Climate Change and the Columbia River

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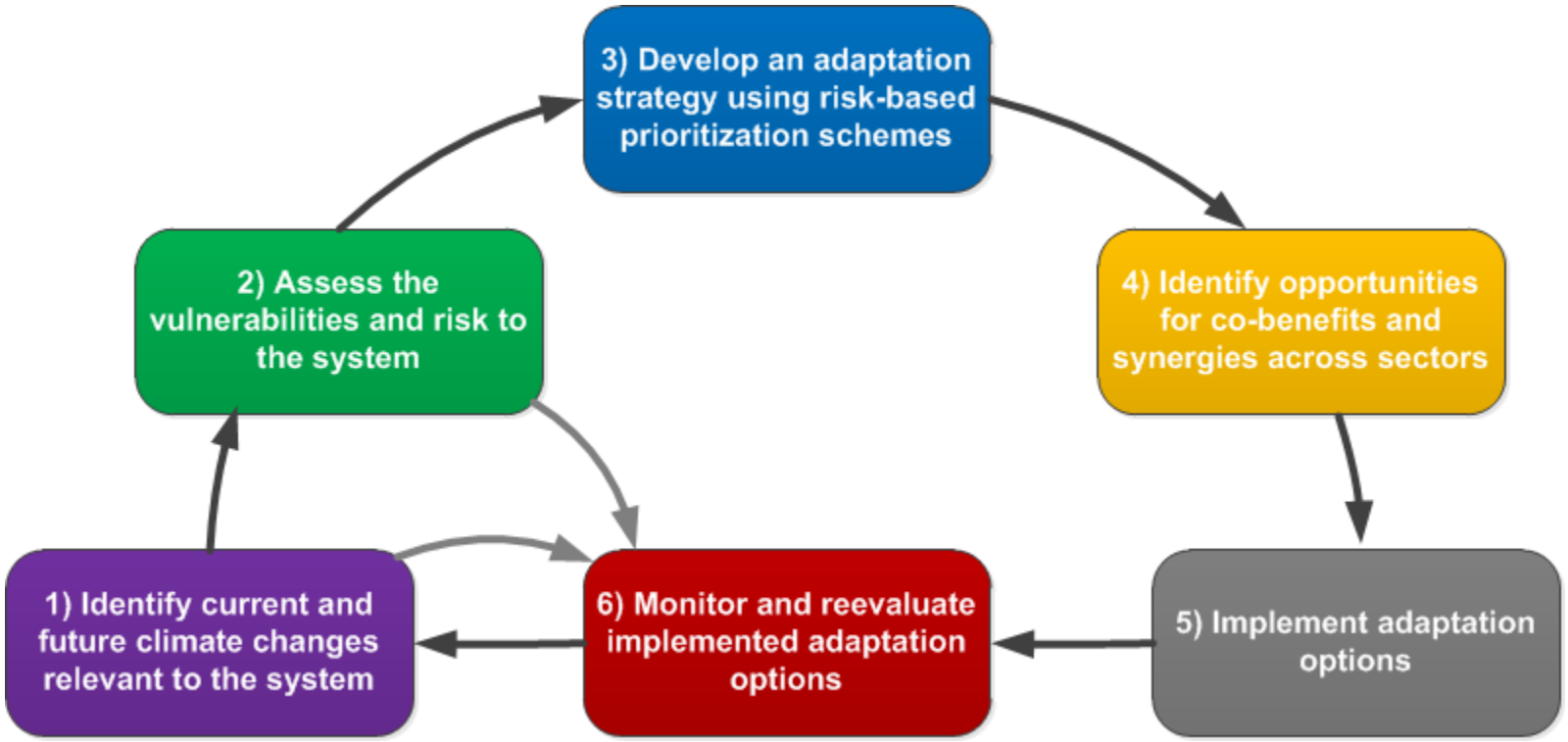
Outline

- What concerns you about climate change and the Treaty Review?
- Brief overview of climate change studies in the Columbia Basin
- Discussion of potential vulnerabilities and risks
- Resources available to learn more
- Discussion of top issues you see for climate change and the future of Columbia River Treaty
- Recommendations to Treaty Review Team

Adaptation Strategy Framework



Taken from: National Academy of Sciences, 2010. “Adapting to the Impacts of Climate Change” National Academies Press, Washington, D.C.

Climate Change Impact Assessment

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Federal / IPCC

Research Partners

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Greenhouse Gas Emission Scenarios

Global Circulation Models

Regional Climate Models

Statistical Downscaling

Statistical Downscaling

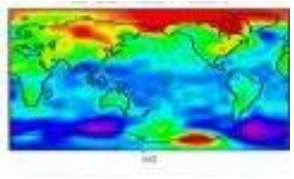
Hydrologic Models

Glacier Mass Balance Models
Dynamic Glacier Models

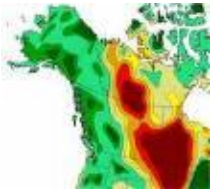
Flow Scenarios

Reservoir Operations Models
System Optimization Models

Resolution
~ 200 kilometer grids

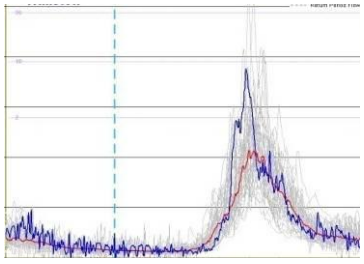


Resolution
~ 45 kilometer grid



Resolution
for model requirements

Flow Scenarios



Adaptation (e.g., Reservoir Operations)

You can't do it alone

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Pacific Climate Impacts Consortium (PCIC)

PACIFIC CLIMATE IMPACTS CONSORTIUM

- BC-wide hydro-climatic trend analysis
- Multi-watershed modeling study

Western Canadian Cryospheric Network (WC2N)

WC²N WESTERN CANADIAN CRYOSPHERIC NETWORK

- Modeling study of coupled glacier & hydrologic change at Mica basin

University of Washington (UW) & River Management Joint Operating Committee (RMJOC)

- Multi-watershed modeling study
- Development of planning data sets for US agencies in Columbia River basin

BONNEVILLE POWER ADMINISTRATION

CLIMATE IMPACTS GROUP
Climate Science in the Public Interest

Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)
Fondation canadienne pour les sciences du climat et de l'atmosphère (FCSCA)

University of Victoria

Environment Canada

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

OURANOS

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

BRITISH COLUMBIA

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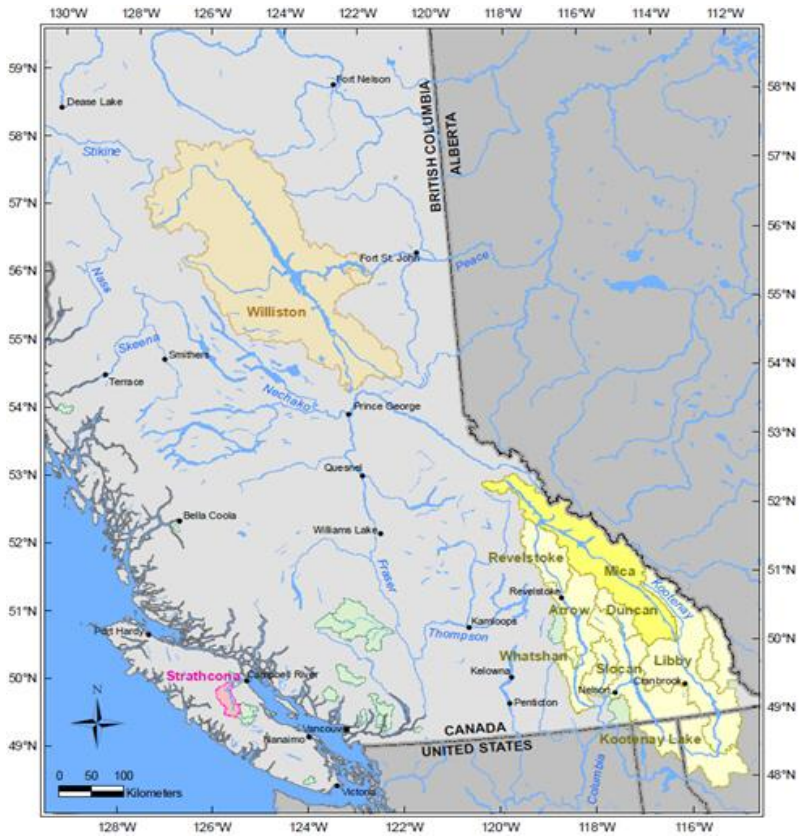
UBC

