CIRC
Climate Impacts Research Consortium

Big Wood Alternative Futures Project:

Intermountain Adaptation Partnership

May 13, 2016

John Stevenson

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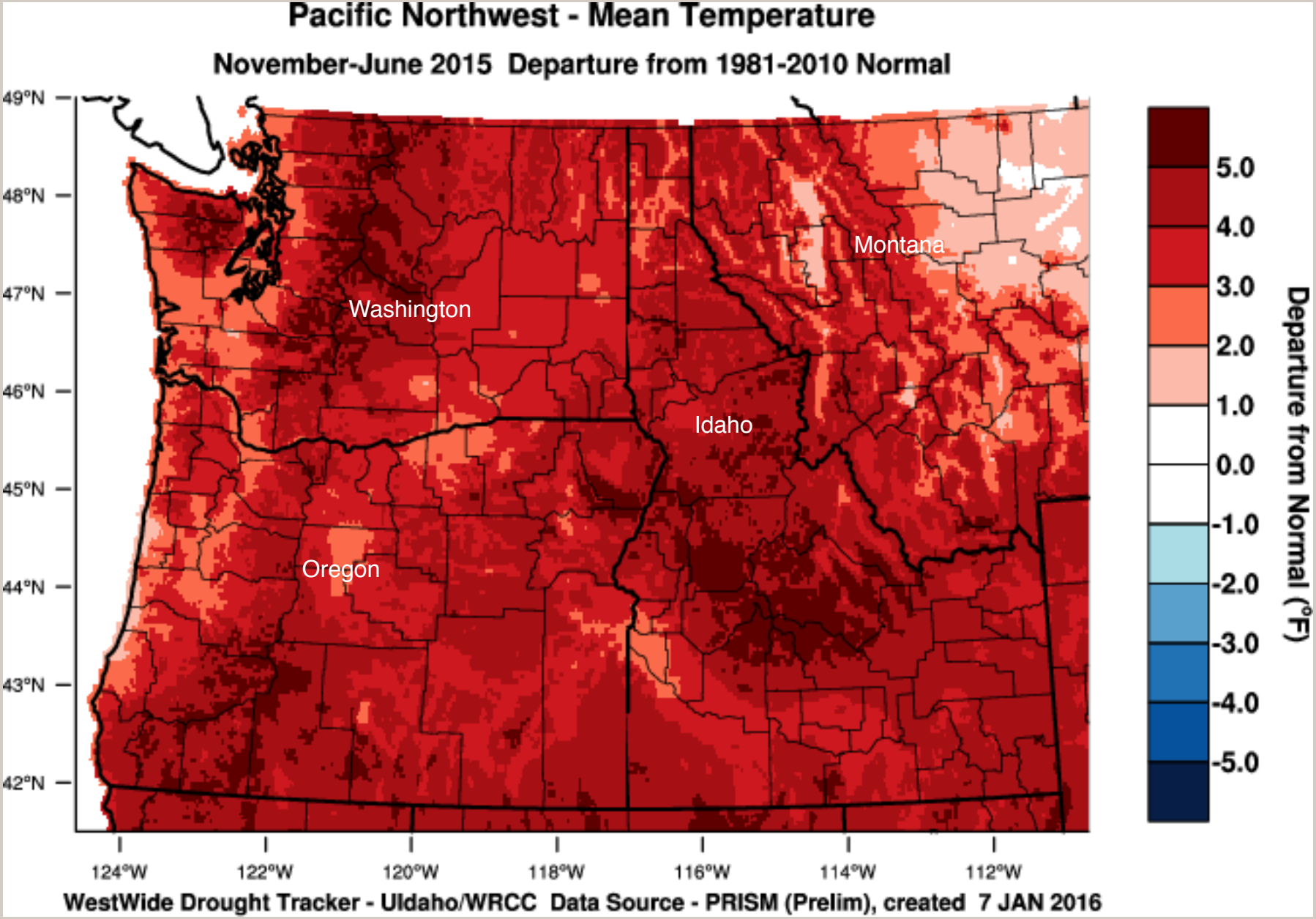
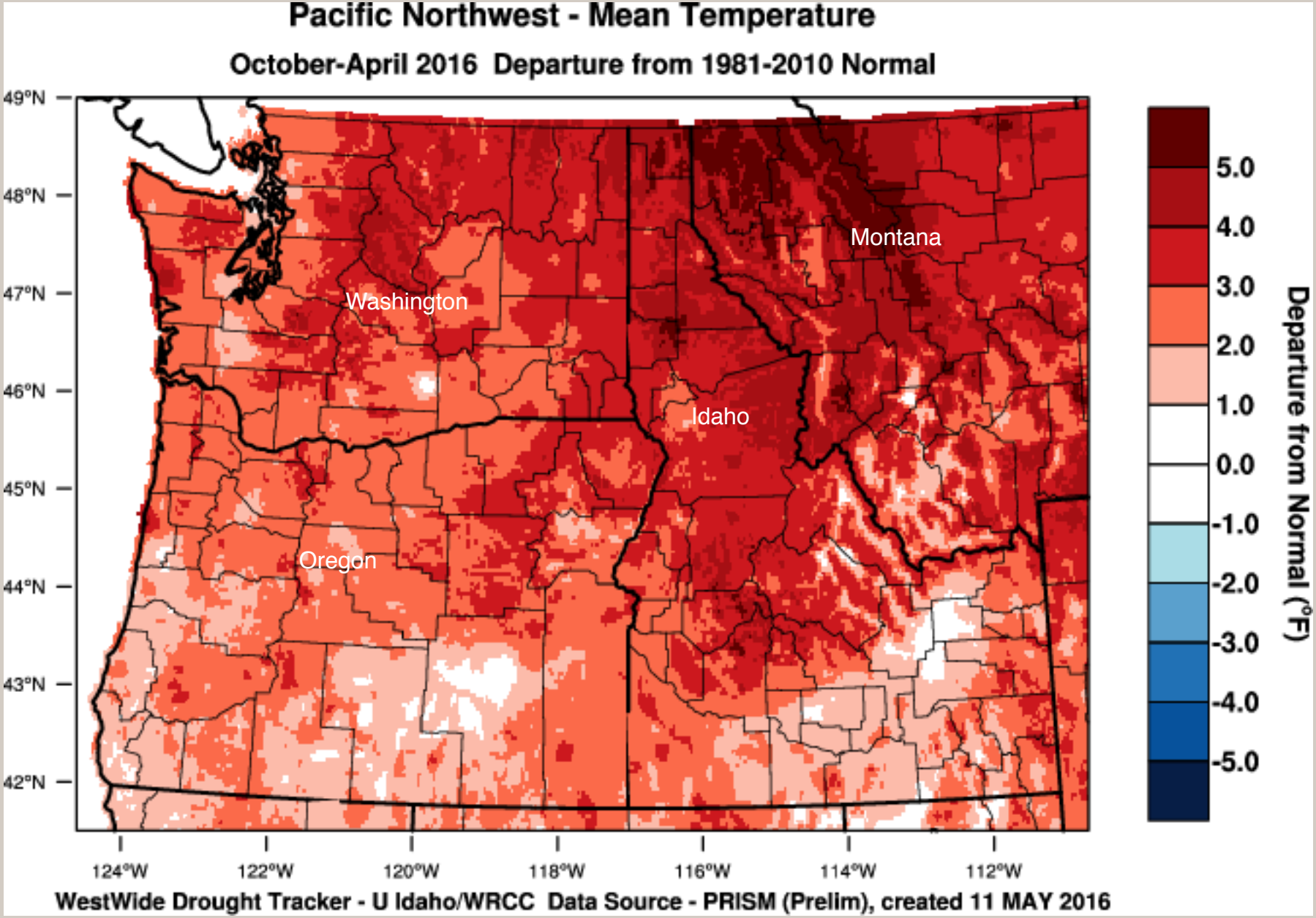
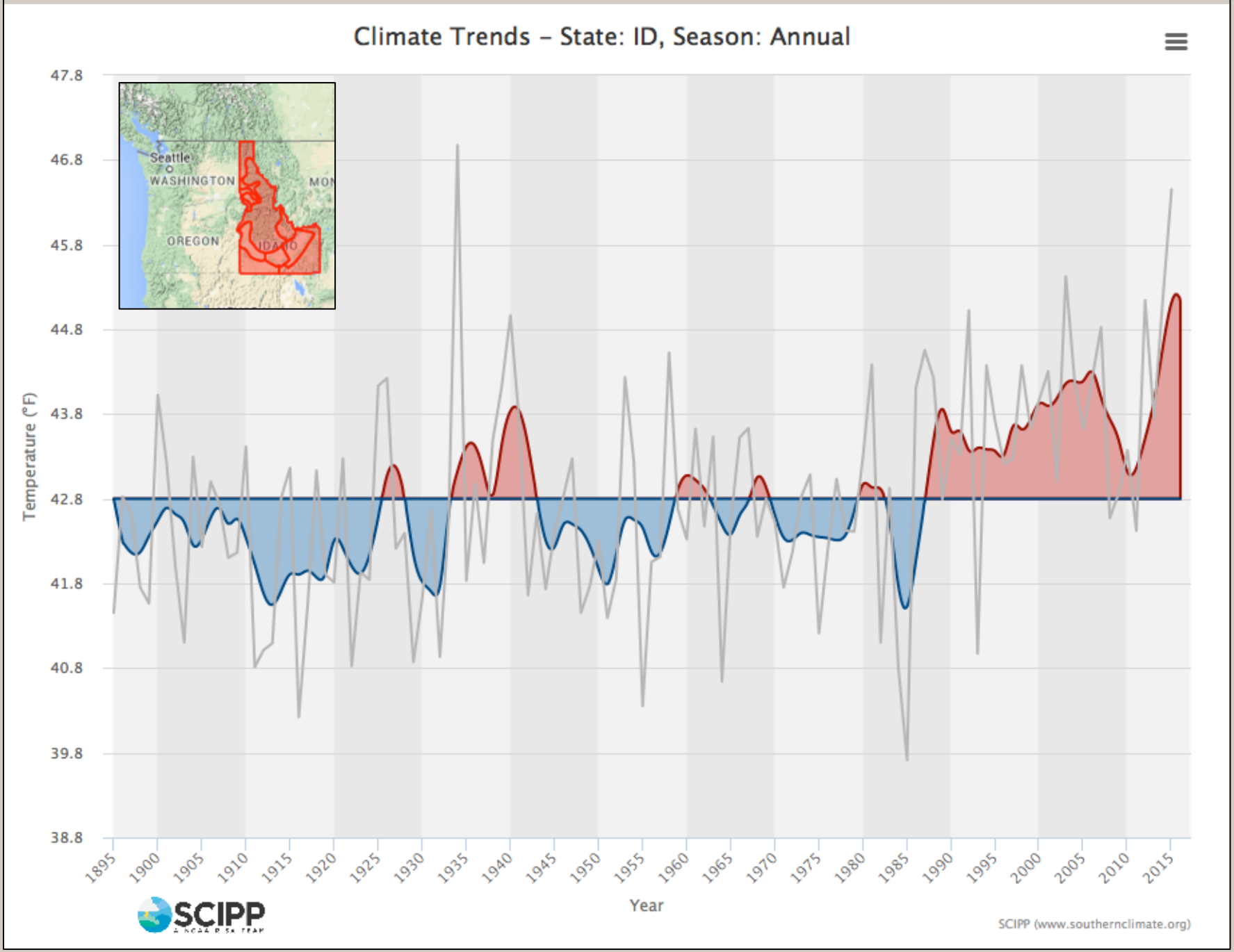
Last Year


Pacific Northwest - Mean Temperature
November-June 2015 Departure from 1981-2010 Normal
49°N
48°N
47°N
46°N
45°N
44°N
43°N
42°N
124°W
122°W
120°W
118°W
116°W
114°W
112°W
Washington
Montana
Idaho
Oregon
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
Departure from Normal (°F)
WestWide Drought Tracker - UIdaho/WRCC Data Source - PRISM (Prelim), created 7 JAN 2016

This year….. so far




Climate Trends – State: ID, Season: Annual
Seattle
WASHINGTON
OREGON
IDAHO
Temperature (°F)
47.8
46.8
45.8
44.8
43.8
42.8
41.8
40.8
39.8
38.8
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
SCIPP
SCIPP (www.southernclimate.org)

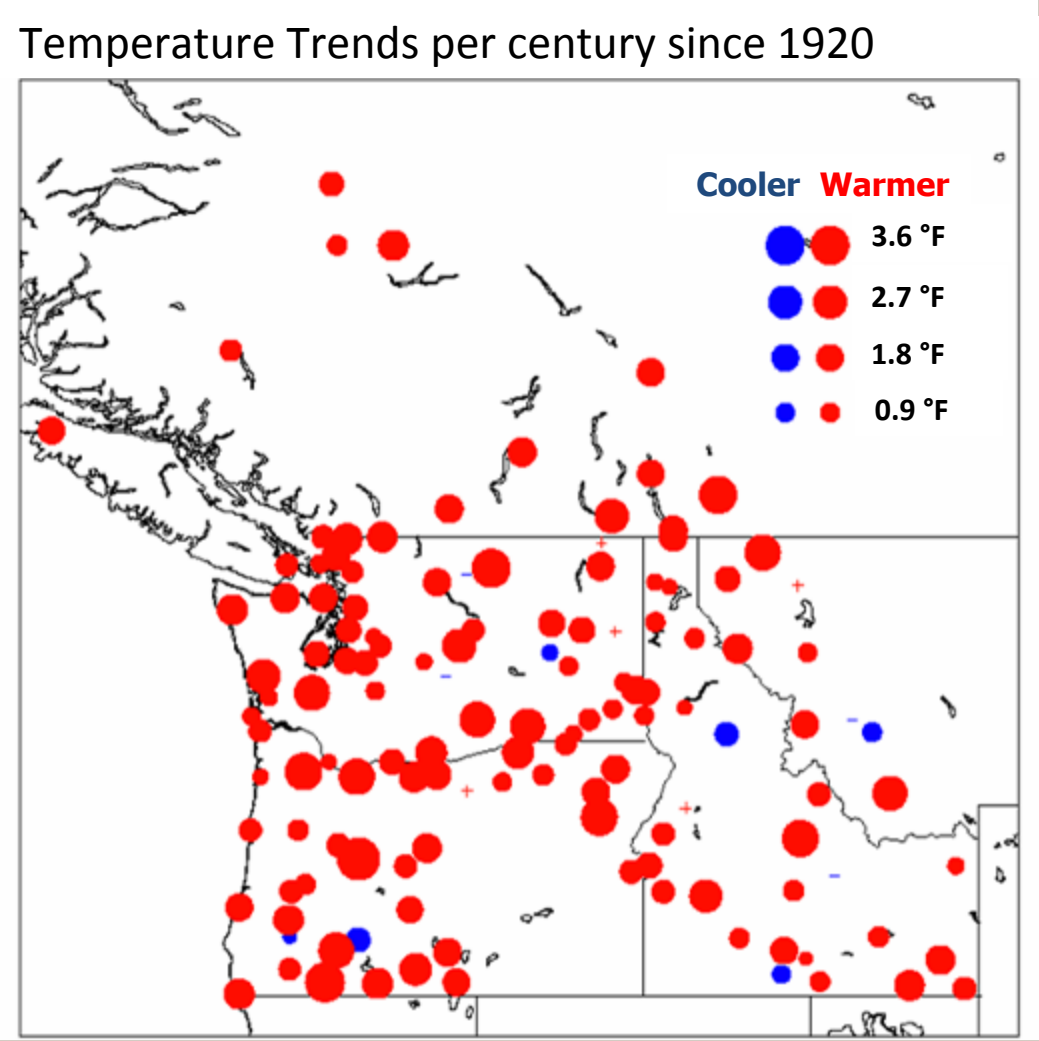
Temperature Trends by Station

Average annual temperature has increased **+1.5°F since 1920**.

