Southern Oregon Climate Action Now
SOCAN
Confronting Climate Change

Climate Change in the Oregon 22nd 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 during this century above that late 20th Century mean.
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 that in the 1970's, are expected to become more serious, with a 200% to 300% greater area consumed by mid-century.
5. An increase in wildfires will pose a substantially-greater problem for both forest and human health.
6. Agriculture, commercial and human water needs will be compromised as summer / fall availability dwindles.
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 (alanjournet@gmail.com), (541-301-4107) and Peter Kleinhenz (kleinhenp@sou.edu) (614-202-5161) April 2015

For a more complete summary, including sources, from which these points are taken, visit: 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).

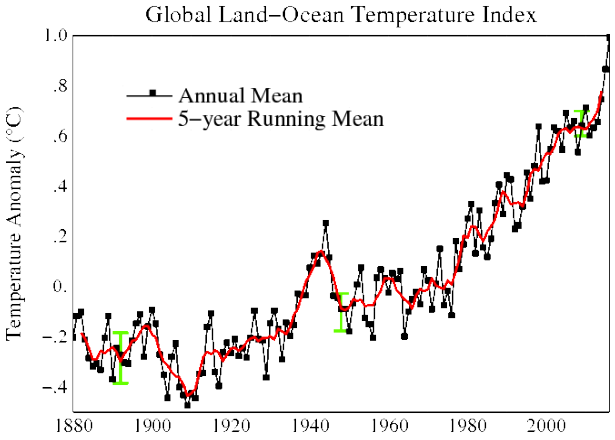


Figure 1. Historic global temperature trend to 2016, NASA Goddard Institute for Space Studies 2017.

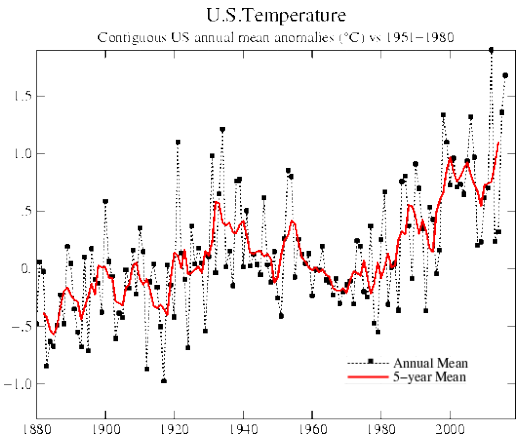


Figure 2. Historic U.S temperature trend to 2016. NASA Goddard Institute for Space Studies 2017.

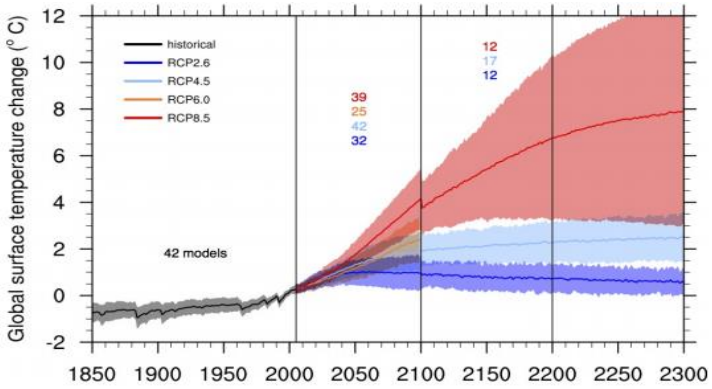


Figure 3. Intergovernmental Panel on Climate Change 2013 global projections. http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

Depending on the RCP: (Representative [Atmospheric 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.

