Southern Oregon Climate Action Now

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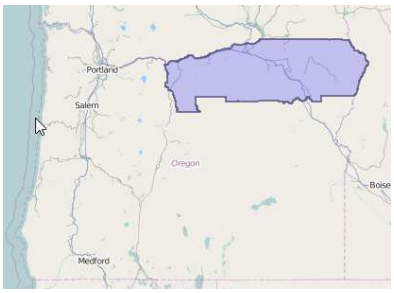
Confronting Climate Change

Climate Change in the Oregon 29th Senate District

July 2017



History, Projections, and Consequences

1. This District temperature increased about 1°F during the last half of the 20th Century and is expected to follow the trend projected for the Northwest potentially increasing another 9°F above the average for that period by 2100.
2. Precipitation will likely continue unchanged on average but with greater variability and a decline during summer with rainfall occurring in heavy downpours causing floods and erosion rather than falling as light rain that replenishes soil moisture.
3. Higher elevation snowfall is expected to decline further. Combined with earlier snowmelt this will compromise stream flow during summer and fall when irrigation is most needed.
4. Wildfire season, already 2.5 months longer than in the 1970s, is expected to become more serious with fire projections suggesting two to four times the area currently burned may be consumed by mid-century.
5. Projections for the dominant commercial tree species of the region (Douglas fir, Ponderosa pine, Grand fir, Western larch, and Englemann spruce) suggest that all species will be seriously compromised by century's end, threatening timber and tourism in the District.
6. This region of Oregon supports non-polluting carbon free renewable energy ventures in the form of wind farms (e.g. Shepherd Flat, The Biglow Canyon, Klondike, Vansye, Stateline, and Elkhorn Valley Wind Farms.) Encouraging these facilities will assist the economy of the region as climate change compromises the more traditional agricultural, forestry, and tourist activities. With continued success, these projects will also contribute to reducing the threat posed by climate change.
7. At the current emissions trajectory, we will exhaust our emissions allowance in 17 years if we wish to maintain the global temperature increase below 2°C (3.6°F) as international agreements dictate.
8. Main health impacts: drought, wildfire, and indirect impacts causing water insecurity, food insecurity, poor air quality, respiratory illness, occupational and recreational hazards, displacement, economic instability, and mental health impact. Vulnerable communities will likely be: low-income households, private well users, people working in agriculture and outdoor recreation, firefighters, first responders, Native Americans, young children and pregnant women.

Compiled by Alan Journet Ph.D. Co-facilitator, Southern Oregon Climate Action Now (alanjournet@gmail.com, 541-301-4107)

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).

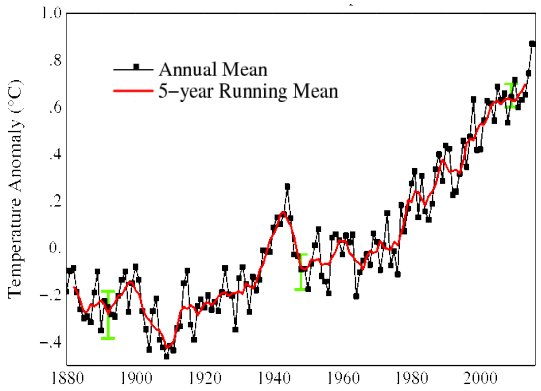


Figure 1. Historic global temperature trend NASA Goddard Institute for Space Studies 2017.

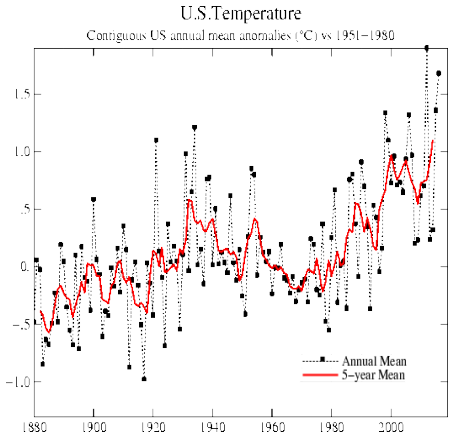


Figure 2. Historic U.S temperature trend. NASA Goddard Institute for Space Studies 2017.

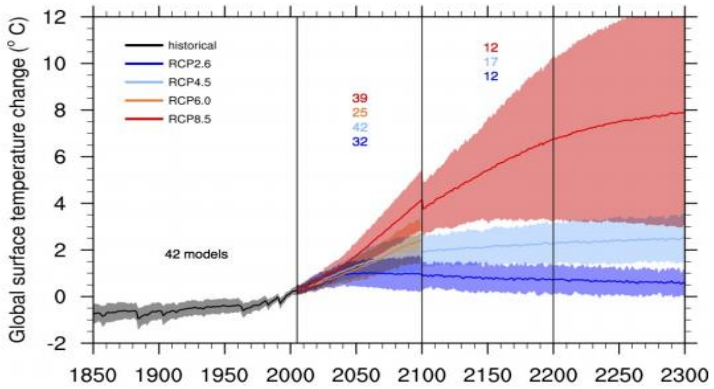


Figure 3. Intergovernmental Panel on Climate Change 2013 global projections.
http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

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.

