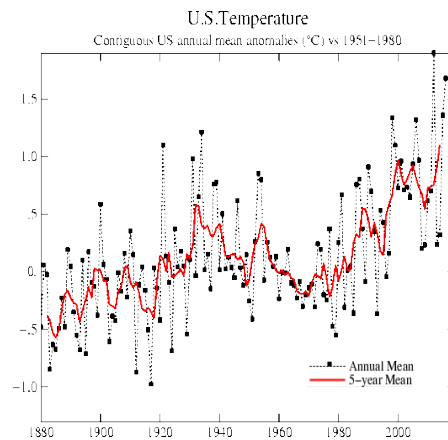
July, 2017

### Global and Regional Temperature:

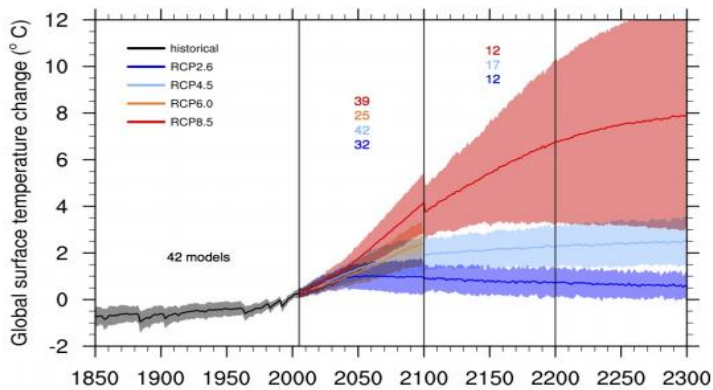
Data from NASA reveal that the Global and U.S. atmospheric temperatures have increased substantially since 1880 (Figures 1 and 2).



**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](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 2<sup>0</sup>F increase, assuming immediate action, to a high of over a 9<sup>0</sup>F increase. The trajectory beyond the century offers an even more challenging high extreme with an extreme 20<sup>0</sup>F 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 12<sup>0</sup>F 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.

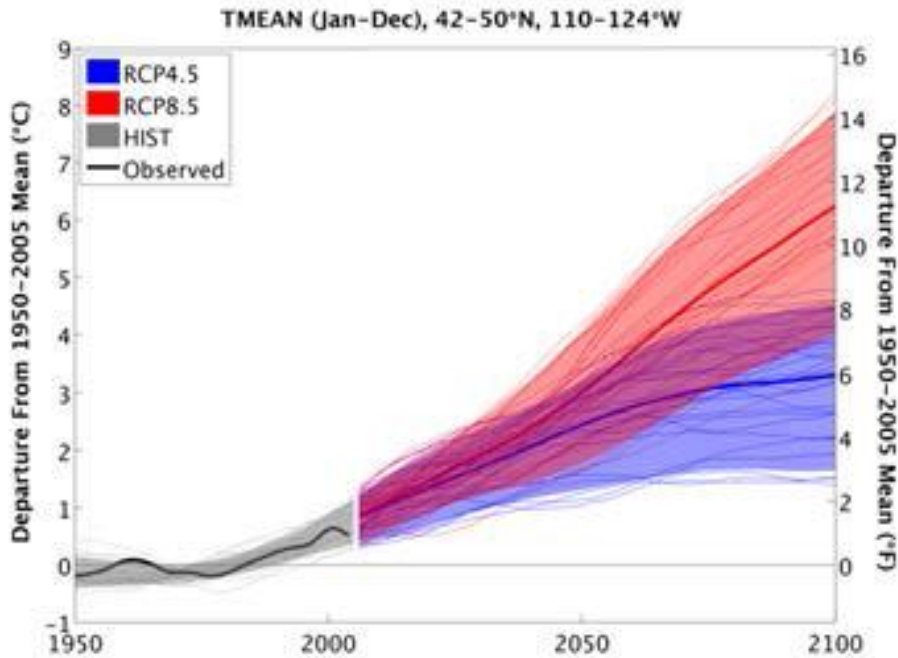


Figure 4. Oregon temperature history and projections through the century (Dalton *et al.* 2013).

