

Climate Change Impacts in Washington State

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*Climate Science in
the Public Interest*



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The UW Climate Impacts Group

Science for climate resilience

Working since 1995 to....

- Produce scientific information that is both useful to and used by decision makers
- Conduct decision-relevant climate research
- Support the interpretation and application of climate science in decision making



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Northwest Climate
Science Center



Key Conclusions

Climate matters

Expectations about climate are embedded in our economy, infrastructure, and management of natural systems.

Significant changes in PNW climate are expected

These changes are a result of rising greenhouse gas emissions.

Climate change will affect many important systems in Washington

Impacted systems include water resources, forests, species and ecosystems, oceans and coasts, infrastructure, agriculture, and human health.

Adaptation can reduce climate risks, but mitigation is required

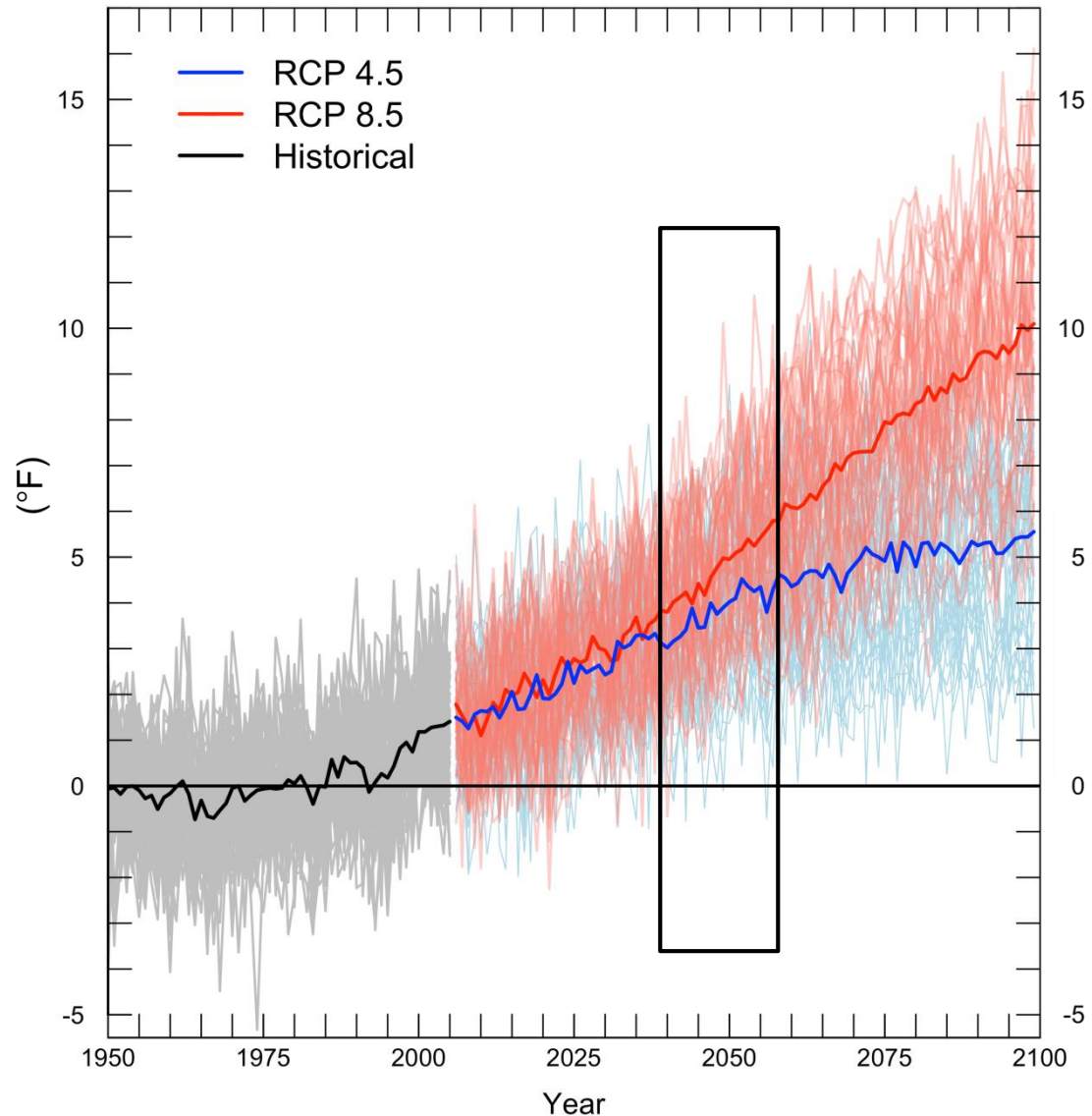
We have the knowledge and tools to begin adapting to climate impacts.



