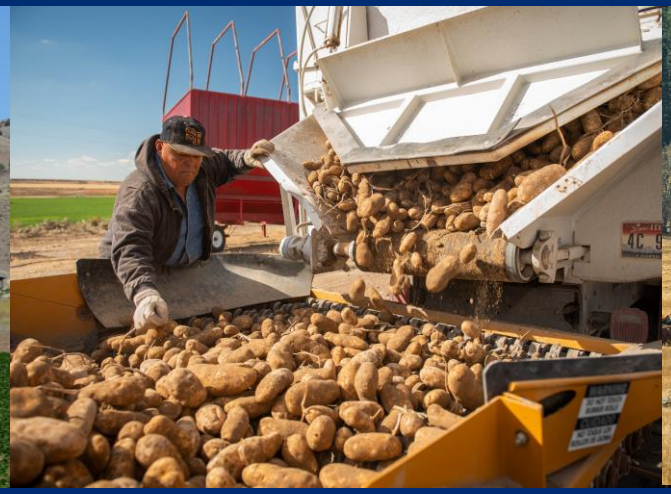
Climate Change in Northwest Forests

USDA Northwest Climate Hub
U.S. DEPARTMENT OF AGRICULTURE

Holly Prendeville, Coordinator

May 2023

Northwest Climate Hub

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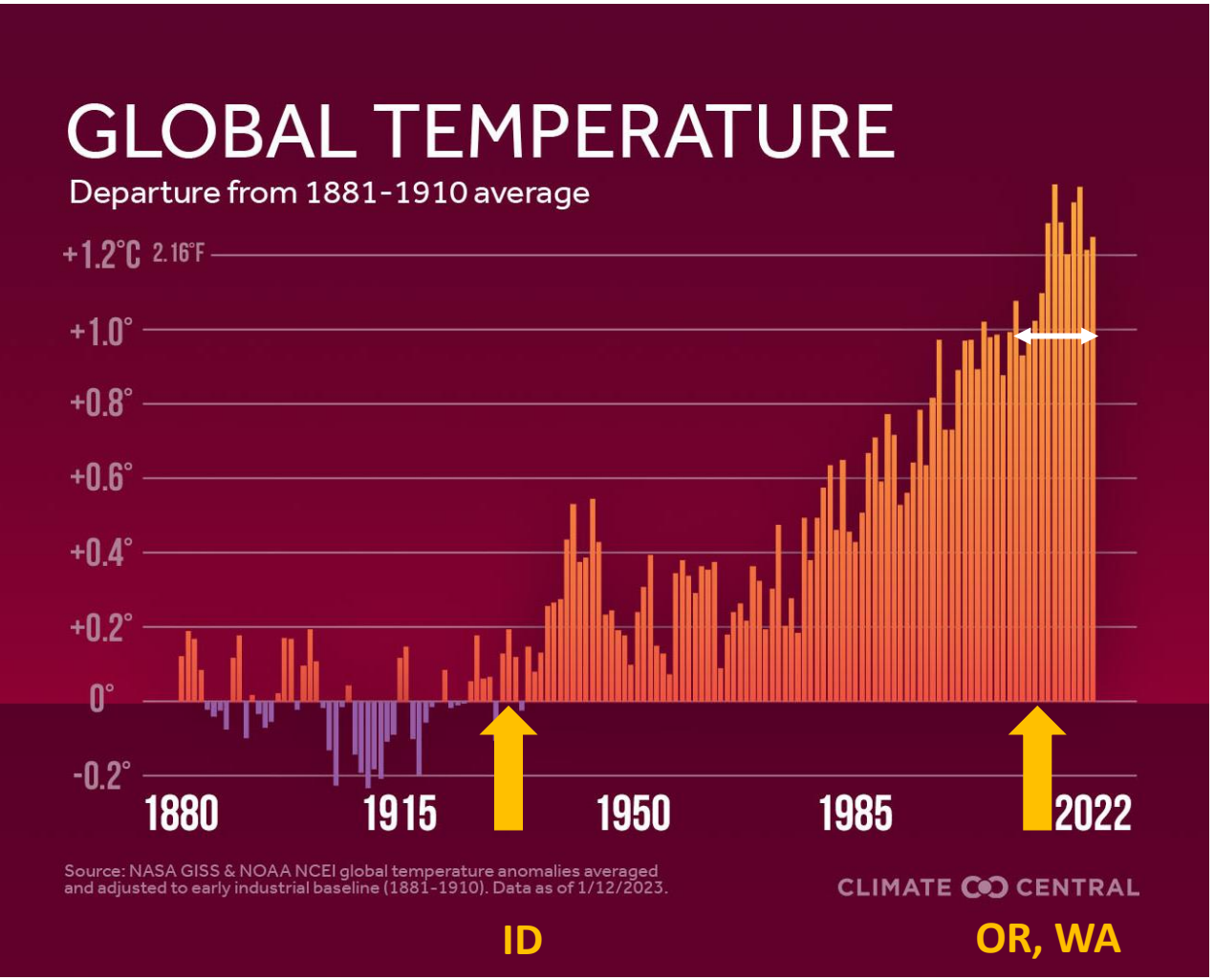
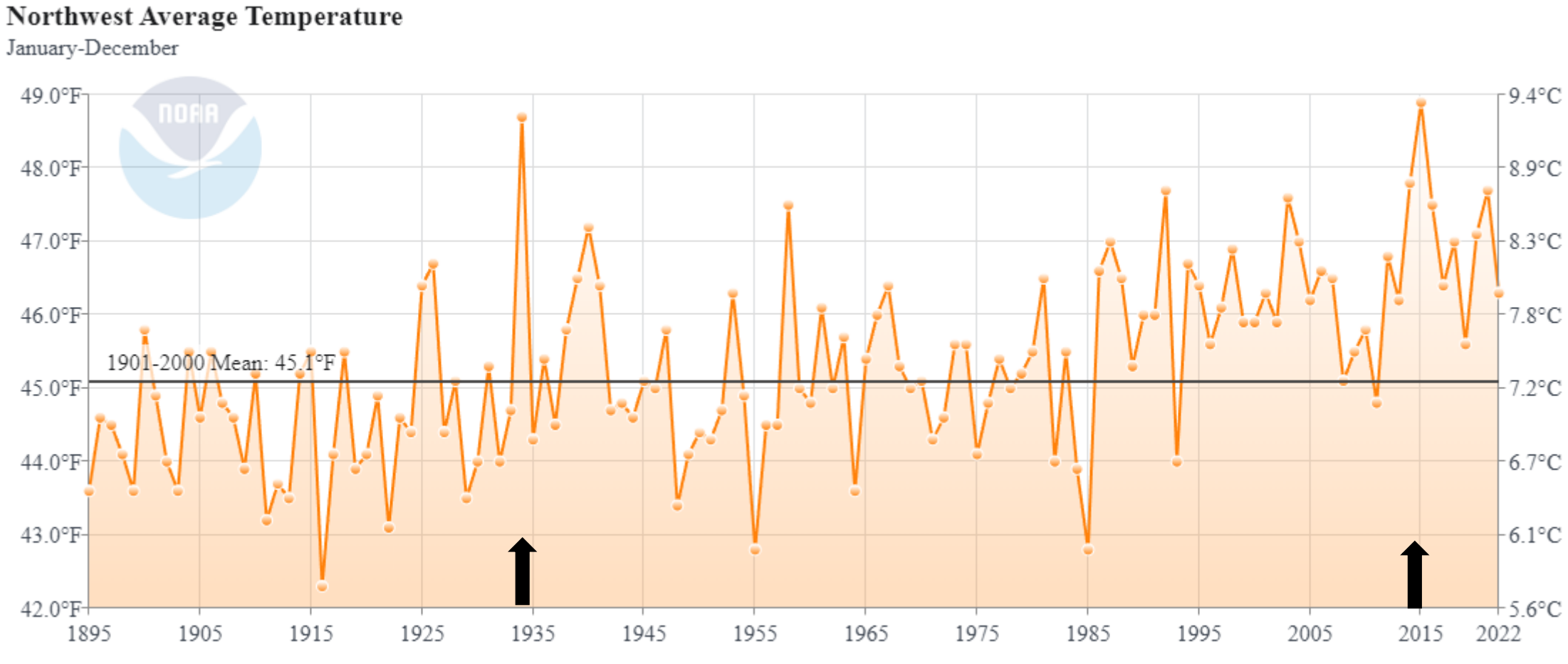
U.S. DEPARTMENT OF AGRICULTURE

