COLLEGE OF THE ENVIRONMENT
UNIVERSITY of WASHINGTON

The changing hydrograph in the Northwest

(and other ways climate affects our energy system)

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NW Energy Coalition
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Climate Science in the Public Interest

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CLIMATE MATTERS

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CLIMATE CHANGE IS EXPECTED

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CLIMATE MATTERS

CLIMATE CHANGE IS EXPECTED

WE CAN TAKE ACTION TO PREPARE

What do we expect?

- **Warming**
- Changes in **total precipitation** expected to be less than past variability
- Reduced **snowpack,** shifts in streamflow timing
- Increases in **heavy rainfall**
- **Changes in the landscape** from fires, pests, et al.

Rapid Warming Projected

Median warming ~4-6°F by 2050, but could exceed 8°F

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

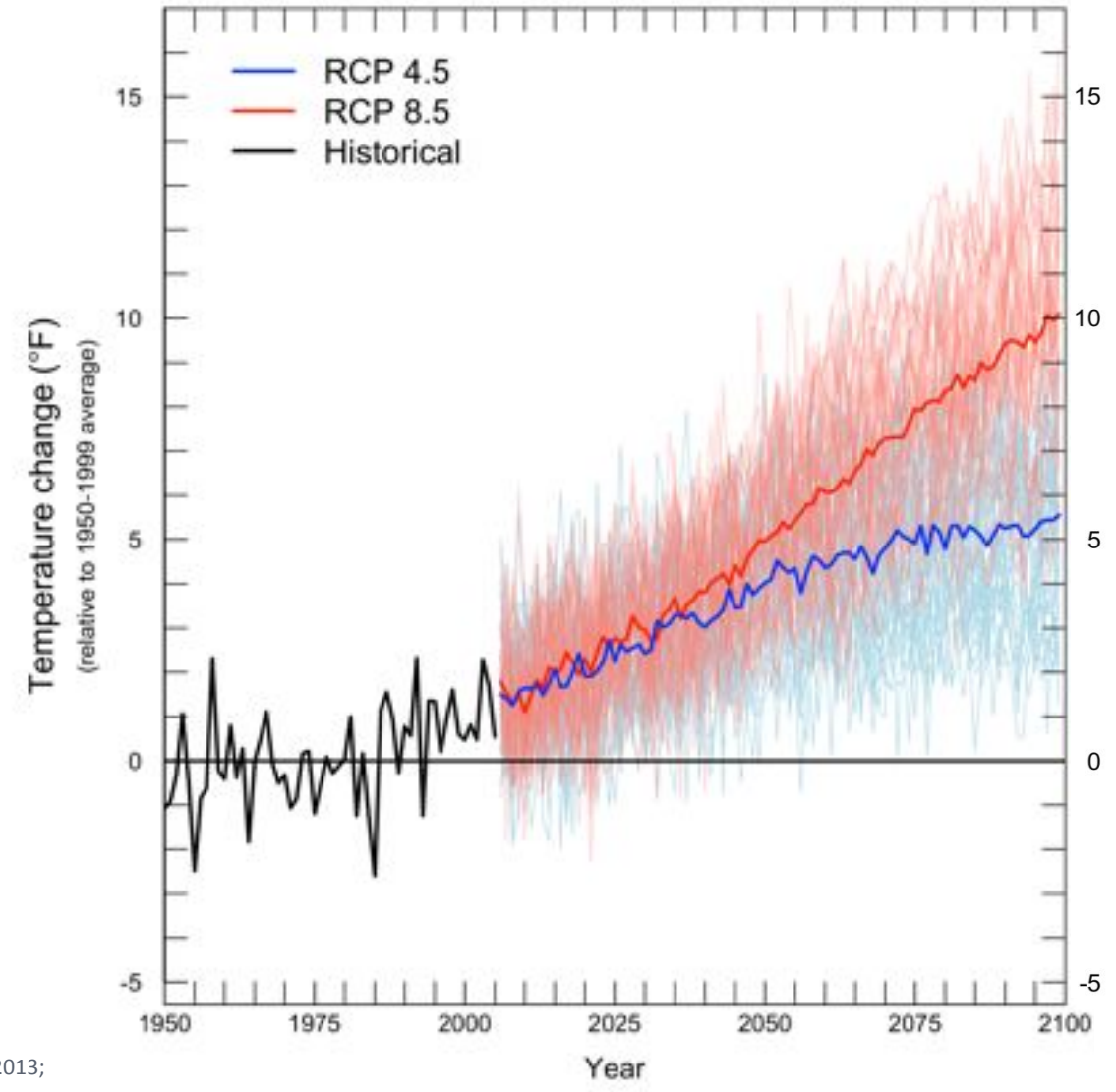


Figure source: Climate Impacts Group, based on projections used in IPCC 2013; 2050 projections from Mote et al. 2013

Continued Variability in Precipitation

Modest increases in average *annual* precipitation, but change is smaller than year-to-year variability

