Big Wood Basin Alternative Futures:
An Experimental Approach to Science

Pacific Northwest DEWS Kick-Off
February 3, 2016
By:
John Stevenson

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CIRC
Climate Impacts Research Consortium
A NOAA RISA TEAM

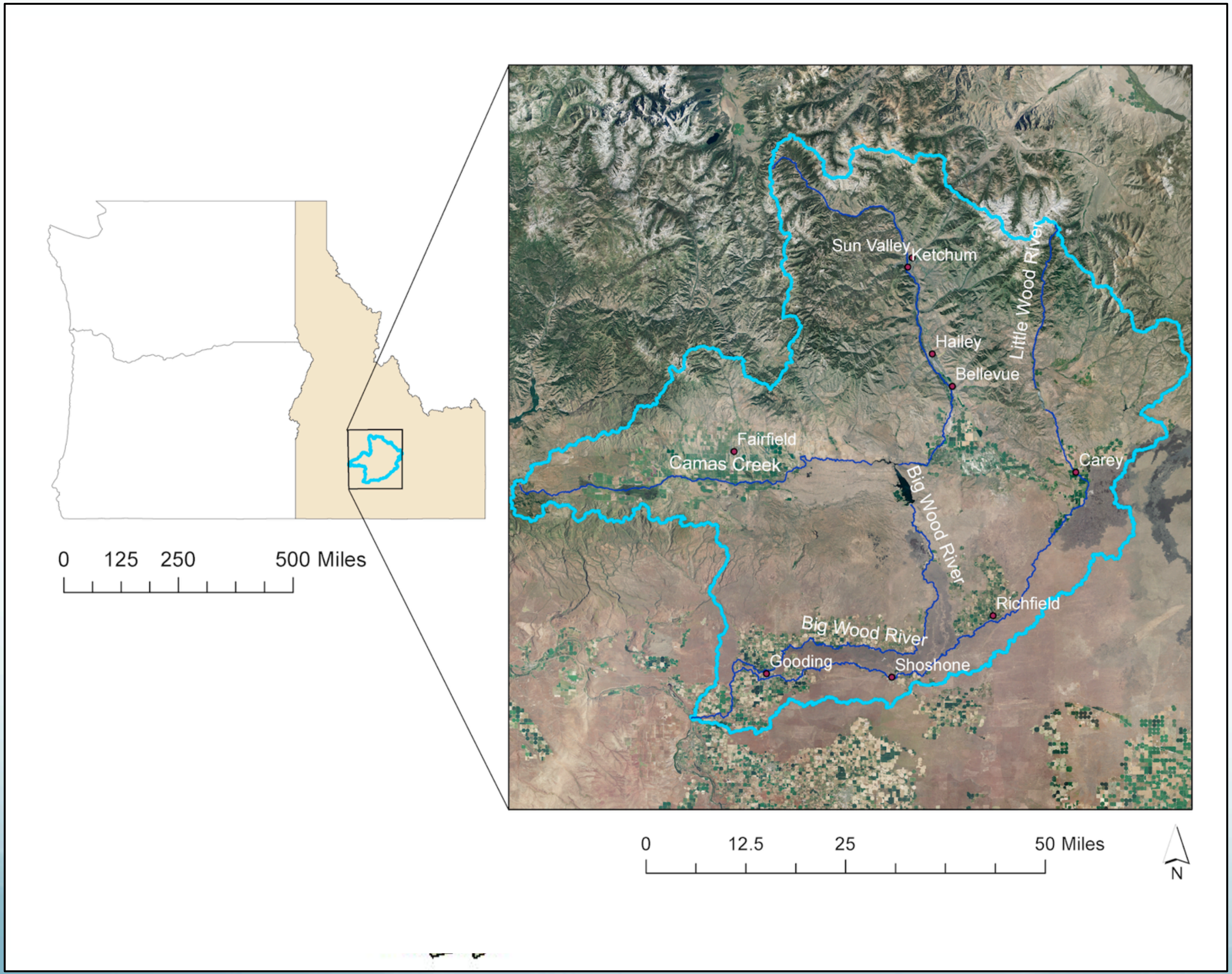
RISA
Regional Integrated Sciences and Assessments

OSU
Oregon State University

Usable Information?

- Literature on science and policy recognizes that ‘useable’, science must be:
- *relevant* (address correct questions)
- *legitimate* (consider multiple perspectives)
- *credible* (scientifically defensible)

Big Wood Basin
Water Supply & Demand



Data from USDA National Agricultural Statistics Service

Issues:

Climate Impact to:

1. *Water Supplies*
2. *Ag Water Demand*
3. *Population growth*

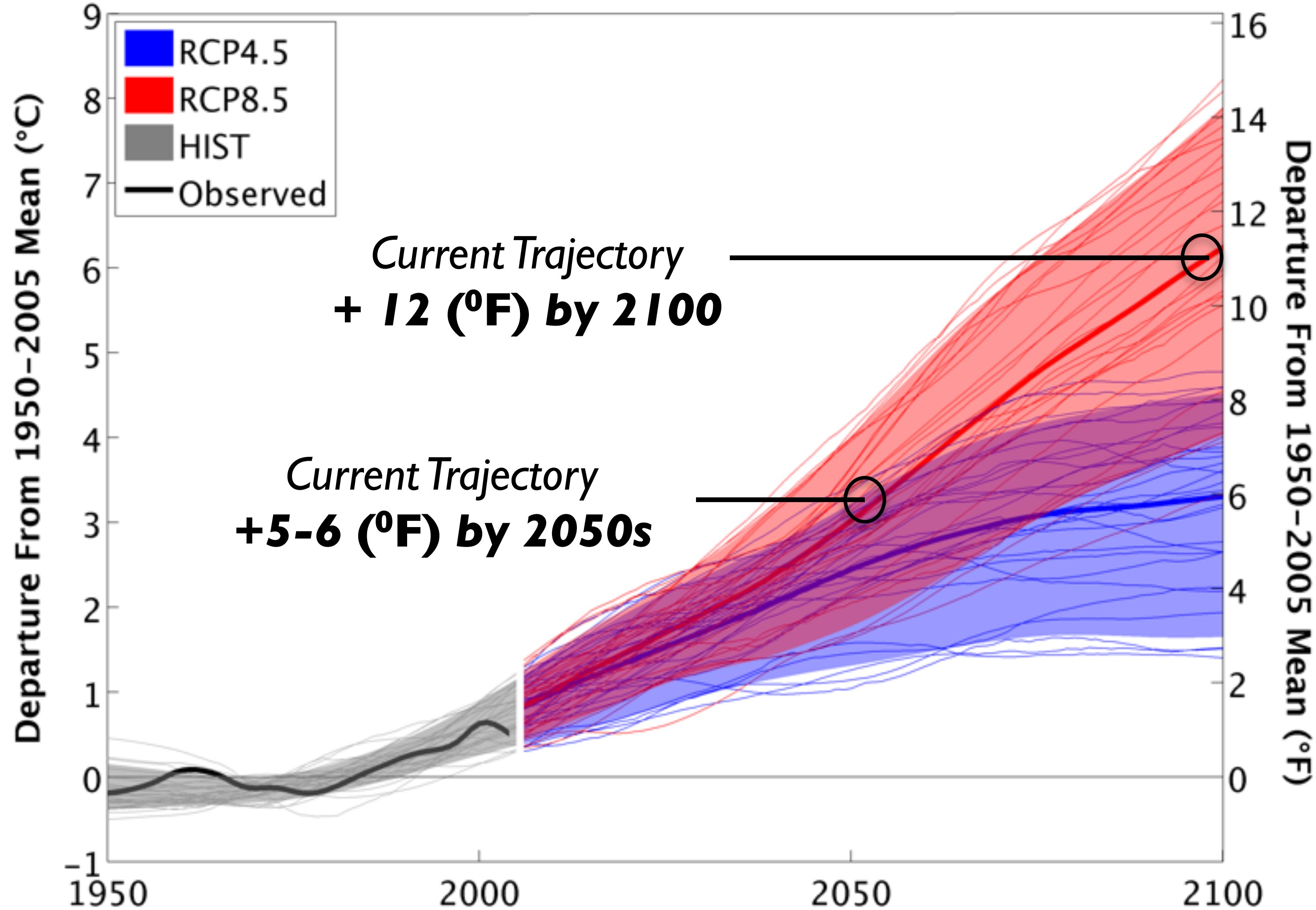
Collaborators:

- *15 organizations*
- *Federal, state local government, private sector, non-governmental, university*

CIRC
Climate Impacts Research Consortium

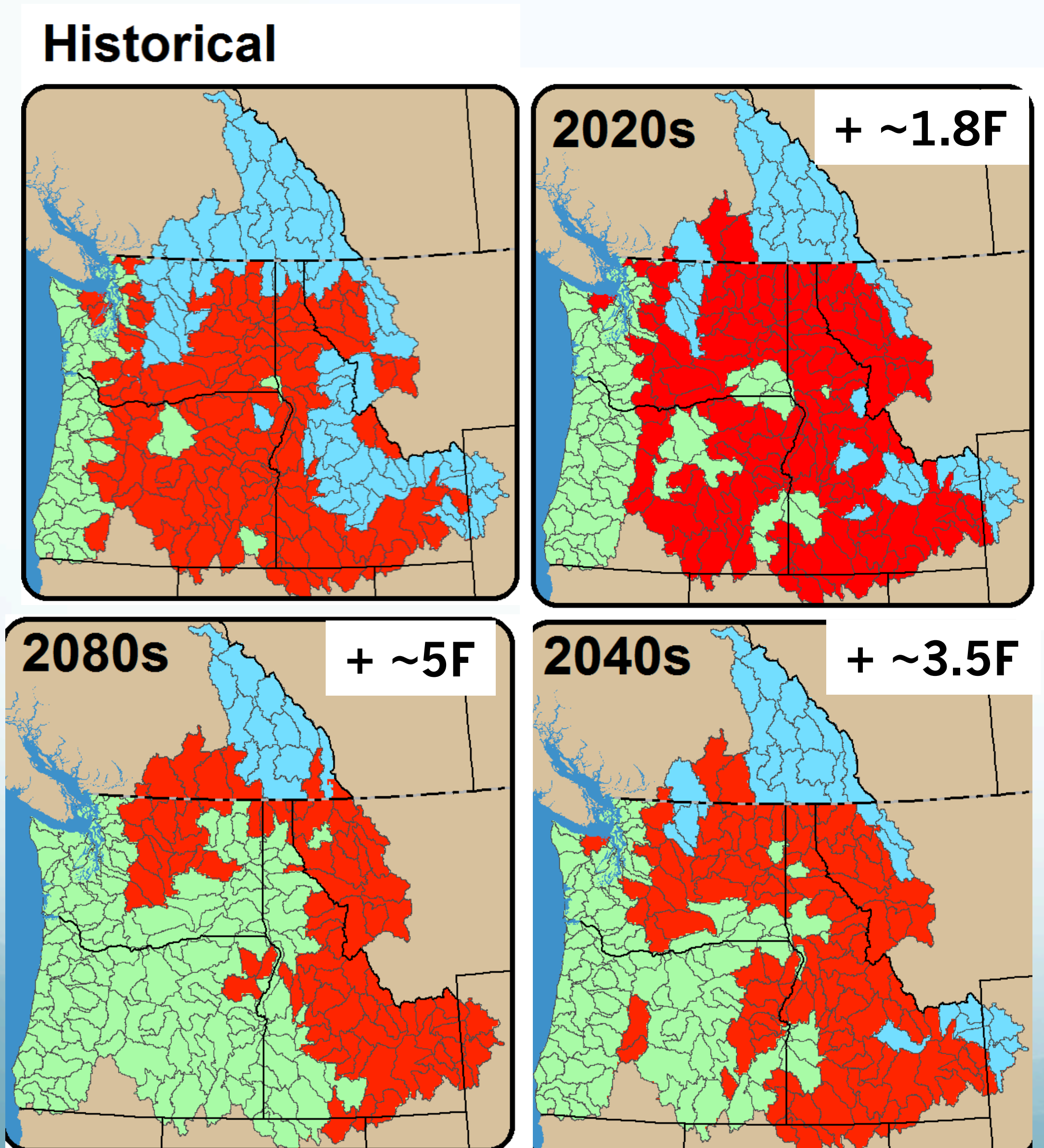
Stakeholder Network

Projected Avg. Winter Temp, PNW

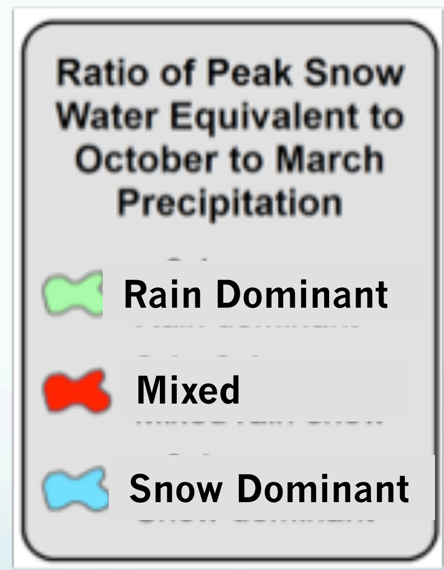


Abatzoglou et al. 2013

How would snowpack respond to warming?



