Southern Oregon Climate Action Now

SOCAN

Confronting Climate Change

Climate Change in the Oregon 12th Senate District

July 2017

History, Projections, and Consequences.

1. During the last half of the 20th century, the temperature increased about 1°F and is likely to rise another 8°F beyond the average for that period by the end of the 21st century.
2. Fire projections suggest two to four times the area burned historically may be burn by mid-century.
3. Since the economy of the 12th District is heavily dependent upon tourism, timber, and to a greater extent, agriculture, the successes of which are in turn dependent upon appropriate temperature, precipitation patterns, and water availability, the impact of future potential climate conditions will likely range from economically disruptive to extremely severe.
4. Snowfall trends and projections are consistently down posing threats for summer and fall water availability for irrigation, commerce, and general consumption.
5. Dwindling and warming summer and fall stream flow will likely compromise fish and aquatic species.
6. Polk and Yamhill counties are the top two wine producing counties in Oregon, with Yamhill county boasting 80 wineries and 200 vineyards.
7. Both temperature and water availability are pertinent to winery operations. Projections indicate trends that will be threatening in both climatic categories.
8. Future climate projections suggest that the 12th Senate District may become unsuitable for some of the critical forest species (notably Western hemlock, and Douglas fir) currently forming the basis of the logging industry.
9. At the current emissions trajectory, we will exhaust our global emissions allowance in 17 years if we wish to maintain the global temperature increase below 2°C (3.6°F) as international agreements dictate.
10. 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, and children and pregnant women.

Compiled by Janel L. Lajoie and Alan Journet (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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July, 2017

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).

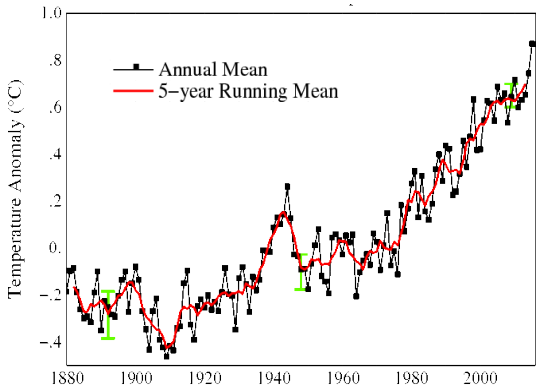


Figure 1. Historic global temperature trend NASA Goddard Institute for Space Studies 2017.

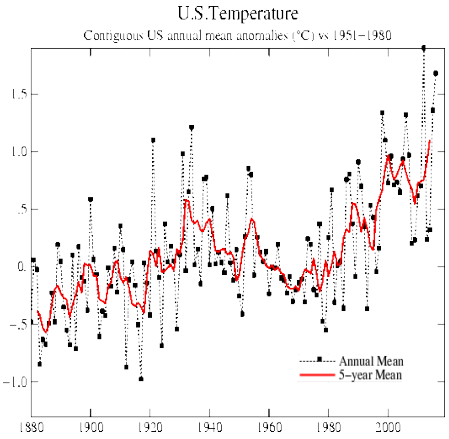


Figure 2. Historic U.S temperature trend. NASA Goddard Institute for Space Studies 2017.

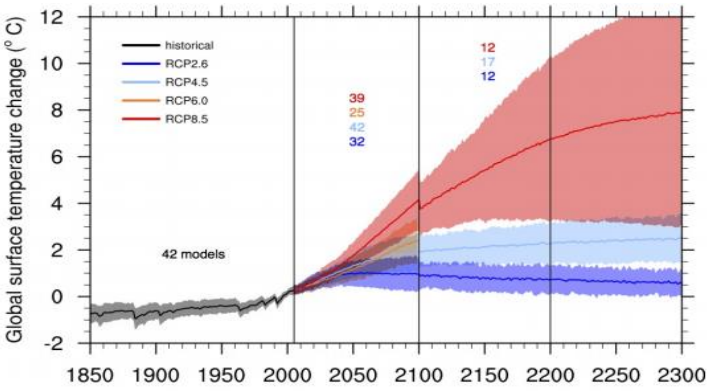


Figure 3. Intergovernmental Panel on Climate Change 2013 global projections.
http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

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.