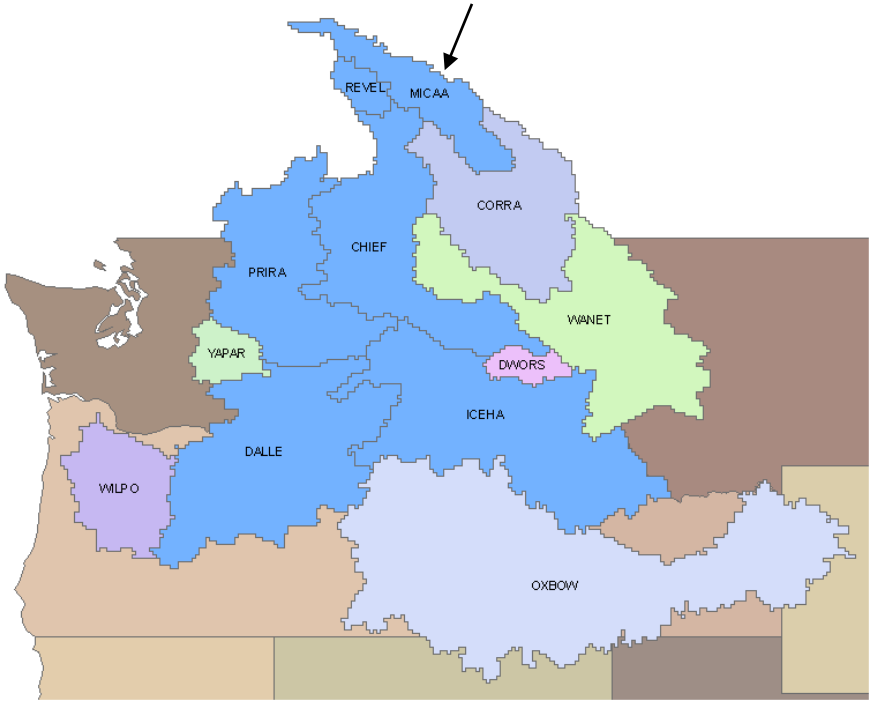
Study areas



PCIC (BC Hydro Study)

- Peace, Columbia, Campbell

WC2N – Mica only



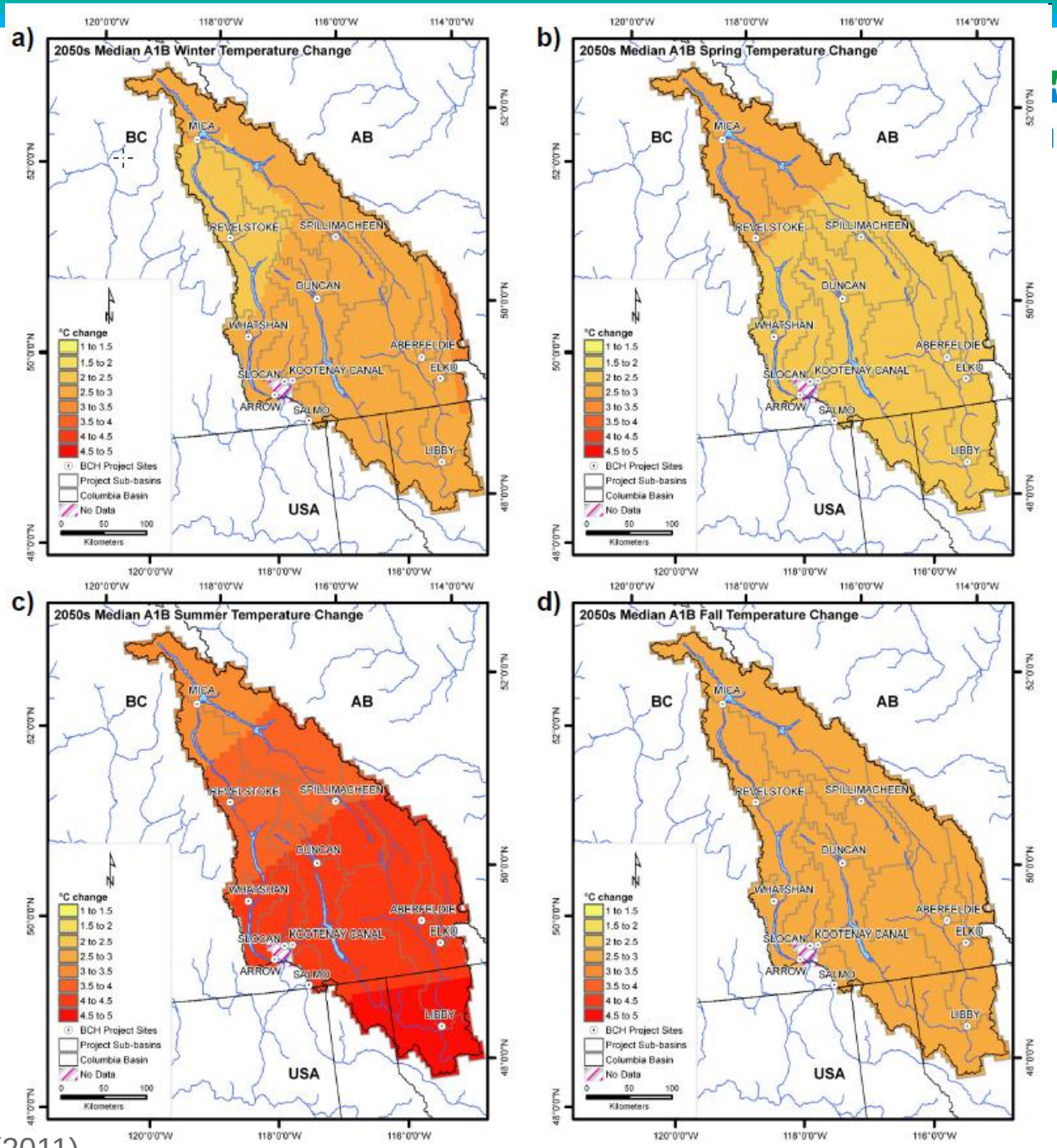
RMJOC (U.S. Study)

– Columbia & Snake

Projected Climate Trends

Change to median temperature in 2050's

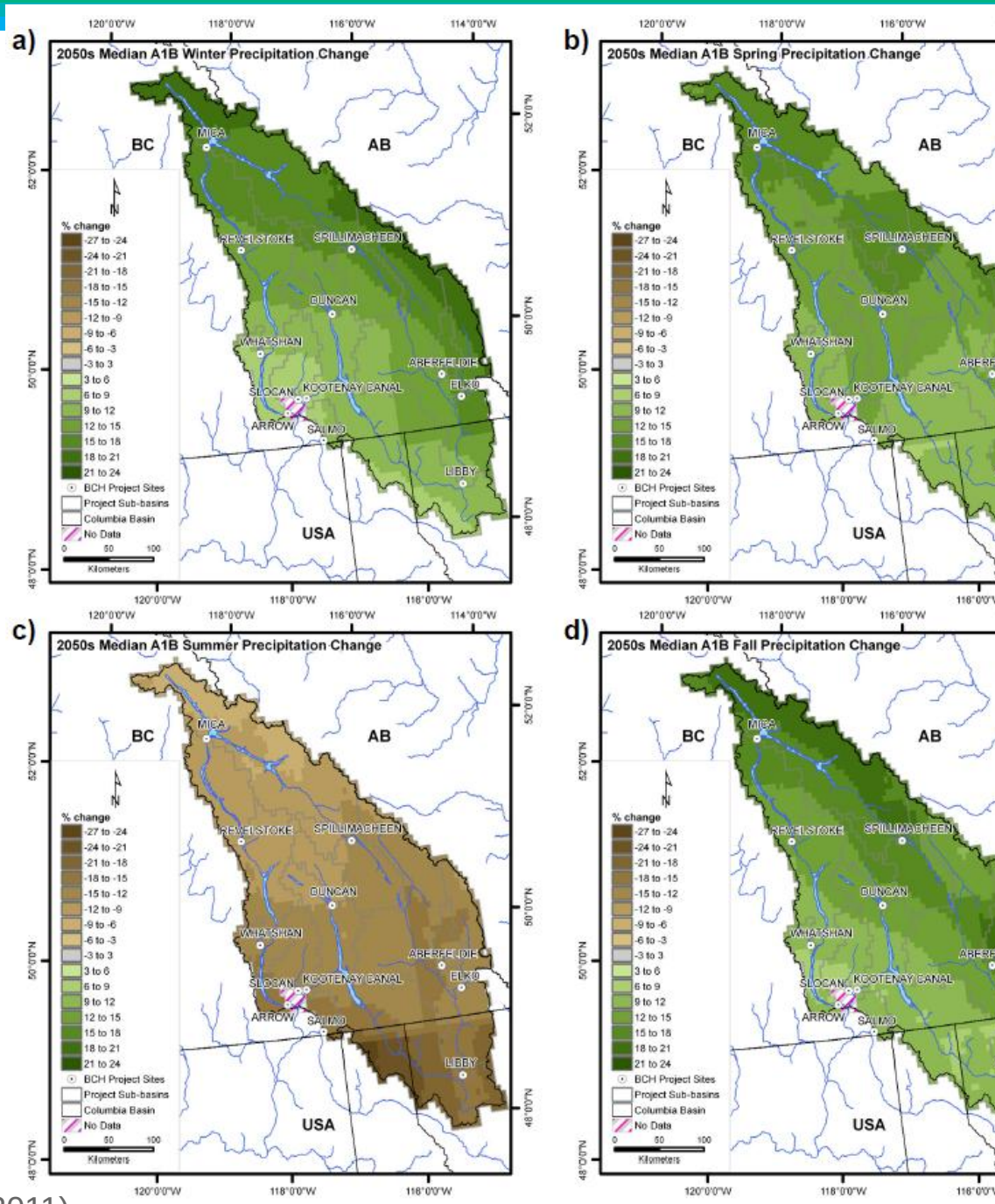
(compared to 1961-1990)