<u>Expansion</u> of rain-dominant basins

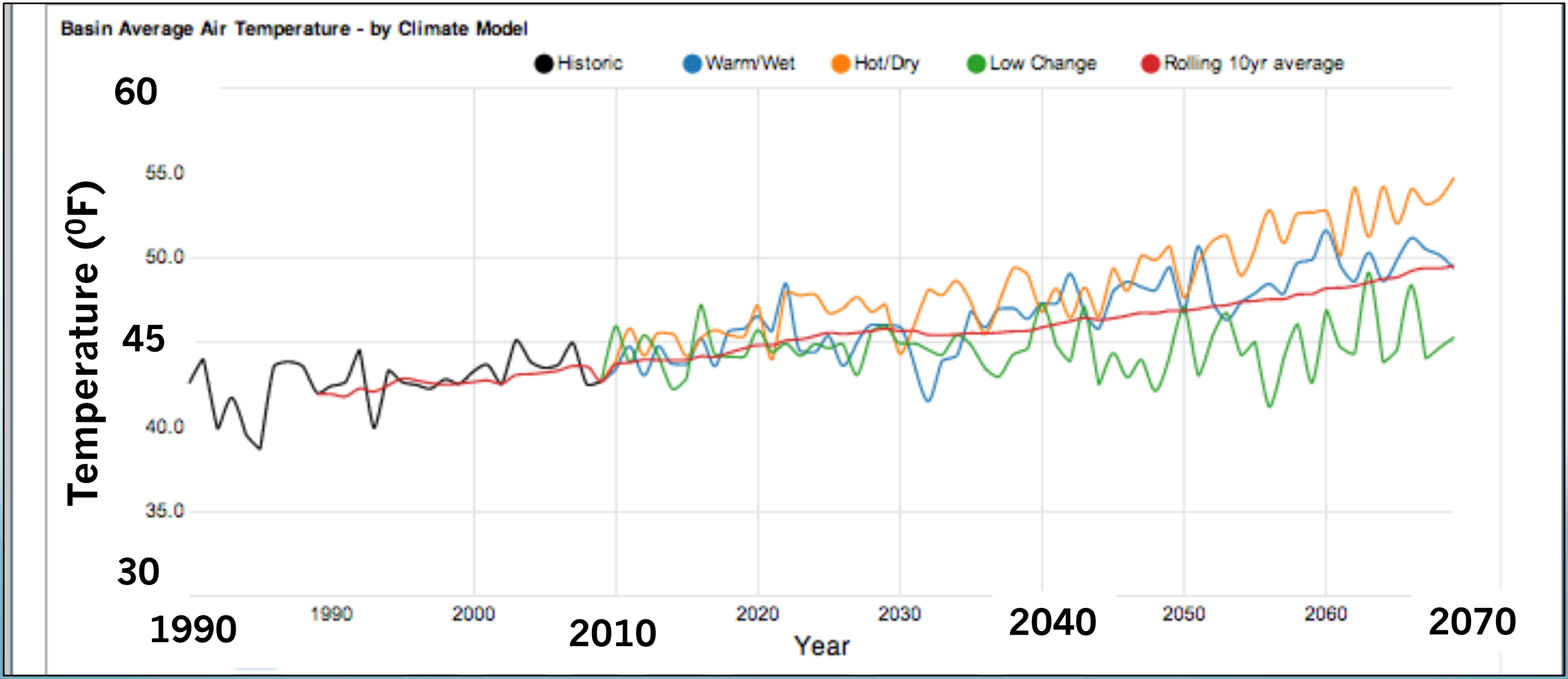


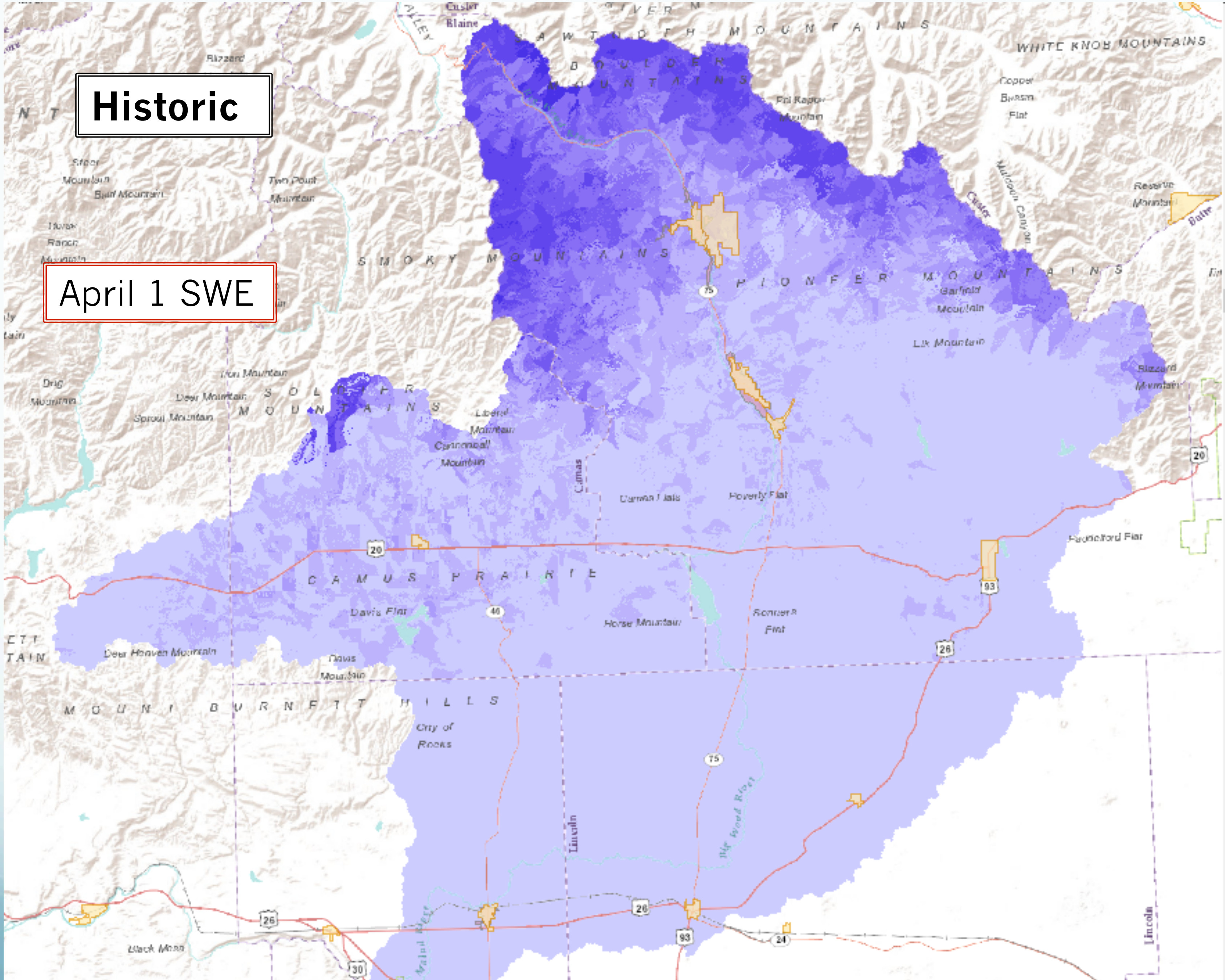
(Hamlet, Carrasco, et al. 2010)

Big Wood: 3 Climate Scenarios

Low Change	Warmer & Wetter	Hotter & Drier
+ 2.5^{0} F	+ 6.5 ^{0} F	+ 7.5^{0} F

By late century



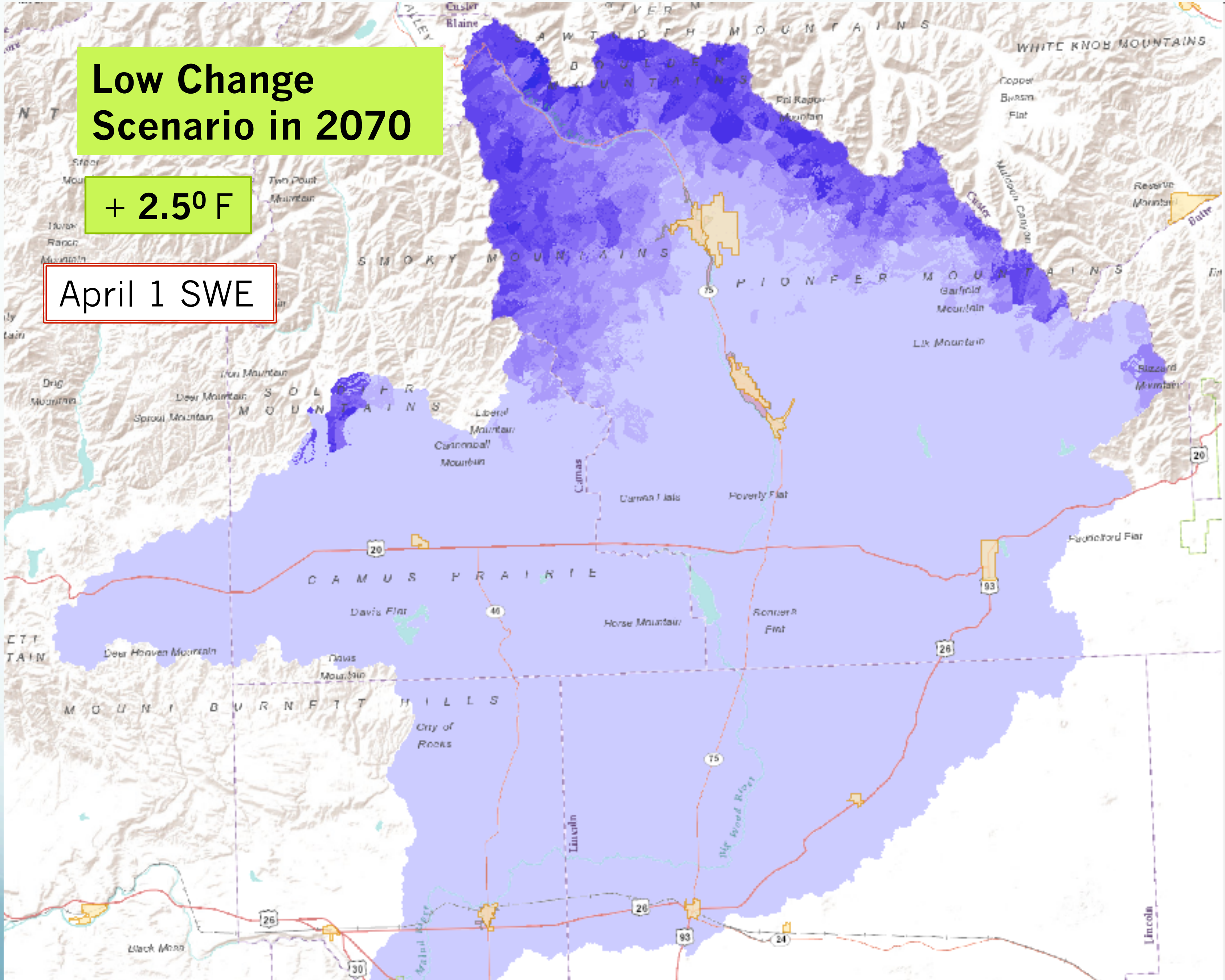


Historic
April 1 SWE
SMOKY MOUNTAINS
PIONEER MOUNTAINS
WHITE KNOB MOUNTAINS
SOLDIER MOUNTAINS
CAMAS PRAIRIE
MOUNT BURNETT HILLS
Camas Flats
Poverty Flat
Davis Flat
Horse Mountain
Deer Heaven Mountain
City of Rocks
Lincoln
Camas
Big Wood River
Black Mesa
20
26
75
93
24
30
46

