Southern Oregon Climate Action Now

SOCAN

Confronting Climate Change

Climate Change in the Oregon 26th Senate District

July 2017

History, Projections, and Consequences

1. The last half of the 20th Century witnessed a District temperature increase of about 1˚F.
2. Projections suggest a further rise of up to 9˚F is possible from the average of that period by the end of the 21st Century.
3. Snowfall and snowpack accumulation, already dropping, are projected to dwindle further, possibly to 10% of historic levels be late century.
4. Although annual average precipitation is expected to hold steady, variability will likely increase and seasonally, winters are expected to be wetter and summers dr1er, with more heavy downpours causing soil erosion and compromising agricultural water needs.
5. Wildfires already exhibit a 2.5 month longer season than in the 1970s. Wildfire risk is expected to become more serious, with up to 700 percent greater area being consumed by mid-century. This will likely pose a substantially greater problem for forests and for human health.
6. A decrease in the winter chill period could create a potential problem for apple and pear growers.
7. Wine varietals may be compromised as growing season conditions warm.
8. Local commercial forestry and tourist activities will likely be compromised as temperatures increase.
9. 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.

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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).

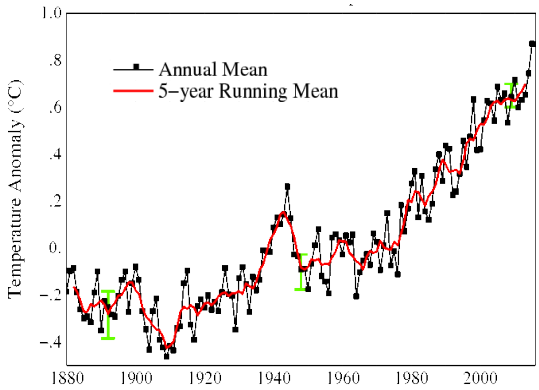

Figure 1. Historic global temperature trend NASA Goddard Institute for Space Studies 2017.

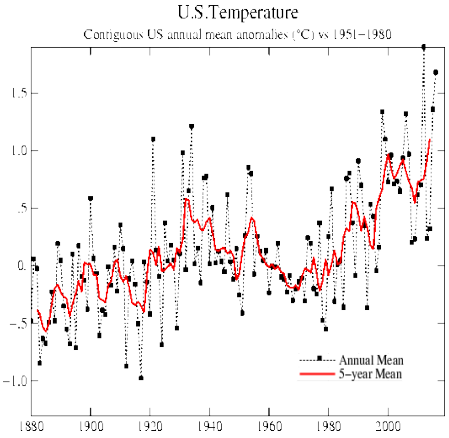

Figure 2. Historic U.S temperature trend. NASA Goddard Institute for Space Studies 2017.

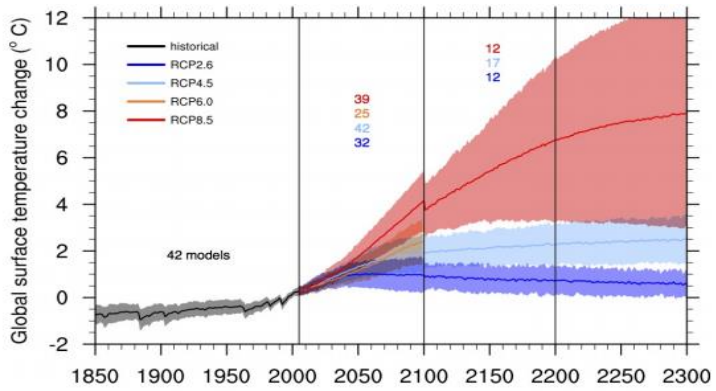

Figure 3. Intergovernmental Panel on Climate Change 2013 global projections.
http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

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.

