Southern Oregon Climate Action Now

SOCAN

Confronting Climate Change

Climate Change in the Oregon 27th Senate District

July 2017

History, Projections, and Consequences

1. During the last half of the 20th Century, the temperature of this District increased about 1°F. From that average, projections suggest a further increase of 10°F is possible.
2. Precipitation has been essentially level on average but variable, and is expected to continue that trend, but with greater variability, and drier summers- suggesting a greater threat of summer drought.
3. Snowpack is expected to continue its decline, further compromising summer and fall water supply.
4. The fire season, already 2.5 months longer than 1970, is expected to consume from two to four times the area that historically burned by mid-century.
5. Since the economy of the 27th District is heavily dependent upon climate sensitive tourism, timber, and to a lesser extent, agriculture, the impact of future potential climate conditions will likely range from economically disruptive to extremely severe.
6. This region contains a sustainable, renewable geothermal power source which is little affected by climatic conditions but which can contribute to reducing the emissions of warming gases.
7. Snowfall, already declining, is expected to plummet by late century compromising irrigation. Mt. Bachelor, the third largest employer in Bend, will be affected by dwindling snowpack.
8. Partly due to its climate and recreational opportunities, Deschutes County with its high desert and dry climate has the fastest growing population among Oregon counties. Summer and winter recreation will need to adapt to face climatic changes.
9. Five resorts are numbered among Deschutes County's top ten taxpayers. Climate change will affect the economic input of these resorts.
10. There are a significant number of microbreweries in the district (24) for which water availability is critical. A decrease in precipitation can lead to a decrease in resources for the breweries, and in turn, for the district.
11. 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.
12. Main climate health impacts will likely 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. Vulnerable communities 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.

Compiled by Janel L. Lajoie janel.lajoie7@gmail.com (541-821-2222) and Alan Journet alanjournet@gmail.com (541-301-4107) June, 2014.

For a more complete summary, including sources, from which these points are taken, visit:
http://socan.eco/oregon-legislative-districts/

This Page Intentionally Left Blank

Southern Oregon Climate Action Now

SOCAN

Confronting Climate Change

Climate Change in the Oregon 27th Senate District

Compiled by

Janel L. Lajoie janel.lajoie7@gmail.com (541-821-2222) and

Alan Journet (alanjournet@gmail.com, 541-301-4107)

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).

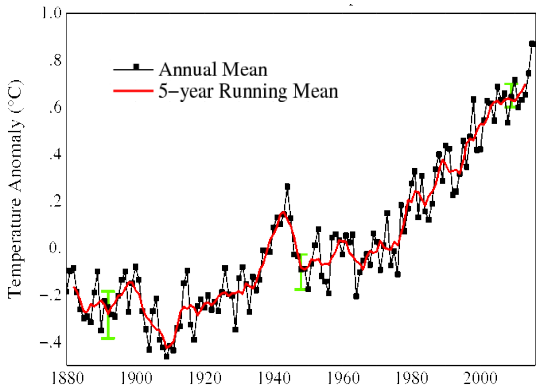


Figure 1. Historic global temperature trend NASA Goddard Institute for Space Studies 2017.

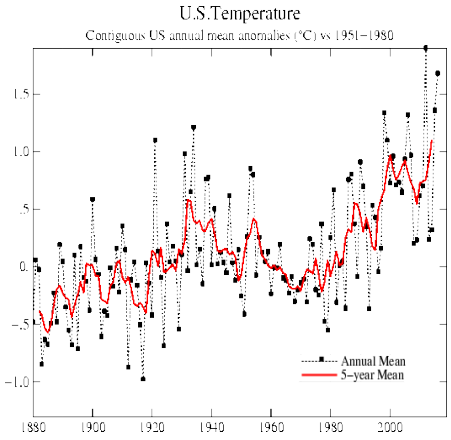


Figure 2. Historic U.S temperature trend. NASA Goddard Institute for Space Studies 2017.

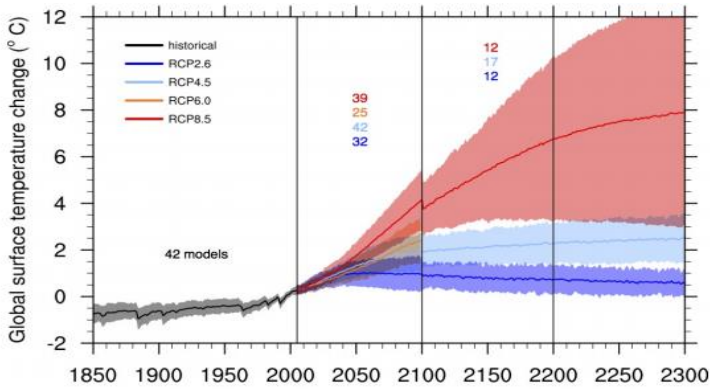


Figure 3. Intergovernmental Panel on Climate Change 2013 global projections. http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter12.pdf

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.