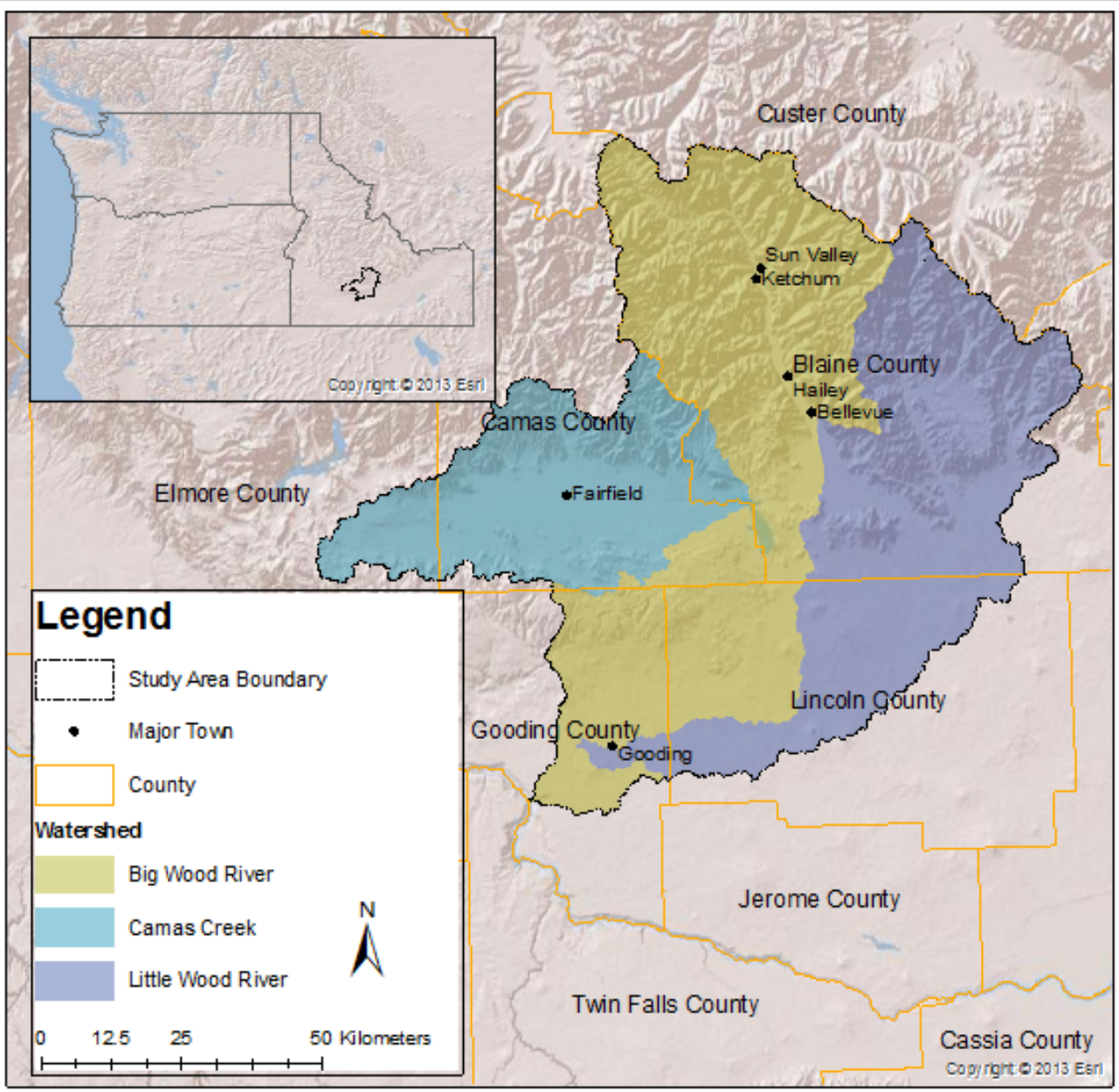
Almost every station shows warming.

Extreme cold conditions have become rarer.

Low temperatures rose faster than high temperatures.



Big Wood Basin



Goals

Evaluate climate Impacts to:

1. Water Supplies
2. Ag Water Demand
3. Evaluate alternative ag. and land use practices

Pilot a Knowledge to Action Network – *i.e. incorporating stakeholders into research process.*

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Network Participants ~50

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Concep

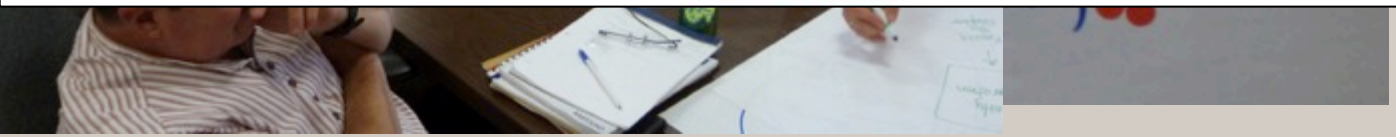
Community Collaboration
Leadership
Trust & Transparency
ID scope & scale of community
Knowing Thy Neighbor
Policy Enforcement

Responsible Development
Natural Habitat
Landscape Preference or Requirements
Land Values
Soil Types
Economy
Housing preferences
Generational Values
Land scarcity
Limited private land
Undevelopable fed land
Geography
Administration of Water Rights
Groundwater Protection
Population Growth Changes
Access to Transportation
Changing Demographics
Second home owners
Young professional
Baby Boomers
Permanent Population
Cost of living
Zoning restrictions
Elected Officials
Local wage earner
Urban amenities
Jobs
Clean Air
Culture
Seattle, SFO, Boise, Portland
National Economy
Regional Economy

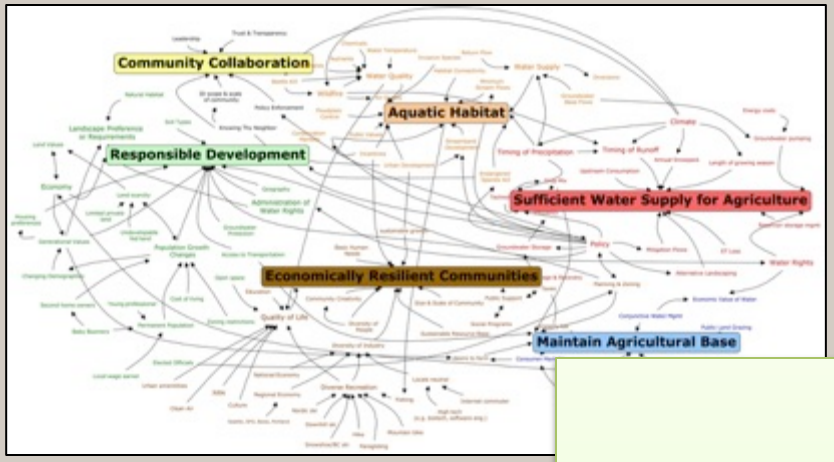
Aquatic Habitat
Chemicals
Water Temperature
Nutrients
Invasive Species
Return Flow
Water Quality
Habitat Connectivity
Beetle Kill
Wildfire
Air Quality
Minimum Stream Flows
Floodplain Control
Conservation Marketing
Public Values
Incentives
Urban Development
Streambank Development
Endangered Species Act

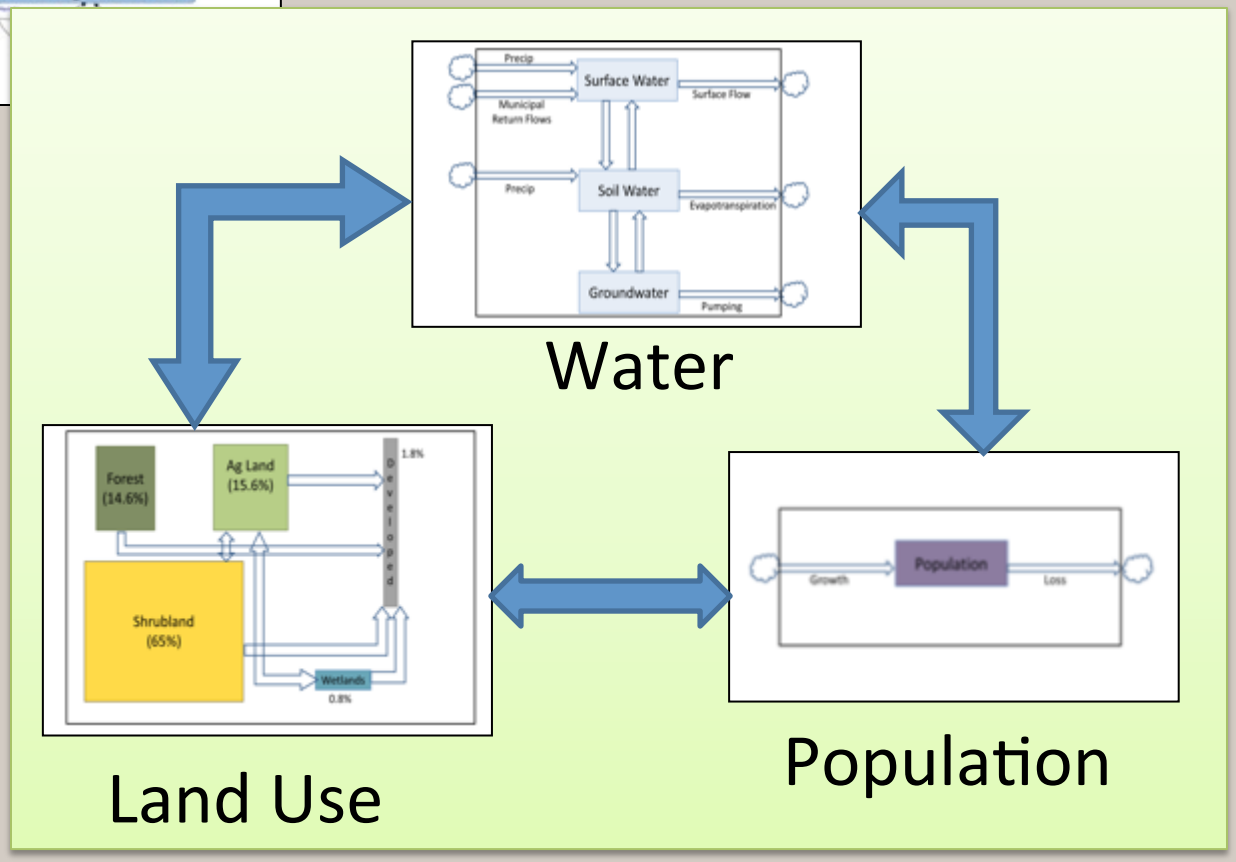
Sufficient Water Supply for Agriculture
Water Supply
Diversions
Groundwater Base Flows
Climate
Energy costs
Groundwater pumping
Timing of Precipitation
Timing of Runoff
Annual Snowpack
Length of growing season
Upstream Consumption
Crop Mix
Reservoir storage mgmt
Policy
Groundwater Storage
Mitigation Flows
ET Loss
Water Rights
Alternative Landscaping
Planning & Zoning
Taxes
Public Support
Economic Value of Water
Conjunctive Water Mgmt
Public Land Grazing
Social Programs
Sustainable Resource Base
Size & Scale of Community
Community Creativity
Diversity of People
Diversity of Industry
Quality of Life
Education
Open space
Basic Human Needs
sustainable growth
Economically Resilient Communities
Diverse Recreation
Fishing
Locale neutral
Internet commuter
High tech (e.g. biotech, software eng.)
Nordic ski
Downhill ski
Hike
Mountain bike
Snowshoe/BC ski
Paragliding

Maintain Agricultural Base
desire to farm
Consumer Markets
Crop Prices
Farm Size Viability



