Summary of Projected Climate Changes for Jefferson County Washington

This document is a compilation of the projected climate changes for Jefferson County based on the “citizen scientist” work of the Local 2020 Climate Adaptation Group. This group reviewed the existing literature on projected impacts to the climate for Washington State, and where available, impacts to the Olympic Peninsula, and compiled this summary. The references used are all listed below. The basic format of the table below is based on the recommendations in the ICLEI/Climate Impacts Group/King County "Preparing for Climate Change - A guidebook for Local, Regional, and State Governments" (http://cses.washington.edu/db/pdf/snoveretalgb574.pdf), Table 4.1, page 38.

The climate change projections are based on different scenarios of greenhouse gas emissions, which have been defined by the Intergovernmental Panel on Climate Change (IPCC). These different emissions scenarios are based on different scenarios of global development over the next 100 years. See Appendix A for a Q&A on the Emissions Scenarios and additional references.

We welcome your input on this document. Please send comments to cindy@l2020.org.

Climate Variable	**General Change Expected**	**Specific Change Expected and Reference Period**	**Size of Projected Change Compared to Recent Changes**	**Information About Seasonal Patterns of Change**	**Confidence**	**Sources and Context**	**Owner**
Air Temp-erature	Warming is expected to occur during all seasons, with most models projecting the largest temperature increases in summer.	Climate models project increases in annual average temperature of +0.6 °C to +1.9 °C by the 2020s; +0.9 °C to +2.9 °C by the 2040s; and +1.6 °C to +5.4 °C by the 2080s for the Pacific Northwest	Projected warming by 2020 is comparable to magnitude of warming experienced since 1900. Warming by the 2080's could be 2 or 3 times the magnitude experienced since 1900.	• Summer potential evapotranspiration (one component of water balance and closely related to fuel moisture and tree stress) is expected to increase by 5 to 18 mm by the 2040s, with much of the largest increases in lower elevation forests in the northeastern portion of the peninsula..	Projections based on both SRES scenario A1B (moderate emissions) and B1 (low emissions)	3	Michael Tweiten

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
Precipitation	Projected changes in annual precipitation in the Pacific Northwest differ considerably between models, but averaged over all models are small (+1 to +2 percent).	Ensemble means of models for precipitation suggest wetter winters (+3.3 percent in the 2040s, +7.6 percent in the 2080s) and drier summers (-8.5 percent in the 2040s, -12.8 percent in the 2080s).	The total amount of precipitation will only increase slightly over historical averages.	Winter precipitation on the Olympic Peninsula is likely to increase by 4.5 to 5 percent, on average depending on location and significant increases in the intensity of winter precipitation in the western portion of the Olympic Peninsula.	Projections based on both SRES scenario A1B (moderate emissions) and B1 (low emissions). The range of projected changes by 2100 AD depends substantially on the general circulation model used. Precipitation regimes range from no change from the current cool, wet maritime climate (CSIRO model) to substantial change to a hot, dry climate (Hadley model).	3	Michael Tweiten

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
Frequency and Severity of Extreme Weather events (Extreme Precipitation)	Precipitation intensity may increase but the spatial pattern of this change and changes in intensity is highly variable across the state.	More intense precipitation projected but the distribution is highly variable. Projected increases in the magnitude (i.e., the amount of precipitation) of 24-hour storm events in the Seattle-Tacoma area over the next 50 years are 14.1%-28.7%, depending upon the data employed. There will also be an increase in the intensity of the winter season in midlatitude areas.	Projected increases in the magnitude of 24-hour precipitation events for the period 2020-2050 for the Seattle-Tacoma area (14.1 to 28.7%) is comparable to the observed increases for 24-hour events over the past 50 years.	Significant increases in precipitation intensity during winter months (Dec-Feb), although with some spatial variability, despite reductions in total winter and spring precipitation Projections for increases in coastal precipitation intensity are for the winter season. There is little information on how summer precipitation intensity may change along the coast.	The intensity of midlatitude storm tracks is likely to increase, there is low confidence for increases in precipitation intensity given the wide range of natural precipitation variability in the PNW. Low confidence for increasing coastal storm track intensity.	Jackson Rosenberg Salathé Ulbrich	Dick Stock-ment

