Climate Change effects on West Side Vegetation

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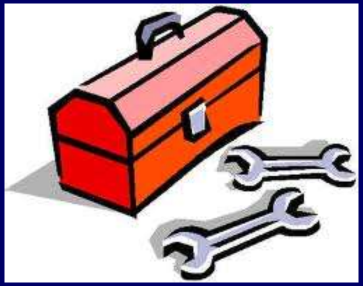
USFS PNW Station



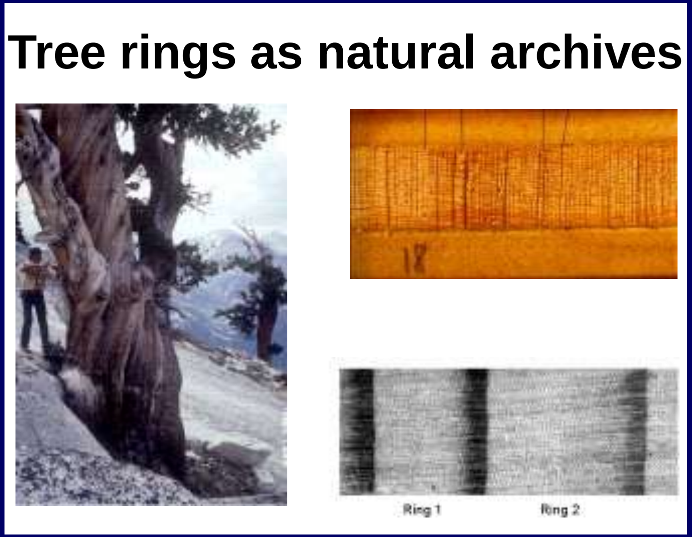
The Tool Box

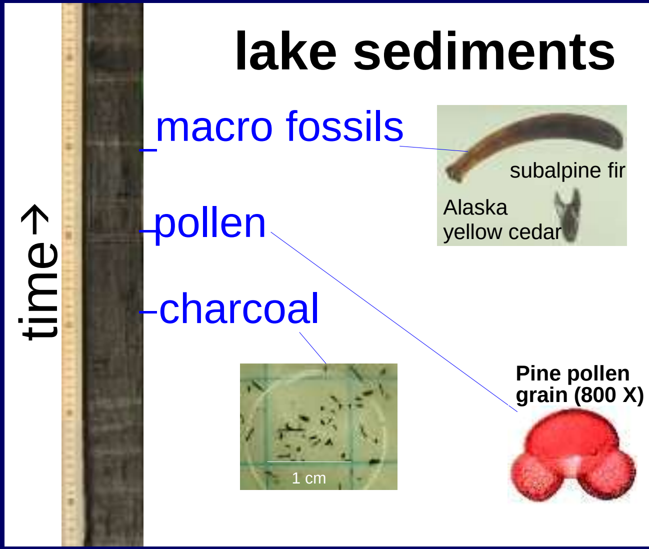
Inferences based on the past

- Long-term paleoecolgical records (pollen, charcoal, macrofossils sediments)
- Modern tree ring records – infer relationships between growth and climatic variability

Projections for the future

- Climate and hydrologic models
- Vulnerability/sensitivity tools and databases
- Dynamic Global Vegetation Models
- Bioclimatic Envelope Models

