



## Climate Change in the Oregon 30<sup>th</sup> Senate District

July 2017



### History, Projections, and Consequences

1. The last half of the 20<sup>th</sup> Century witnessed an increase in temperature of about 1°F
2. Projections suggest a further rise of up to 10°F is possible above the late 20<sup>th</sup> Century average during by 2100 creating greater potential for drought and fire
3. Snowfall and snowpack accumulation, already dropping, are projected to dwindle further, possibly to 10% of historic levels by late century.
4. Although annual average precipitation is expected to hold steady, seasonally, winters are expected to be wetter and summers drier, with more heavy downpours.
5. Wildfires already exhibiting a 2.5 month longer season than in the 1970s, are expected to become more serious, with up to 700 percent greater area being consumed by mid-century posing problems for forests and human health.
6. Agriculture will likely suffer due to decreasing supplies of water for irrigation, increasing incidence of pests and disease attacks, and growing competition from weeds threatening local agriculture.
7. 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.
8. Climatic shifts will likely compromise the viability of important forest and timber species in the district.
9. At the current emissions trajectory, we will exhaust our allowance in 17 years if we wish to maintain the global temperature increase below 2°C (3.6°F) as international agreements dictate.
10. The main health impacts: wildfire, drought, and infectious disease. The top health concerns: poor air quality, respiratory illness, occupational hazards, displacement, contaminated drinking water, water insecurity, vector-borne disease, economic instability, and mental health impacts. Vulnerable communities: low-income households, American Indians, private well users, rural households, people working in agriculture, firefighters, first responders, Native Americans, young children and pregnant women.

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Southern Oregon Climate Action Now

# SOCAN

Confronting Climate Change

## Climate Change in the Oregon 30<sup>th</sup> Senate District

Compiled by Elaine Bianchi & Alan Journet

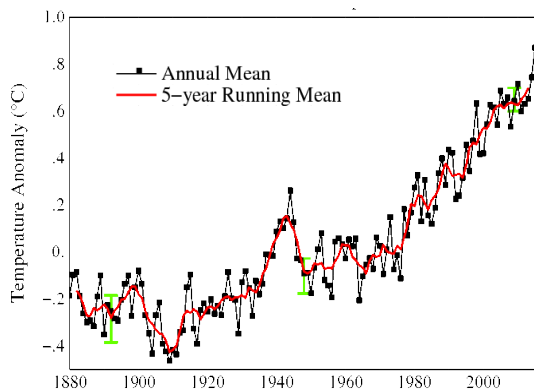
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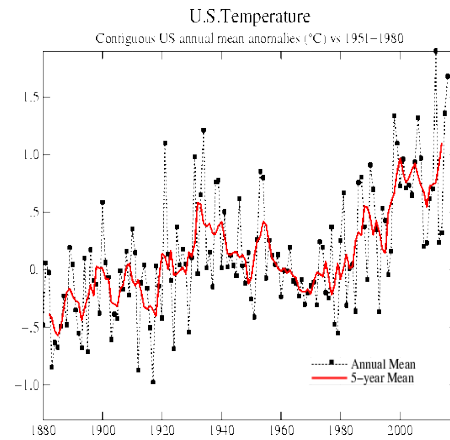
July 2017

### ***Global and Regional Temperature:***

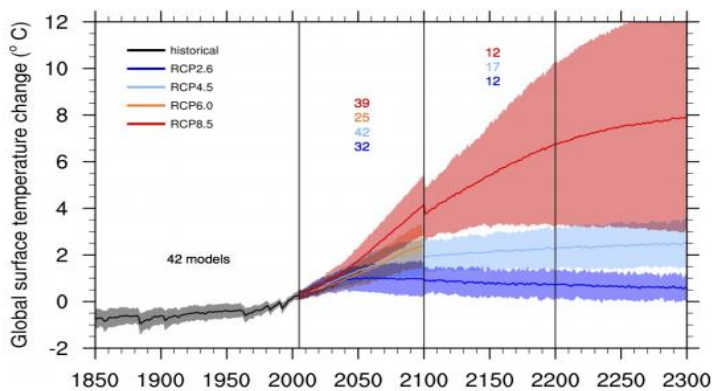
Data from NASA reveal that the Global and U.S. atmospheric temperatures have increased substantially since 1880 (Figures 1 and 2).