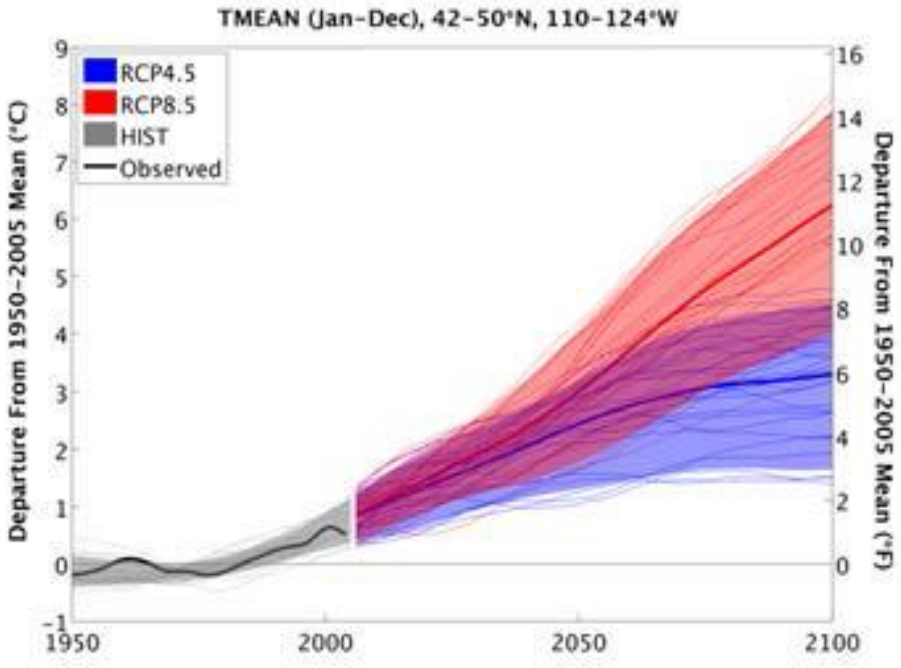


Figure 4. Oregon temperature history and projections through the century, from Dalton *et al.* (2013).
http://library.state.or.us/repository/2010/201012011104133/summaries.pdf

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 drier.

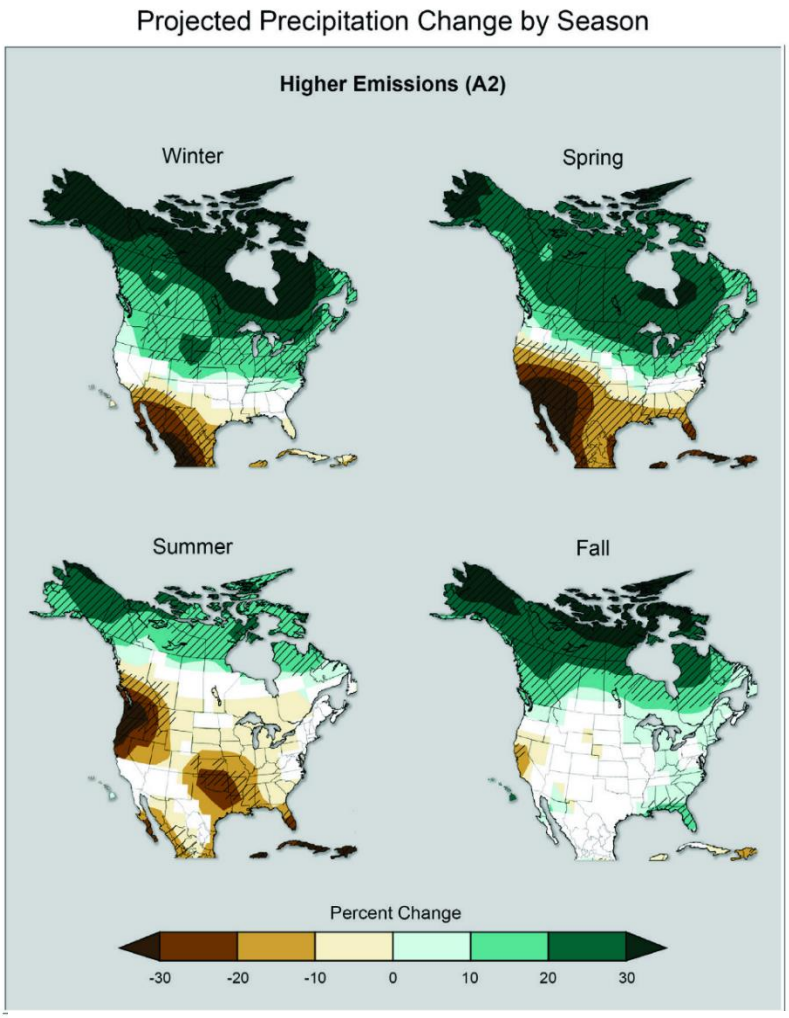


Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average. Melillo *et al.* 2014 http://www.globalchange.gov/what-we-do/assessment