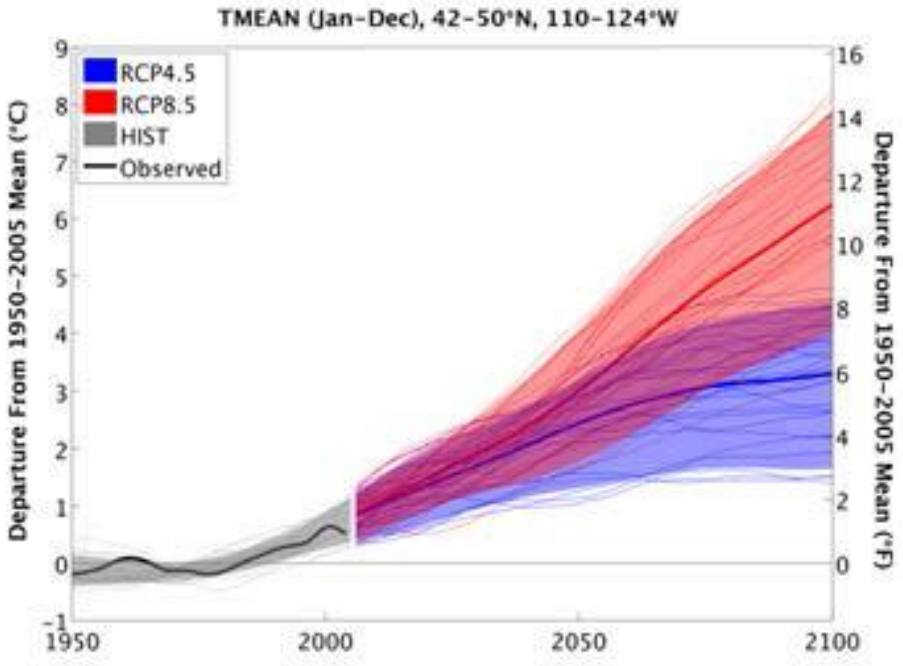


Figure 4. Oregon temperature history and projections through the century (Dalton *et al.* 2013).
http://library.state.or.us/repository/2010/201012011104133/summaries.pdf

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.