<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.

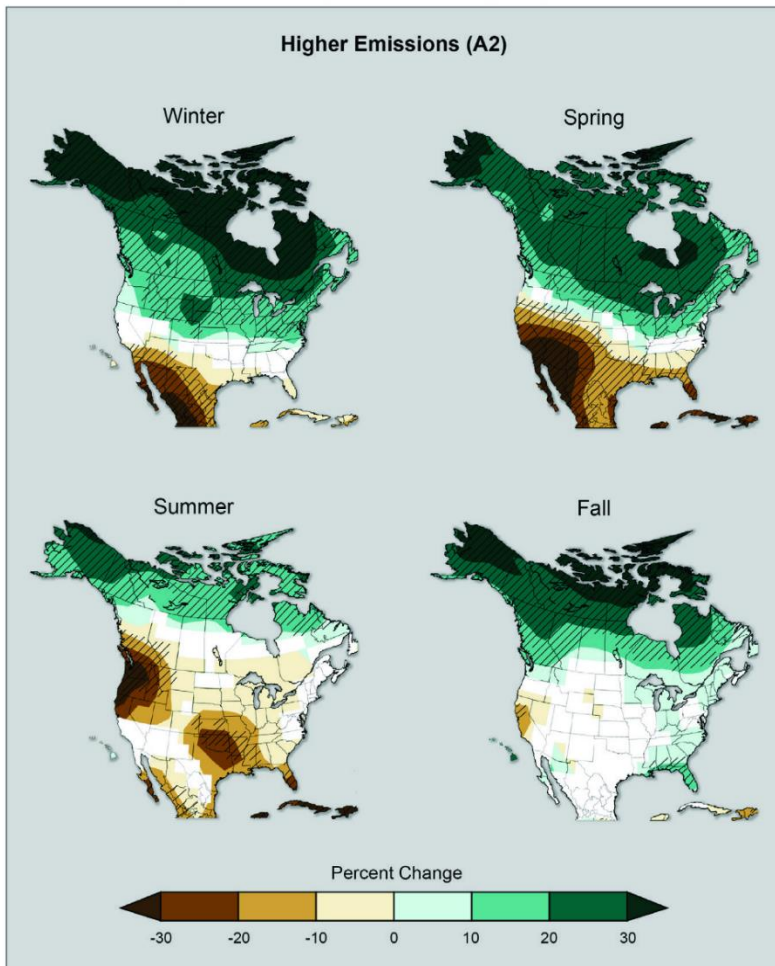
The lower range for continued temperature increase resulting from the greenhouse gases **already released** is inevitable; for this we will simply have to prepare and adapt.

**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

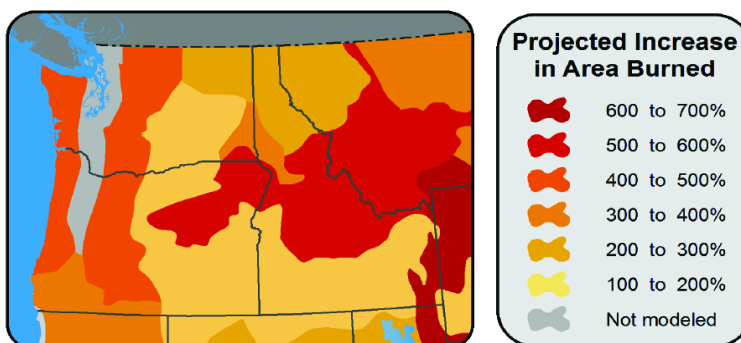


**Figure 5.** Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average (Melillo *et al.* 2014). <http://www.globalchange.gov/what-we-do/assessment>

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 2.2<sup>0</sup>F warming, a condition potentially evident by mid-century (Figure 6).