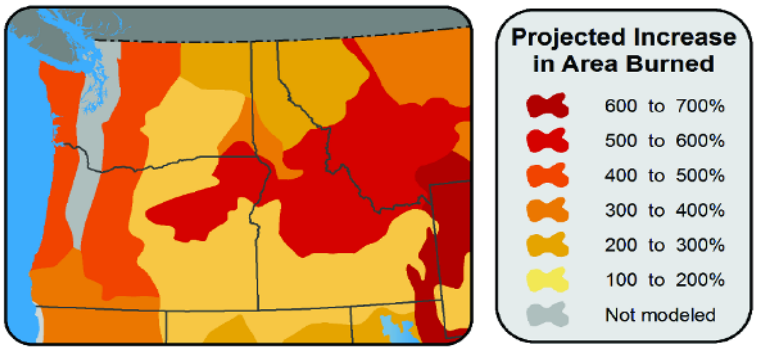


Figure 6. Anticipated wildfire consequences of a 2.2^{0}F warming in area burned. Melillo *et al.* 2014. http://www.globalchange.gov/what-we-do/assessment

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 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 ^{o}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^{o}C (app 37^{o}F). As the ocean warms, 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 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 22nd Oregon Senate District Climate History and Projections:

Temperature trends and projections for Multnomah County (Figure 7) show an increase of over a degree since the mid-19th century with a rise of some 9°F by late century depending on the emissions trajectory.

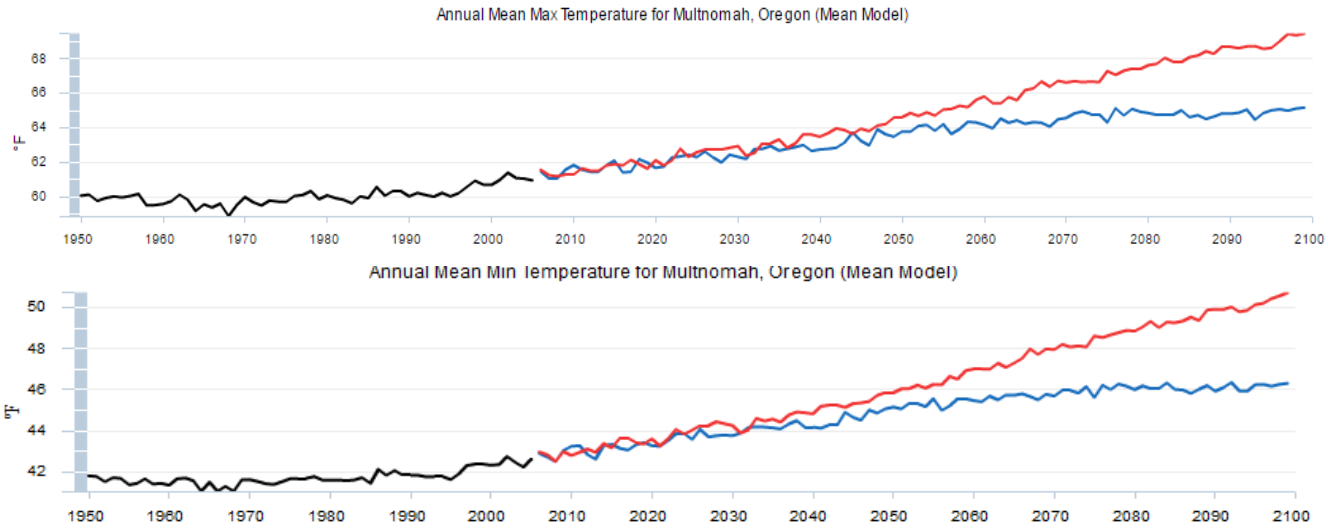


Figure 7. Mean Maximum (upper) and Minimum (lower) temperatures for Multnomah County. Red lines represent the business as usual future scenario while blue assumes some reduction in emissions occurs (USGS 12017).