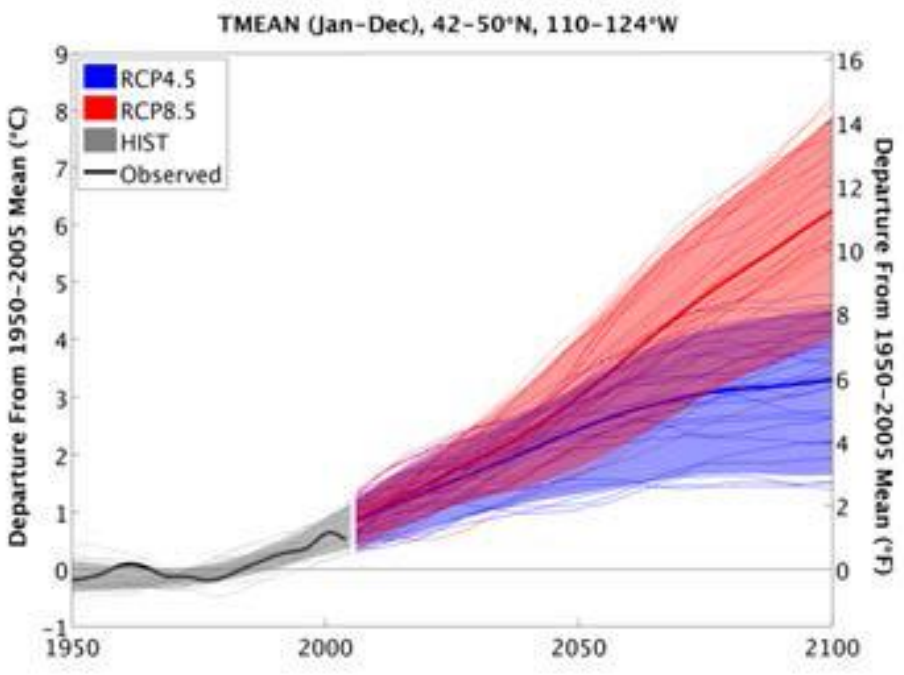


Figure 4. Oregon temperature history and projections through the century (Dalton *et al.* 2013).
http://library.state.or.us/repository/2010/201012011104133/summaries.pdf

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.

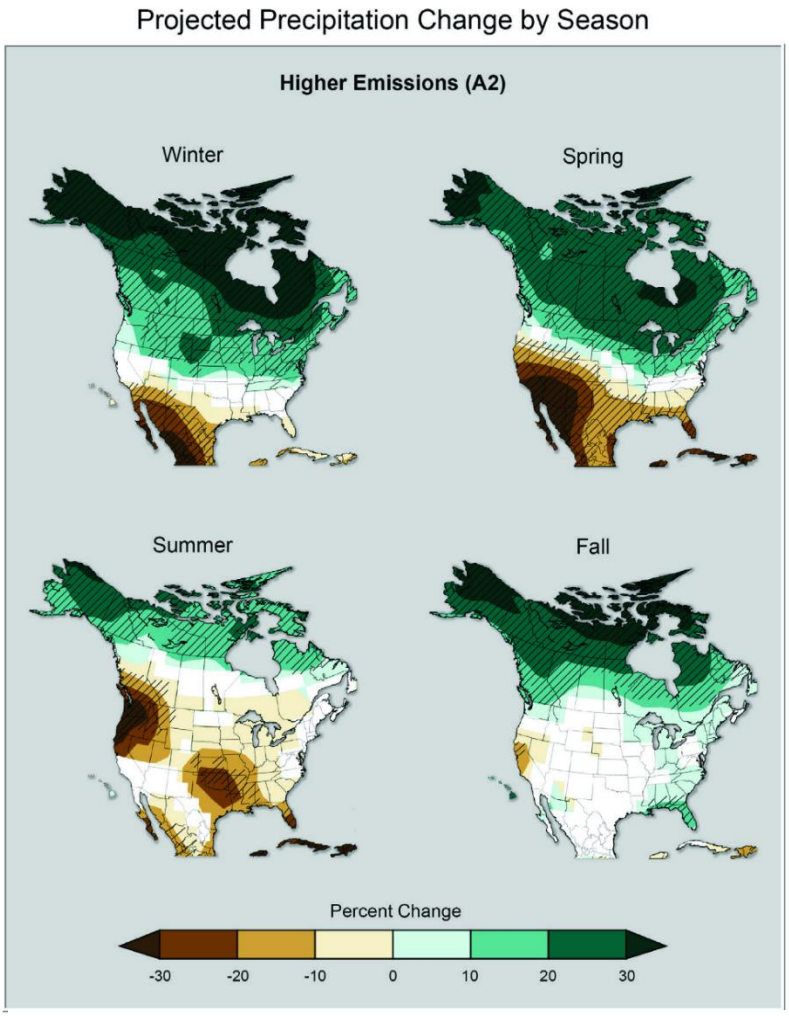


Figure 5. Projected precipitation patterns in the U.S. comparing 2071 – 2099 to the 1900 – 1960 average (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