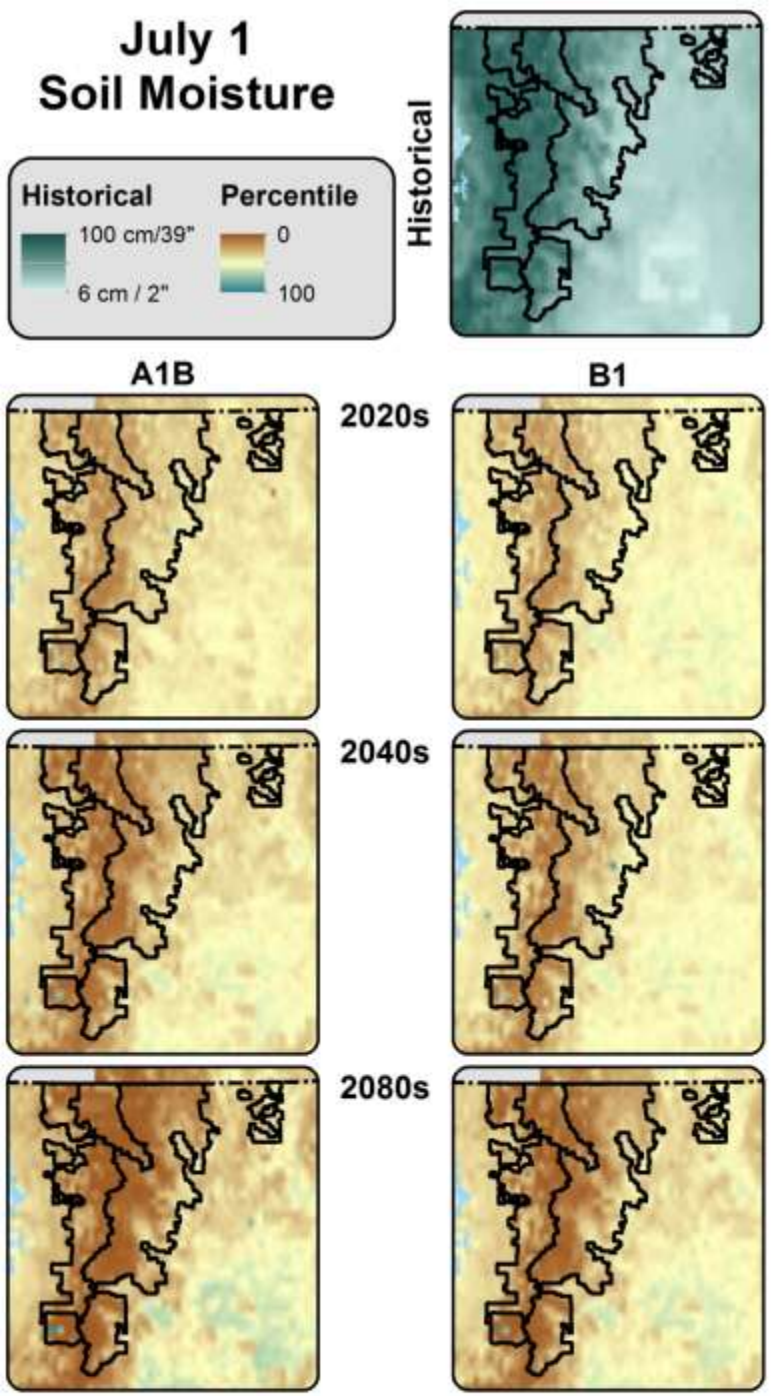




photos courtesy of: S. Prichard

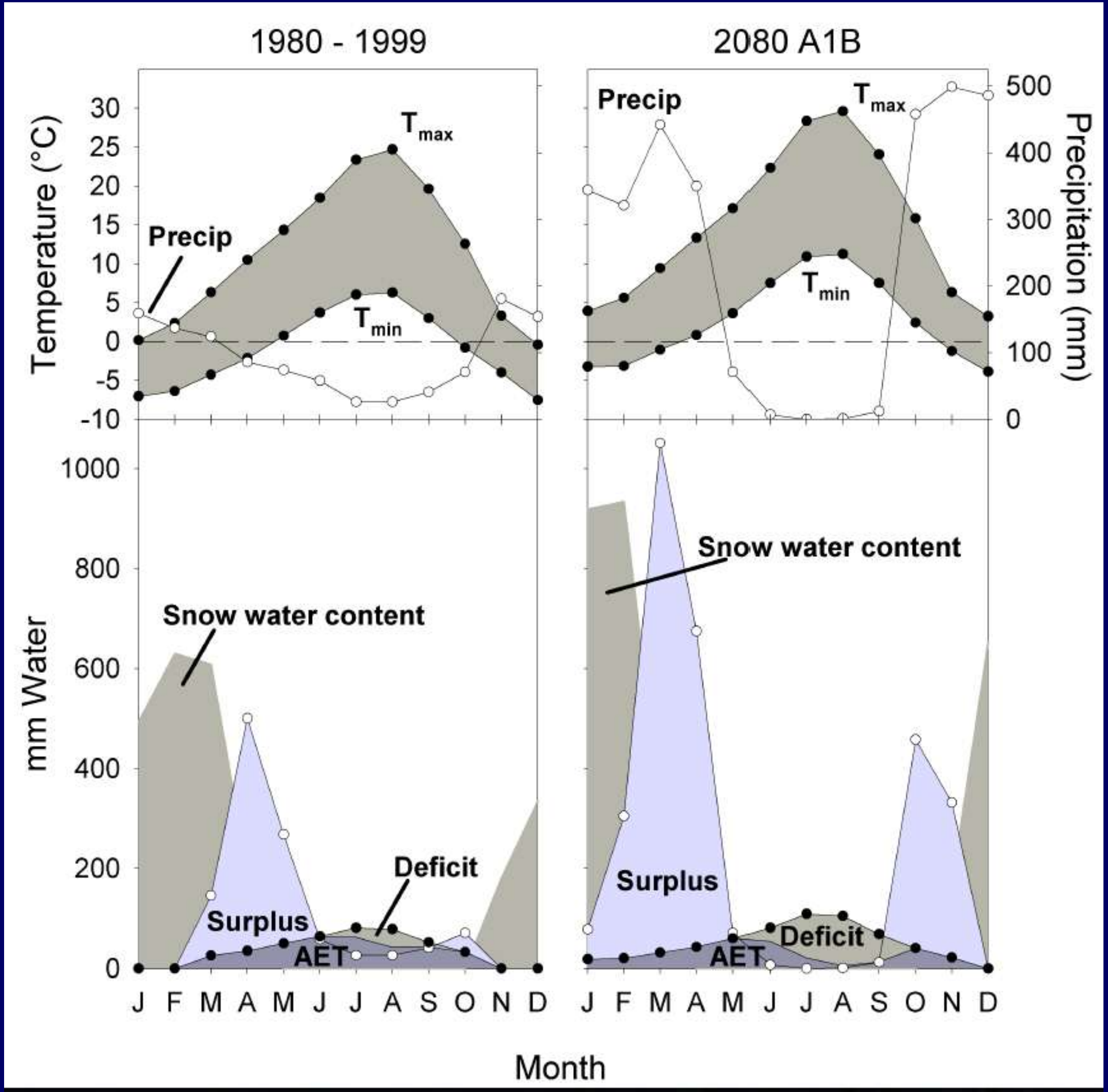
Soil Moisture Projections

- Downscaled climate data for two emissions scenarios as input to a hydrologic model
- Percentile of historical (<50 percentile indicates decreasing soil moisture)
- Modest decreases in July 1 soil moisture throughout the NCAP region.
- West side of the Cascades: decreases in soil moisture because of reduced winter snowpack and warmer summer temperatures.



Water Balance Deficit

The difference between atmospheric demand for water and the water available to satisfy that demand.