The world is warmer



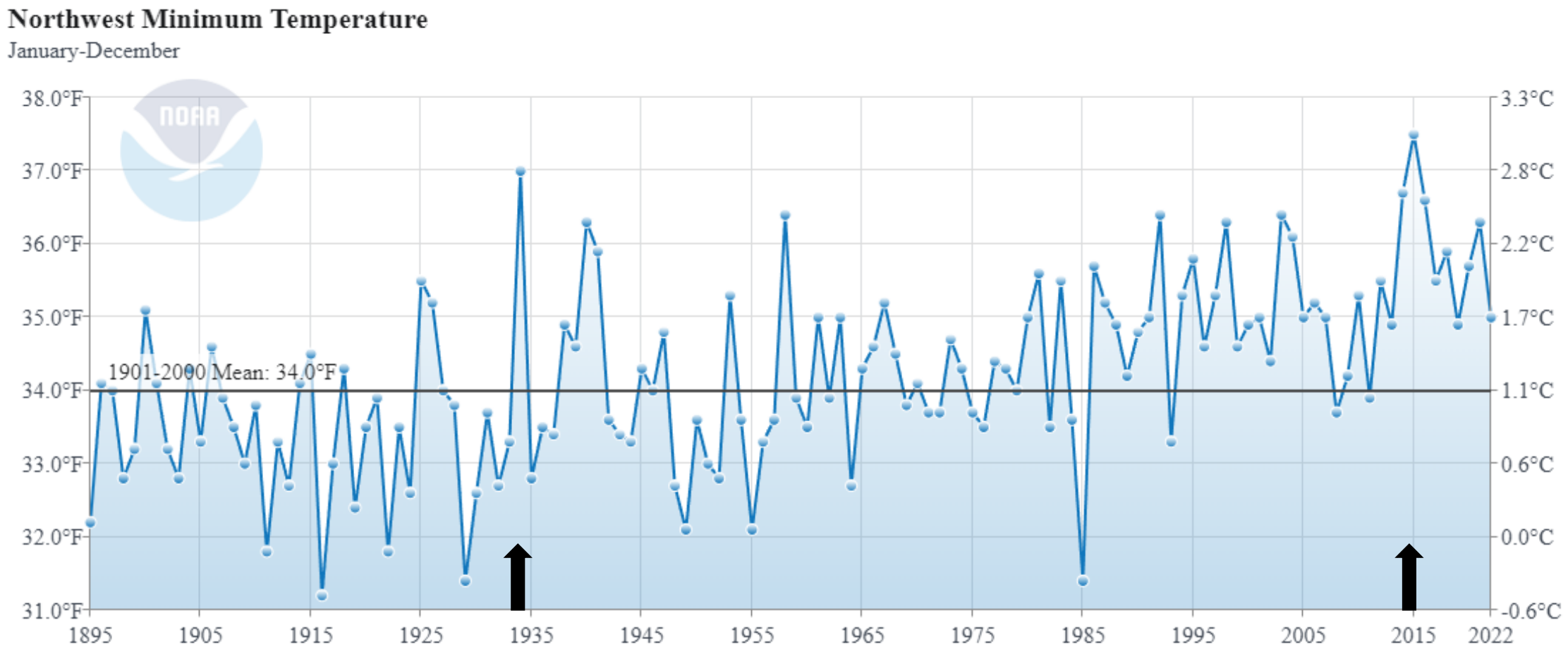
Observed temperatures: NW is also warmer

Since 1895, average temperature has increased almost 2°F



Observed temperatures: NW is also warmer

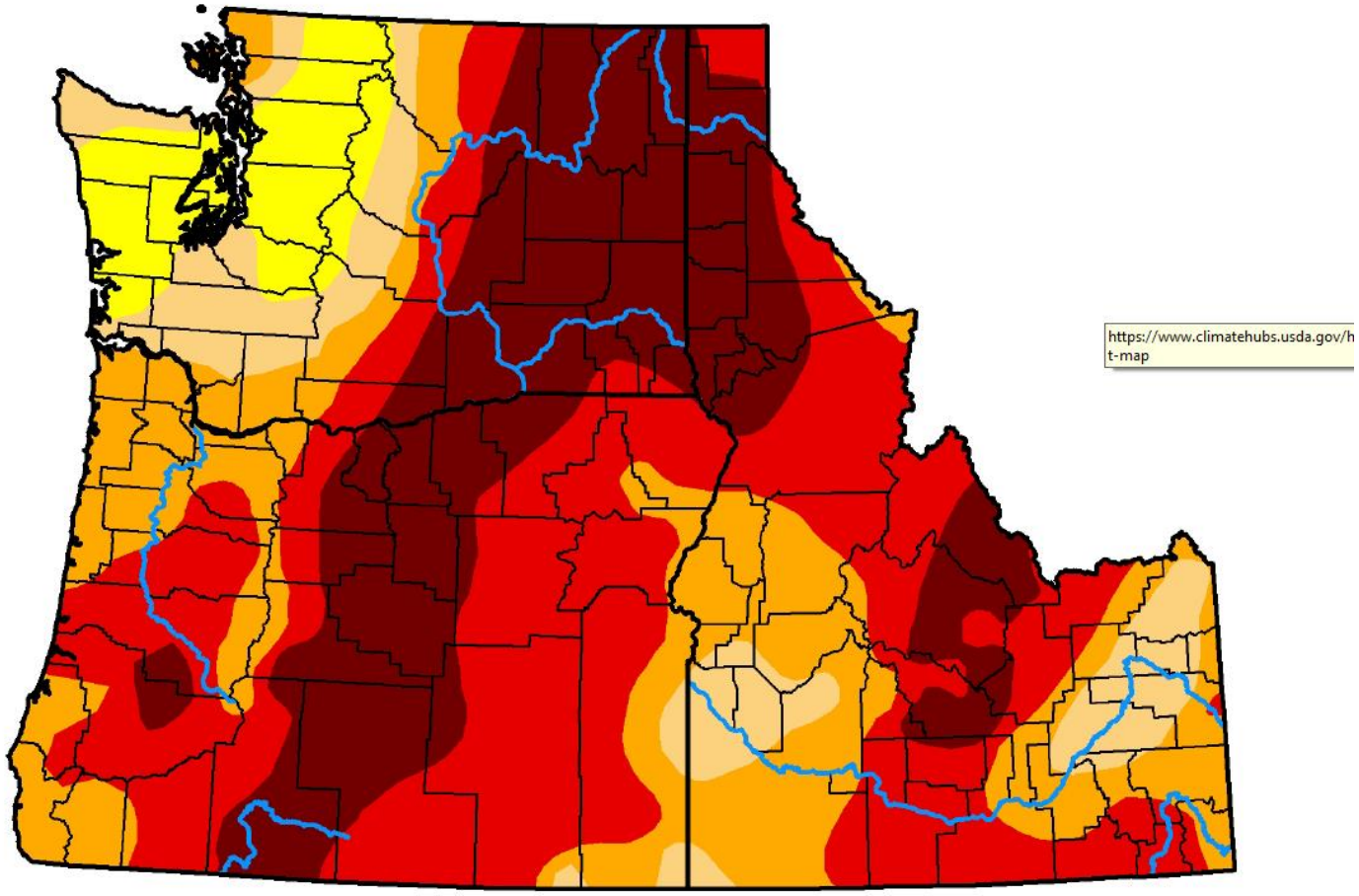
Higher minimum temperatures: longer frost-free season