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
(Extreme Heat)	More extreme heat events expected	Increases in extreme heat events are projected for the 2040s, and show increases in the mean annual number of heat events, mean event duration, and maximum event duration.	Projected increases in number and duration of events are significantly larger than the number and duration of events between 1980-2006. The frequency of exceeding the 90th percentile daytime temperature (Tmax) increases from 30 days per year in the current climate (1970-1999) to 50 days per year in the 2040s (2030-2059).	n/a (relevant to summer only)	Medium confidence. There is less confidence in subregional changes in extreme heat events, although confidence in warmer summer temperatures overall is high.	Jackson Rosenberg Salathé Ulbrich	Dick Stock-ment

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
Sea level	Sea level rise of 0.8' – 5.1'	Sequim Bay region, … 0.8 feet (2025 and 2045), 2.0 (055 and 2090), 5.1 feet (2100)	The longest water level record in WA State, collected since 1892 in Seattle, shows a relative sea level rise of 0.68 feet/century"	Seasonality issue is primarily an issue of a combination of king tides and storm surge: example, +6 inches of sea level rise in Olympia shifts the probability of occurrence for the 100-year flood event from a 1% annual chance to 5.5% annual chance (1-in-18 year) event.	Sea level rise projections vary with greenhouse gas scenarios. The average and associated ranges reported in IPCC 2013[2] are +17 in. (range: +11 to +24 in.) for the very low (RCP 2.6) greenhouse gas scenario to +29 in. (range: +21 to +38 in.) for the very high (RCP 8.5) scenario. Note: 0.8'-5.1' is based on JSK report, see detail section below, and see its references for confidence.	See detailed section below.	Cindy Jayne/ Barney Burke

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
Acidity of Marine Waters	Increased acidification and aragonite concentration	“*Ocean acidity, for 2100:* +38 to +41% for a low greenhouse gas scenario and +100 to +109% for a high greenhouse gas scenario (relative to 1986-2005).” [4, p.ES-2] “Surface waters will experience increasingly frequent corrosive water masses ...while the twilight or middle zone ….and bottom layers …will be almost entirely corrosive by the later half of the 21st century.” [6]	“These changes, commonly referred to as ocean acidification, are occurring at a rate nearly ten times faster than that of any previous period within the last 50 million years”, [4, p1-1]; “The acidity of the ocean has increased by about +26% since 1750 [4, p1-1];	“These acidified waters appear in their most pronounced form during the spring through to the late summer months when the prevailing coastal winds seasonally shift southward, favoring upwelling of corrosive subsurface ocean waters.”	JSK Projections based on the SRES A2 scenario, others as quoted	See detailed summary below.	Cindy Jayne

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
Water Tempera-ture	Ocean surface temperatures off the coast of Washington are projected to warm.	Ocean surface temperatures off the coast of Washington are projected to warm by +2.2°F by the 2040s (2030-2059, relative to 1970-1999). [4, p.5-9] Projected warming greatest near the surface and generally decreasing with depth. Projected change for 2081-2100 relative to 1986-2005: Top 330 ft (RCP 2.6 to RCP 8.5): +1.1 to +3.6 °F Top 3,300 ft (RCP 2.6 to RCP 8.5): +0.5 to +1.1 °F. [4, p.4-7]	In the Strait of Georgia and West of Vancouver Island: significant warming observed. Average for top 330 ft: +0.4°F/decade (1970-2005). [4, p.2-6] Ocean surface waters (top 250 ft.) warmed by +0.6 to +0.9°F from 1971 to 2009 (global average). Warming trends are evident at nearly all depths in the ocean. [4, p.1-1]	Projected changes in winter sea surface temperatures in the North Pacific are expected to be as large as the range of natural variability by 2030-2050 (relative to 1950-1999) under a medium greenhouse gas scenario. [J][8]	Projections of coastal ocean temperatures are unclear due to limited understanding of changes in coastal upwelling and the large influence of natural variability. [4, p.5-9]	4, 5	Kevin Clark/ Cindy Jayne