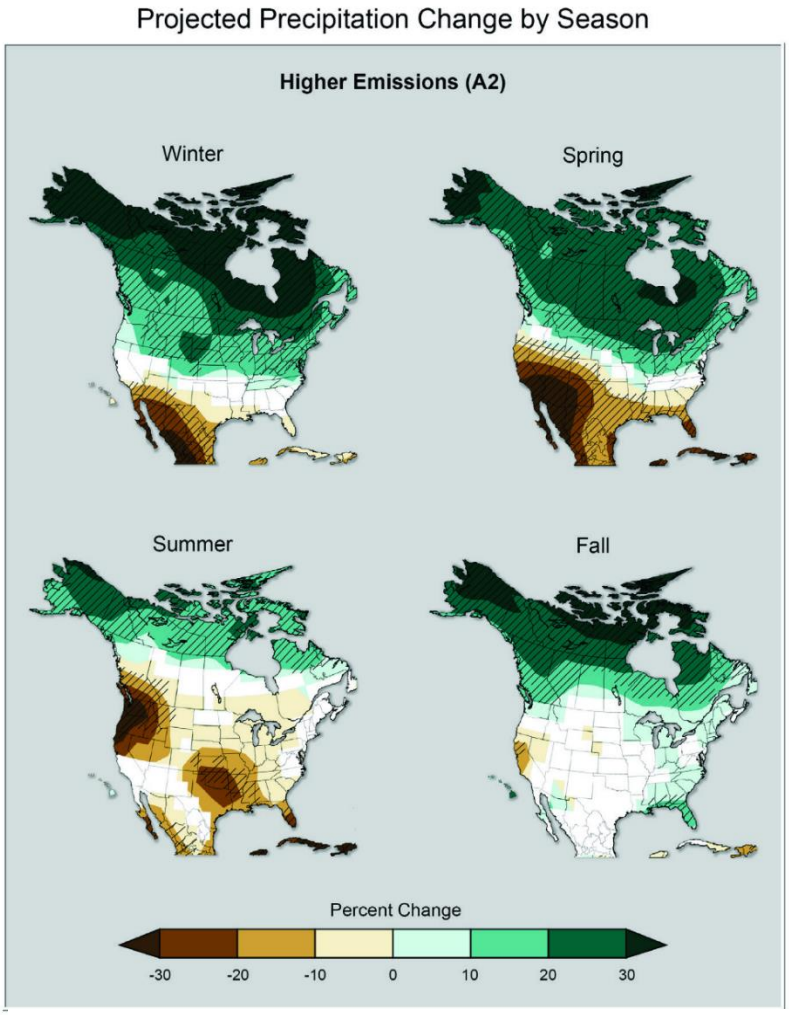


Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

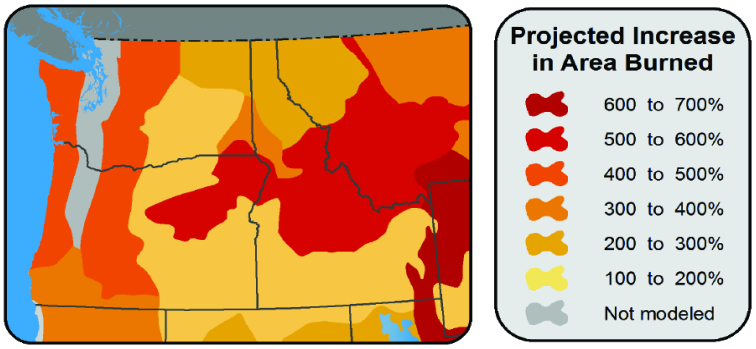


Figure 6. Anticipated wildfire consequences of a 2.2^{0}F warming in area burned (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

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 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 ^{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! Results 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 becoming more acidic. 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 12th Oregon Senate District Climate History and Projections:

The historic and projected temperature trends 1950 – 2099 (Figure 7, 8) for the District, taken respectively from Benton County in the south and Yamhill County in the North indicate a historic rise of about a degree F during the second half of the 20th century but a projected rise through this century of over 8^{o}F (red line) under the business as usual scenario of accelerating fossil fuel usage and emissions but also a rise of over 4^{o}F (blue line) even if we reduce the emissions trajectory substantially.

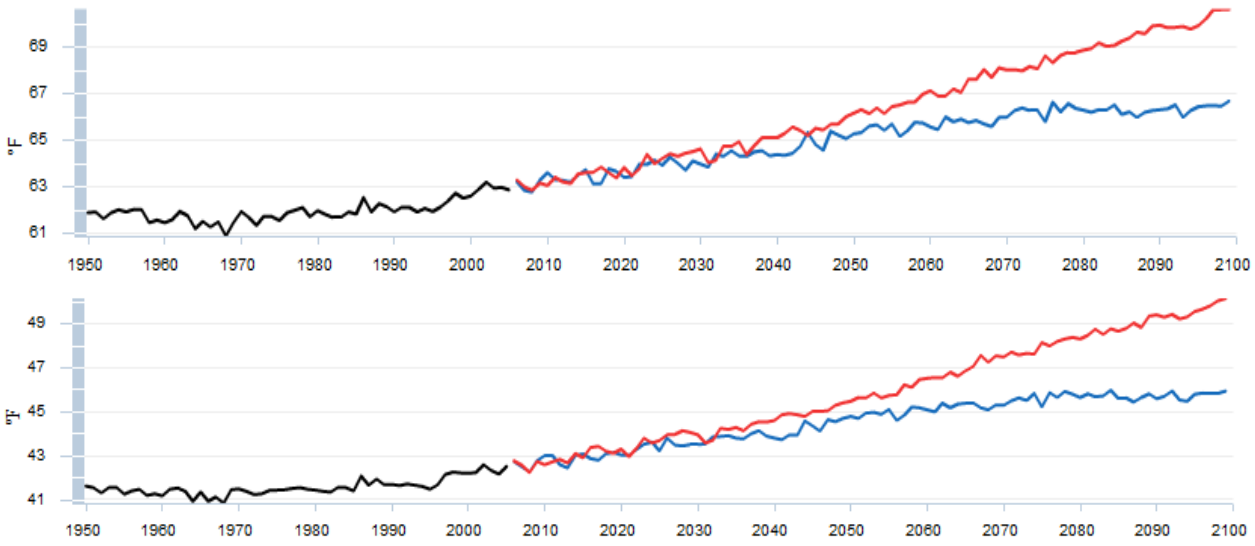


Figure 7. Temperature history and projections for Benton County. Upper = mean maximum, lower = mean minimum. USGS 2017).