Low Change Scenario in 2070

+ 2.5^0 F

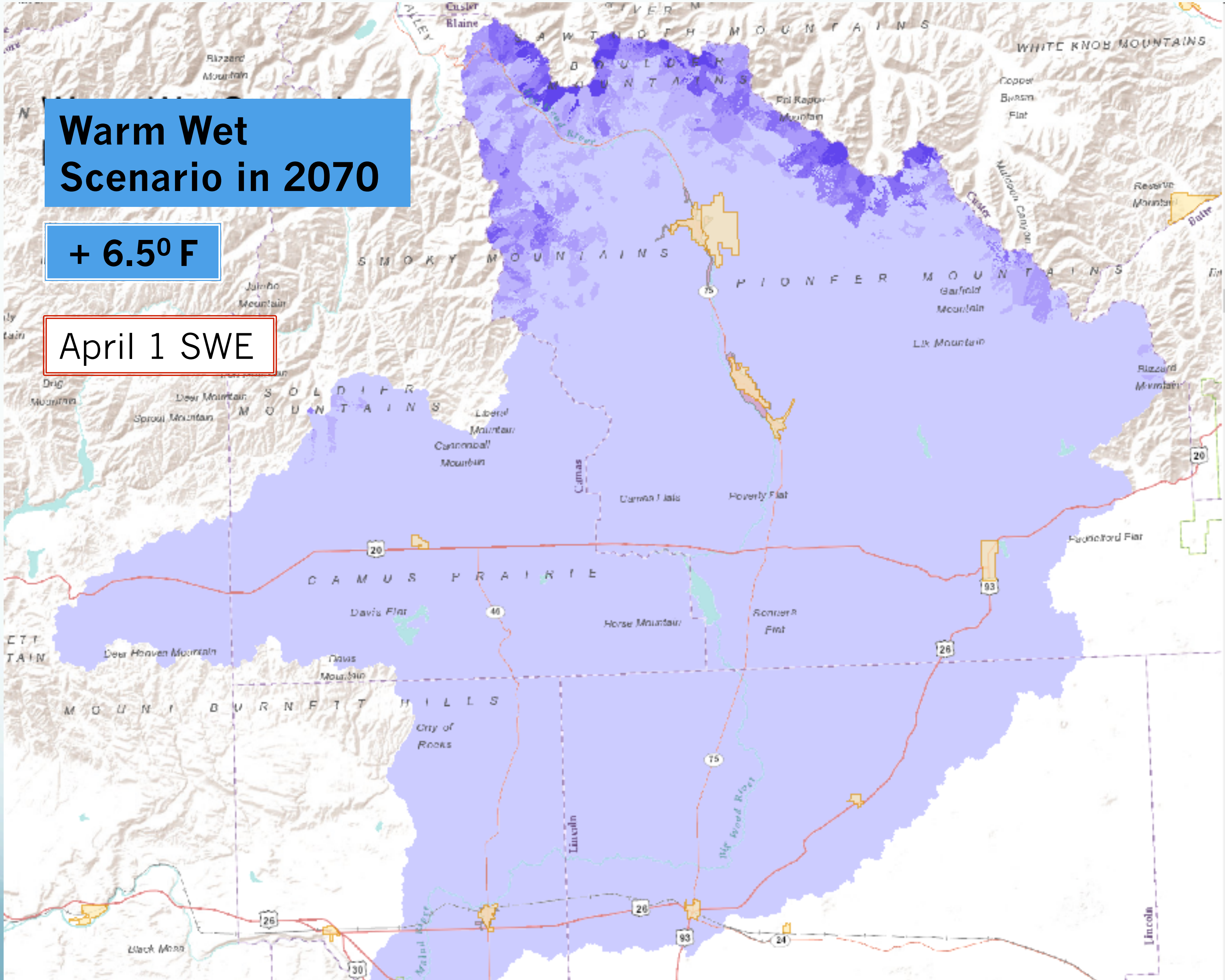
April 1 SWE



Warm Wet Scenario in 2070

+ 6.5⁰ F

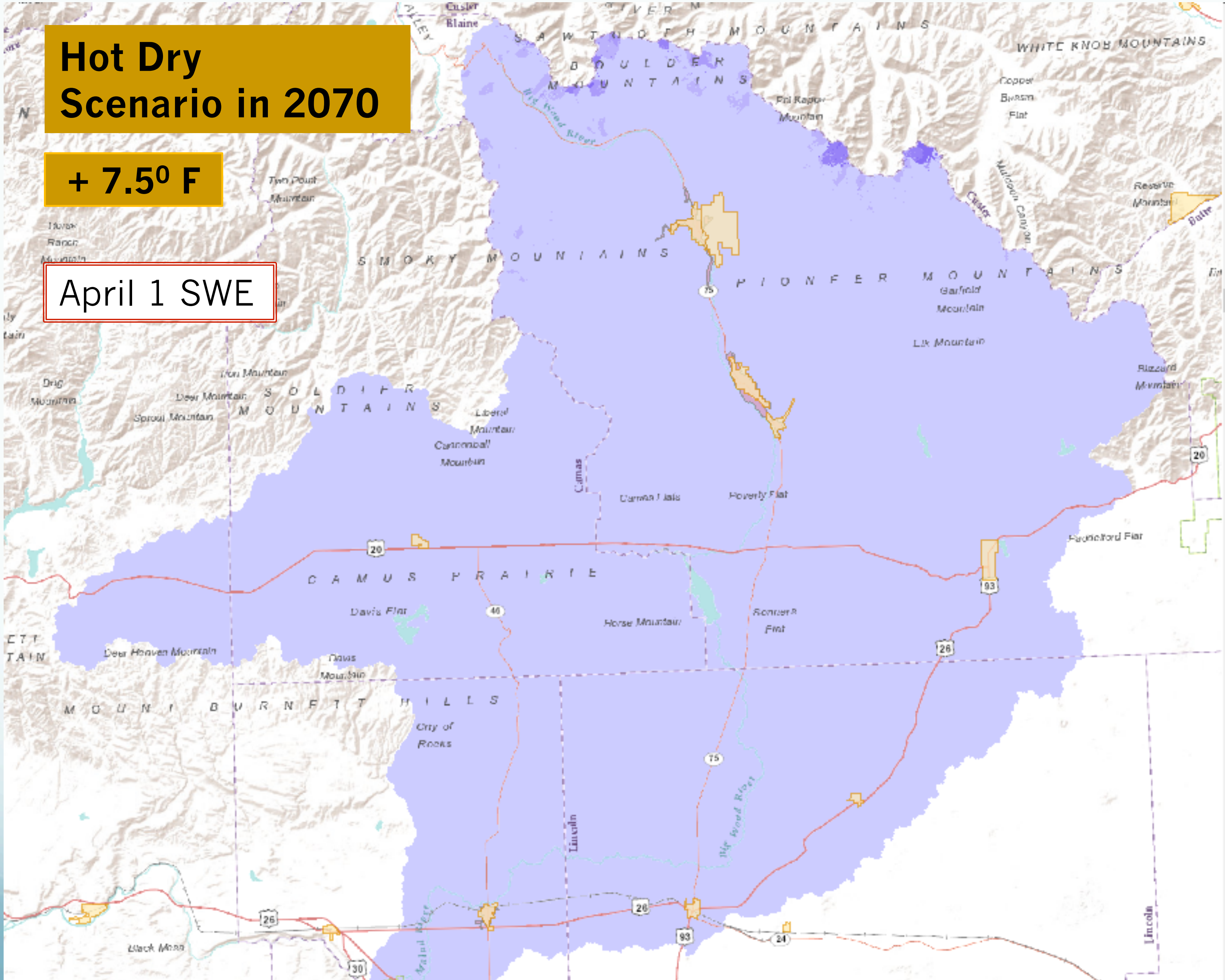
April 1 SWE



Hot Dry Scenario in 2070

+ 7.5^0 F

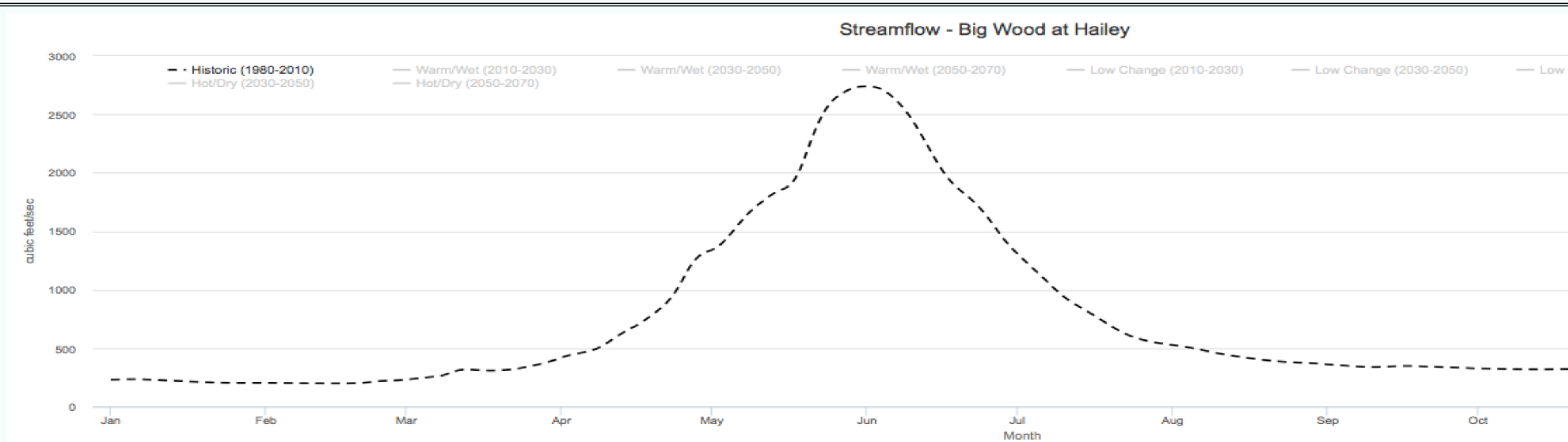
April 1 SWE



Big Wood Climate Response

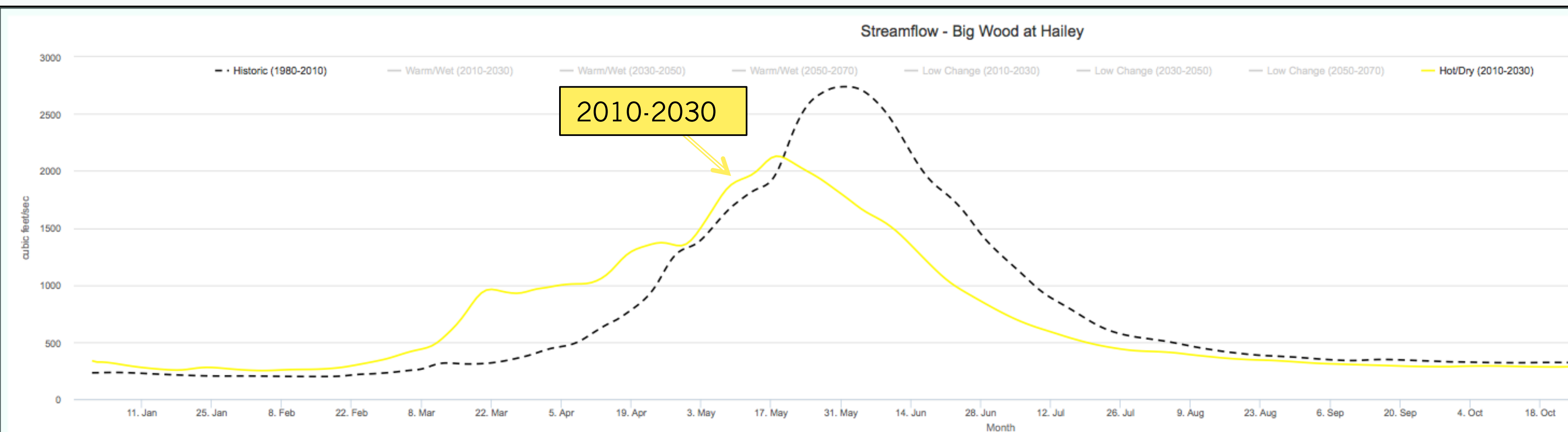
2060s

Photo Credit: IDFG



Big Wood Climate Response
2060s

Photo Credit: IDFG



Big Wood Climate Response

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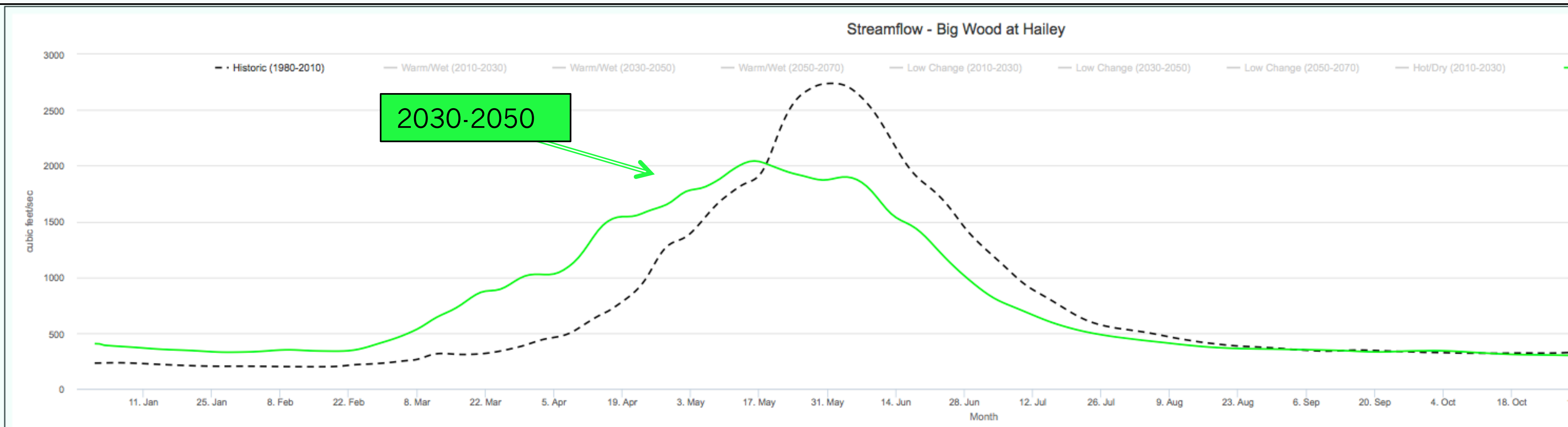
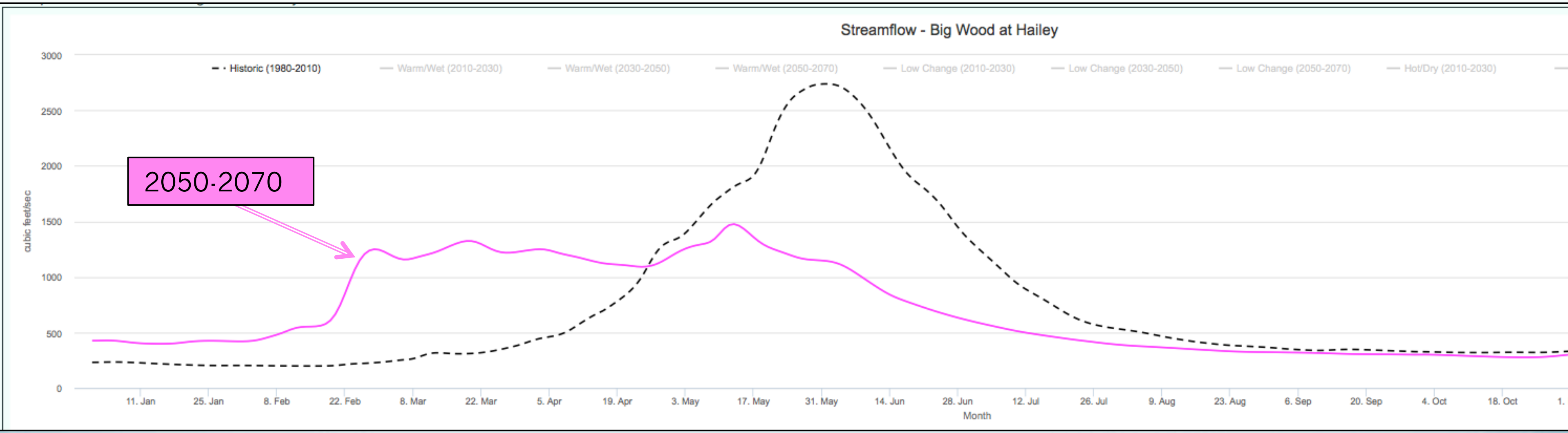


Big Wood
Climate Response
2060s

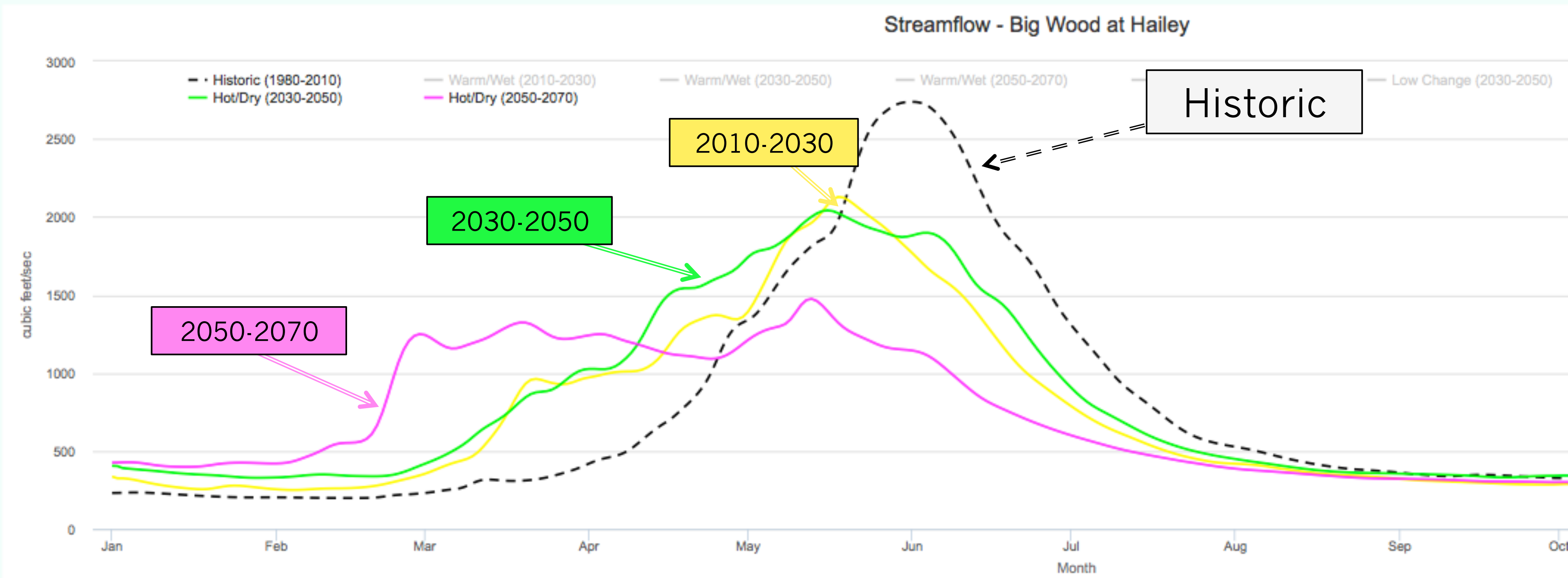
Photo Credit: IDFG



Big Wood Climate Response

2060s

Photo Credit: [IDFG]

