Southern Oregon Climate Action Now
SOCAN
Confronting Climate Change

Climate Change in the Oregon 7th Senate District

July 2017

History, Projections, and Consequences

1. The second half of the 20th Century witnessed an increase in temperature of about 1˚F. Projections suggest an overall rise of up to 9˚F beyond the average for that period is possible during this century creating greater potential for drought.
2. Snowfall and snowpack accumulation, already dropping, are projected to dwindle further, possibly to 10% of historic levels be late century.
3. Although annual average precipitation is expected to hold steady, seasonally winters are expected to be wetter and summers drier, with more heavy downpours.
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. This will likely pose a substantially more serious problem for forest and human health.
5. Agriculture will likely suffer due to decreasing supplies of water for irrigation, increasing incidence of pests and disease attacks, and growing competition from weeds threaten local agriculture.
6. 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.
7. Climatic shifts will likely compromise the viability of important forest and timber species in the district.
8. 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.
9. Main health impacts are likely to be: heat, allergens, 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, Native Americans, children, and pregnant women.

Compiled by Elaine Bianchi & Alan Journet (bianchielainem@gmail.com, 509-630-2358) (alanjournet@gmail.com, 541-301-4107) May 2014

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).

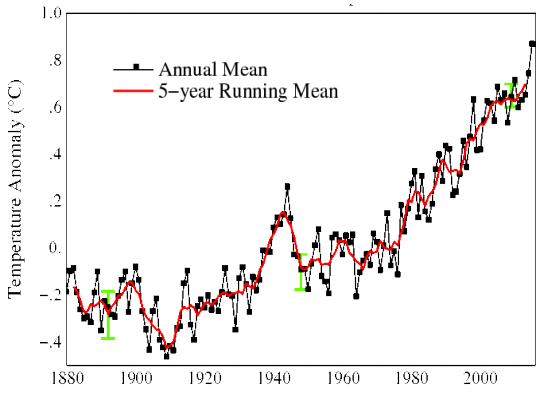


Figure 1. Historic global temperature trend NASA Goddard Institute for Space Studies 2017.

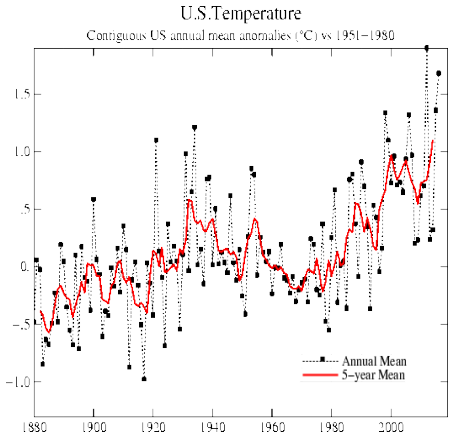


Figure 2. Historic U.S temperature trend. NASA Goddard Institute for Space Studies 2017.

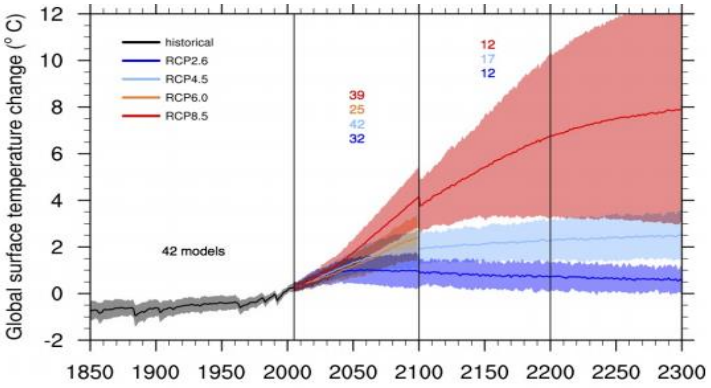


Figure 3. Intergovernmental Panel on Climate Change 2013 global projections. http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

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.