**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.

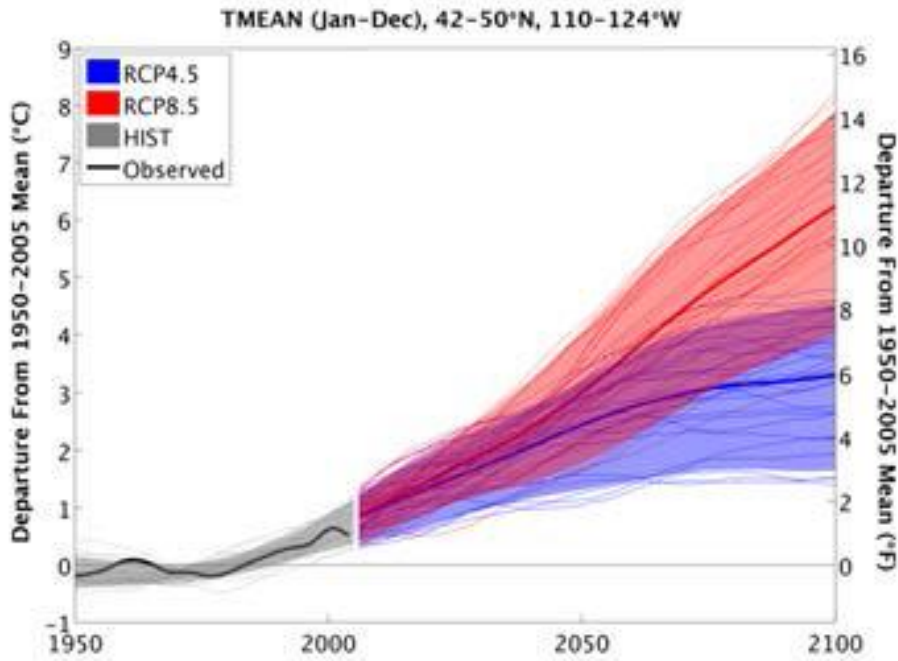


**Figure 3.** Intergovernmental Panel on Climate Change 2013  
global projections.

[http://www.climatechange2013.org/images/uploads/WGIA\\_R5\\_WGI-12Doc2b\\_FinalDraft\\_Chapter12.pdf](http://www.climatechange2013.org/images/uploads/WGIA_R5_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<sup>0</sup>F increase, assuming immediate action, to a high of over a 9<sup>0</sup>F increase. The trajectory beyond the century offers an even more challenging high extreme with an extreme 20<sup>0</sup>F 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<sup>0</sup>F 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.

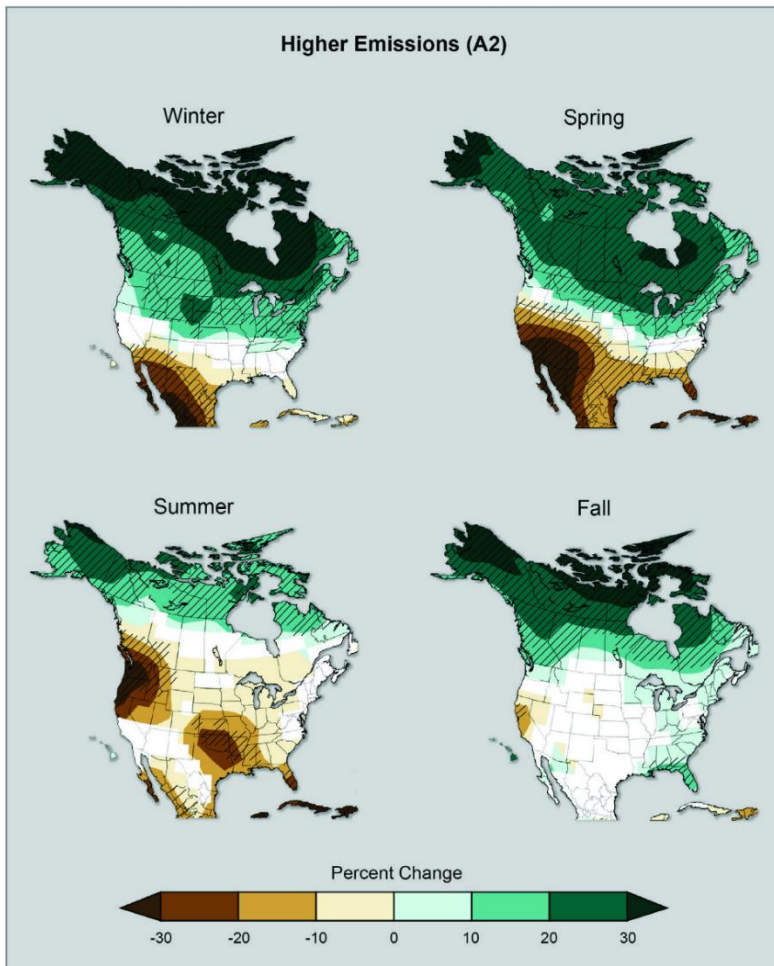
The lower range for continued temperature increase resulting from the greenhouse gases already released is inevitable; for this we will simply have to prepare and adapt.

### ***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.

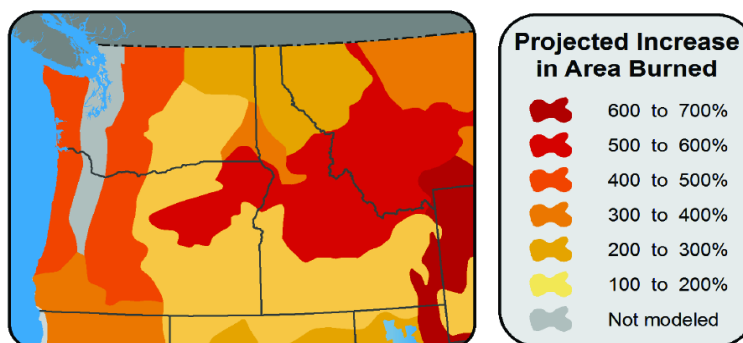
The region generally is expected to exhibit fall and spring seasons that are little different from historical patterns, with winters possibly a little wetter. Notably, however, summers will likely be considerably drier.