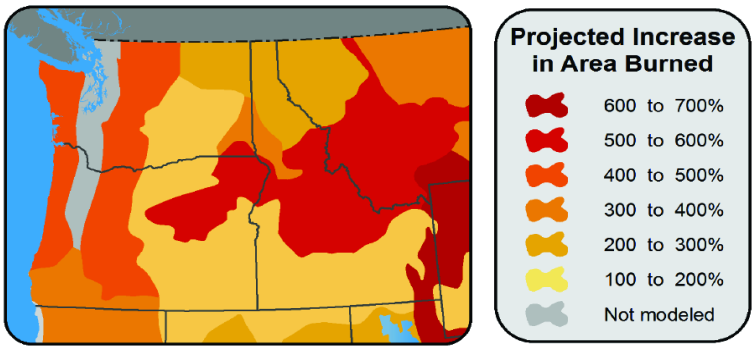


Figure 6. Anticipated wildfire consequences of a 2.2^{o}F warming in area burned (Melillo *et al.* 2014). http://www.globalchange.gov/what-we-do/assessment

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 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! 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.

Oregon 2nd Congressional District Historic Temperature Trend cf Oregon and U.S:

Since the Oregon Senate 27th District falls within the 2nd Federal Congressional District, it is instructive to see how historic patterns have fared across that district.

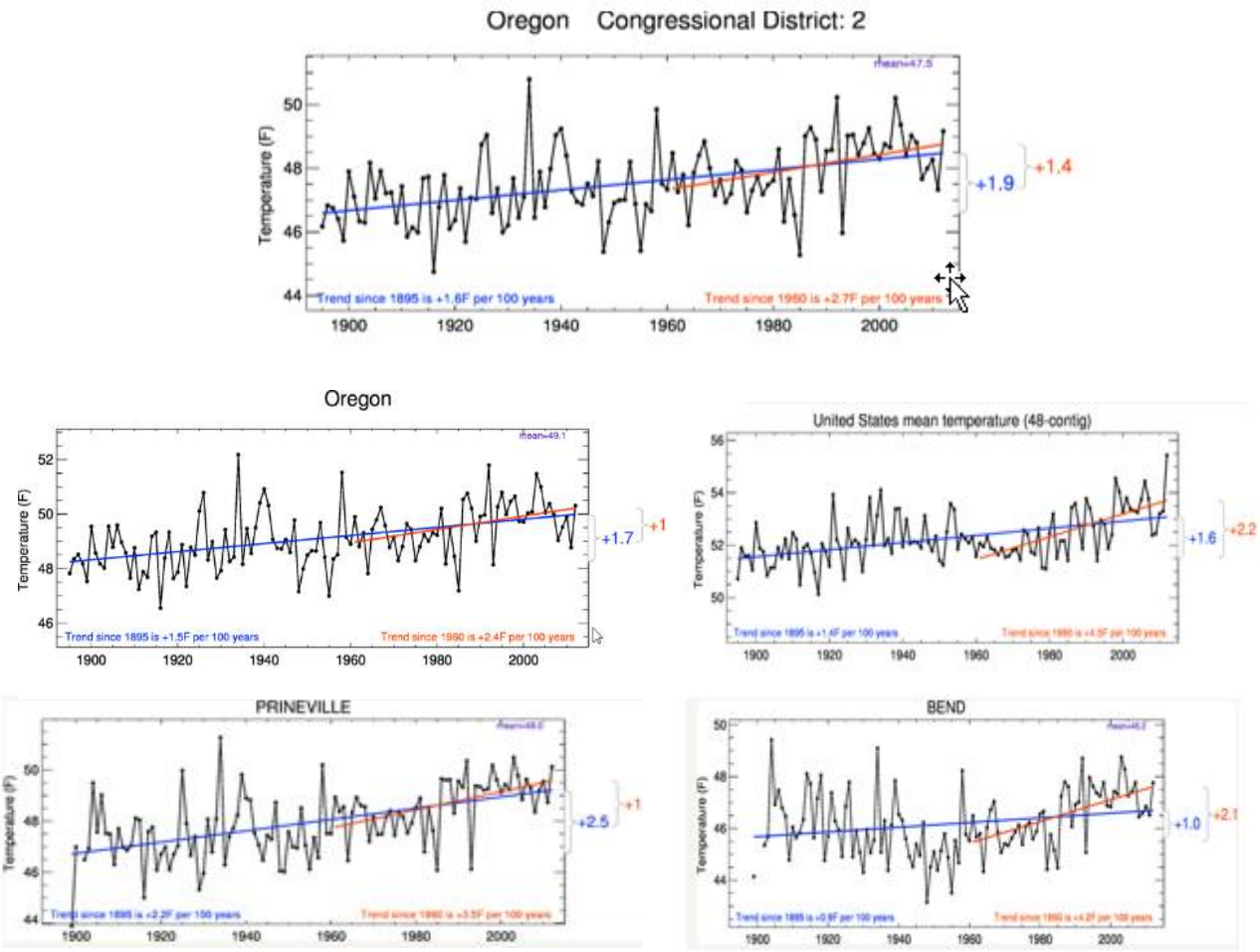


Figure 7. Temperature trends through the Second US Congressional District
http://temperaturetrends.org/global.php?district=2&state=OR
and http://wundergound.com/.