Rapid Warming Projected

All scenarios indicate
warming in the 21st
century

Projected Change in Average Annual PNW Temperature
(relative to 1950-1999 average)



2050s (relative to 1950-1999)	
Low emissions (RCP 4.5)	+4.3°F (2.0-6.7°F)
High emissions (RCP 8.5)	+5.8°F (3.1-8.5°F)

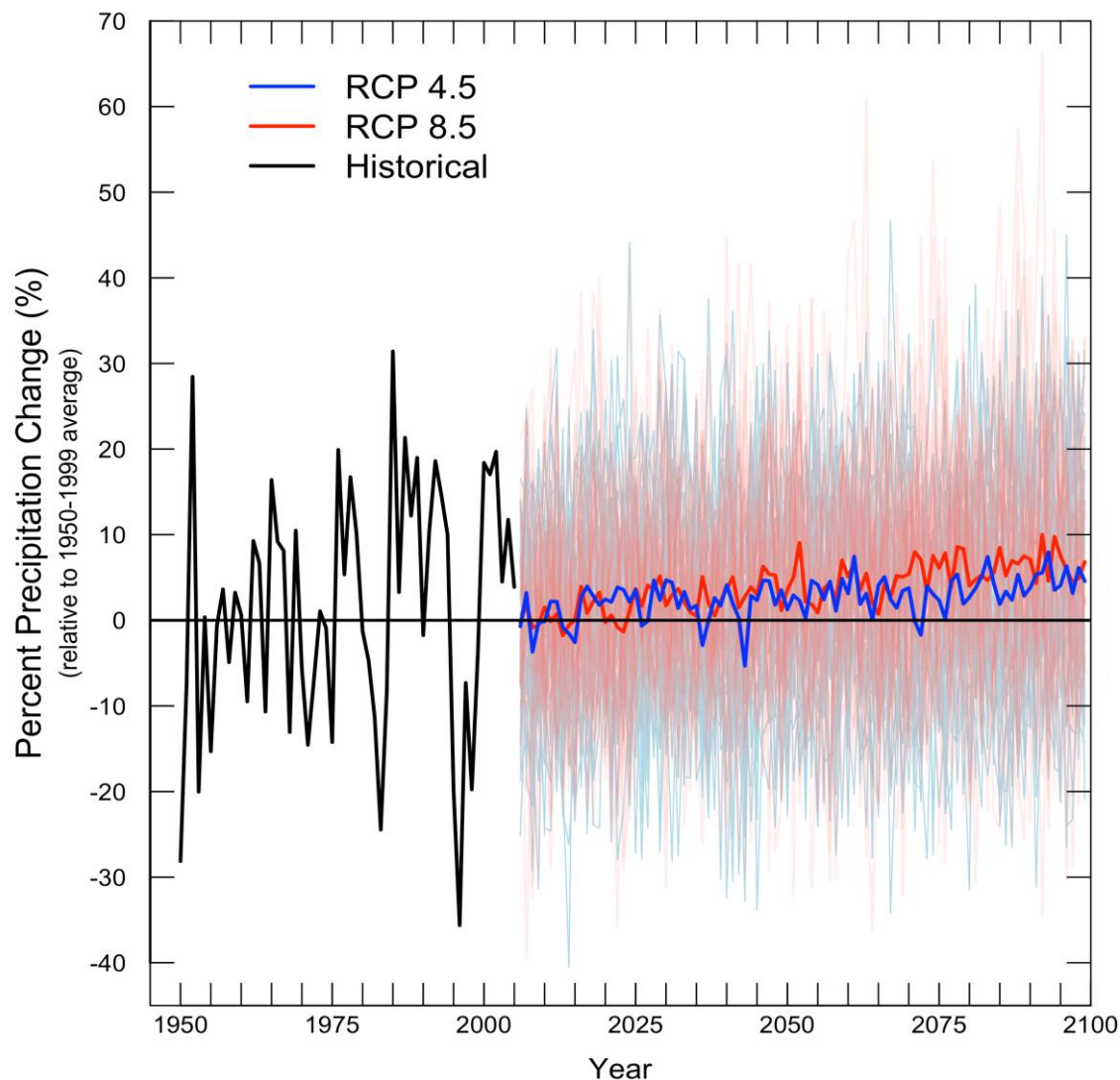
Continued Variability in Precipitation

Modest increases in average *annual* precipitation projected in most scenarios.

***Seasonal* patterns reinforced.** Wetter fall, winter, and spring; drier summers likely.

More frequent heavy rainfall events expected.