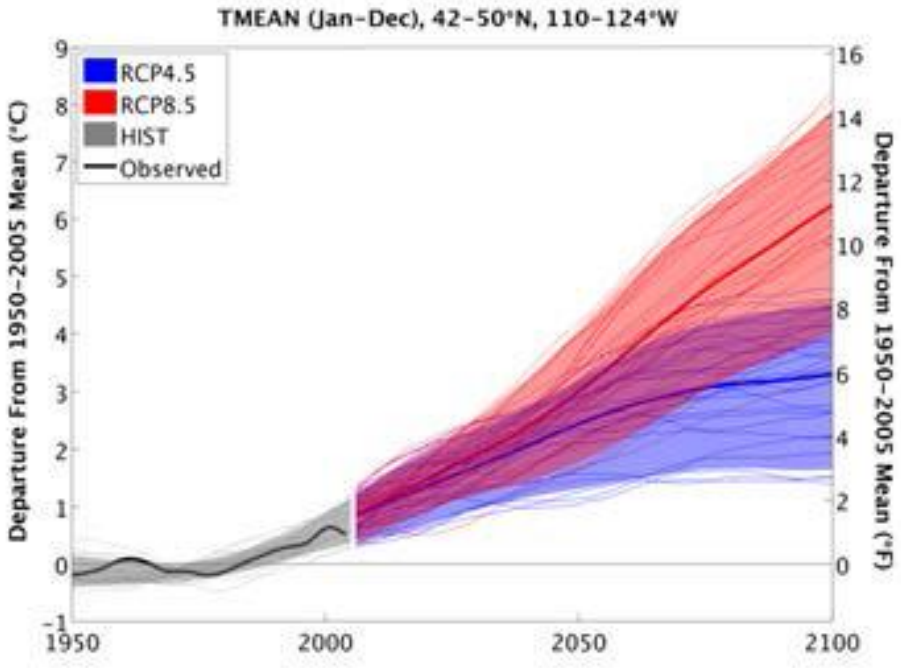


Figure 4. Oregon temperature history and projections through the century (Dalton *et al.* 2013).
http://library.state.or.us/repository/2010/201012011104133/summaries.pdf

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.