The data indicate that the 2nd Congressional District as a whole has been warming at a rate of 1.4°F per century (Figure 7), 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 district is not immune to the consequences of climate change as can be seen by the warming rate of Bend, Oregon at 2.2°F for the century.

The 27thOregon Senate District Climate History and Projections

The temperature trend for Deschutes County (Figure 8) depicts a rise of about 1.0°F over the second half of the last century with a projected rise of a further 10 °F from that average by the end of this century according to the Business as Usual future of increasing fossil fuel use and

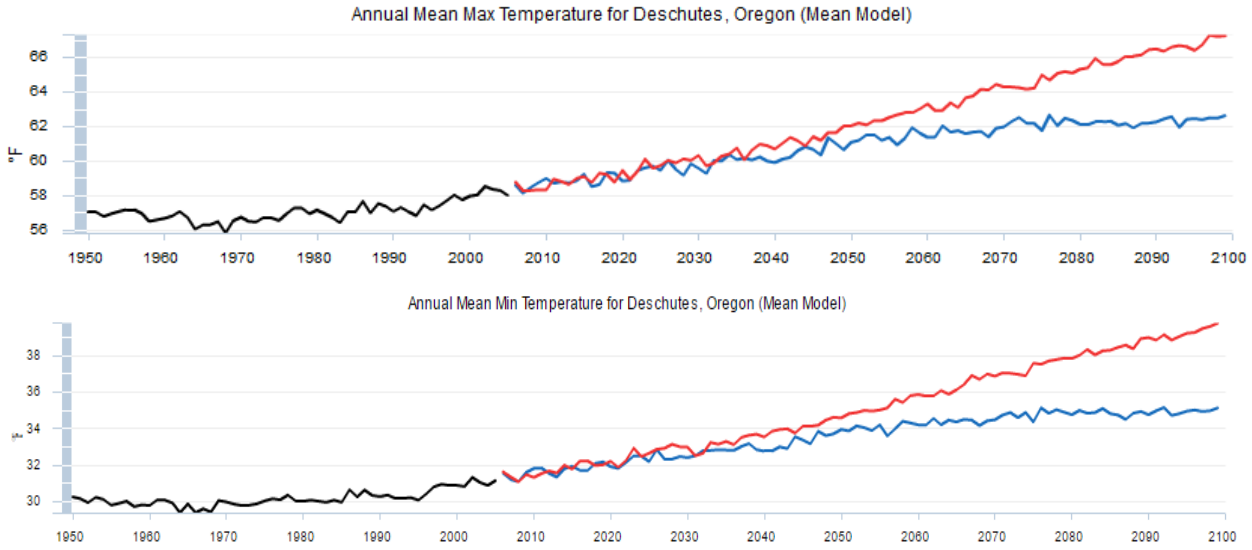


Figure 8. Historic and projected average maximum and minimum temperature trends for Deschutes County (USGS 2017).

greenhouse gas emissions (red line). Meanwhile, with a lowered emissions trajectory, the temperature increase will likely also be reduced (blue line).

The rising temperature trend grades from the 7 - 8^{o}F range above late 20th century average for coastal Oregon to some 10^{o}F above that average for Eastern counties.

Precipitation history and projections (Figure 9) indicate no change regardless of scenario. However, it is also important to appreciate that the combination of level precipitation and higher temperatures will cause greater evaporation and thus induce extended droughts, particularly during the anticipated dryer summer growing season. Additionally, the wetter winters and drier summers (Figure 5, above) will further compromise agriculture.

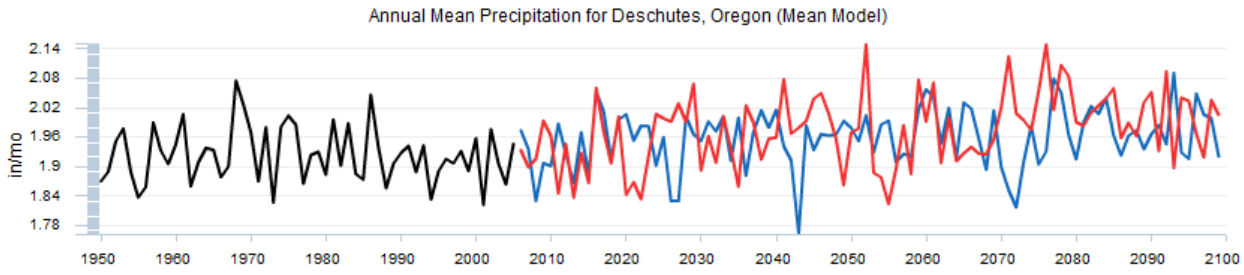


Figure 9. Historic and projected precipitation trends for Deschutes County (USGS 2017).