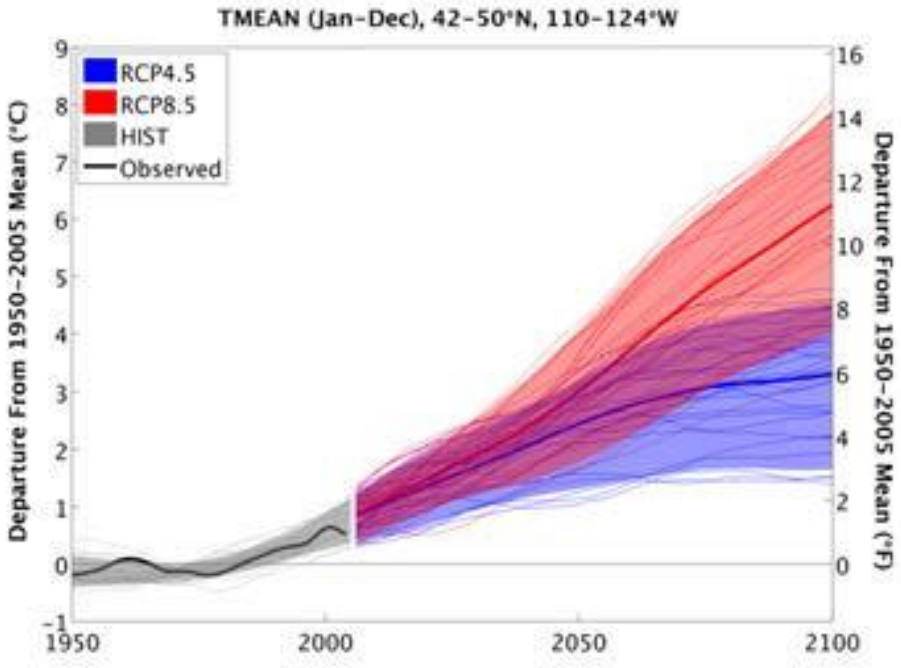


Figure 4. Oregon temperature history and projections through the century (Dalton *et al.* 2013).
http://library.state.or.us/repository/2010/201012011104133/summaries.pdf

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.