Projected Precipitation Change by Season



**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°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°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 °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°C (approximately 37°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 30th Oregon Senate District Climate History and Projections***

Historic and Projected Temperature for Baker County, typical of Senate District 30 (Figure. 7) indicate about a 1<sup>0</sup>F rise during the latter half of the 20th Century. Projections are based on the Business as Usual scenario of continued accelerating fossil fuel use and greenhouse gas emissions (red line) and a substantially lowered emissions trajectory (blue line). By the end of this century, the temperature rise may be 10<sup>0</sup>F above the average for the last half of the 20<sup>th</sup> Century.

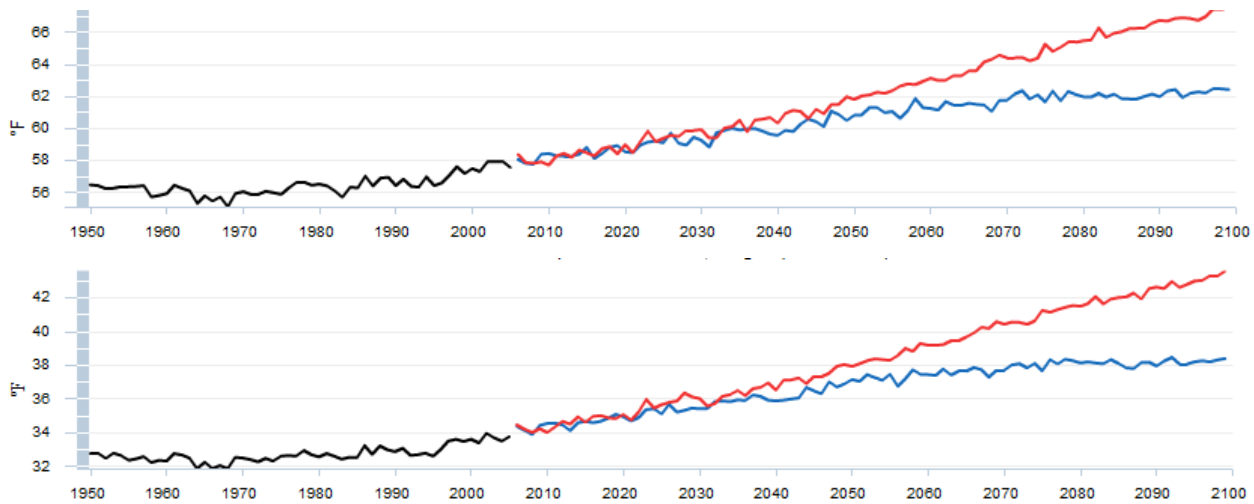


Figure 7. Temperature history and projections for Baker County (upper mean maximum, lower mean minimum) representing District 30 (USGS 2017).

The rising temperature trend grades from the 7 - 8<sup>0</sup>F range above late 20th century average for coastal Oregon to some 10<sup>0</sup>F above that average for Eastern counties.

Though precipitation (Figure 8) will likely not change much on average, greater bvariability is likely with wetter and drier years. The seasonal pattern depicted in Figure 5 suggests drier summers. Combined with gthe higher summer temperatures this will create greater potential for drought resulting in an increased fire risk and length of fire season.

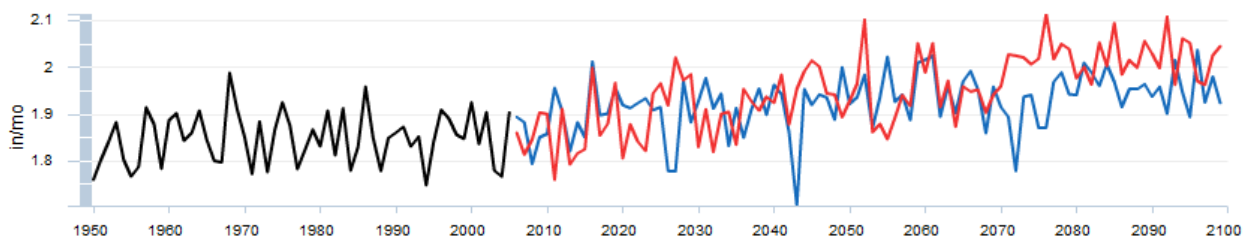


Figure 8. Historic and projected precipitation patterns for Baker County (USGS 2017).

## Oregon Senate District 30 Climate Summary

Snowfall and consequent snowpack accumulation depicted for Harney County (Figure 9.) have been on the decline and will likely continue to do so through the century.