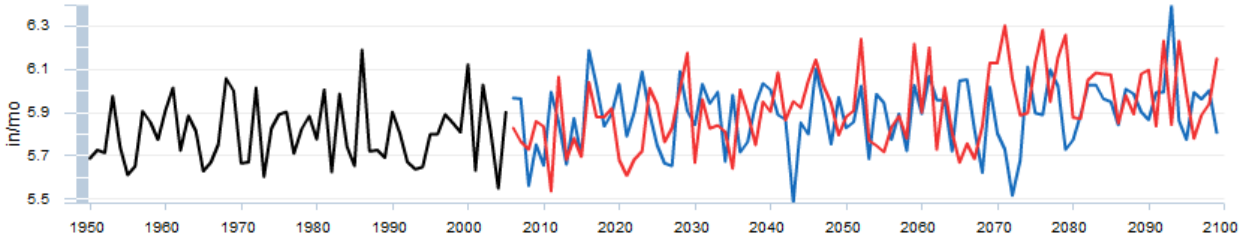


Figure 8. Precipitation trend and projections for Multnomah County USGS 2017).

Precipitation projections for Multnomah County show little historic change (Figure 8) with a similar projected trend regardless of emissions scenario. However, the future suggests greater variability with wetter and drier years, and note expected seasonal precipitation changes (Figure 5), with drier summers and greater likelihood of drought.

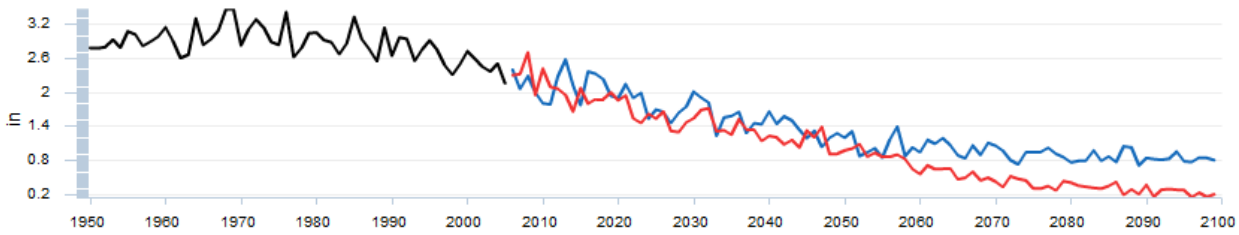


Figure 9. Snowfall trend and projections for Multnomah County (USGS 2017).

Snowfall is decreasing rapidly in Senate District 22, a trend that is expected to continue (Figure 9). As snow melts, streams and aquifers get replenished. Senate District 22 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:

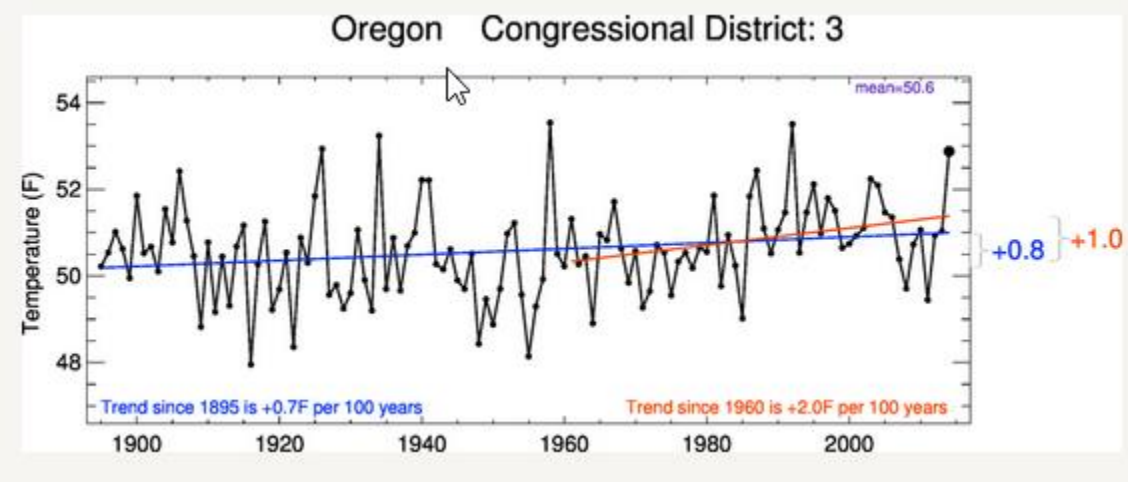


Figure 10. Congressional District 1 historic temperature trends.
http://temperaturetrends.org/district.php?district=3&state=OR

Senate District 22 lies within Oregon's 3rd Federal Congressional District. Temperature trends from that district (Figure 10) show that the temperate, on average, has risen 1.8 degrees Fahrenheit since 1895. The temperature, since 1960, has been rising at an even faster rate.

