Southern Oregon Climate Action Now
SOCAN
Confronting Climate Change

Climate Change in Oregon's 18th Senate District

July 2017

History, Projections, and Consequences.

1. The last half of the 20th Century witnessed an average annual temperature increase of about 1°F. Meanwhile, projections suggest, compared to the average for that period, a rise of some 8-9°F is possible by late this century, with summers rising much more than winters.
2. Although annual average precipitation is expected to remain steady, seasonally winters are expected to be a little wetter and summers drier, with more heavy downpours promoting floods and soil erosion.
3. Snowfall and snowpack accumulation, already dwindling, are projected to reduce to less than 15% of historic levels further threatening agriculture as snowmelt arrives earlier and summer and fall water availability declines.
4. Wildfires, already exhibiting a 2.5 month longer season than in the 1970s, are expected to become more serious, with some 200 to 300 percent greater area being consumed by mid-century.
5. Increased wildfires will likely pose a substantially greater problem not only for forests and tourism but also for human health.
6. Climatic shifts themselves will likely compromise the viability of important forest and timber species such as Douglas fir important in the district
7. 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. Additionally, changes in river flows could disrupt hydroelectric power generation.
8. Action is urgent because at the current accelerating emissions trajectory, we will exhaust our allowance in 17 years if we wish to maintain the global temperature increase below 2°C (3.6°F) as international agreements dictate.
9. 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 Alan Journet (alanjournet@gmail.com, 541-301-4107) & Brianne Foster (fosterb2@sou.edu, 971-404-6181) April, 2015.

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

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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).

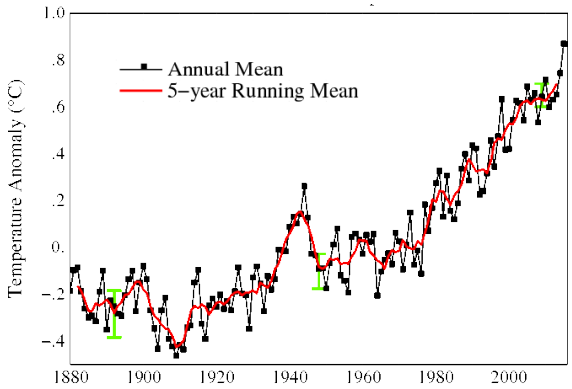


Figure 1. Historic global temperature trend NASA Goddard Institute for Space Studies 2017.

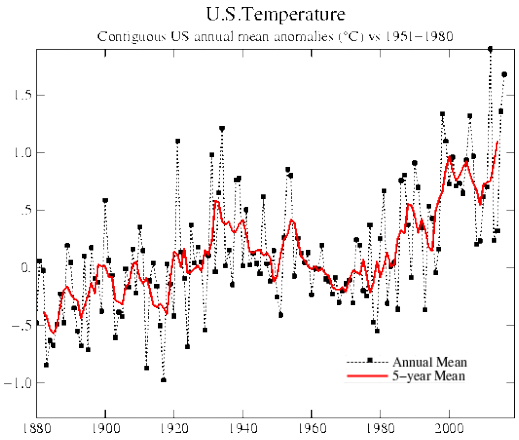


Figure 2. Historic U.S temperature trend. NASA Goddard Institute for Space Studies 2017.

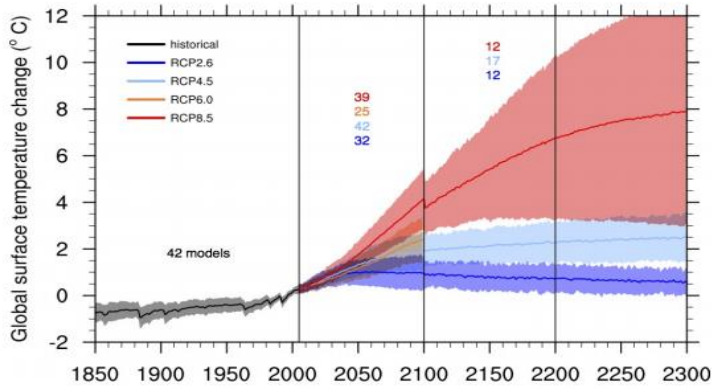


Figure 3. Intergovernmental Panel on Climate Change 2013 global projections. http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

Depending on the RCP: (Representative [Carbon] Concentration Pathway) we follow globally (Fig. 3), this century may result in from a 2^0F increase, assuming immediate action, to a high of over a 9^0F increase. The trajectory beyond the century offers an even more challenging high extreme with an extreme 20^0F 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 12^0F 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.