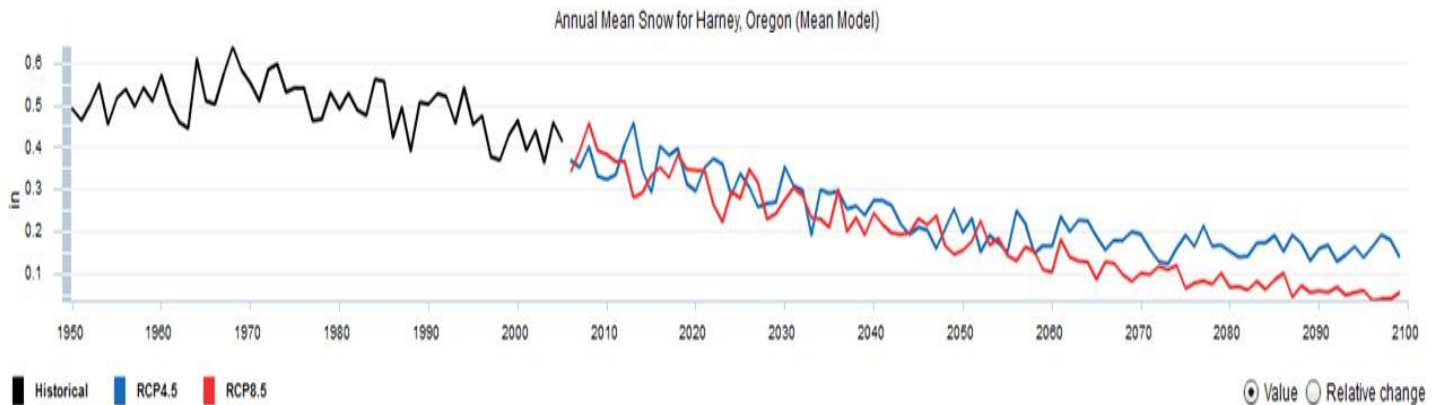


Figure 9. Historic and projected snowfall trends in Harney County, (USGS 2017)

Dwindling snowfall and rising temperatures will likely compromise the already fluctuating lakes of Eastern Oregon's Northern Great Basin And Range ecoregion. Wetlands such as Malheur Lake and the lakes of the Warner Valley are likely to be more compromised than has historically been their pattern. Basins in the east of the Cascades are projected to have low summer flow in the future as groundwater recharge declines over time. Lower order streams in transient rain-snow basins and in semi-arid eastern Oregon will be the most vulnerable to rising summer air temperature and diminished low flow.

### ***Federal Congressional District Historical Temperature Trend:***

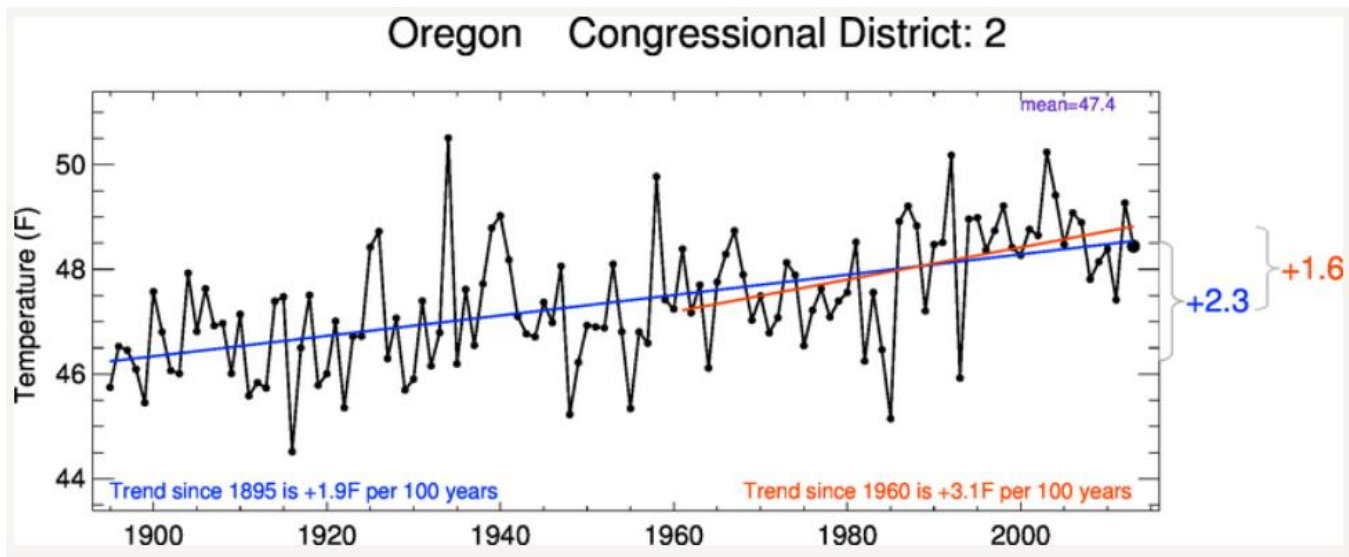


Figure 10. Average temperature trend within the 2<sup>nd</sup> Federal Congressional District.

<http://www.temperaturetrends.org/district.php?district=2&state=OR>.