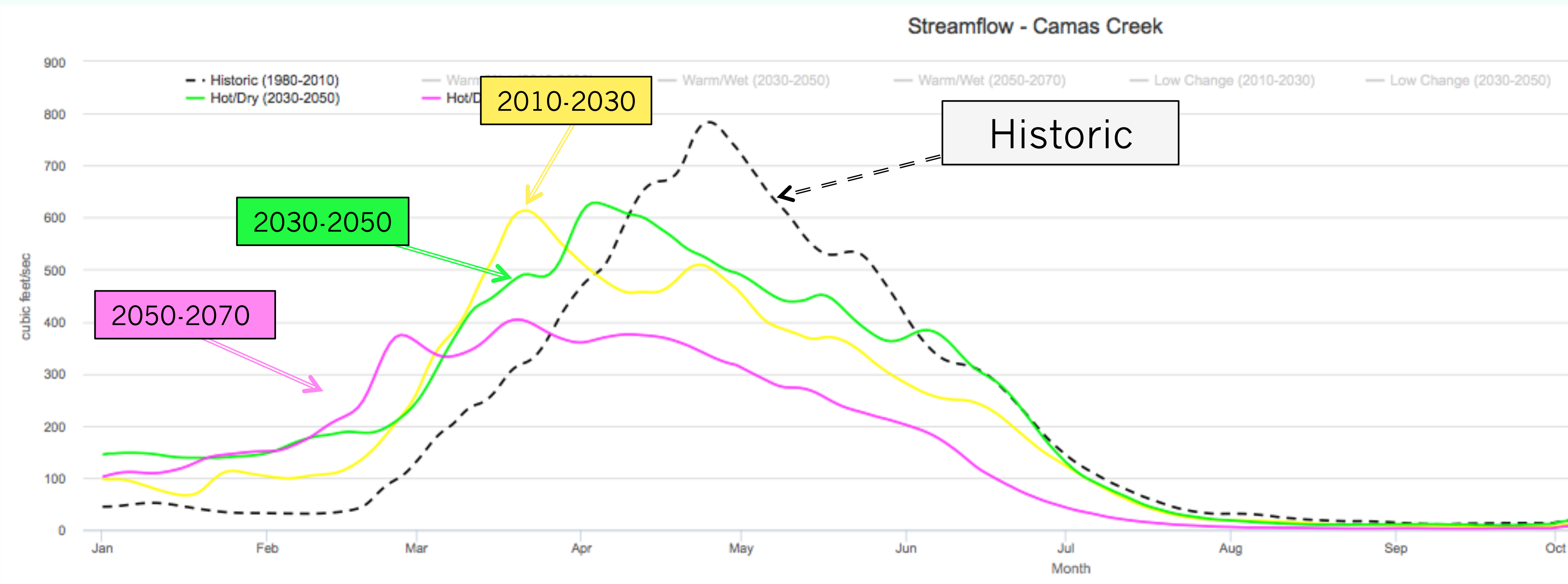


Camas Creek Climate Response *2060s*

Credit: Edwin Poon

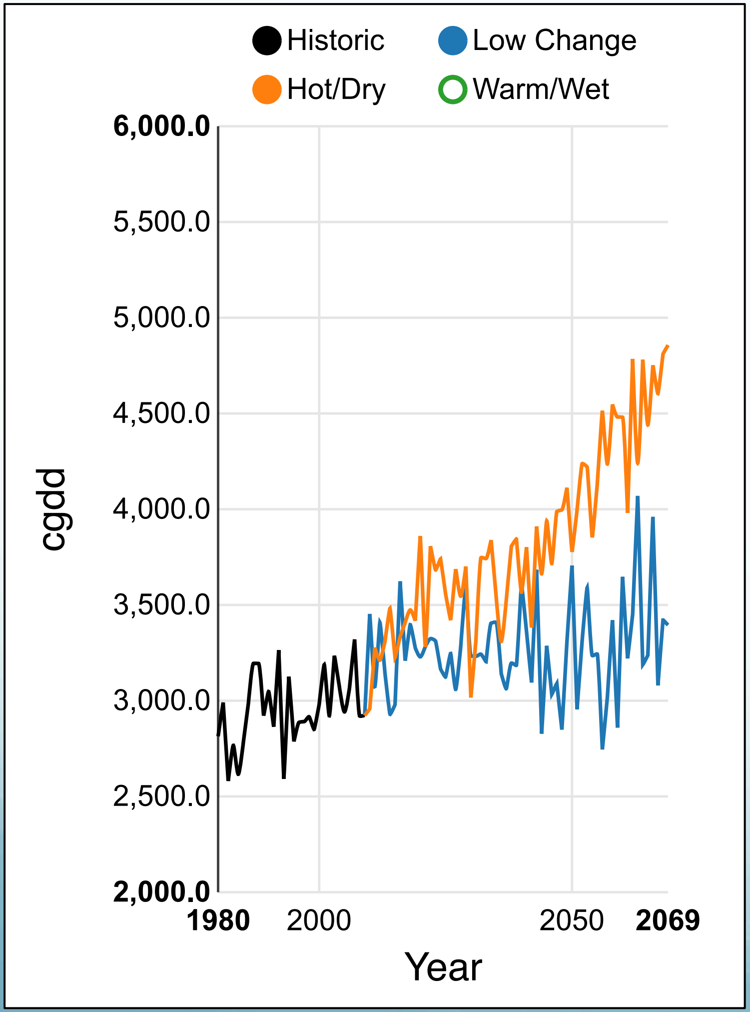
Camas Creek Climate Response *2060s*

Credit: Edwin Poon

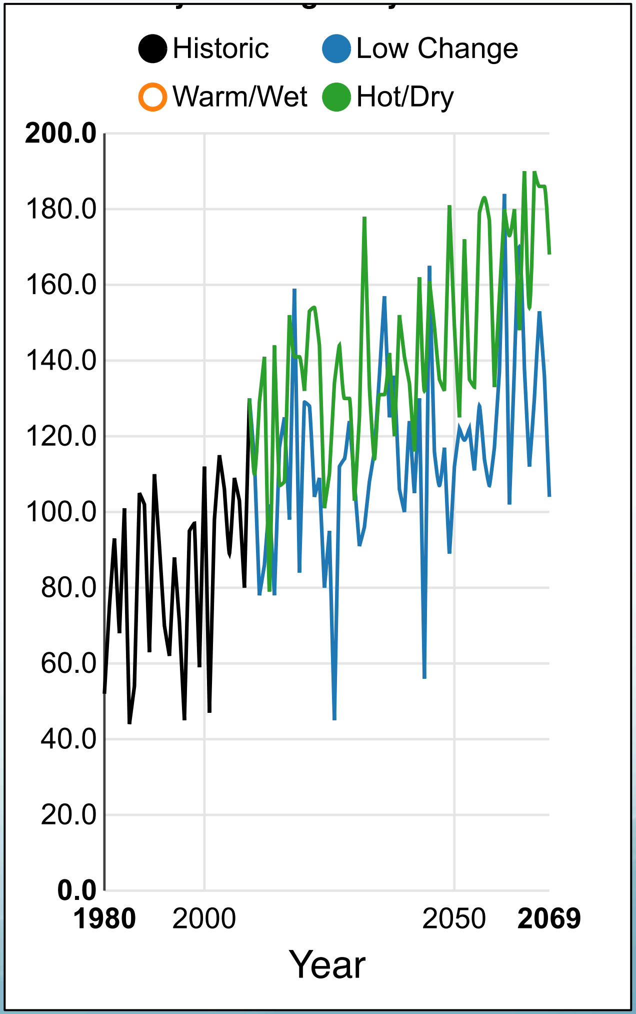


Big Wood Growing Conditions

Growing Degree Days increase by ~ 50% under Hot/Dry Scenario



Frost-free period increase ~ 2x under Hot/Dry Scenario



Big Wood Ag. Water Demand

Management Scenarios*:*

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

		Management Scenarios	
		More Managed	Less Managed
Economic Base	Ag Boom	Ag Boom, More Managed (ABMM)	Ag Boom, Less Managed (ABLM)
	Tourist Boom	Tourist Boom, More Managed (TBMM)	Tourist Boom, Less Managed (TBLM)

Big Wood Ag. Water Demand

Management Scenarios:

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Big Wood Ag. Water Demand

Management Scenarios*:*

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

'More managed' assumptions:

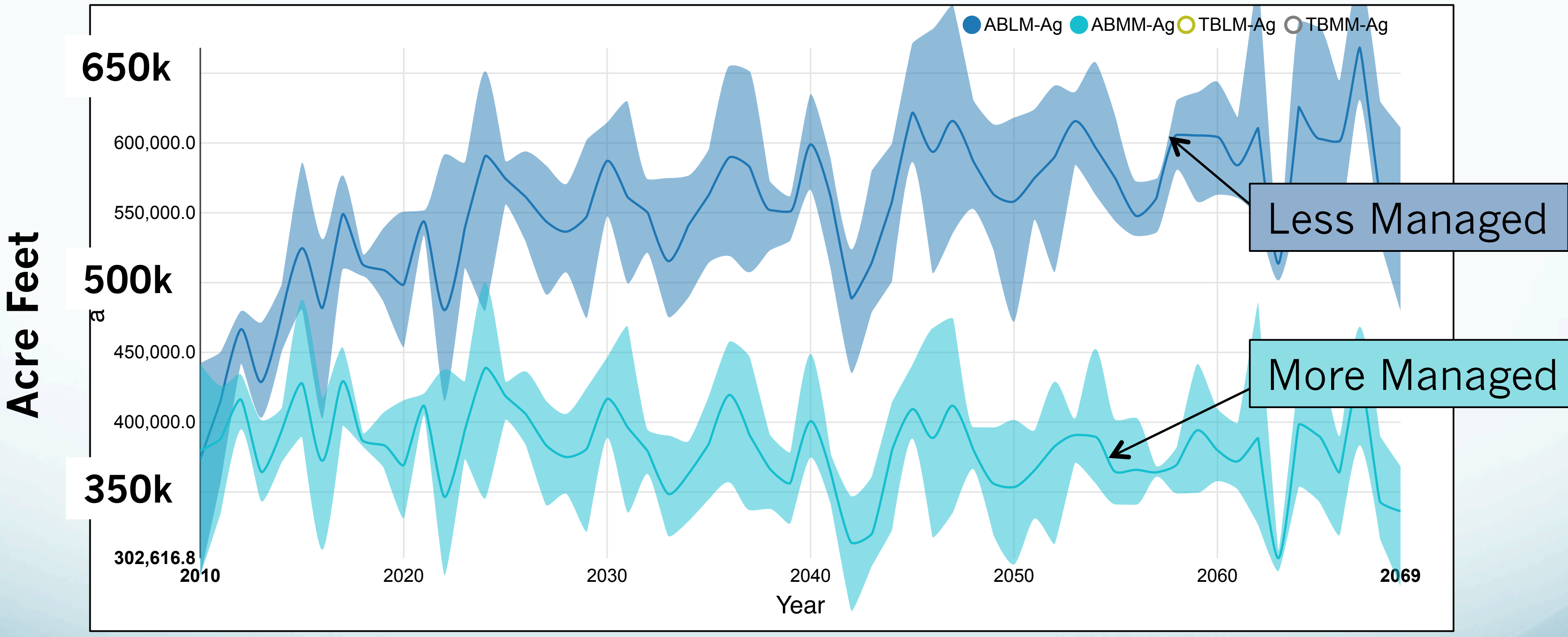
- More ac. of *lower* ET crops
- Agricultural buffer zones (*protect from development*)
- Water storage + 25k AF
- Conveyance & farm efficiency: +5 to 10%.
- 266K acres of production (~today's area)

'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

Agricultural Water Demand

Top curve: Ag water demand through 2070 with today's:
1) Crop selection, 2) conveyance efficiency, 3) add'l ag. land



Bottom curve: Ag water demand through 2070 with:
1) Less water intensive crops, 2) + 10% conveyance efficiency.

"Data Explorer"

Making Data Accessible:

Storylines **Around**:

- Temperature
- Snowpack
- Water Demand,
- Etc...

Envision Big Wood Basin

Exploring water futures under alternative climate and management scenarios

Home | Introduction | Scenarios | Storylines | Conclusions | About

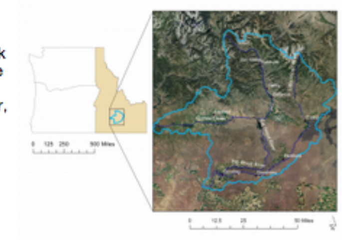
Background - The Big Wood Basin

<<Previous: Table of Contents   Next: The Process>>

The site describes an "alternative futures" assessment for the Big Wood Basin, Idaho.

LOCATION

The total study area encompasses the Big Wood River, Little Wood River, and Camas Creek drainages in central Idaho totaling approximately 8,300 square kilometers (see Figure 1). The primary focus of the study is on the water resources of the Big Wood River basin, which includes the Big Wood River and Camas Creek (approx. 6,000 square kilometers). However, approximately 100 square kilometers in the Little Wood River drainage are irrigated from the Big Wood River so that basin is included in the study area for the purpose of simulating irrigation although otherwise it is not studied in detail. The study area lies within portions of Blaine, Camas, Elmore, Gooding and Lincoln counties and the major population centers include Ketchum, Sun Valley, Hailey, Bellevue, Fairfield, and Gooding.



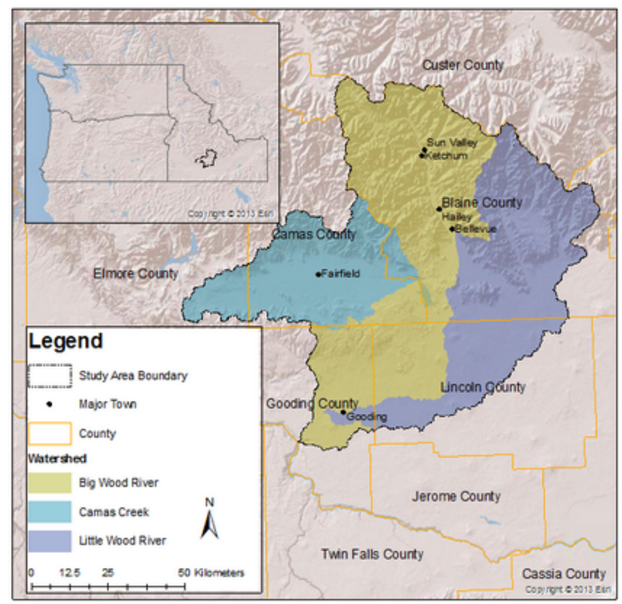


Figure 1. Map of Study Area.

Land ownership in the study area is approximately 66% public and 34% private. The majority (58%) of the public land is managed by the U.S. Bureau of Land Management (BLM) with the U.S. Forest Service overseeing 35% and the State of Idaho managing approximately 5% (U.S. Bureau of Land Management, Idaho State Office, Geographic Sciences, 2009).

Envision Big Wood Basin

Exploring water futures under alternative climate and management scenarios

Storyline - Surface Temperatures

<<Previous: Model Selection   Next: Precipitation>>

Take Home Message

Temperatures have increased in the Big Wood River Basin over the last 30 years and are expected to continue through the 21st century.