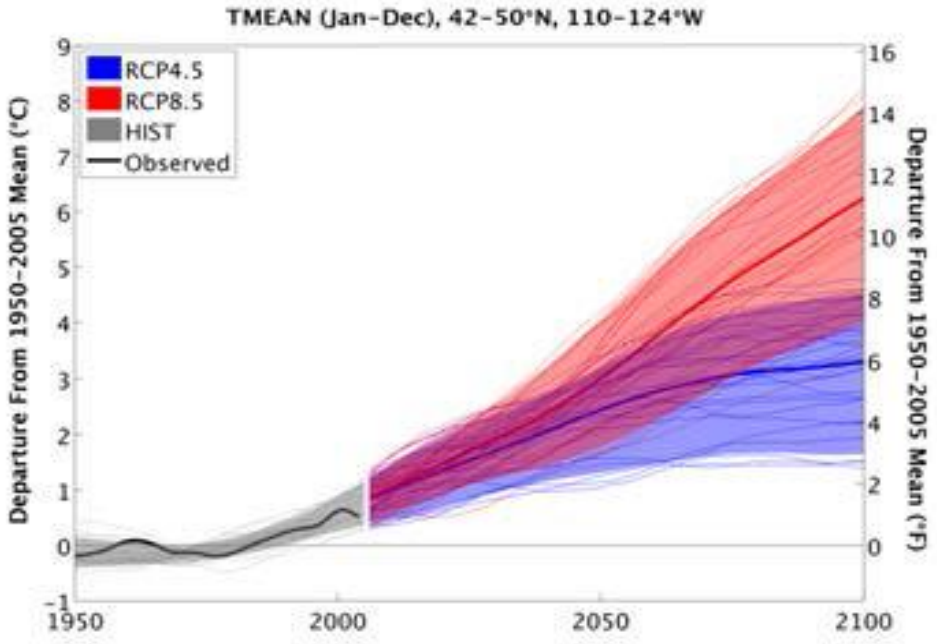


Figure 4. Oregon temperature history and projections through the century, from Dalton *et al.* 2013.
http://library.state.or.us/repository/2010/201012011104133/summaries.pdf

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 as a whole 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 dryer.

