The Role of Climate on Moist Mixed Conifer Forest

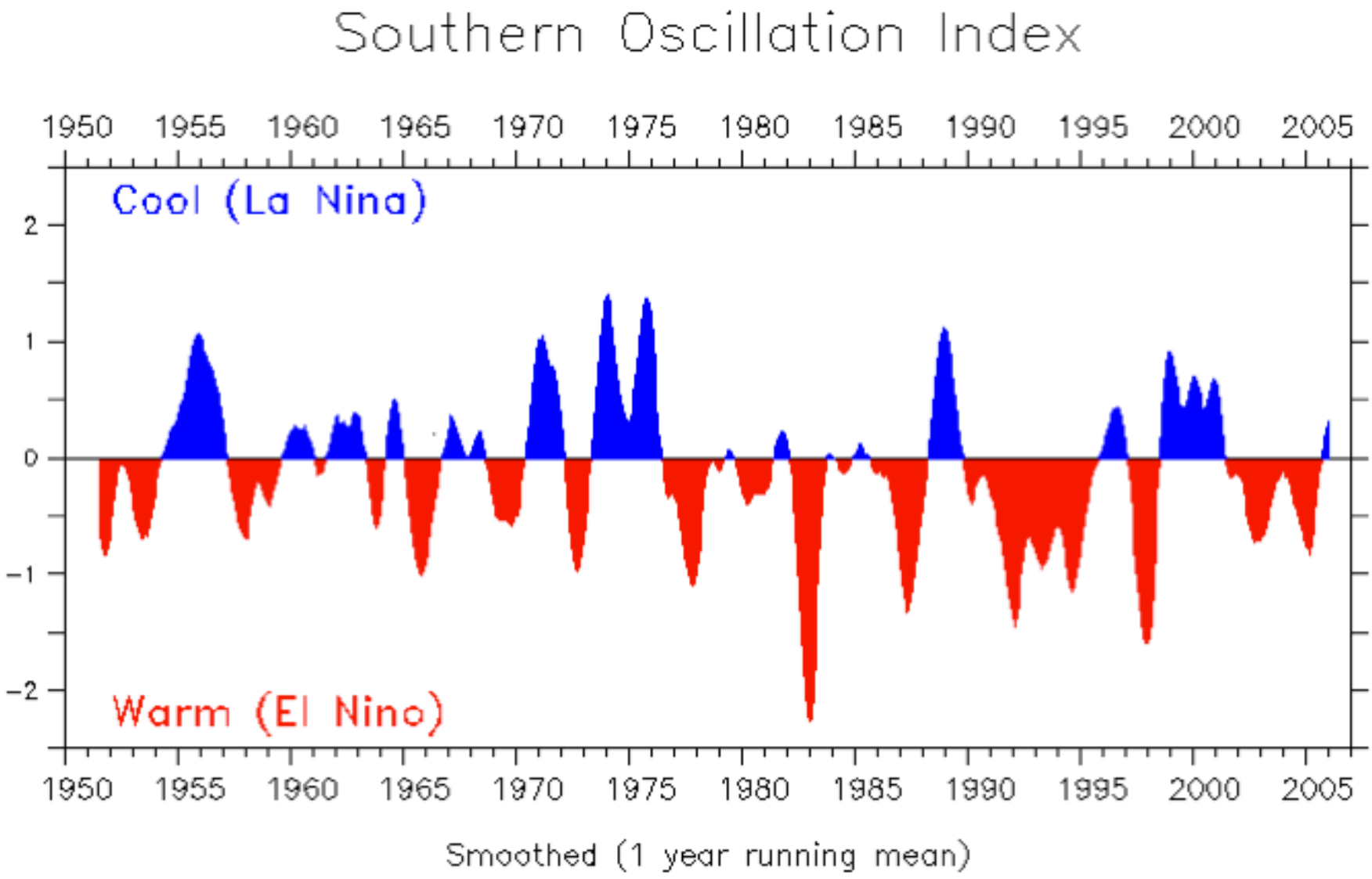
Marc G Kramer

UF | IFAS CALS
UNIVERSITY of FLORIDA

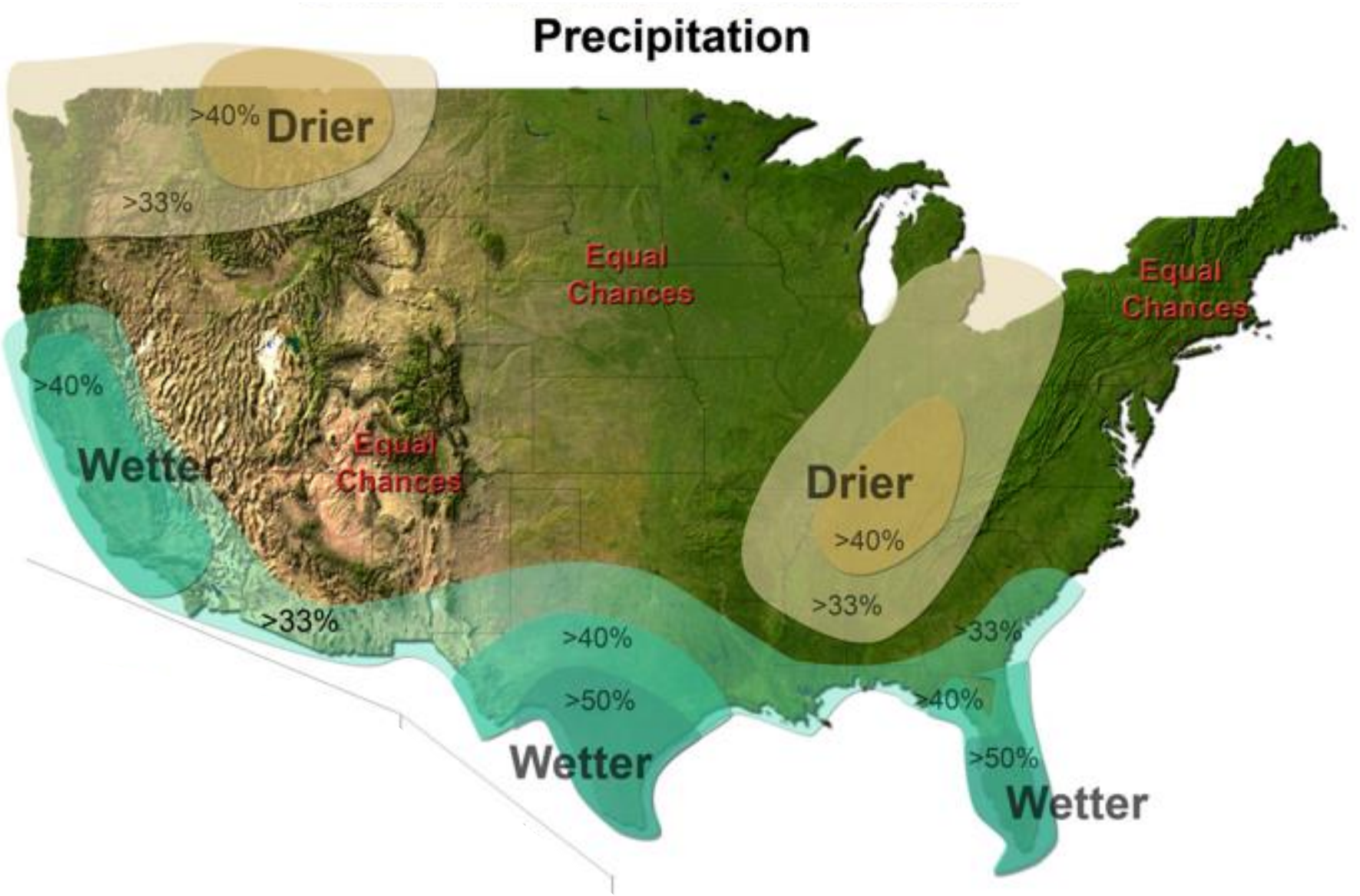
Background

Background

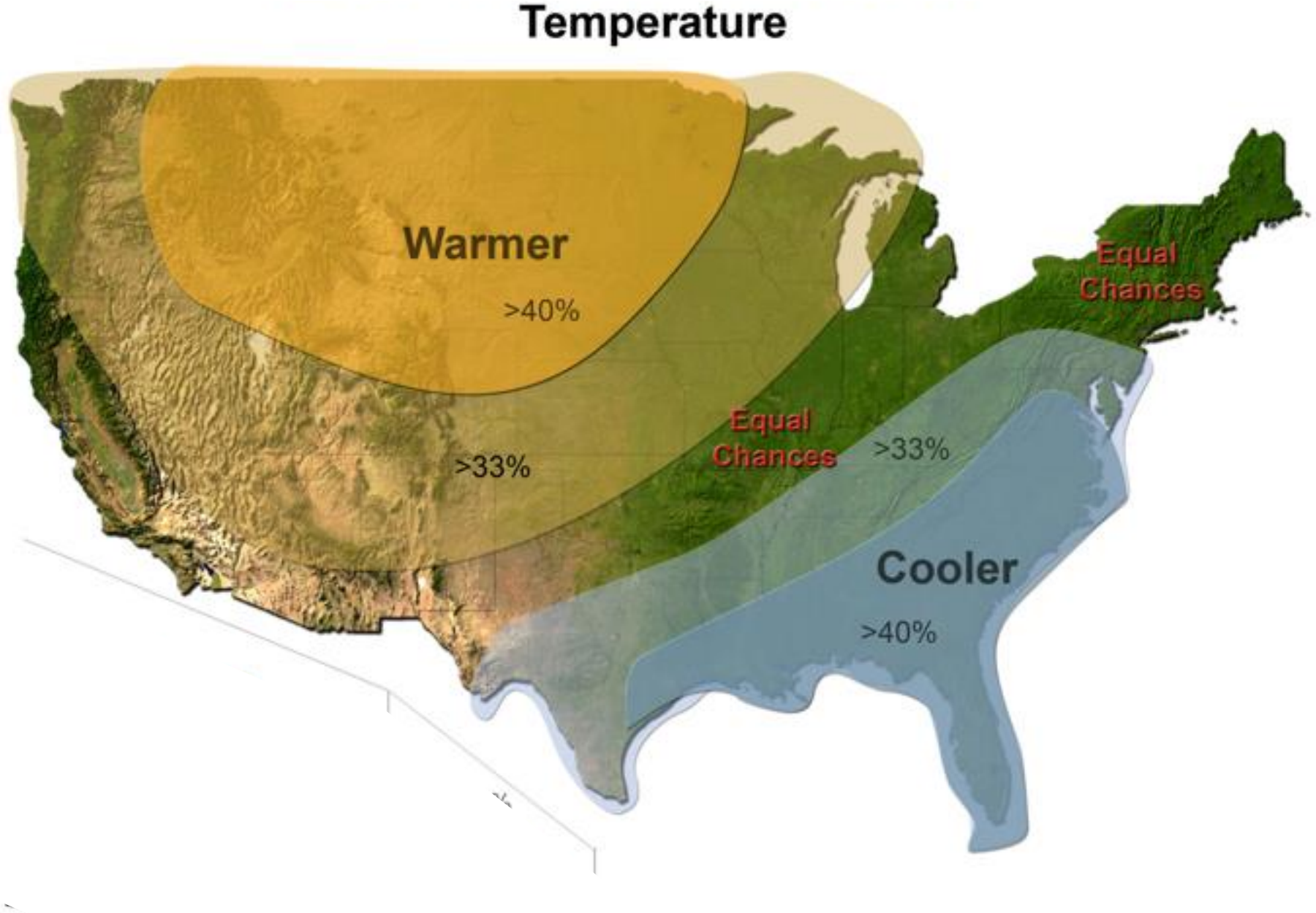
El Niño Southern Oscillation (ENSO) is the Dominant Driver of Climate in Moist Mixed Conifer Forests


Southern Oscillation Index
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Cool (La Nina)
Warm (El Nino)
2
1
0
−1
−2
Smoothed (1 year running mean)