Projected Change in Average Annual PNW Precipitation
(relative to 1950-1999 average)

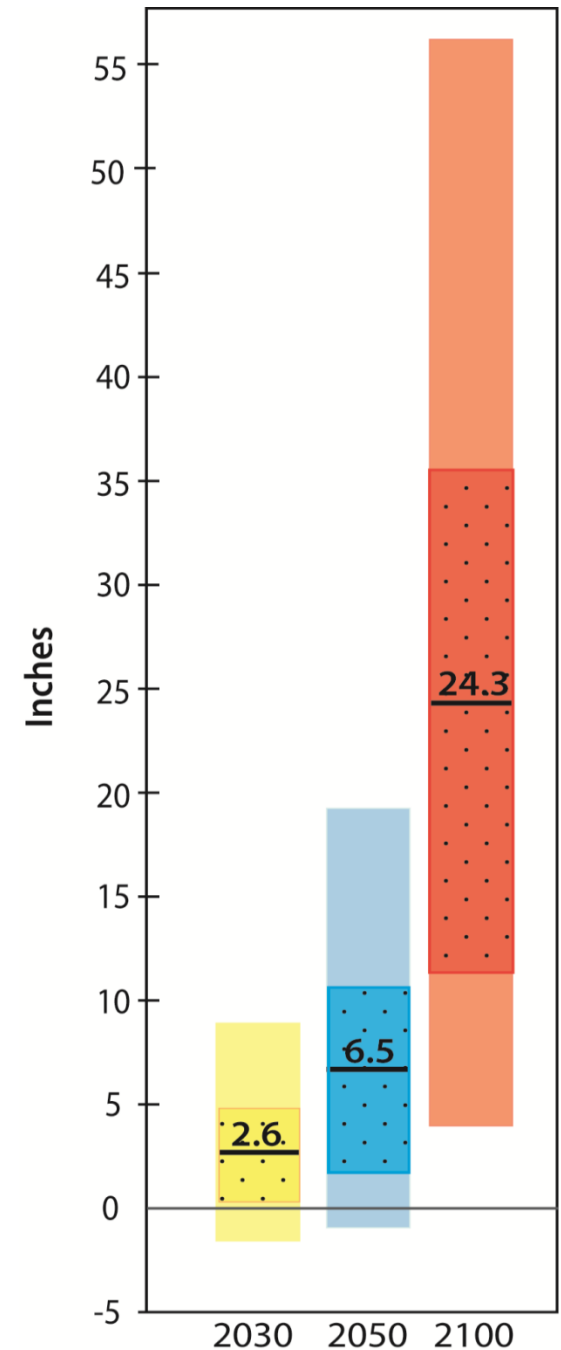




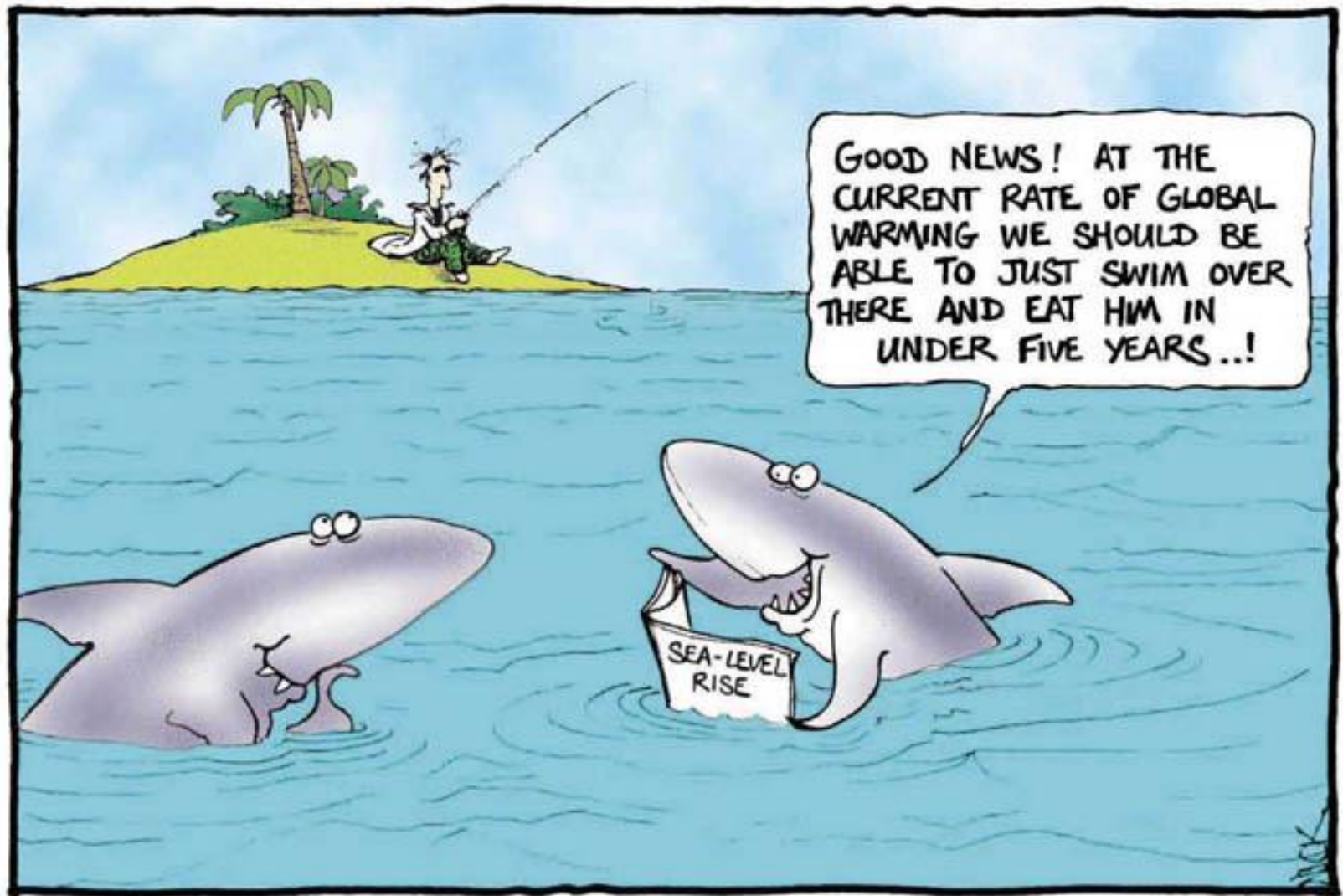
Sea Level Rise Projected in All Scenarios by 2100