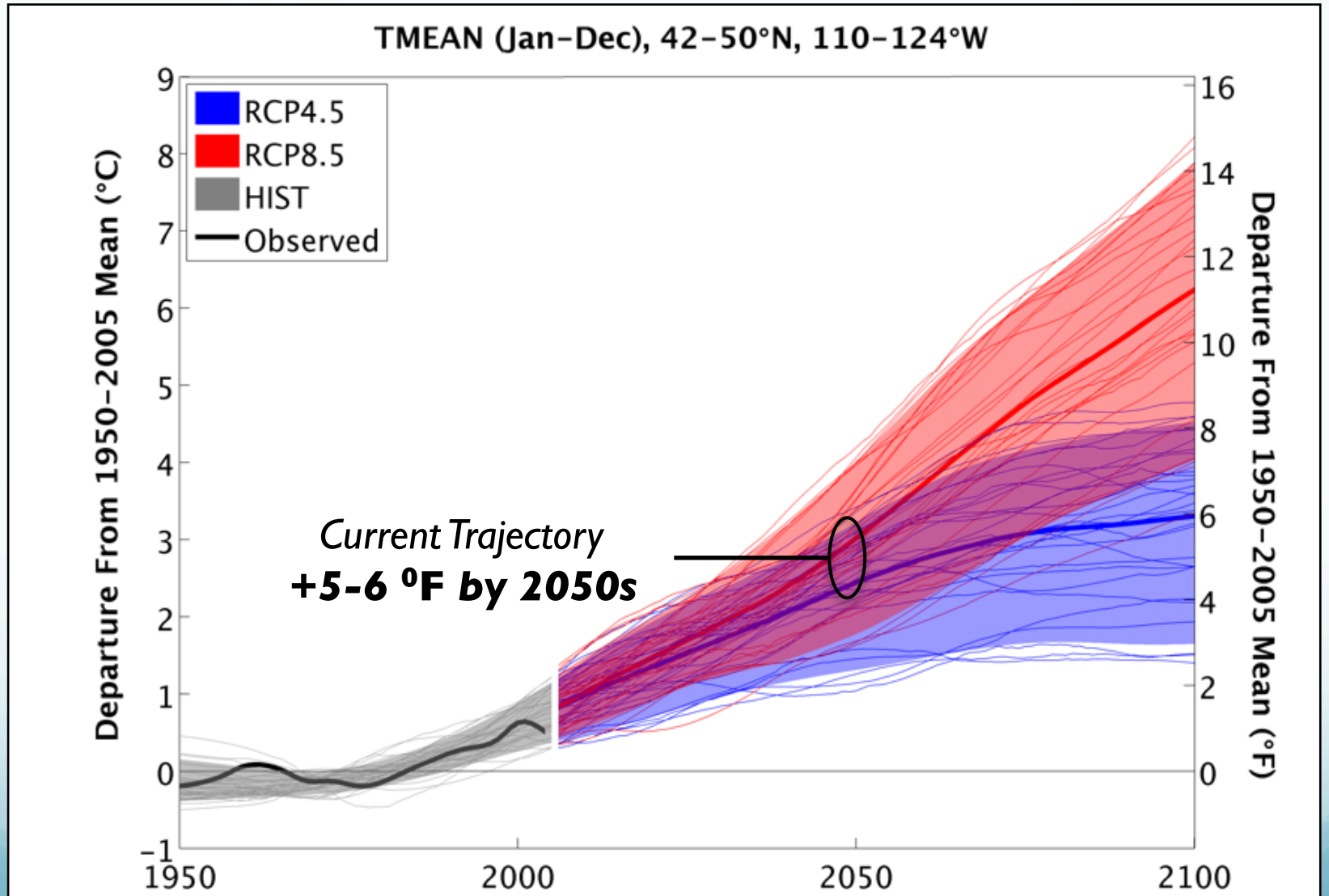
System Dynamics Model & Working Groups





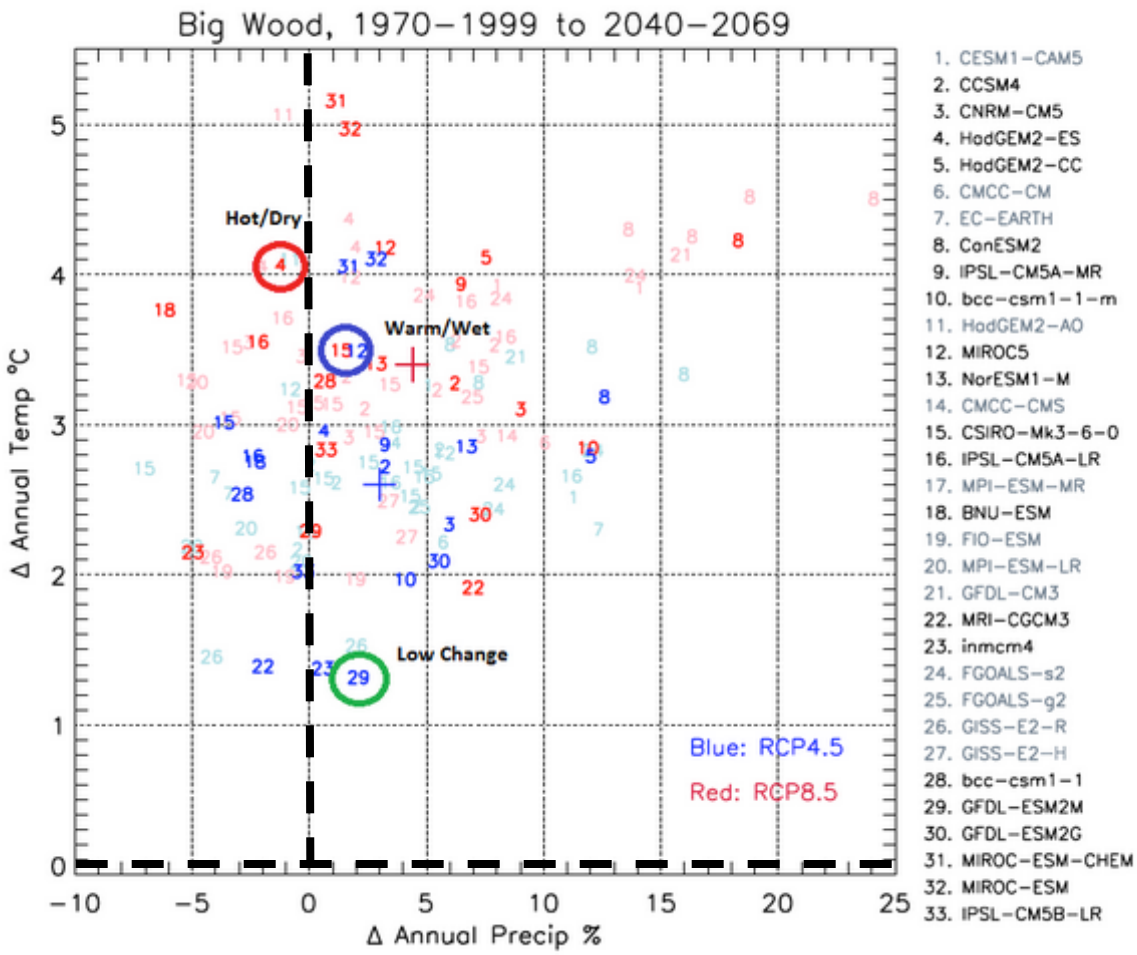
Stakeholder validation of system representation

Projected Avg. Winter Temp, PNW



Abatzoglou et al. 2013

Big Wood: 3 Climate Scenarios



1. CESM1–CAM5
2. CCSM4
3. CNRM–CM5
4. HadGEM2–ES
5. HadGEM2–CC
6. CMCC–CM
7. EC–EARTH
8. CanESM2
9. IPSL–CM5A–MR
10. bcc–csm1–1–m
11. HadGEM2–AO
12. MIROC5
13. NorESM1–M
14. CMCC–CMS
15. CSIRO–Mk3–6–0
16. IPSL–CM5A–LR
17. MPI–ESM–MR
18. BNU–ESM
19. FIO–ESM
20. MPI–ESM–LR
21. GFDL–CM3
22. MRI–CGCM3
23. inmcm4
24. FGOALS–s2
25. FGOALS–g2
26. GISS–E2–R
27. GISS–E2–H
28. bcc–csm1–1
29. GFDL–ESM2M
30. GFDL–ESM2G
31. MIROC–ESM–CHEM
32. MIROC–ESM
33. IPSL–CM5B–LR

Δ Temperature, °C

	RCP4.5	RCP8.5
Max.	4.1	5.1
75%	2.9	4.1
Mean	2.6	3.4
25%	2.1	2.8
Min.	1.3	1.9

Δ Precipitation, %

	RCP4.5	RCP8.5
Max.	12.1	18.3
75%	5.8	7.1
Mean	3.0	4.4
25%	−0.20	0.20
Min.	−2.8	−6.1

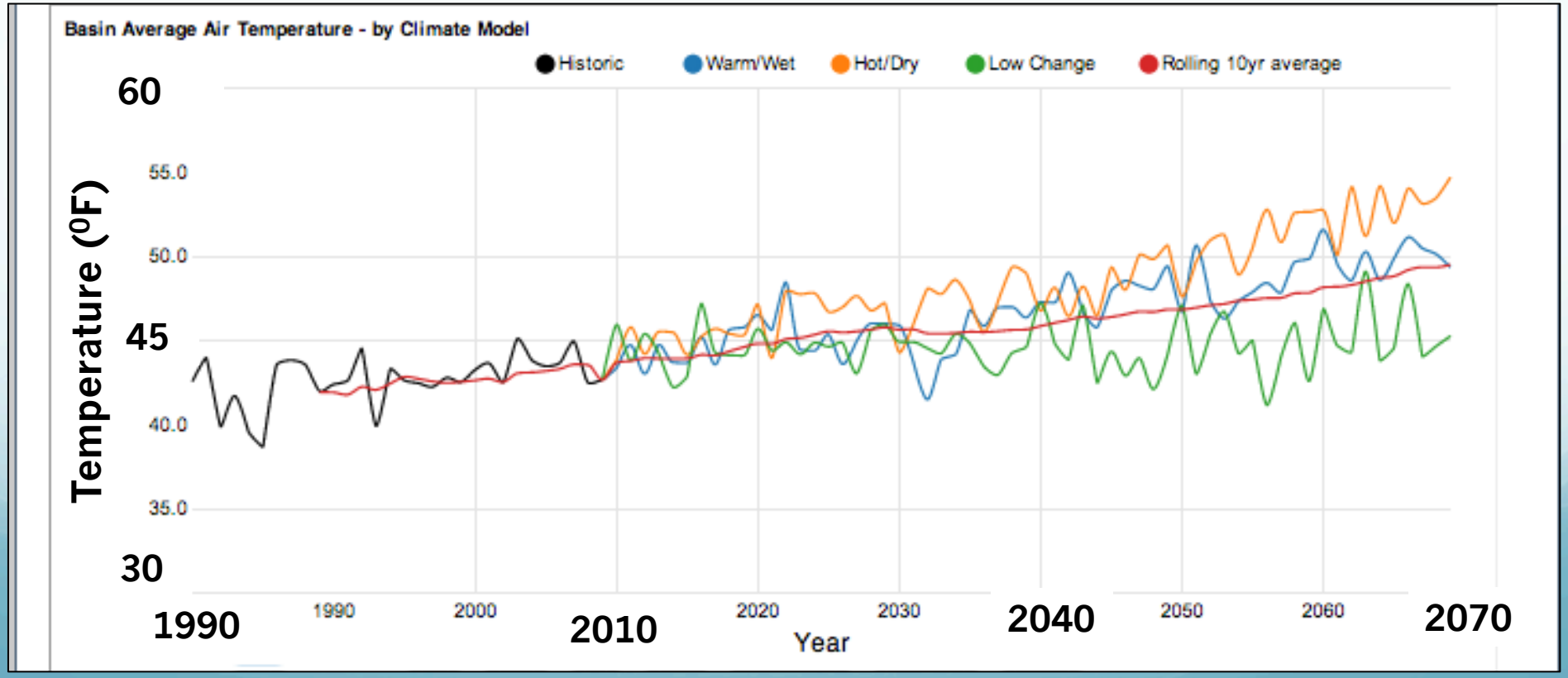
Where models had multiple ensemble members, ensembles were averaged prior to calculating statistics in the table above.

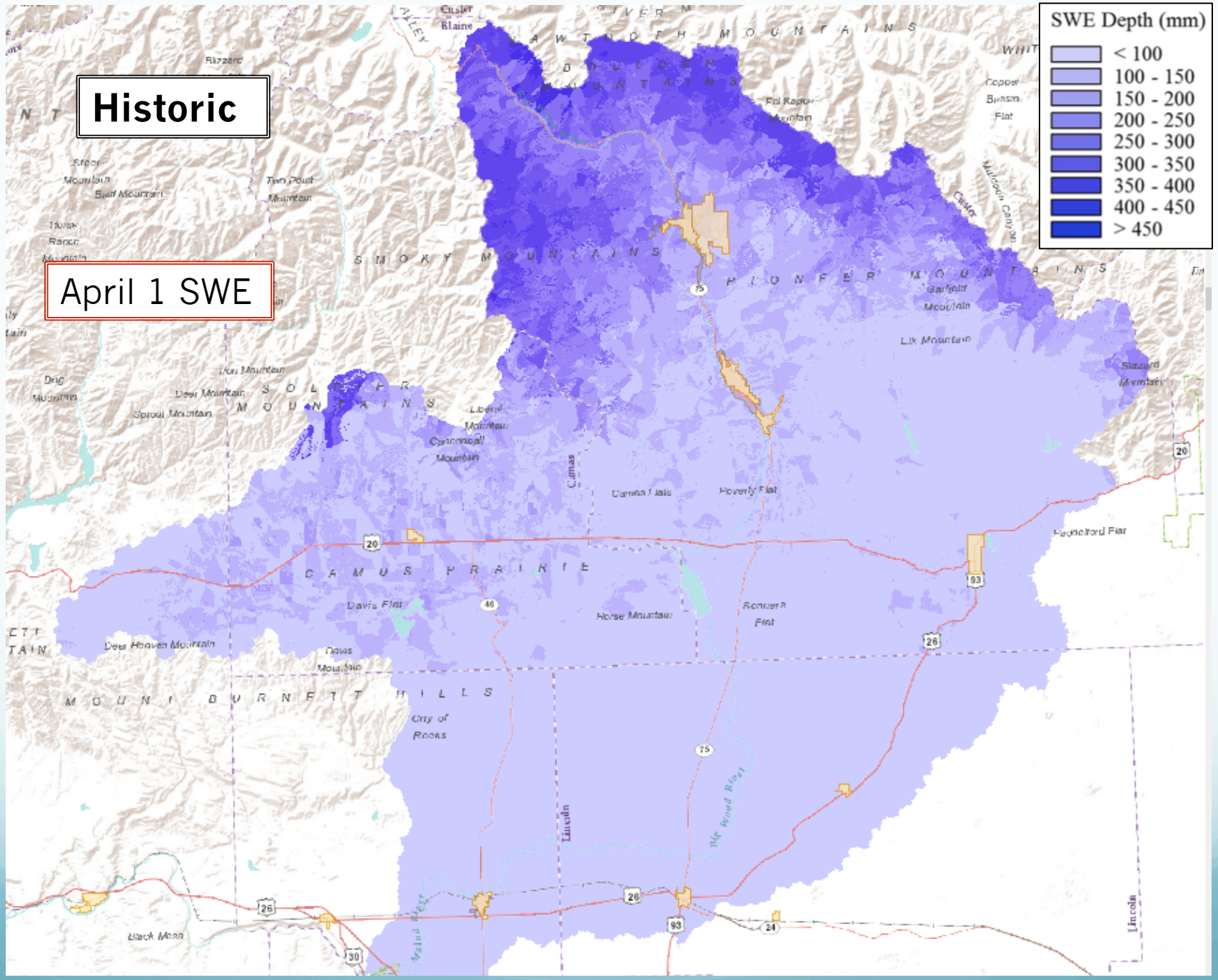
Key:
Dark color = MACA available
Light color = MACA not available
Models ranked by performance index
"+" = mean of RCP