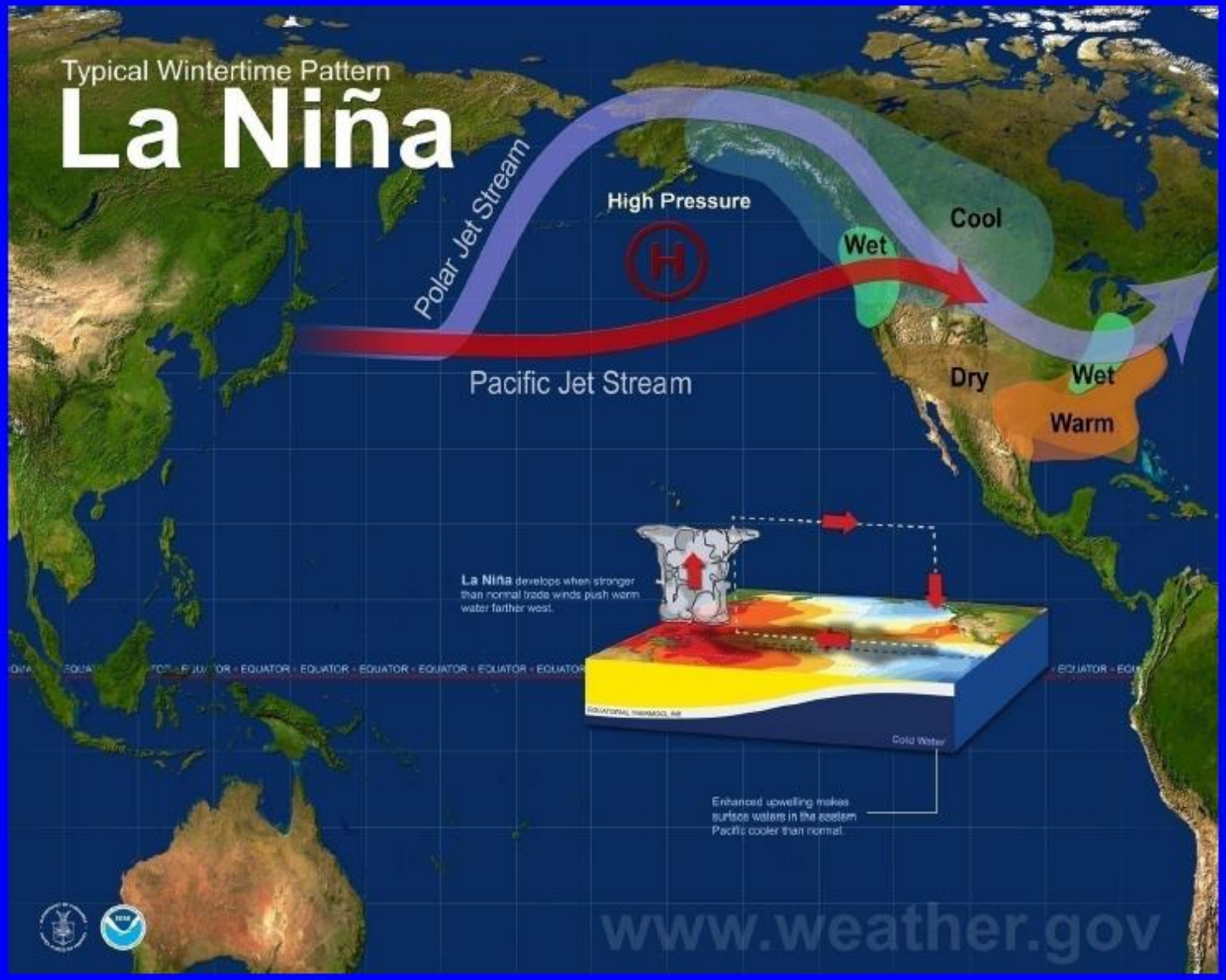
Typical El Niño Winter Outlook



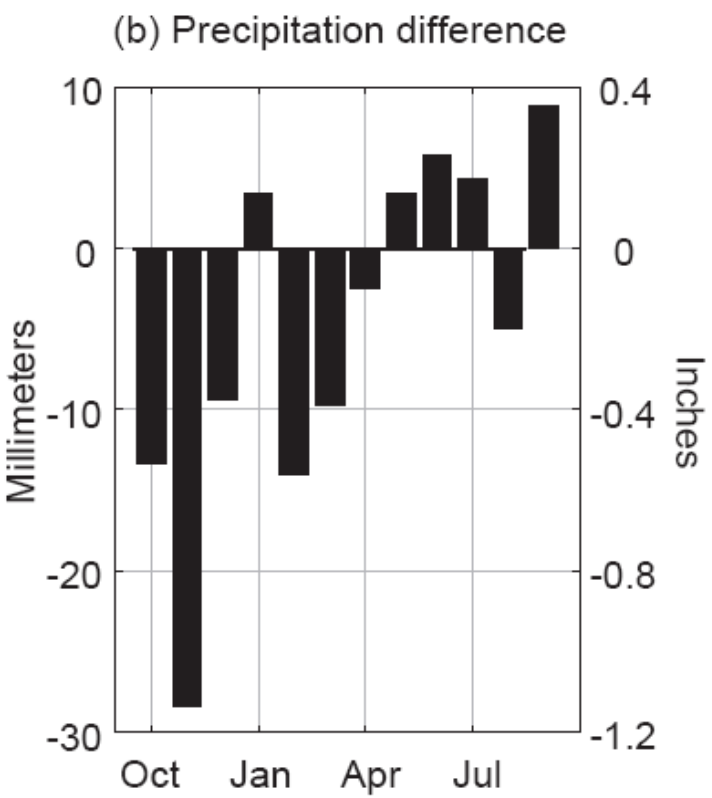
Typical El Niño Winter Outlook

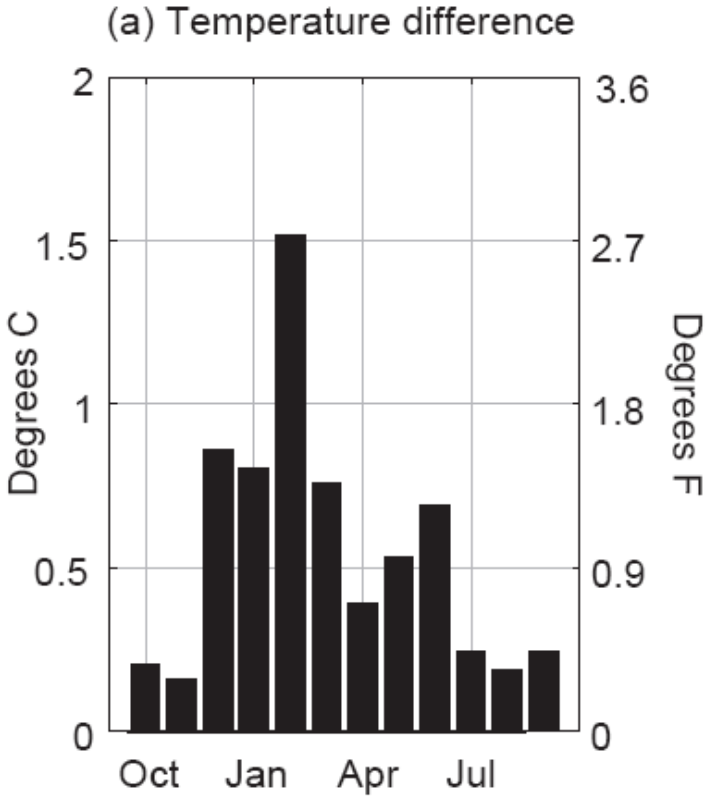


Typical US Temperature, Precipitation and Jet Stream Patterns during La Niña Winters



Large Differences in Rainfall Amounts and Temperature Exist Between El Niño and La Niña Years in the Pacific Northwest