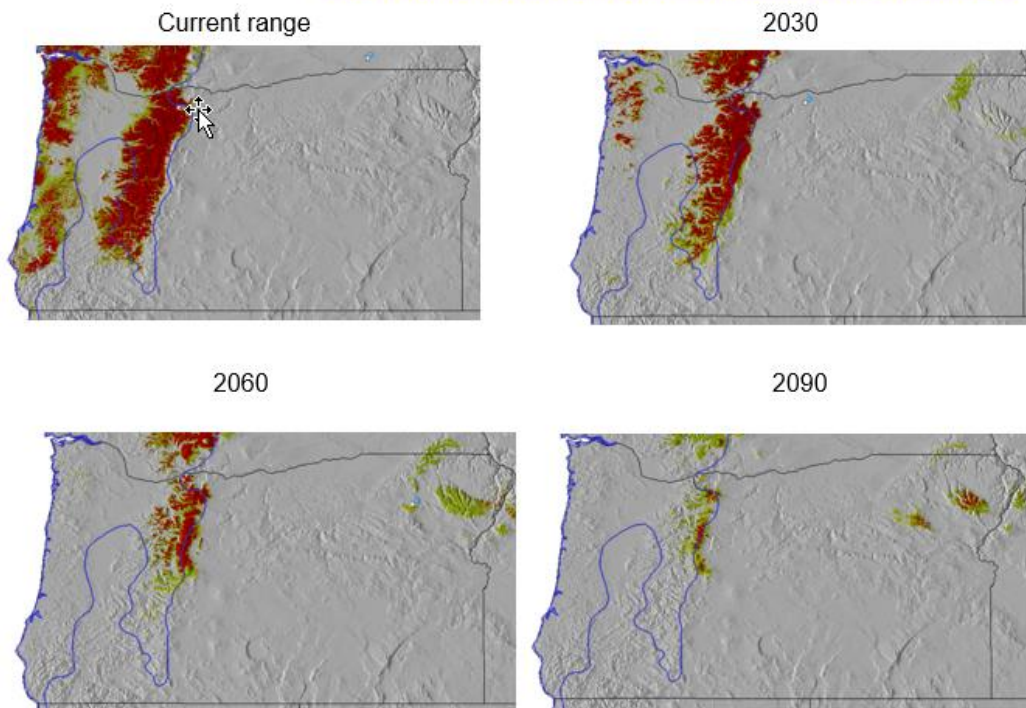
Since the Oregon Senate 30th District falls within the Second Federal Congressional District, it is instructive to see how historic patterns have fared across that district.

The data indicates (Figure 10) that the second Congressional District has been warming at a rate of  $1.9^{\circ}\text{F}$  per century, a rate faster than that of Oregon as a whole ( $1.2^{\circ}\text{F}$  per century) but slower than the United States average rate of  $2.2^{\circ}\text{F}$  for the century. This district is not immune from the consequences of climate change.

### ***Oregon's 30th Senate District Economy:***

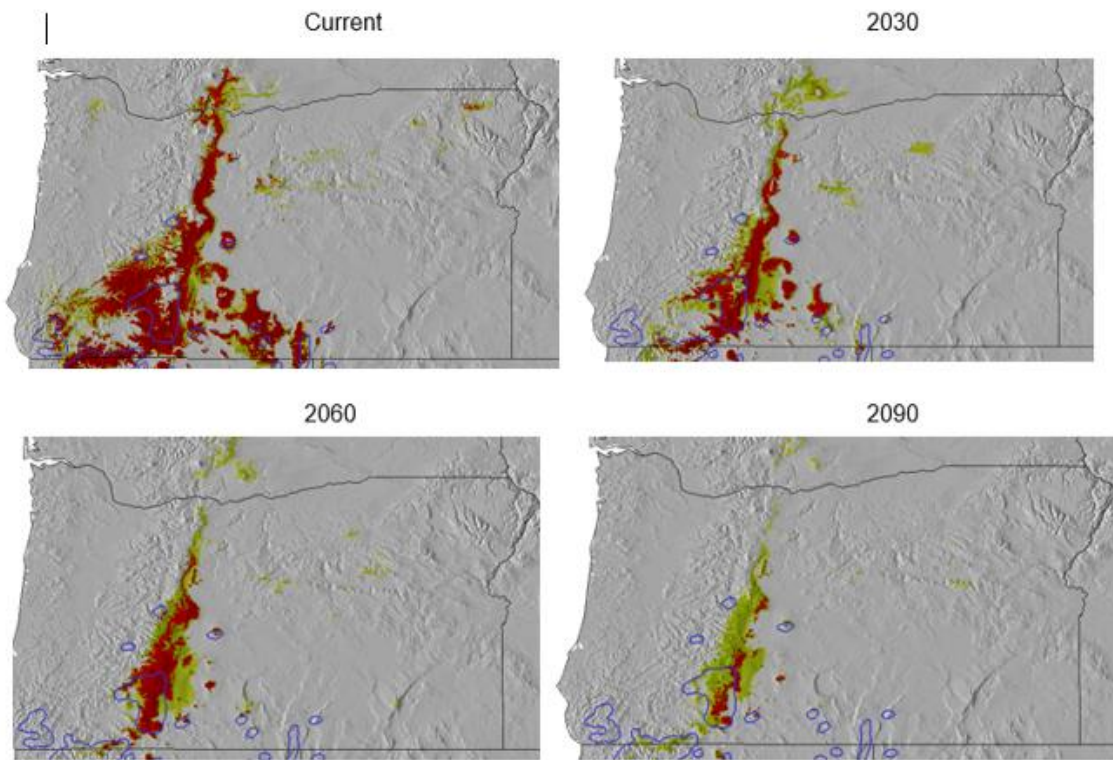
The dominant component of the local economy of Senate District 30 is agriculture, which will likely be threatened as climate change proceeds. Decreasing supplies of water for irrigation, increasing incidence of pests and disease attacks, and growing competition from weeds will probably be the main problems. Timber harvesting and milling is also important to the 30th District's economy. A wide range of harvestable species are commercially important in this large rural District, including: Western hemlock, Alpine and White fir, Incense cedar, and Lodgepole pine, Ponderosa pine, and Douglas fir. The current range and projected range (red represents optimal and green sub-optimal conditions) of these species through this century are presented in Figures 11 - 17): purple indicates high viability, green medium viability and colorless zero viability (Rehfeldt *et al.* 2006). Collectively these projections suggest an