Projected Range, Seattle *Relative to 2000 (NRC 2012)*

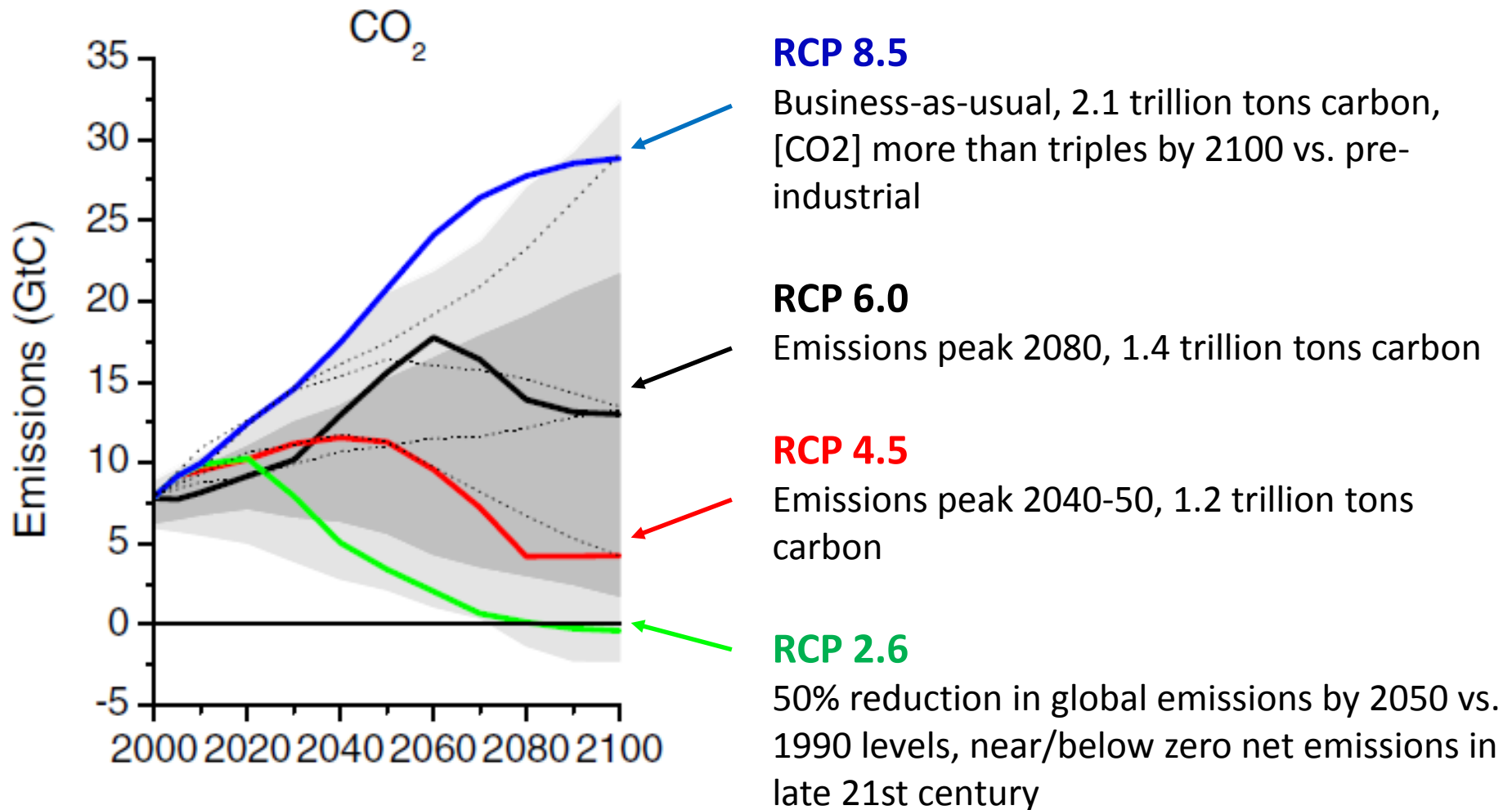
2030	-1.5 to +8.8 inches
2050	- 1.0 to +18.8 inches
2100	+3.9 to +56.3 inches