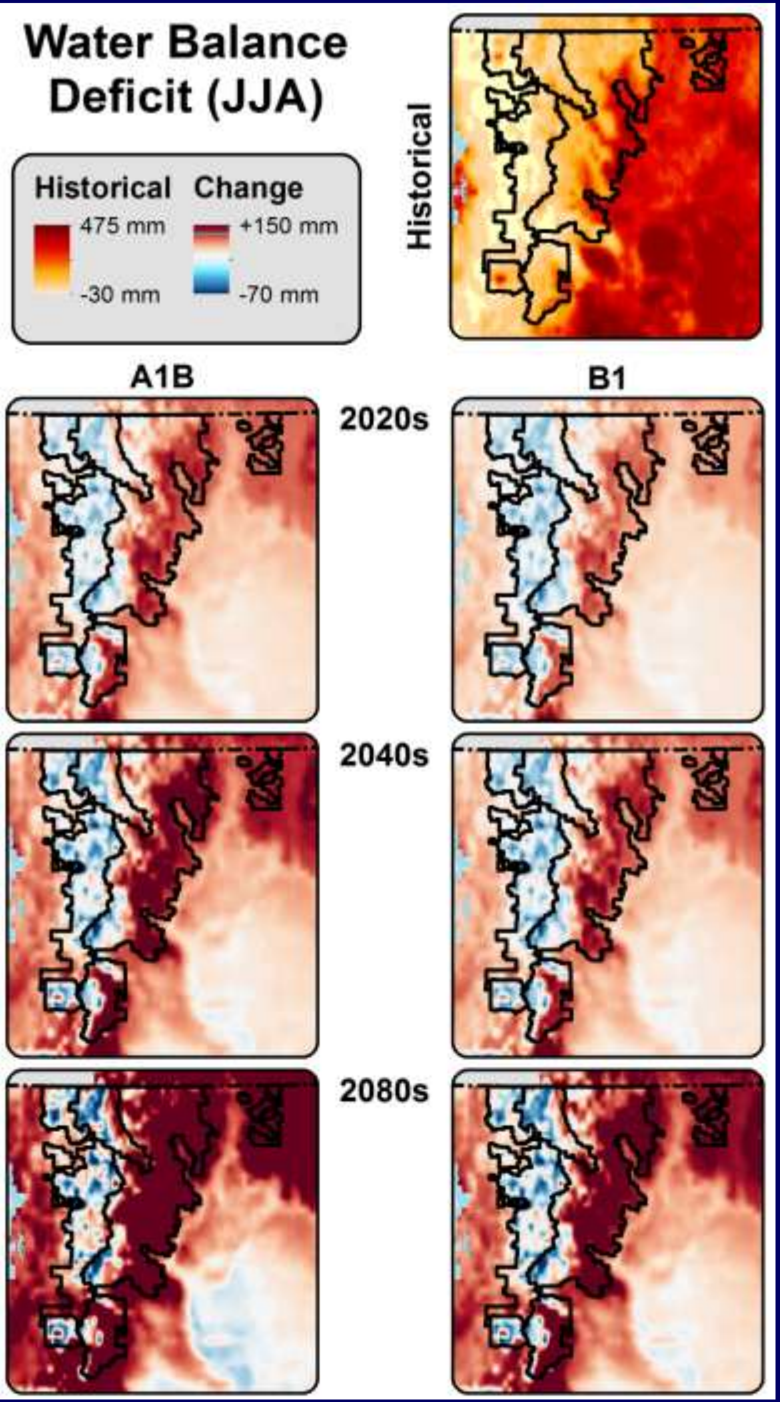


slide courtesy of: J. Littell

Water balance deficit and forest effects

As deficit increases:

- tree growth and regeneration adversely affected in water-limited systems.
- tree vulnerability to insect attack increases.
- fuel moisture declines, so fire activity (spread, severity, area, frequency) likely increases in forested systems.