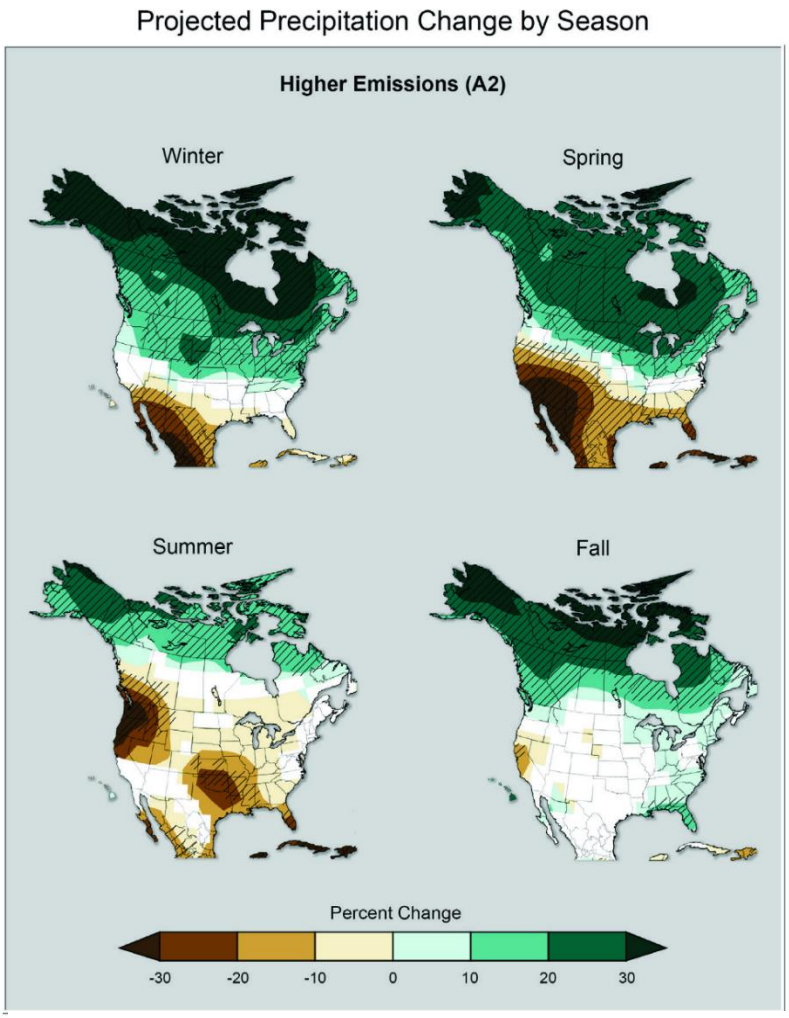


Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

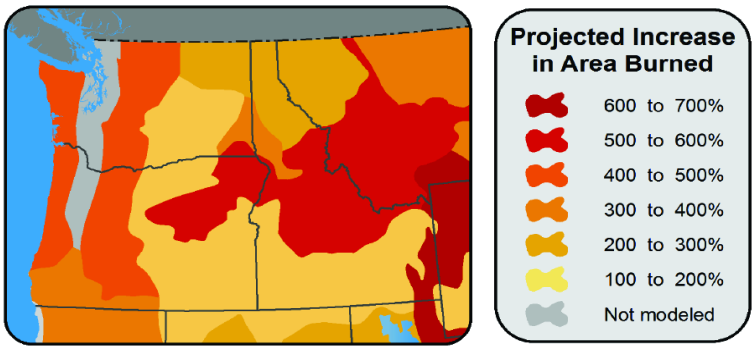


Figure 6. Anticipated wildfire consequences of a 2.2^{0}F warming in area burned (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

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 (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 7th Oregon Senate District Climate History and Projections

Historic and projected temperature for Lane County are depicted in Figure 7. These show a warming of about 1^0F during the latter half of the 20th Century with a possible warming of some 8^0F beyond the average for that period by the end of the 21st Century. The projections suggest

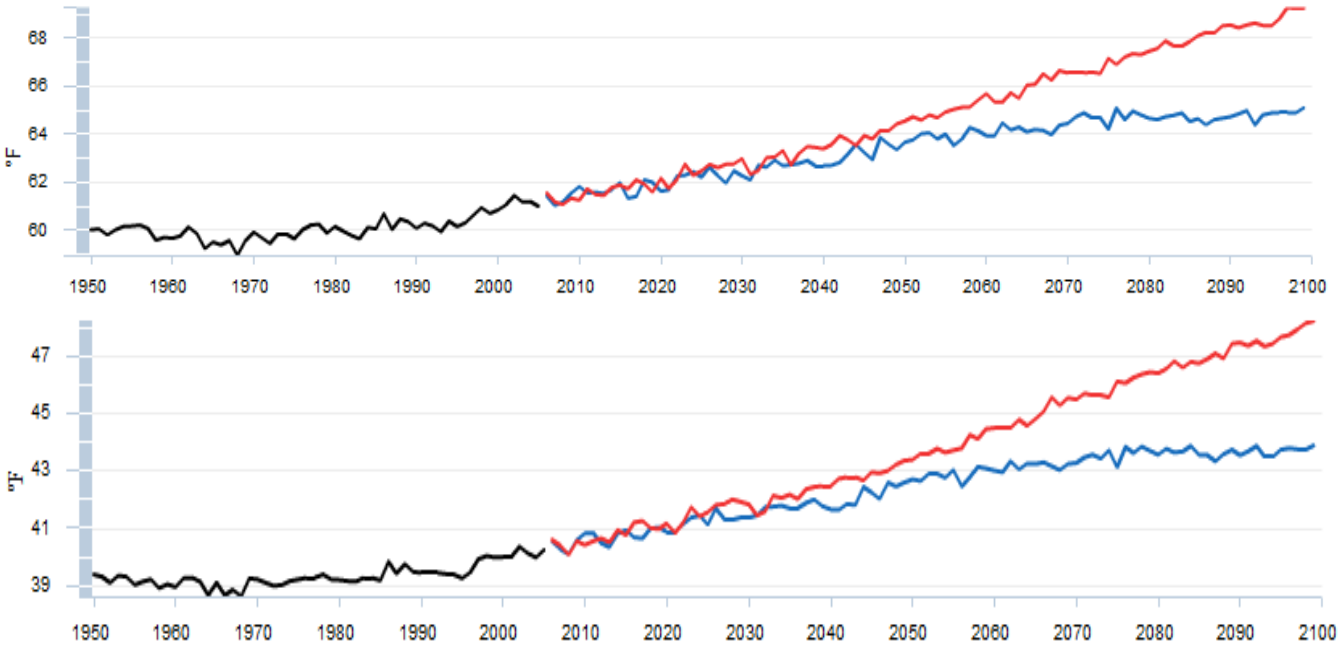


Figure 7. Mean Maximun (upper) and Minimum (lower) temperature trends for Lane County. Red represents the Business as Usual scenario of accelerating fossil fuel use and Greenhouse gas emissions; Blue assumes some reduction in this trajectory. Source USGS 2017.