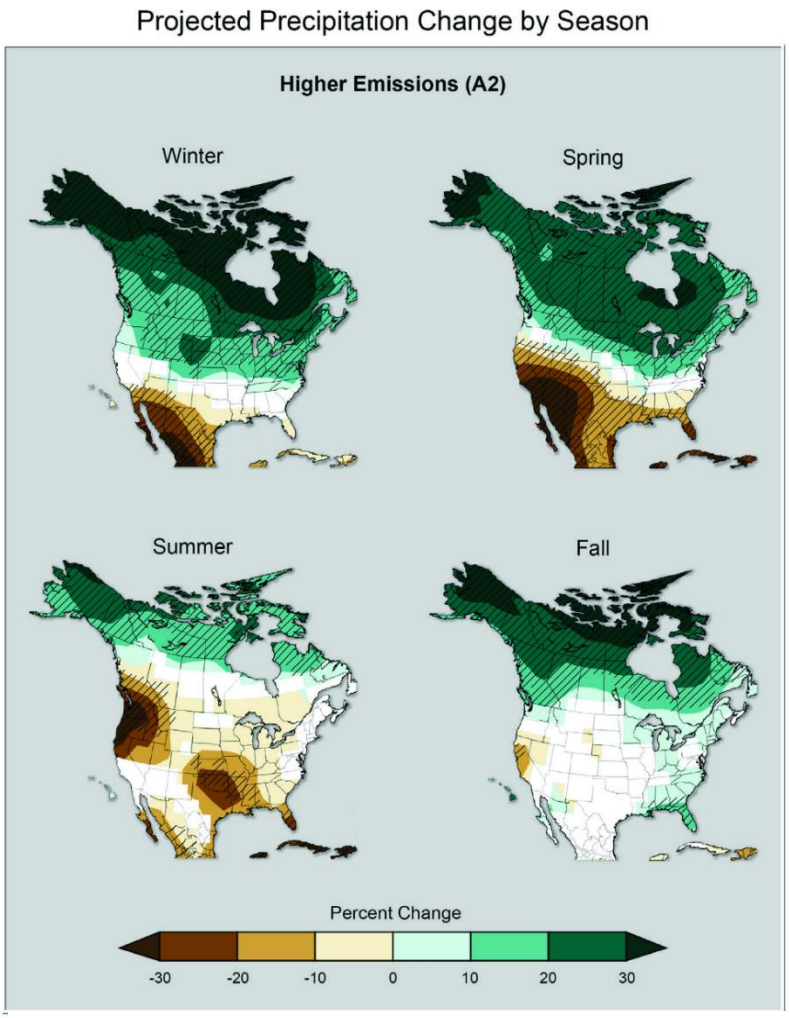


Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average. Melillo *et al.* 2014 http://www.globalchange.gov/what-we-do/assessment

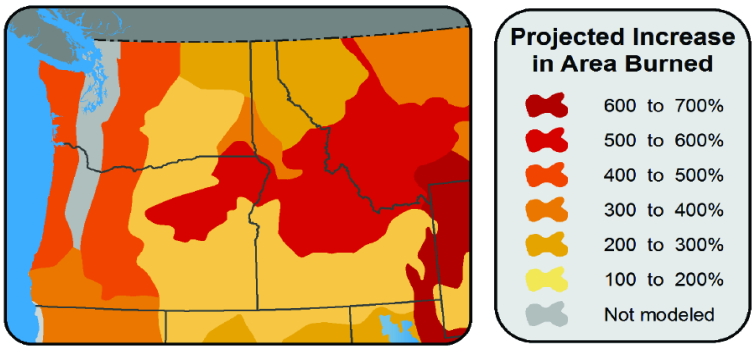


Figure 6. Anticipated wildfire consequences of a 2.2^{0}F warming in area burned. Melillo *et al.* 2014. http://www.globalchange.gov/what-we-do/assessment

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^{0}F warming, a condition potentially evident by mid-century (Figure 6).

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 ^{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^{0}C (app 37^{0}F). As the ocean warms, then, it expands and sea level rises. Second, as land born ice enters the ocean, whether as water or ice, it increases the volume of the ocean. Both these phenomena have caused sea level already to rise and are expected to continue this influence. The impact is influence by the pattern or land adjustment: if land is rising, the impact is reduced, whereas a subsiding coastal late will exacerbate the impact. Projections for Newport suggest a potential century rise of between 6" and nearly five feet. Higher sea level poses 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 comprised coastal habitat integrity for tidal flat, estuary, and marsh natural communities should not be overlooked.

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.

The 18th Oregon Senate District Climate History and Projections:

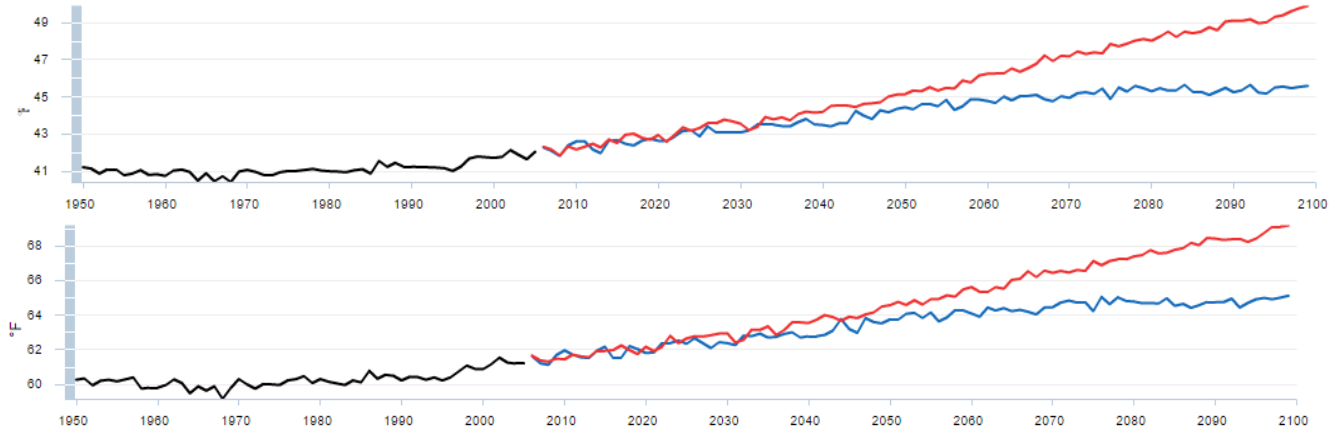


Figure 7. Historic and projected trends for mean minimum and maximum temperatures for Washington County, Oregon; upper is mean minimum temperature, lower is mean maximum (USGS 2017).