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
Frequency and Severity of Wildfires	Potential for increased frequency and size of fire incidents. Definitive escalation of the costs associated with fire suppression.	Difficult to gauge for Jeff Co. Damp environments are generally less vulnerable to widespread fire hazard, yet changes to mid-altitude snow pack levels will create a greater abundance of dry fuel during the extending warm months.	The recent change is in seen in severity of recent weather conditions: heavier rain, deeper cold, longer dry spells.	Changes to the snowpack altitutde have an impact on both summer and winter conditions. Less snowpack in summer creates drier and more vulnerable conditions for fire. Less snowpack in winter results in increased flash flooding.	Confidence in increased likelihood of a fire event is strong. Confidence that a significant and impactful fire event will occur within the next 5 years is moderate.	See Below.	Ben Bauer-meister

Climate Variable	General Change Expected	Specific Change Expected and Reference Period	Size of Projected Change Compared to Recent Changes	Information About Seasonal Patterns of Change	Confidence	Sources and Context	Owner
Frequency and Severity of Flooding	Increases in most watersheds. Sea level rise will exacerbate coastal river flooding and increase the frequency of today's extreme tidal/storm surge events.	Projections for the 2080s (2070-2099, relative to 1916-2006): Rain dominant watersheds: +18% (range: +11 to +26%) Mixed rain-snow watersheds: +32% (range: −33 to +132%)	Number of days with rain > 1 inch: +13% (±7%) Number of days with rain > 3 inches: +22% (±22%); for 2041-2070, (relative to 1971-2000) for a high greenhouse gas scenario	Increase in the number of heavy rain events occurring in early fall. These changes may result in more severe flooding in rain dominant and mixed rain and snow basins.	Lower confidence in the precipitation-dependent changes in stream flows. High confidence that sea level will increase globally, but much uncertainty in the specific amount of increase and how it will vary by location. Some uncertainty about data indicating subsidence in South Puget Sound.	Kunkel Salathé Snover Tohver	Dick Stockment

Notes and References:

1. Climate Variables above are from Washington State Integrated Climate Response Strategy, page 35 (reworded a bit to list the variable, not the impact)

2. Format above is from: The ICLEI/Climate Impacts Group/King County "Preparing for Climate Change - A guidebook for Local, Regional, and State Governments" (http://cses.washington.edu/db/pdf/snoveretalgb574.pdf), Table 4.1, page 38 (which has examples.)

3. Halofsky, Jessica E.; Peterson, David L.; O'Halloran, Kathy A.; Hawkins Hoffman, Catherine, eds. 2011. Adapting to climate change at Olympic National Forest and Olympic National Park. Gen. Tech. Rep. PNW-GTR-844. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 130 p.

4. *Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers*. http://cses.washington.edu/cig/reports.shtml

5. Climate Change in the Northwest: Implications for our Landscapes, Waters and Communities: http://www.cakex.org/sites/default/files/documents/ClimateChangeInTheNorthwest.pdf

6. Jamestown S'Klallam Tribe Climate Change Adaptation Report: http://www.jamestowntribe.org/programs/nrs/nrs_climchg.htm

Supporting Detail

Air Temperature

References included above.

Precipitation

References included above.

Frequency and Severity of Extreme Weather Events

Jackson, J.E. et al. 2010. Public health impacts of climate change in Washington State: projected mortality risks due to heat events and air pollution. *Climatic Change* 102(1-2): 159-186, doi: 10.1007/s10584-010-9852-3.
Rosenberg, E., P. Keys, D. Booth, D. Hartley, J. Burkey, A. Steinemann, and D. Lettenmaier (2010), Precipitation extremes and the impacts of climate change on stormwater infrastructure in Washington State, *Climatic Change*, 319-349.

Salathe, E., L. Leung, Y. Qian, and Y. Zhang (2010), Regional climate model projections for the State of Washington, *Climatic Change*, 51-75.