**Figure 6.** Anticipated wildfire consequences of a 2.2<sup>0</sup>F 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 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 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! 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 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 becoming more acidic. 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.

### ***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.

### ***Sea Level Rise:***

Sea level rise in the Pacific Northwest by 2100 is anticipated to range from 1 to over 4 feet (Melillo *et al.* 2014, Dalton *et al.* 2013). This will likely inundate wetlands, and cause declines in quality of tidal flats and beaches. With higher ocean level the impact of storms will become more dramatic and destructive. Meanwhile, warming oceans will compromise marine migratory species such as salmon while these species and others such as oysters and crustaceans will suffer more extensively as ocean acidification becomes more severe.

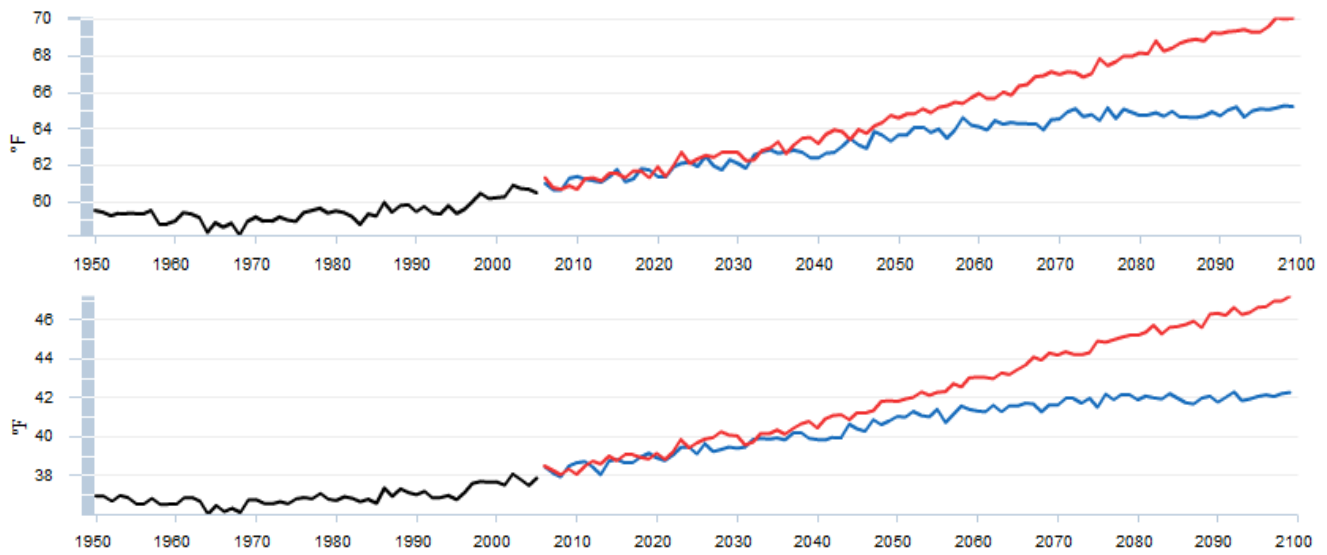
### ***The 19th Oregon Senate District Climate History and Projections:***

Temperature history and projections for Clackamas County (Figure 7) show a rise during the latter half of the 20<sup>th</sup> century of about 1°F with a projected further rise from the average over that period of some 8°F by the end of this century if the Business as Usual scenario of accelerating fossil fuel use and greenhouse gas emissions is followed (red line). The rise will be less if we exhibit emissions reductions (blue line).