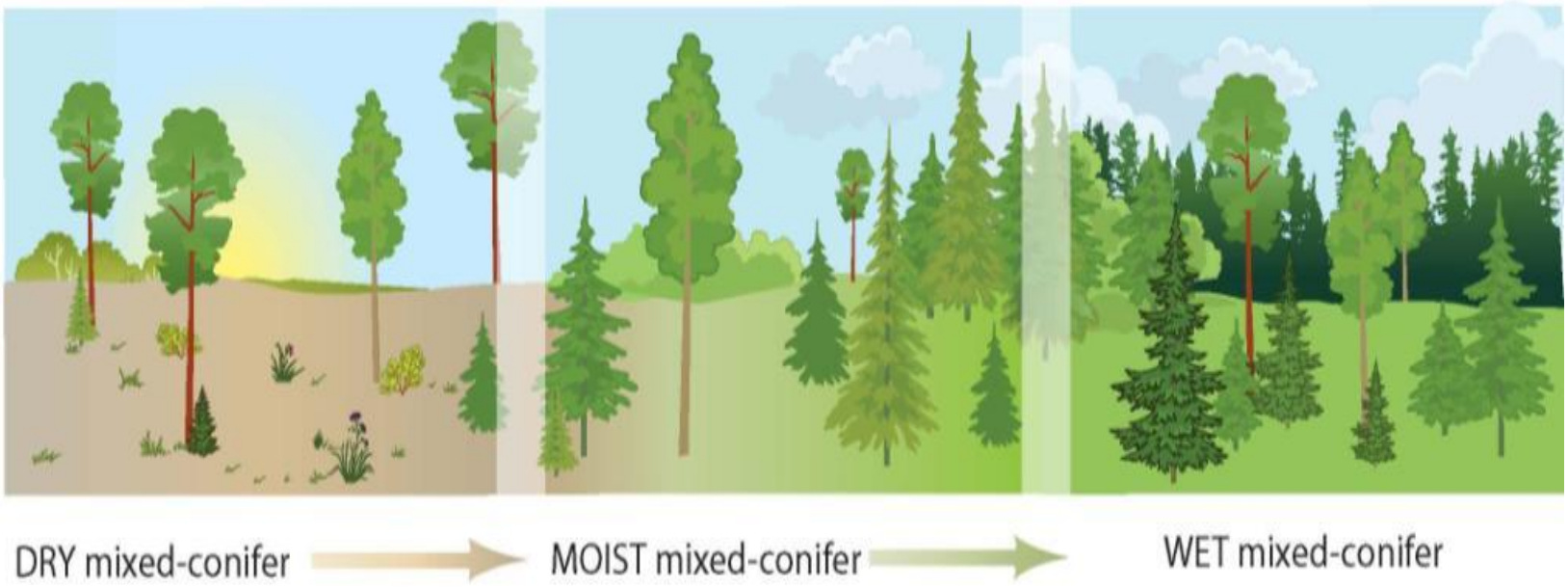




Source: University of Washington, NOAA

Moist Mixed Conifer Forest

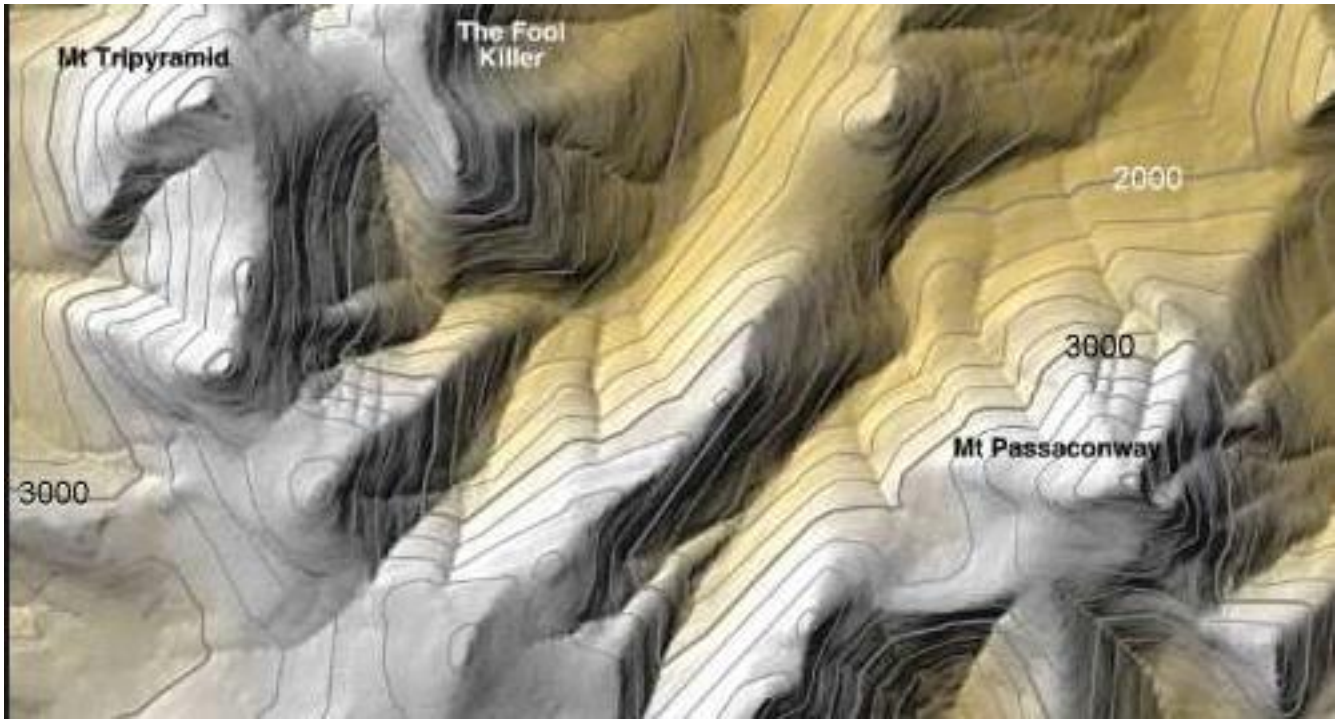
The moist mixed-conifer forest type is in a central position along a complex moisture, gradient in this region.

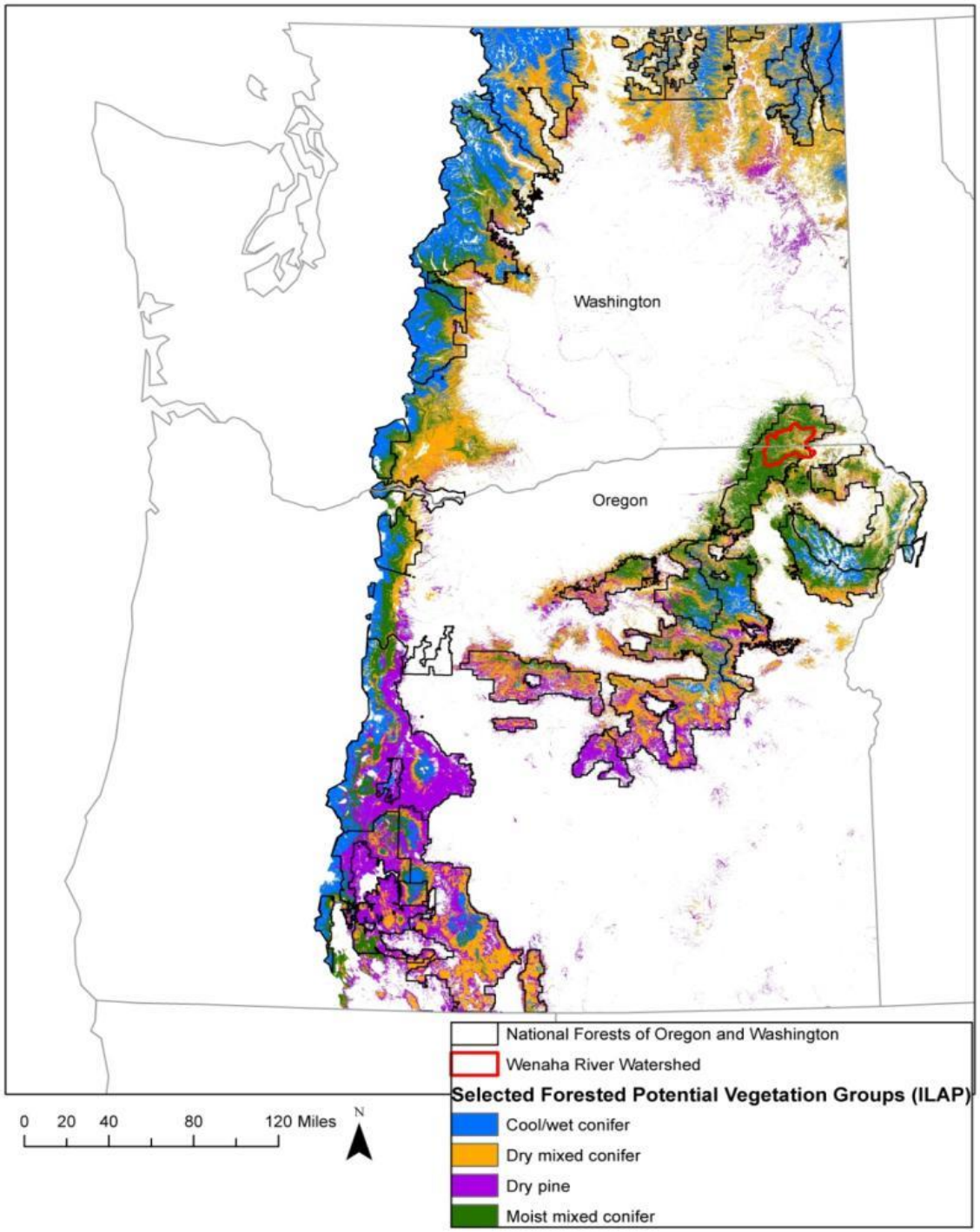


At the regional scale, the moisture gradient is structured by large-scale topographic features (ie..the Cascade Mountains) and a south – southwest stormtrack

.