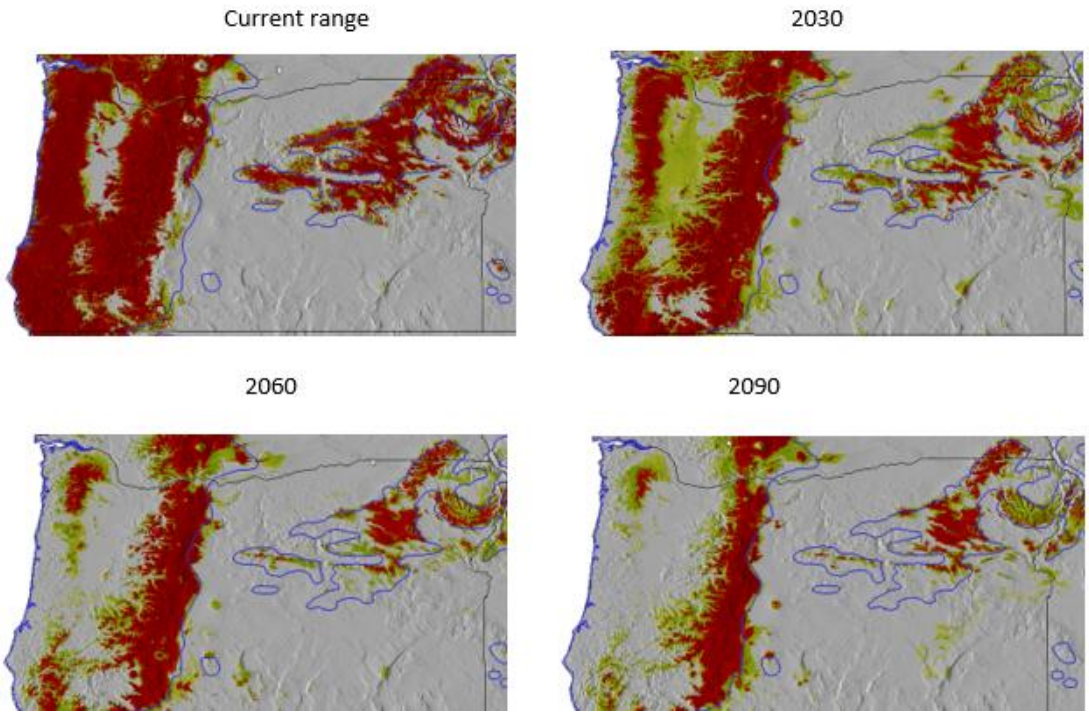
Oregon 22nd Senate District Economy:

Climate change would significantly impact the economy of Multnomah County, within which Senate District 22 is contained. The economy of Multnomah County centers on manufacturing, transportation, wholesale/retail trade, and tourism. It is the home of Portland Airport and Portland Docks.

Much of Senate District 22 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. The Port is dependent on import / export commodities such as lumber and grain; as climate change compromises production of these commodities, an economic impact will likely be felt.

Figure 11 Douglas fir (*Psuedotsuga menzeisii*) current and projected distribution through the 21st Century
http://charcoal.cnre.vt.edu/climate/species/



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 the region is the Douglas fir-dominated forest. The climate envelope projections (Rehfeldt *et al.* 2006) presented for Douglas fir in Figure 11 where purple represent high viability, green medium viability, and clear non-viability, 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. 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 governments inevitably increase

restrictions on fossil fuel use (the primary cause of climate change), the County's manufacturing sector could either suffer from increased operational costs, or 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.

Although climate change has a far greater direct effect on rural communities than urban areas, it must be remembered that urban areas rely on healthy rural regions for their water supply and their agricultural, and forestry products. 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 and snowpack diminishes skiing, and reduced river flow potentially diminishes fishing and water recreation. Additionally, as the Pacific Northwest, projected to suffer less than most of the country from the warming climate, becomes the target for climate refugees from across the U.S. increasing population will place a greater burden on dwindling water supplies.

If climatic changes continue unabated, the nature and economic activity contained within Senate District 22 will experience an impact. Senate District 22 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 22 unless serious action is taken soon. There will be times in the future when those living in Senate District 22 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^{o}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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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**
Allowed	**825**	**2°C**
Fossil Fuel Reserves	**725**	**3 - 4°C**
Accessible Reserves	**780**	**5 - 6°C**

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