U.S. Drought Monitor – 24 August 2021

Drought Classification

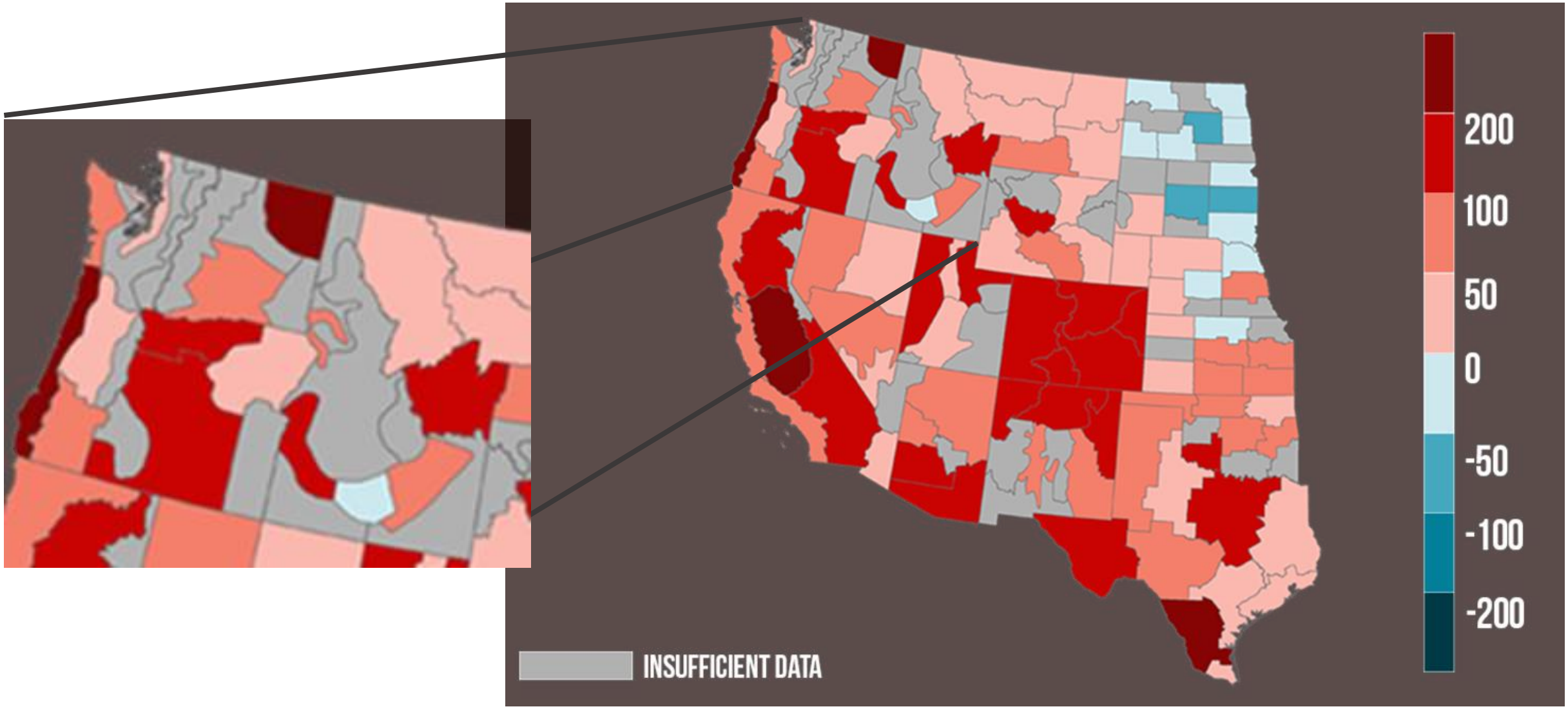
- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
- No Data



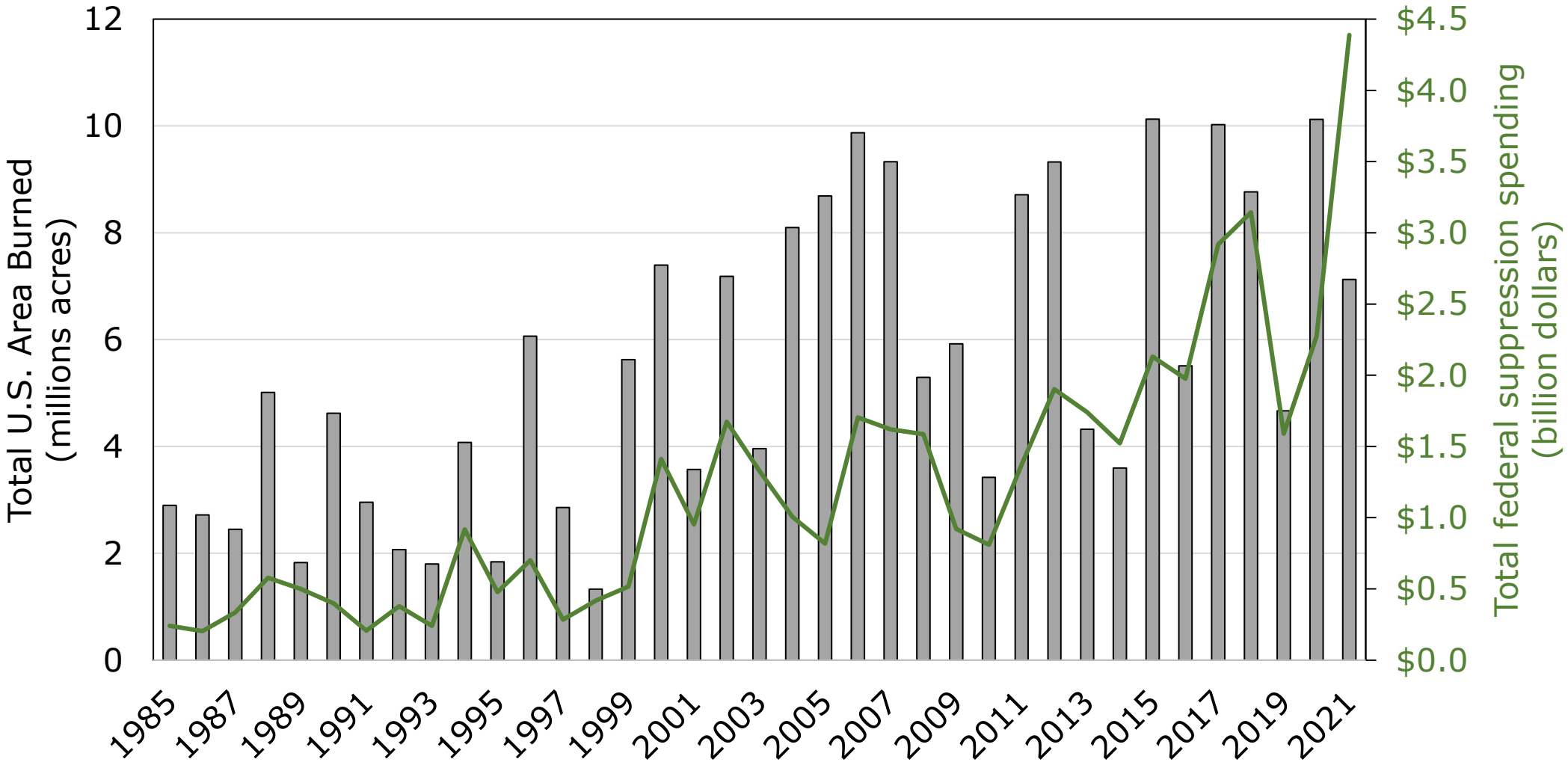
Firmageddon?!

Change in fire weather days

(% change from 1973 to 2020)