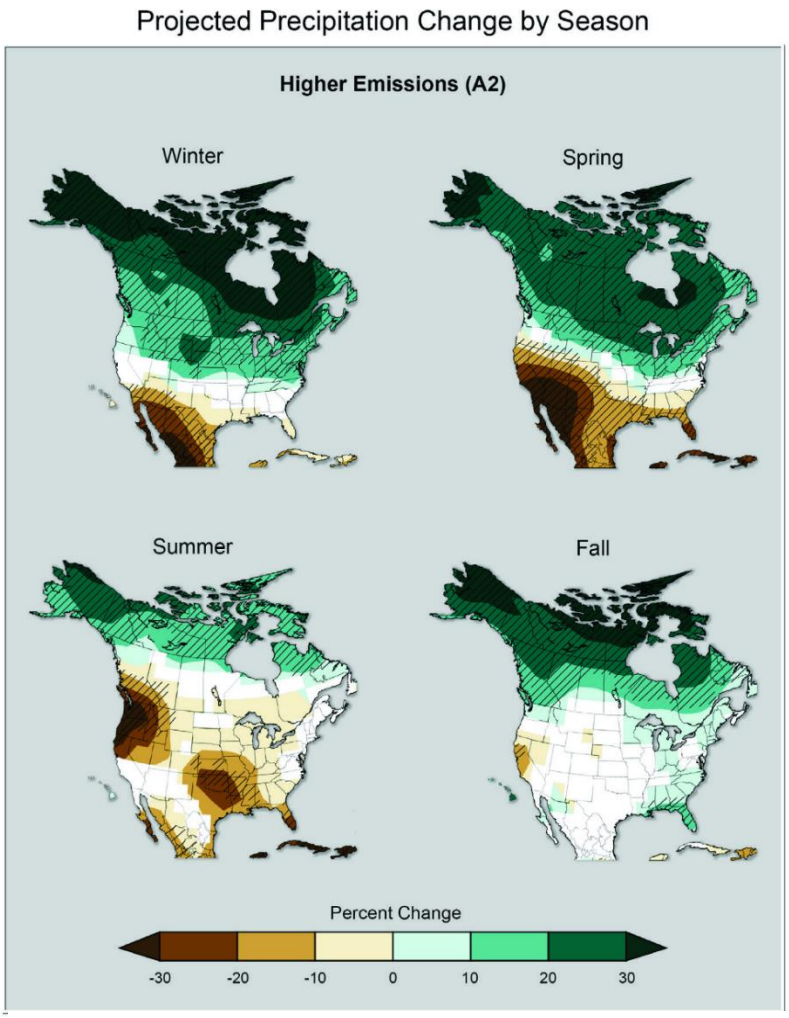


Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

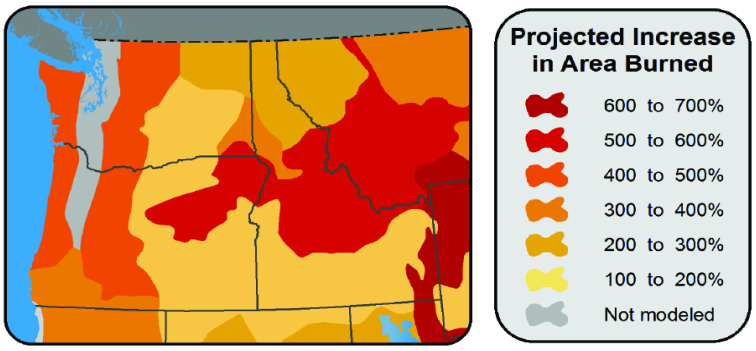


Figure 6. Anticipated wildfire consequences of a 2.2^{o}F warming in area burned (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

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 (approximately 37^{o}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 29th Oregon Senate District Climate History and Projections

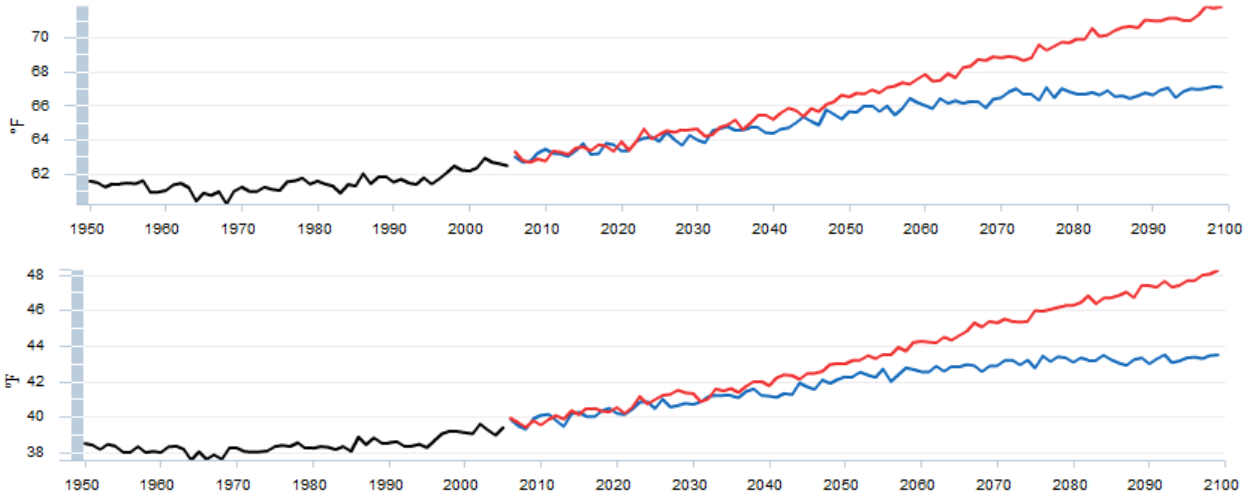


Figure 7. Temperature history and projections for Gilliam County (typical of Senate District 29) - upper mean maximum, lower mean minimum (USGS 2017).

(USGS 2017Historic and Projected Temperature for Gilliam County (Figure. 7) are typical of the counties in Senate District 28. The last half of the 20th Century witnessed an increase of about 1°F while the balance of this century may see an increase of a further 9°F or more from the mean for that period. The rising temperature trend grades from the 7 - 8°F range above late 20th century average for coastal Oregon to some 10°F above that average for Eastern counties.

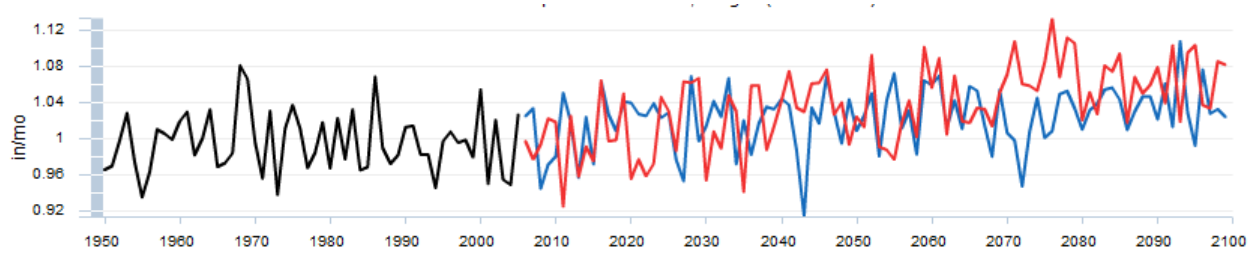


Figure 8 Precipitation history and projections for Gilliam County (USGS 2017).