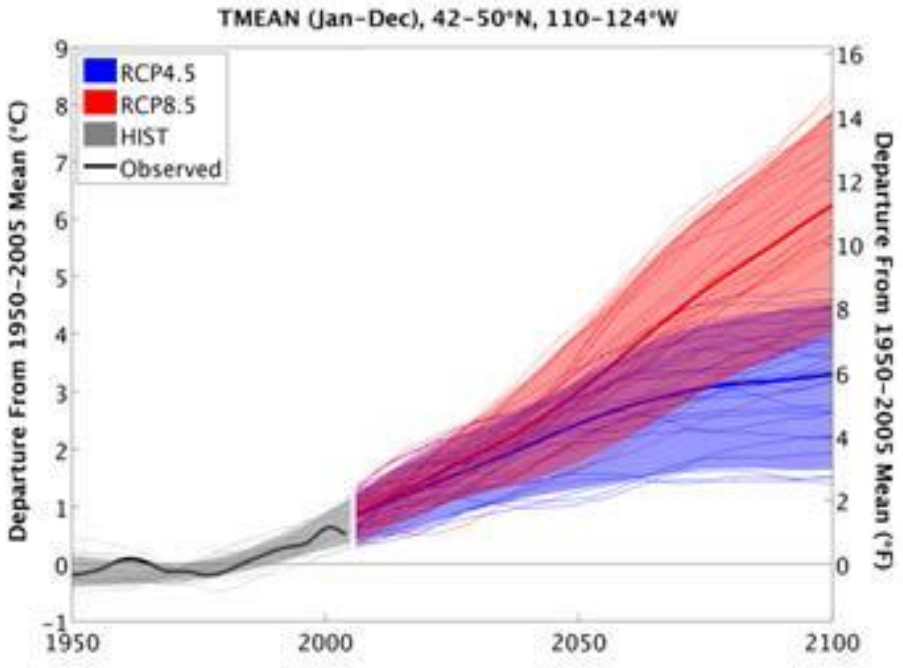

Figure 4. Oregon temperature history and projections through the century (Dalton *et al.* 2013).
http://library.state.or.us/repository/2010/201012011104133/summaries.pdf

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.