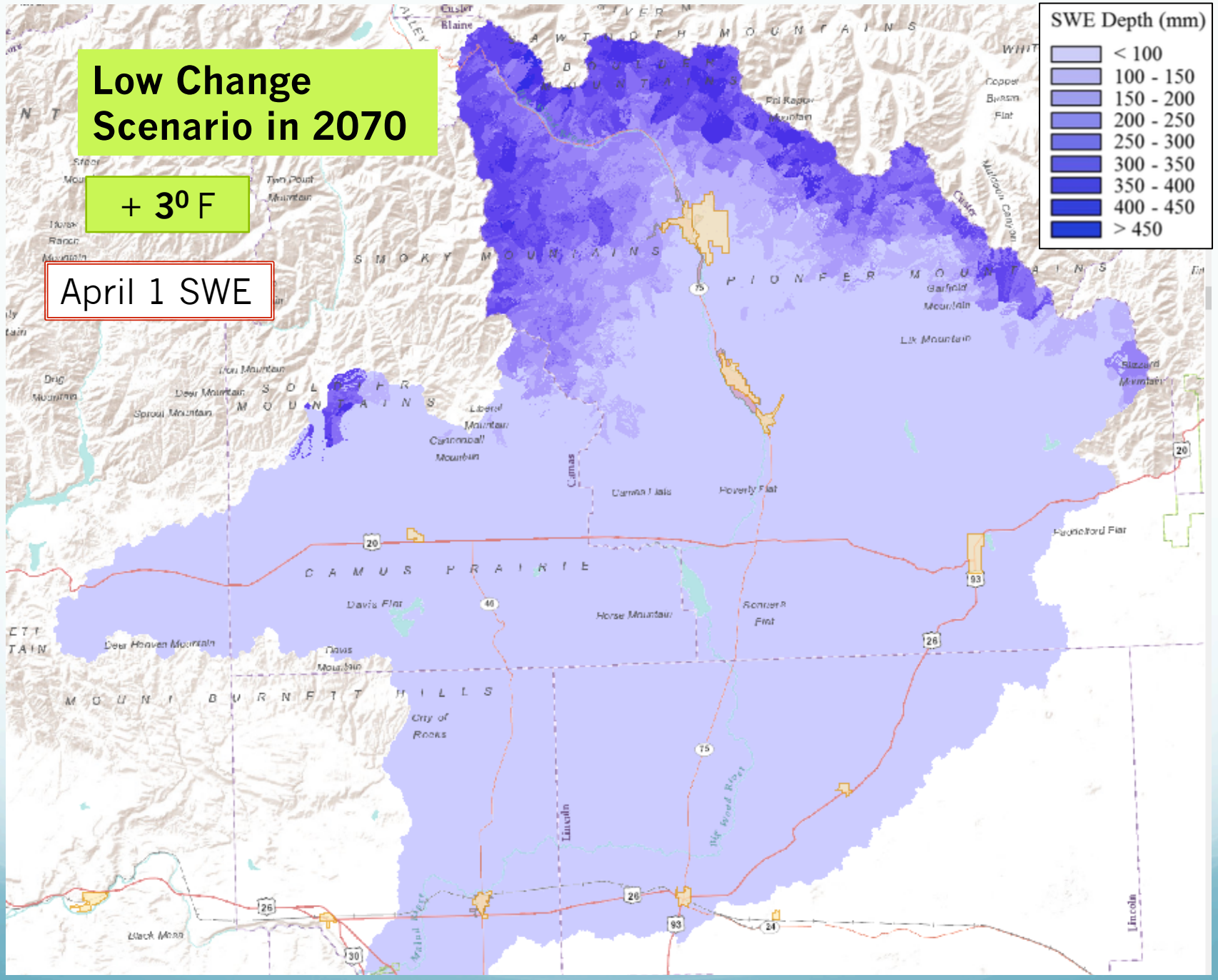
Big Wood: 3 Climate Scenarios

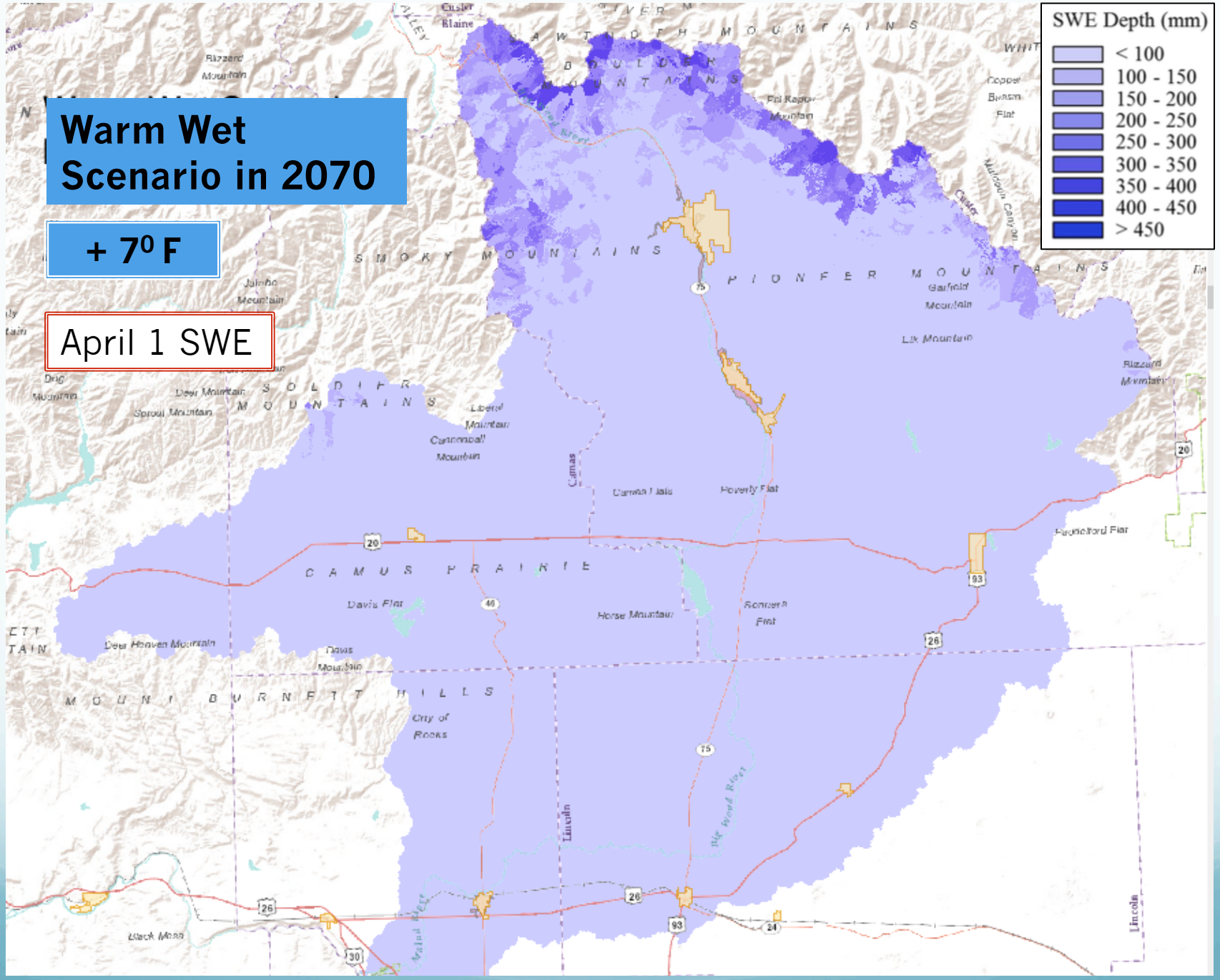
Low Change	Warmer & Wetter	Hotter & Drier
+ 3⁰ F	+ 7⁰ F	+ 11⁰ F

By late century




Historic
April 1 SWE
SWE Depth (mm)
< 100
100 - 150
150 - 200
200 - 250
250 - 300
300 - 350
350 - 400
400 - 450
> 450
SMOKY MOUNTAINS
PIONEER MOUNTAINS
CAMAS PRAIRIE
Camas
Lincoln
Custer
Blaine

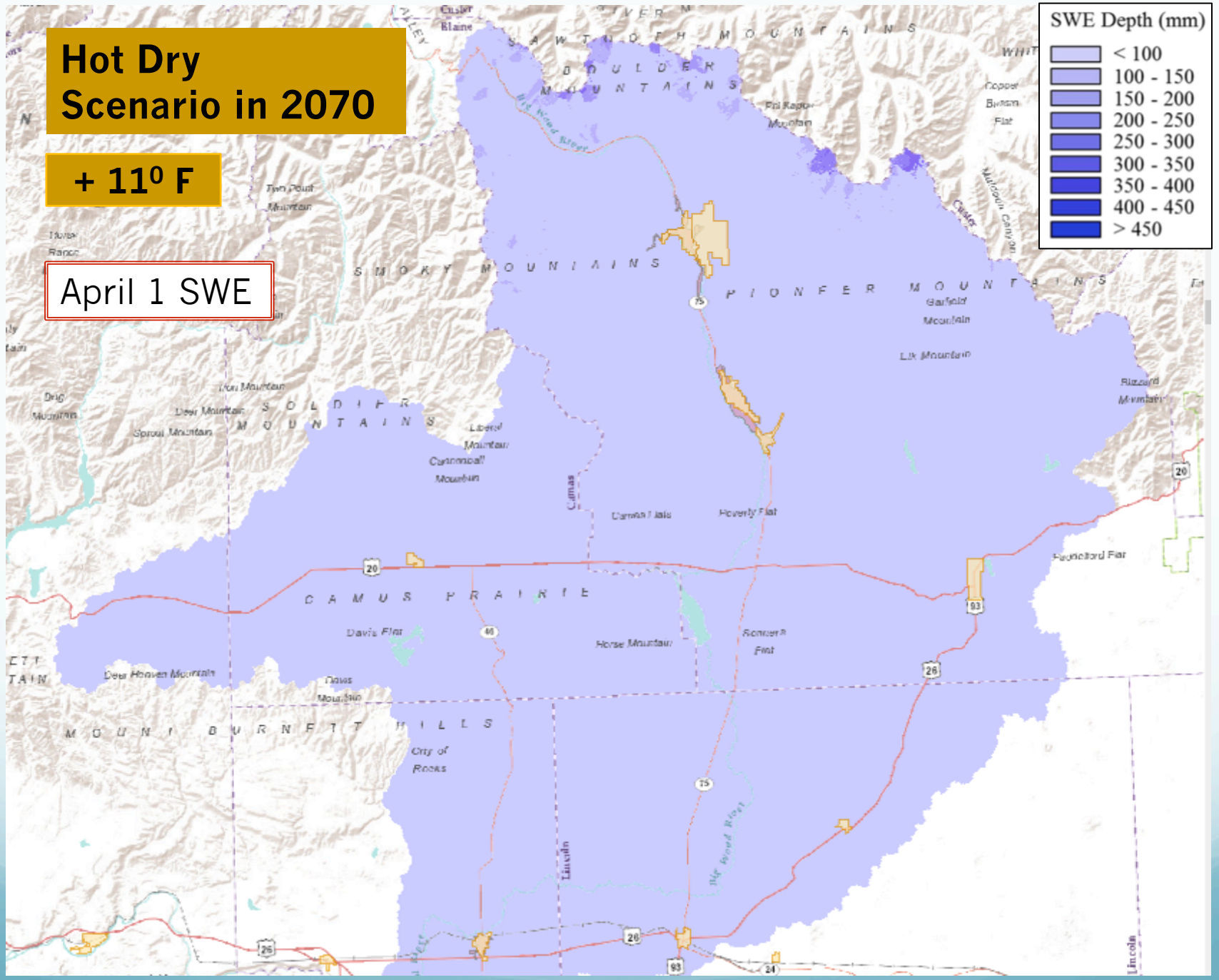

Low Change Scenario in 2070
+ 3⁰ F
April 1 SWE
SWE Depth (mm)
< 100
100 - 150
150 - 200
200 - 250
250 - 300
300 - 350
350 - 400
400 - 450
> 450
SMOKY MOUNTAINS
PIONEER MOUNTAINS
CAMAS PRAIRIE
Camas
Lincoln
Blaine
Custer
Twin Peak Mountain
Garfield Mountain
Lix Mountain
Blizzard Mountain
Liberal Mountain
Cannonball Mountain
Beverly Flat
Davis Flat
Horse Mountain
Deer Heaven Mountain
Davis Mountain
City of Rocks
Black Mesa
Big Wood River
Malad River
Copper Basin Flat
Pal Raptor Mountain
Muldoon Canyon
Camas Flats
Pennsylvania Flat
Rocky Flat
Drig Mountain
Deer Mountain
Sprout Mountain
Iron Mountain
Sugar Mountain
Three Ranch Mountain
20
26
30
24
46
75
93


Warm Wet Scenario in 2070
+ 7⁰ F
April 1 SWE
SWE Depth (mm)
< 100
100 - 150
150 - 200
200 - 250
250 - 300
300 - 350
350 - 400
400 - 450
> 450
SMOKY MOUNTAINS
PIONEER MOUNTAINS
CAMAS PRAIRIE
Camas
Lincoln
Blaine
Custer