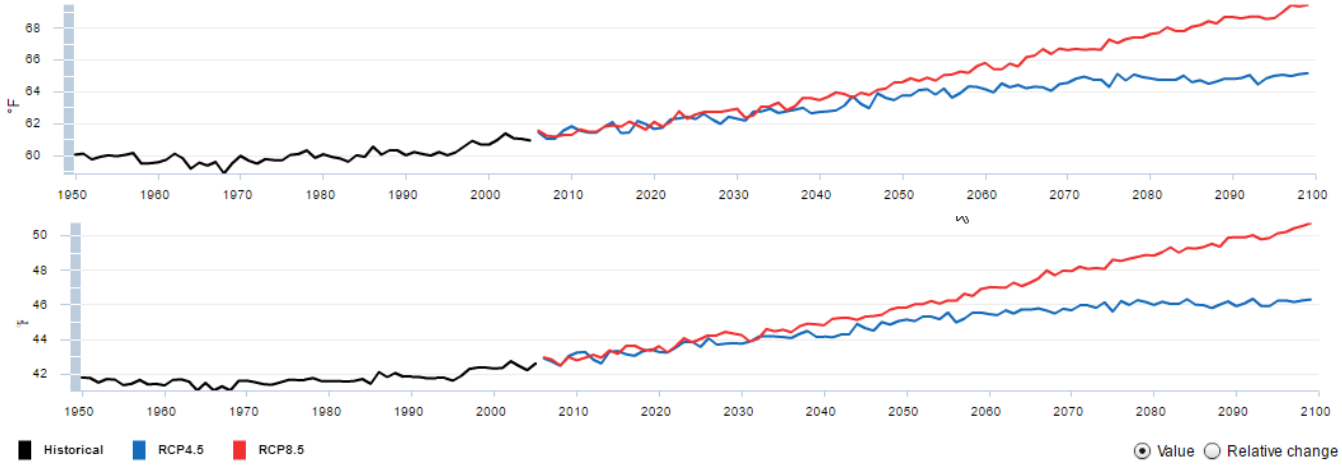


Figure 8. Historic and projected trends for mean minimum (upper graph) and maximum (lower graph) temperatures for Multnomah County Oregon (USGS 2017).

Temperature history and projections for Clackamas (Figure 7) and Multnomah County (Figure 8) show a rise from the 1970s of about 1.5^{o}F with a projected further rise of some 8 or 9^{o}F by the end of the century if the Business as Usual scenario of increasing fossil fuel use and greenhouse gas emissions (red line) is followed. The rise will be less if we exhibit emissions reductions (blue line).

The precipitation trend and projections for Washington County (Figure 9) parallels that for Multnomah County and shows a level history with a similar projection into the future. However, as temperature rise and summer rainfall decreases, increased drought is likely.

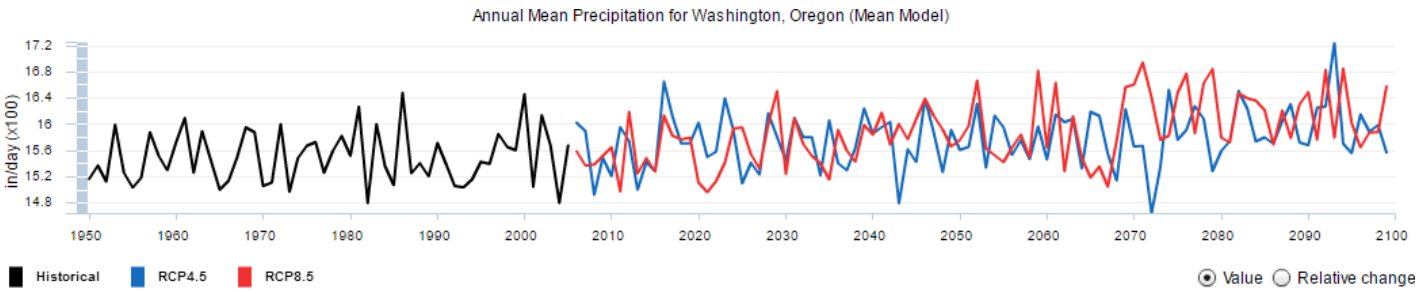


Figure 9. Historic and projected trend for precipitation in Washington County, Oregon (USGS 2017).