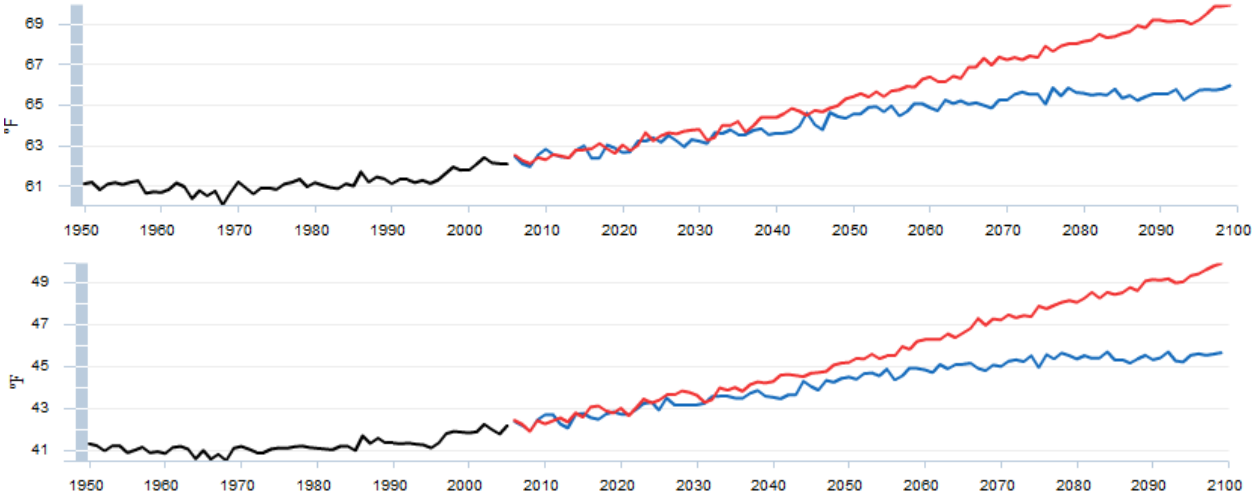


Figure 8. Temperature history and projections for Yamhill County. Upper = mean maximum, lower = mean minimum (USGS 2017).

Precipitation for Benton and Yamhill Counties (Figures 9, 10) 1950-2080 suggest a generally flat average trend though with greater variability through the balance of this century under both scenarios. This portends wetter and drier years will occur.

It is important to appreciate that the combination of comparable precipitation and higher temperatures will cause greater evaporation and thus extended droughts, particularly during the anticipated drier summer growing season. This will negatively affect both summer and winter recreational opportunities, and irrigation needs for agriculture.

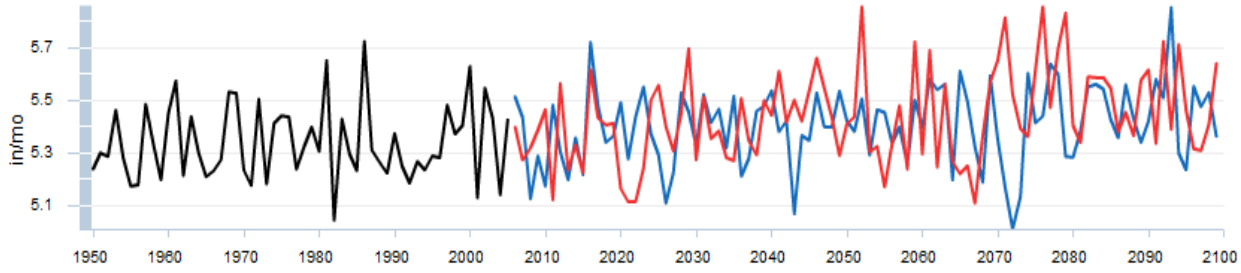


Figure 9. Precipitation history and projections for Benton County (USGS 2017).

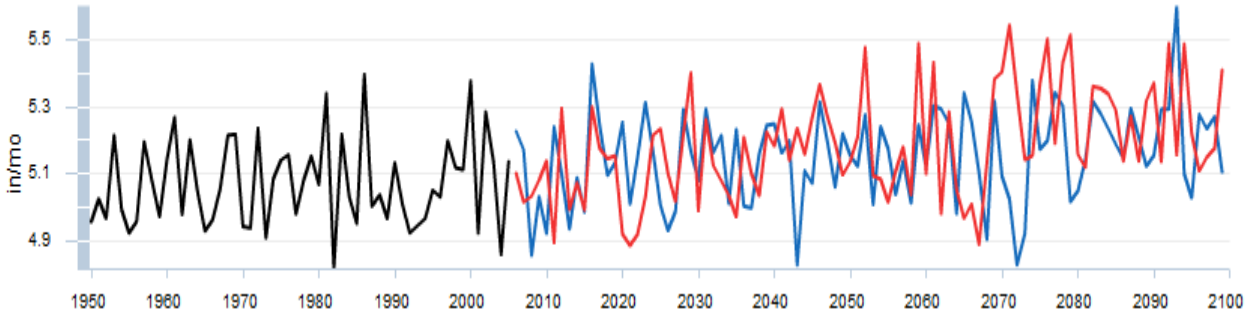


Figure 10. Precipitation history and projections for Yamhill County (USGS 2017)

Snowfall in the District for Benton and Yamhill Counties (Figures 11 and 12) decreased during the last century and is expected to drop further to minuscule amounts by late century if the business as usual scenario is followed through the century but only slightly more if we reduce emissions.