Ulbrich, U., Pinto, J.G., Kupfer, H., Leckebusch, G.C., Spangehl, T., Reyers, M. 2008. Changing Northern Hemisphere Storm Tracks in an Ensemble of IPCC Climate Change Simulations. *Journal of Climate*, 21, 1669-1679. DOI: 10.1175/2007JCLI1992.1

(IPCC) Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

Sea Level

From*: Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers*, p. 9-2.

Domain	2030	2050	2100
Puget Sound (Mote et al. 2008)[E]	---	+ 6 inches *(+3 to +22 in.)*	+13 inches *(+6 to +50 in.)*
NW Olympic Peninsula (Mote et al. 2008)		0 inches *(-5 to +14 in.)*	+2 inches *(-9 to +35 in.)*

Same report, Page 9-1: Global sea level is projected to increase by +11 to +38 inches by 2100 (relative to 1986-2005), depending on the amount of 21st century greenhouse gas emissions.

Same report, Page 9-1: Sea level rise projections vary with greenhouse gas scenarios. The average and associated ranges reported in IPCC 2013[2] are +17 in. (range: +11 to +24 in.) for the very low (RCP 2.6) greenhouse gas scenario to +29 in. (range: +21 to +38 in.) for the very high (RCP 8.5) scenario.

CPJ note: this is a bit lower estimate than the one used in the JSK report below, which assumed global sea level rise of 1.6 to 4.6 feet by 2100, or 19.2 – 55.2 inches.

Same report, page 9-3:

Sea level rise increases the frequency of today's extreme tidal/storm surge events. Higher sea level amplifies the inland reach and impact of high tides and storm surge, increasing the likelihood of today's extreme coastal events. For example, +6 inches of sea level rise[F] in Olympia shifts the probability of occurrence for the 100-year flood event from a 1% annual chance to 5.5% annual chance (1-in-18 year) event.[8] With +24 inches of sea level rise,[G] the 100-year flood event would become an annual event (Table 9-2).

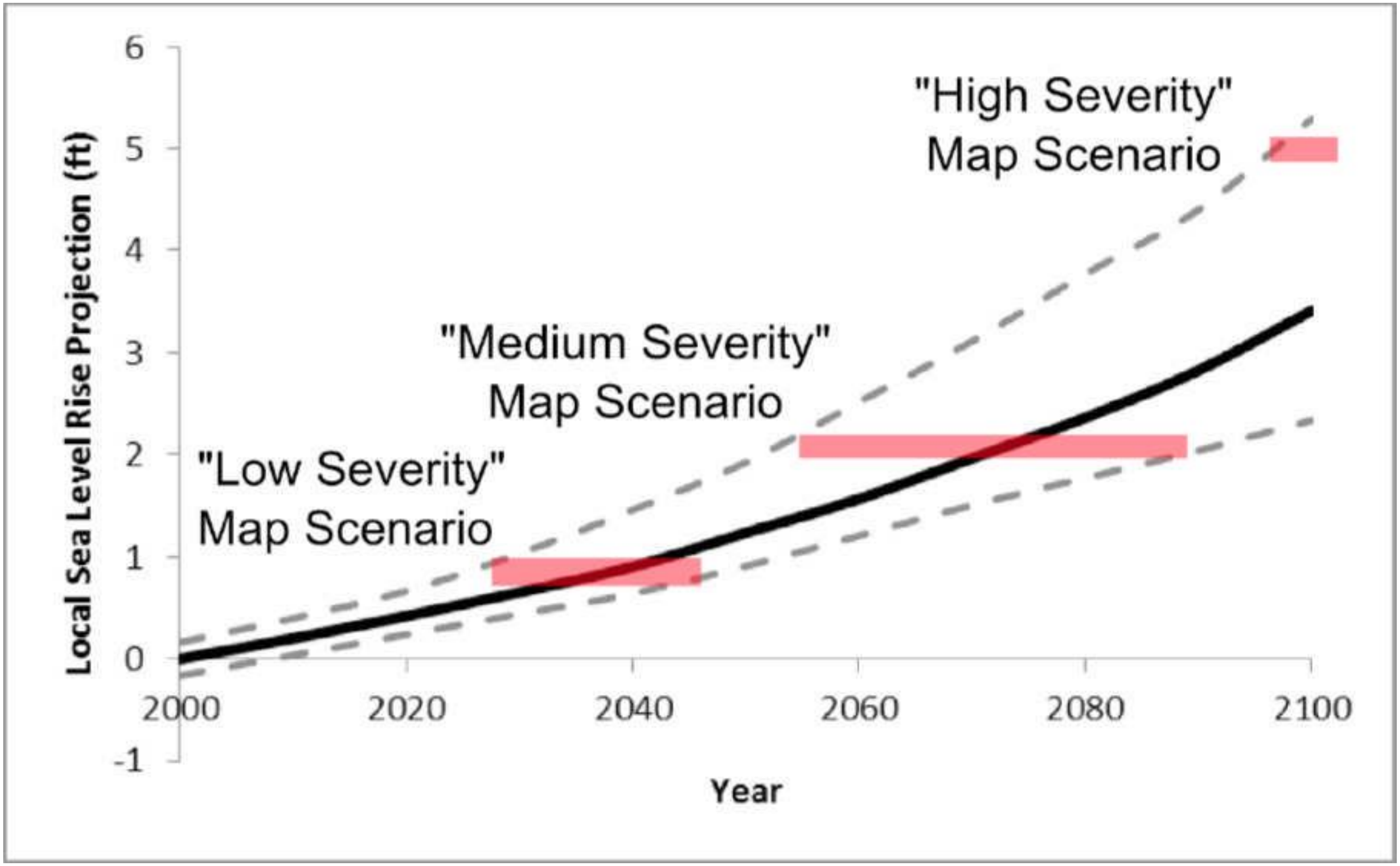
Jamestown S'Klallam Tribe Climate Change Adaptation Report (JSK):
http://www.jamestowntribe.org/programs/nrs/nrs_climchg.htm:

".. Sequim Bay region, …a "Low Severity" scenario with a mean water level of 0.8 feet above current sea level (projected to occur between 2025 and 2045), a "Medium Severity" scenario with a mean water level of 2.0 feet above current sea level (projected to occur between 2055 and 2090), and a "High Severity" scenario with a mean water level of 5.1 feet above the current sea level, which may occur by the end of the century." (P.17)

JSK p 16 – "average vertical land movement in Sequim Bay of -0.7 feet/century."
JSK page 16:

Appendix A:
Blyn Panga Station (-2.75 mm/year, starting in 2001). Per my spreadsheet, 0.90'/century; 48.0160 -122.9275
Sequim Panga Station: -2.88 mm/year, starting in 2007. Per my spreadsheet, 0.94'/century
P436: coordinates: 48.045303 236.865653
(http://www.geodesy.cwu.edu/panga/panga_coor.html)

JSK p 15: "The longest water level record in WA State, collected since 1892 in Seattle, shows a relative sea level rise of 0.68 feet/century"



“The National Academy of Science projections suggest mean sea level rise of 0.6 to 1.6 feet by 2050, and 1.6 to 4.6 feet by 2100, with the ranges in projections driven, primarily, by uncertainty regarding future greenhouse gas emissions.” (A-8)

These three stations suggest average vertical land movement in the Sequim Bay region of -0.7 feet/century(2.11 mm/yr). (page A- 8)

Acidity of Marine Waters

There are two aspects: pH level and level of aragonite. “How corrosive ocean water becomes is dependent on its aragonite saturation” (p.21, Jamestown S’Klallam (JSK) 08/13 final report). “Ω Arargonite is a measure of the availability of calcium carbonate to many marine organisms. In general, levels below 1 are corrosive and may make it difficult for some marine organisms to build shells.” From figure 13, level of aragonite in Strait of Juan de Fuca looks like ~0.8, and pH is 7.6.

From Appendix B of JSK, “Ω aragonite is a function of the concentration of CO2, water, temperature, and pressure. As a result, some organisms, especially small plankters (*ed: any organism that is an element of plankton, per dictionary.com*), will start to show degradation at Ω aragonite values less than 1… Waters with Ω aragonite values less than 1 are generally termed “corrosive”, a convention that is used in this report. Corrosive waters have already been documented in the Strait of Juan de Fuca.”