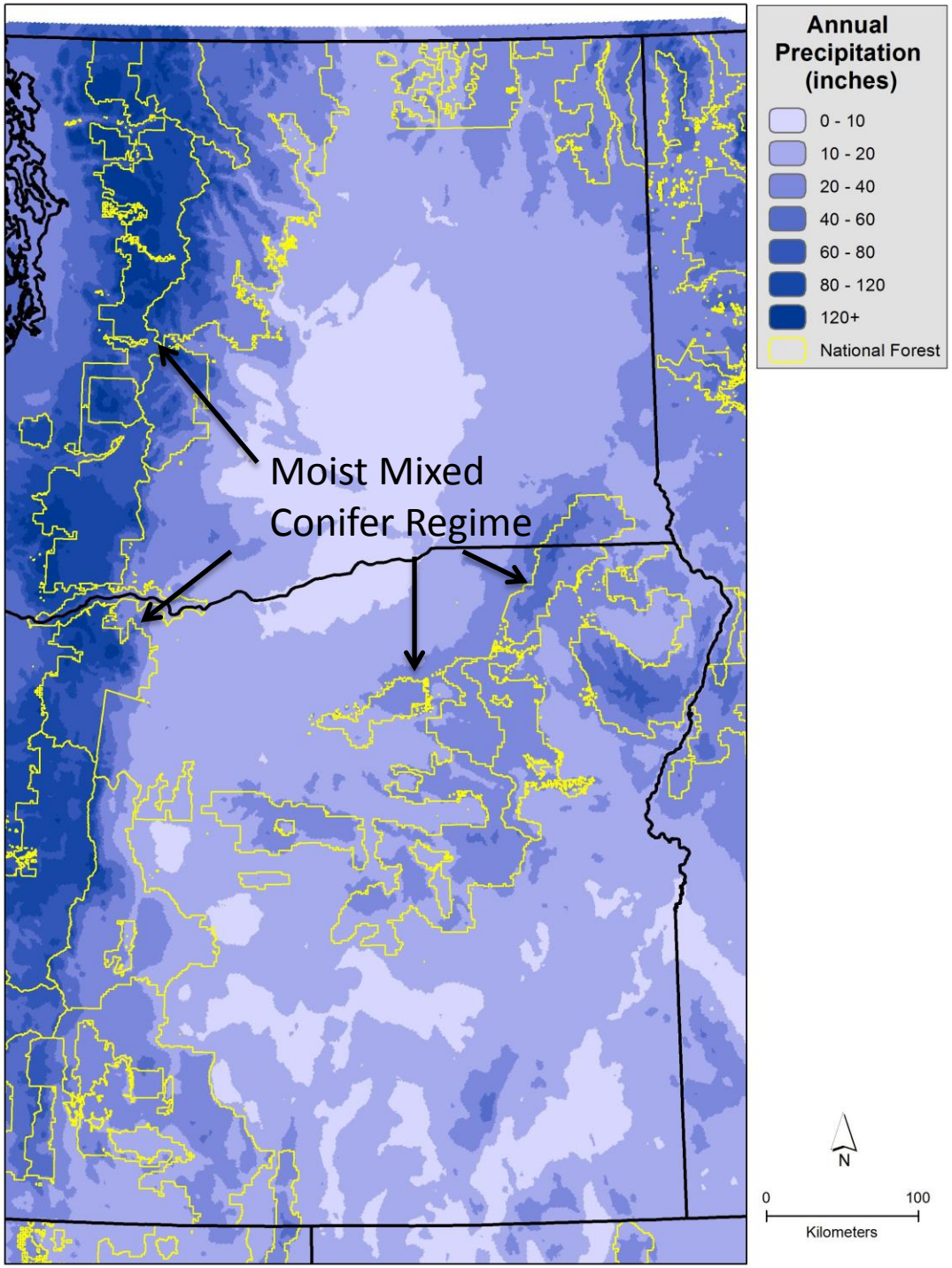
At the localized scale, mountainous terrain creates localized gradients in soil moisture, driven principally by differences in exposure to sunlight and wind.
(e.g. dry windy south facing aspects vs cool moist north facing hillslopes)




Washington
Oregon
0 20 40 80 120 Miles
N
National Forests of Oregon and Washington
Wenaha River Watershed
Selected Forested Potential Vegetation Groups (ILAP)
Cool/wet conifer
Dry mixed conifer
Dry pine
Moist mixed conifer

WA

OR

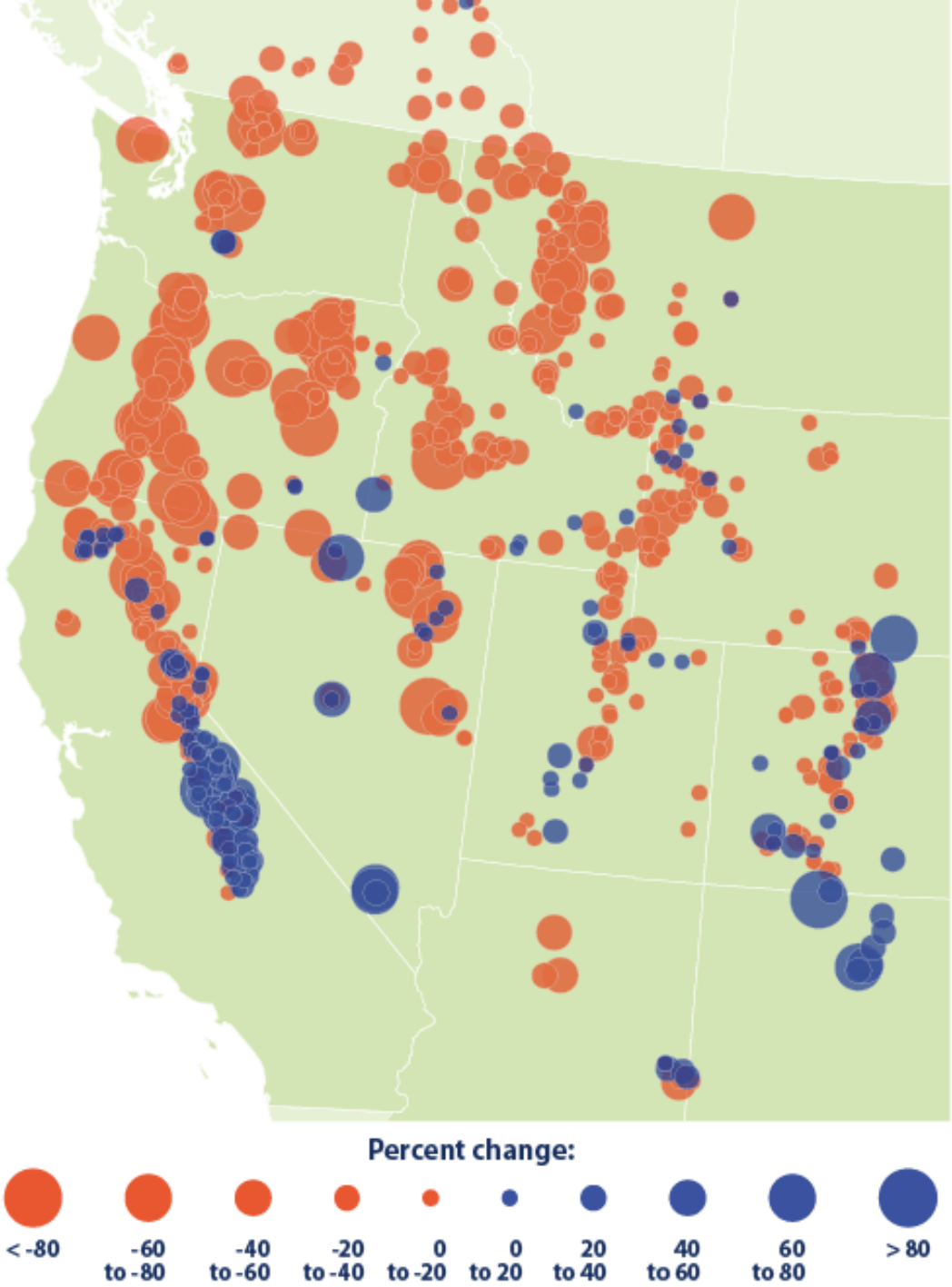


Source: Oregon State University

Historical Trends in Snowpack Decline.