Hot Dry Scenario in 2070

+ 11⁰ F

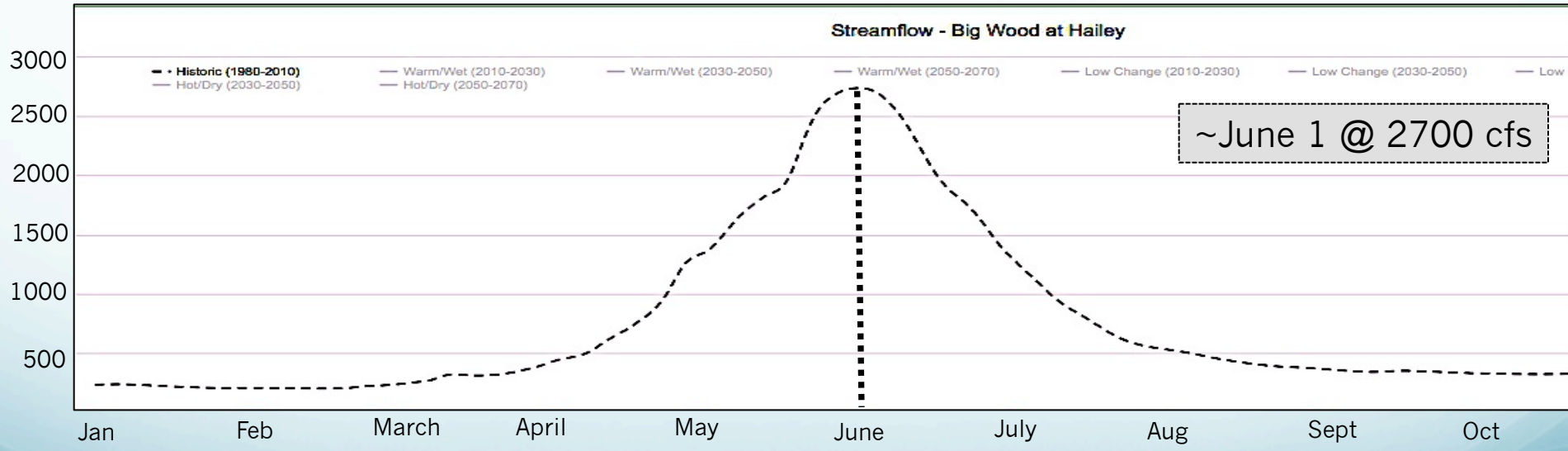
April 1 SWE



Big Wood Climate Response

Historic

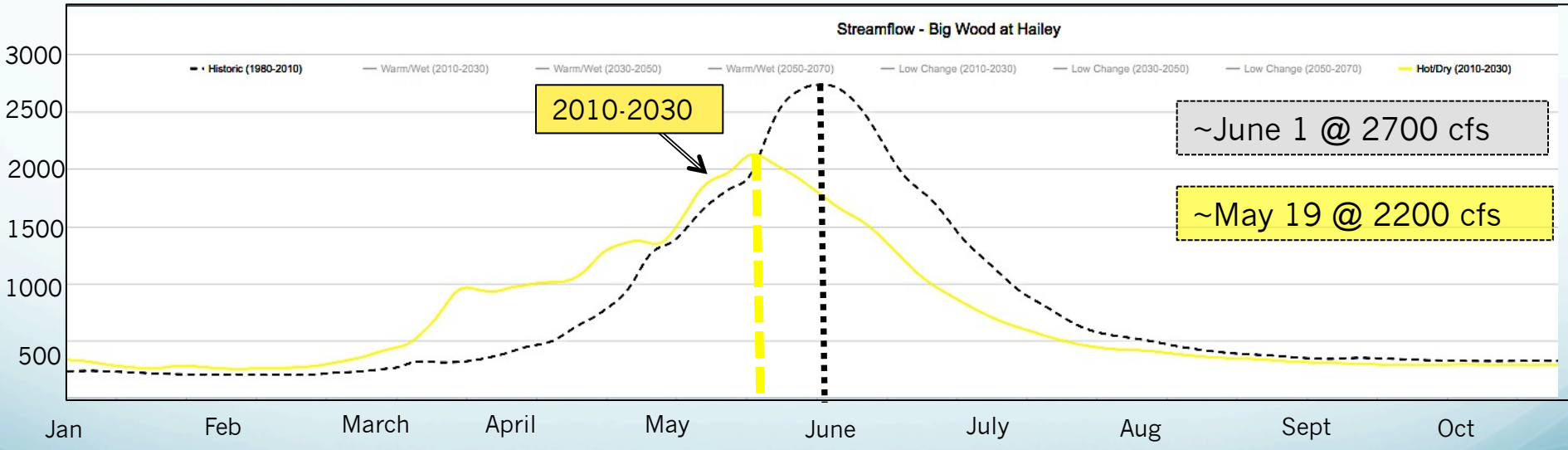
Photo Credit: IDFG



Big Wood Climate Response

Hot-Dry Scenario

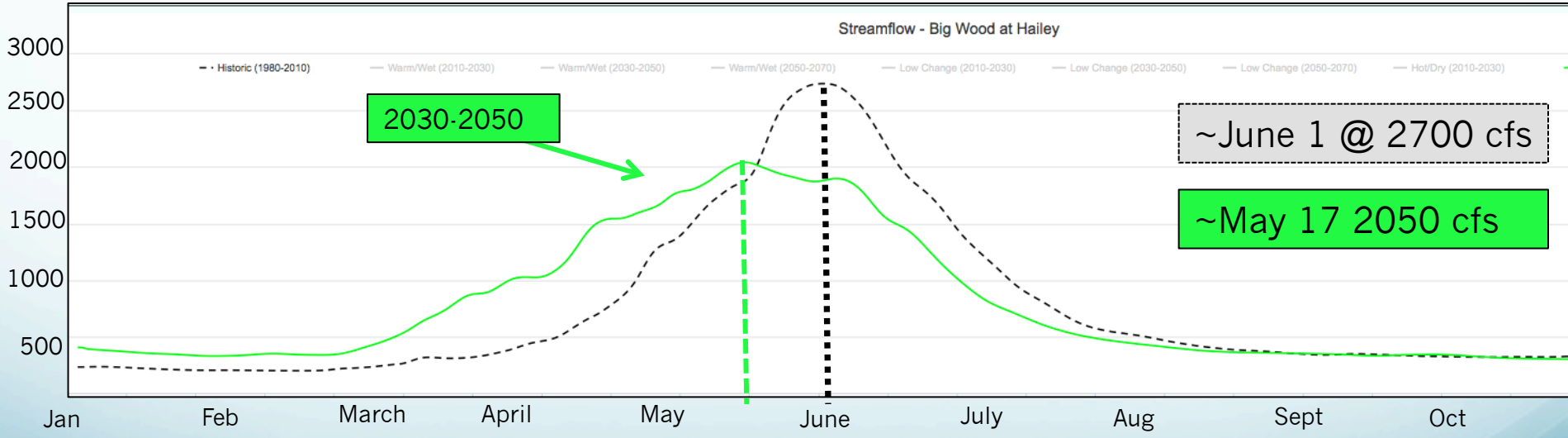
Photo Credit: IDFG



Big Wood Climate Response

Hot-Dry Scenario

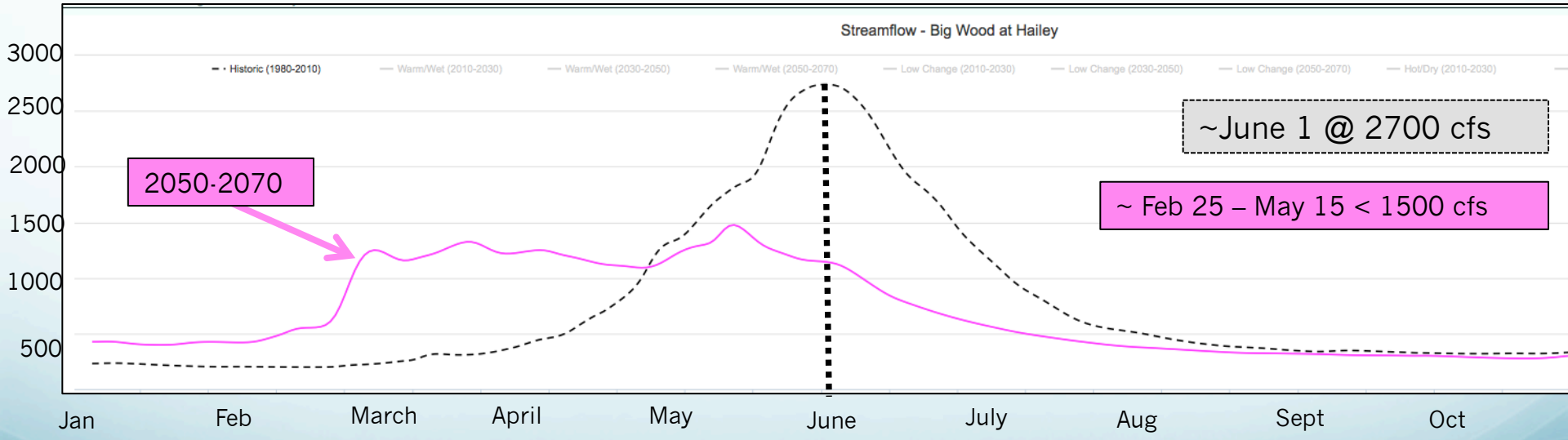
Photo Credit: IDFG



Big Wood Climate Response

Hot-Dry Scenario

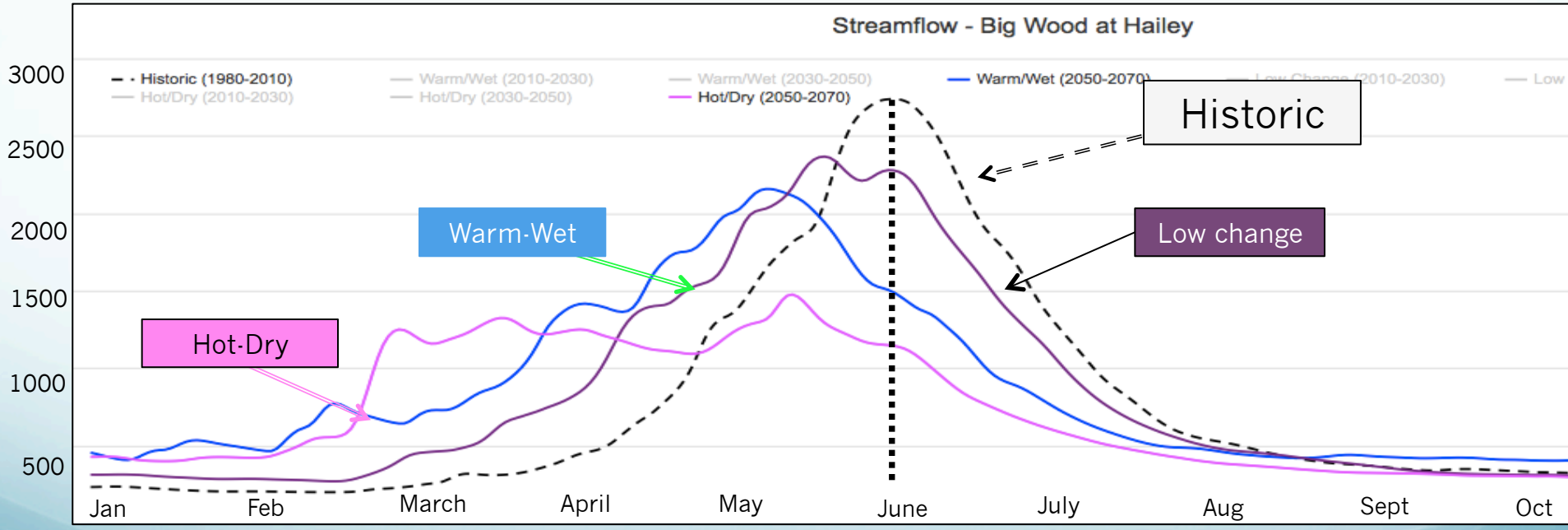
Photo Credit: IDFG



Big Wood Climate Response

All Climate 2050-2070

Photo Credit: IDFG

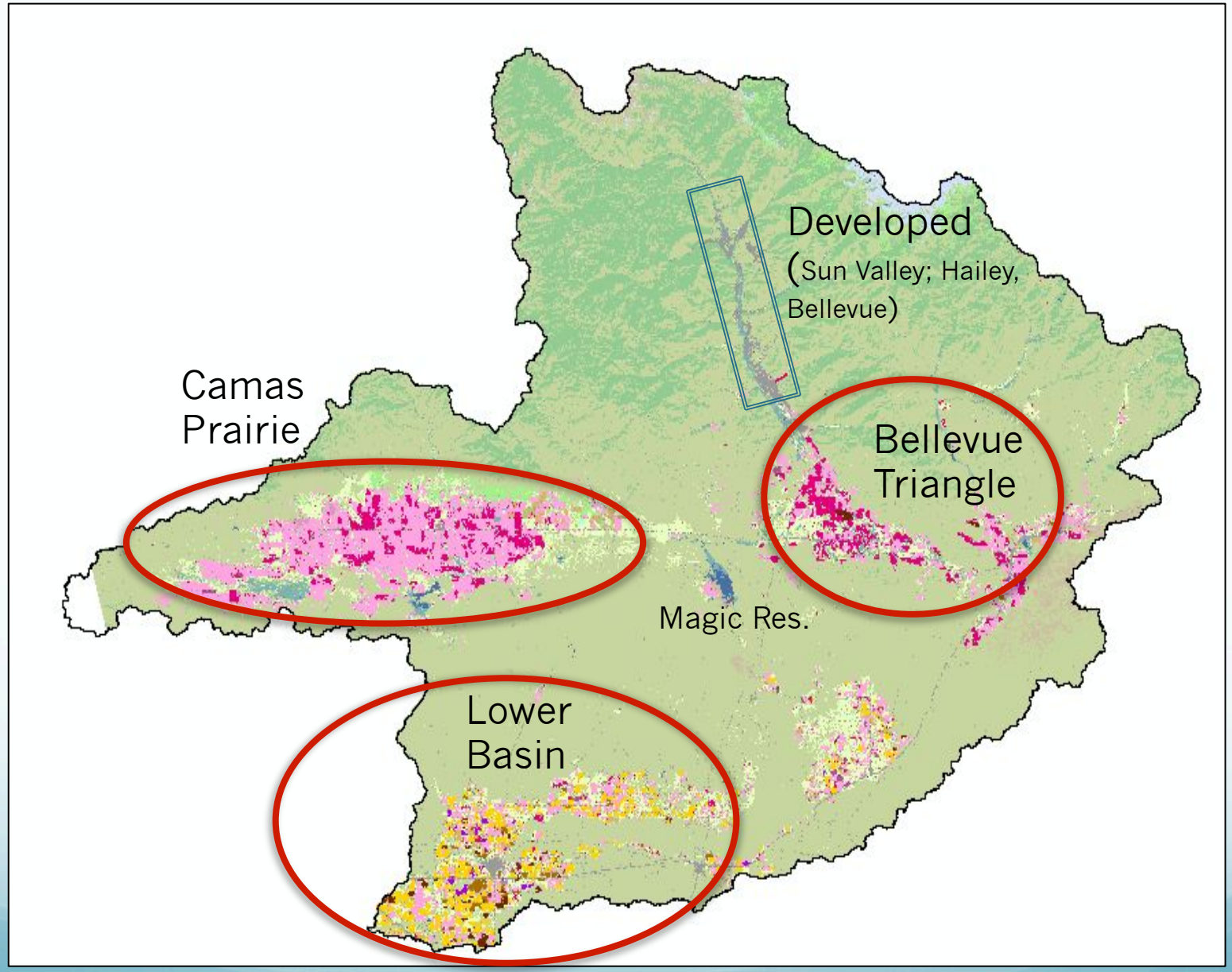


Changes for Agriculture

Credit: Sam Beebe

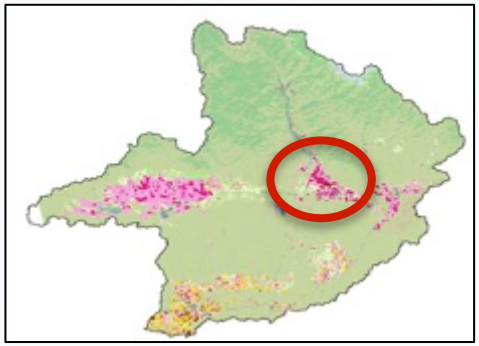
Credit: UoD Carvel REC

Credit: J. Stephen Conn



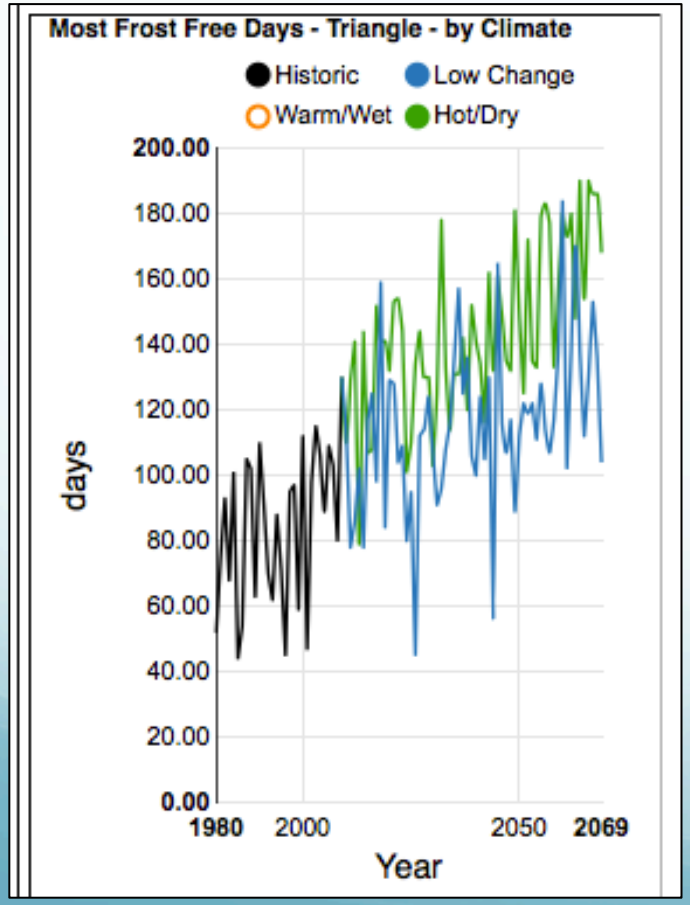
Data from USDA National Agricultural Statistics Service