Historic and projected precipitation (Figure 8) for Gilliam County demonstrate a variable pattern but essentially flat trend. However, the future is likely to be more variable, with wetter

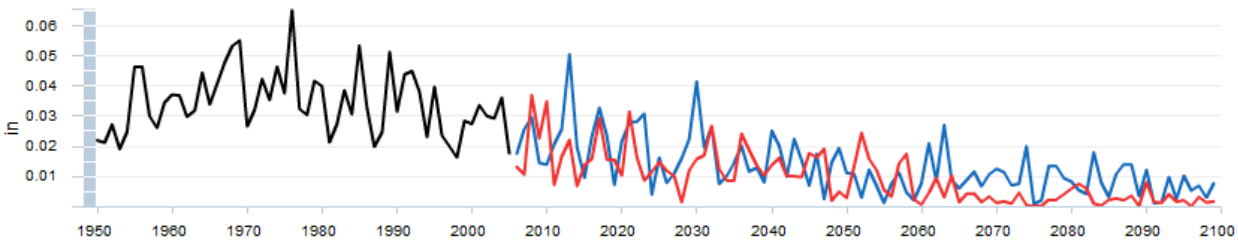


Figure 9. Snowpack accumulation for Gilliam County (USGS 2017).

and drier years. It is also important to appreciate that even with level average precipitation, higher temperatures will cause greater evaporation and thus induce extended droughts, particularly during the anticipated drier summer growing season (Figure 5) when water is especially important for agriculture.

Finally, snowpack accumulation (Figure 9) throughout the region has been declining and is expected to continue that trend to as low as 10% of the historic average by century's end, further exacerbating water shortfall through the century

Oregon 2nd Congressional District Historic Temperature Trend cf Oregon and US:

Since the Oregon Senate 3rd District falls within the Second Federal Congressional District, it is instructive to see how historic patterns have fared across that district.

The data indicate (Figure 10) that the second Congressional District has been warming at a rate of 1.4°F per century, a rate faster than that of Oregon as a whole (1.2°F per century) but slower than the United States average rate of 2.2°F for the century. This entire district is clearly experiencing the consequences of climate change

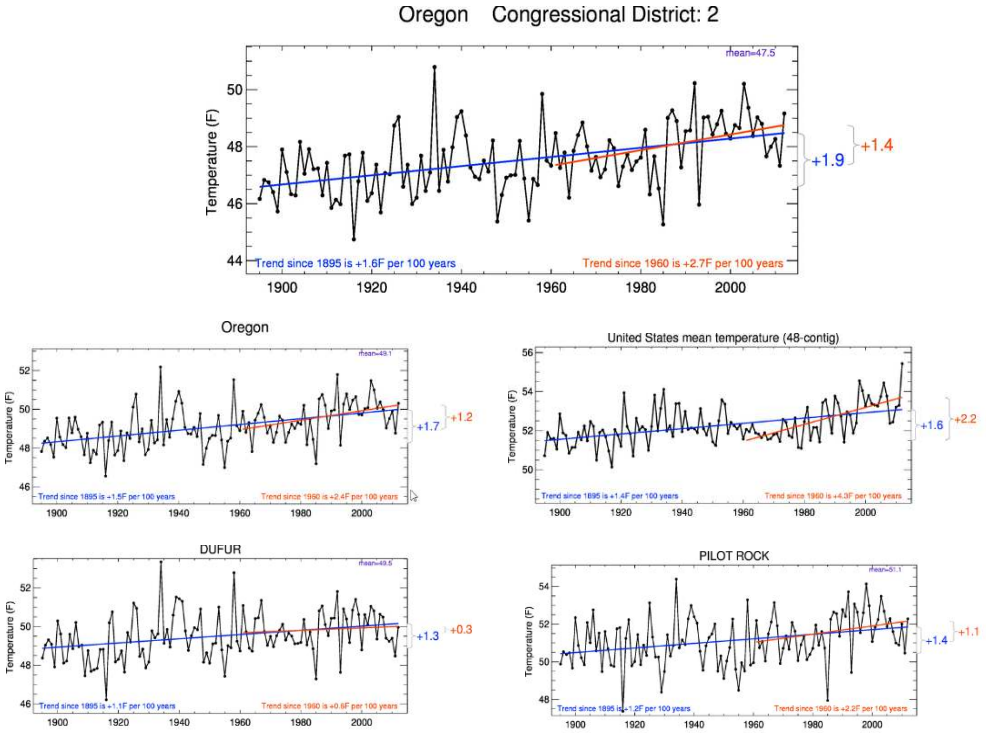


Figure 10. Temperature trends through the Second US Congressional District
http://temperaturetrends.org/global.php?district=2&state=OR

District Economy:

The economy of the 29th Senate district is rooted primarily in agriculture, ranching, forestry, and tourism. Since climatic factors are critical to the success of agriculture, ranching, and

forestry, it is anticipated that climate change could have profound effects for the economy throughout the region – not only because of the temperature impacts themselves (increasing temperature generally leads to reduced crop yield), but also because of the potential for much drier growing seasons with depleted water availability. Tourism (whether purely for recreational enjoyment of the outdoors, or for hunting) is dependent on healthy natural ecosystems. Since the ongoing health of these systems is dependent on temperature and precipitation patterns, climate change is also likely to compromise the climatic basis for tourism in the region.