Snowfall is decreasing rapidly in Washington County, and is projected to continue this decline (Figure 9). As snow melts, streams and aquifers get replenished. Senate District 18 will face water scarcity if climate change continues unabated. The social, economic, and environmental consequences of snowfall scarcity are varied and require careful consideration.

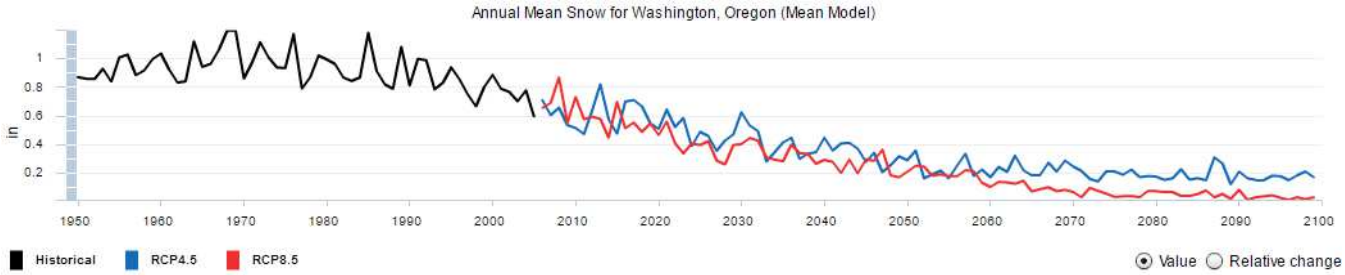


Figure 10. Snowfall history and projections for Washington County (USGA 2017).

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:

Senate District 18 lies within Federal Congressional Districts 1 and 3. The data (Figure 11) indicates that the 1st Congressional District has been warming recently at a rate of 2.3^0F per century, while the District 3 value is 2.0^0F, both rates being slower than that of Oregon as a whole (2.4^0F per century) and the United States average rate of 4.3^0F for the century. Still, the average temperature is increasing and these districts are not immune to the consequences of climate change.

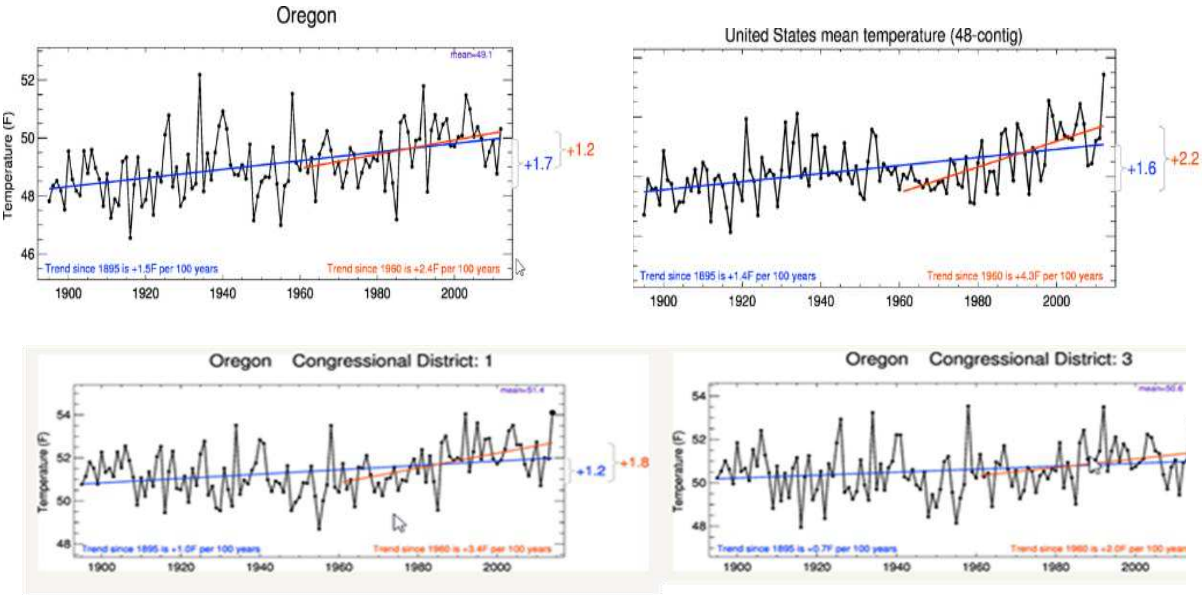


Figure 11. Temperature trends through the 1st and 3rd US Congressional Districts (Weaver *et al.* 2015).