What's "the number"?



Projections Vary Depending on Future Greenhouse Gas Emissions



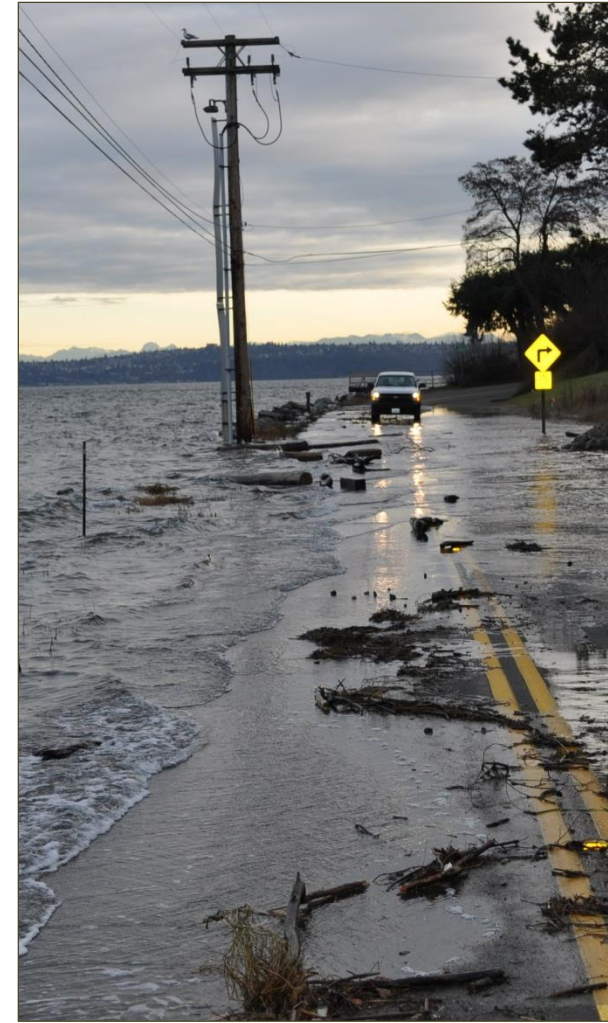
“The” number will also depend on...

- The expected time horizon of the decision being made (e.g., 20 years vs. 100 years),
- The ability to adapt the decision over time,
- Available alternatives,
- Risk tolerance, and
- Cost

among other factors...



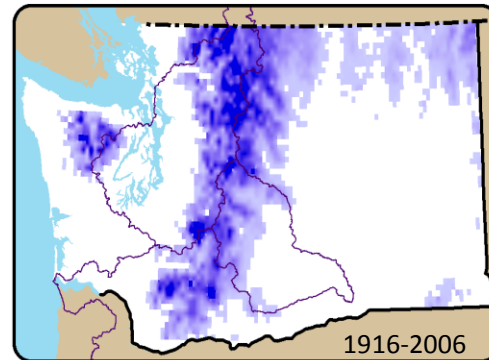
Many, Many Challenges – Three Major Risks (+OA)



As identified in *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities* (Dalton et al. 2013)

All Scenarios Indicate Less Snow

Historical



Historical

2400mm/95 in.
10 mm / 0.4 in.