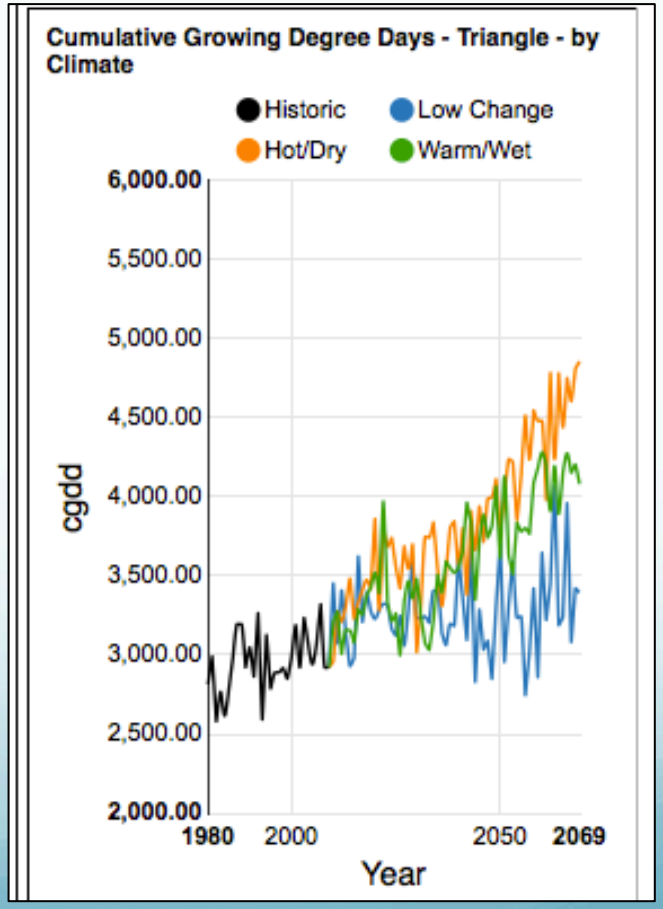
Bellevue Triangle



Frost free days increase
~ 40 to 75 days

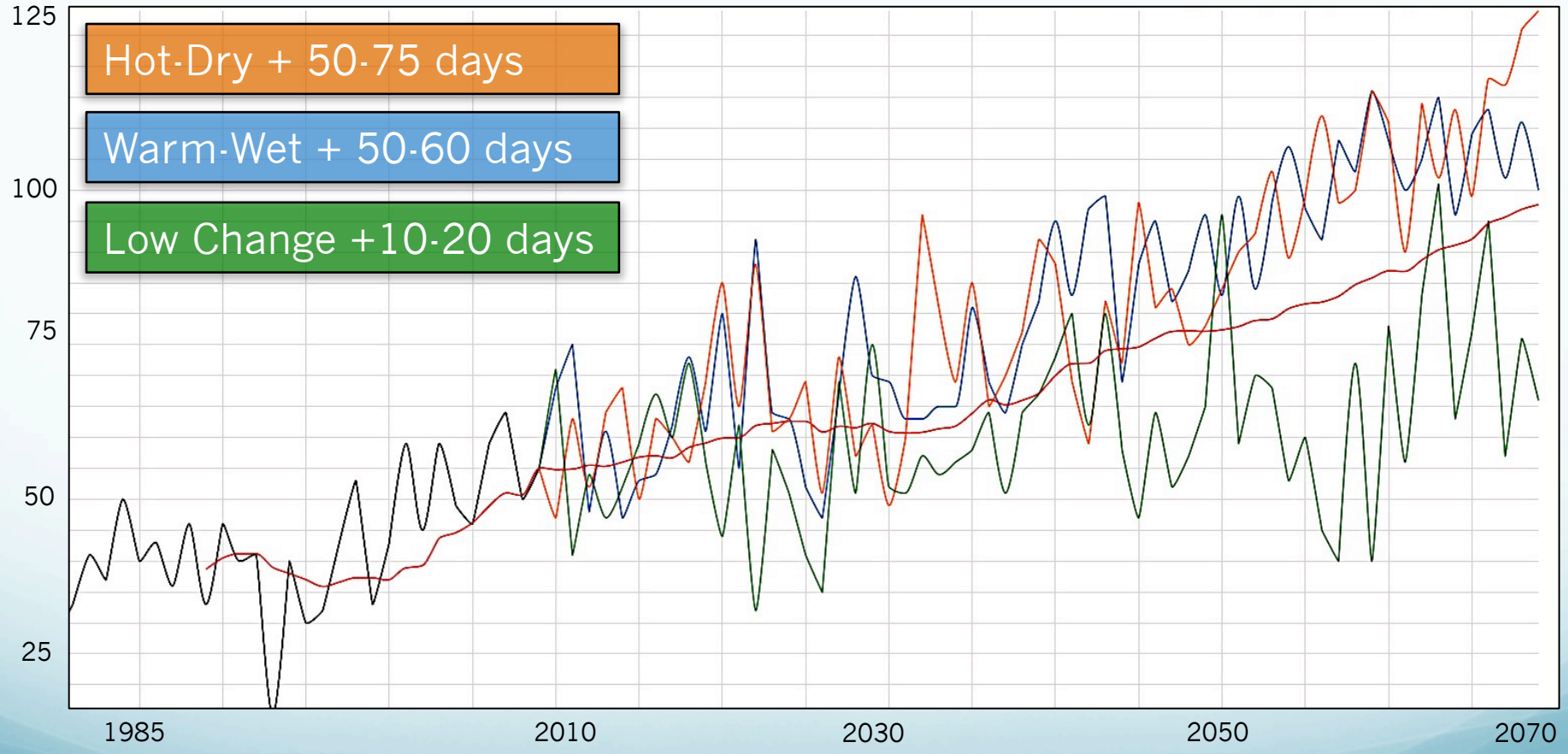
Heat units increase
~ 400 to 1500 CGDD



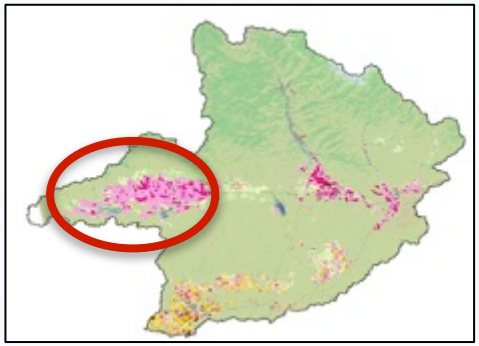


Crop Heat Stress

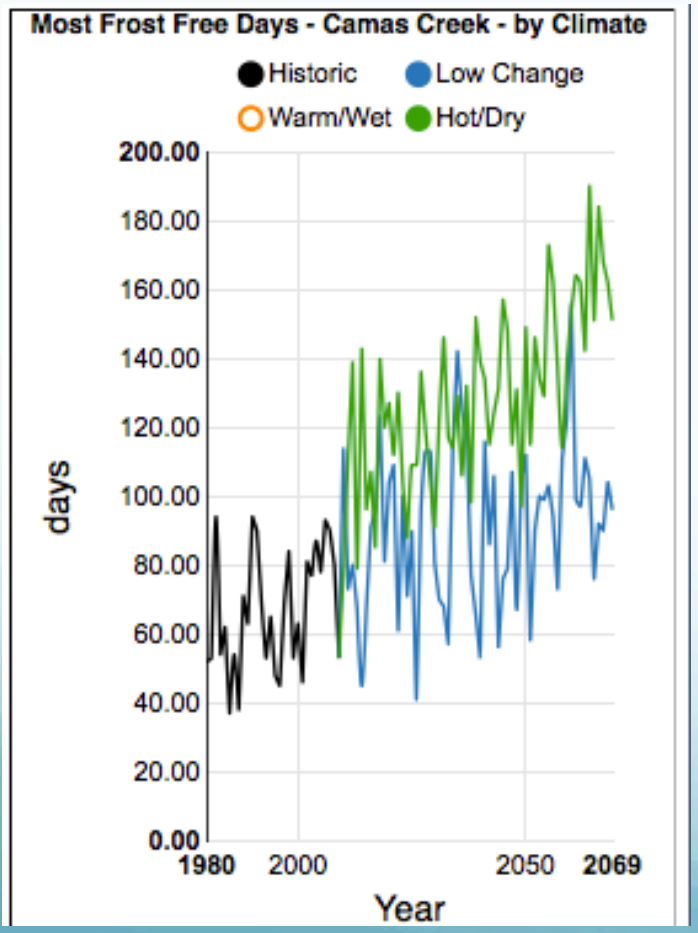
(Days over 90F) *Triangle*



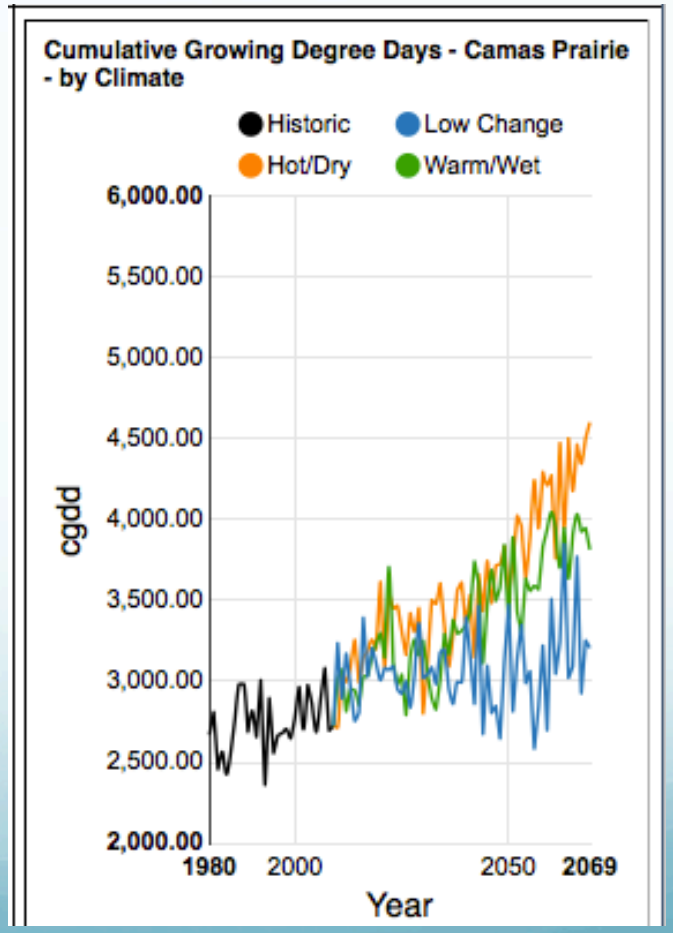
Camas Prairie:



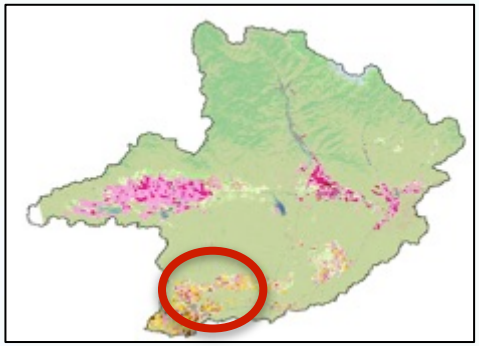
Frost free days increase
~ 35 to 90 days