Source: PCIC: Schnorbus et al. (2011)

Projected Climate Trends

2050s Precipitation



Source: PCIC: Schnorbus et al. (2011)

Projected Trends in April Snowpack

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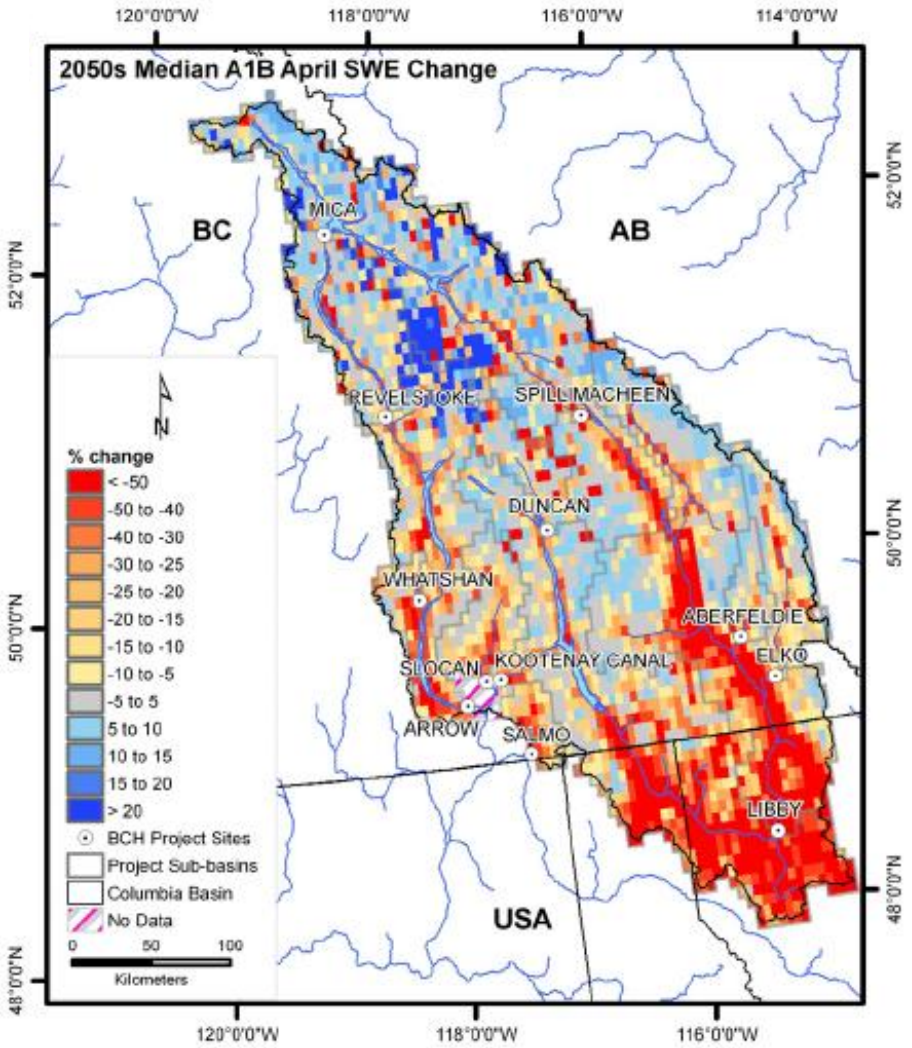
Median April 1 SWE anomaly

North-south and vertical gradient

On average across the basin, median 2050s anomaly of April 1 SWE is (only) -30 mm

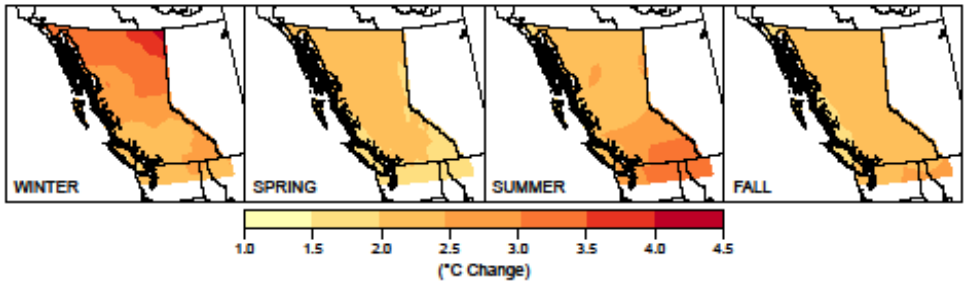
SWE decreases at low elevations are offset by increases at high elevations

Snow covered area will likely decrease

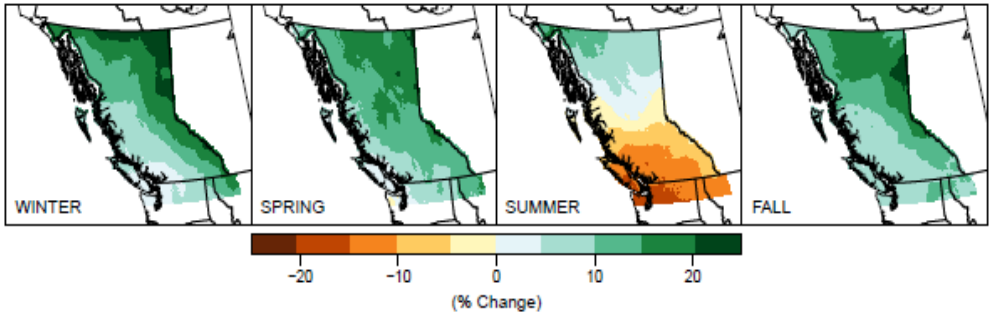


Hydrologic Impacts - Results

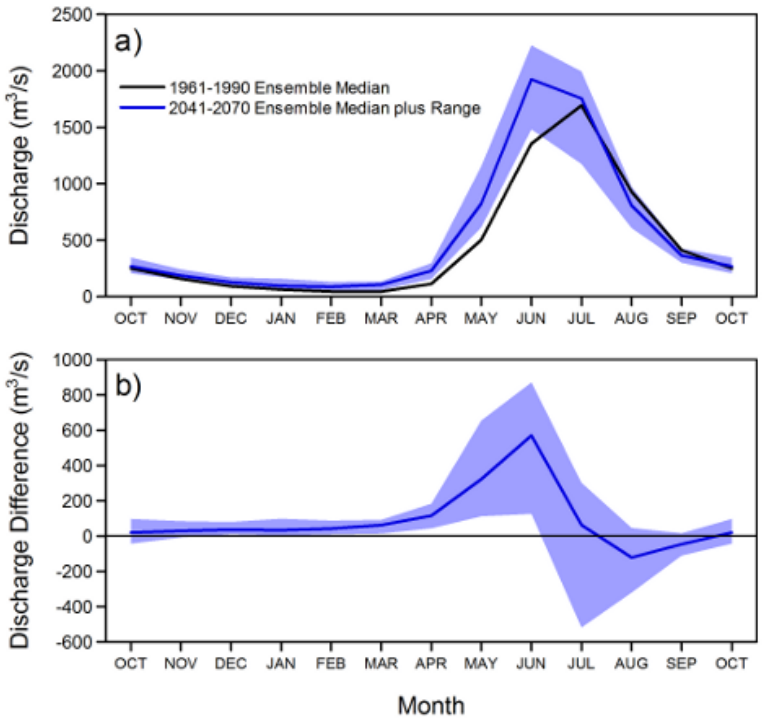
Seasonal mean temperature change in the 2050's (2041-2070) relative to the1961-1990 baseline period.