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

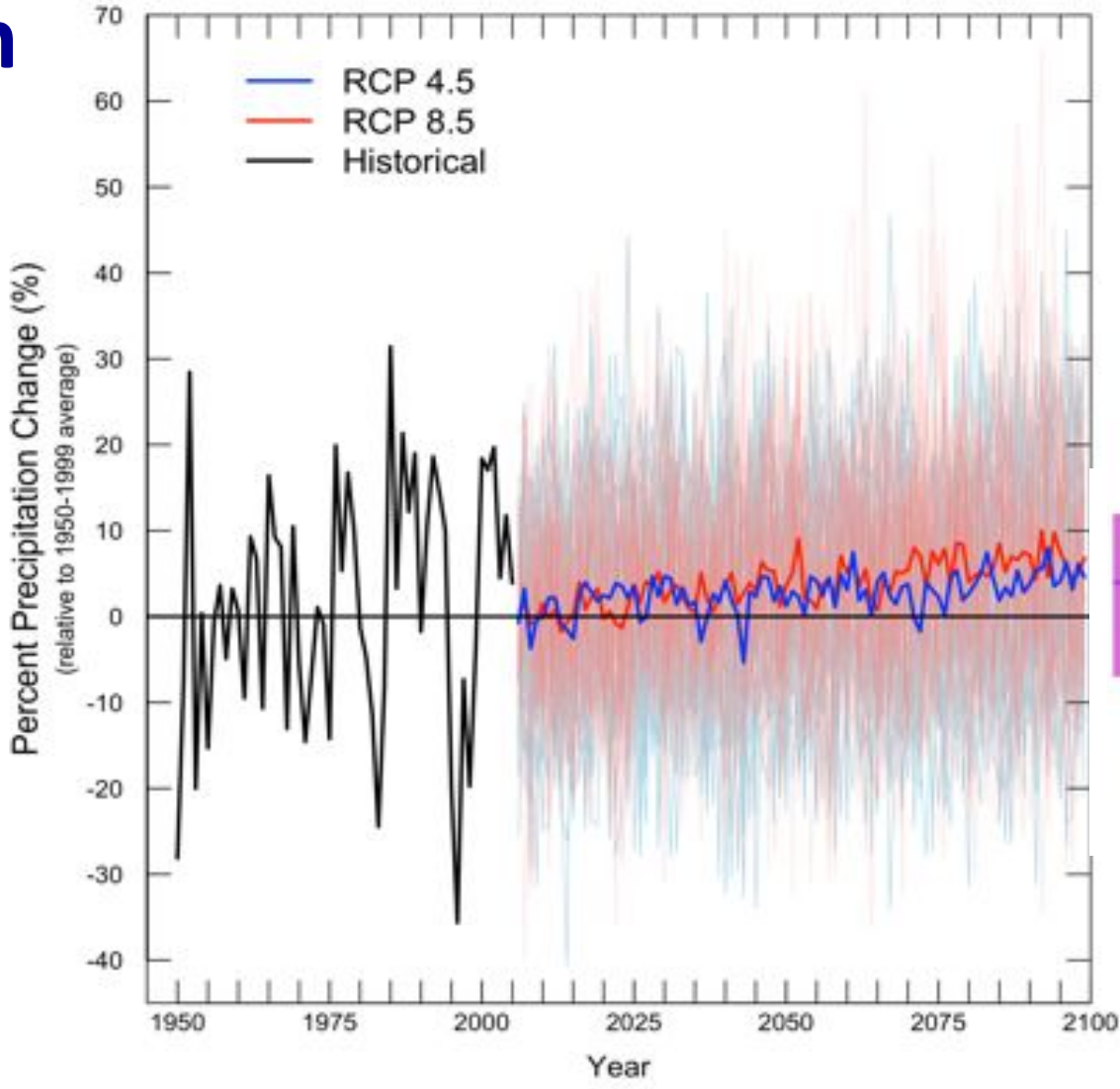
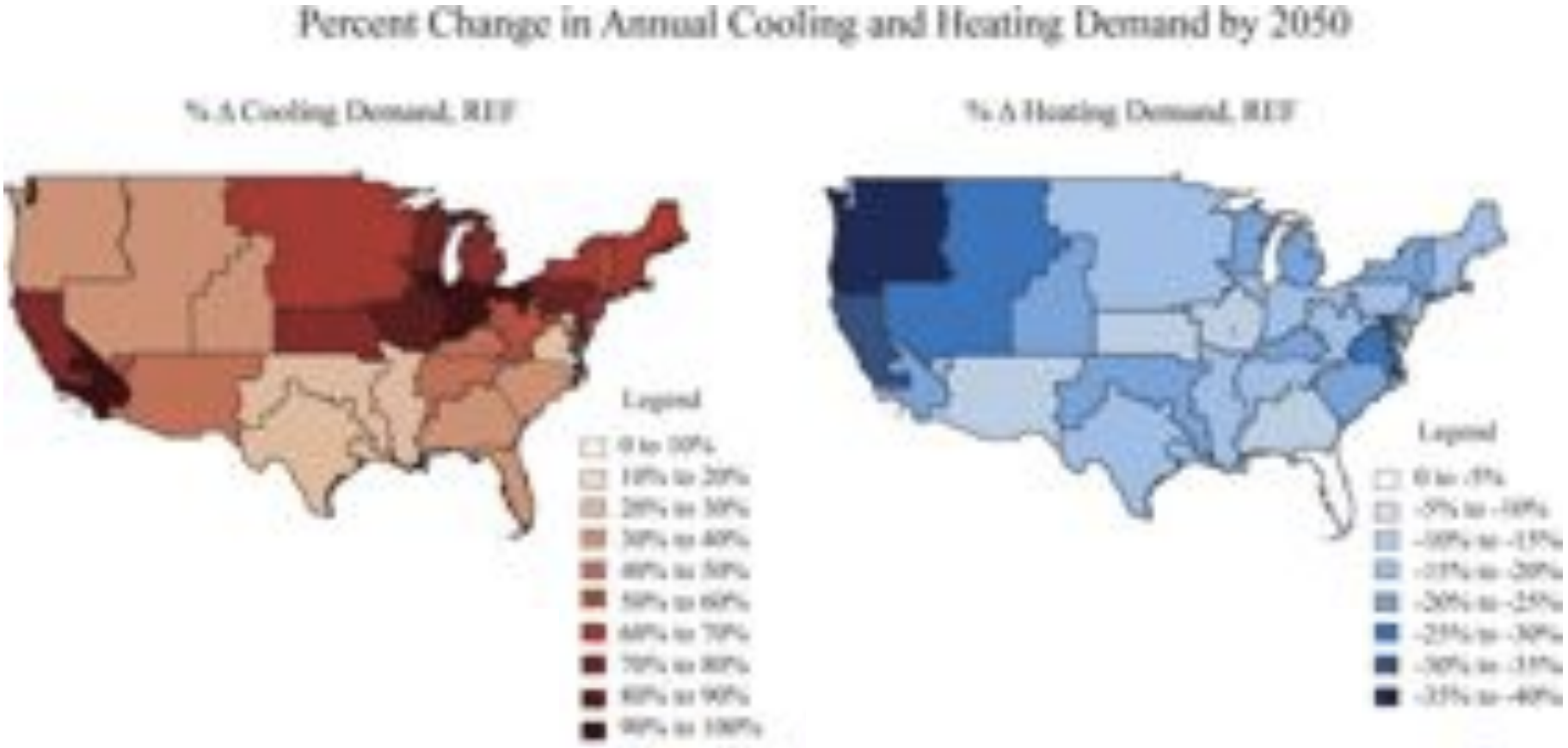