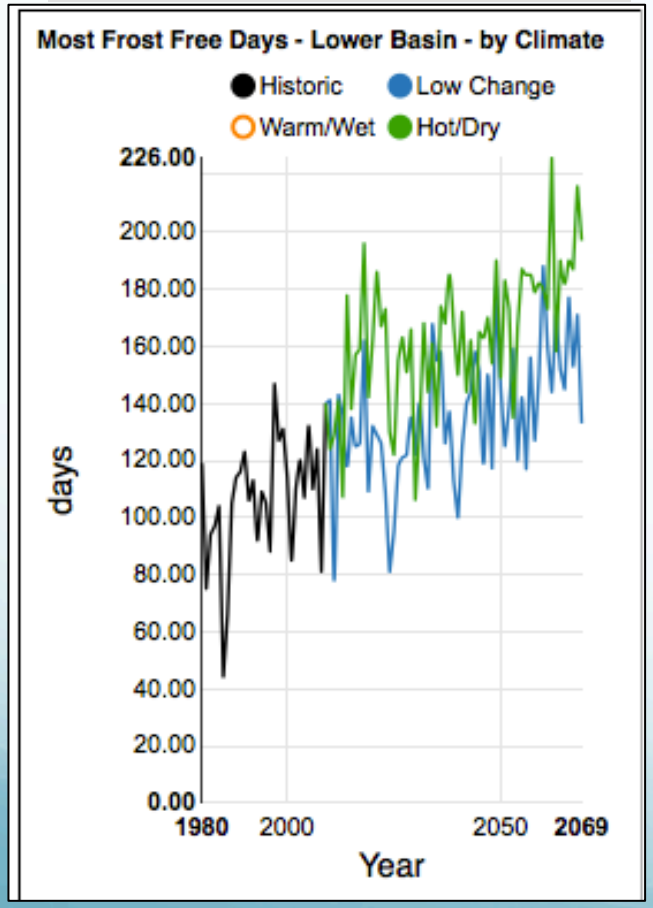
Heat units increase
~ 500 to 1500 CGDD



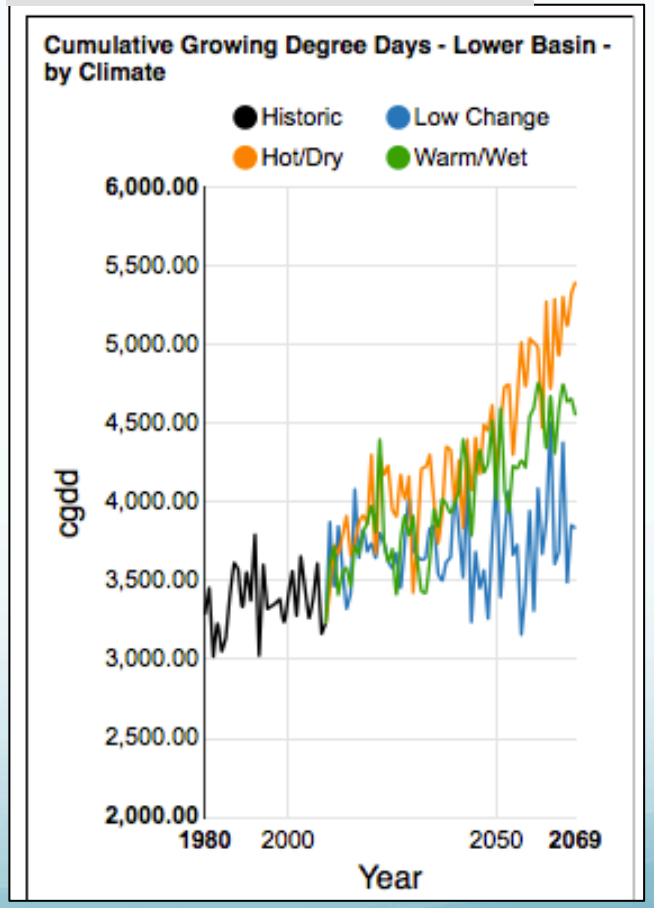
Lower Basin



Frost free days increase
~ 50 to 70 days



Heat units increase
~ 500 to 1600 CGDD



Changes for Recreation

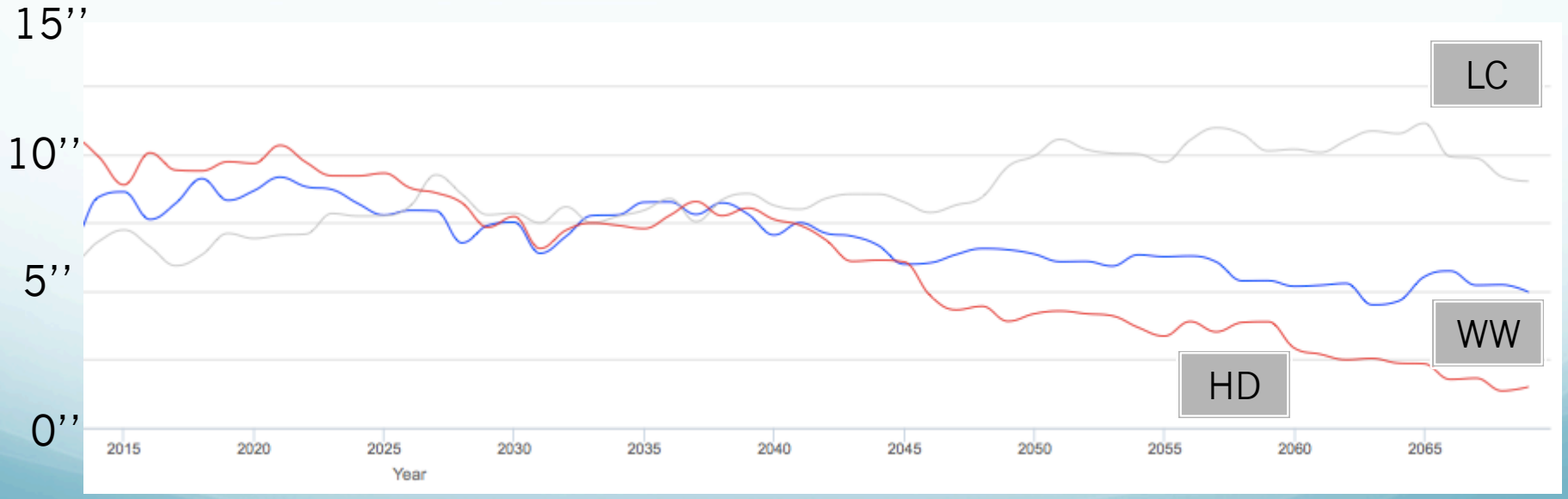
Credit: Trysil

Credit: Thomas Hawk

Credit: Thomas Hawk

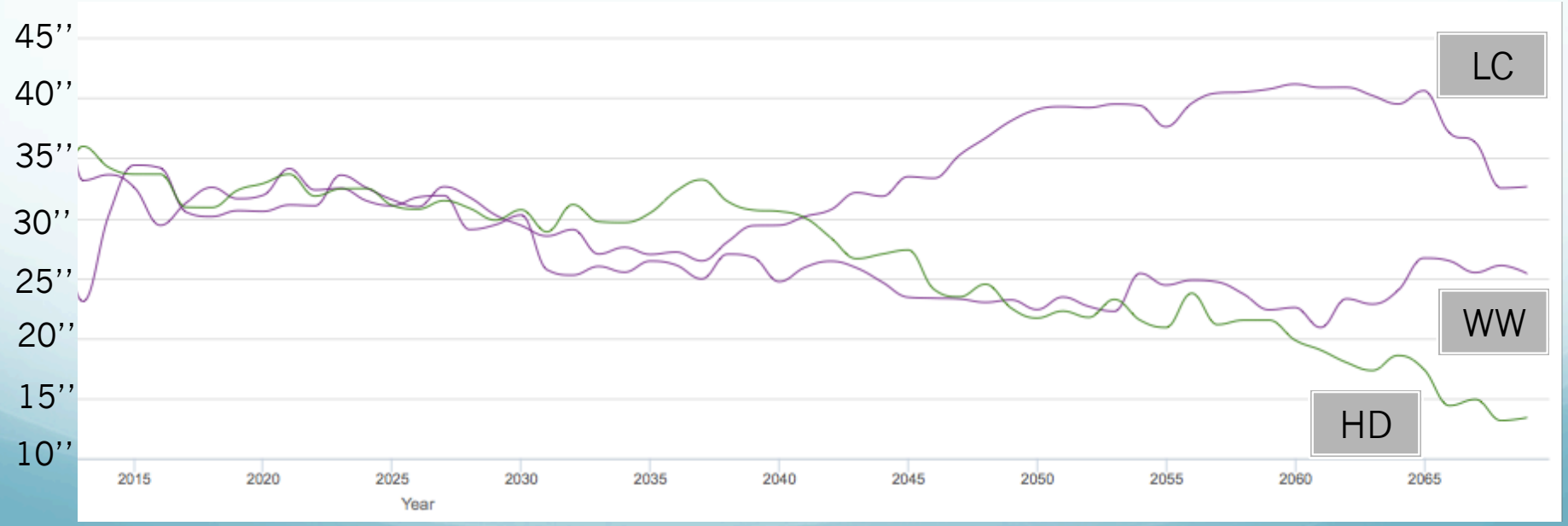
Snow Depth on *Valley Floor*

December 15 @5000-6400 ft.

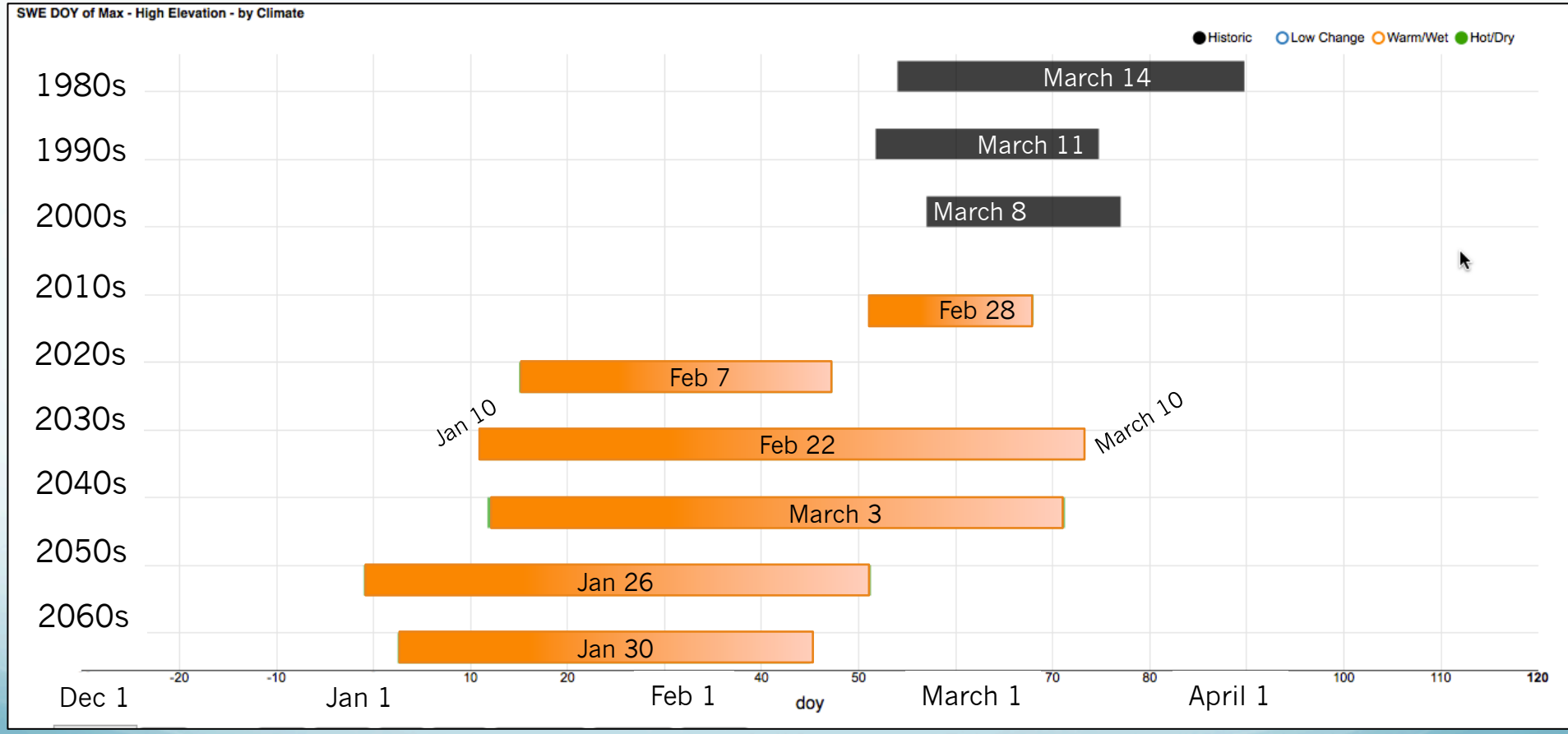


Snow Depth on *Galena*

December 15 @~7500 ft.



Timing of *Maximum Snow*



Scenario Development Workshop

"What if….."

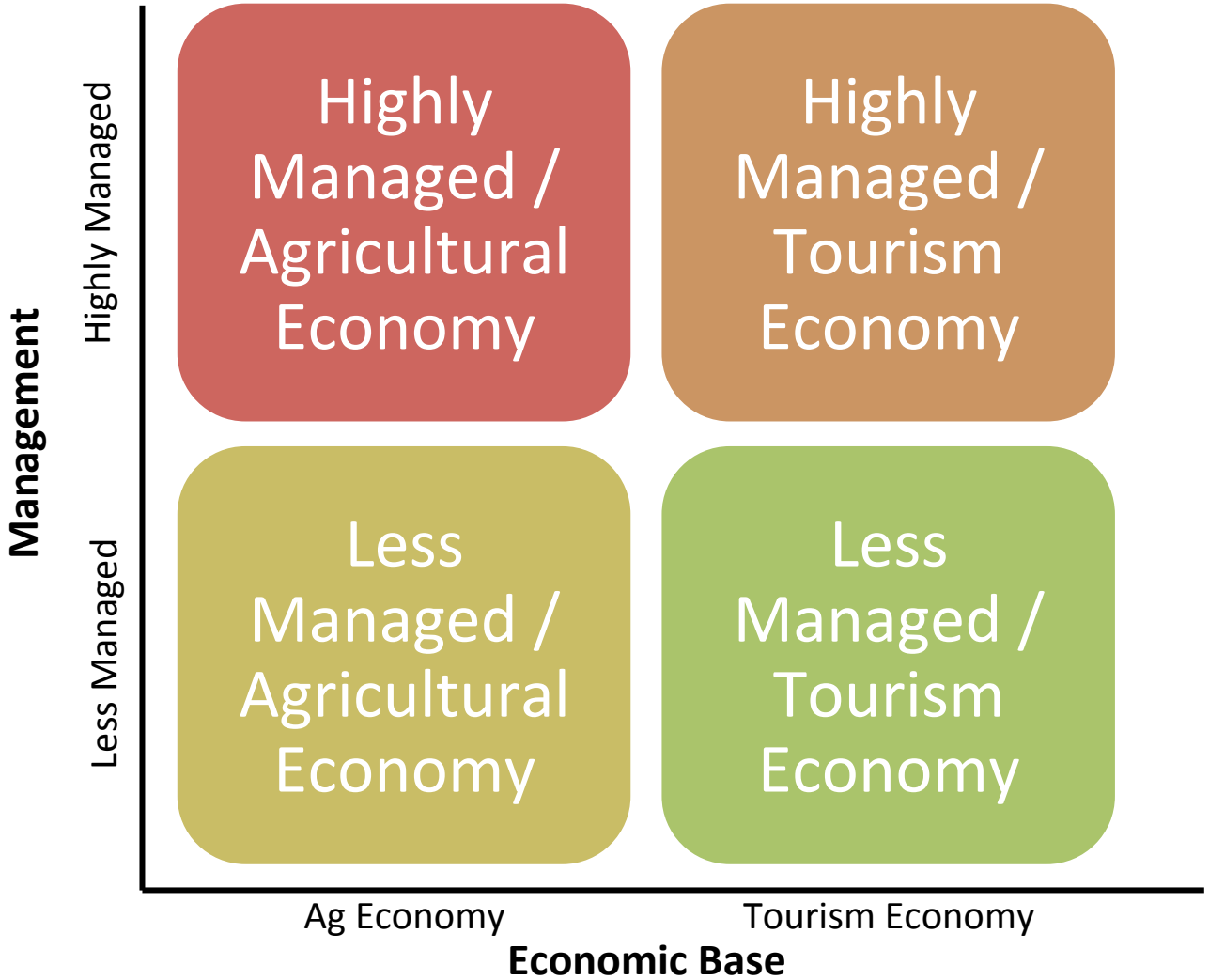
- Basin population doubled?
- ESA listing in Big Wood
- Water storage tripled?
- Had a winter with no snowpack?
- Etc.

Grouped into 4 scenario themes:

- *Tourism Economy*
- *Agricultural Economy*
- *High Management*
- *Low Management*

X *Climate*

Alternative Management Scenarios



Big Wood Ag. Water Demand

Ag. Management Scenarios*:*

What kind of influence can water managers/users have on supply & demand?