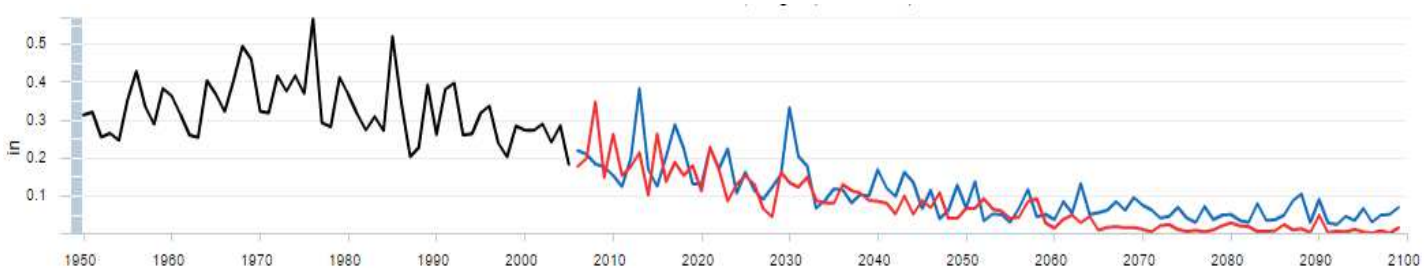


Figure 11. Snowfall history and projections for Yamhill County (USGS 2017).

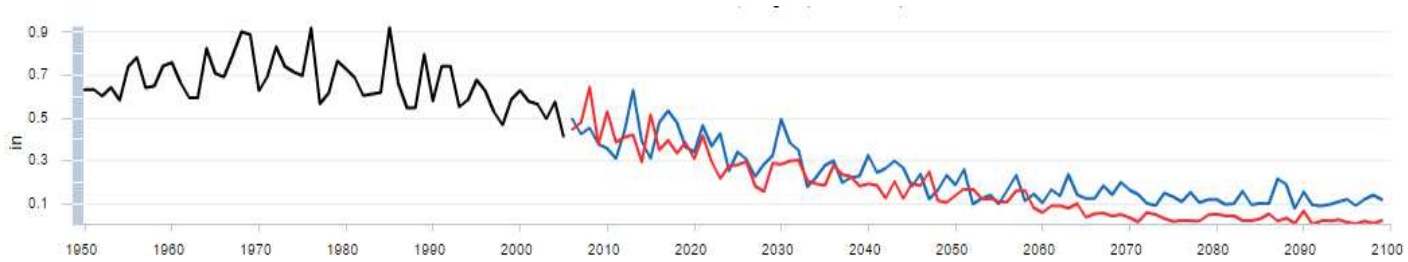


Figure 12. Snowfall history and projections for Yamhill County (USGS 2017).

Federal Congressional District Historic Temperature Trends:

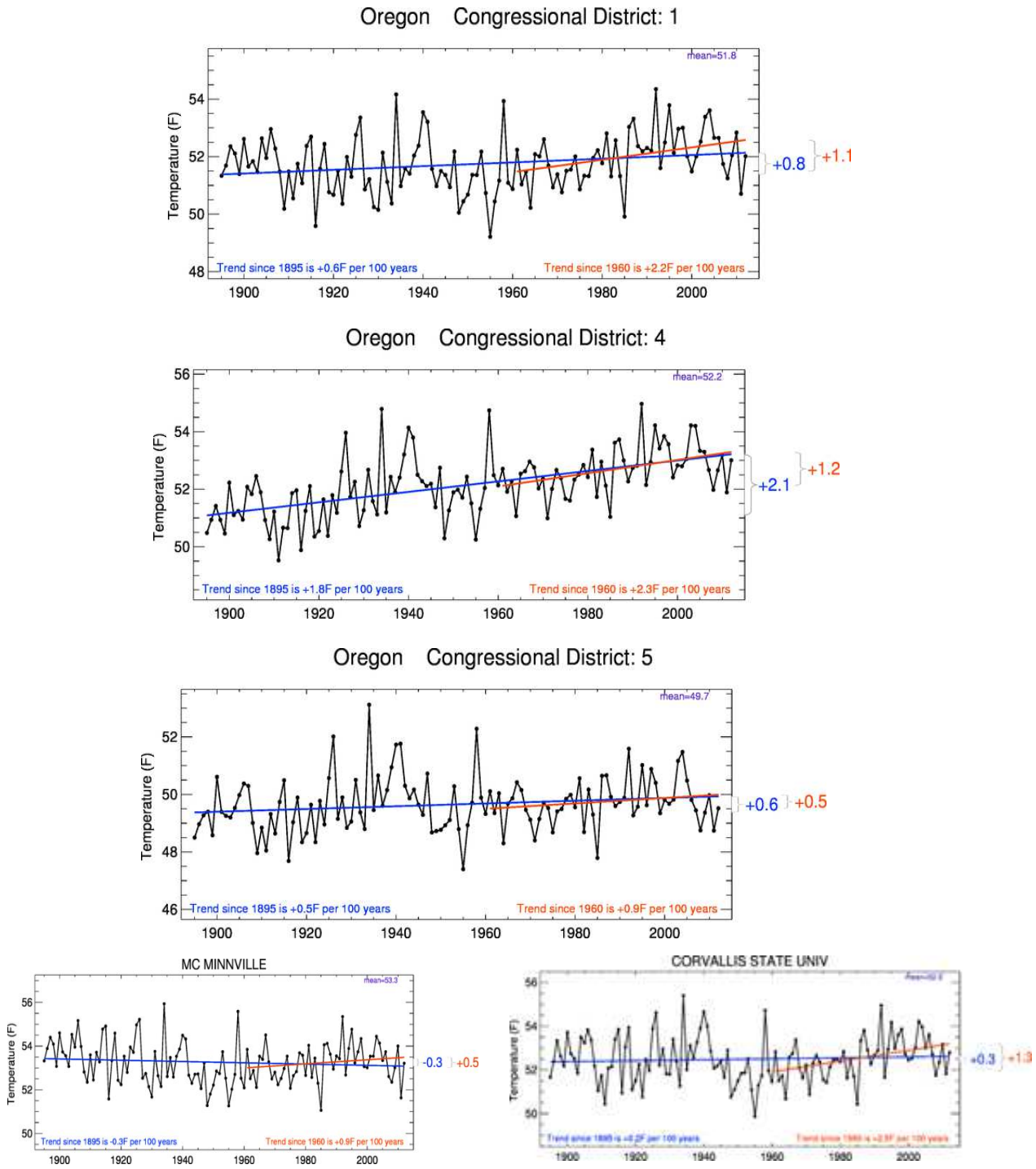


Figure 13. Temperature trends throughout the 1st, 4th, and 5th U.S. Congressional Districts http://temperaturetrends.org/global.php?district=2&state=OR

Since the Oregon 12th Senate District falls within the 1st, 4th, and 5th Federal Congressional Districts, it is instructive to see how historic patterns have fared across those districts.

The data indicate (Figure 13) that the 1st, 4th, and 5th Congressional Districts have been warming at an average rate of 1.8°F per century, which is 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 district is not immune to the consequences of climate change as can be seen by the warming rate of Corvallis, Oregon at 2.5°F for the century.

Oregon 12th Senate District Economy

The economy of the 12th Senate district is rooted primarily in tourism, agriculture, and forestry, technology, and is the capital of Oregon's wine industry. The area is a world leader in production of seed crops, as well as Christmas trees, sheep, lumber, grass and legume seeds, and plywood.