Meanwhile, historic snowfall records for Deschutes County (Figure 10) show a decrease since the 1970s with a reduction projected to some 10% of last century averages by the end of the century assuming the business as usual scenario, though somewhat less of a reduction if emissions reductions are undertaken. These trends, in combination, will negatively affect both summer and winter recreational opportunities, and agriculture.

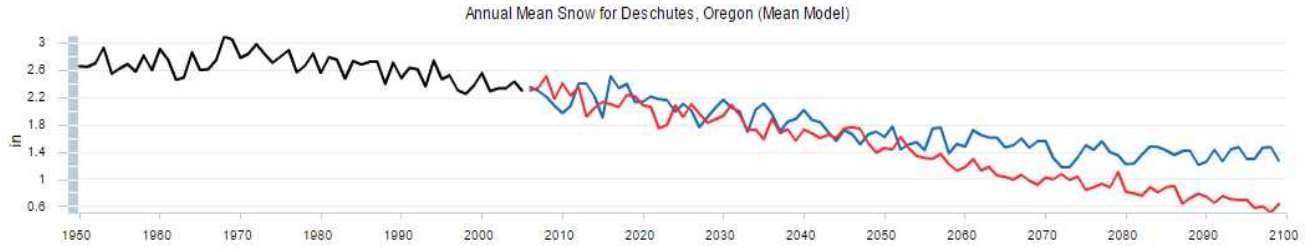
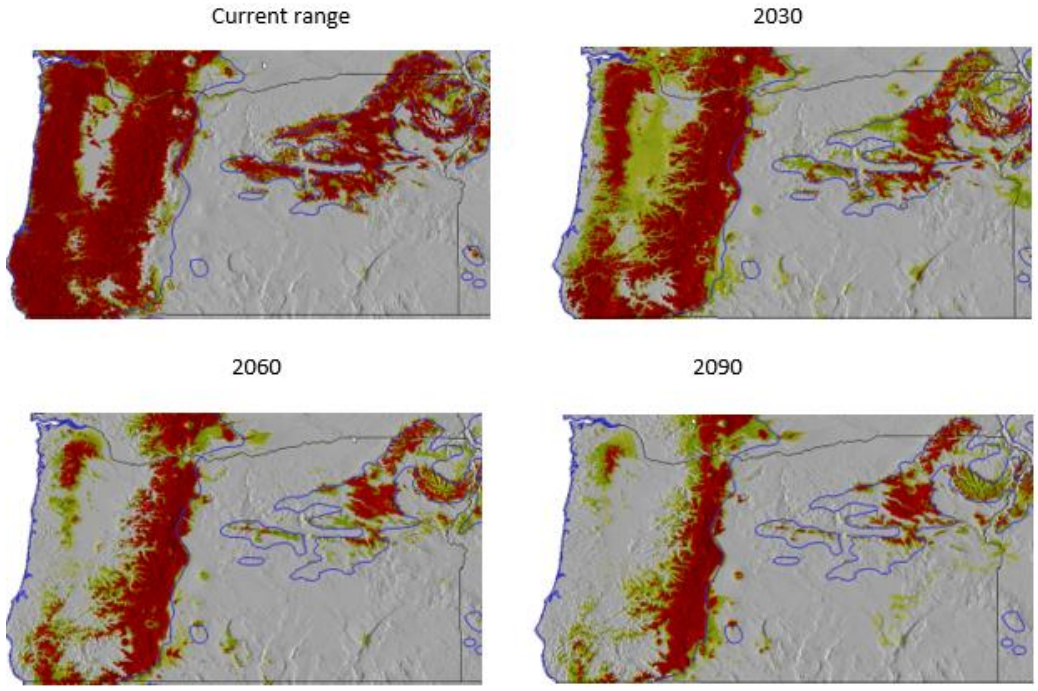


Figure 10. Snowfall trend and projections for Deschutes County, Oregon. Red represents the 'business as usual' future scenario, while blue assumes we reduce emissions considerably.
http://www.usgs.gov/climate_landuse/clu_rd/apps/nccv_viewer.asp

District Economy:

The economy of the 27th Senate district is rooted primarily in tourism, agriculture, and forestry. The district's economy was once based on agriculture, timber harvesting, and wood processing, but as lumber mills began to close, tourism and recreational activities became the economic backbone of the county. The snowfall patterns depicted above would likely compromise the winter recreation activities of the region.