Change

-100%
0%

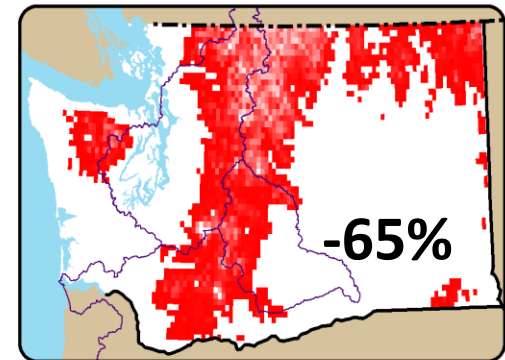
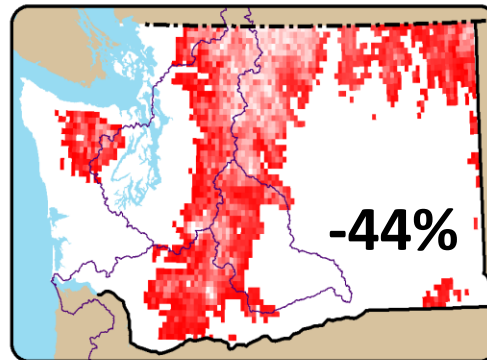
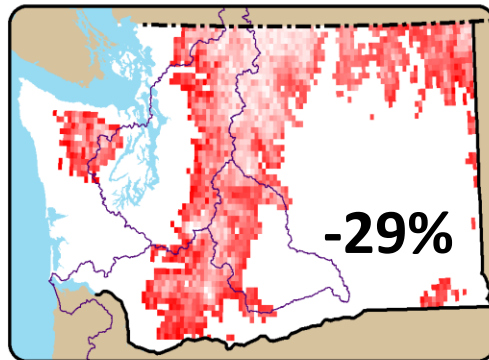
Apr. 1 Snow Water Equivalent

2020s

2040s

2080s

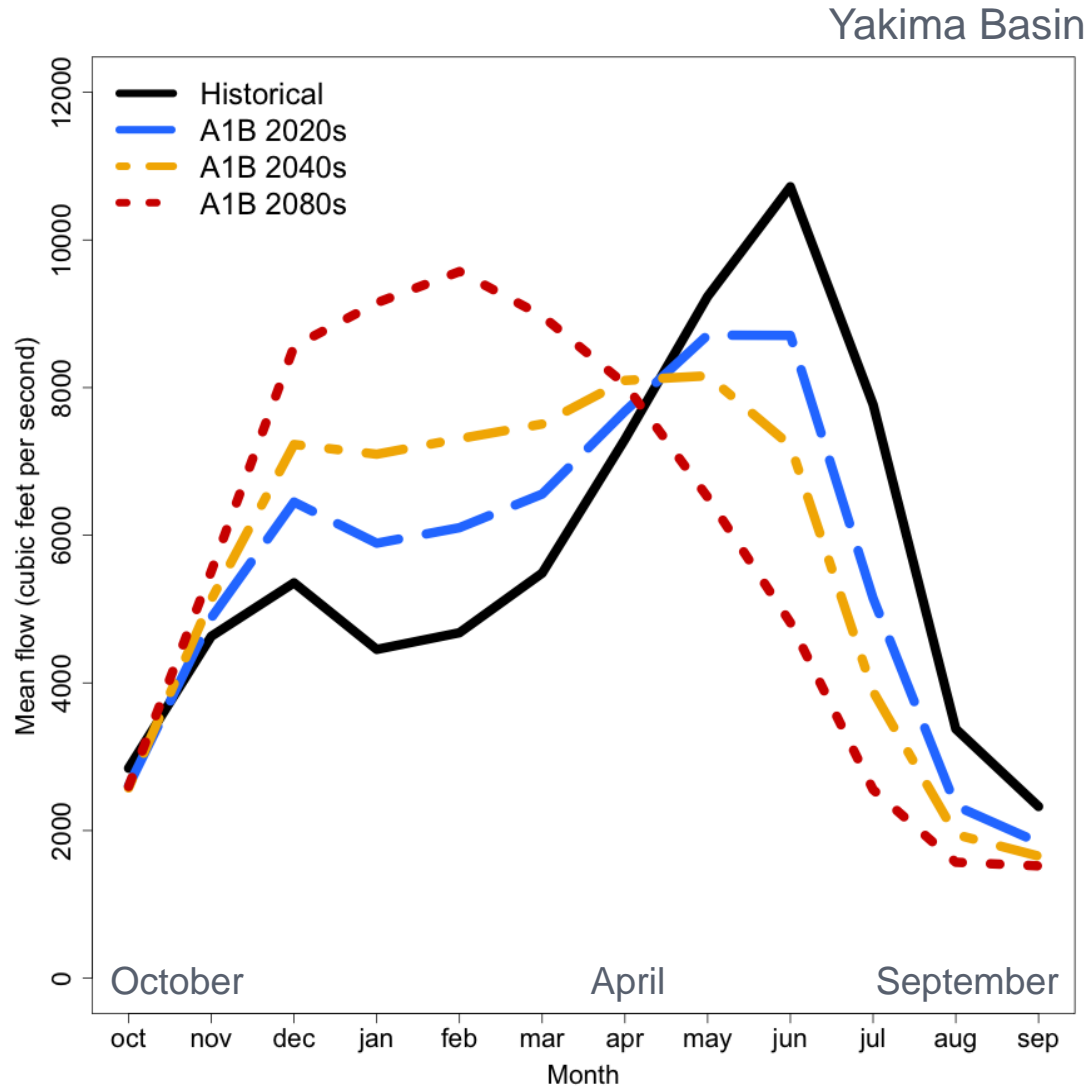
A1B



Elsner et al. 2010

Why? Spring snowpack is projected to decline as more winter precipitation falls as rain rather than snow, especially in warmer mid-elevation basins. Also, snowpack will melt earlier with warmer spring temperatures.