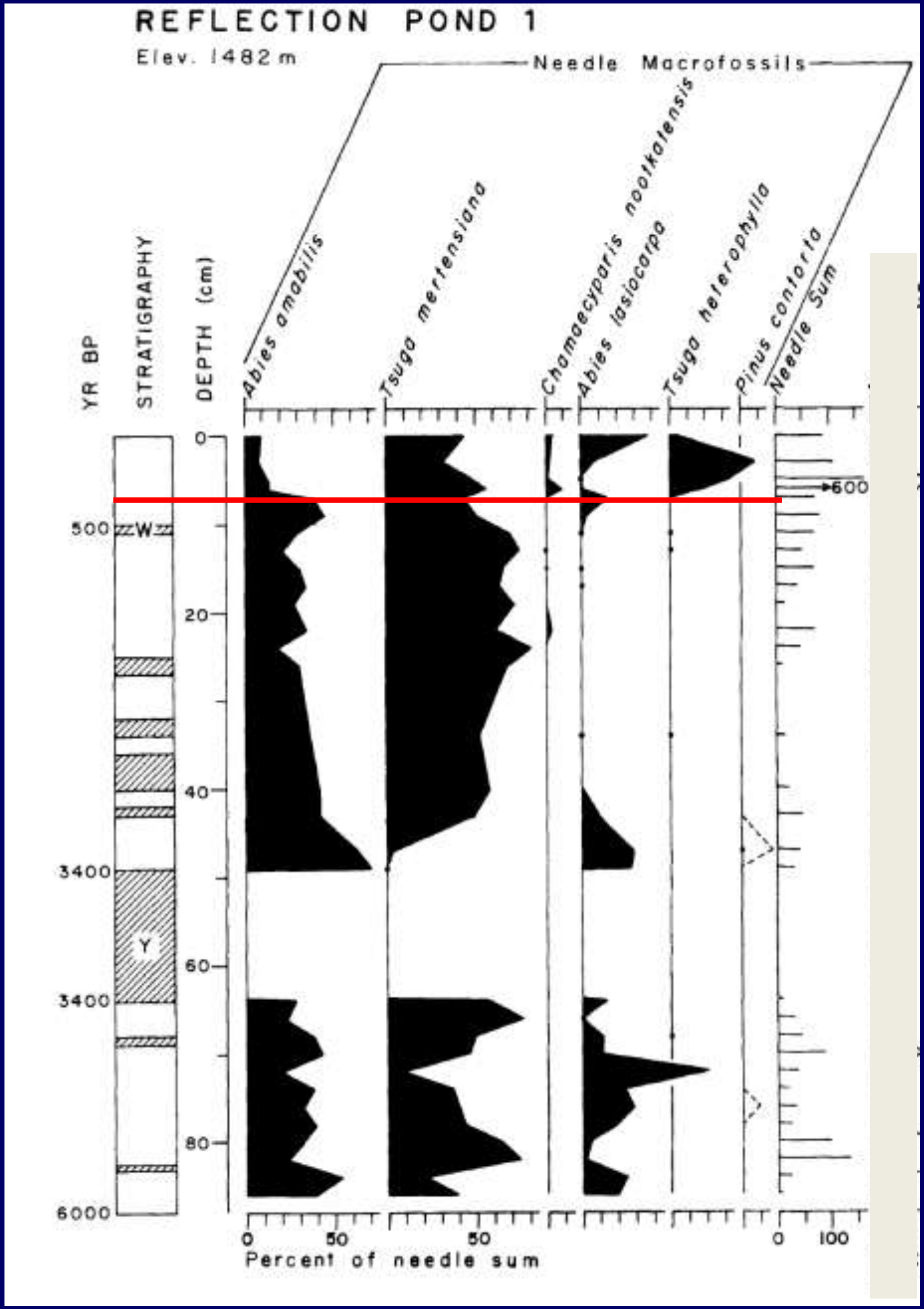


Growth, Regeneration, and Mortality

- Tree growth and regeneration are sensitive to climatic variability.
- Responses to climatic variability depend on growth limiting factors, which vary by species, elevation, latitude, and topography.
- Douglas-fir growth is limited by water availability on the west slopes of the Cascades (Littell et al. 2008).
- Low elevations west of the Cascades – growth and regeneration of Douglas-fir could become limited with increases in water deficit.
- Other drought intolerant species also may be affected.