Background

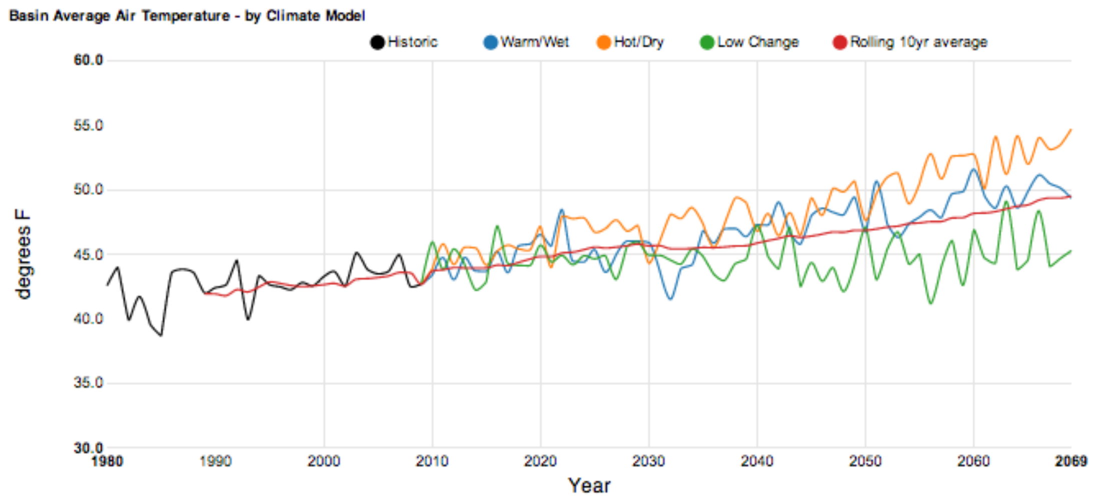
We use projections of future temperature to drive several important processes in the basin model. The first is *evapotranspiration*, the amount of moisture moving into the atmosphere from the combination of evaporation and plant transpiration from vegetation including forest, crops,and shrublands. This process is highly influenced by the Earth's surface temperature.as well as for determining. The second process uses temperature to project changes in snowpack and snow accumulation rates for the basin. In particular, we looked at minimum and maximum air temperatures from each of the three climate scenarios, which we have provided as ihnteractive charts and maps below.

Key Findings

- Air temperatures are predicted to increase in all future climate scenarios.
- Compared to past climate (1980-2010) temperatures may increase between 4 degrees F in the low change scenario and up to 11 degrees F in the warm/dry scenario by 2070.
- The average change across all three climate scenarios is approximately 7.5 degrees F warmer than the 1980-2010 average.

The Data

The following chart shows a summary of the basin average air temperature for the entire Big Wood Basin. You can "turn on" and "turn off" particular models by clicking on the legend entries near the top of the chart. Clicking the buttons at the bottom of the chart also filter the chart display by scenario. You can further filter the data displayed on the chart by entering a search string in the "Filter" box near the bottom of the chart.



Filter: reset Shortcuts: ablm abmm tblm tbmm Low Change Warm/Wet Hot/Dry

<<Previous: Model Selection   Next: Precipitation>>

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Questions?

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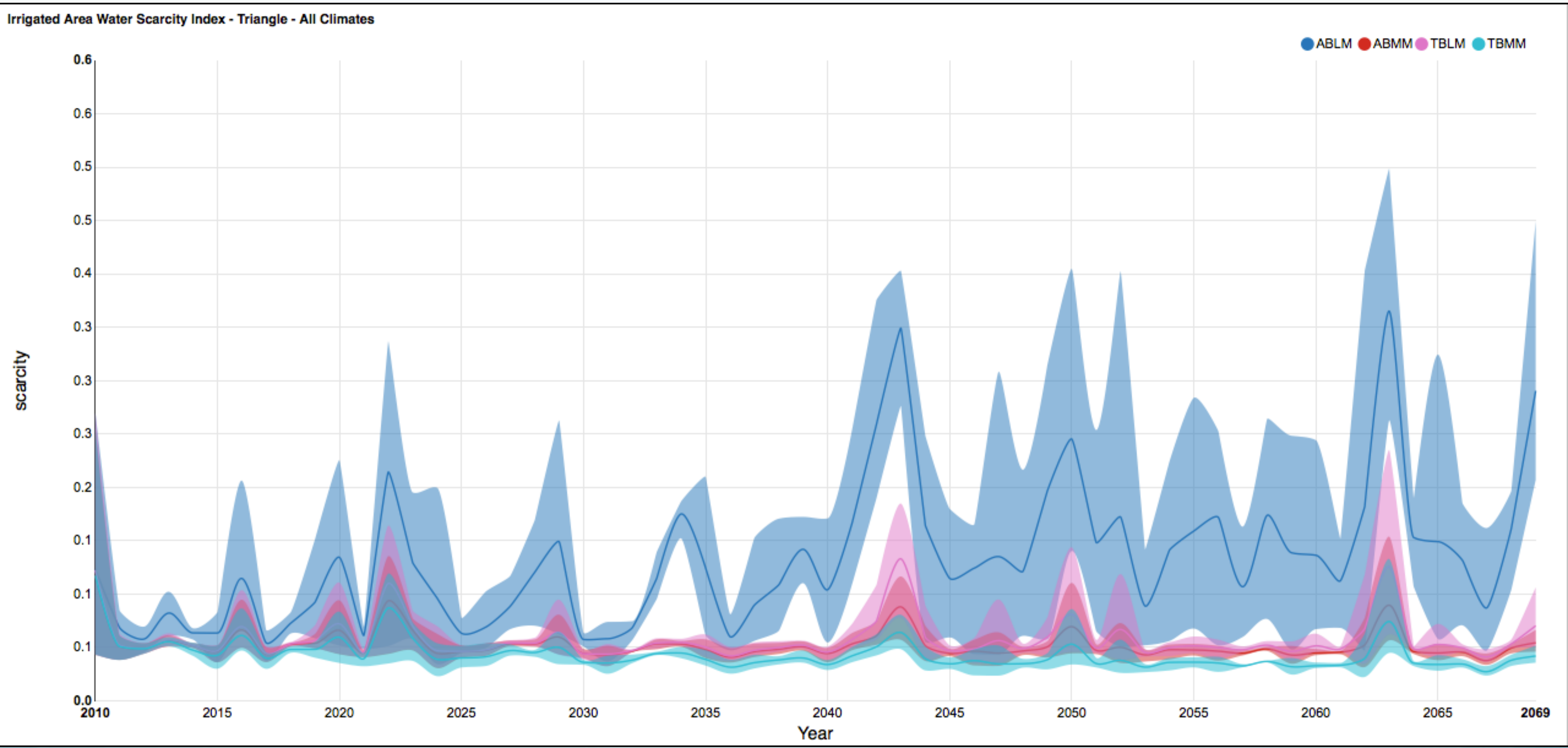
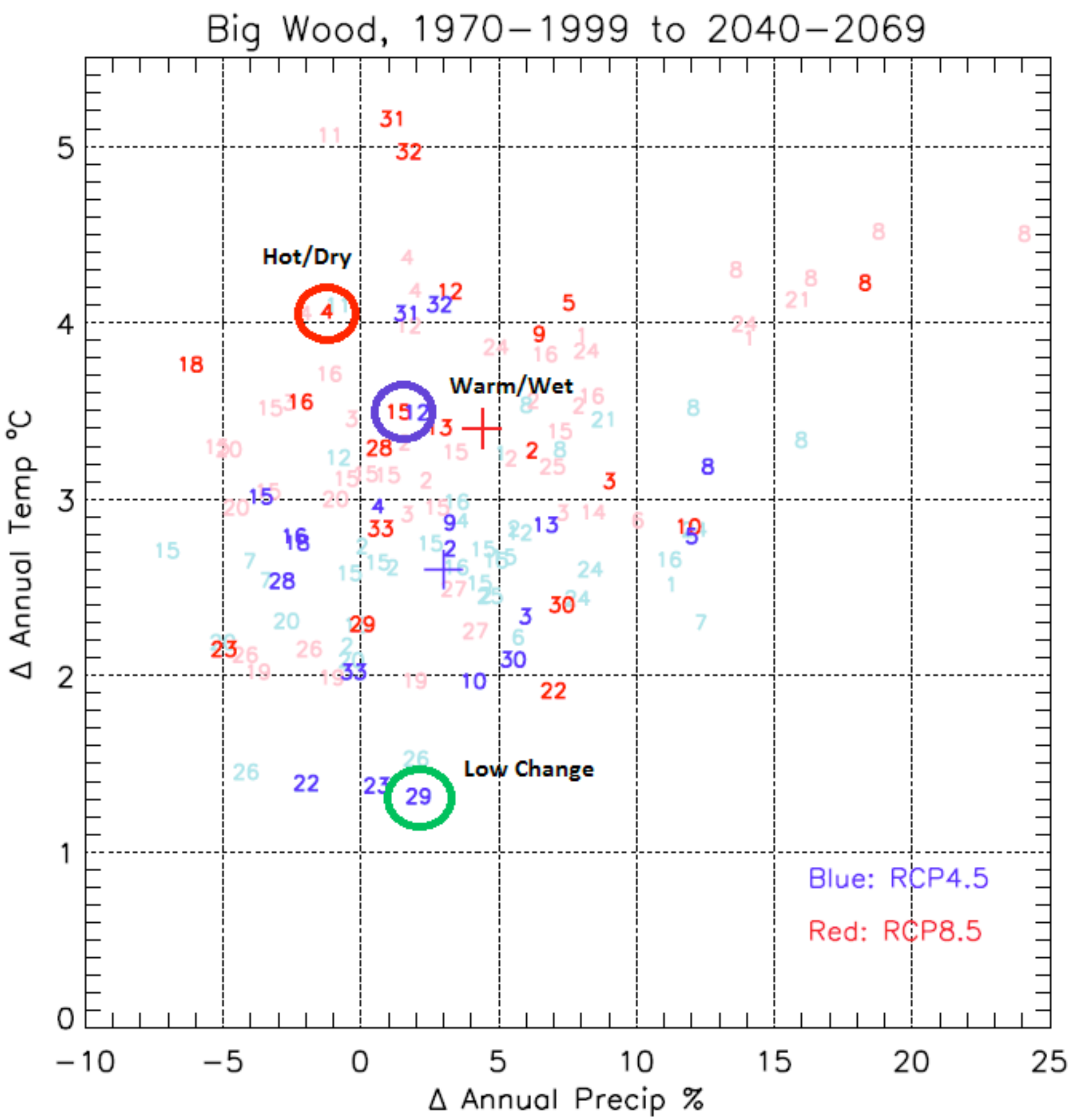
14/10/2004

Big Wood: Water Scarcity

How much water you need v. water available





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

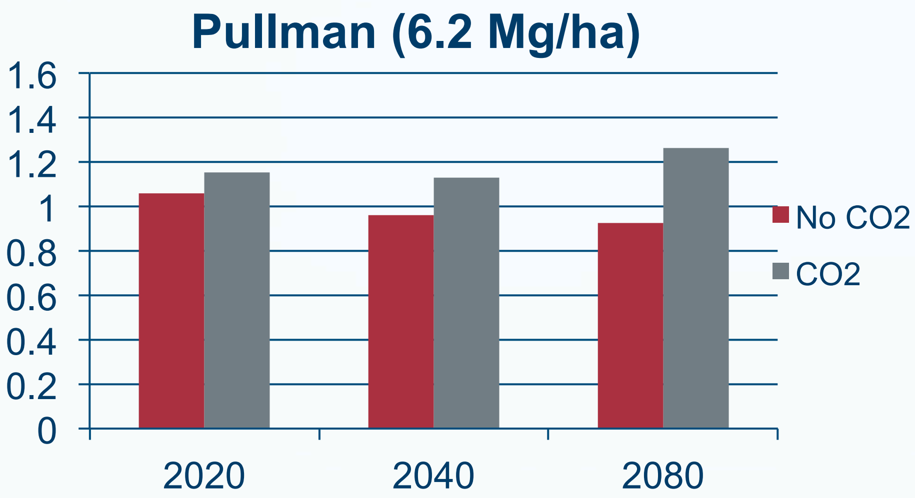
Δ Precipitation, %

	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

Project Results: Winter Wheat



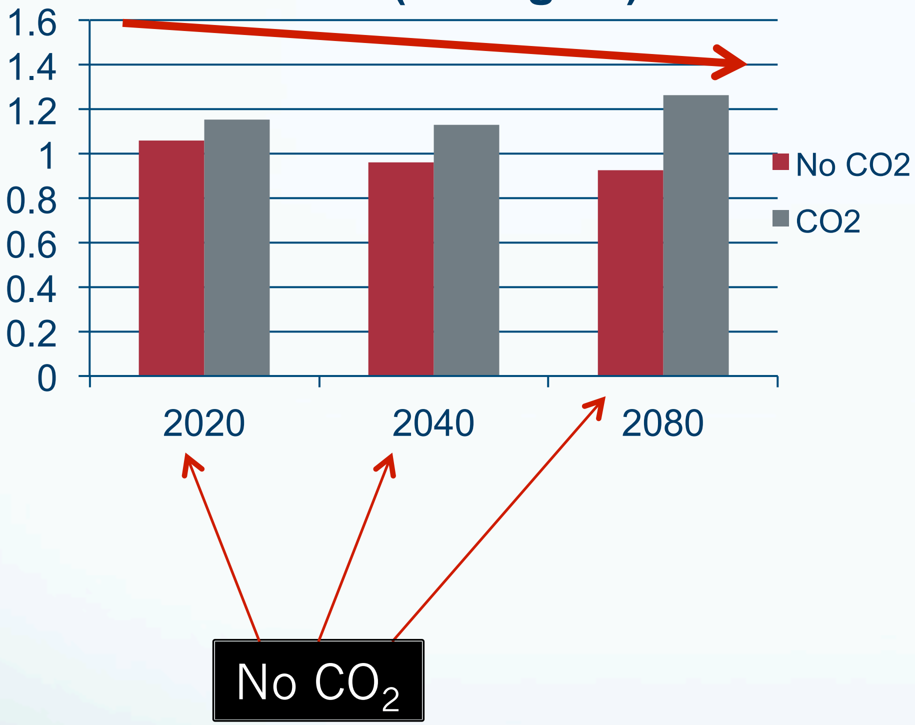
Cropping simulation of winter wheat yields under future warming with and without the influence of increased CO_2