**Figure 11. Western hemlock (*Tsuga heterophylla*) current and projected distributions.** <http://forest.moscowfsi.wsu.edu/climate/species/index.php>



imminent threat to commercial timber production in the District compromising such entities as Malheur Lumber Co., Bright Wood Corporation, Fremont Sawmill, Grant Western Lumber Company. 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

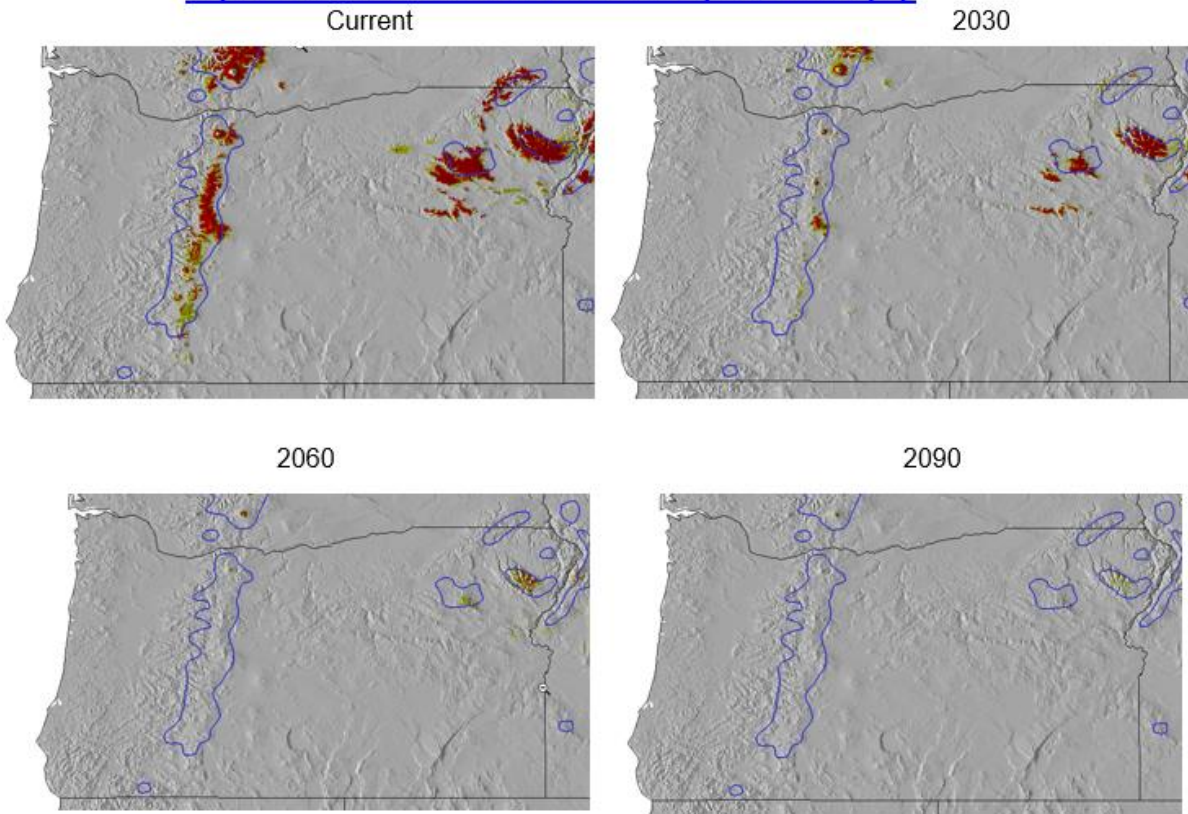
**Figure 12 White fir (*Abies concolor*) Current and Projected distribution**  
<http://charcoal.cnre.vt.edu/climate/species/>



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 bark beetles and other insects. These attacks can increase fire risk and reduce timber production.

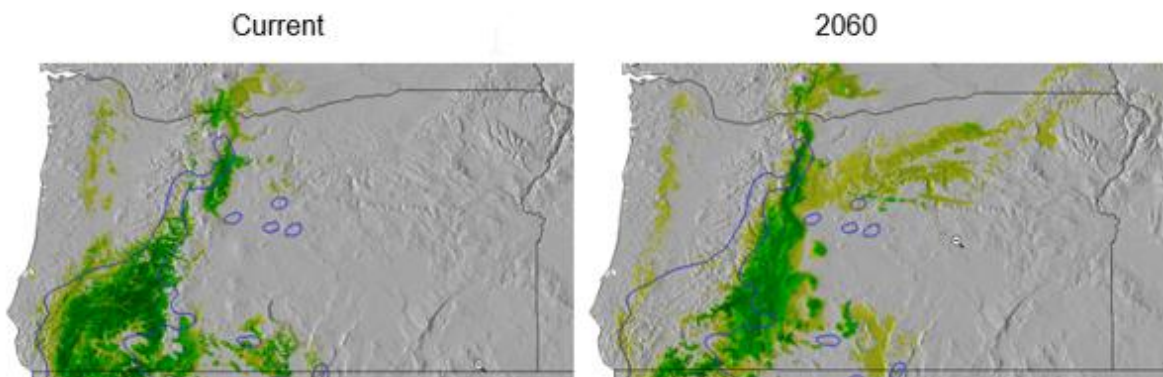
**Figure 13 Subalpine fir (*Abies lasiocarpa*) current and projected distributions**