The primary timber species of the Umatilla Forest are Grand fir (*Abeis grandis*), Douglas fir (*Pseudotsuga menzeisii*) Ponderosa pine (*Pinus ponderosa*), followed by Western larch (*Larix occidentalis*) and Engelmann spruce (*Picea engelmannii*). As the century unfolds, the (Rehfeldt *et al.* 2006) climate envelopes suggest (Figures 10 – 14) these species may be severely comprised by climatic conditions (red indicates high viability, green reduced viability, blank non-viability).

These projections are based on the 'Business As Usual' model that assumes a continuation of the current trends of accelerating greenhouse gas emissions (Rehfeldt *et al.* 2006). They suggest that some of the important tree species may no longer exist within the 29th Senate District by the end of the Century. This indicates not only the value of managing forests of the region for resilience in the face of climate change, but also the importance of taking steps to minimize climate change such that the 'Business As Usual' scenario does not come to pass.

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 10 White fir (*Abies concolor*) Current and Projected distribution
http://charcoal.cnre.vt.edu/climate/species/

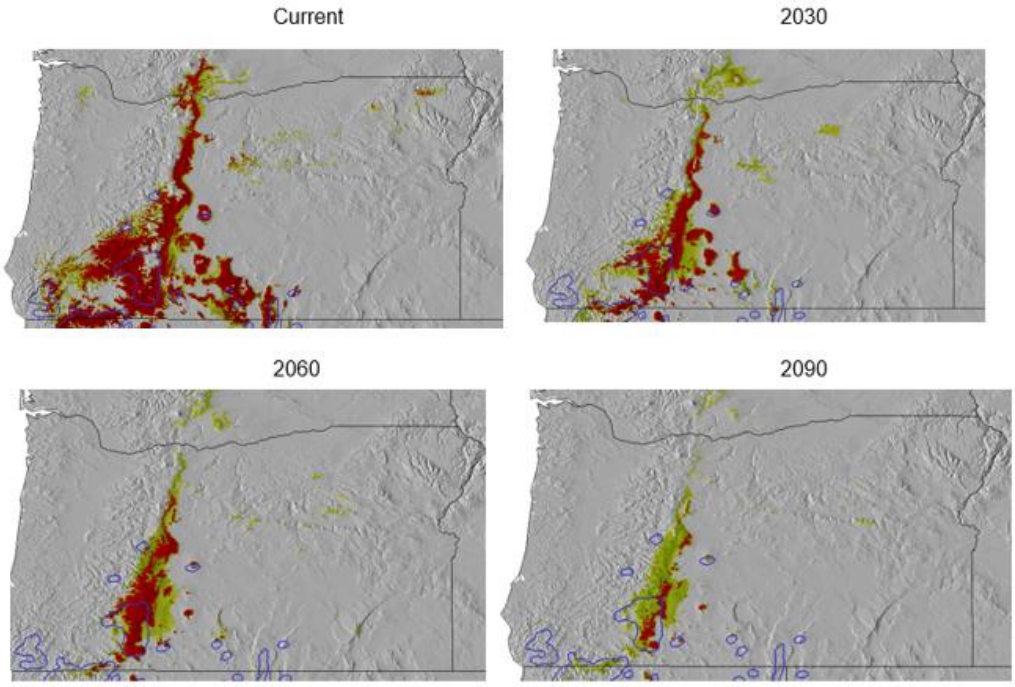


Figure 11 Douglas fir (*Psuedotsuga menzeisii*) current and projected distribution through the 21st Century
http://charcoal.cnre.vt.edu/climate/species/