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



The dominant commercial tree species in the region are: Douglas fir, Ponderosa pine, Grand fir/White fir, Lodgepole pine, Western larch, Shasta red fir in south, Sugar pine (low number). Projections for future distributions of four of these species in Oregon are depicted in Figures 11 – 14. Posing an economic challenge for the timber industry, the future for many of these species in the region is threatened.

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

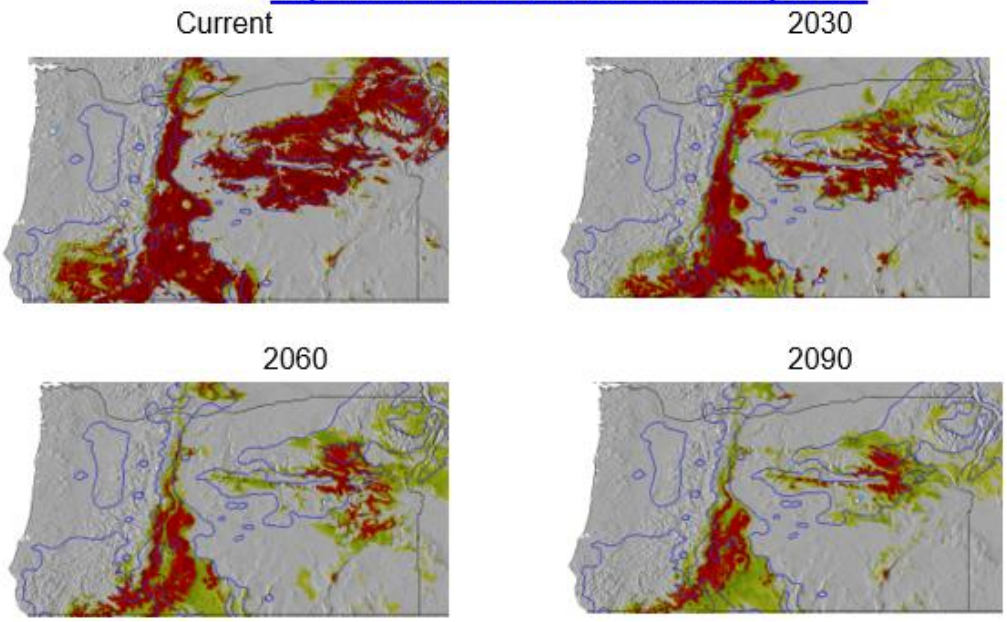
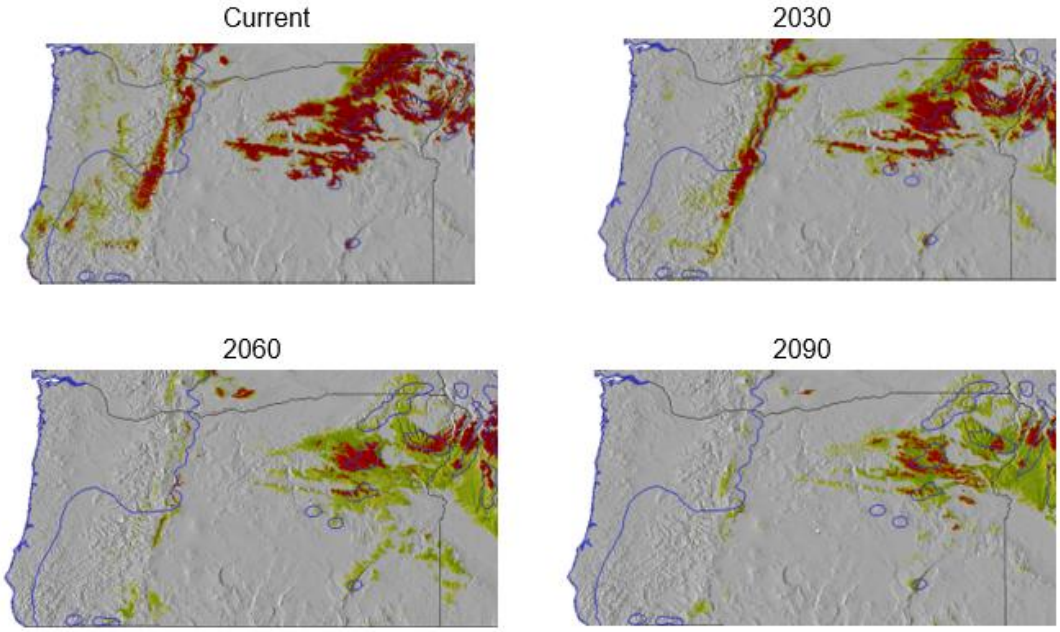
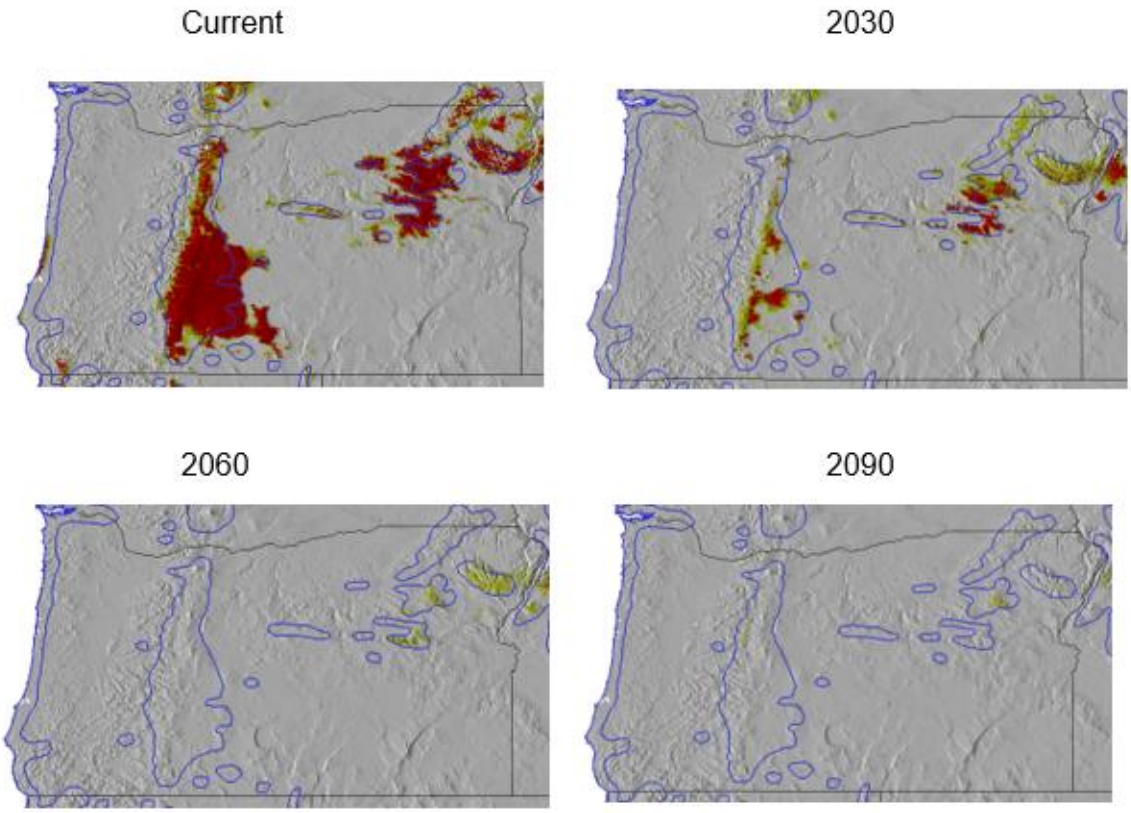