<http://forest.moscowfsi.wsu.edu/climate/species/index.php>



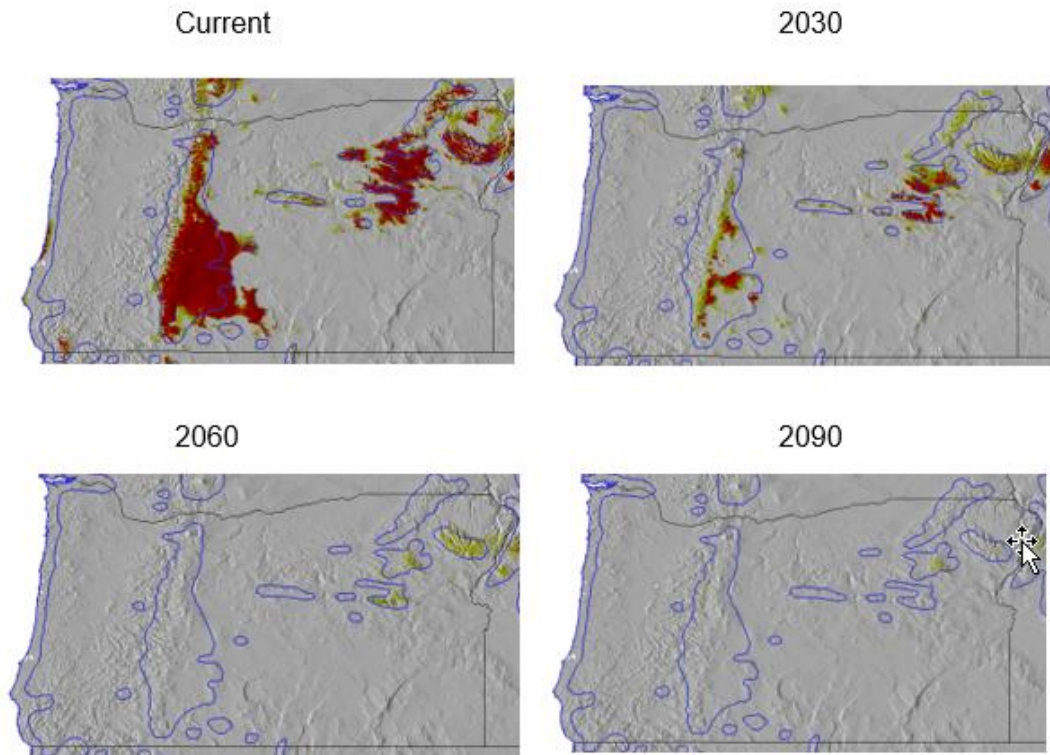
**Figure 14 Incense cedar (*Calocedrus decurrens*) Current and Projected distribution**

<http://charcoal.cnre.vt.edu/climate/species/>



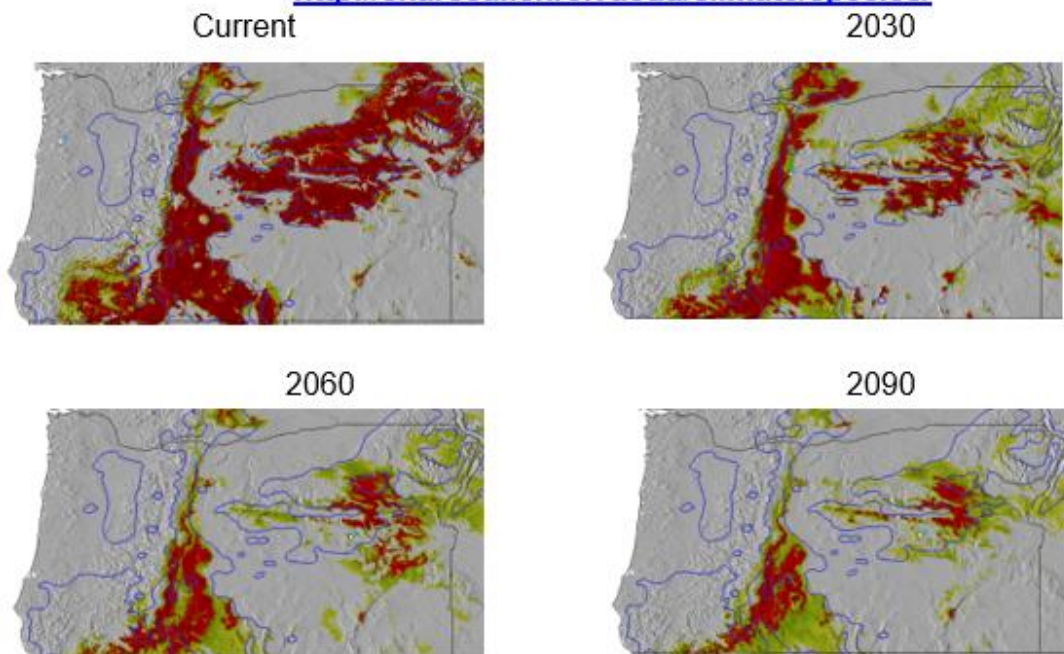
**Figure 15 Lodgepole pine (*Pinus contorta*) current and projected distribution through the 21<sup>st</sup> Century**