'More managed' assumptions:

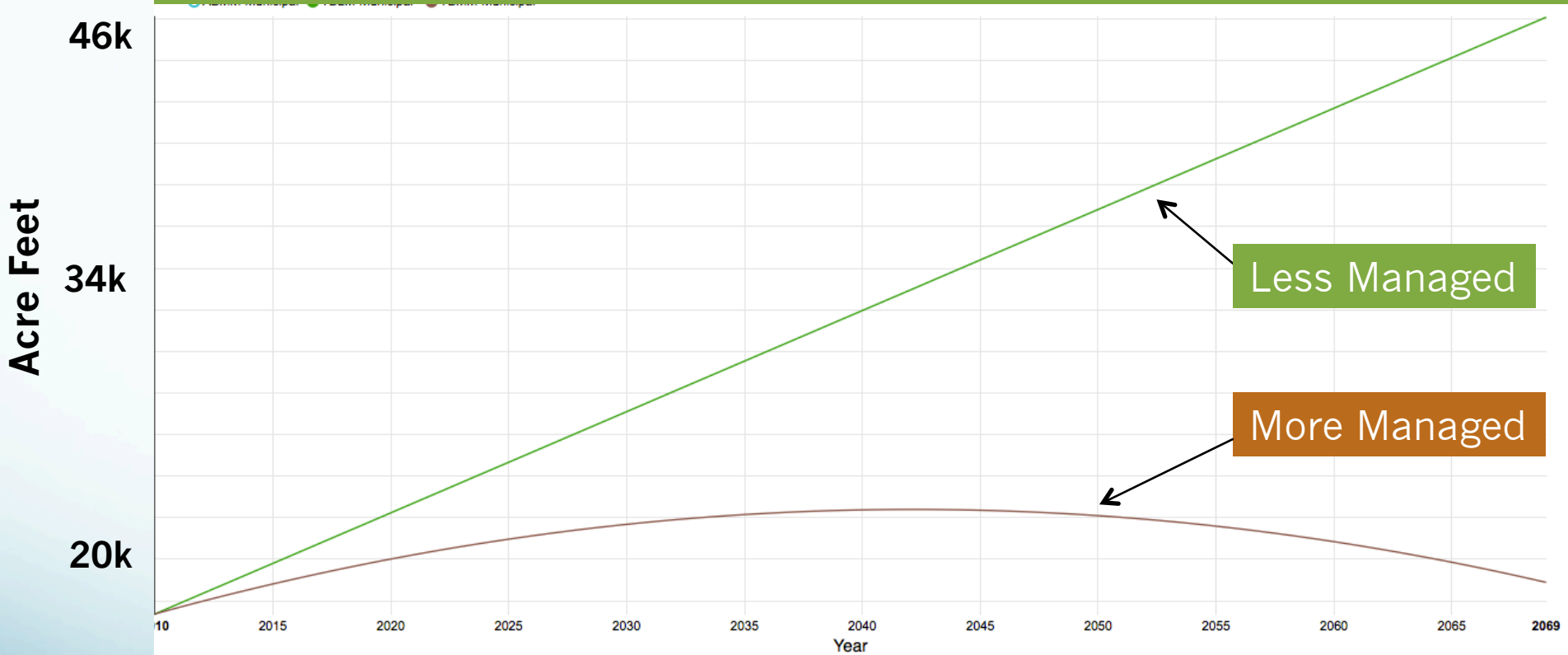
- More ac. of **lower ET** crops
- Agricultural buffer zones (*protect from development*)
- Water storage + 25k AF
- Conveyance & farm efficiency: **+5 to 10%.**
- **266K** acres of production (~today's area)

'Less managed' assumptions:

- More ac. of **higher ET** crops
- Expansion of Mu. Development
- Water storage (no change: 191k AF)
- Conveyance & farm efficiency: (**No change ~31 to 58%)**.
- **314K** acres of production

Municipal Water Demand

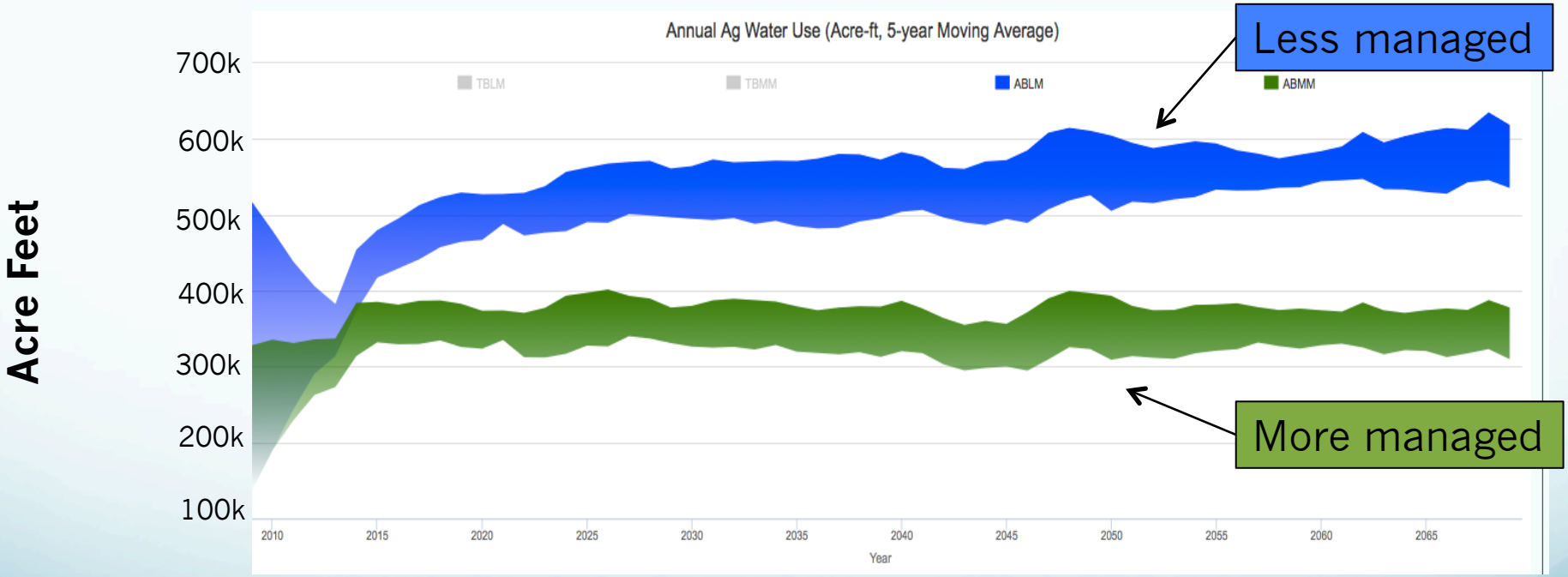
LM: Annual population growth (2.8%) across today's p/capita use



MM: Annual population growth (2.8%) with 1% annual decrease of today's p/capita use

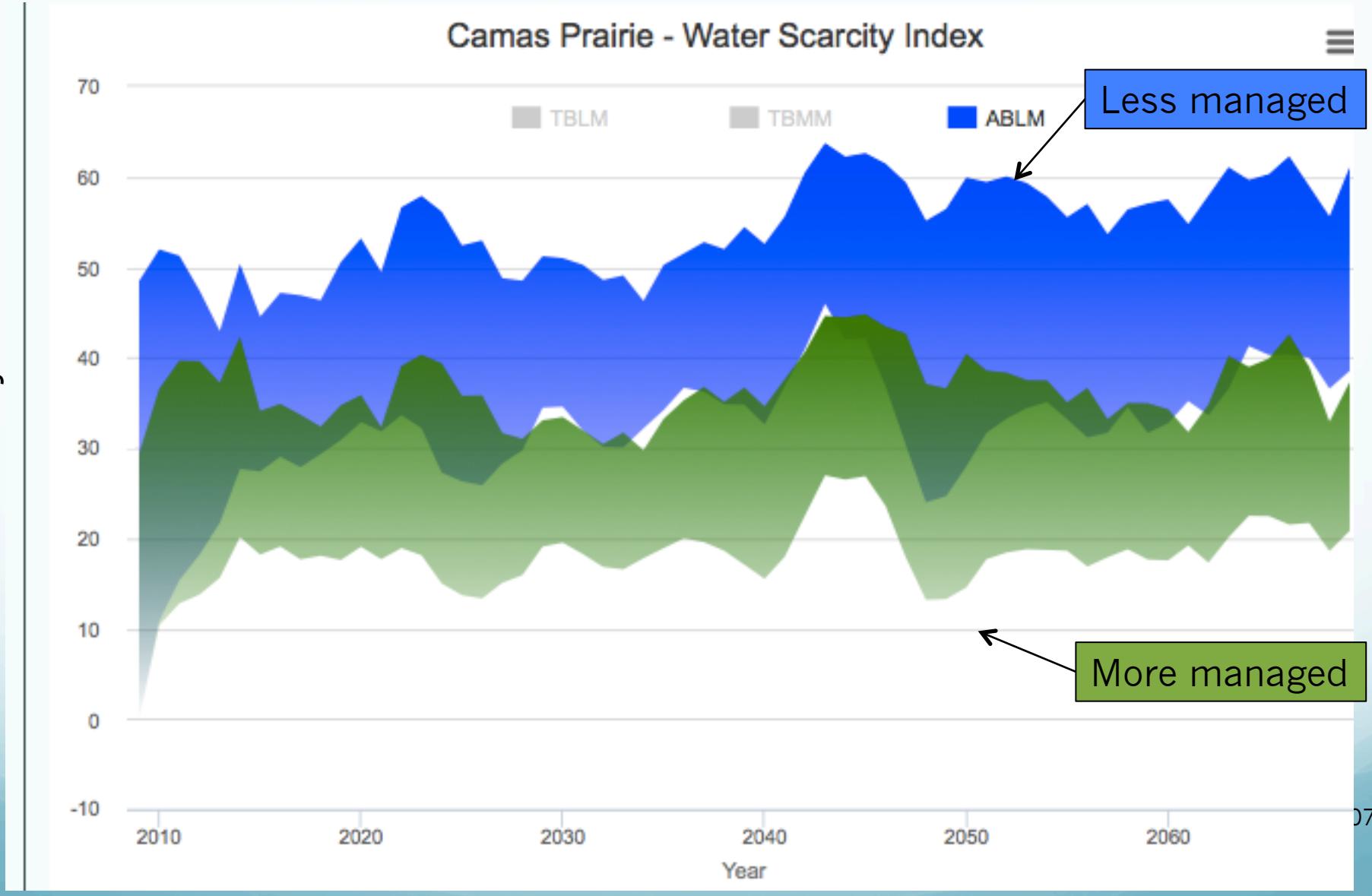
Agricultural Water Demand

LM: Ag water demand through 2070 with :
1) Status quo conveyance efficiency 2)⬆ ET crops 3)⬆ acres

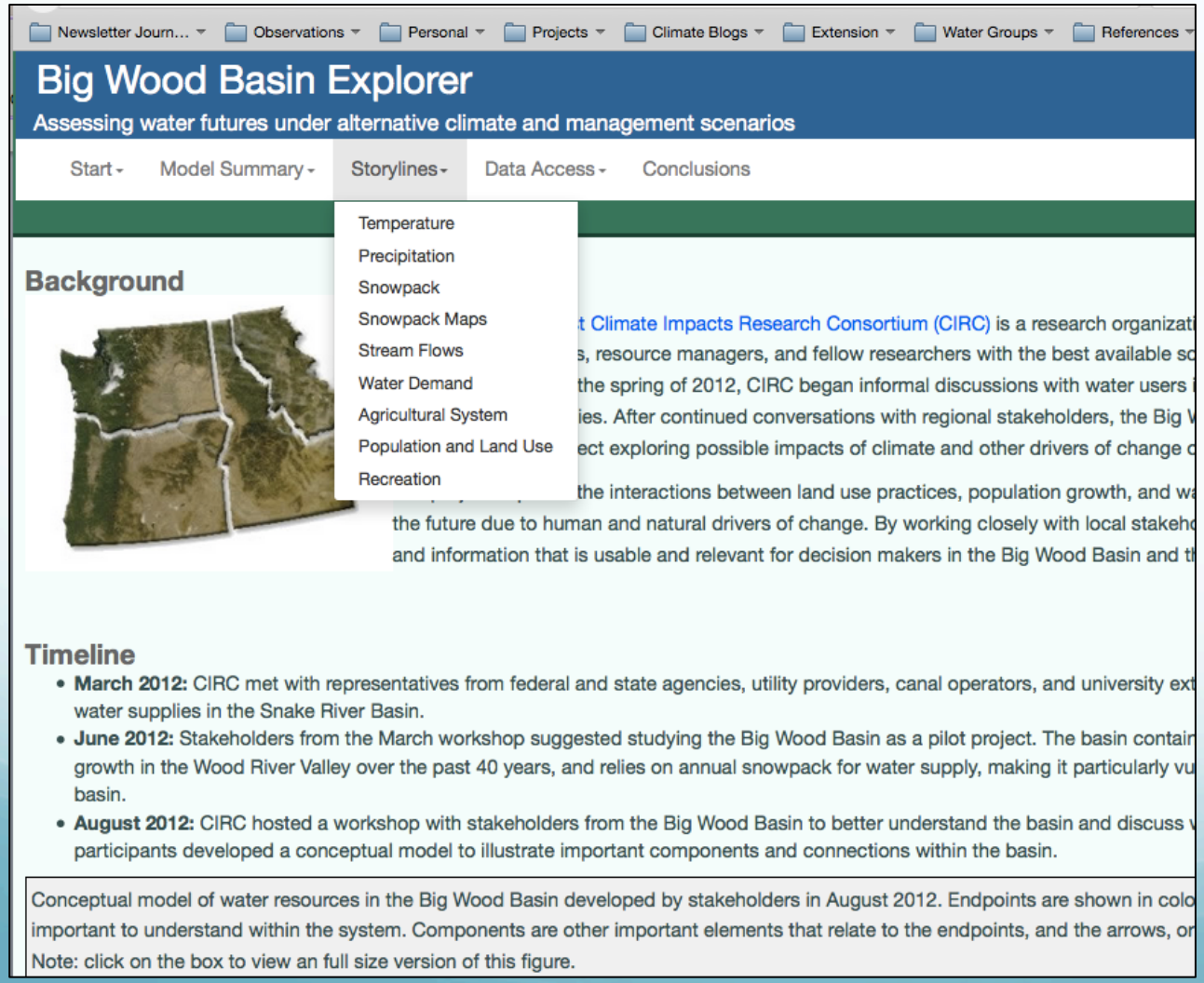


MM: Ag water demand through 2070 with:
1) + 10% conveyance efficiency 2)⬇ET crops, 3) ~ same Ag acres.

Water Scarcity



Questions?



Project accessible through:

Big Wood Basin Explorer.....

http://explorer.bee.oregonstate.edu/StudyAreas/BigWood/Overview.aspx