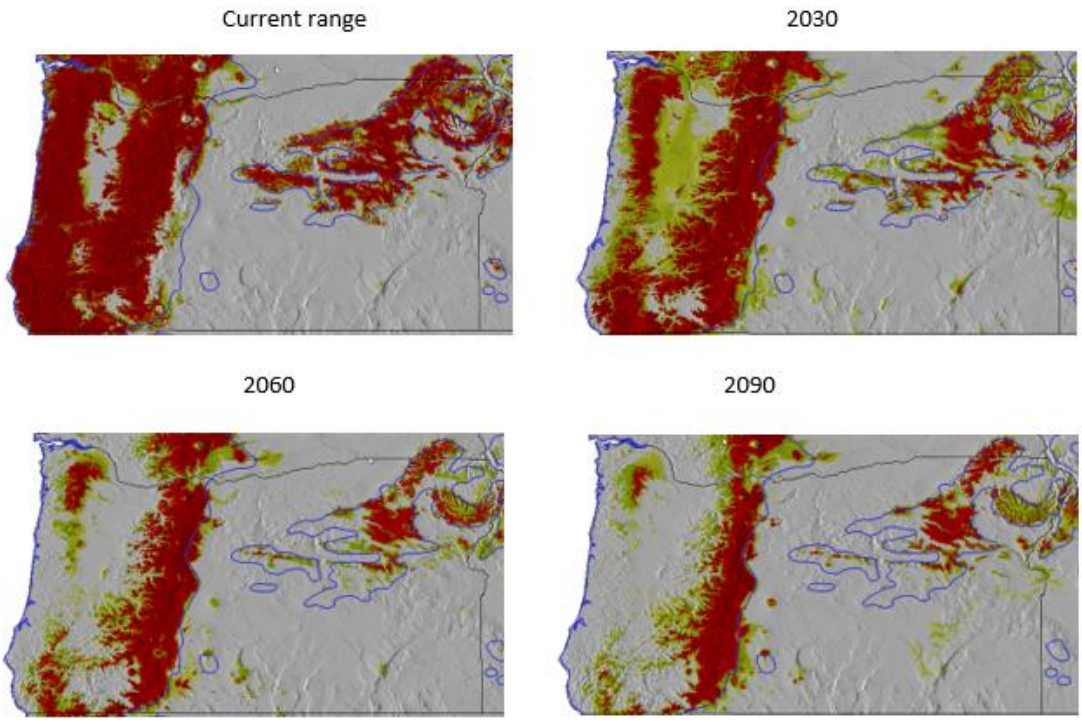


Figure 12 Ponderosa pine (*Pinus ponderosa*) Current and Projected Distribution through the 21st Century
http://charcoal.cnre.vt.edu/climate/species/

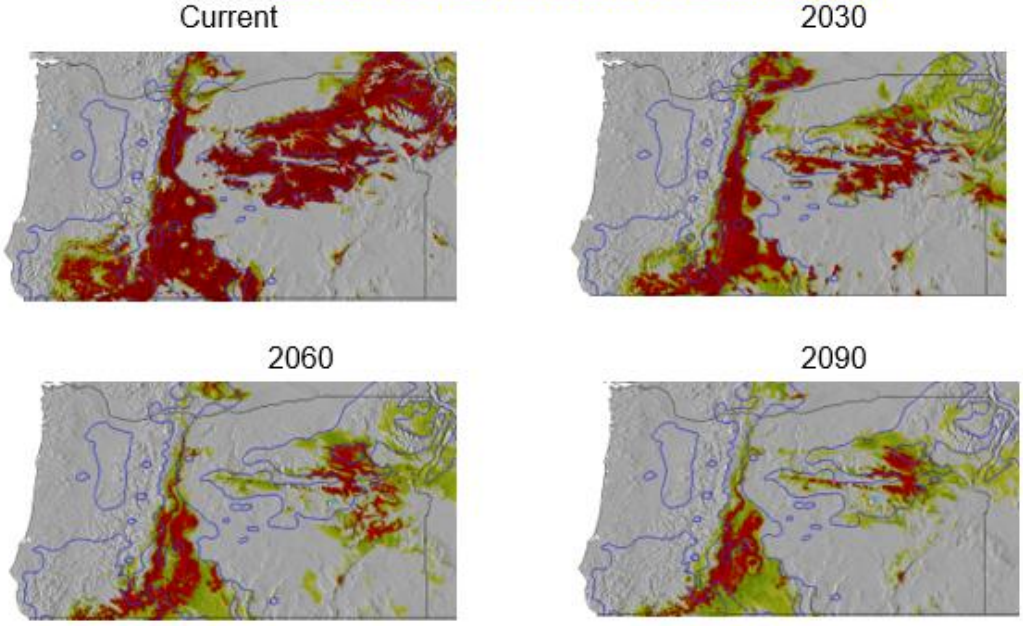


Figure 13 Western larch (*Larix occidentalis*) Current and Projected Distributions
http://charcoal.cnre.vt.edu/climate/species/