Climate Impacts Group 2009

Stockle et.al. 2010

Project Results: Winter Wheat

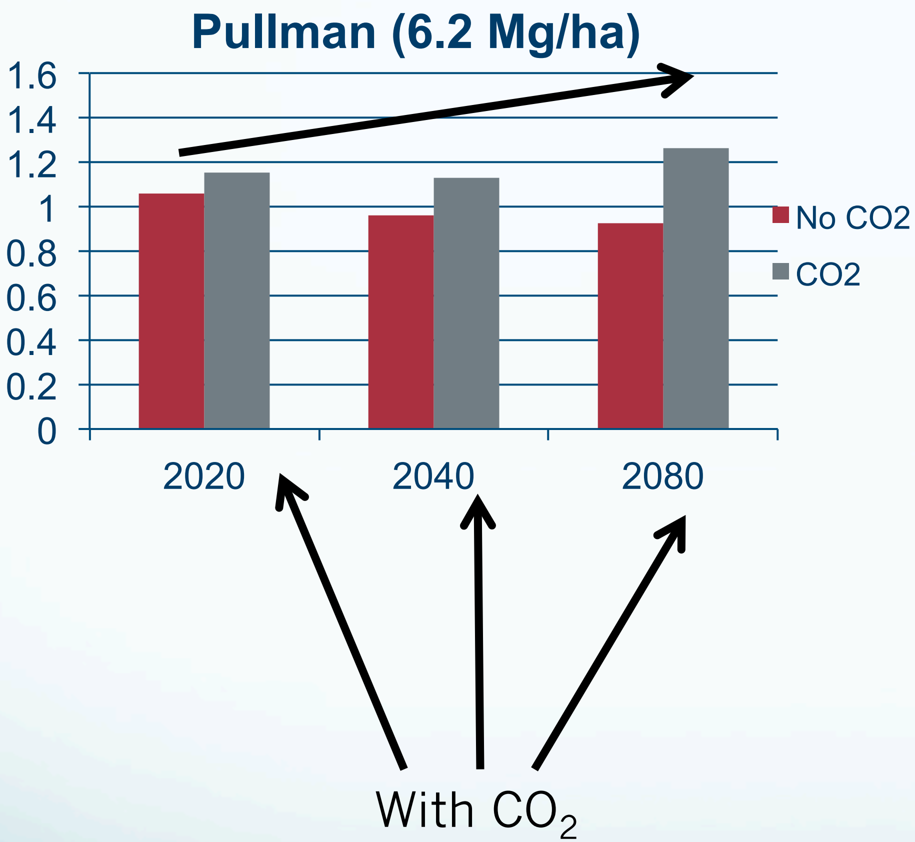
Pullman (6.2 Mg/ha)



With heat increases but Without CO_2, yields decline

Climate Impacts Group 2009

Project Results: Winter Wheat



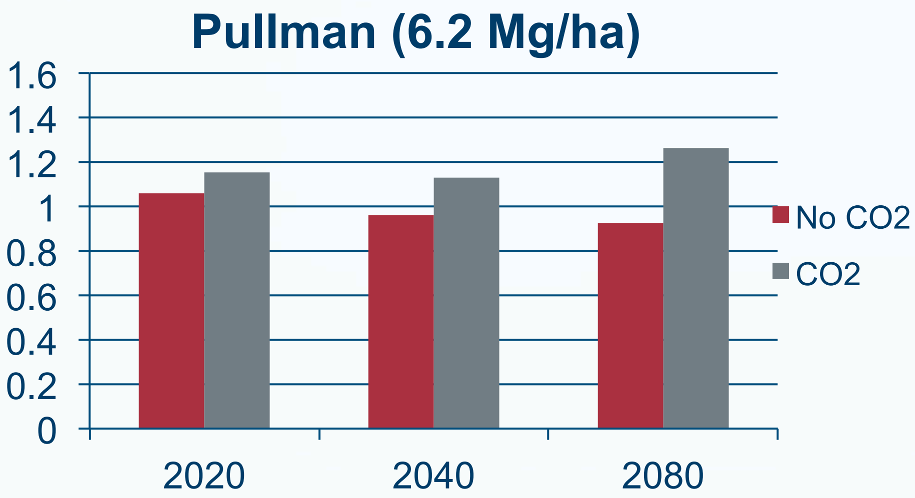
With heat increases AND Without CO_2 yields decline

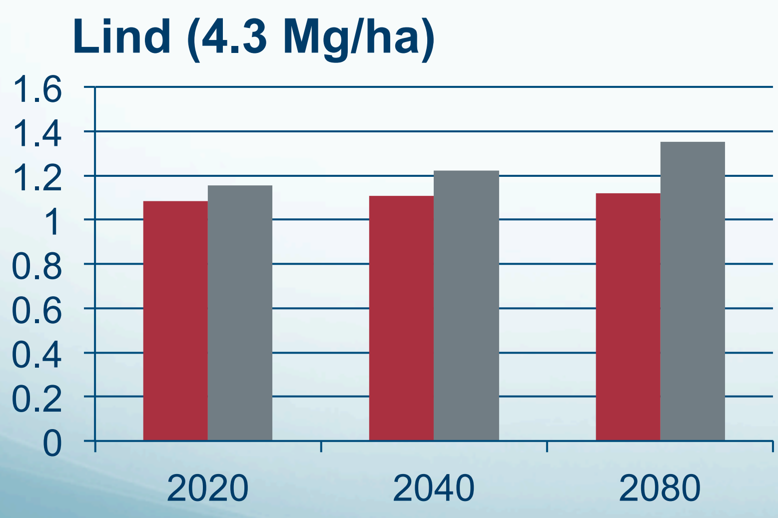
Increased CO_2 overcomes potential losses in Winter Wheat

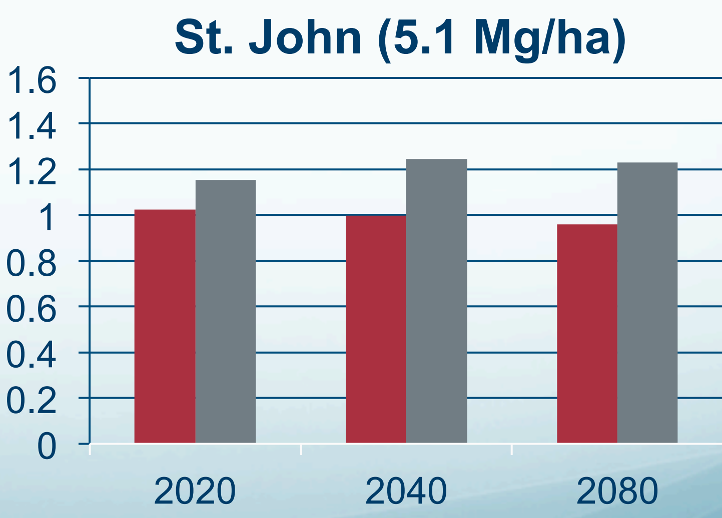
Stockle et.al. 2010

Climate Impacts Group 2009

Project Results: Winter Wheat







Stockle et.al. 2010

Climate Impacts Group 2009

What Will Warming Mean For **Potato Growth?**

(+) More growing degree days may accelerated plant growth

Photo credit: tpmartins
No changes

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(+) More growing degree days may accelerated plant growth

(+) CO_2 fertilization can boost production up to 28%

Photo credit: tpmartins
No changes

What Will Warming Mean For **Potato Growth?**

(+) **More growing degree days may** accelerated plant growth

(+) **CO_2 fertilization** can boost production up to 28%.

BUT….

(-) Increased heat can impeded transfer of carbohydrates to tuber and **reduced size.**

(-) Prolonged heat stress (87^0 F+) can lead to **lower tuber quality**

Photo credit: tpmartins
No changes

What Will Warming Mean For **Potato Growth?**

(+) More growing degree days may accelerated plant growth

(+) CO_2 fertilization can boost production up to 28%

(-) Heat can impeded transfer of carbohydrates to tuber and **reduced size.**

(-) Prolonged heat stress (87^0 F+) can lead to **lower tuber quality**

> Overall:

Yields under **warmer climate** and **increased CO_2** may not change at all, ... or decrease by up to 15% - **more research is needed.**

Photo credit: tpmartins
No changes

What Will Warming Mean For **Potato Growth?**

Overall:
Yields may decrease from 0 to 10-15%

Possible Adaptations:

- *Delay plantings to reduce heat exposure during tuber growth*
- *Breeding programs to select for cultivars that maintain green broadleaf period to utilize longer growing season.*

Photo credit: tpmartins
No changes

What Will Warming Mean For **Rangelands?**

What Will Warming Mean For **Rangelands?**

(+) Increased CO_2

- Can increase grass production (up to 40% in CO)
- Improve plant water efficiency

What Will Warming Mean For **Rangelands?**

(+) Increased CO_2

- can increase grass production (up to 40% in CO)
- Improve plant water efficiency

(-) Increased CO_2

- Decrease ‘digestibility’ because of lower protein and nitrogen content
- Increase competition from invasive (e.g. cheat grass, starthistle)

What Will Warming Mean For:
Irrigation Supplies

Photo credit jkiralyphotography, no changes

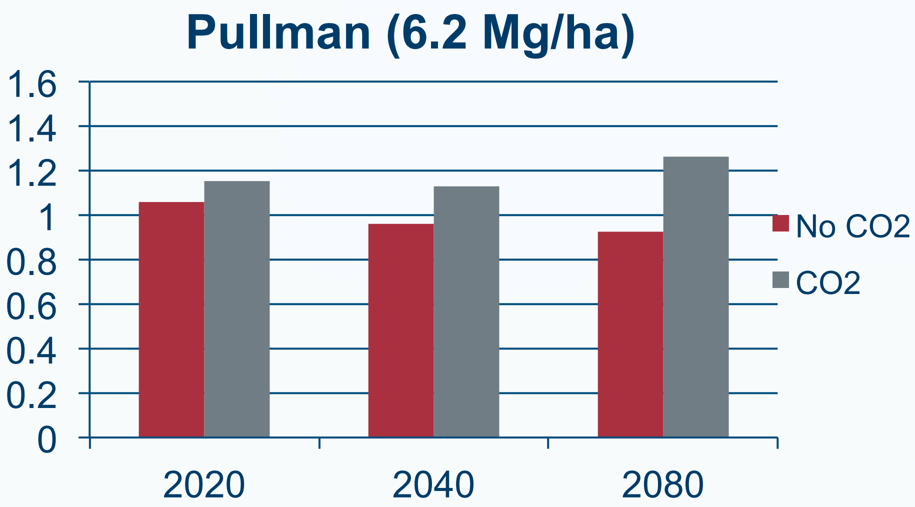
Future Precipitation:

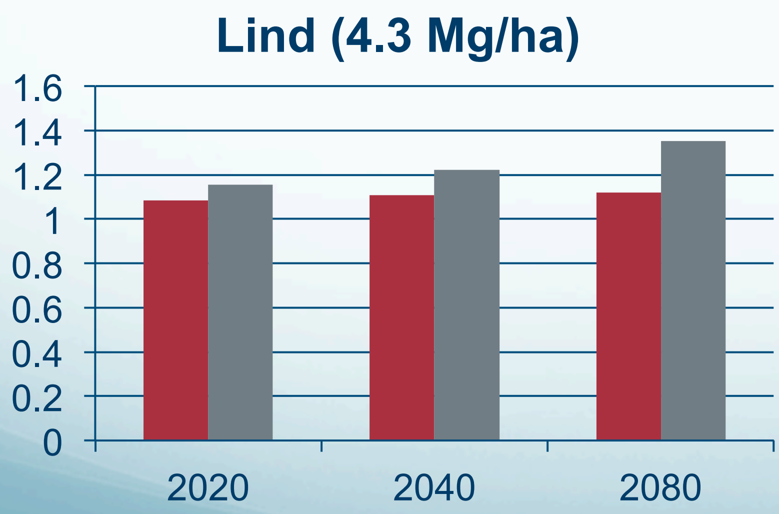
(+/-) Possibly wetter winters, drier summers