Figure source: Climate Impacts Group, based on projections used in IPCC 2013

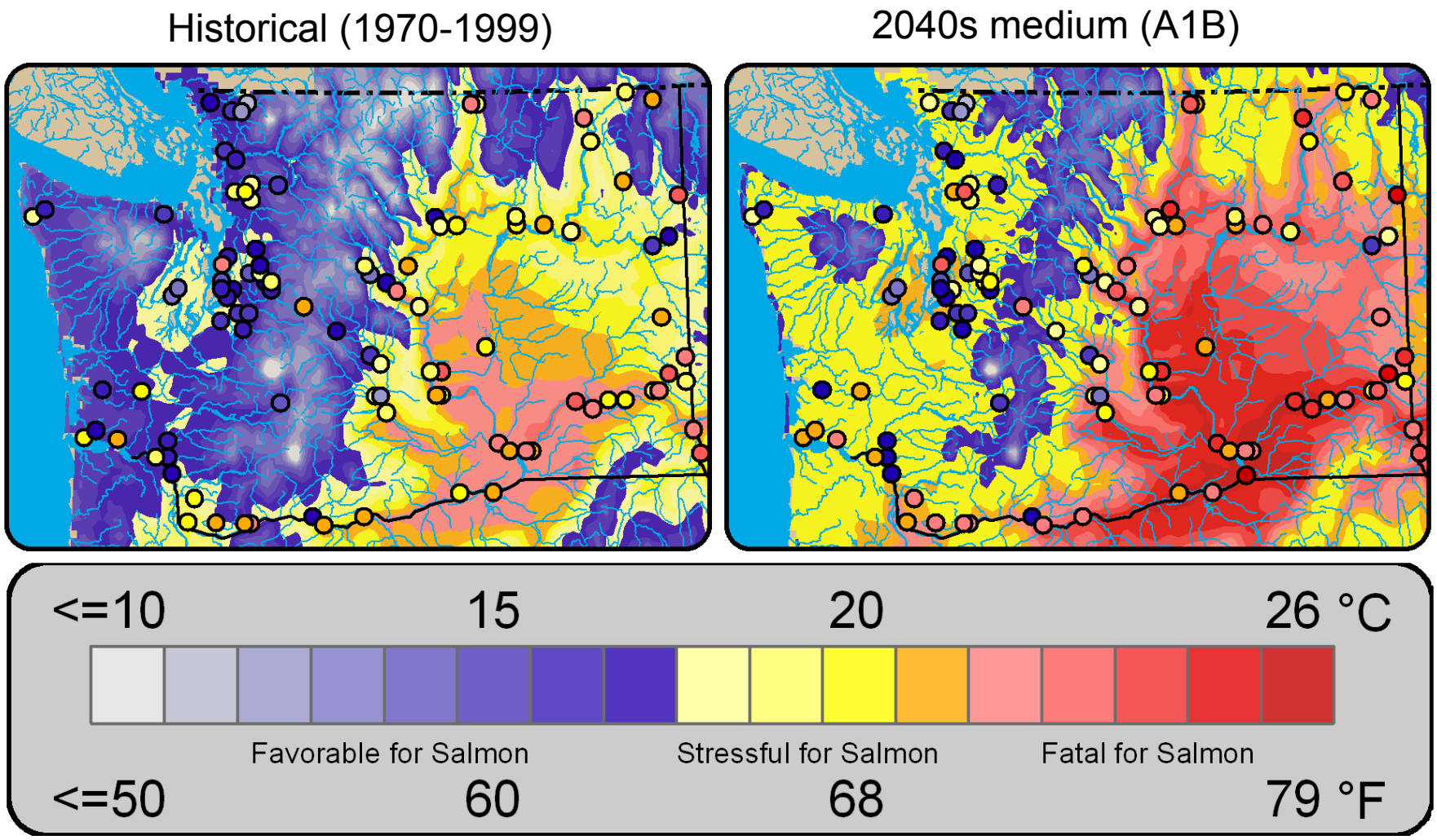
Changes in Electricity Demand



Jaglom et al 2014., Energy Policy, 73, 524-539

Warmer Stream Temperatures

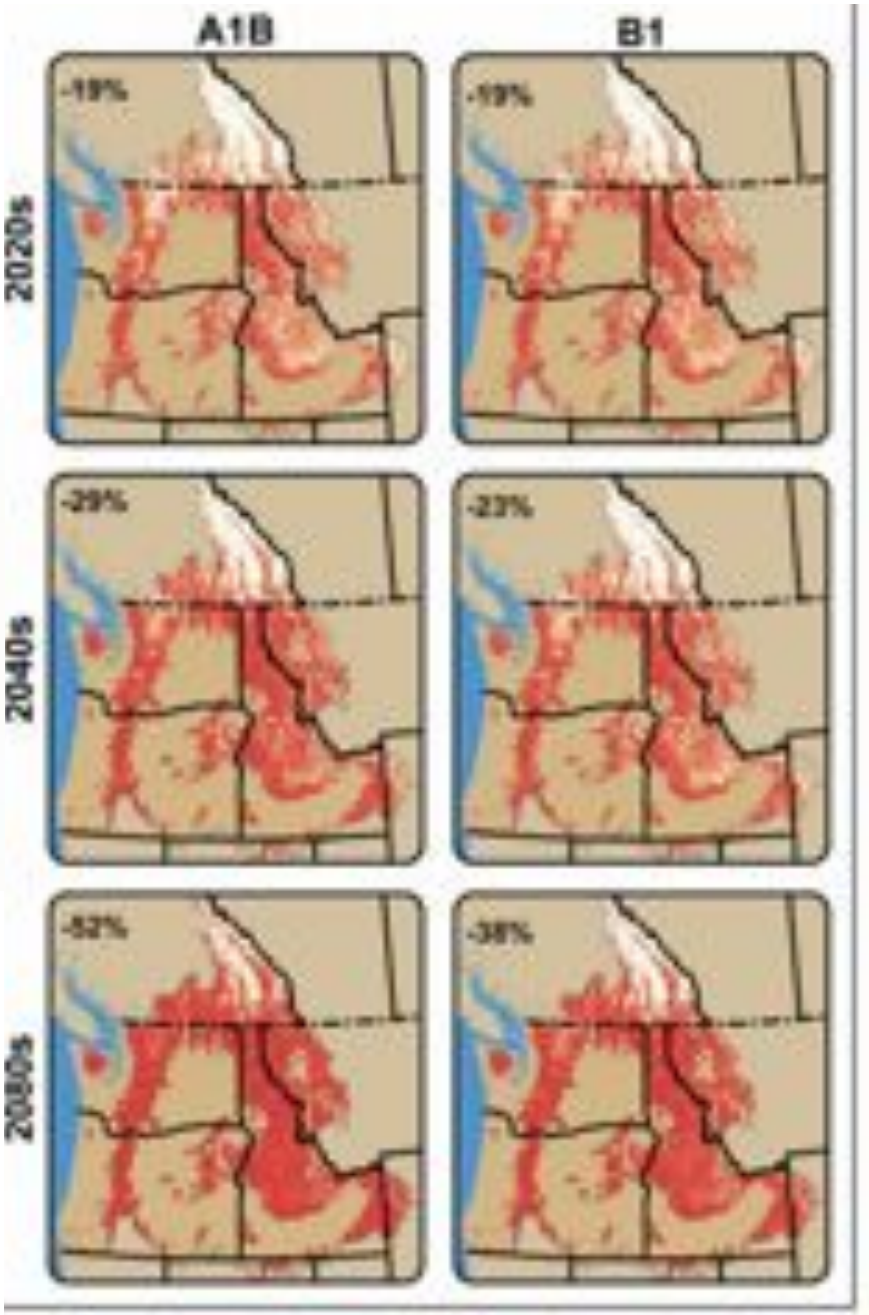
August Mean Surface Air Temperature and Maximum Stream Temperature