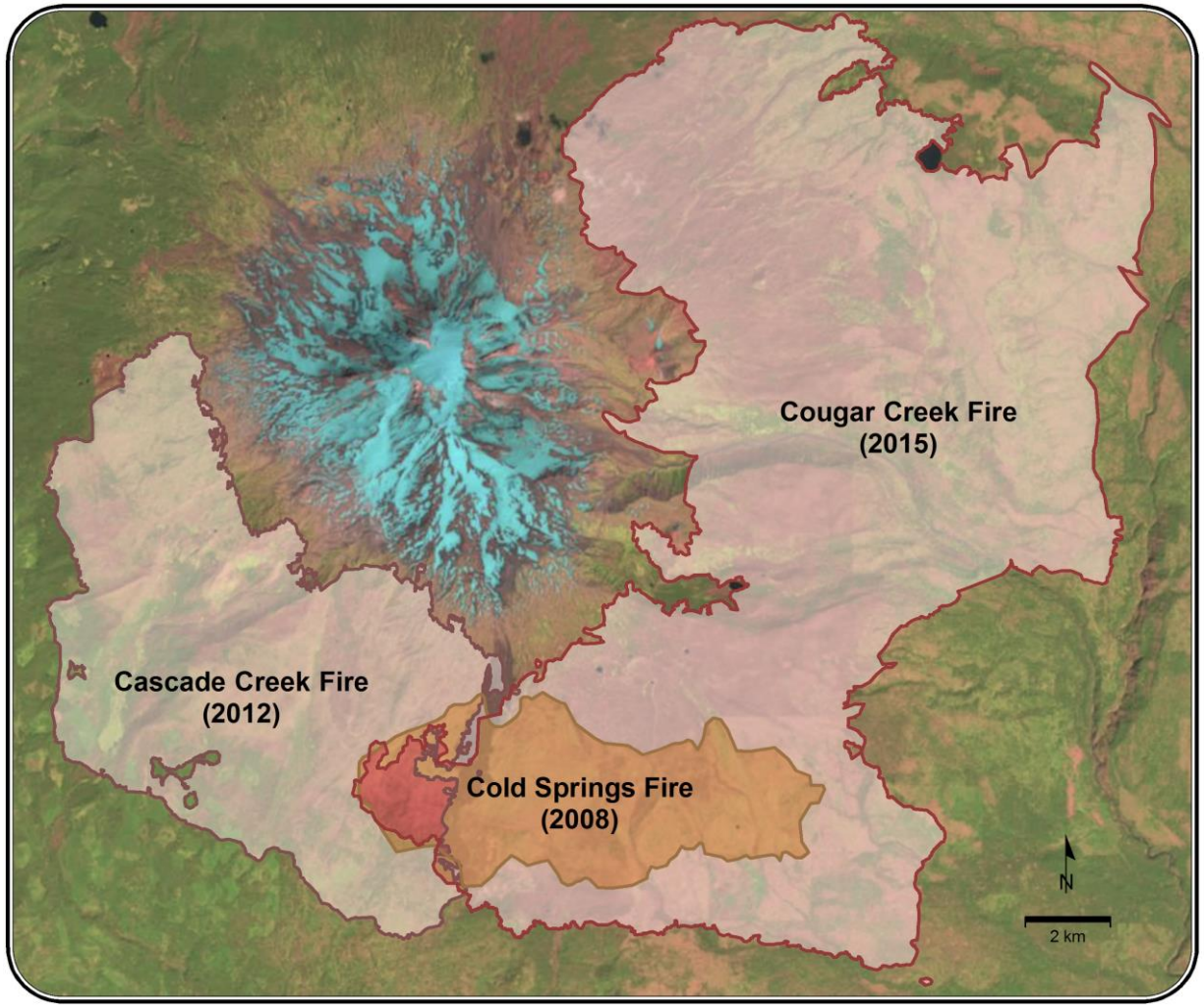
Wildfire area burned in the U.S.