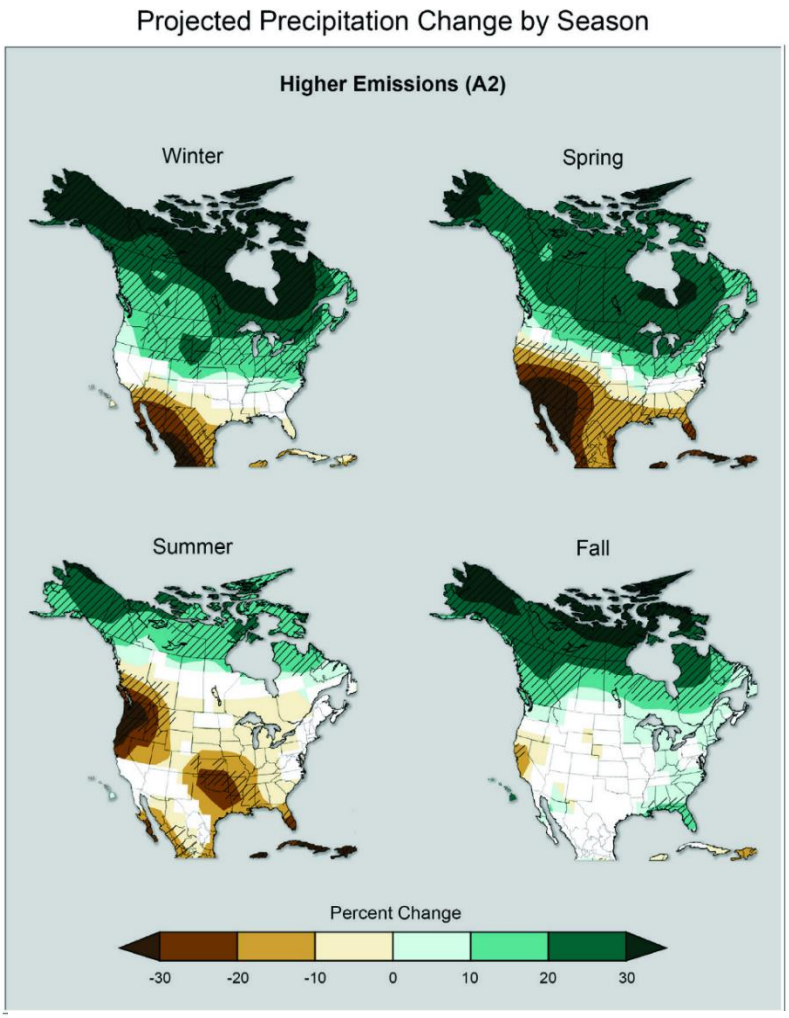

Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

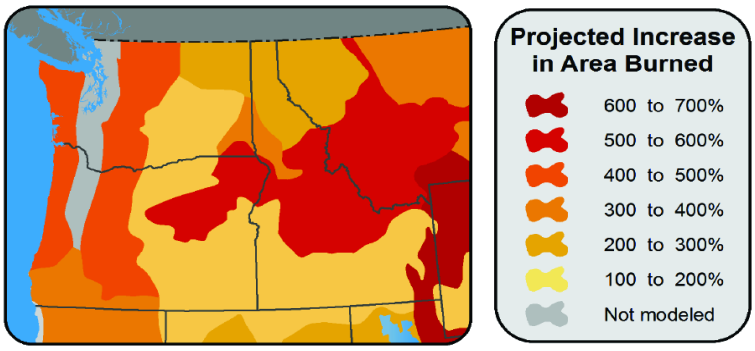

Figure 6. Anticipated wildfire consequences of a 2.2^{0}F warming in area burned (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

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 26th Oregon Senate District Climate History and Projections

Historic and Projected Temperature (Figure 7) indicate a historic rise of about 1.0^{0}F during the last half of the 20th Century. Projections through this century suggest a rise of some 9.0^{0}F is possible beyond the average for that period.

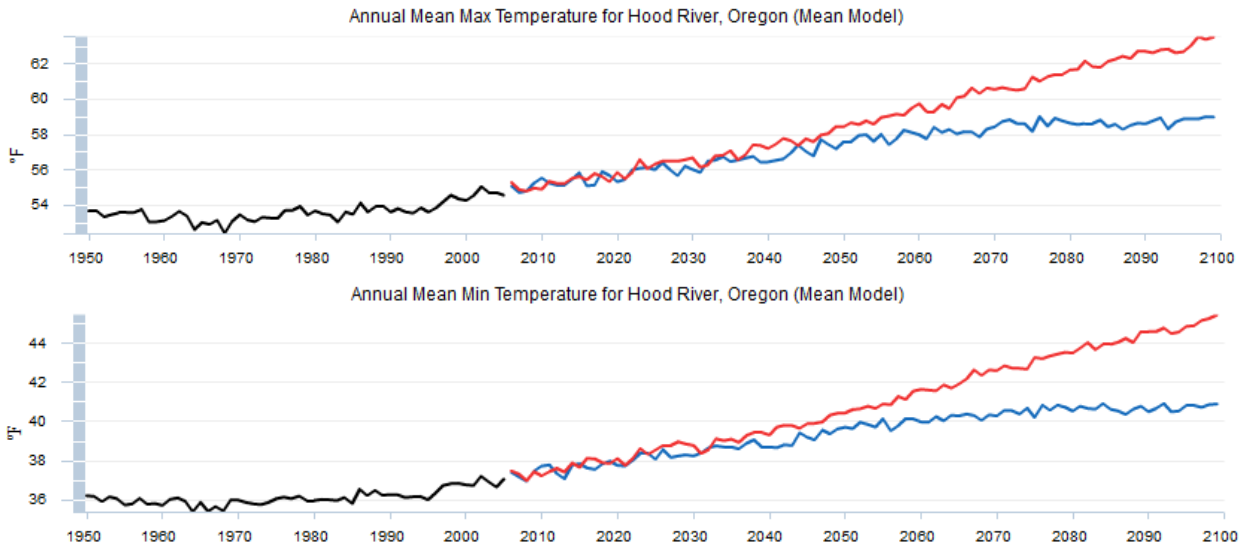

Figure 7. Temperature history and projections for Hood River County (upper mean maximum, lower mean minimum). Red represents the business as usual scenario of accelerating fossil fuel use and greenhouse gas emissions. Blue represents a reduction in that trajectory (USGS 2017)

Mean annual precipitation (Figure 8) has been essentially flat but variable and will probably continue thus, though with greater variability, meaning wetters and drier years. Combined with the seasonal trends indicated in Figure 5, these data suggest a greater risk of summer/fall drought.