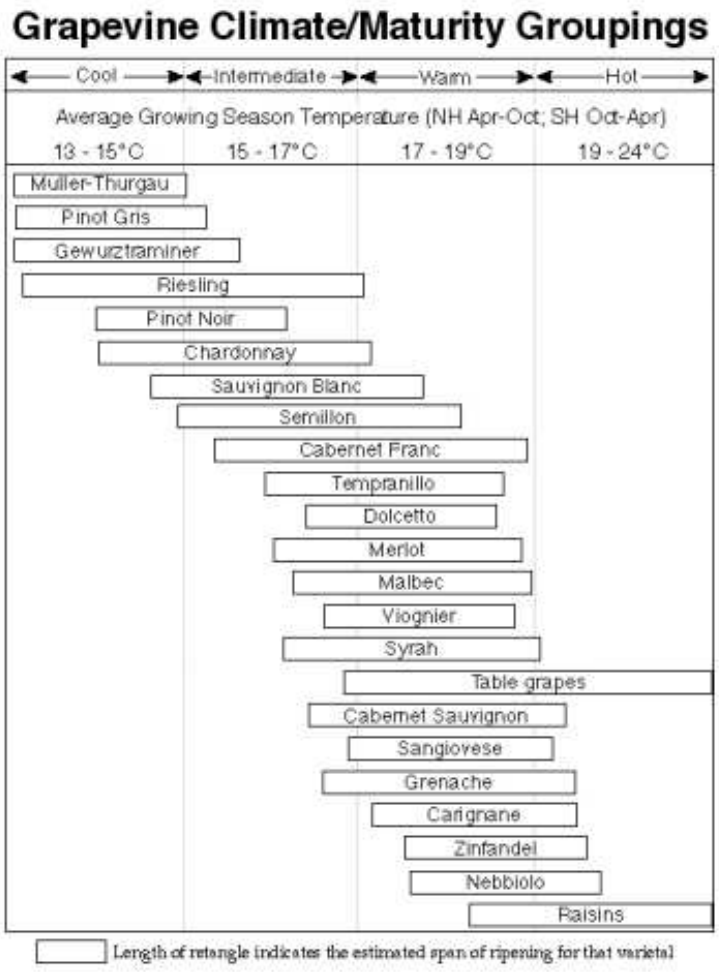


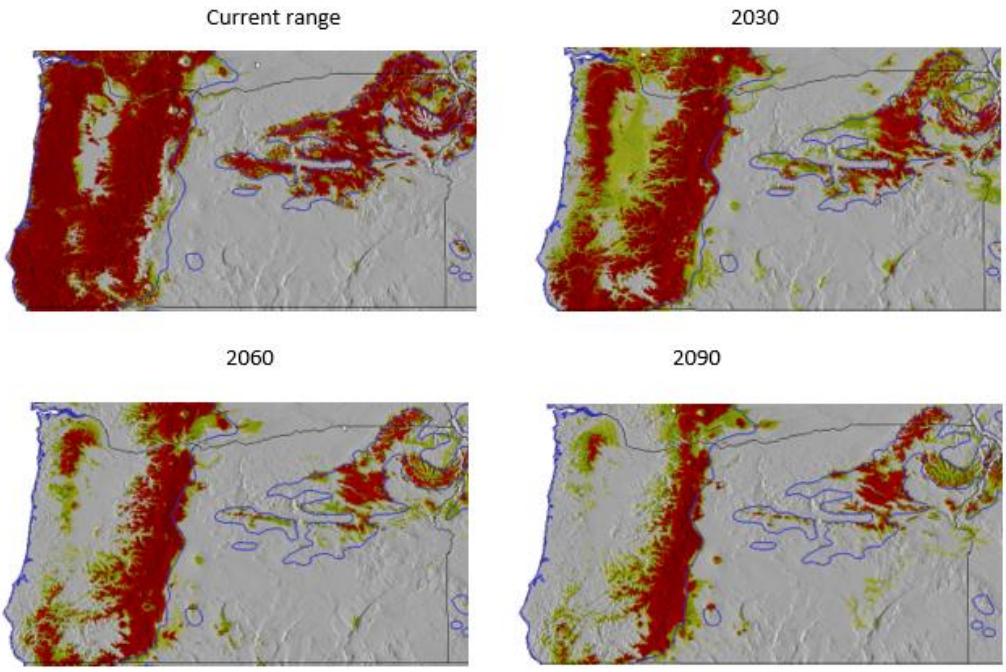
Figure 14. Optimal growing conditions for grape varietals of Oregon. http://www.sou.edu/envirostudies/gjones_docs/GJones%20Climate%20Change%20Geoscience%20Canada.pdf

The ongoing health of our natural ecosystems is pertinent to retain the revenue stream provided by these activities. Much of the area in the district is forested; Benton County contains two National protected areas including the William L. Finley National Wildlife Refuge and portions of the Siuslaw National Forest, and Yamhill County contains the Tualatin River National Wildlife Refuge and portions of the Siuslaw National Forest. This region of Oregon contains a substantial portion of the state's swiftly growing wine industry. Decreased precipitation will affect groundwater recharge, which will, in turn affect the available water supply for growing grapes. Climate is a controlling factor in grape and wine production (Figure 14); changes can affect both the suitability of certain varietals to a region, and the quality and type of wine that can be produced. For high quality wines such as those produced in the 12th district, equilibrium between soil, varietal, and climate must be maintained. It is expected that increasing temperatures will lead to a northern shift of wine

growing areas. Increased atmospheric concentrations of carbon dioxide (CO_2) and other greenhouse gases will also affect climatic conditions important for agriculture.

Since climatic factors are critical to the success of agriculture 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 diminished water availability.