Median Precipitation Change Projected for the 2050s



Columbia River at Mica Dam



Source: PCIC: Schnorbus et al. (2011)

Projected Trends in Monthly Inflows

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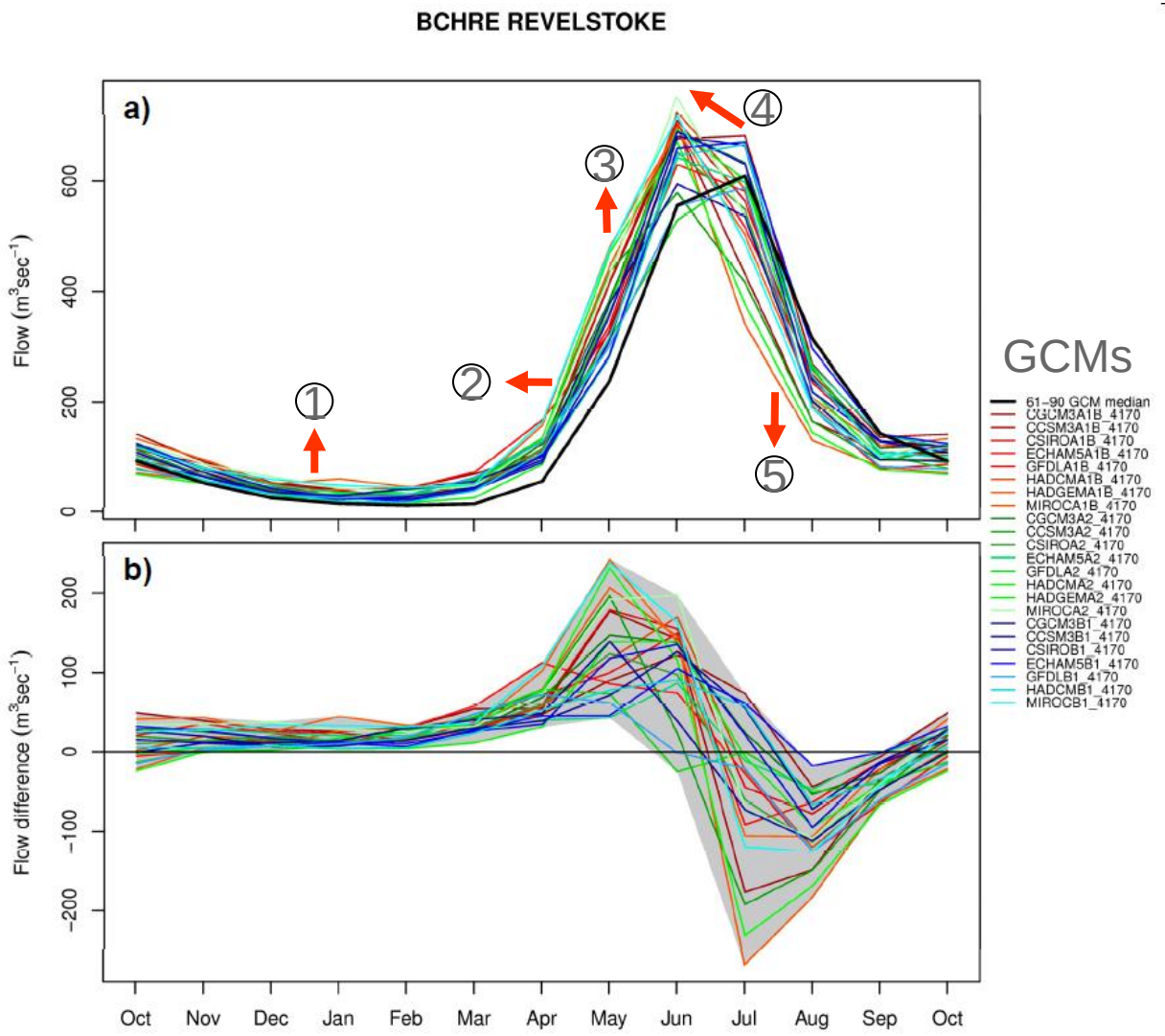
REVELSTOKE

1) Higher winter baseflow
2) Earlier spring melt
3) Higher spring melt
4) Earlier peak
5) Lower summer flow



Projected Trends in Monthly Inflows

BC hydro
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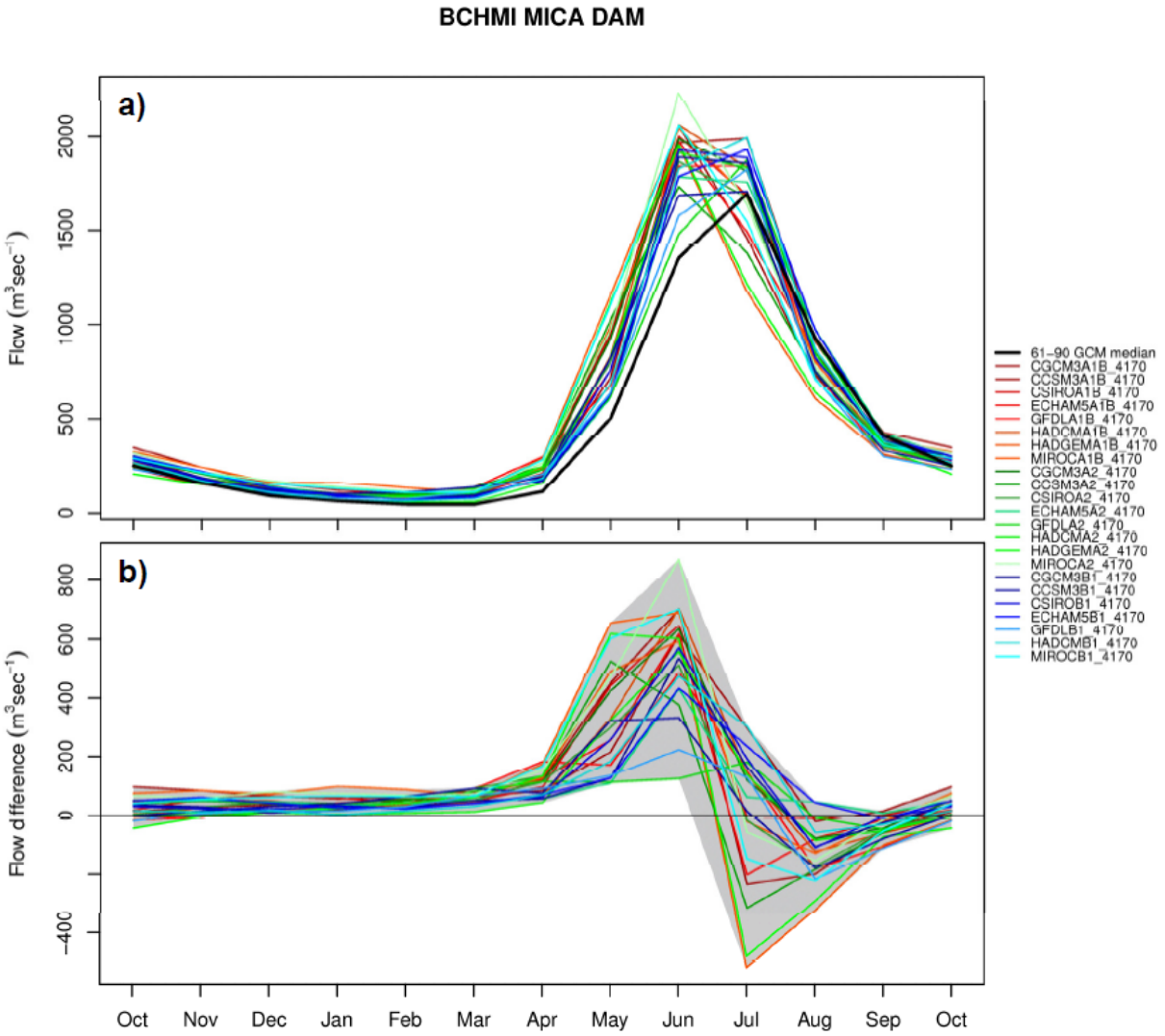
MICA