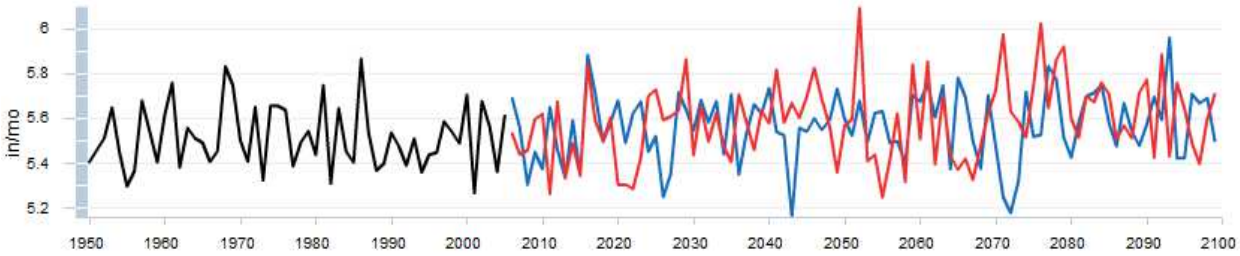


Figure 8. Historical and future projections of precipitation in Cottage Grove and surrounding areas. USGS 2017

that summer temperatures will likely increase dramatically, while winter temperatures will likely increase less.

The parallel historic trends and future projections show considerable variability but a generally flat average trend. The future suggests a continued flat trend but with greater variability,

meaning wetter and drier years. When combined with the seasonal trends depicted in Figure 5, this suggests great potential for an increased summer drought severity.

Meanwhile, snowfall and consequent snowpack accumulation have been declining for decades in Lane County and will likely continue to decline at an alarming rate (Figure 9).

Through the century, rising temperatures will probably reduce the peak snowpack in the Cascades slopes east of Eugene, OR. by more than fifty percent. Climate change will likely reduce the snowpack that feeds the McKenzie River in the spring and summer by 56 percent. The loss of snowpack will be 2.5 times bigger than the largest reservoirs that are in the basin right now. More than 200,000 people, including Eugene residents, depend on the McKenzie for drinking water (Sproles, 2013). The higher temperature, combined with earlier snowmelt and high elevation snowpack reduction suggest more severe wildfire seasons.

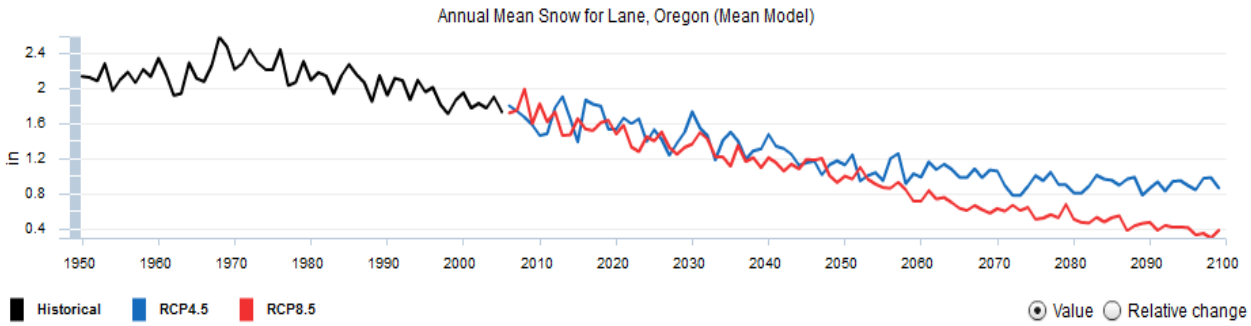


Figure 9. Lane County historic annual average snowpack in inches is presented in black with projections in blue and red. The projections are based on greenhouse gas concentration trajectories; blue assumes some redress in emissions while red assumes continued Business As Usual. USGS 2017

Federal Congressional District Historical Temperature Trend

The 7th Senate District is located within Oregon's Federal Congressional District 4. Figure 10 illustrates a similar historic warming trend of over 2˚F as seen in Figures 7 and 8.