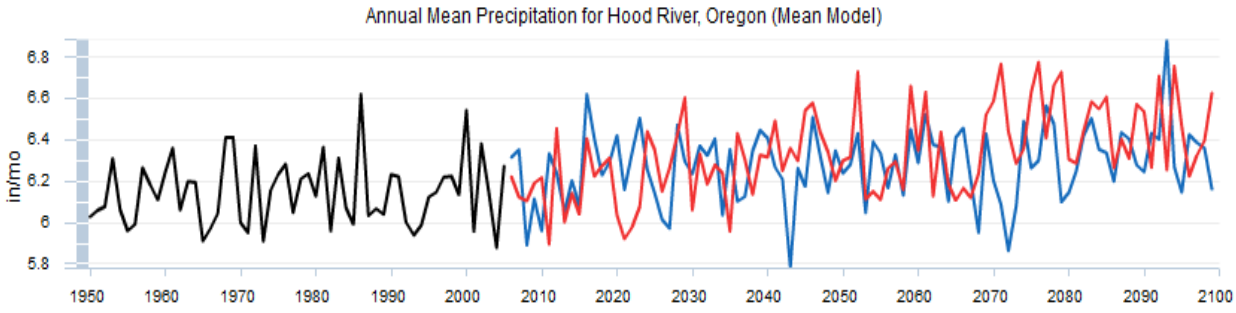

Figure 8. Precipitation projections for Hood River County (USGS 2017).

Meanwhile, snowfall and consequent snowpack accumulation (Figure 9.) have been on the decline in Hood River County and will likely continue to do so through the century severely compromisng late summer and fall water availability.

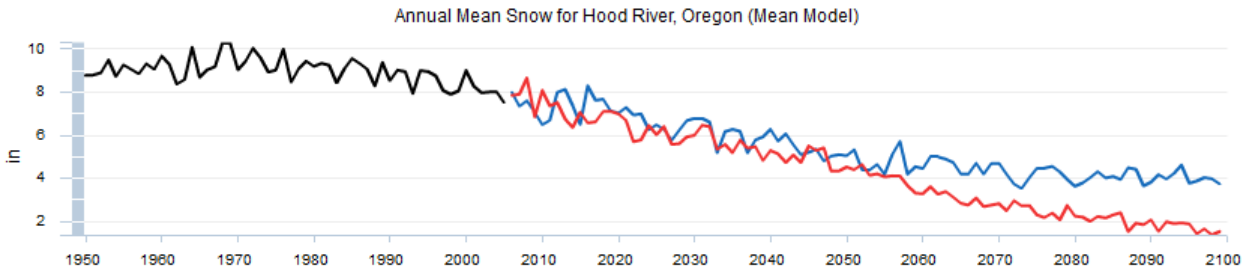

Figure 9. Historic and projected snowfall trends for Hood River County (USGS 2017).

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Federal Congressional District Historical Temperature Trend:

Since the Oregon Senate 26th District falls within the Second and Third Federal Congressional District, it is instructive to see how historic patterns have fared across those districts.