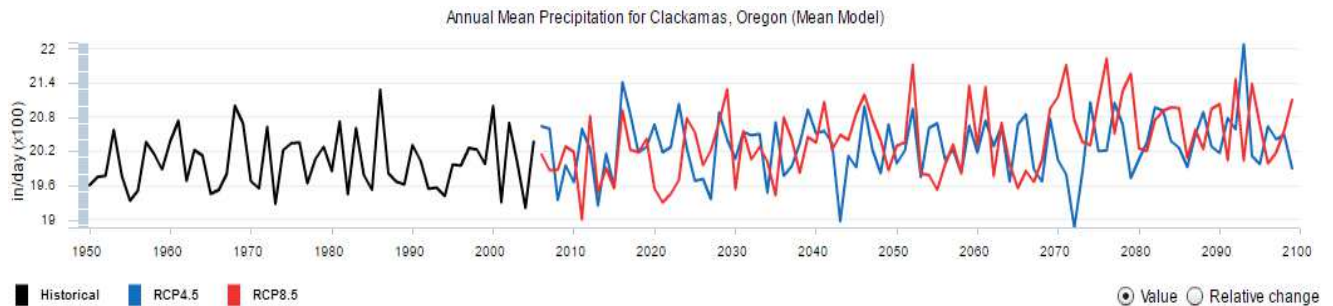
The precipitation trend and projections for Clackamas County (Figure 8) show a level history with a similar projection into the future. However, as temperature rise and summer rainfall decreases, increased drought is likely.



## Oregon Senate District 19 Climate Summary

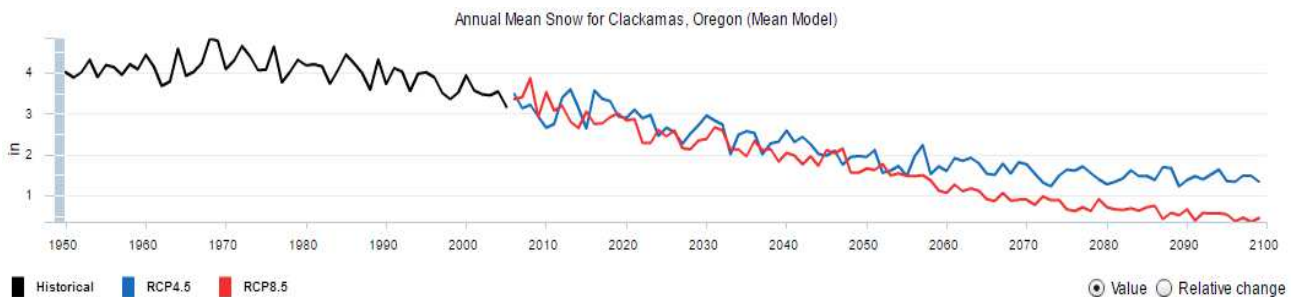


**Figure 7.** Temperature trends and projections for Clackamas County, Oregon. Mean maximum temperatures are represented in the upper graph, mean minimum in the lower graph. (USGS 2017)



**Figure 8.** Precipitation trend and projections for Clackamas County under Business as Usual (red) and reduced emissions (blue) scenarios. (USGS 2017)

Snowfall is decreasing rapidly in Clackamas County, and is projected to continue (Figure 9). As snow melts, streams and aquifers get replenished. Senate District 19 will face water scarcity if climate change continues unabated. The social, economic, and environmental consequences of snowfall scarcity are varied and require careful consideration.