* Projections are compared with 1970-1999 average

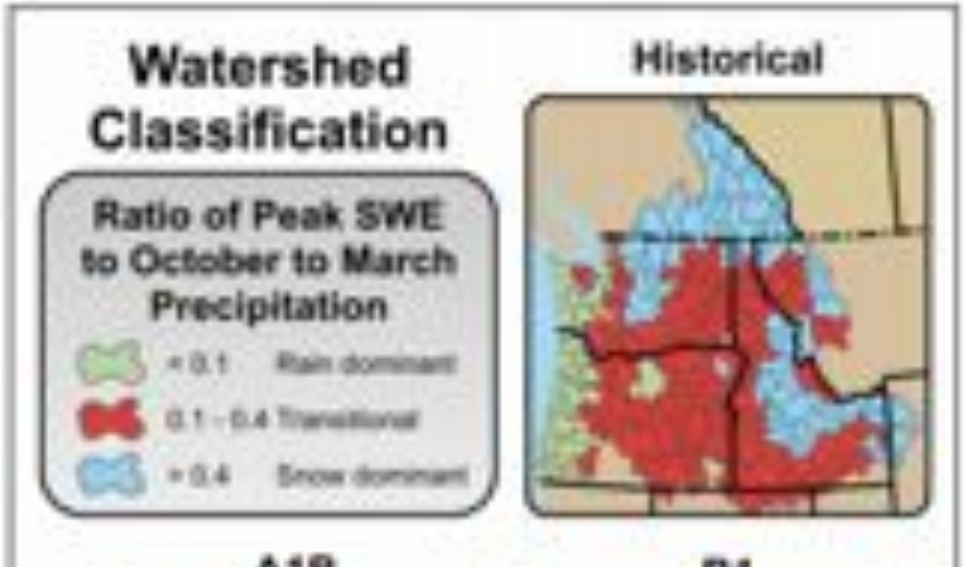
Mantua et al. 2010

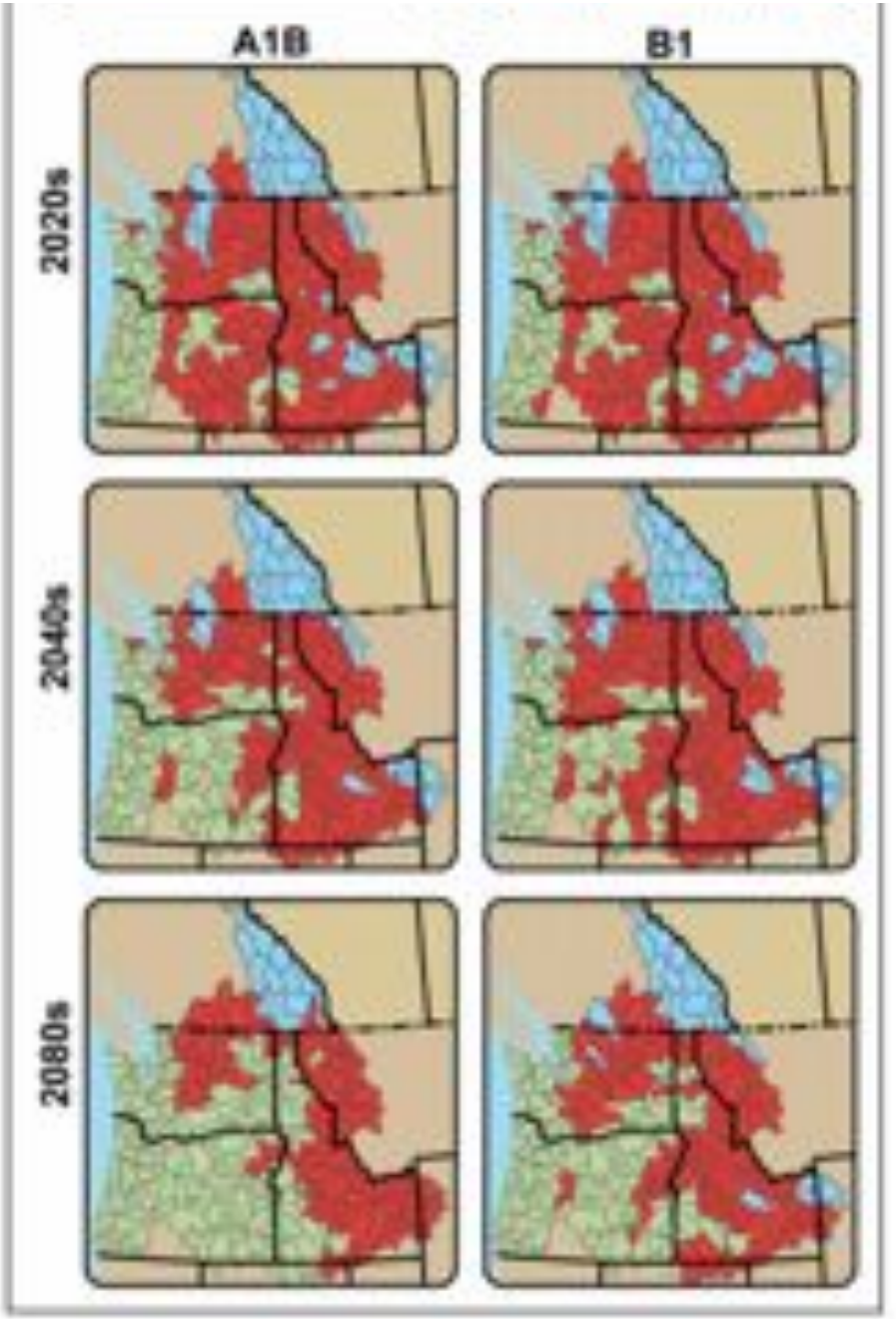
Vanishing Snowpack



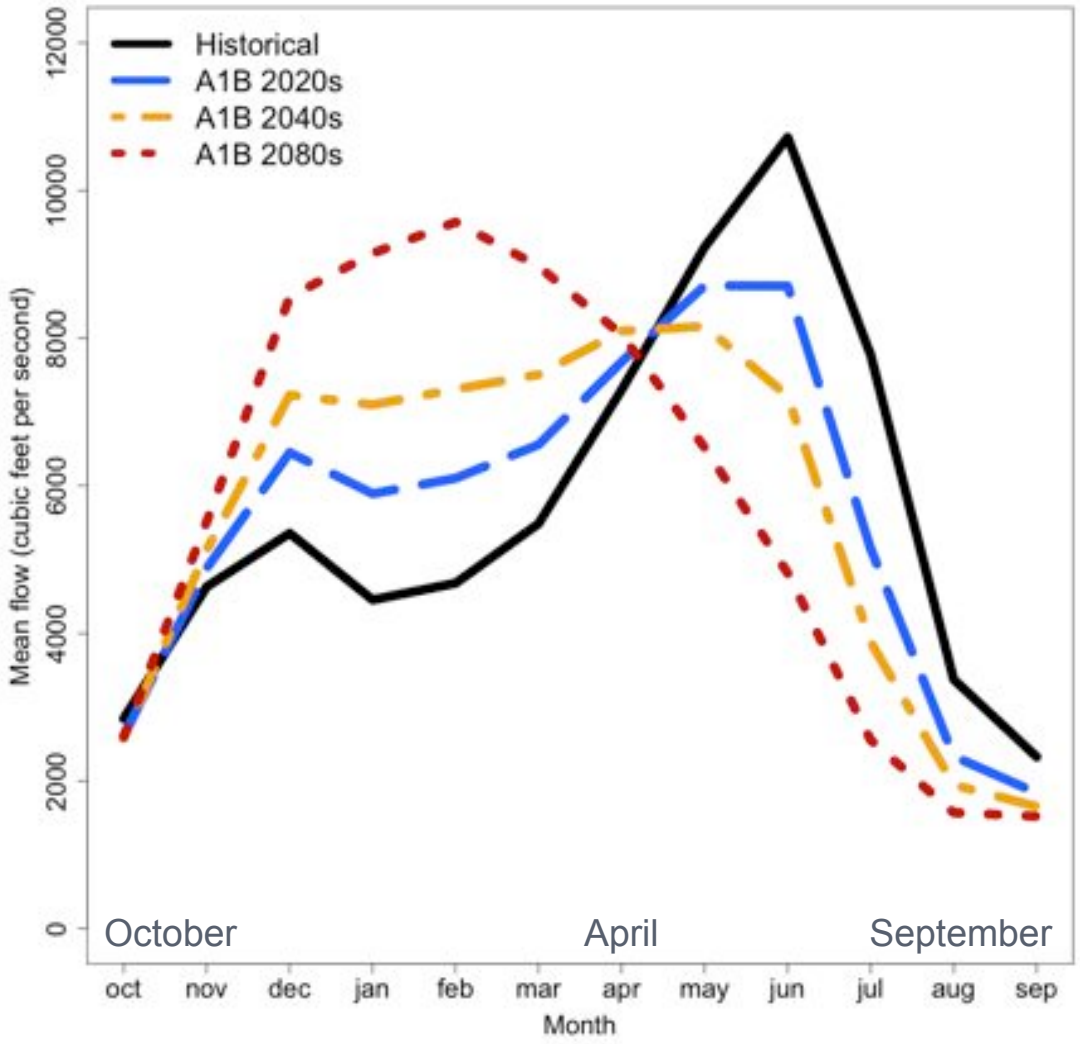
Hamlet et al. 2013, *AtmosphereOcean*, 51:4, 392-415