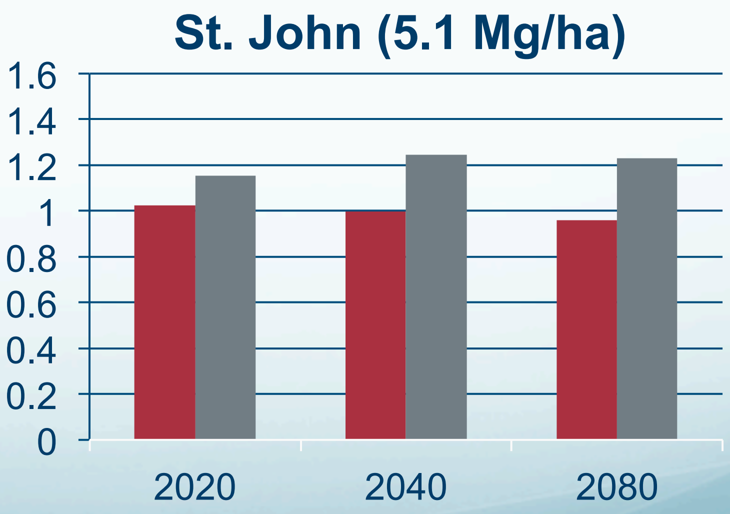
(-) Loss of snowpack

(-) Higher winter flows, lower summer flows

Project Results: Winter Wheat

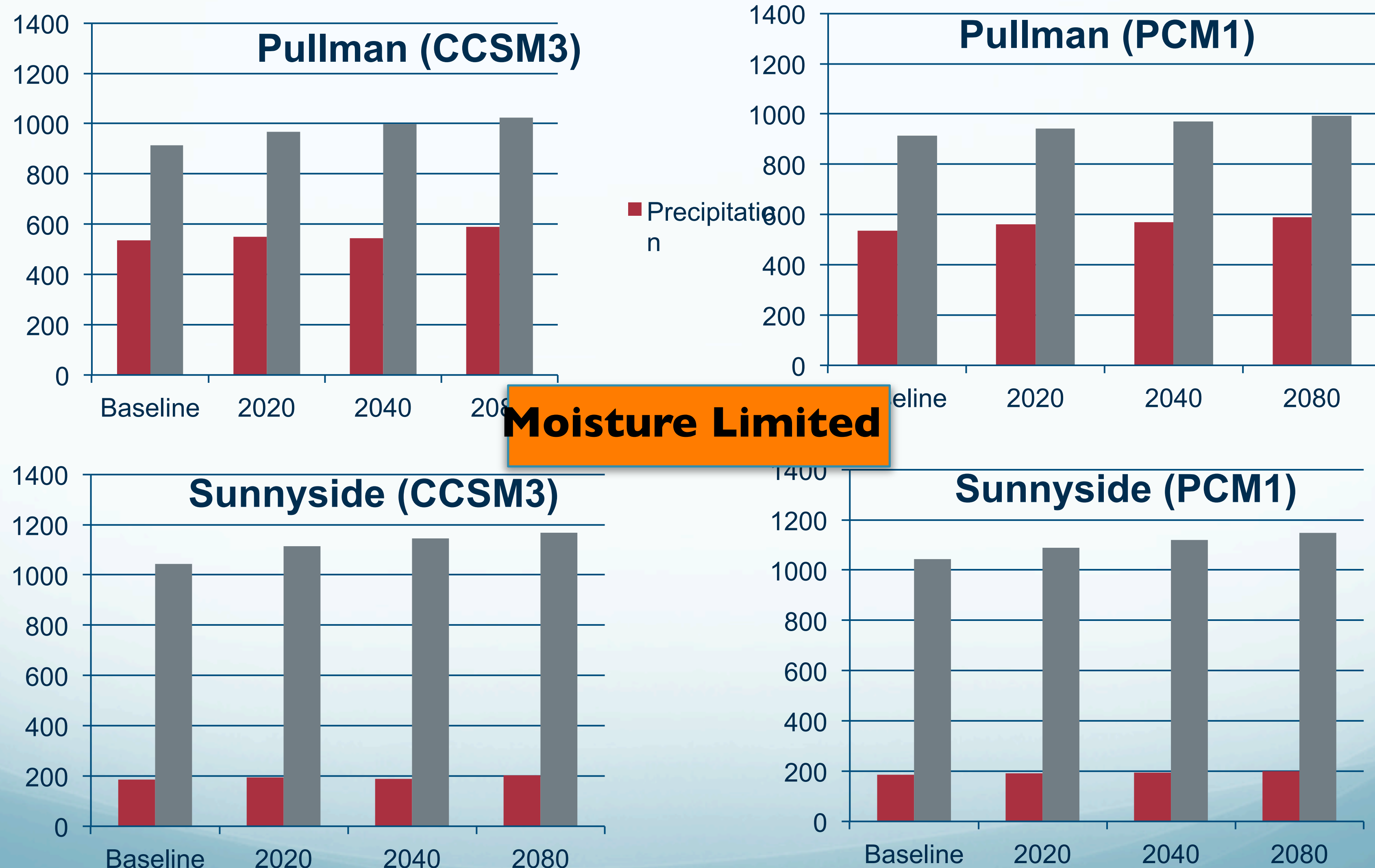






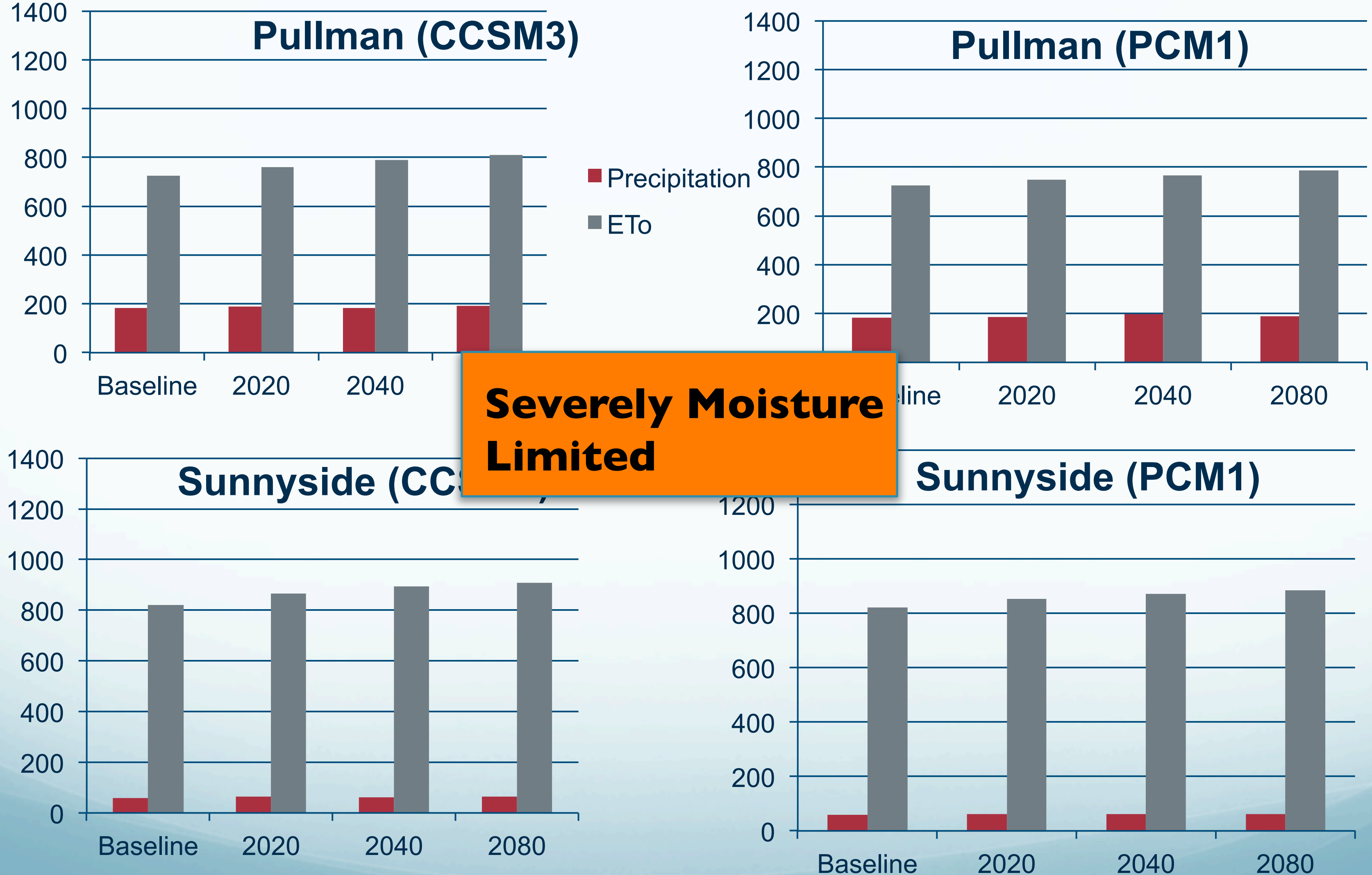
Climate Impacts Group 2009

Annual Precipitation and Potential Evapotranspiration ETo (mm)



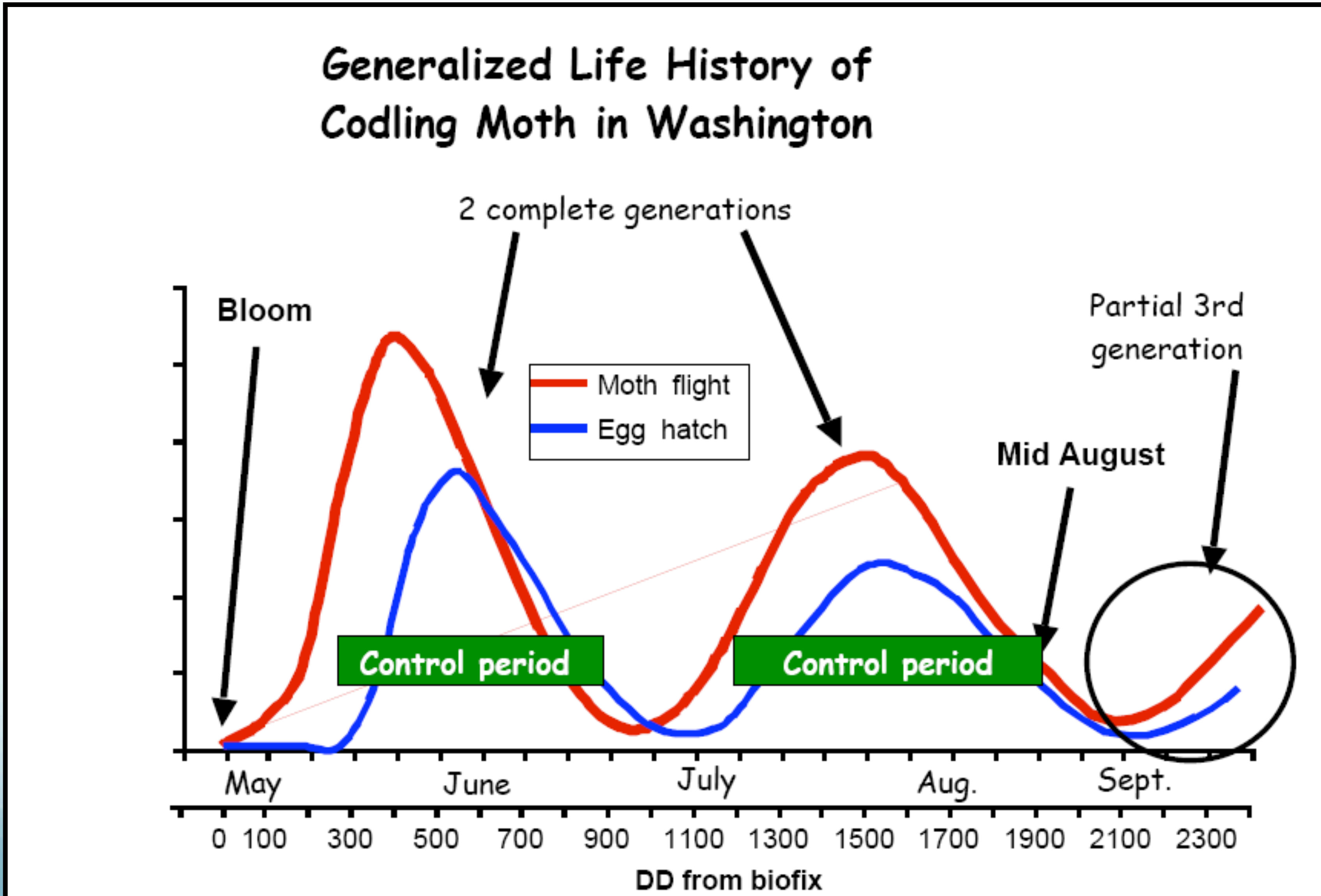
Climate Impacts Group 2009

Seasonal (April 1- Sept 30) Precipitation and Potential Evapotranspiration ETo (mm)



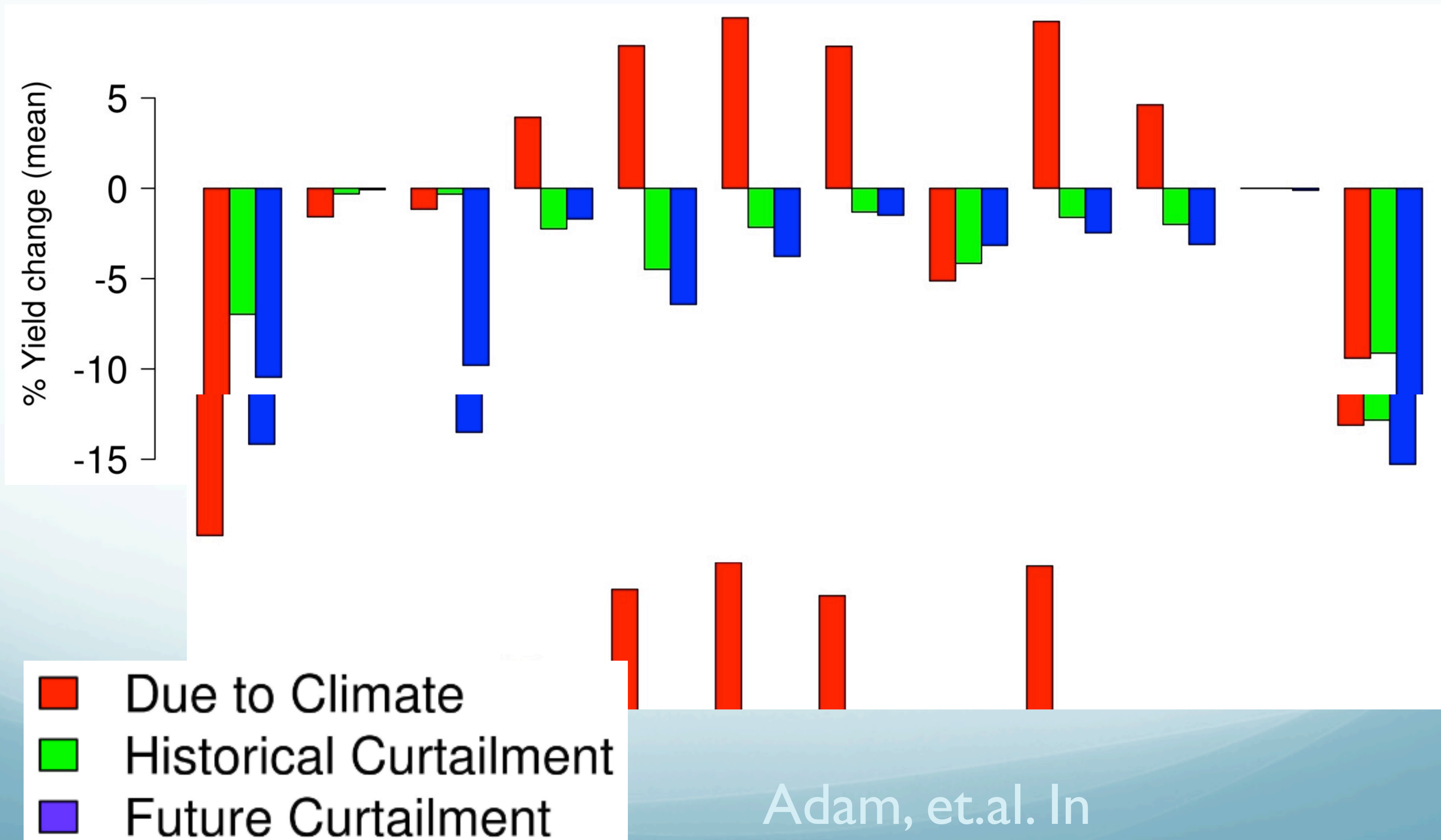
Climate Impacts Group 2009

Pests



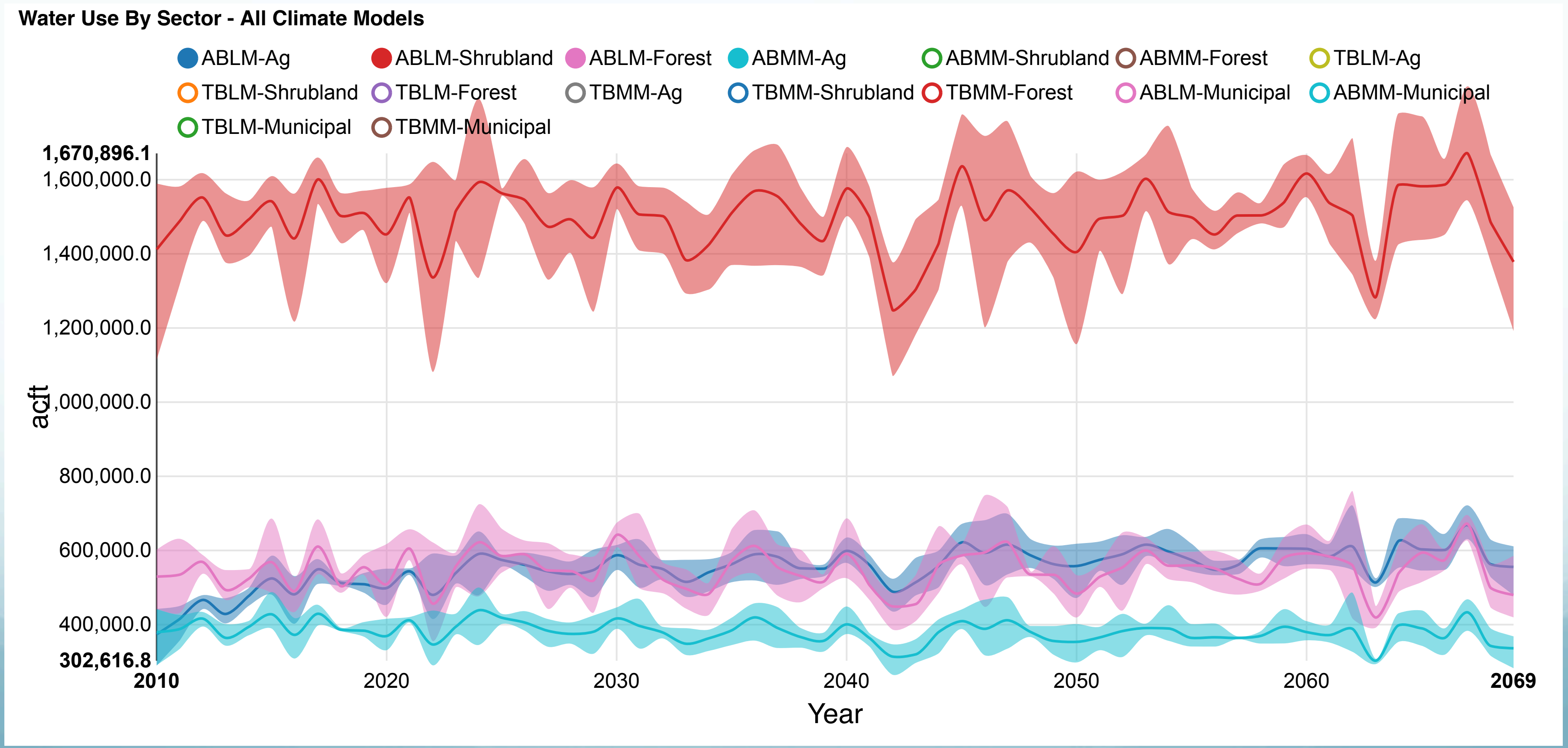
J. Brunner

Projected Climate Change Impacts on Crop Yield: Curtailment
Columbia River Supply & Demand Forecast