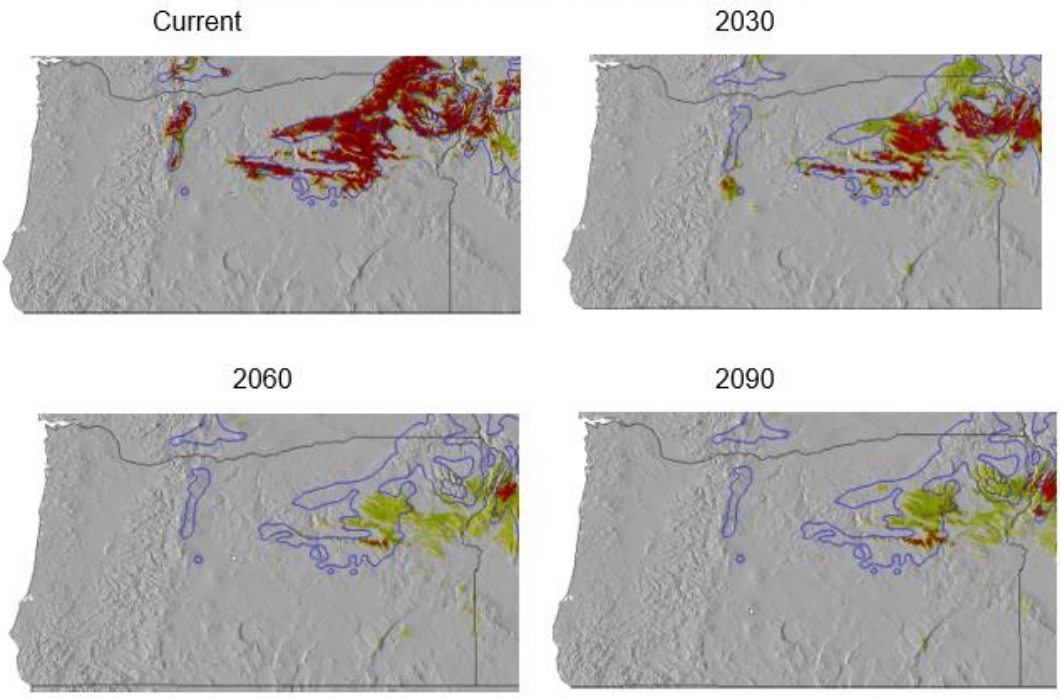
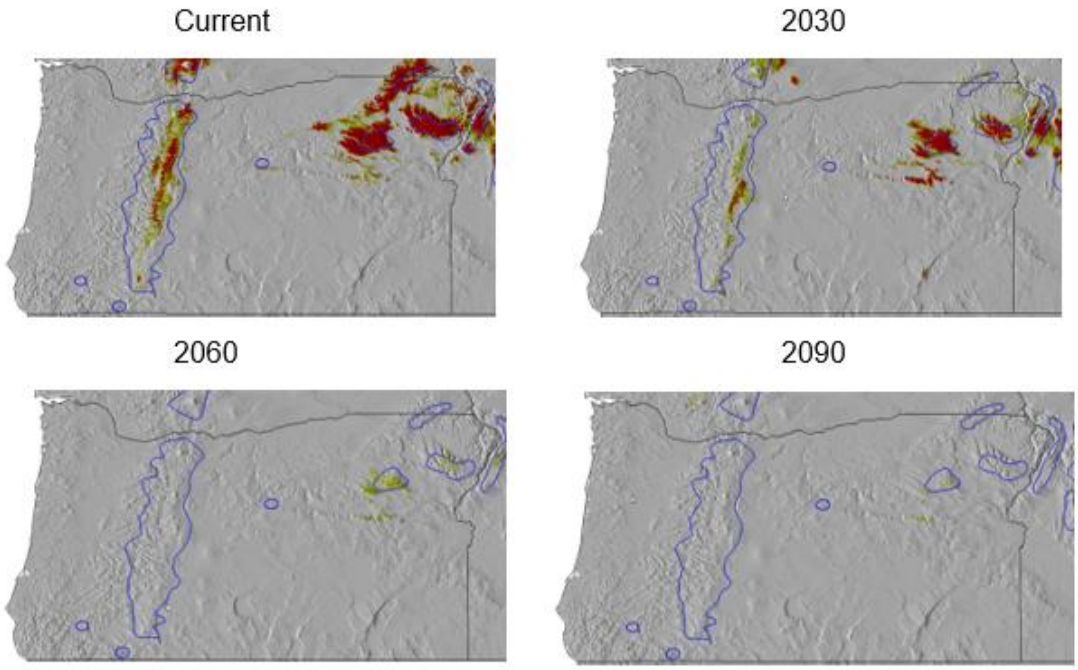


Figure 14 Englemann spruce (*Picea englemannii*) Current and Projected Distributions
http://charcoal.cnre.vt.edu/climate/species/



The Columbia River Gorge and Valley are home also to a number of important wineries with predominant varietals as: Merlot, Cabernet Sauvignon, Chardonnay, Sauvignon Blanc, Gewurztraminer, Semillon, Pinot noir, Chenin Blanc, Syrah, Pinot Gris, and Riesling. Like all agricultural crops, different grape varietals perform better under different growing season conditions. Figure 14 depicts the optimal growing season temperature for many of Oregon's grape varietals.

The continued economic success of the 29th District is substantially dependent on the maintenance of a favorable climate. Should the climate projections for the balance of this century play out, the 29th Senate District will be forced to undertake considerable adaptation to the developing conditions to sustain its economy.

Underlining the potential for renewable energy production in the region, several wind farms exist in the District. Shepherd Flat (Gilliam County), Biglow Canyon and Klondike (Sherman County), Vansye and Stateline (Umatilla County) are the largest such ventures in Oregon, while Elkhorn Valley Wind Farm is located on the ridges of Pyles Canyon. These facilities supply non-polluting carbon free electricity augmenting the generation capacity of hydroelectric dams on the Columbia River. Promoting renewable energy would assist companies such as these to increase operations. It is exciting that such opportunities exist to sustain a regional economy that is likely to be compromised through the century as climate trends overtake the region.