Shifting Streamflows – 2080s





Increasing flood risk

For the Skagit, 2040s:*

- the historical 100-year event becomes a 22-year event
- the historical 30-year event becomes an 7-year event

For the Snohomish, 2040s:*

- the historical 100-year event becomes a 30-year event
- the historical 10-year event becomes an 5-year event

* Naturalized flows
(no dams)

Photo source: Seattle Times

Impacts: Water



Increased wildfire risk

Area burned by fire in the Columbia River Basin is projected to double by 2020s, triple by 2040s, x5 by 2080s (relative to median for 1916-2006). (*Littell et al. 2010, 2012*)



Discovery Fire burns near volatile stands of insect-damaged trees, 2009, DNR



Increased risk of insect outbreaks

Near-term increased
risk of mountain pine
beetle outbreaks in
drier forests will
exacerbate fire risk.

(Littell et al. 2010, 2012)



Photo: DNR

Reduced suitability for key pine species

Only 15% of the area currently suitable for three pine species in Washington – ponderosa pine, lodgepole pine, and whitebark pine - is projected to remain suitable for all three by the 2060s. (*Littell et al. 2010, 2012*)



Photo: DNR



Increasing demands for fire response

Compounded by increasing fire risk in the Western U.S.



Potential impacts on timber production

Long-term transformation of forest landscapes, combined with changes in fire risk and insect damage, could impact timber production on public and private forests



Ecological, economic, and community impacts

Management challenges and air quality impacts, particularly at the urban/wildland interface.



Loss of land to rising seas

More than 140,000 acres of coastal lands lie within 3.3 feet elevation of high tide in WA & OR, exposing public and private property, infrastructure, and habitat to climate impacts.



Multiple compounding factors

Sea level rise + river flooding + high tide + coastal storms + subsidence = erosion + landslides + flooding + permanent inundation + ...



Widespread impacts

Private and public property, urban and transportation infrastructure viability and functioning, toxics mobilization, ecological resources, habitat restoration

Additional Risk Areas: **Agriculture and Human Health**



Agriculture is fairly adaptable, although some crops and locations are more vulnerable

WA state agriculture is projected to be affected by warming temperatures, rising carbon dioxide, and changes in water availability.



Health impacts stem from a wide range of climate change impacts

Likely to see increased rates of heat related illnesses (including heat exhaustion and stroke); respiratory illness (e.g., allergies, asthma); vector-, water-, and food-borne diseases; and mental health stress.

Who is Working on Climate Resilience in WA?



City of
OLYMPIA



City of Seattle



King County



Washington
Department of
**FISH and
WILDLIFE**



SOUNDTRANSIT



Tacoma



WASHINGTON STATE DEPARTMENT OF
Natural Resources



**WATER SUPPLY
FORUM**

Serving Snohomish, King & Pierce Counties



**US ARMY
CORPS OF ENGINEERS**



Snohomish County



TACOMA POWER
TACOMA PUBLIC UTILITIES



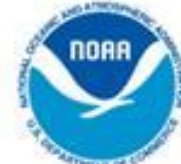
Washington State Department of
Health



PORT OF BELLINGHAM
Washington State



NATIONAL MARINE
SANCTUARIES



NATIONAL
PARK
SERVICE



Swinomish Indian
Tribal Community



**JAMESTOWN
SKALLAM
TRIBE**



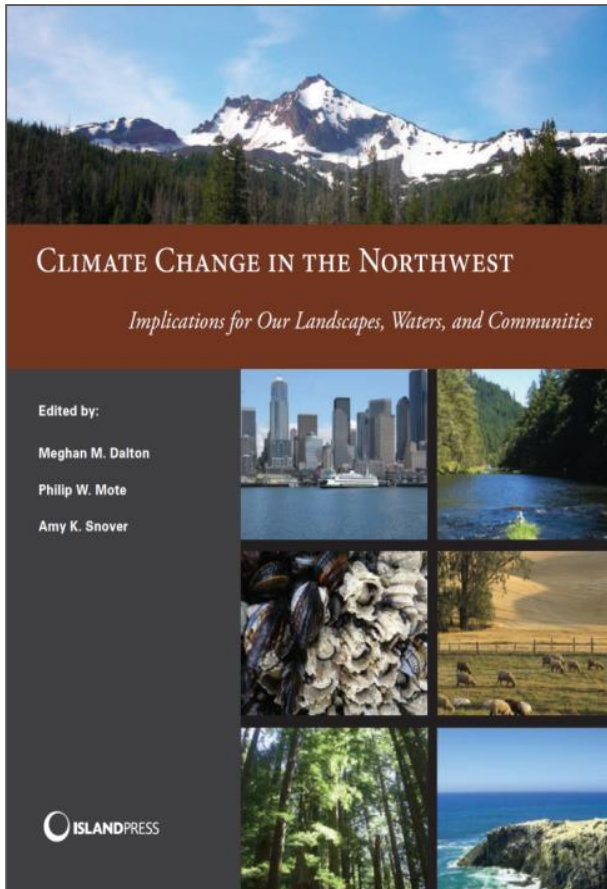
**The Nature
Conservancy**
Protecting nature. Preserving life.