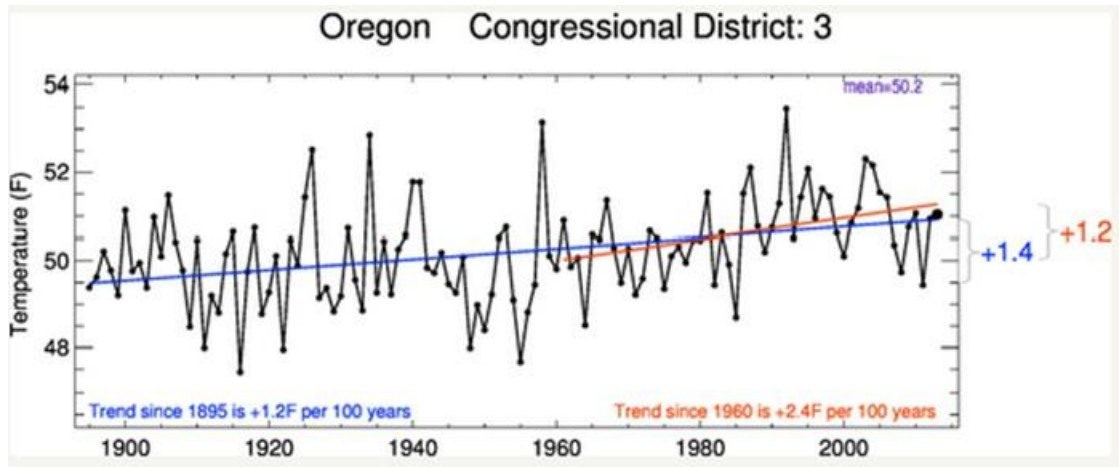


**Figure 9.** Snowfall trend and projections for Clackamas County, Oregon according to the Business as Usual Scenario (red) and with some reduction in emissions (blue) (USGS 2017).



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 decrease agricultural productivity and increase the risk of wildfires in Senate District 19.

**Federal Congressional District Historic Temperature Trend:**



**Figure 10.** Congressional District 3 historic temperature trends.  
<http://temperaturetrends.org/district.php?district=3&state=OR>

A large portion of Senate District 19 lies within Oregon’s 3<sup>rd</sup> Federal Congressional District. Temperature trends from that district (Figure 10) show that the temperature, on average, has risen 1.2 degrees Fahrenheit since 1895. The temperature, since 1960, has been rising at twice that rate.

**Oregon 19th Senate District Economy:**

Climate change would significantly impact the economy of Washington, Clackamas, and Multnomah County. Orchards and vineyards occupy over 10,000 acres in Washington County alone. Agriculture would suffer from climate change as decreased precipitation and snowfall (figures 8 and 9) would result in less productivity. Waterways and aquifers would not be replenished to their full extent and, with an equal or greater draw of water in the future, agriculture would be among the first industries to suffer.

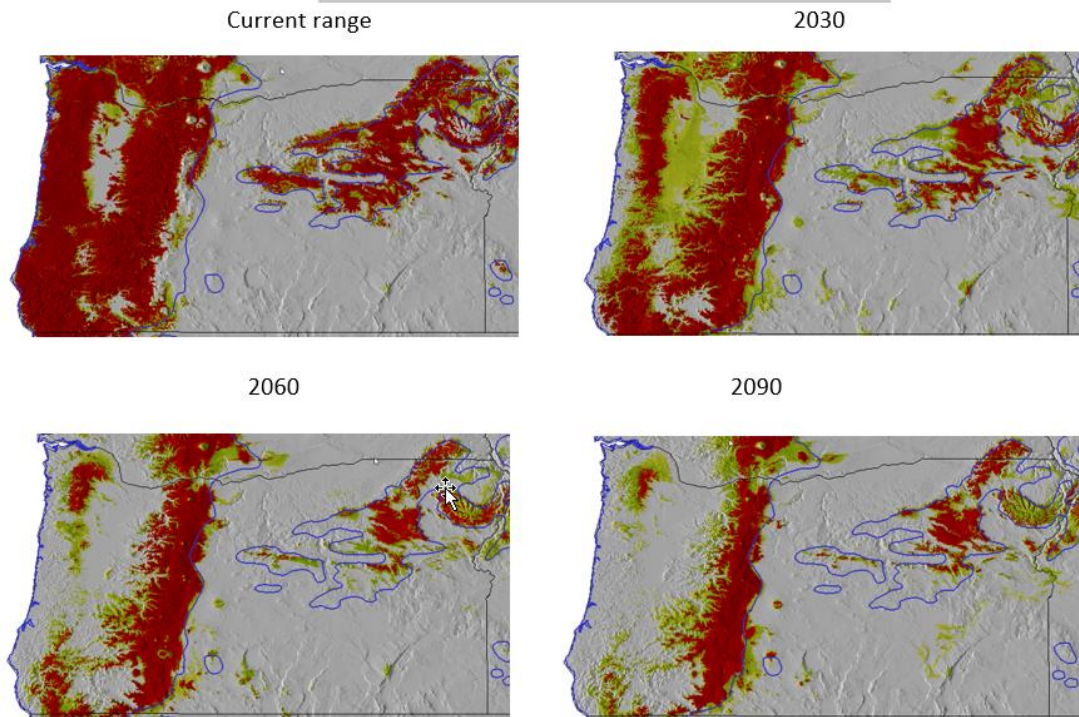
Nike is one of only two Fortune-500 companies based in Oregon and even it would suffer as a result of climate change. Several studies have shown that rubber production could be severely impacted by climate change (Abdlatif *et al.* 2012). Nike would likely incur far greater