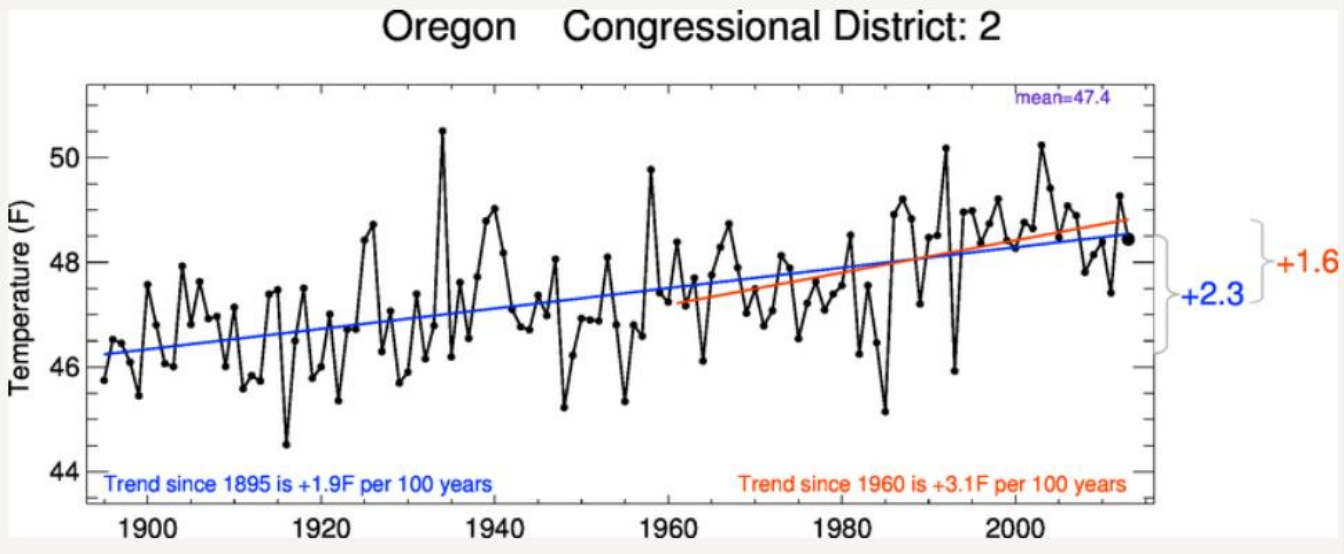


Figure 10. Average temperature trend within the 2nd Federal Congressional District.
http://www.temperaturetrends.org/district.php?district=2&state=OR

The data indicate (Figure 10) that the second Congressional District has been warming at a rate of 1.9^{0}F per century, a rate faster than that of Oregon as a whole (1.2^{0}F per century) but slower than the United States average rate of 2.2^{0}F for the century.

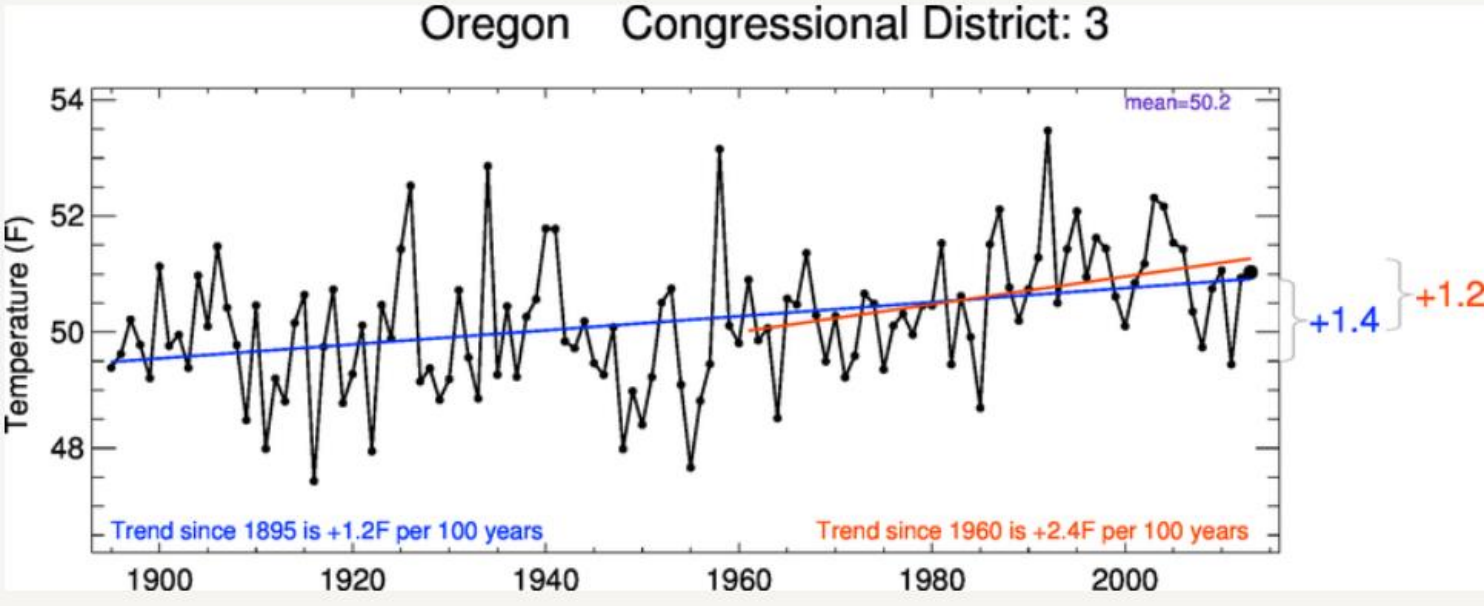


Figure 11. Average temperature trend within the 3rd Federal Congressional District. http://www.temperaturetrends.org/district.php?district=3&state=OR

Figure 11 shows the Third Congressional District has been warming at a rate of 1.2^{0}F per century, which is consistent with that of Oregon as a whole (1.2^{0}F per century) but slower than the United States average rate of 2.2^{0}F for the century. These districts are not immune to climate change.