Projected Trends in Monthly Inflows

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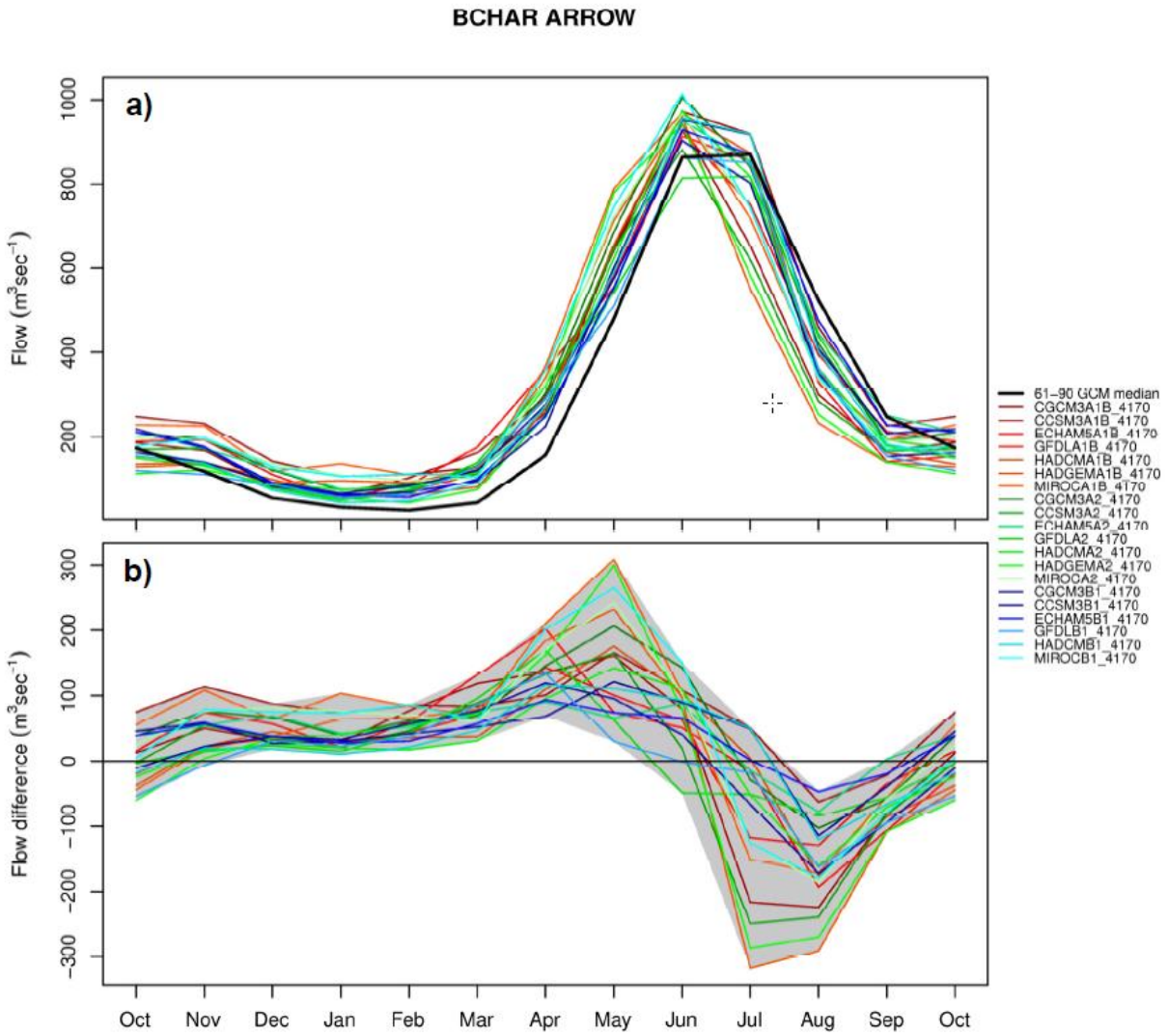
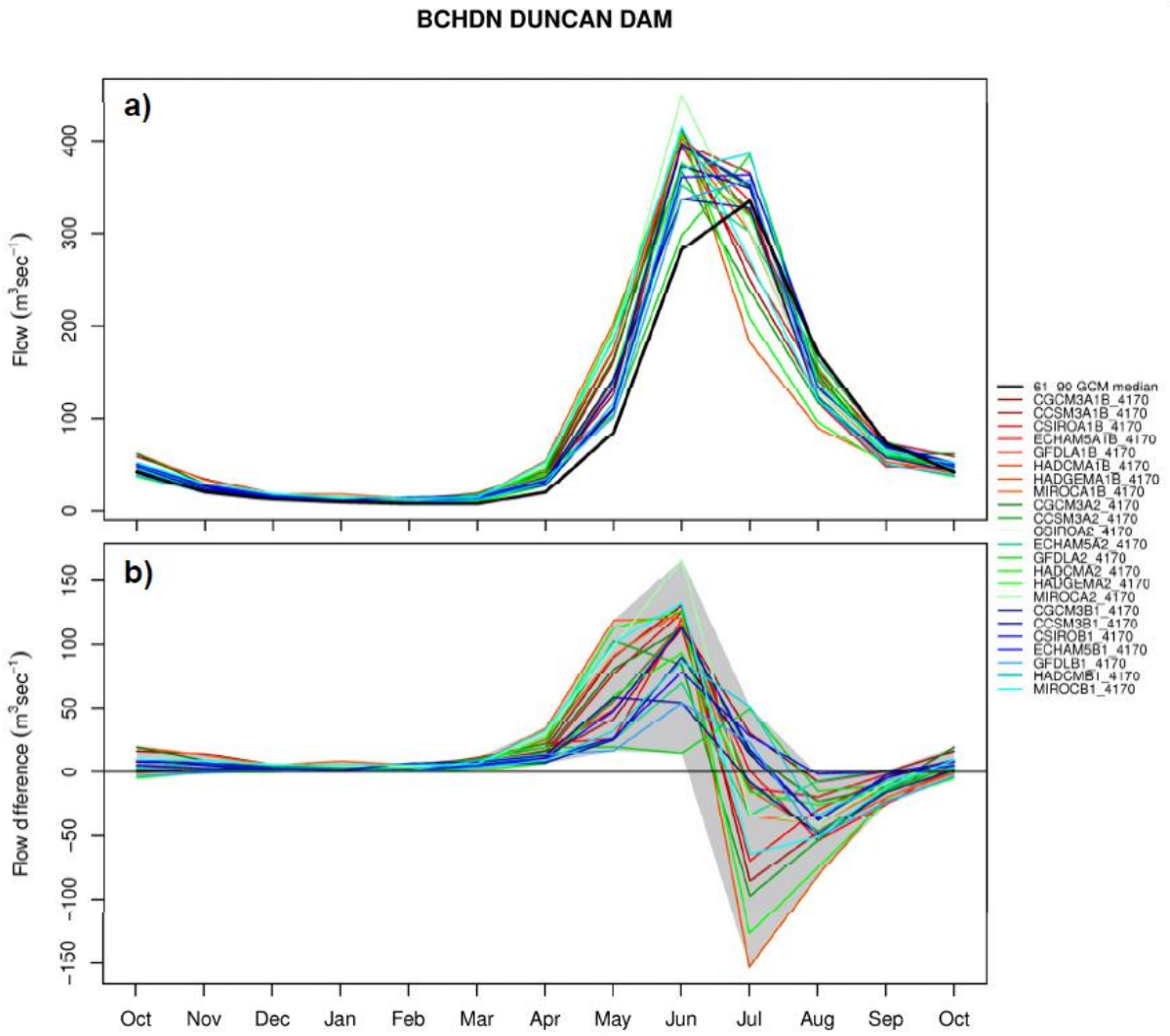
ARROW