Figure 15 Douglas fir (*Psuedotsuga menzeisii*) current and projected distribution through the 21st Century
http://charcoal.cnre.vt.edu/climate/species/

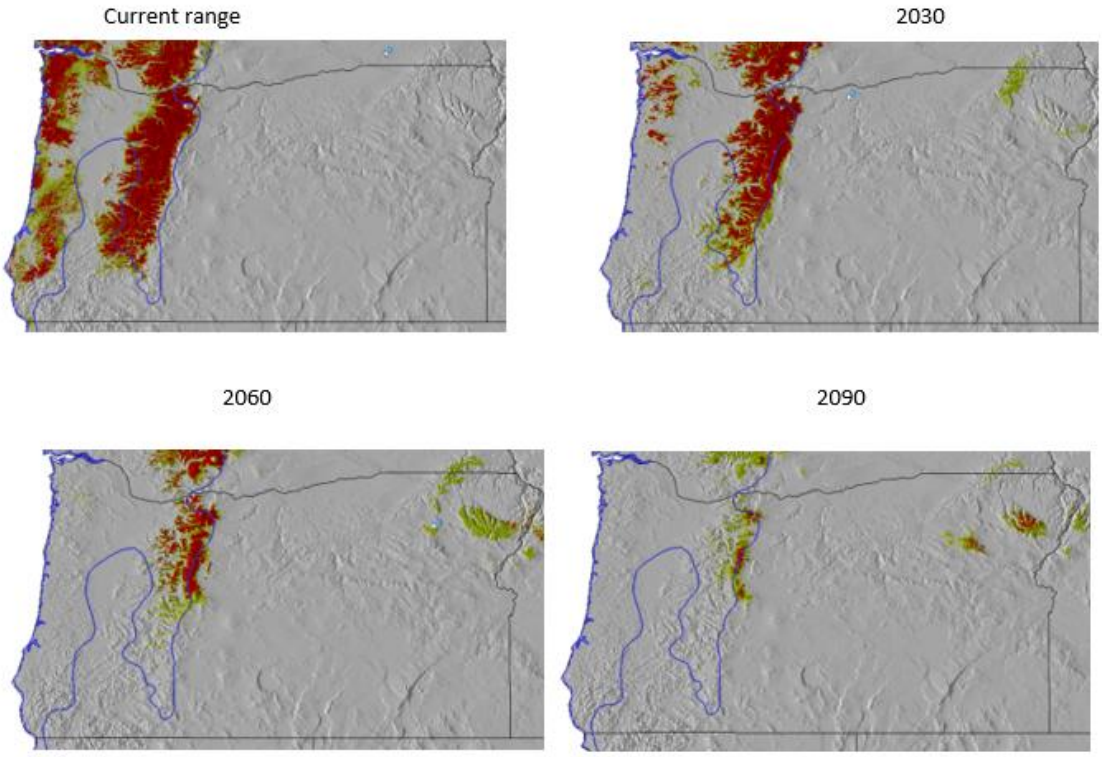


The Siuslaw National Forest has two distinct vegetation zones: Sitka spruce and western hemlock. The Sitka spruce zone contains areas where the coast influence of mild temperatures, winds, and dense fog discourage other types of vegetation. Western hemlock grows well in shade beneath the dense Douglas-fir canopy. As Douglas fir matures, western hemlock takes over. Both zones contain freshwater, upland, offshore, and estuarine habitats that support a wide variety of vegetation, fish, and wildlife.

Future climate projections suggest that the 12th Senate District region may become less suitable for some of the critical forest species currently forming the basis of the logging industry, notably Douglas fir and Western hemlock (Figures 15 and 16). It would behoove those concerned about maintaining such activities in the district to address climate change to prevent these projections playing out to the detriment of our forests. In addition, 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 16 Western hemlock (*Tsuga heterophylla*) current and projected distribution through the 21st Century
http://charcoal.cnre.vt.edu/climate/species/



The continued economic success of the 12th District is substantially dependent on the maintenance of a favorable climate. Should the climate projections for the balance of this century play out; the 12th Senate District will be forced to undertake considerable adaptation to the developing conditions to sustain its economy.

It would behoove governments and representatives throughout the district to be aware of the threat that climate change poses to the traditional economy of Western Oregon, to initiate steps to prepare for these changes, and 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 the 12th Senate District Counties were obtained from local Chamber of Commerce and Wikipedia searches, and Jones, G 2003 Climate and Terroir: Impacts of Climate Variability and Change of Wine.

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 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, 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**
Emissions 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.

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