Figure 13 Grand fir (*Abies grandis*) Current and Projected Distributions
http://forest.moscowfsl.wsu.edu/



An economic study for Oregon Department of Fish and Wildlife and Travel Oregon found that nearly $79 million was spent in Deschutes County in 2008 on fishing, hunting, and wildlife viewing alone. The ongoing health of our natural ecosystems is pertinent to retaining that revenue stream.

Figure 14 Lodgepole pine (*Pinus contorta*) current and projected distribution through the 21st Century
http://charcoal.cnre.vt.edu/climate/species/



The region boasts over 300 sunny days per year, and during summer visitors enjoy activities such as hiking, mountain biking, rock climbing, camping, golfing, boating, rafting, and sightseeing. In the winter months, downhill and cross-country skiing, snowshoeing, snowboarding, and snowmobiling are all popular activities. Both summer and winter tourist activities will be affected by climate change by compromising the basis for tourism in the region.

This region of Oregon contains a sustainable, renewable geothermal power source which is little affected by climatic conditions. Mt. Bachelor is the third largest employer in Bend, and will certainly be affected by the expected dwindling snowpack. Since 1900 there has been an average of a 15.5 inch decrease in snow pack per century for the Bend area. Deschutes County with its high desert and dry climate has the fastest growing population in Oregon, partly due to its recreational opportunities. Summer and winter recreation will need to adapt to face climatic changes. Five resorts number among the top ten taxpayers of Deschutes County; climate change consequences will undoubtedly affect the economic success of these resorts. Many microbreweries exist in the district (24). Availability of water is critical to their operation; a decrease in precipitation and snowpack will lead to a decrease in water resources for the breweries, and in turn, for the district.

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.

The continued economic success of the 27th District is substantially dependent on the maintenance of a favorable climate. Should the climate projections for the balance of this century play out; the 27th Senate District will be forced to undertake considerable adaptation to the developing conditions in order to sustain its economy.