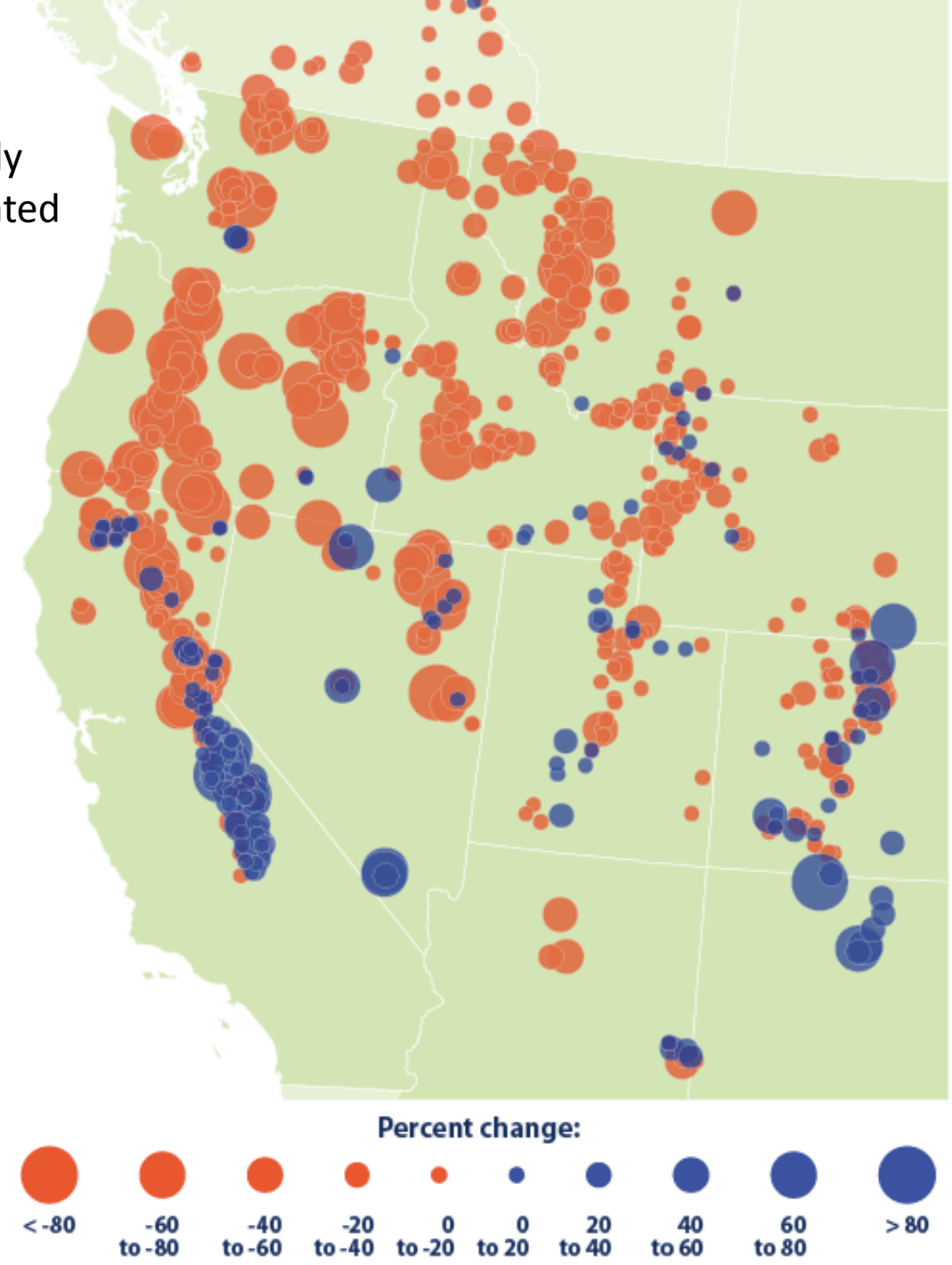
Snowpack Has Declined at Many Stations in the Pacific Northwest.

Mote et al. 2003 and 3 others.

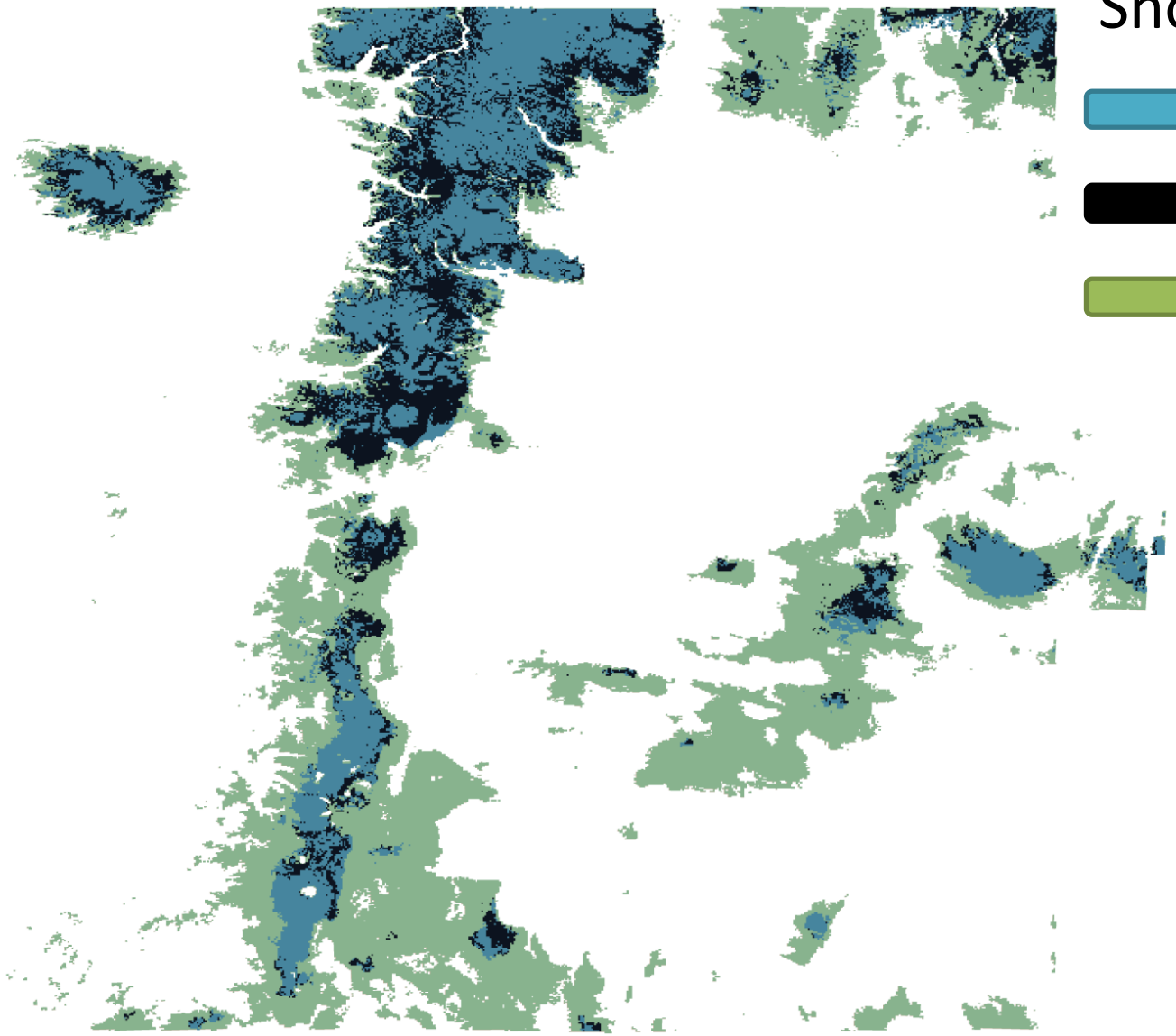


Source:EPA

Changes are Largely Attributed to Elevated Winter and Spring Temperatures .