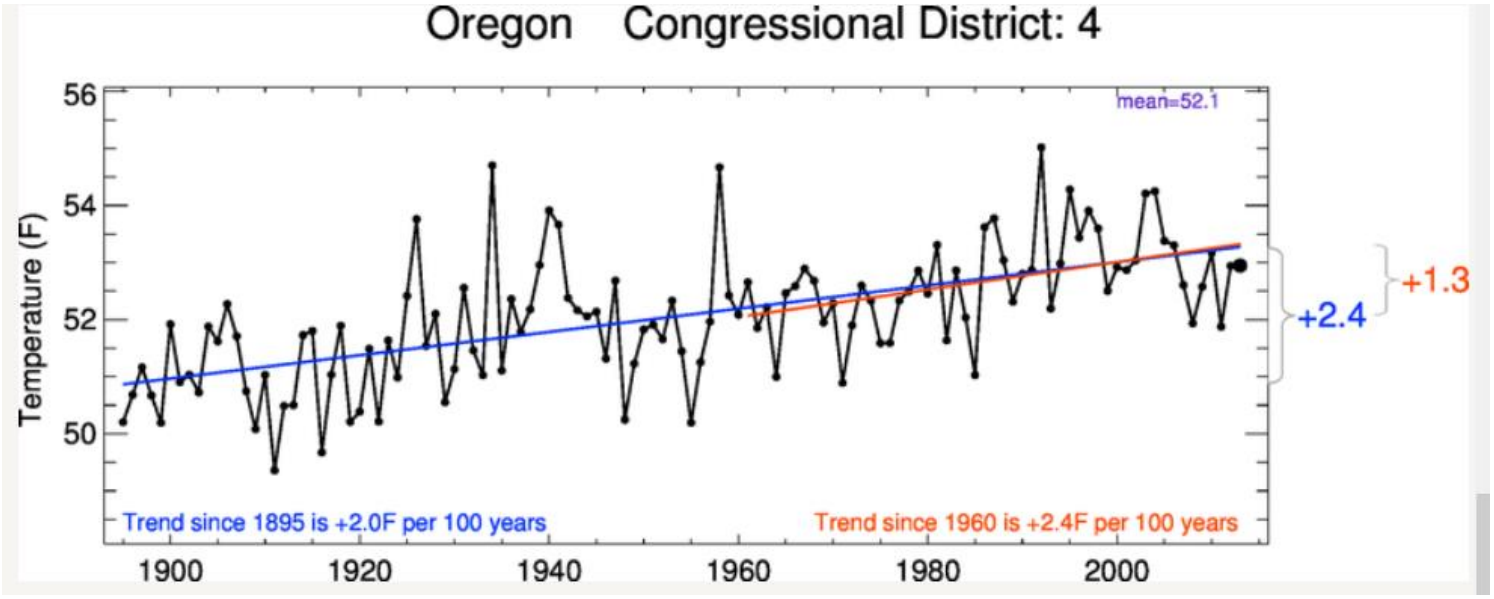


Figure 10. Average temperature trend within the 4th Congressional District.
http://www.temperaturetrends.org/district.php?district=4&state=OR