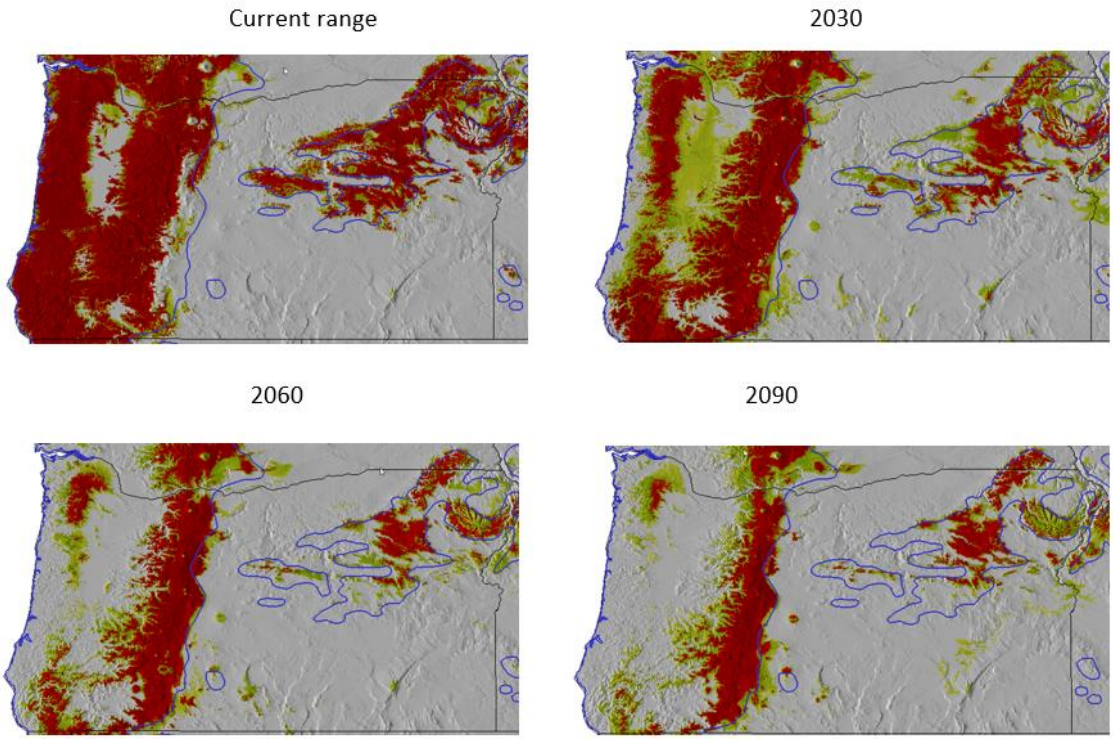
Oregon 18th Senate District Economy:

Climate change would significantly impact the economy of Washington and Multnomah Counties. Orchards and vineyards occupy over 10,000 acres in Washington County alone. Agriculture would suffer from climate change as decreased precipitation and snowfall (Figures 7 and 8) 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 because 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 could have a negative ripple effect on the economy of Senate District 18.

The timber industry, a major economic component of Washington County, relies mainly on Douglas fir-dominated forests. The climate envelope projections presented for Douglas fir in Figure 12 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 12 Douglas fir (*Psuedotsuga menzeisii*) current and projected distribution through the 21st 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 10) 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 18 will suffer. Senate District 18 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 18 unless serious action is taken soon. There will be times in the future when those living in Senate District 18 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.

Table 1 Carbon Dioxide Emissions and Temperature Consequences

Emissions	Gigatons CO_2 added to atmosphere	Temperature increase
1850 – 2000	**1035**	**0.8°C**
2000 – Now	**440**	**1.5°C**
Emissions Allowed	**825**	**2°C**
Fossil Fuel Reserves	**725**	**3 - 4°C**
Accessible Reserves	**780**	**5 - 6°C**
Additional Reserves	**1280**	**??**

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 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^{o}C to 1.6^{o}C (2.7 - 2.9^{o}F) (Dixon 2001). If we wish to avoid an increase over 2^{o}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^{o}C upper limit. In relation to shooting beyond 2^{o}C, the World Bank (2012) acknowledged there is: "no certainty that adaptation to a 4^{o}C world is possible."

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

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