Source:EPA



Snowpack Regime

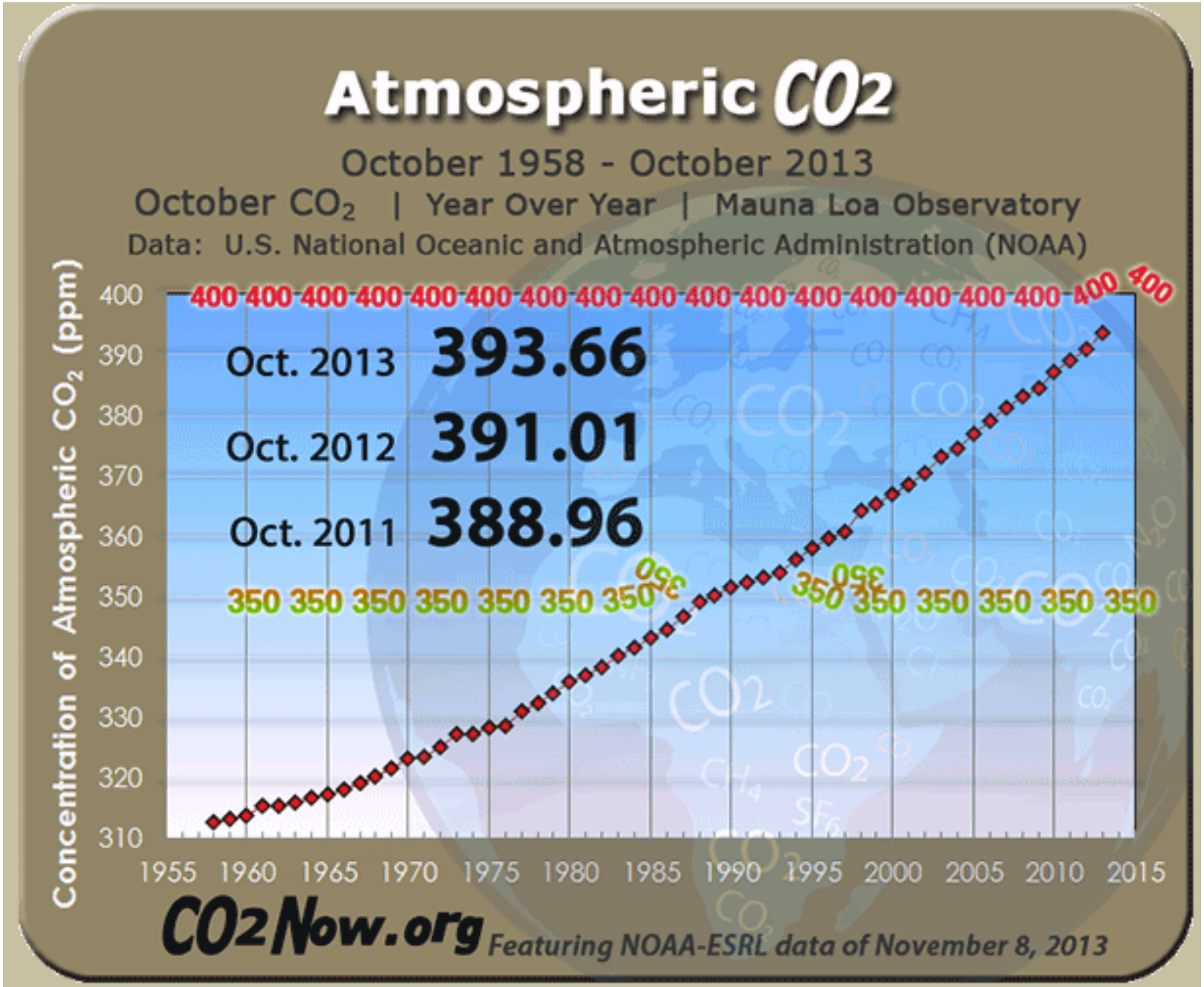
- Most Persistent
- Least Persistent
- Ephemeral

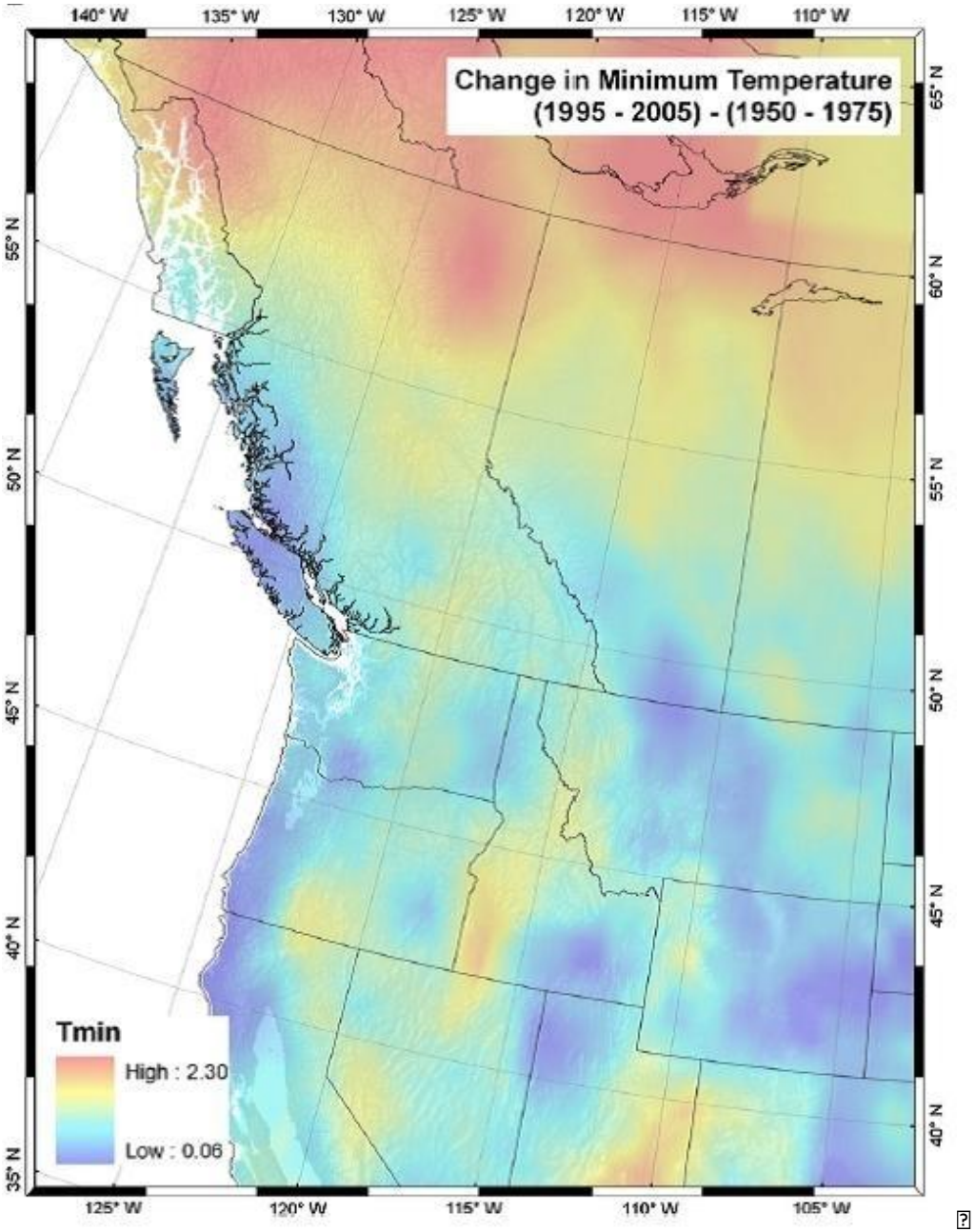
Based on Δ snowmelt timing, El Niño vs. La Niño

.