Modeled projections for coastal zones of Northern California (Figure B-1) suggest that, as the century progresses, parts of the continental shelf will be almost continuously bathed in corrosive waters …Surface waters will experience increasingly frequent corrosive water masses ...while the twilight or middle zone ….and bottom layers …will be almost entirely corrosive by the later half of the 21st century.” “Projections based on the SRES A2 scenario.”
(p 11, Appendix B).

JSK: p 22 – “These projections are broadly relevant to conditions on Washington’ outer coast, as the Northern California and Washington coast waters are both dominated by upwelling events, and are part of the California Current system. As outer coastal waters are transported into the Strait of Juan de Fuca it is likely that the Strait will see an increasing occurrence of corrosive conditions.”

Climate Change in the Northwest: Implications for our Landscapes, Waters and Communities: p 74: “Conditions in the coastal waters of the Northwest lead to some of the most highly acidified marine waters found worldwide (NOAA OAR 2012). These acidified waters appear in their most pronounced form during the spring through to the late summer months when the prevailing coastal winds seasonally shift southward, favoring upwelling of corrosive subsurface ocean waters.” P 75: “These changes, commonly referred to as ocean acidification, are occurring at a rate nearly ten times faster than that of any previous period within the last 50 million years Kump et al. 2009; Hönisch et al. 2012).”

“Ocean waters on the outer coast of Washington and the Puget Sound have become about +10 to +40% more acidic since 1800 (decline in pH of −0.05 to −0.15).” 4. *Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers*. http://cses.washington.edu/cig/reports.shtml (page 2-6)

Water Temperature

Elevated ocean temperatures are documented for NW waters from 1900 to 2008 (Deser et al. 2010), with future increases very likely, though characterized by considerable spatial and temporal variability. [5, p. 75-76]

Ocean surface temperatures off the coast of Washington are projected to warm by +2.2°F by the 2040s (2030-2059, relative to 1970-1999). [4, p.5-9]

Projected warming greatest near the surface and generally decreasing with depth. Projected change for 2081-2100 relative to 1986-2005:
Top 330 ft (RCP 2.6 to RCP 8.5):
+1.1 to +3.6°F Top 3,300 ft (RCP 2.6 to RCP 8.5):
+0.5 to +1.1°F. [4, p.4-7]

In the Strait of Georgia and West of Vancouver Island: significant warming observed. Average for top 330 ft: +0.4°F/decade (1970-2005). [4, p.2-6] Ocean surface waters (top 250 ft.) warmed by +0.6 to +0.9°F from 1971 to 2009 (global average). Warming trends are evident at nearly all depths in the ocean. [4, p.1-1]

Projected changes in winter sea surface temperatures in the North Pacific are expected to be as large as the range of natural variability by 2030-2050 (relative to 1950-1999) under a medium greenhouse gas scenario.[J][8] However, coastal ocean temperatures are strongly affected by coastal upwelling of colder water from ocean depths, and by large scale climate variability such as El Niño – current research is unclear as to how these might be altered by climate change. [4, p.5-4]

Projections of coastal ocean temperatures are unclear due to limited understanding of changes in coastal upwelling and the large influence of natural variability. [4, p.5-9]

Frequency and Severity of Wildfires

References:

http://www.fs.fed.us/ccrc/cases/olympic.shtml

http://www.fs.fed.us/ccrc/cases/olympic.shtml

http://wildland-fires.findthedata.org/#graph/

http://www.vetmed.wsu.edu/org_nws/NWSci%20journal%20articles/2006%20files/Issue%203/04%20Medler.pdf

Frequency and Severity of Flooding

Kunkel, K. E. et al., 2013: *Part 6. Climate of the Northwest U.S.*, NOAA Technical Report NESDIS 142-6.