Watersheds Change Their "Type"



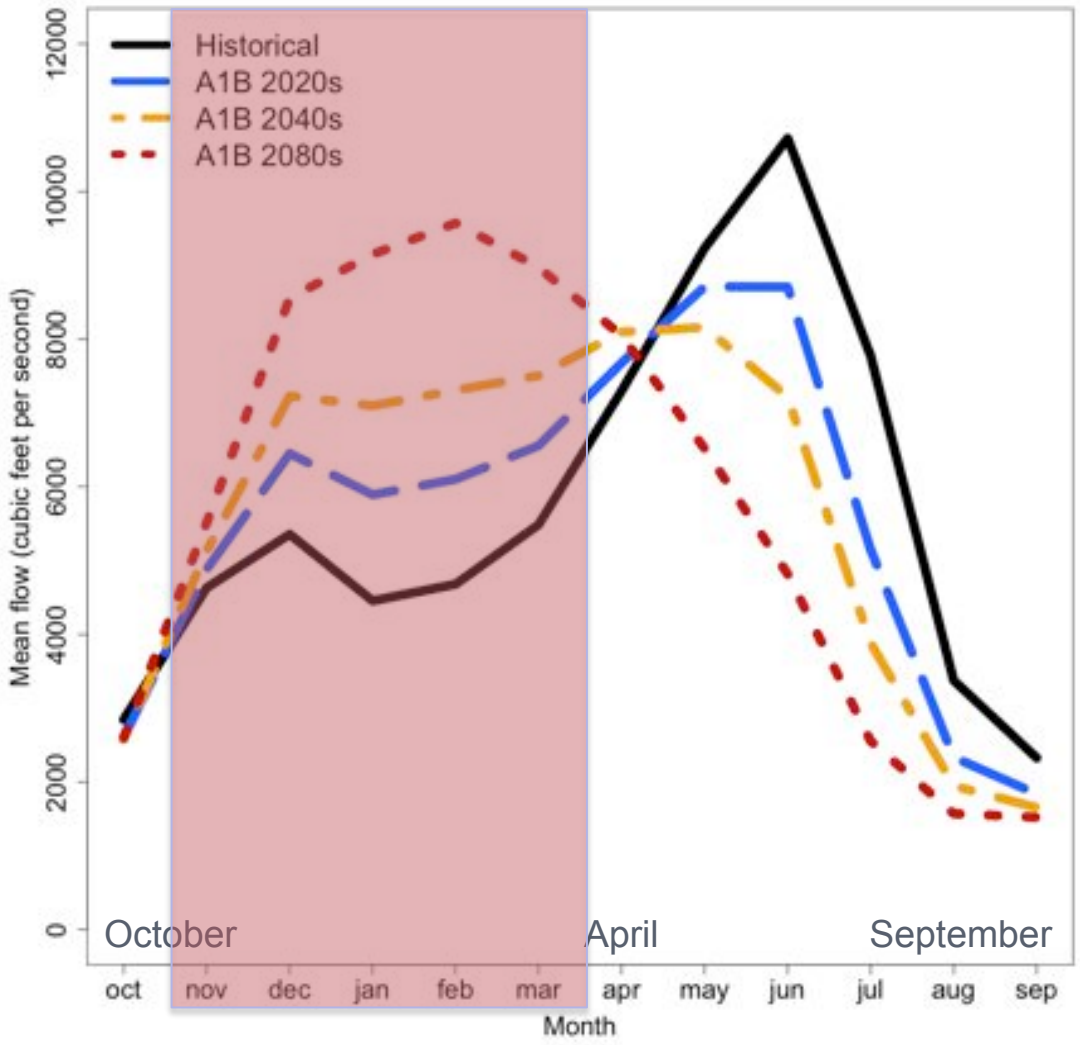


Shifting Streamflows – Yakima Basin



Elsner et al. 2010

Shifting Streamflows – Yakima Basin

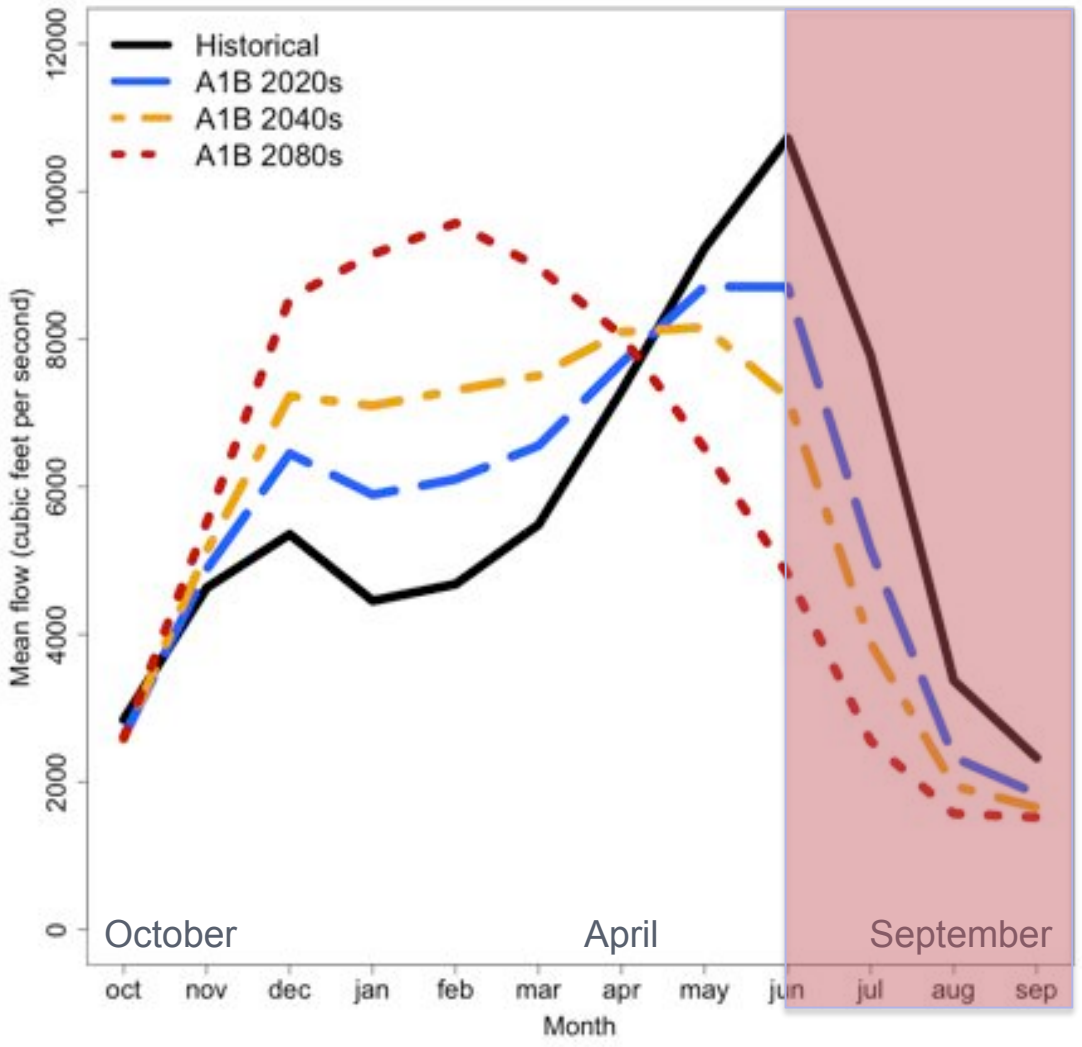


Increasing flows in the fall and winter

Flood risks increase

Elsner et al. 2010

Shifting Streamflows – Yakima Basin