Oregon's 26th Senate District Economy:

Senate District 26 has long been an agricultural center of the Pacific North West. Over 225,000 tons of apples, pears, and cherries are annually produced in the Mid-Columbia River area. The fruit industry is the #1 economic contributor in Hood River County. Declining snowpack and dwindling glaciers pose a threat to critical water availability for the orchard industry. District 26 is also home to more than a dozen wineries. Hood River is considered to be a cool climate wine-growing area and is best known for producing high quality Pinot Gris, Pinot Noir and other early season varieties. 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 the optimal growing season temperatures for a range of varietals grown in Oregon. The serious impact of a growing season temperature increase can be inferred from this illustration.

Future climate patterns as projected would negatively impact the economy through a reduction in crop yields since increasing temperature consistently reduces crop productivity.

The blossoming wine industry and the apples and pears produced would also be affected by the altered growing season. A potential problem for apple and pear growers is the need for a solid winter chill period. This is decreasing. While not immediately a problem, if the trend of decreasing chill hours continues the consequences for fruit production could become relevant.

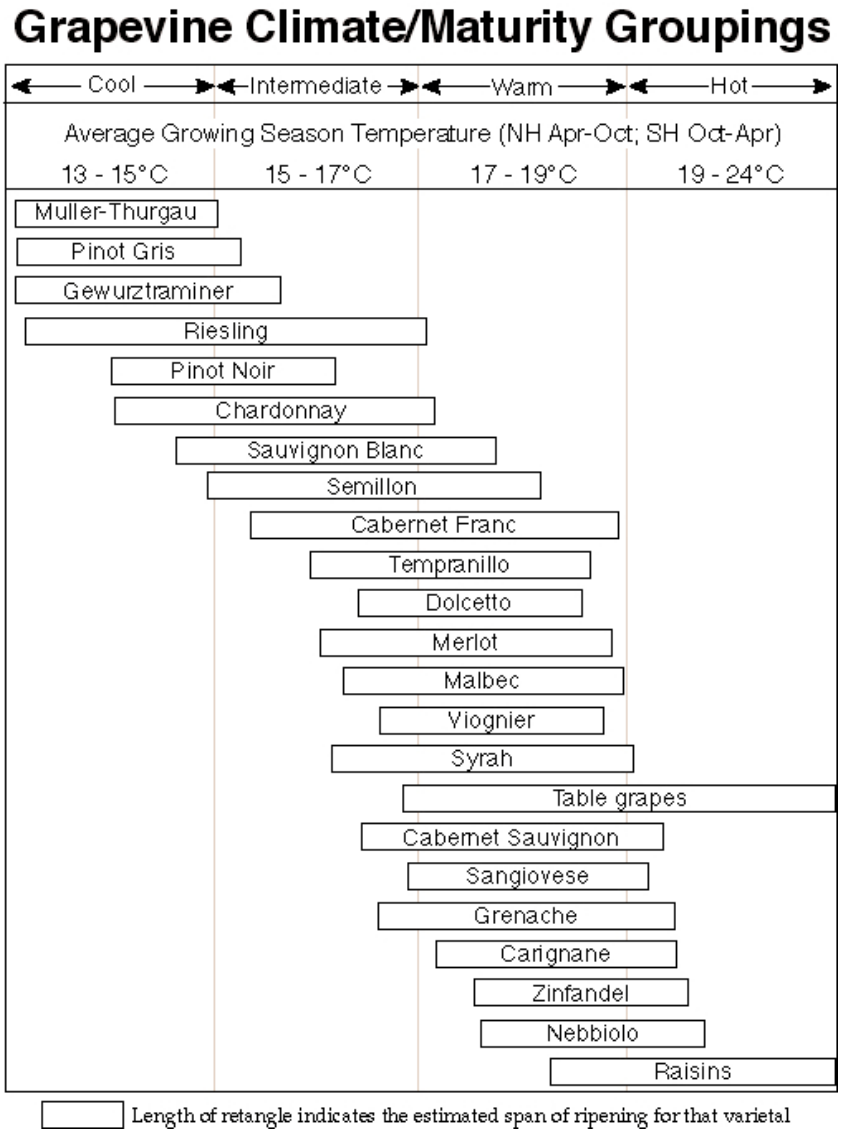
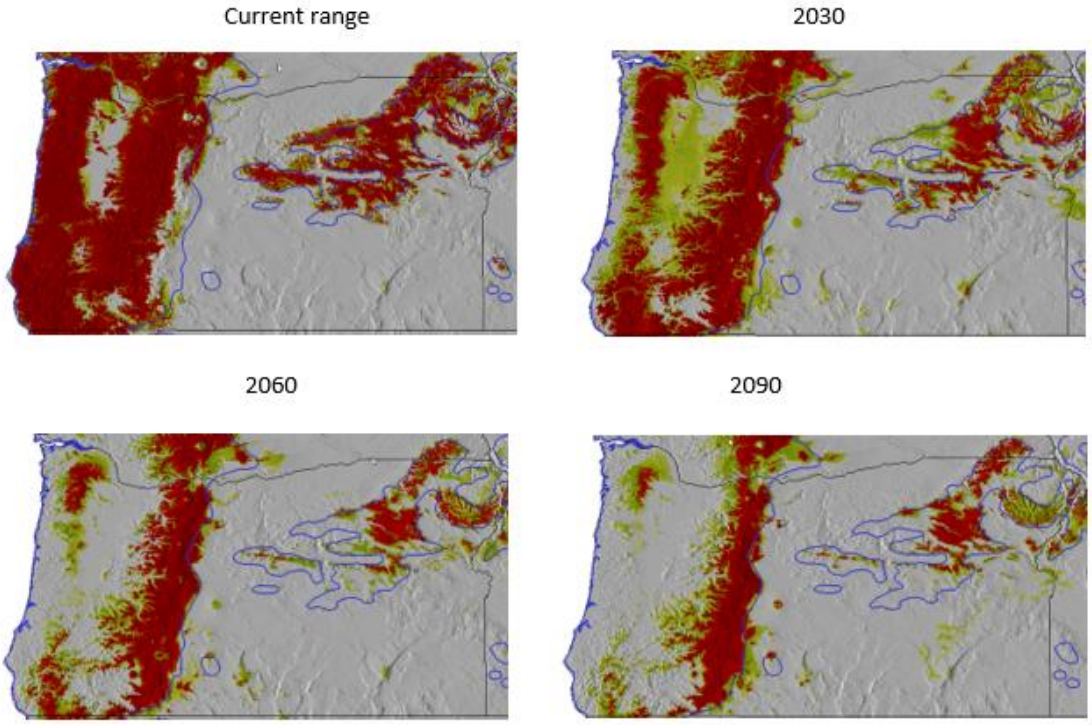