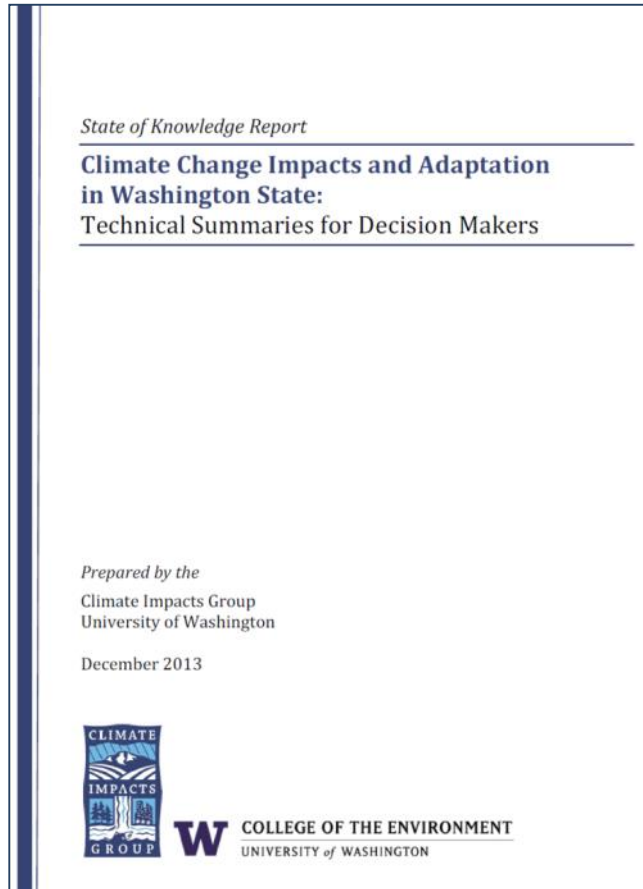
**NATIONAL
WILDLIFE
FEDERATION**



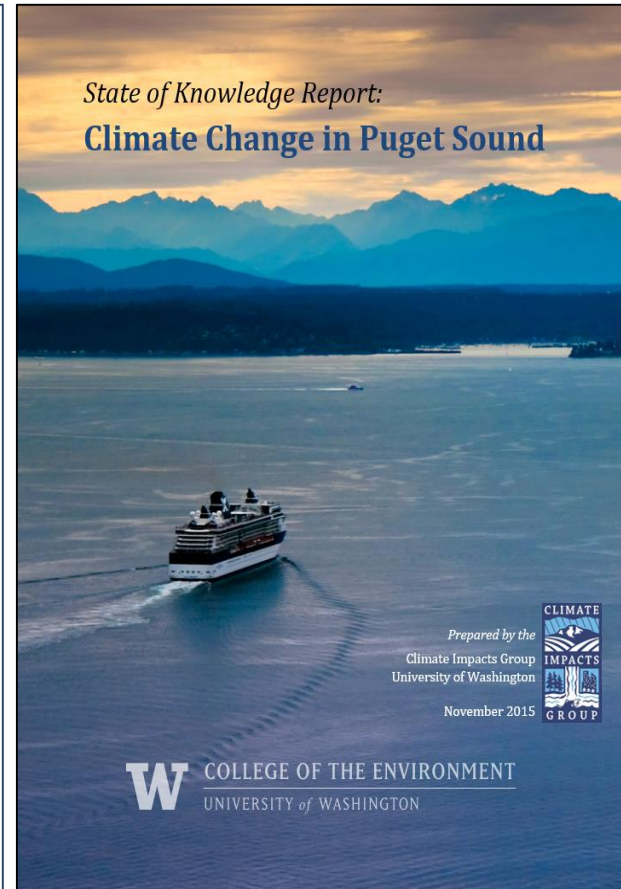
For More Details...



Dalton et al. 2013



Snover et al. 2013



Mauger et al. 2015

State-Supported Research Areas 2016-2017

Extreme events - wet (heavy downpours, floods, storm water, floods + SLR, landslides)

Extreme events - dry (drought response as dress rehearsal for cc vulnerability and resilience),

Successful adaptation – defining, framing

Building regional awareness of climate risks and capacity for building climate resilience

Biodiversity, conservation, and habitat connectivity in a changing climate



The Climate Impacts Group

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