Projected Trends in Monthly Inflows

BC hydro
FOR GENERATIONS

DUNCAN



Projected Trends in Monthly Inflows

BC hydro
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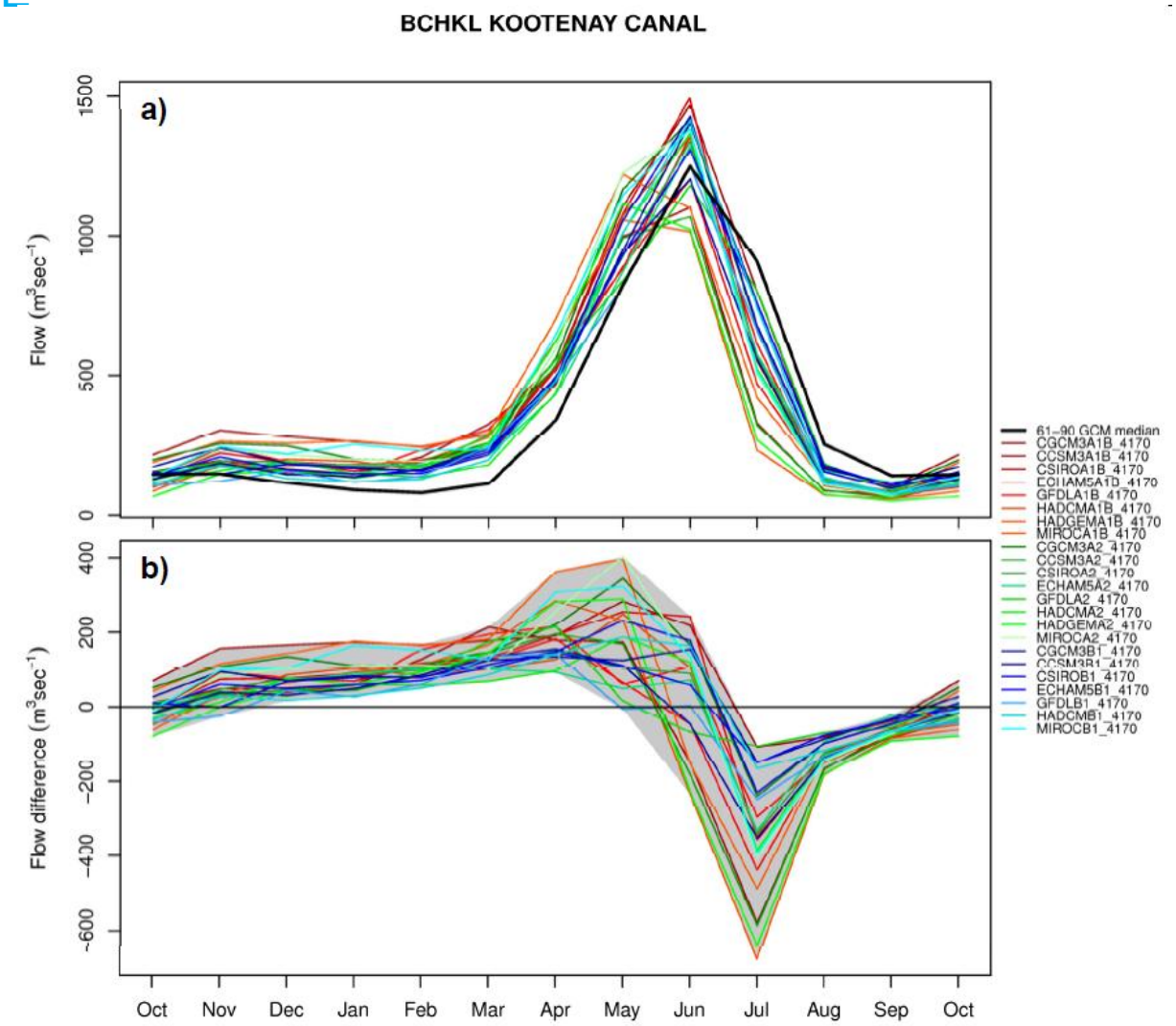
KOOTENAY LAKE



Projected Mean August Inflow at Mica
static vs. dynamic glaciers

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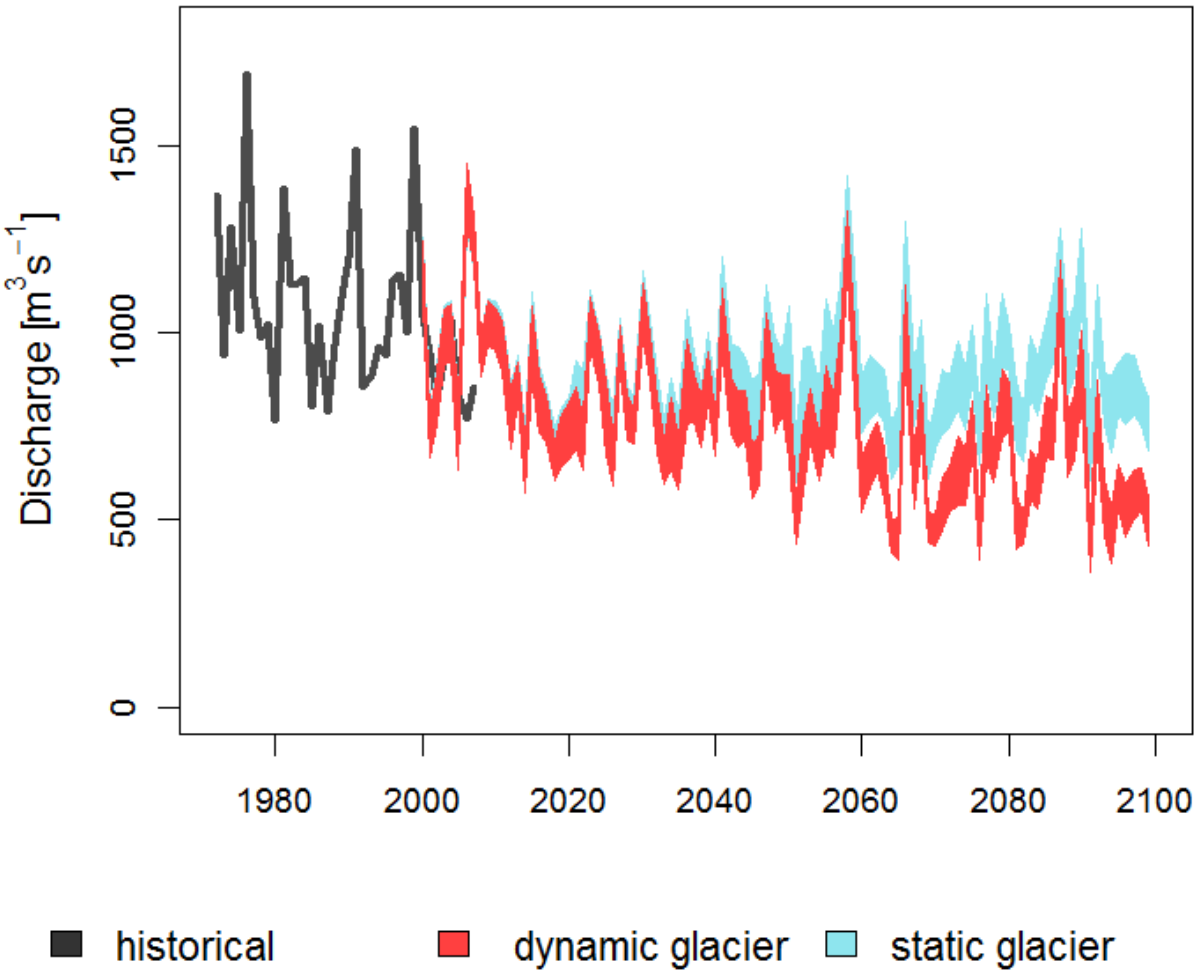