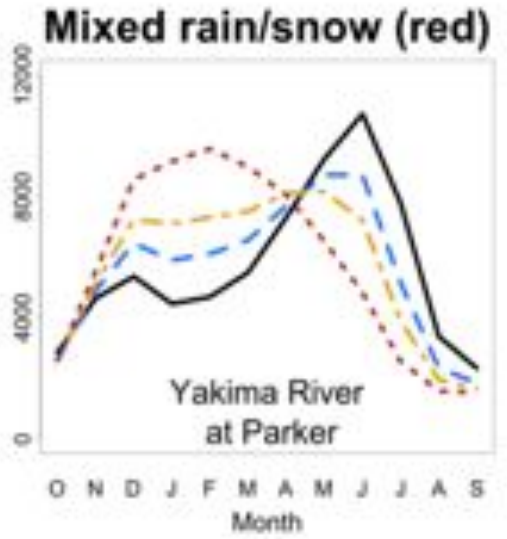
Earlier peak flow

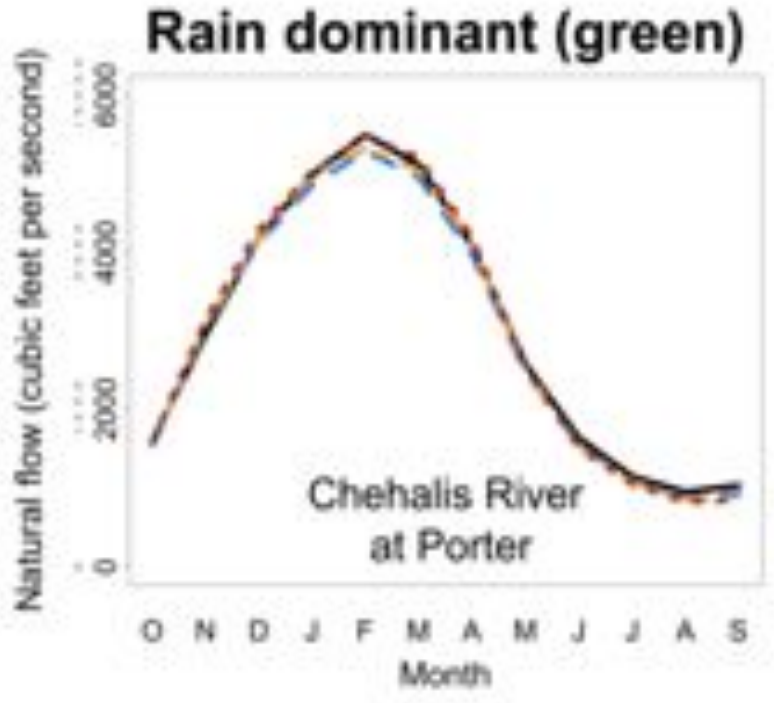
More prolonged low-flow period

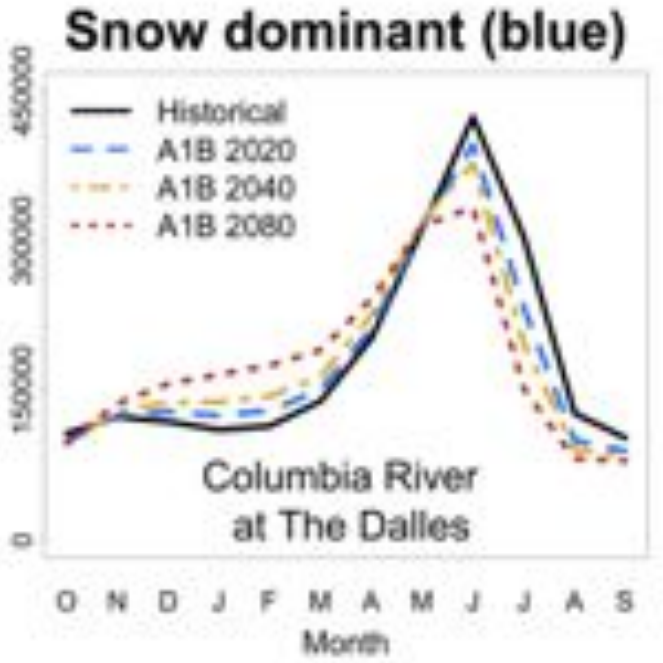
Greater competition among water users

Elsner et al. 2010

Mixed basins most sensitive, but snow-dominant basins will become more "transitional"