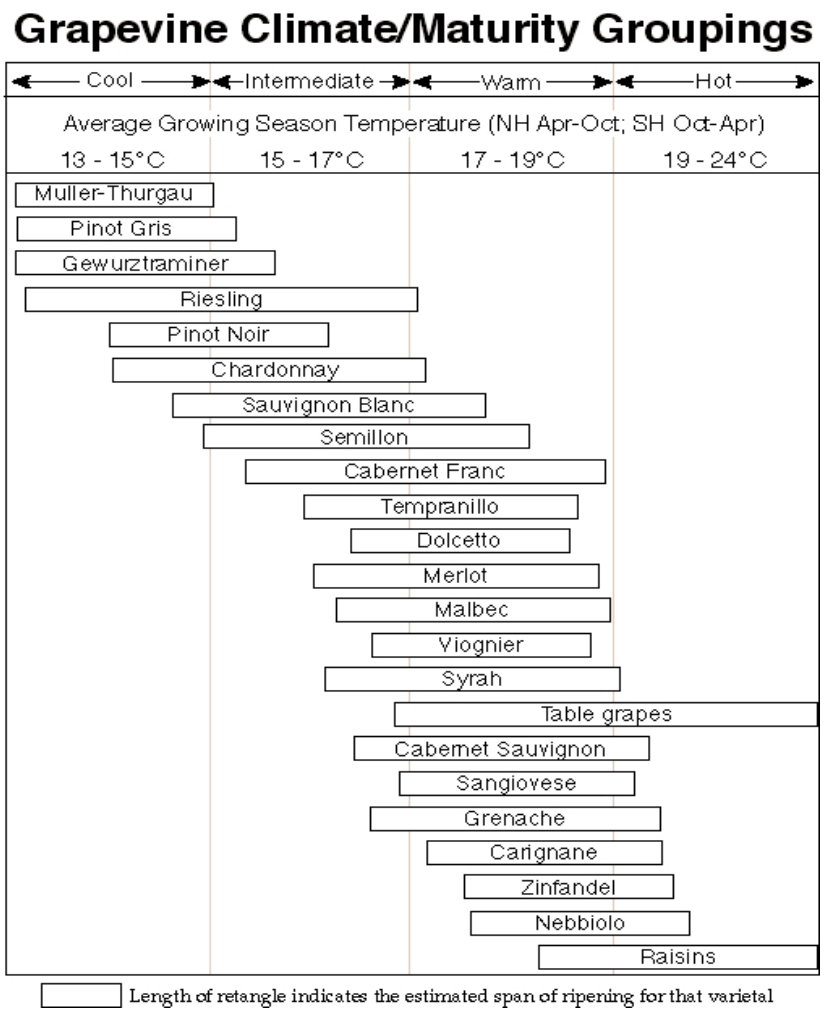


Figure 15. Grape varietal optimum growing season temperature. http://www.sou.edu/envirostudies/gjones_docs/GJones%20Climate%20Change%20Geoscience%20Canada.pdf

It would behoove governments and representatives throughout the district to be aware of the threat that climate change poses to the traditional economy of North Central and Northeastern Oregon, to initiate steps to prepare for these changes, and to promote efforts at all levels of government to minimize the threat that climate change poses by encouraging renewable energy and discouraging carbon emissions.

Information on the primary economic activities of 29th Senate District Counties were obtained from Wikipedia – augmented by local Chamber of Commerce searches.

Potential Agricultural Impacts:

Our field crops are planted in soil and climatic conditions to which they are well adapted. This

Table 1 Carbon Dioxide Emissions and Temperature Consequences		
Emissions	**Gigatons CO_2 added to atmosphere**	**Temperature increase**
1850 – 2000	**1035**	**0.8^oC**
2000 – Now	**440**	**1.5^oC**
Allowed	**825**	**2^oC**
Fossil Fuel Reserves	**725**	**3 - 4^oC**
Accessible Reserves	**780**	**5 - 6^oC**
Additional Reserves	**1280**	**??**

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.

Potential Health Impacts:

According to the Oregon Health Authority (2014), the main climate impacts to health are likely to be: drought, wildfires, and indirect impacts. The top health concerns will be: water insecurity, food insecurity, poor air quality, respiratory illness, occupational and recreational hazards, displacement, economic instability, and mental health impact. Communities that are especially vulnerable will be: low-income households, private well users, people working in agriculture and outdoor recreation, firefighters and 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^oC as a limit beyond which we should not allow the global temperature to climb. This limit is echoed by the World Bank (2012, 2013, 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^oC to 1.6^oC (2.7 - 2.9^oF) (Dixon 2001). If we wish to avoid an increase over 2^oC 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.

Contact Your Senator: Bill Hansell

Capitol Phone: 503-986-1729
Capitol Address: 900 Court St NE, S-415, Salem, OR, 97301
Email: Sen.BillHansell@oregonlegislature.gov
Website: http://www.oregonlegislature.gov/hansell

House District 57: Representative Greg Smith

Capitol Phone: 503-986-1457
Capitol Address: 900 Court St NE, H-482, Salem, OR 97301
Email: Rep.GregSmith@state.or.us
Website: http://www.oregonlegislature.gov/smithg

House District 58: Representative Greg Barreto

Capitol Phone: 503-986-1458
Capitol Address: 900 Court St NE, H-390, Salem, OR 97301
Email: Rep.GregBarreto@state.or.us
Website: http://www.oregonlegislature.gov/barreto

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