Projected Trends in Median Annual Inflow

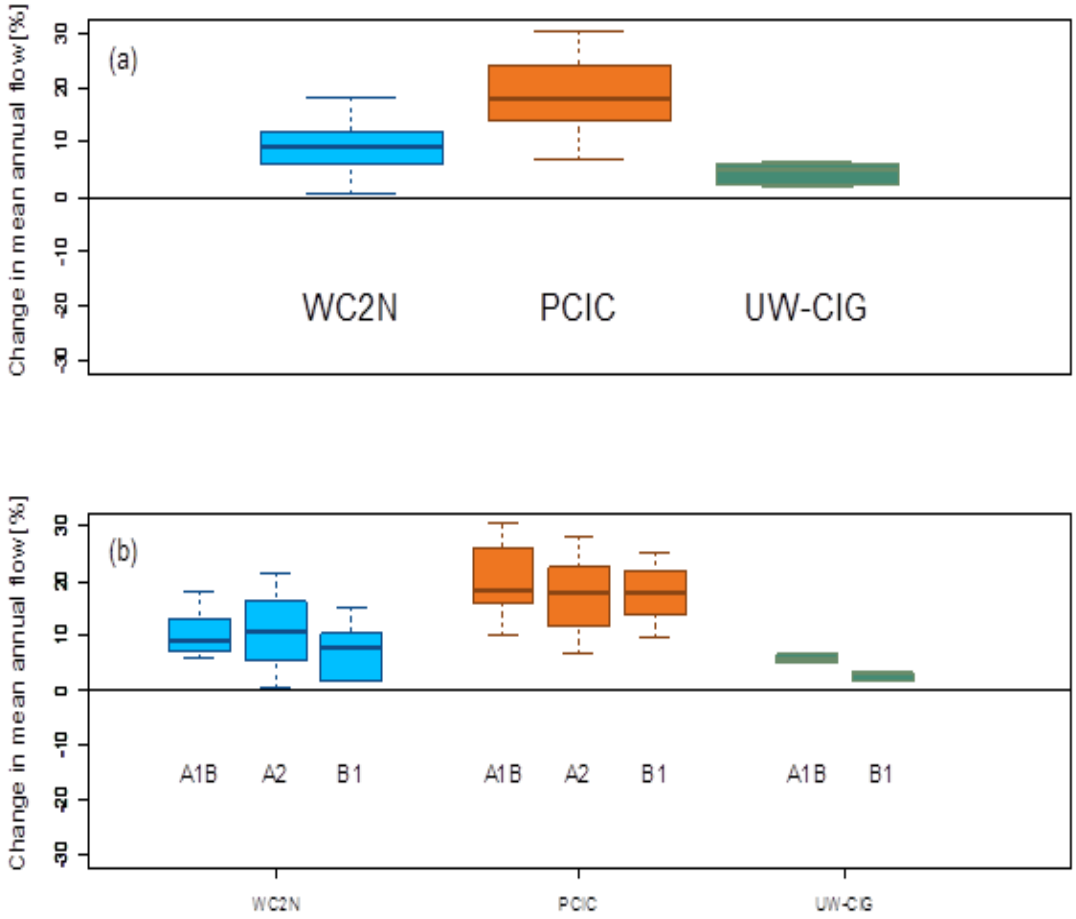
1. Annual flow is projected to increase at the majority of the project sites
2. Differences between scenarios are smaller than the combined inter-annual and inter-GCM differences

	median annual precipitation* (%)	median annual temperature* (ºC)	median annual flow* (%)				
SRES	Columbia region		MCA	REV	ARD	DDM	KLK
B1	+10	+1.8	+16	+13	+12	+13	+12
A1B	+7	+2.7	+22	+17	+16	+18	+13
A2	+5	+2.3	+17	+10	+8	+12	+7
mean	+7.3	+2.3	+18	+13	+12	+14	+11

* relative to 1961-1990 baseline

Source: PCIC

Inter-comparison of future scenarios



Comparison of range of future annual runoff from three studies for the Columbia River above Mica dam

US Columbia Basin Projected Impacts

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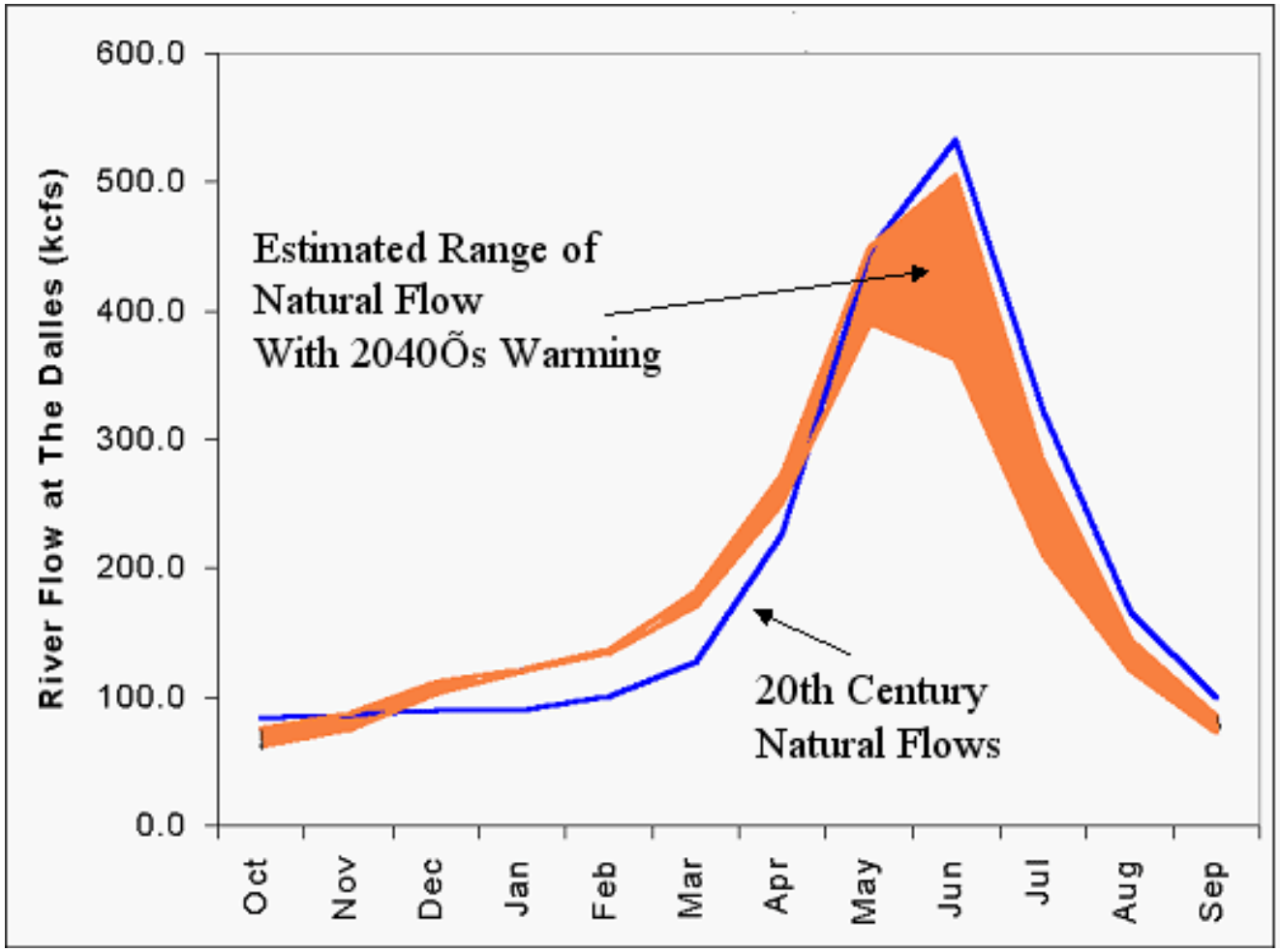
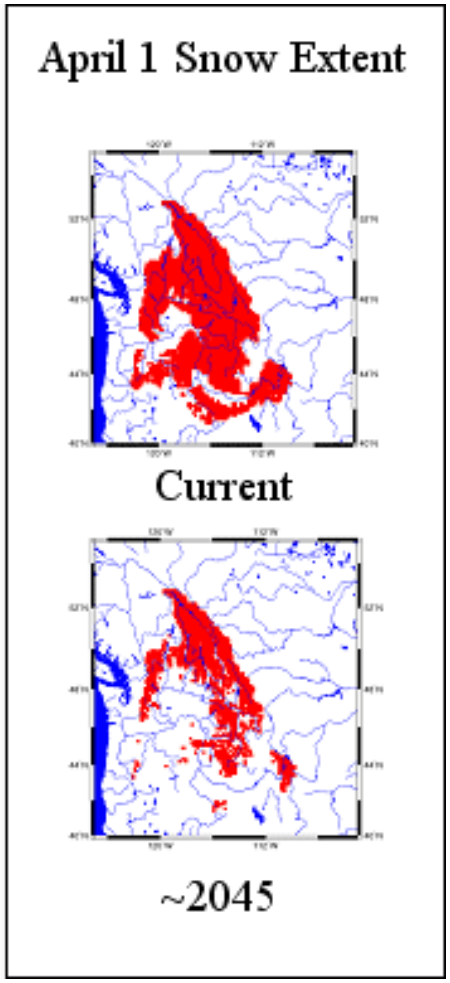