Oregon's 7th Senate District Economy

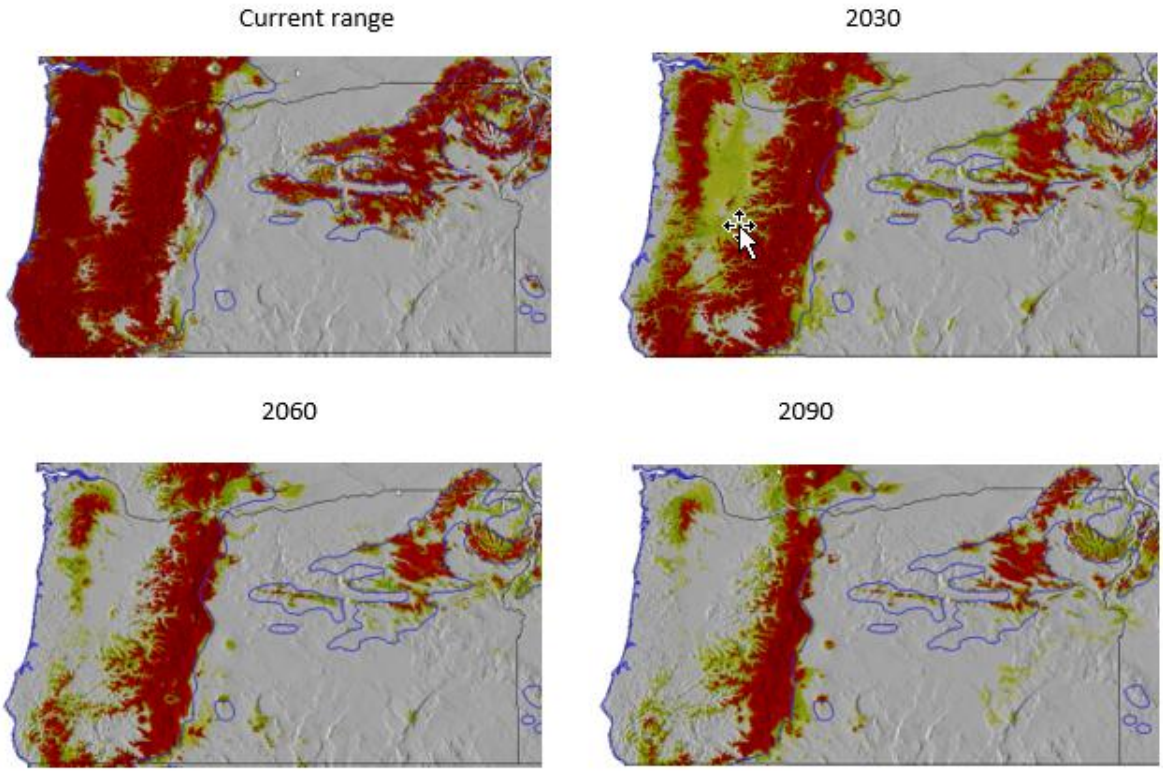
The local economy of Senate District 7 is made up of agriculture, healthcare, manufacturing and forestry. Agriculture will likely take the hardest hit due to climate change. Decreasing supplies of water for irrigation, increasing incidence of pests and disease attacks, and growing competition from weeds threaten local agriculture. Large, well known farms such as the Lochmead and Stroda Farms may suffer from climate change. Although timber/lumber production has declined it is still a significant component of this district's economy.

Forests and Climate Change: Like all natural systems, forests are influenced by the key variables of temperature and precipitation, the two factors most influenced by climate change. At the same time, because forests store carbon in their biomass, they can also have a profound direct impact on climate change, as they either store this carbon or release it through fire and logging operations. An important forest - climate interaction exists where each influences the other. Projected climate change impacts also threaten forests due to higher forest fire risk, decreasing tree growth, and increasing insect attacks. Higher summer temperatures, earlier spring snowmelt, and potential reductions in summer soil moisture will likely contribute to increased wildfire risk. Similarly, drought stress and higher temperatures will likely impede tree growth, though high-elevation forests may experience increased growth in the short term. These climate impacts will also probably contribute to increased frequency and intensity of attacks from mountain pine beetles and other insects. These attacks can increase fire risk and reduce timber production

The most economically important tree species in District 7 is Douglas fir (*Pseudotsuga menziesii*). The current range and projected range (red represents optimal and green sub-optimal conditions) through this century (Figure 11) suggest a reduction in conditions favorable for Douglas fir by the end of the century. Area timber companies such as Oregon Woods Inc., Peterson Pacific Corp, Shiloh Forestry Inc., and the local Weyerhaeuser branch will likely struggle to maintain profitable operations.

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



Wine is another economically important industry in Senate District 7. The majority of Oregon's wineries can be found here in the Willamette Valley, capitalizing on both the international fame of its Pinot Noir and the easy access to Portland. It is the coolest of Oregon's wine regions, the Willamette Valley's climate is perfectly suited to certain grape varieties that don't require intense sun and heat to ripen, typically varieties originating in Northern Europe such as Pinot noir and Chardonnay; Riesling, Gewurztraminer, Pinot Blanc and Pinot Gris. The Willamette Valley is also a beacon for wine tourism in Oregon, due to its easy access to the urban

population and travel destination of Portland Oregon. The projected increase in temperatures along with longer summers and less rain would greatly alter the growing season and make it difficult to continue to grow these varieties of grapes. Figure 12 depicts optimal temperatures for varietals grown in the region including the impact climate change will have on wine growing. Wineries will likely have to turn to warmer season grapes to stay in business.