production costs for its shoes. This would have a negative ripple effect on the economy of Senate District 19.

The timber industry, a major economic component of Washington and Clackamas County, relies mainly on Douglas fir-dominated forests. The climate envelope projections presented for Douglas fir in Figure 11 indicated that conditions for this species may be severely compromised through the century posing a threat to the regional timber industry. 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 11 Douglas fir (*Pseudotsuga menzeisii*) current and projected distribution through the 21<sup>st</sup> Century**

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



Tourism would be impacted by climate change as well. As river flow diminishes so will the flow over such attractions as Multnomah Falls, thus discouraging tourists. Lakes and rivers, with a reduced flow due to higher temperatures and less precipitation, would be less attractive to tourists and locals alike. A smaller amount of mid-elevation snowpack (Figure 9) would also decrease the amount of water feeding the rivers, lakes, and waterfalls of Senate District 19. Regardless of political affiliation, residents of this Senate District are likely to be negatively affected by climate change should the projections occur as suggested.

If climatic changes continue unabated, the nature and economic activity contained within Senate District 19 will suffer. Senate District 19 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 19 unless serious action is taken soon. There will be times in the future when those living in Senate District 19 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).

The trends and consequences discussed here are based on readily available data. An overall

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

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 Rob Wagner**

**Capitol Phone:** 503-986-1719

**Capitol Address:** 900 Court St NE, S-213, Salem, OR, 97301

**Email:** [Sen.RobWagner@oregonlegislature.gov](mailto:Sen.RobWagner@oregonlegislature.gov)

**Website:** <http://www.oregonlegislature.gov/wagner>

**House District 37: Representative Rachel Prusak:**

**Capitol Phone:** 503-986-1437

**Capitol Address:** 900 Court St NE, H-371, Salem, OR 97301

**Email:** [Rep.RachelPrusak@oregonlegislature.gov](mailto:Rep.RachelPrusak@oregonlegislature.gov)

**Website:** <http://www.oregonlegislature.gov/prusak>

**House District 38: Representative Andrea Salinas**

**Capitol Phone:** 503-986-1438

**Capitol Address:** 900 Court St NE, H-485, Salem, OR 97301

Email: [Rep.AndreaSalinas@oregonlegislature.gov](mailto:Rep.AndreaSalinas@oregonlegislature.gov)

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

### **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-file-system-action?file=/user\\_files/kd/pdf/onepage01.pdf](http://www.gfdl.noaa.gov/cms-file-system-action?file=/user_files/kd/pdf/onepage01.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](https://data.giss.nasa.gov/gistemp/graphs_v3/Fig.A2.gif) and

[http://data.giss.nasa.gov/gistemp/graphs\\_v3/Fig.D.gif](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

## Oregon Senate District 19 Climate Summary

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/>

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](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

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