Wildfires are reburning areas more frequently

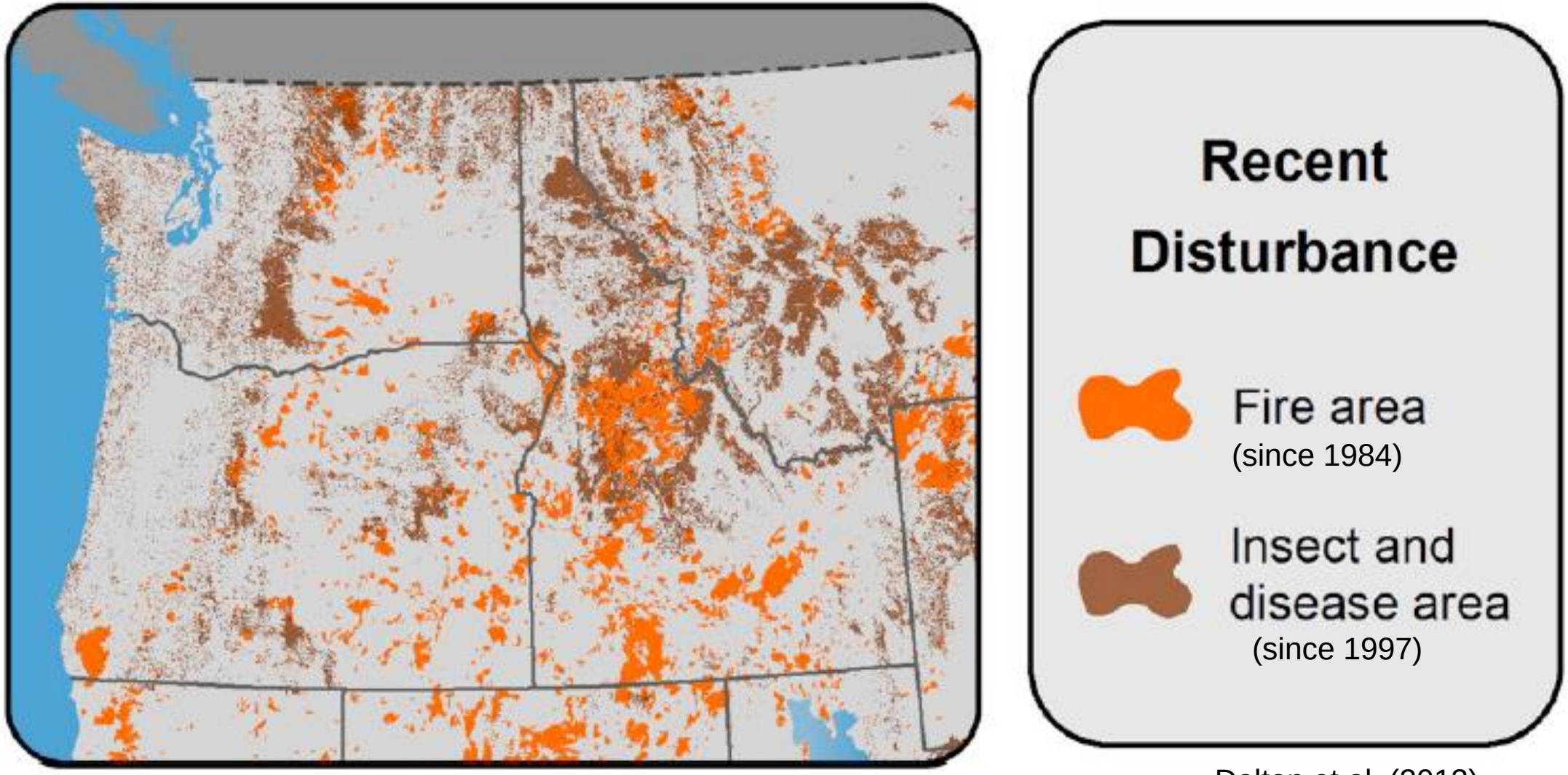
Southwest Washington

Fires have burned some areas 3 times since 2008



Map by R. Norheim

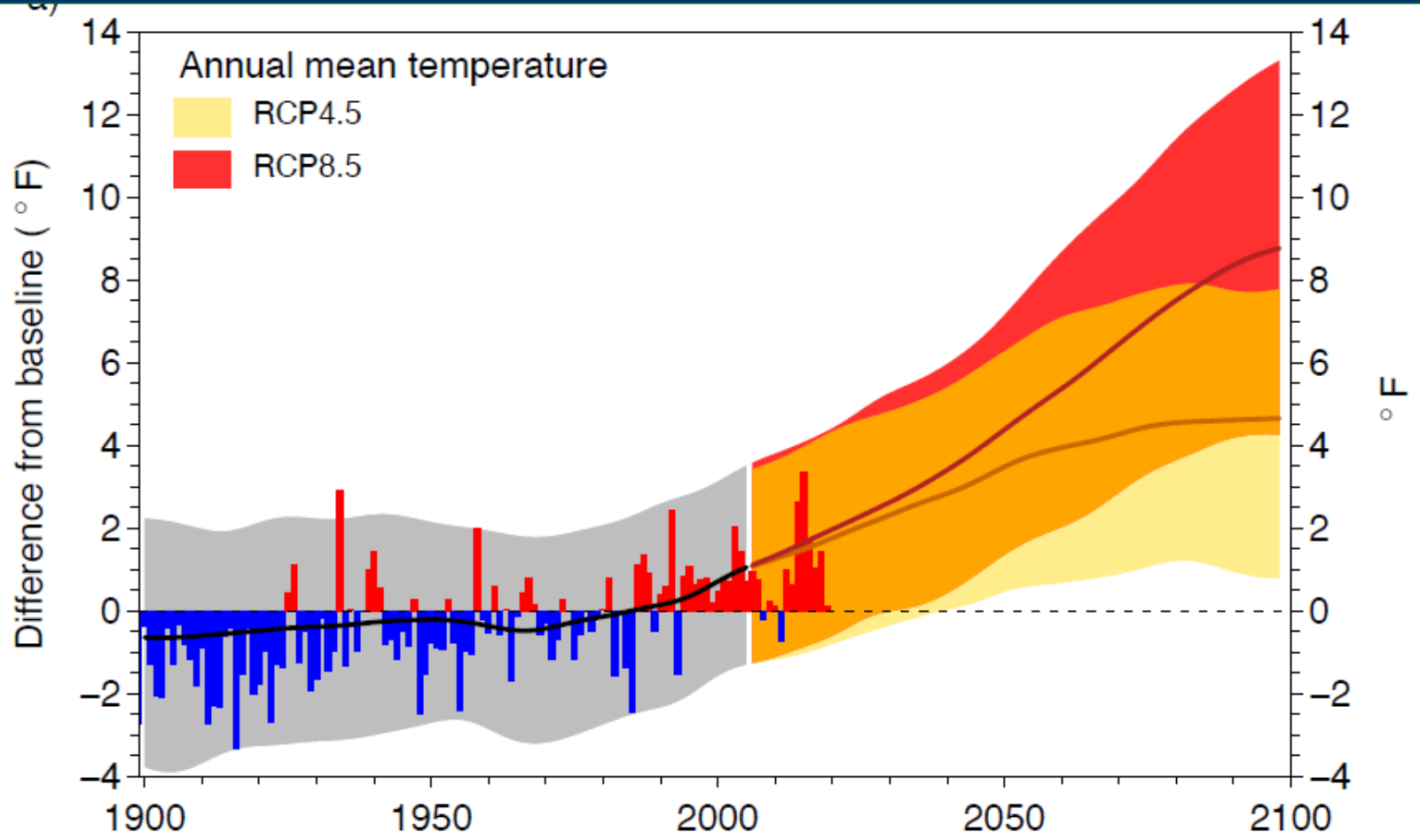
Interacting disturbances?



Dalton et al. (2013)

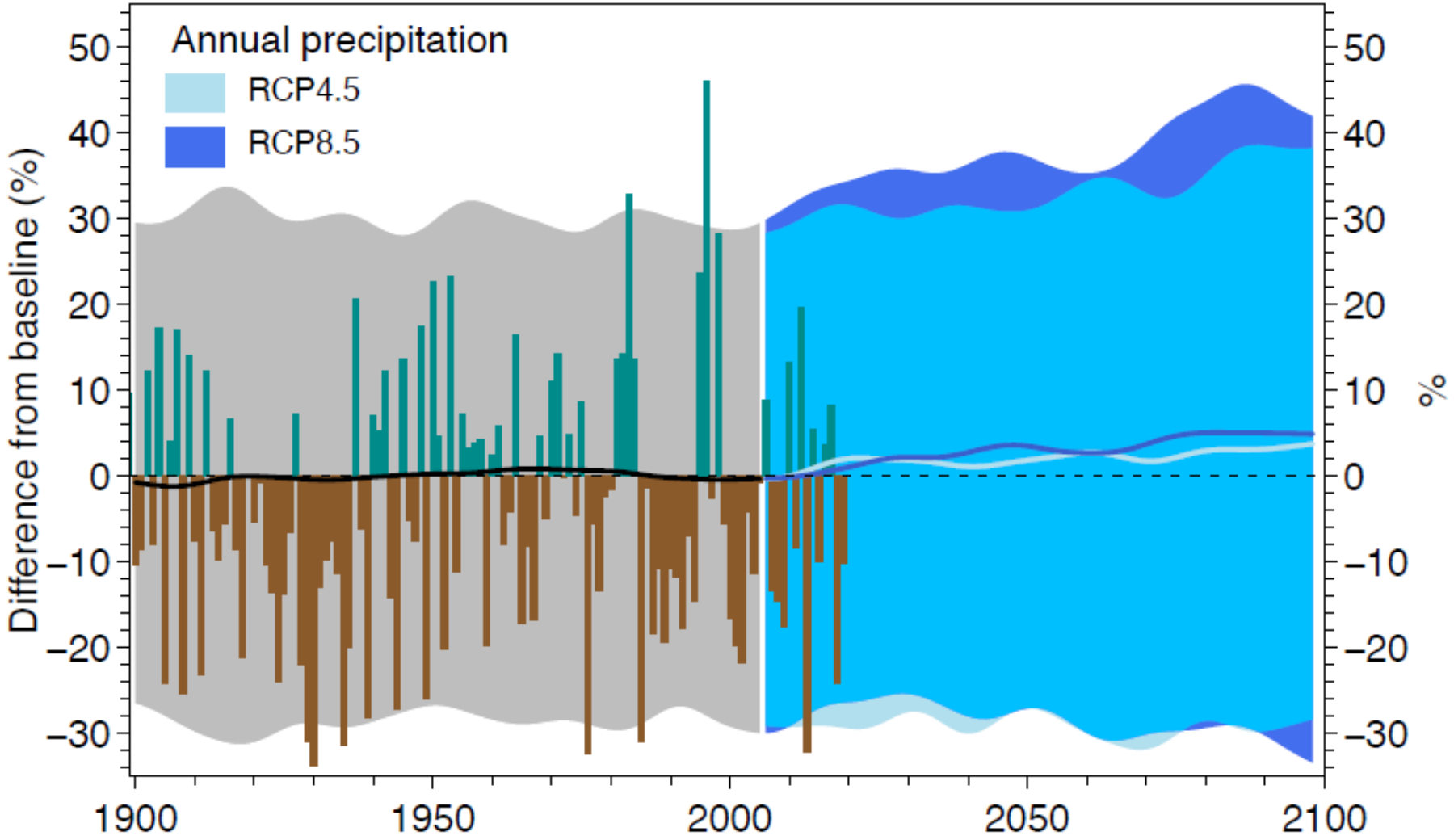
Projected temperatures

High emissions greenhouse gas scenario (RCP 8.5), project annual average temperature to increase by 11 °F by the 2080s