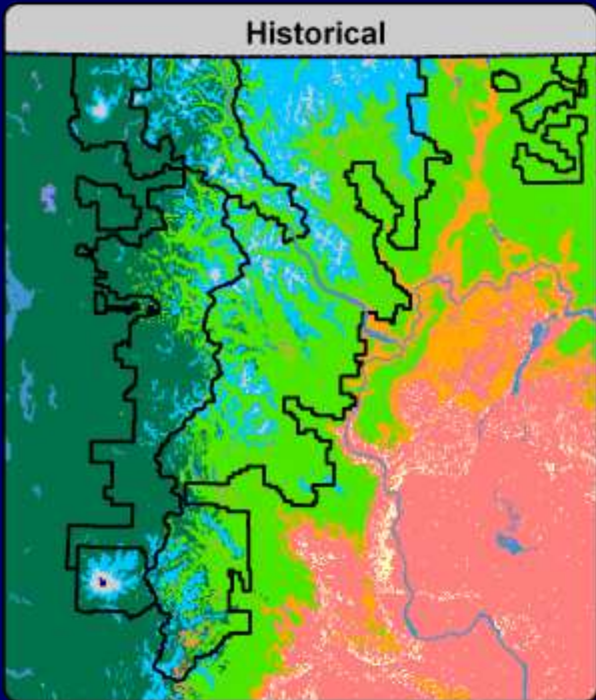
Species Distributions

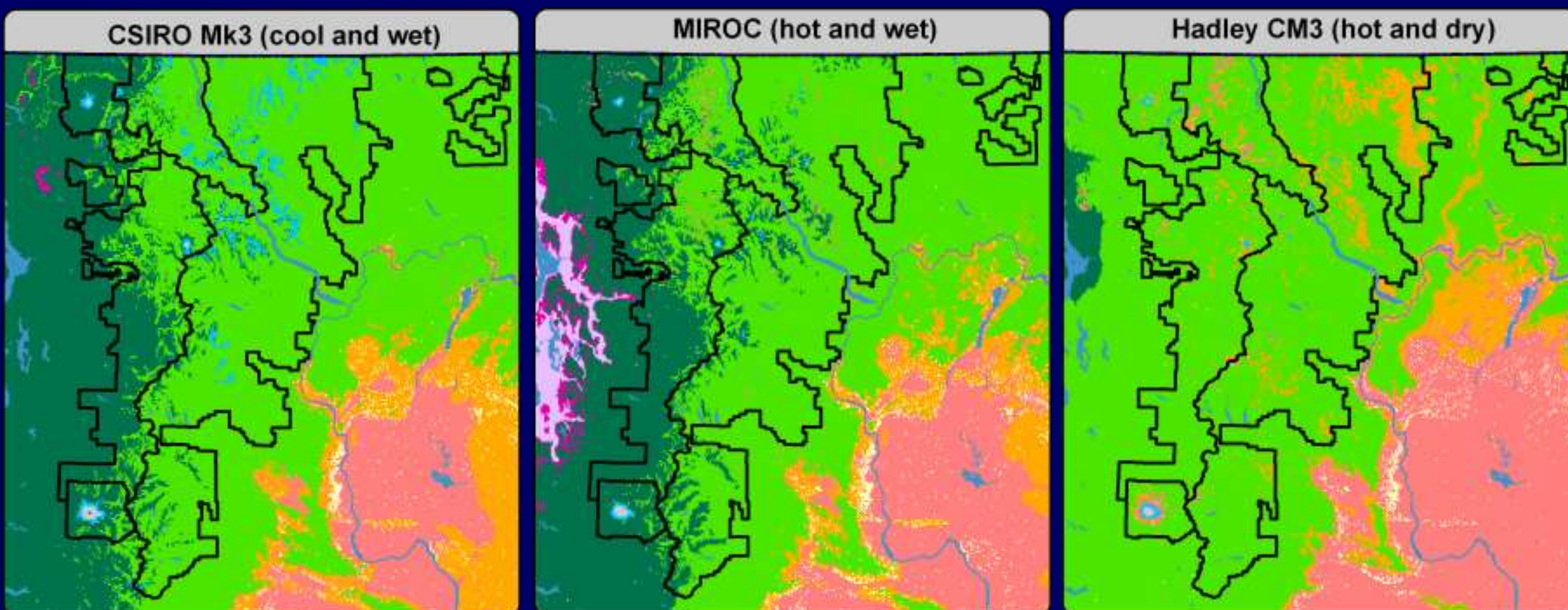
- Abundance and distribution of tree species respond individualistically to changes in climate.
- Example: western hemlock at higher elevation during 19th century warming.
- Are warm periods of the past an analog for the future?
  9000 ~ 5000 years BP
  900 ~ 700 years BP
- Potential for novel climates and no-analogue futures.



Dunwiddie 1986

Simulated Potential Vegetation under 3 GCM runs with the A2 SRES emission scenario (2070-2099 mode) using the MC1 dynamic global vegetation model





Percentage of NCAP area in each vegetation type (Historical and projections for 2070-2099)

		Climate Model Scenario		
MC1 Vegetation Type	**Hist.**	**CSIRO** cool, wet	**MIROC** hot, wet	**Hadley** hot, dry
Maritime conifer forest	29	24	32	0
Temperate conifer forest	40	71	66	89
Temperate conifer woodland	1	<1	<1	9
Temperate shrubland	1	<1	1	1
C3 Grassland	<1	<1	<1	<1
Subalpine forest	25	5	1	<1
Tundra	3	<1	<1	<1

Regional examples of MC1 Vegetation Types (Rogers 2009)

MC1 Vegetation Type	Regional Examples
Maritime conifer forest	Douglas-fir, western hemlock, Pacific silver fir
Temperate conifer forest	Ponderosa pine, Douglas-fir, lodgepole pine, grand fir,
Temperate conifer woodland	Ponderosa pine – western juniper woodland
Temperate shrubland	Big sgaebrush – blue bunch wheat grass, big sagebrush-Idaho fescue
Subalpine forest	Subalpine fir, lodgepole pine, mountain hemlock, white bark pine
Tundra	Alpine meadows