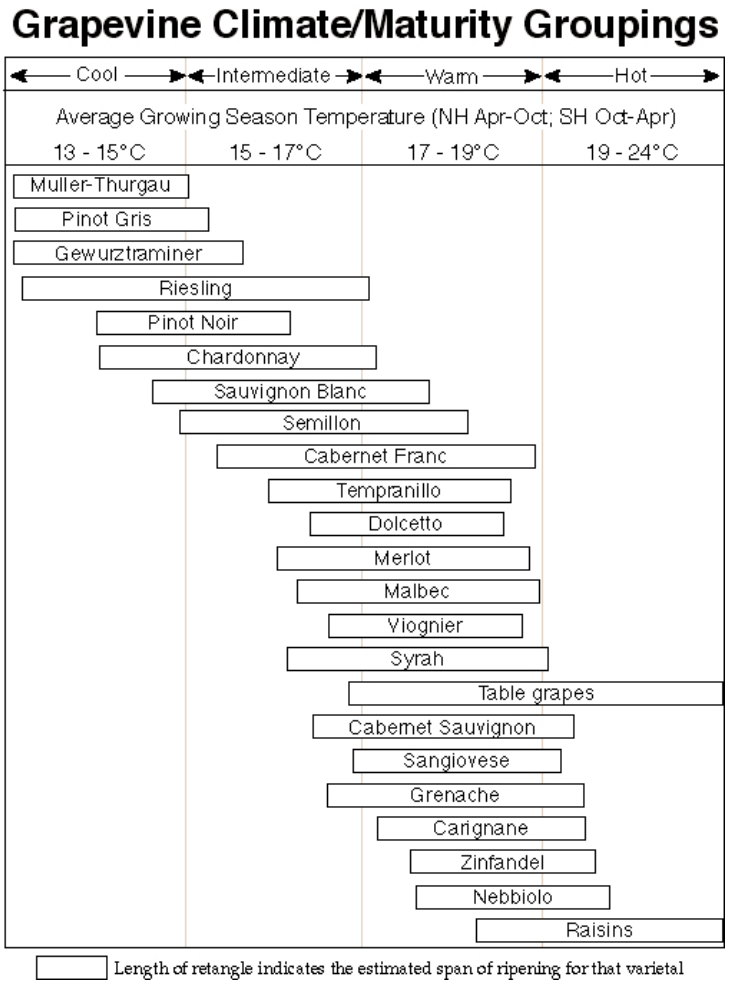


Figure 12. Grape varietals grow optimally where climatic conditions suit them. This graph depicts optimal growing season (April – October) temperatures for the varietals commonly grown in western Oregon. http://www.sou.edu/envirostudies/gjones_docs/GJones%20Climate%20Change%20Geoscience%20Canada.pdf

Outdoor recreation, popular in District 7, is extremely dependent on the natural resource base and the weather. Impacts from climate change will vary among leisure activity. Rapid climate change could mean that many plant and animal species are unable to adapt and may become extinct in the process. Hunters and wildlife enthusiasts will more than likely follow the wildlife north or learn to hunt and view other forms of wildlife that move into the areas that they themselves usually frequent. A longer summer poses a threat to winter activities such as cross-country and downhill skiing, snow shoeing, skating, ice fishing, etc. Less snow cover and a shorter winter season could threaten the livelihoods of ski resort operators who have the potential to go out of business. The indirect effects of this include the loss of tourism revenues to local restaurants, hotels and other forms of amusement as well as the loss of jobs for people within the community.

Oregon's 7th District Health

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

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.

A Timeline For Action

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**	**??**

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, 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 (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°C upper limit. In relation to exceeding that 2°C limit, the World Bank (2012) acknowledged there is: "no certainty that adaptation to a 4°C world is possible."

There can be little doubt that much urgency should be attached to addressing this issue.

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