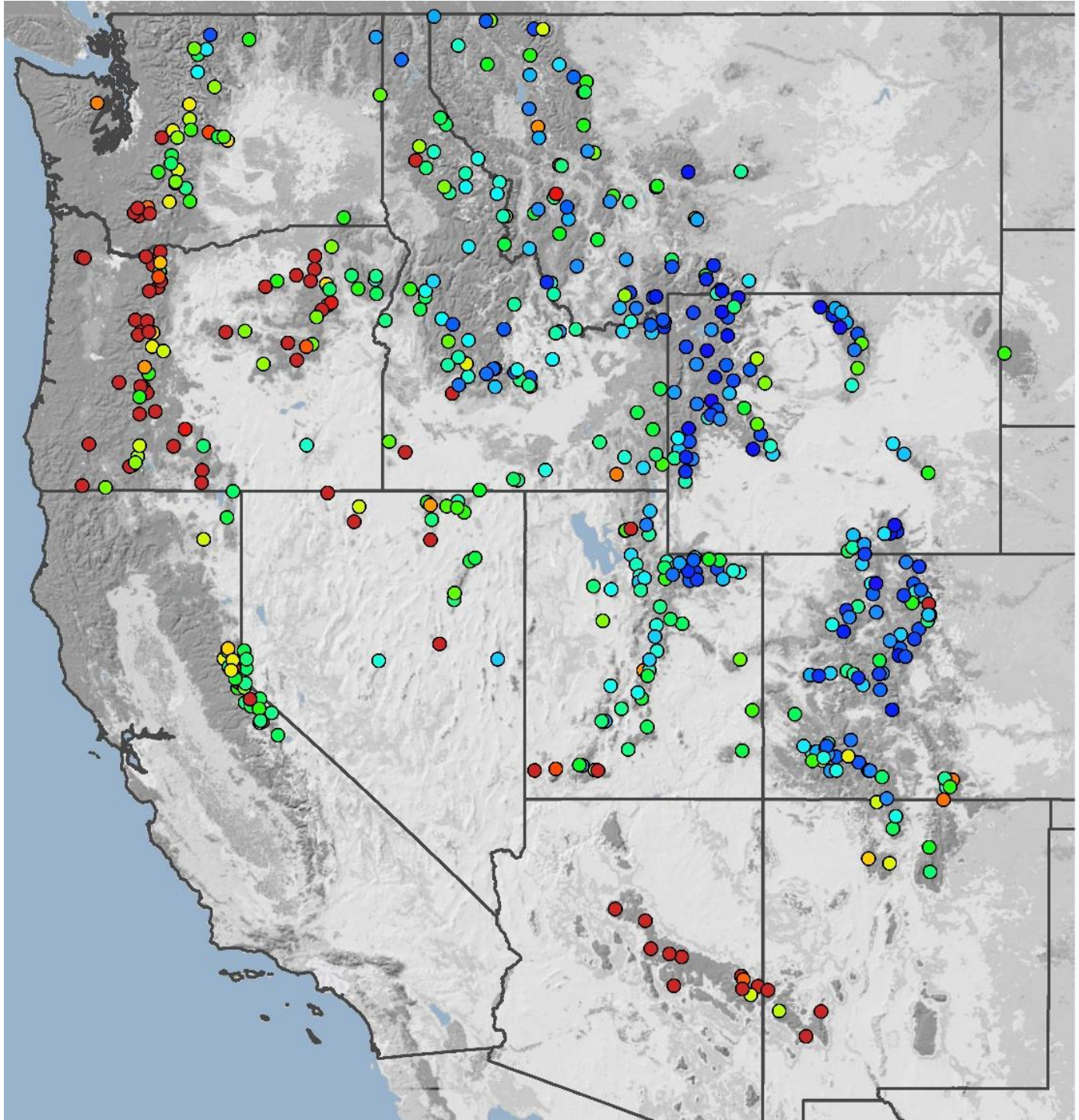


Fifth OR Climate Assessment, 2021

Projected precipitation



Fifth OR Climate Assessment, 2021



Snowpack Sensitivity

Percent Change
April 1 SWE

-25
-50
-75
-100

3°C temperature increase

Data from C. Luce

How will trees grow in a warmer climate?

Eastside coniferous forest

Moisture limited

Growth will decrease:

- Ponderosa pine
- Douglas-fir
- Western larch
- White fir/grand fir

How will trees grow in a warmer climate?

Low elevation, westside forest

Moisture limited

Growth will decrease:

- Douglas-fir
- Western hemlock
- Western redcedar
- Sitka spruce

How will trees grow in a warmer climate?

High-elevation coniferous forest

Energy limited

Growth will increase:

- Subalpine fir
- Mountain hemlock
- Lodgepole pine

How will trees grow in a warmer climate?

Riparian areas, wetlands, groundwater-dependent systems

Water controlled

Growth and regeneration will change:

- Species composition
- Fire susceptibility

Extreme weather + increased disturbance: Our primary challenge

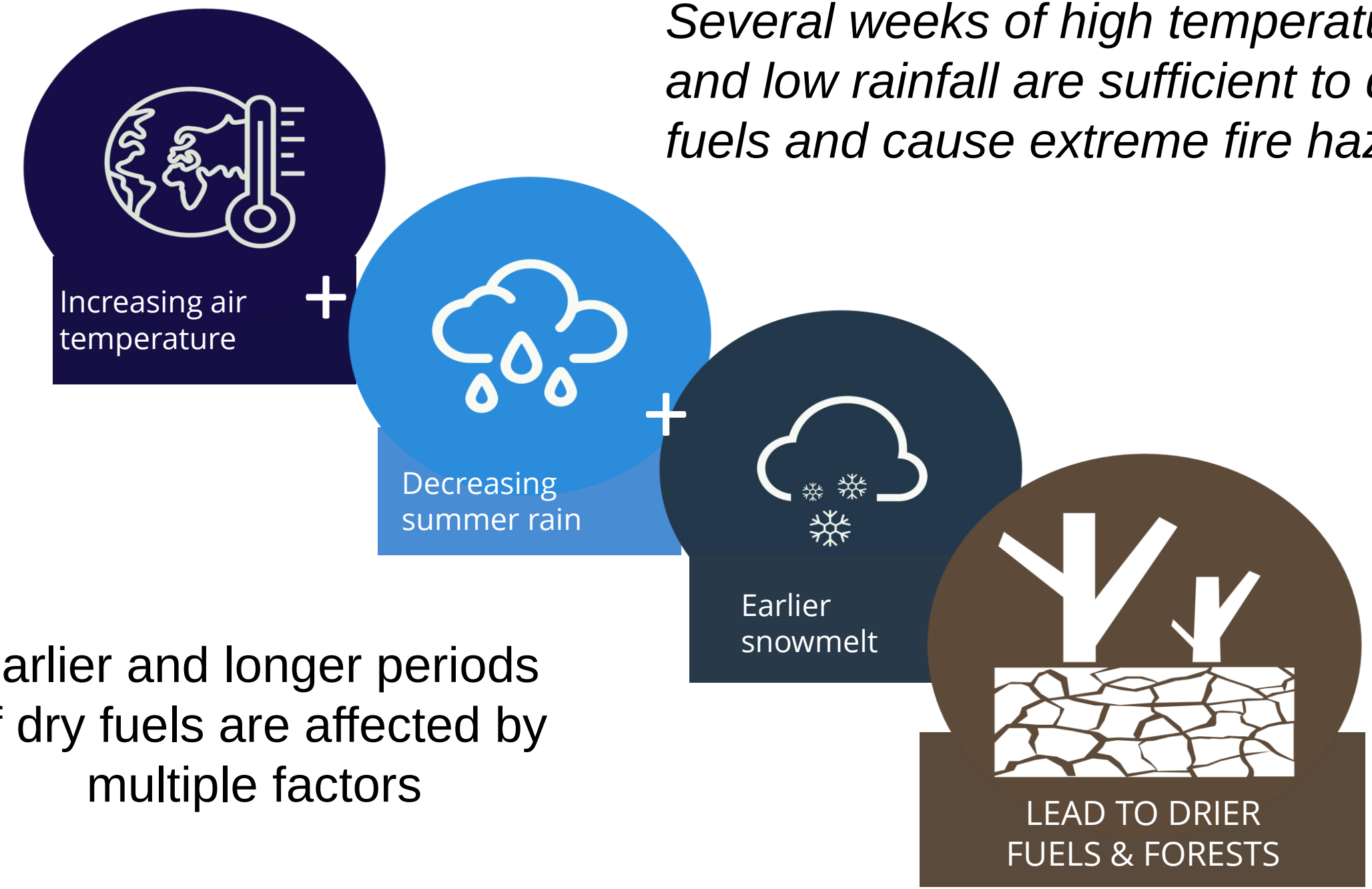
Climate change affects insects

Mountain pine beetle (MPB)

Warmer temperature has favored MPB by:

- Increasing its reproductive rate
- Allowing an expanded geographic range

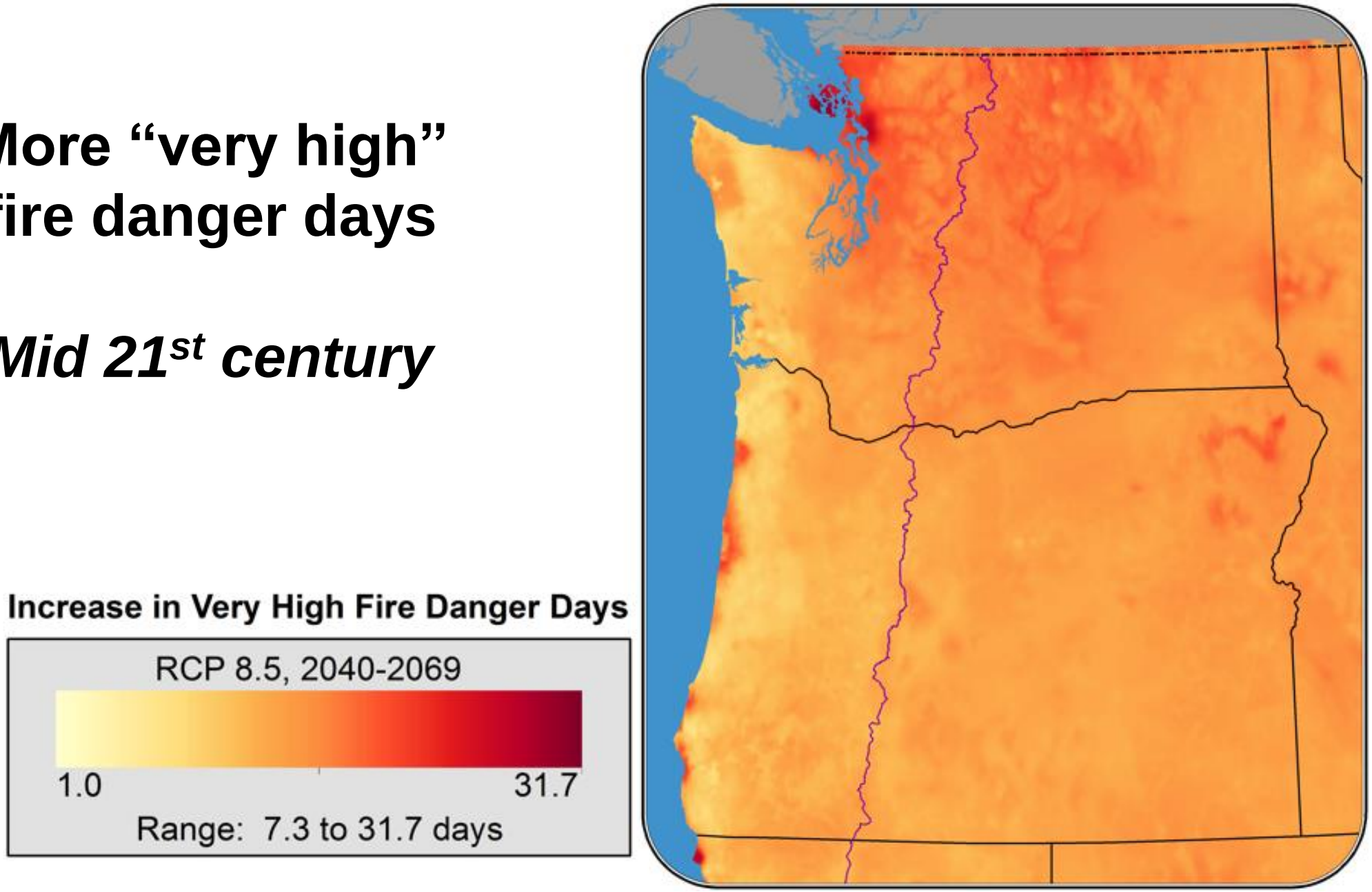
Several weeks of high temperature and low rainfall are sufficient to dry fuels and cause extreme fire hazard.



Earlier and longer periods of dry fuels are affected by multiple factors

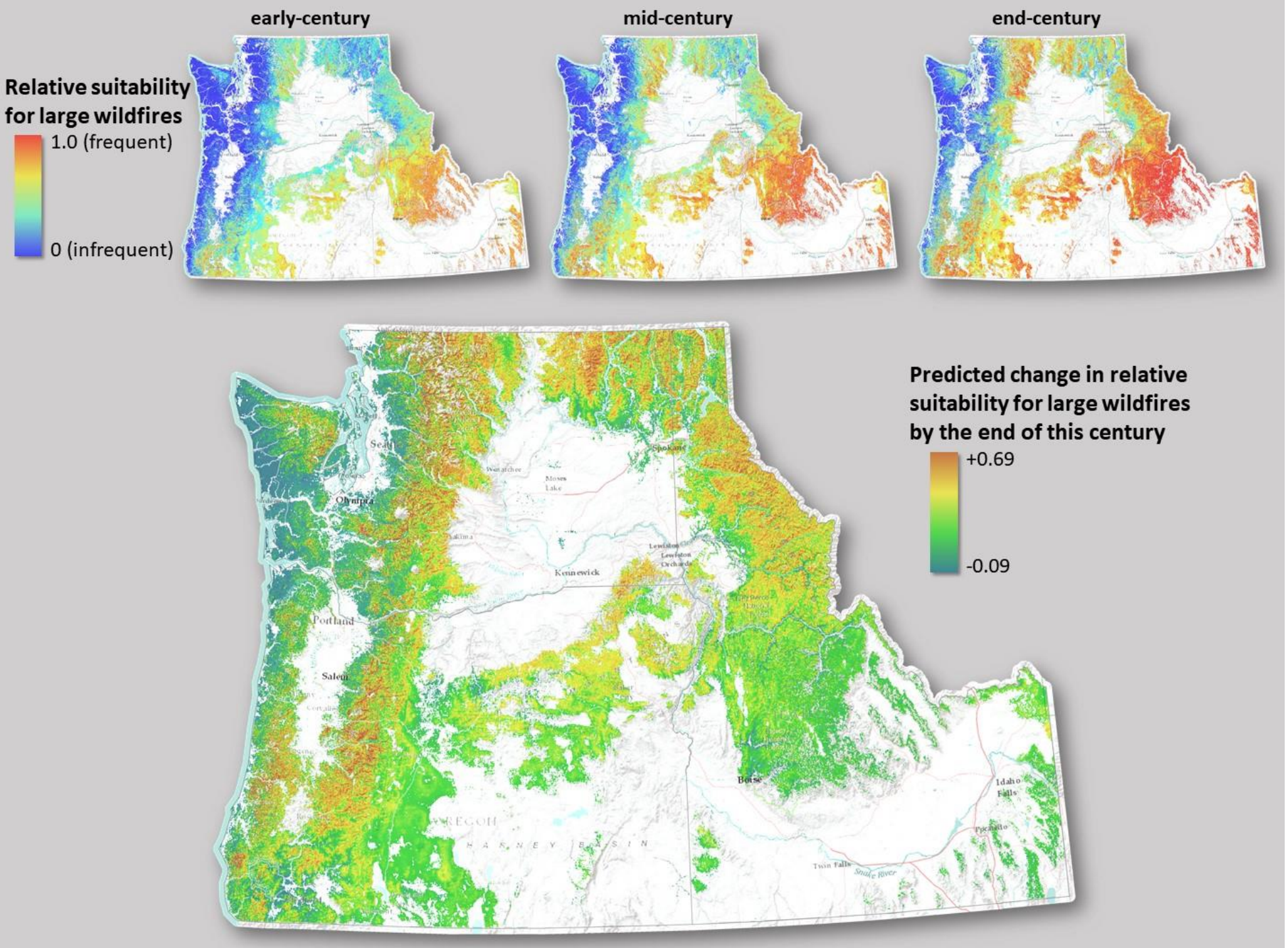
More “very high” fire danger days

Mid 21st century



Source: Northwest Climate Toolbox

Suitability for large wildfires



Adapted from Davis et al. 2017

Large west-side fires of the past

- **Year ~1700 fire episode:**
  - → **>1 million acres on Olympic Peninsula,**
  - → **3 to 10 million acres in western WA**

(Henderson et al. 1989)

- **1902 Yacolt complex**
  - → **>1 million acres**

(National Interagency Fire Center)