<http://charcoal.cnre.vt.edu/climate/species/>



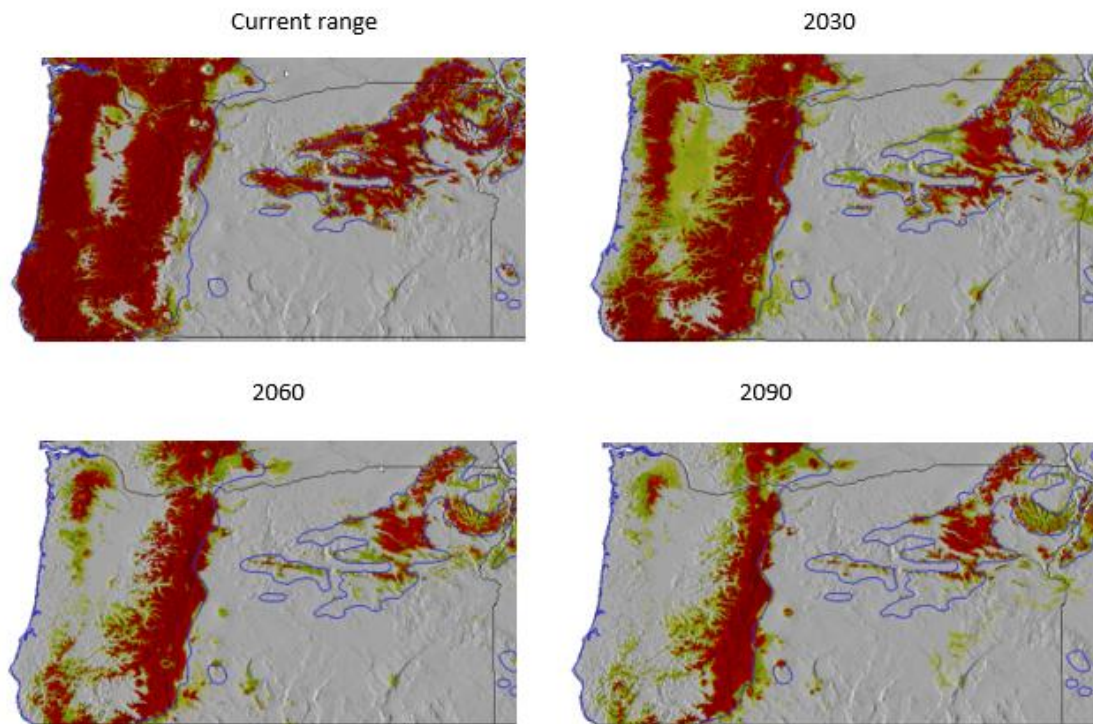
**Figure 16 Ponderosa pine (*Pinus ponderosa*) Current and Projected Distribution through the 21<sup>st</sup> Century**

<http://charcoal.cnre.vt.edu/climate/species/>



**Figure 17 Douglas fir (*Psuedotsuga menzeisii*) current and projected distribution through the 21<sup>st</sup> Century**

<http://charcoal.cnre.vt.edu/climate/species/>



Outdoor recreation, popular in District 30, is extremely dependent on the natural resource base and the weather. Impacts from climate change will vary among leisure activities. 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 with reduced snowpack poses a threat to winter activities such as cross-country and downhill skiing, snow shoeing, skating, ice fishing, etc. 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.

Since much of Oregon's 30<sup>th</sup> Senate District lies on the edge of the Great Basin, trends for that region are relevant. Water resources are expected to enjoy enhanced winter stream flow but suffer negatively from lower summer stream flow. Warmer winters will delay the start of winter sports seasons, shorten the season, and increase the likelihood of rain.

***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: wildfire, drought, and infectious disease. The top health concerns will be: poor air quality, respiratory illness, occupational hazards, displacement, contaminated drinking water, water insecurity, vector-borne disease, economic instability, and mental health impacts. Communities that will be especially vulnerable will be: low-income households, American Indians, private well users, rural households, people working in agriculture, 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°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).

<b>Table 1 Carbon Dioxide Emissions and Temperature Consequences</b>		
<b>Emissions</b>	<b>Gigatons CO<sub>2</sub> added to atmosphere</b>	<b>Temperature increase</b>
<b>1850 – 2000</b>	<b>1035</b>	<b>0.8°C</b>
<b>2000 – Now</b>	<b>440</b>	<b>1.5°C</b>
<b>Allowed</b>	<b>825</b>	<b>2°C</b>
<b>Fossil Fuel Reserves</b>	<b>725</b>	<b>3 - 4°C</b>
<b>Accessible Reserves</b>	<b>780</b>	<b>5 - 6°C</b>
<b>Additional Reserves</b>	<b>1280</b>	<b>??</b>

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°C to 1.6°C (2.7 - 2.9°F) (Dixon 2001). If we wish to avoid an increase over 2°C the math tells us that we can only allow another 825 gigatons (billions of tonnes) 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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