Source: NOAA SNODAS 2002-2012

Complex localized terrain structures the timing of snowpack melt and consequently soil moisture regime at both the regional and localized scale for moist mixed conifer patches.


Atmospheric CO2
October 1958 - October 2013
October CO2 | Year Over Year | Mauna Loa Observatory
Data: U.S. National Oceanic and Atmospheric Administration (NOAA)
Concentration of Atmospheric CO2 (ppm)
400
390
380
370
360
350
340
330
320
310
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Oct. 2013 393.66
Oct. 2012 391.01
Oct. 2011 388.96
CO2Now.org
Featuring NOAA-ESRL data of November 8, 2013



Projected changes in minimum temperature throughout the Pacific Northwest.

Temperature

- Mean average temperature has been observed to have increased by 0.8° C (1.50 °F) since 1900.

- Climate forecasting models, when averaged, project increases in annual temperature of
  - 1.1°C (2.0 °F) by the 2020s,
  - 1.8°C (3.2°F) by the 2040s, and
  - 3.0◦°C (5.3°F) by the 2080s,

  *compared with the average temperature from 1970-1999.

Precipitation

- Trends in historical and projected future changes in precipitation in the Pacific Northwest are less clear than for temperature.

- For example, precipitation in the Pacific Northwest has increased by 13-38 percent since 1900 but has shown substantial inter-annual and inter-decadal variability during the 20th century, which current climate models are unable to simulate under future warming scenarios.

- Some, but not all models predict slight future increases in annual precipitation (1-2 percent in 2030-2059, and 2-4 percent in 2070-2099).

Historical and Projected Trends in Climate for Moist Mixed Conifer Forests

Historical and Projected Trends in Climate for Moist Mixed Conifer Forests

Summary

Reduced Snowpack Amounts (up to 50% projected decline)
Increased Rain on Snow
Warmer Air Temperatures
Change in the Timing of Spring Snowmelt (Earlier)
More Climate Extremes

Source IPCC 2013, CIG University of Washington 2009, Mote et al. 2005

Historical and Projected Trends in Climate for Moist Mixed Conifer Forests

Summary

Reduced Snowpack Amounts (up to 50% projected decline)
Increased Rain on Snow
Warmer Air Temperatures
Change in the Timing of Spring Snowmelt (Earlier)
More Climate Extremes

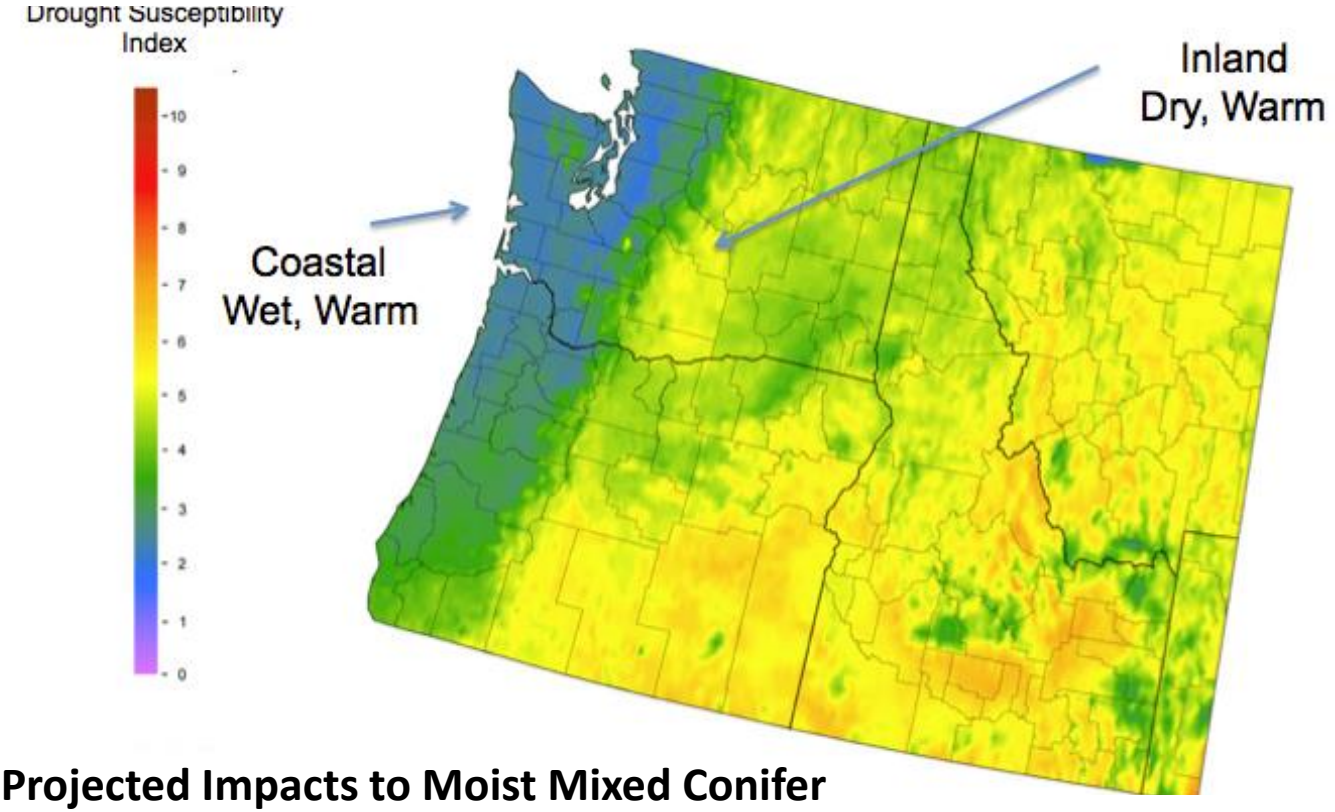
Projected Impacts To Moist Mixed Conifer Forests

Reduced Soil Moisture
Increased Drought Stress
    Increased Fire Intensity, Severity and Frequency
    Increased Susceptibility to Insect Attack
Phenologic Shifts (Earlier Onset of Budbreak, Longer Growing Season)

Source IPCC 2013, CIG University of Washington 2009, Mote et al. 2005

Regional Projected Impacts

Moist Mixed Conifer Regime



Projected Impacts to Moist Mixed Conifer

Reduced Soil Moisture
Increased Drought Stress
- Increased Fire Intensity, Severity and Frequency
- Increased Susceptibility to Insect Attack

Phenologic Shifts (Earlier Budbreak, Longer Growing Season)

IPCC 2013, CIG University of Washington 2009, Mote et al. 2005

Key Findings

El Niño/Southern Oscillation (ENSO) remains the most important coupled ocean-atmosphere phenomenon to cause climate variability on seasonal to interannual time scales in the Pacific Northwest.

Key Findings

El Niño/Southern Oscillation (ENSO) remains the most important coupled ocean-atmosphere phenomenon to cause climate variability on seasonal to interannual time scales in the Pacific Northwest.

Projected changes in climate will be manifest at both highly localized and broad regional scales for moist mixed conifer forests.

Key Findings

El Niño/Southern Oscillation (ENSO) remains the most important coupled ocean-atmosphere phenomenon to cause climate variability on seasonal to interannual time scales in the Pacific Northwest.

Projected changes in climate will be manifest at both highly localized and broad regional scales for moist mixed conifer forests.

Necessitating the need for multiscale, hierarchical approach to address future climate change impacts.

Thank you !