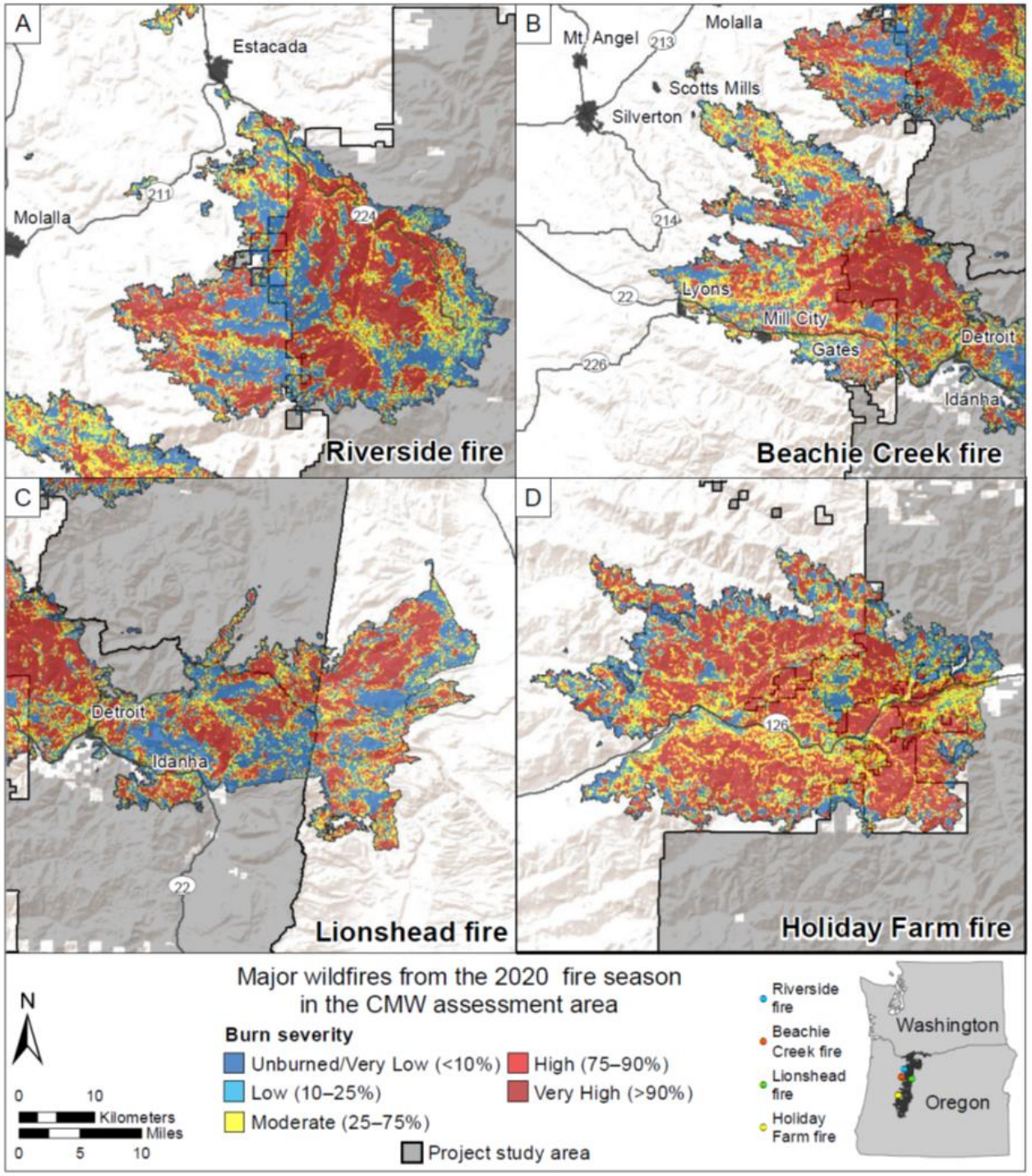
- **1933 Tillamook burn**
  - → **350,000 acres**

(Kemp 1960)

Slide by J. Halofsky and D. Donato

2020 Fires in Oregon

- Strong east winds were a key driver of fire spread.
- Fires were similar to east wind-driven events in the past.
- Event was consistent with what we might expect to occur more frequently with climate change



Disturbances will interact

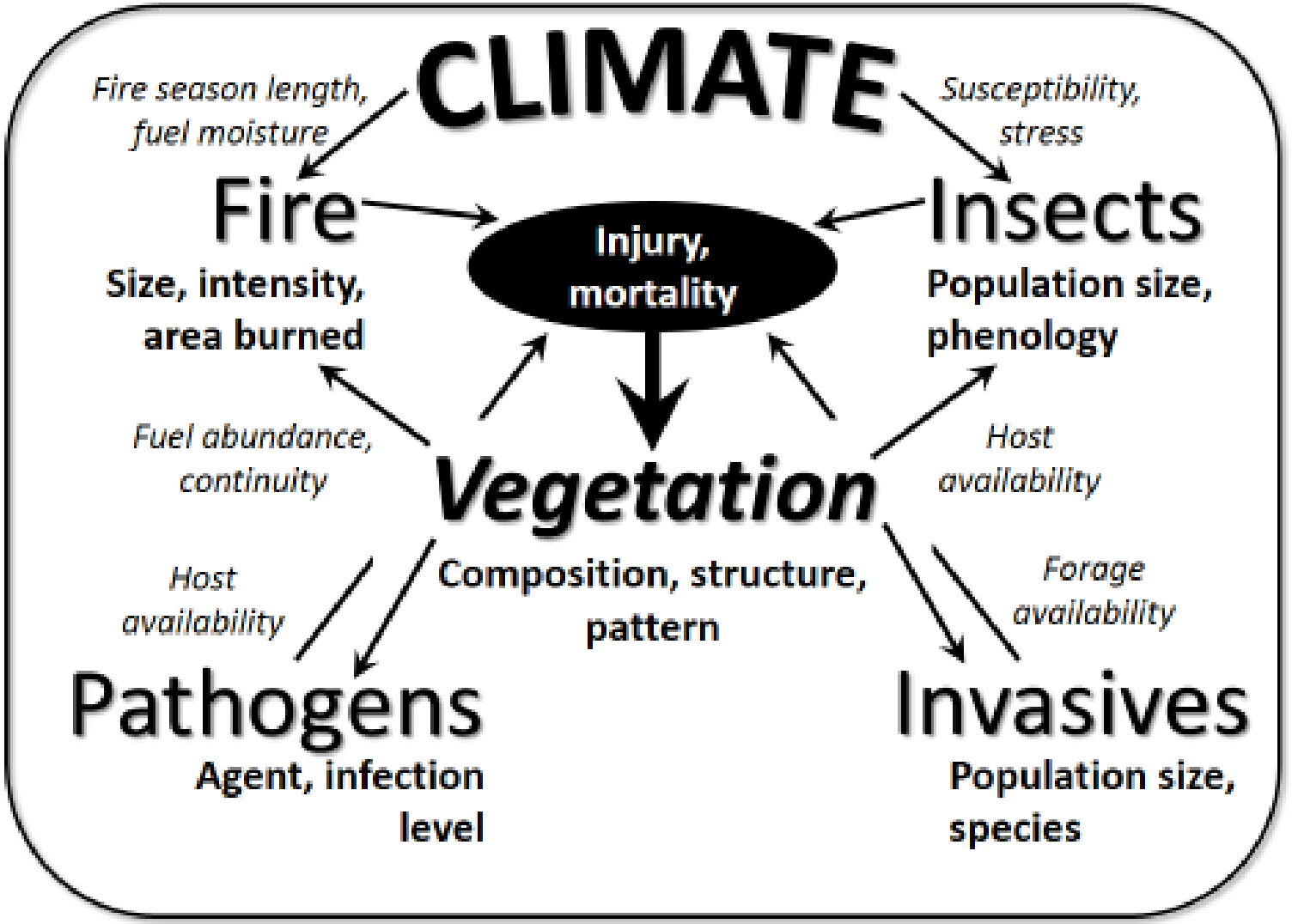


Figure by R. Loehman

What does this mean for forests in the Northwest and beyond?

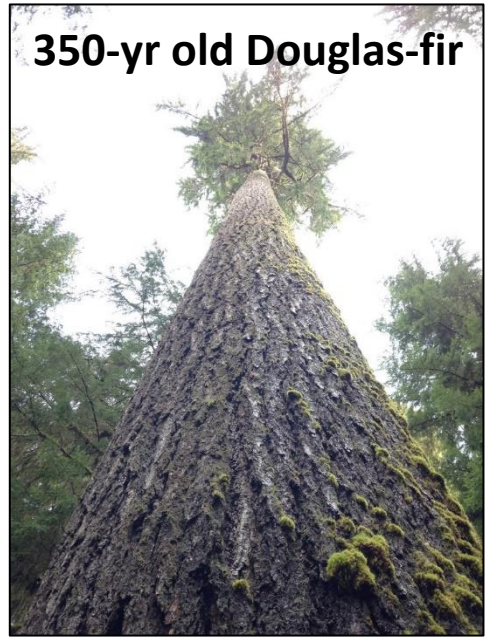
What does this mean for forests in the Pacific Northwest and beyond?

- Lower soil moisture will cause gradual changes in abundance and distribution of species; drought-tolerant species will be more competitive.
- Increased disturbance (wildfire, insect outbreaks) will facilitate vegetation change; younger forest age/structure.
- Increased non-native plant species will compete with native species.

High severity “reburns” may occur before forests recover from the most recent high-severity fire

Large fires are creating larger and more homogeneous patches of stand-replacing fire

Regeneration is very sensitive to climate



Drought, bark beetle outbreaks, and fires will likely interact

Forests will change in species composition and structure, and in some places will transition to non-forest.

Species sensitivity to climate change depends on:

- Shade tolerance
- Fire tolerance
- Drought tolerance
- Climatic tolerance
- Genetic plasticity
- Current abundance
- Level of stress
- Dispersal capability
- Adaptive capacity