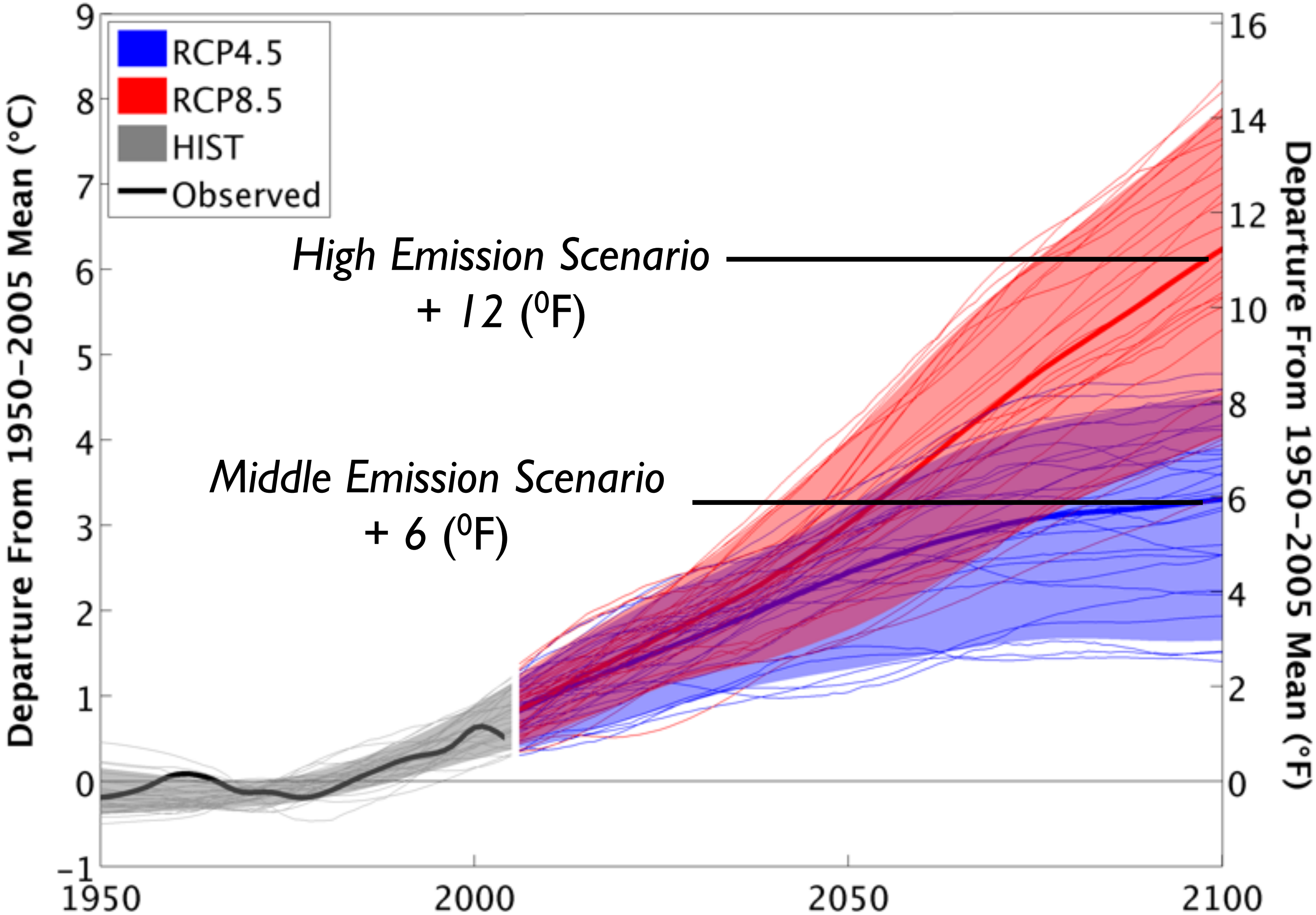


Adam, et.al. In

Big Wood: Water Demand



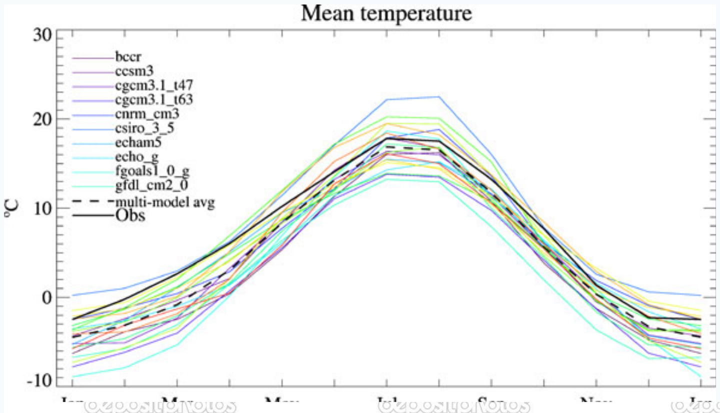
Projected Avg. Winter Temp, PNW



Abatzoglou et al. 2013

#1 <u>Model Skill</u>:

How well do models represent the PNW seasonal temperature cycle?

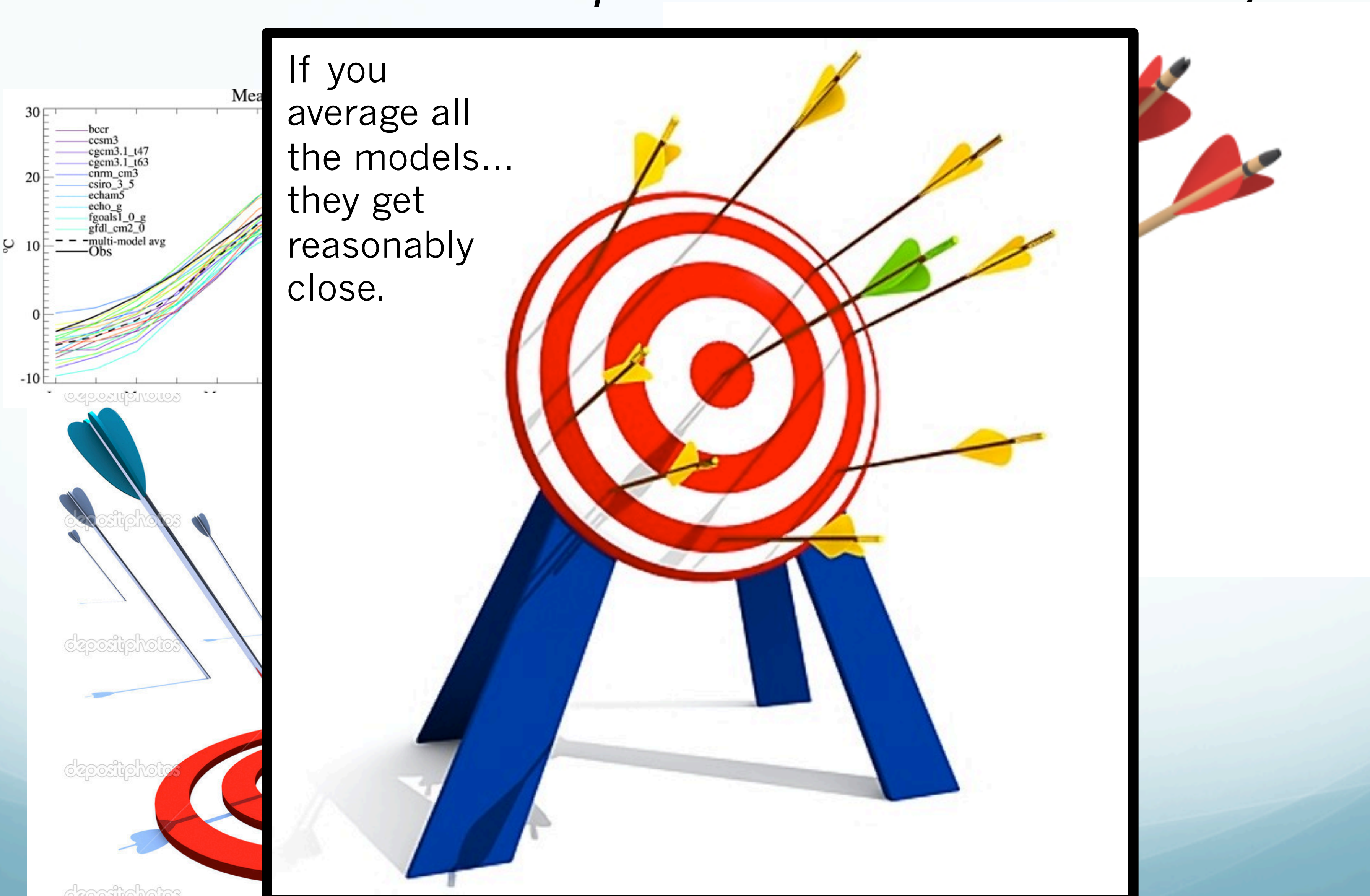


Not perfect bullseye

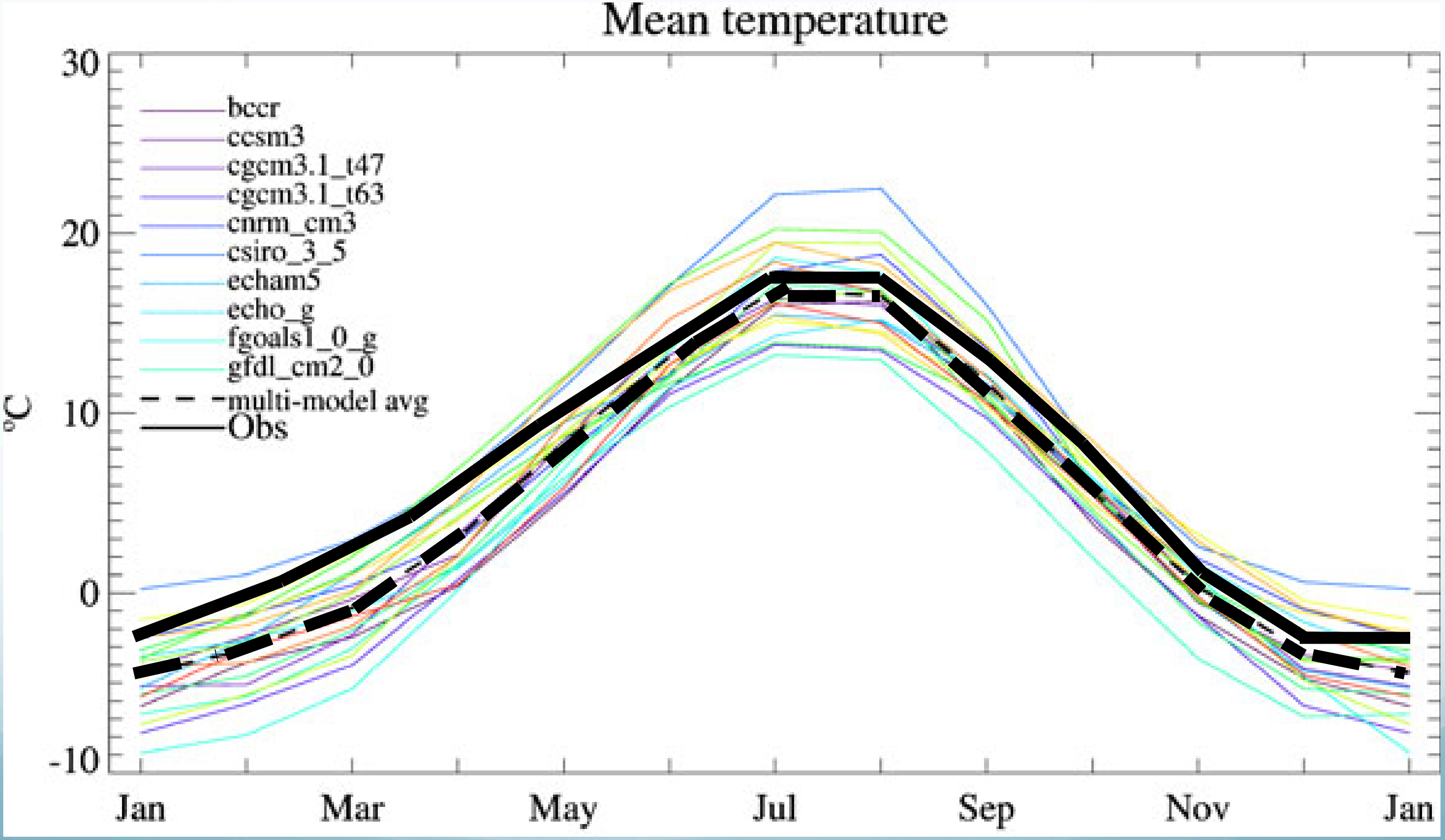
Not not completely off the mark

#1 Model Skill:

How well do models represent the PNW seasonal cycle?



How well do models represent the PNW seasonal temperature cycle in 20th Century?



Temperature Trends by Station

Yearly avg. temperature has increased +1.5°F since 1920.

Extreme cold conditions have become rarer.

Low temperatures rose faster than high temperatures.