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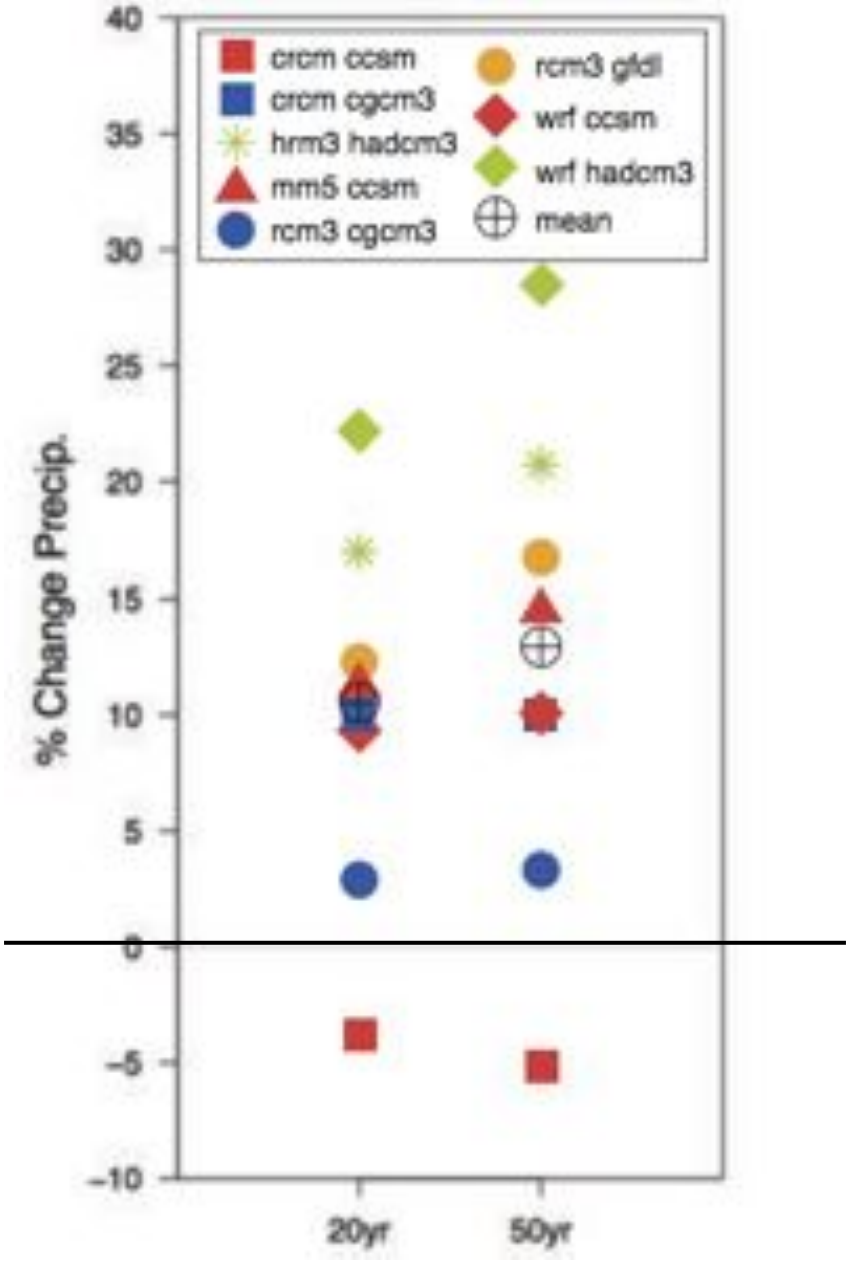
Heavier rainfall events get heavier

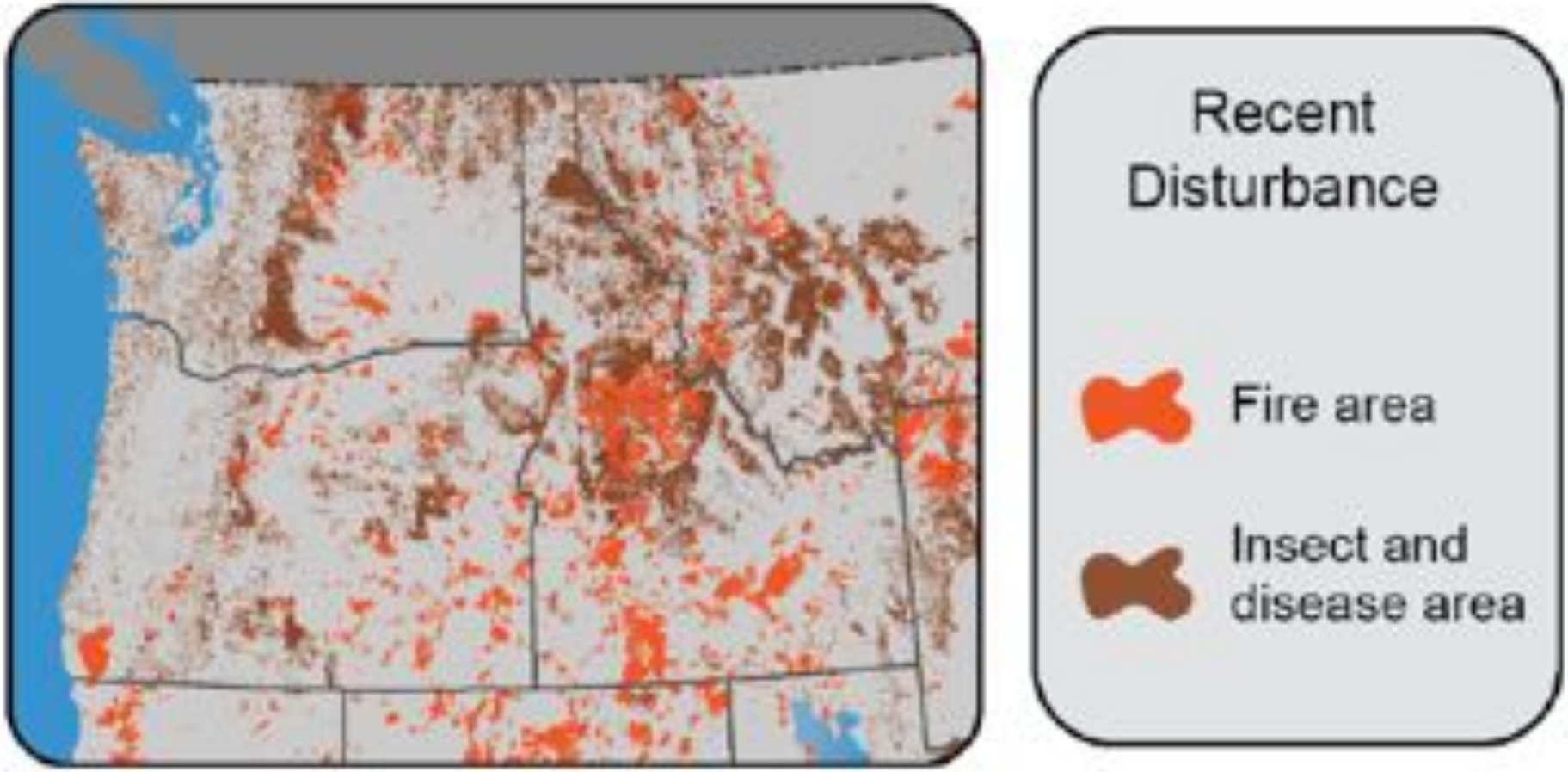
Frequency and intensity of heavy rainfall
both projected to increase