It would behoove governments and representatives throughout the district to be aware of the threats that climate change poses to the traditional economy of Central 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 and geothermal energy and discouraging carbon emissions.

Information on the primary economic activities of 27th Senate District Counties were obtained from 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 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: 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, 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).

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°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 tons) of Carbon dioxide and equivalent emissions. Given that the current annual rate of global

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

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.

Contact your Representative: Tim Knopp

Capitol Phone: 503-986-1727
Capitol Address: 900 Court St NE, S-309, Salem, OR, 97301
Email: sen.timknopp@state.or.us
Website: http://www.oregonlegislature.gov/knopp

House District 53: Representative Jack Zika

Capitol Phone: 503-986-1453
Capitol Address: 900 Court St NE, H-387, Salem, OR 97301
Email: Rep.JackZika@oregonlegislature.gov
Website: http://www.oregonlegislature.gov/zika

House District 54: Representative Cheri Helt

Capitol Phone: 503-986-1454
Capitol Address: 900 Court St NE, H-371, Salem, OR 97301
Email: Rep.CheriHelt@oregonlegislature.gov
Website: http://www.oregonlegislature.gov/helt

Literature:

Dalton, MM., PW. Mote, and A.K. Snover [Eds.] 2013. *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities.* Washington, DC: Island Press, 230 pp.

Dixon 2001 Global Warming Commitment: Temperatures Would Rise Even with No Further Additional Greenhouse Gas Increases. NOAA. http://www.gfdl.noaa.gov/cms-filesystem-action?file=/user_files/kd/pdf/onepageb01.pdf

IEA 2009, *World Energy Outlook*, International Energy Agency, Paris, France, 691 pp.

IPCC 2013. Climate Change 2013: The Physical Science Basis; Summary for Policymakers WGI IPCC Switzerland.

Le Quéré C, Moriarty R. Andrews R, Peters G, Ciais P, Friedlingstein P, Jones S, Sitch S, Tans P, Arneth A, Boden T, Bopp L, Bozec Y, Canadell J, Chevallier F, Cosca C, Harris I, Hoppema M, Houghton R, House I, Johannessen T, Kato E, Keeling R, Kitidis V, Klein Goldewijk K, Koven C, Landa C, Landschützer, Lenton A, Lima I, Marland G, Mathis J, Letzl N, Nojiri Y, Olsen A, Ono T, Peters W, Pfeil B, Poulter B, Raupach M, Regnier P, Rödenbeck C, Saito S, Salisbury J, Schsuter U, Schwinger J, Séférian R, Segcshneider J, Steinhoff T, Stocker B, Sutton A, Takahashi T, Tilbrook B, van der Werf G, Viovy N, Wang Y 2014 Global Carbon Budget 2014 Earth System Science Data 7: 521-610.

Melillo, JM., TC. Richmond, and GW Yohe, [Eds.] 2014: *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

Miller SM, Wofsy SC, Michalak AM, Kort EA, Andrews AE, Biraud SC, Dlugokencky EJ, Eluskiewicz J, Fischer ML, Janssens-Maenhout G, Miller BR, Miller, JB, Montzka SA< Nehkorn T, Sweeney C. 2013, Anthropogenic emissions of methane in the United States. Proceedings of the National Academy of Science, 110 (50) http://calgem.lbl.gov/Miller-2013-PNAS-US-CH4-Emissions-9J5D3GH72.pdf.

NASA Goddard Institute for Space Studies July 2017 *GISS Surface Temperature Analysis.* Retrieved from NASA Goddard Institute for Space Studies: https://data.giss.nasa.gov/gistemp/graphs_v3/Fig.A2.gif and http://data.giss.nasa.gov/gistemp/graphs_v3/Fig.D.gif

Oregon Health Authority 2014, Oregon Climate and Health Profile Report, Climate and Heath Program, Public Health Division, Oregon Health Authority: Summary provided by Emily York MPH, Climate & Health Program Coordinator, Oregon Public Health Division, Oregon Health Authority.
http://public.health.oregon.gov/HealthyEnvironments/climatechange/Documents/oregon-climate-and-health-profile-report.pdf

Quick M, 2014 How Many Gigatons of Carbon Dioxide…?
http://www.informationisbeautiful.net/visualizations/how-many-gigatons-of-co2/

UN 2009 United Nations Framework Convention on Climate Change: Copenhagen Accord. United Nations, Stockholm, Sweden.
http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

USGS 2017 National Climate Change Viewer (NCCV) United States Geological Survey
https://www2.usgs.gov/climate_landuse/clu_rd/nccv/viewer.asp

World Bank 2012, *Turn Down the Heat: Why a 4^{o}C Warmer World Must be Avoided*. The World Bank, Washington DC. 84pp

World Bank 2013, *Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for*

Resilience. The World Bank, Washington DC. 213pp
World bank 2014, *Turn Down the Heat: Confronting the New Climate Normal*. The World Bank, Washington DC. 275pp