Salathé, E.P. Jr et al., 2013. Estimates of 21st Century Flood Risk in the Pacific Northwest Based on Regional Climate Model Simulations. Submitted

Snover, A.K., P.W. Mote, L.C. Whitely Binder, A.F. Hamlet, and N.J. Mantua. 2005. *Uncertain Future: Climate Change and Its Effects on Puget Sound.* Climate Impact Groups, Center for Science in the Earth System, Joint Institute for the study of the Atmosphere and Oceans, University of Washington.

Tohver, I. et al., 2013. Impacts of 21st century climate change on hydrologic extremes in the Pacific Northwest region of North America. *Journal of the American Water Resources Association*, in press.

APPENDIX A EMISSIONS SCENARIOS

Emission Scenarios Q and A

Q: Why do future projections for climate change have such large ranges of possible outcomes?

A: Despite how climate change tends to be discussed in the media the main source of uncertainty in how climate will change in this century is not our current understanding of how the climate works but our uncertainty in how human society and technology will change in the years to come. The range of values for IPCC climate projections comes from using different scenarios of global development over the next 100 years as input into climate models.

Q: How can the IPCC know how human societies will develop?

A: They cannot know. When a specific prediction is impossible, a useful and well established strategy is to develop "strategic scenarios" that generate a range of possible outcomes. Usually two main driving variables are chosen and the four possible combinations of these factors are used to generate scenarios. That is what the IPCC did in order to generate emission scenarios.

Q: What were the two main variables?

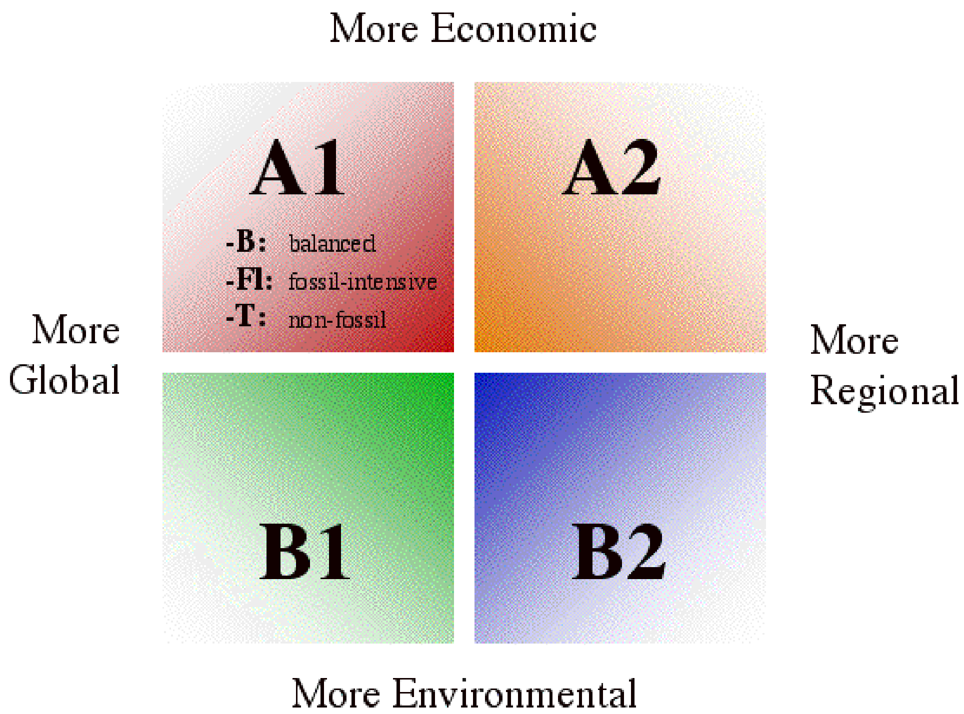
A: The first variable is whether societies focus on policies that favor economic growth or whether societies focus on policies that promote social equity and environmental stewardship. The first group is labeled "A" and the second is labeled "B". The second variable is whether societies focus on global development and the different regions of the world converge in their characteristics or whether different regions pursue their own agendas and diverge in their characteristics. The convergent, globalized scenarios are labeled with a "1" and the divergent, regional scenarios are labeled with a "2". So we have scenarios A1, A2, B1 and B2.

Q: Aren't there some other scenarios with more letters and numbers as well?