Multiple models, 2041-2070 vs. late 20th century



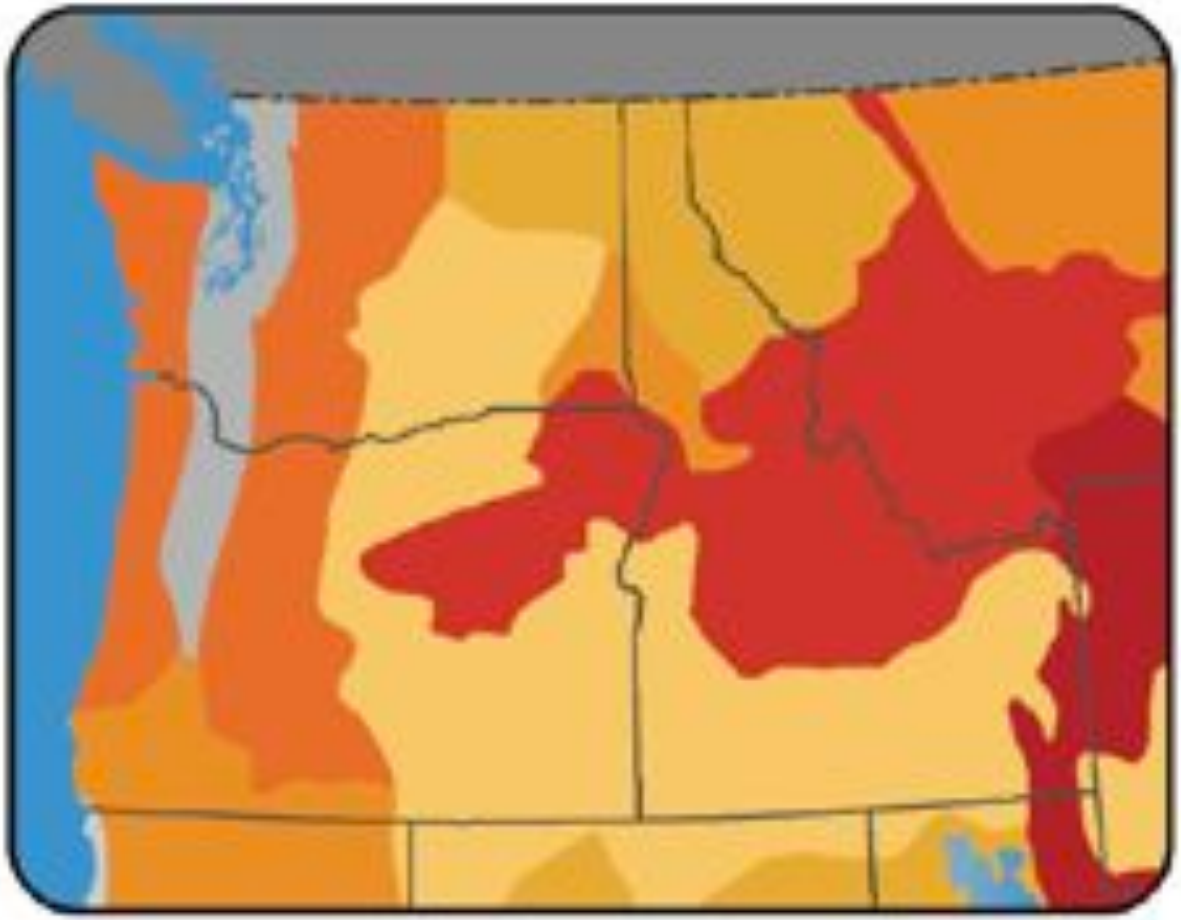
NCA Technical Input for the Northwest (2013)
Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities

Landscape is already undergoing significant change



Mote et al. 2014; Data sources: Eidenshink et al. 2007; USGS 2012; USFS 2012

Future fire risk projected to grow



NRC 2011

The future is unlikely to resemble the past…

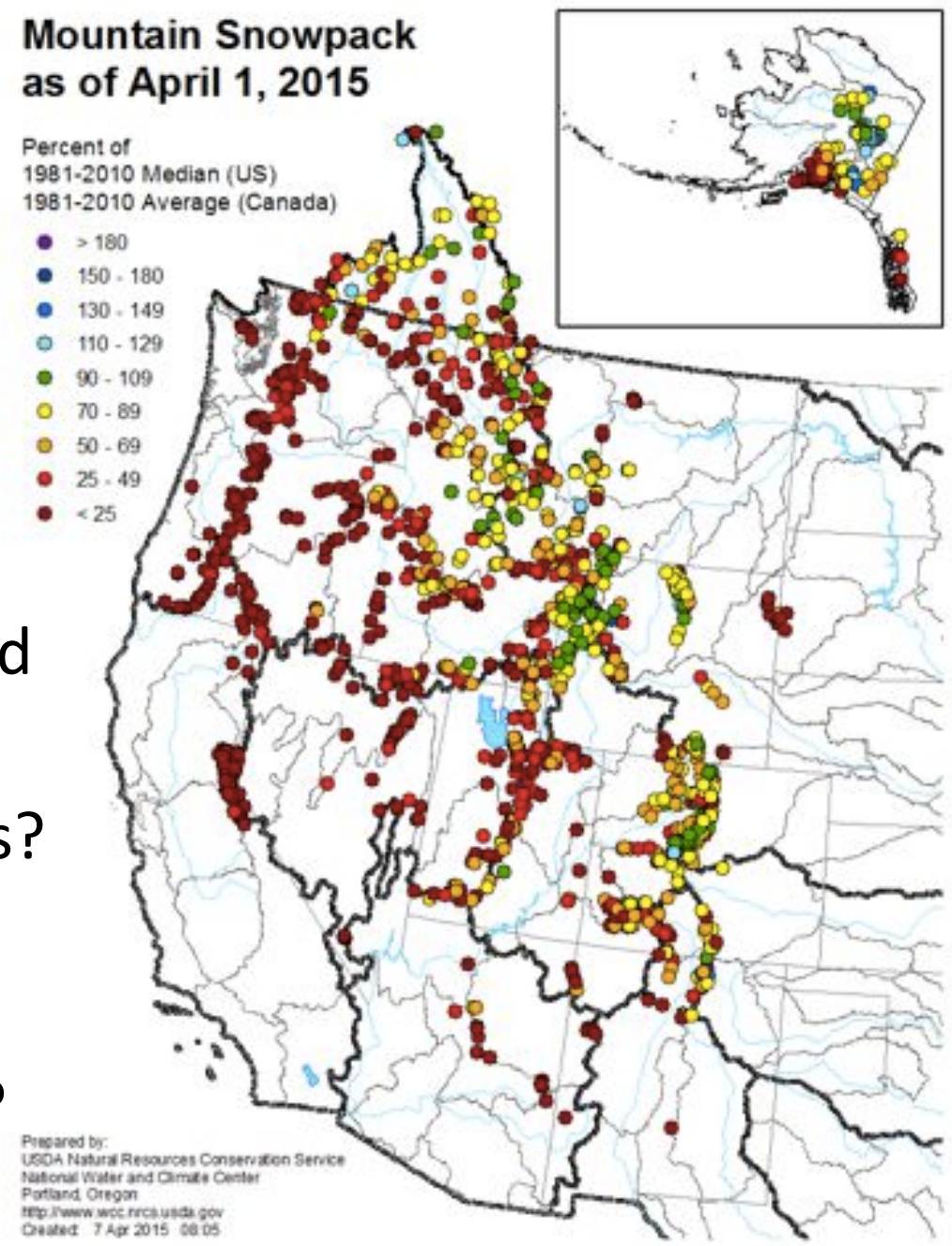
- Warmer
- Changes in the timing and amount of streamflow
- Changes in our landscape
- The Northwest's hydroclimate will be **dynamic**

The future is unlikely to resemble the past…

- Challenges for infrastructure and operations
- Risks and solutions are shared: Decisions by one set of managers will affect other managers
- Finding robust strategies
  - Goes beyond engineering
  - Will be iterative
  - Requires diverse engagement
- Past extremes can be a useful "playbook"

2015: Analog for the future

- PacNW - Temperatures looked like mid-21st century; snowpack looked like end-of-century
- What are our sensitivities? What "broke?"
- Can we handle an extended version of this?



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