Figure 12. Grape varietals grow optimally where climatic conditions suit them. This graph depicts optimal growing season temperatures for the varietals commonly grown in Oregon.
http://www.sou.edu/envirostudies/gjones_docs/GJones%20Climate%20Change%20Geoscience%20Canada.pdf

Mt. Hood Forest Products LLC, South of Hood River, specializes in green Douglas fir timber. As climate change overtakes the region, the vitality and viability of this commercial species will likely be compromised. Figure 13 displays future trends in the viability of Douglas fir according

to the 'business as usual' future scenario: purple represents high viability, green lower viability, and grey non-viability (Rehfeldt *et al.* 2006). 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 13 Douglas fir (*Psuedotsuga menzeisii*) current and projected distribution through the 21st Century
http://charcoal.cnre.vt.edu/climate/species/



Tourism is another important factor in the District 26 economy. Hood River first experienced a boom in tourism after being discovered as a site for world-class windsurfing, and more recently kiteboarding. Home to Mt Hood and the Hood River national Forest, the region also boasts some of the best kayaking, mountain biking, skiing, and hiking areas in the United States. Projected decrease in snowfall in the region will likely severely compromise winter and summer sports recreational activities. Both summer and winter tourist activities will be affected by climate change which will compromise the basis for tourism in the region.

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.

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, first responders, Native Americans, young 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, 2014) and the International Energy Agency (IEA 2009).

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

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°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 Your Senator Chuck Thomsen

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