A: Yes. To explore the role of technological choices the A1 scenario was expanded to include three specific technological alternatives. The first, A1FI, supposes globalized economic growth continues using Intensive use of Fossil Fuels as energy sources. A1T supposes that globalized economic growth continues but with a Transition to predominately all non-fossil fuels energy sources like nuclear, hydro, solar and wind. Finally A1B supposes a Balance between fossil fuel and non-fossil fuel energy sources. This break down shows the impact that technological development has on climate change even if globalized economic growth continues.

Q: Why do they have such boring labels?

A: The IPCC wanted to just describe the range of possibilities that would occur if no specific Climate Change policies were made. They did not want to promote or endorse any scenario so they gave them non-evocative labels.



Adapted from **IPCC**, 2001: *Climate Change 2001: Synthesis Report. A contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp.

Image from : http://www.meteor.iastate.edu/gccourse/gwpotential/images/chart.gif, downloaded on April 29, 2014.

Q: So the IPCC isn't trying to promote one of these scenarios?

A: No they are not. Each scenario is seen as an equally likely future trajectory from our current societies. More than that, even though some of these scenarios seem "environmentalist" none of them includes any collective response to the threat of climate change itself. If societies or governments did "do something" about climate change they would be in a policy space outside any of the emissions scenarios.

Q: So how do these choices in human economic policy get turned into precipitation and temperature?

A: Each scenario has characteristic rates of population growth, rates of economic growth, energy intensity, land use patterns and regional diversity starting with today's situation. Many social scientists contributed to developing the scenarios and estimated what the emissions of different green house gases are each year with different combinations of these factors. Greenhouse gases are carbon dioxide, methane, and other gases produced by industrial processes or land use change that trap heat energy in the atmosphere. The concentration of greenhouse gases is used as input into global climate models. The relationship between greenhouse gases and the Earth's energy balance is very well understood and gives the basis for climate change projections.

Q: So how can I be a savvy consumer of climate change projections?

A: When you hear a climate change or climate change impacts projection you should expect to hear a range of values. If you don't, try to figure out which emissions scenario they are using so you know which extreme of the range of possibilities this information is coming from.

Q: Where can I learn more about emissions scenarios?

A: The IPCC has a nice summary report at this website:

http://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf

APPENDIX B - RESOURCES

Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers. http://cses.washington.edu/cig/reports.shtml

Preparing for a Changing Climate: Washington State Integrated Climate Response Strategy: https://fortress.wa.gov/ecy/publications/publications/1201004.pdf

Climate Change in the Northwest: Implications for our Landscapes, Waters and Communities: http://www.cakex.org/sites/default/files/documents/ClimateChangeInTheNorthwest.pdf

Adapting to Climate Change at Olympic National Forest and Olympic National Park: http://www.fs.fed.us/pnw/pubs/pnw_gtr844.pdf

Jamestown S'Klallam Tribe Climate Change Adaptation Report: http://www.jamestowntribe.org/programs/nrs/nrs_climchg.htm

Washington State Climate Change Preparing for Impacts Clearinghouse: Impacts, Preparation, Adaptation Resources: www.ecy.wa.gov/climatechange/ipa_resources.htm

UW Climate Impacts Group - Summary of Projected Changes in Major Drivers of Pacific Northwest Climate Change Impacts: http://cses.washington.edu/cig/files/climatedriverssummary.pdf

Olympic Coast National Marine Sanctuary climate change study

See also: http://olyclimate.org/links/ for other links (I tried to cover the key ones here above, but feel free to browse), and also their summaries of sector impacts in the "local climate change references" section.

http://www.georgetownclimate.org/adaptation/clearinghouse (info on sea level rise and urban heat, and on sector impacts on coasts, public health, water, transportation)

http://www.usgs.gov/climate_landuse/clu_rd/nex-dcp30.asp (usgs data on temperature and precipitation changes)

Climate Adaptation resource at the Washington Dept of Natural Resources website (the first set of references on this link have a lot of overlap w/ items above, but at the bottom there are sections on the following sectors: forest, oceans, habitat, water)