Source: University of Washington Climate Impacts Group

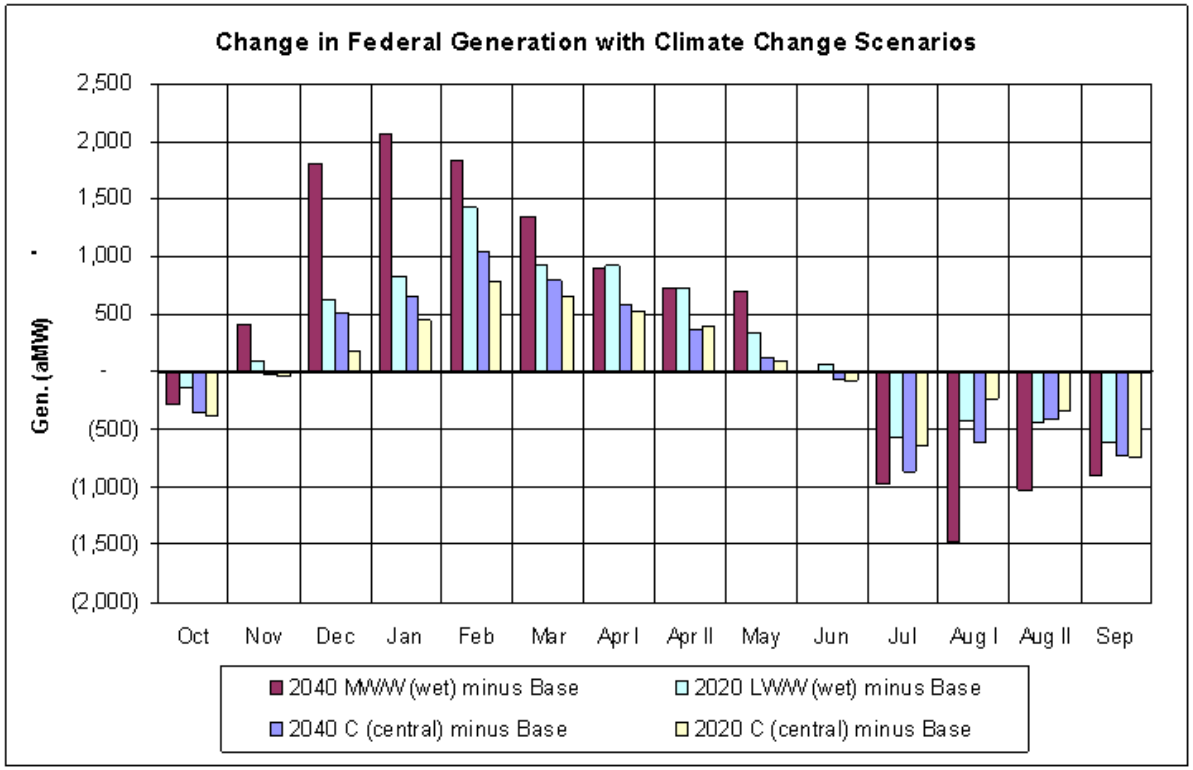
What does this mean for the Treaty Review?

US and Canada have agreed to use the results of US climate change studies as input to the CRT Review studies.

- Same or more water available, particularly in Canadian Columbia
- Timing of runoff is changing
  - Potential impacts for Flood Control
  - Lesser impacts to Generation

Potential Changes to Generation

Climate change can affect hydropower generation both through changes in water availability (more in winter) and changes to electricity consumption patterns (more summer air conditioning)

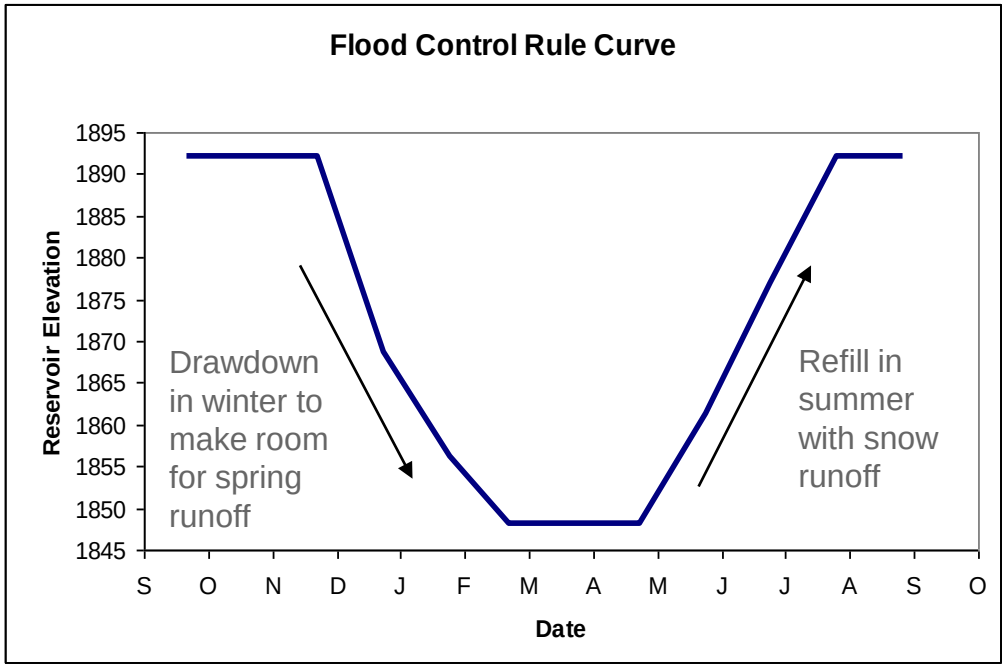


Source: RMJOC

Considerations for Flood Control

- Space required for flood control is based on the amount of snowpack, rainfall during the refill season (spring and summer), and shape and timing of the runoff.
- Based on April – August water supply forecast

Currently



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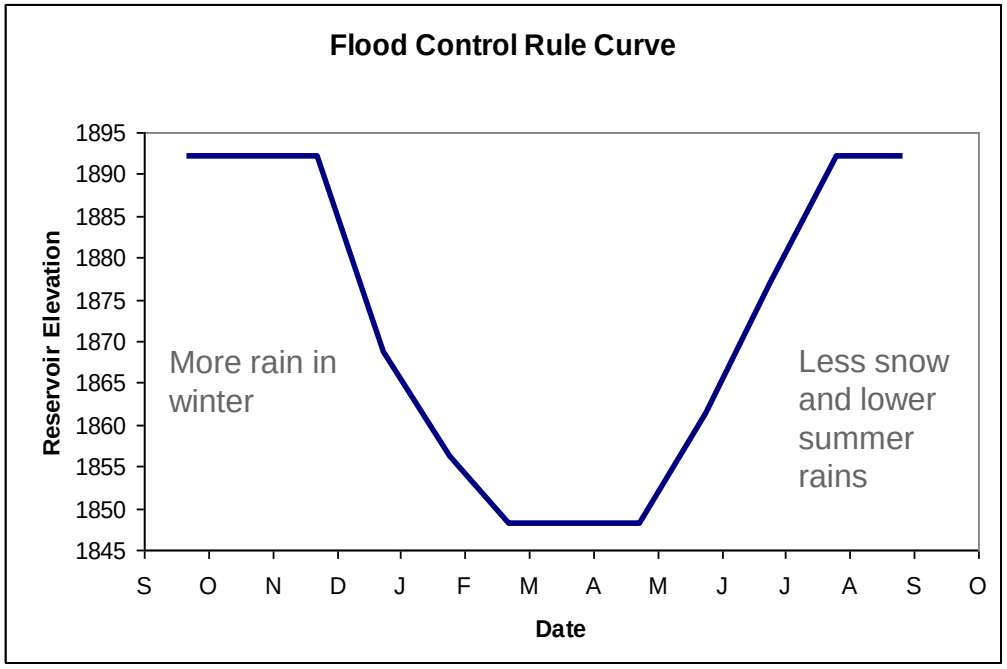
- Flood events may be more rain-driven in future.
- Treaty focus is currently on Spring flood control.
- Winter flood control may become increasingly important

Climate change projections:



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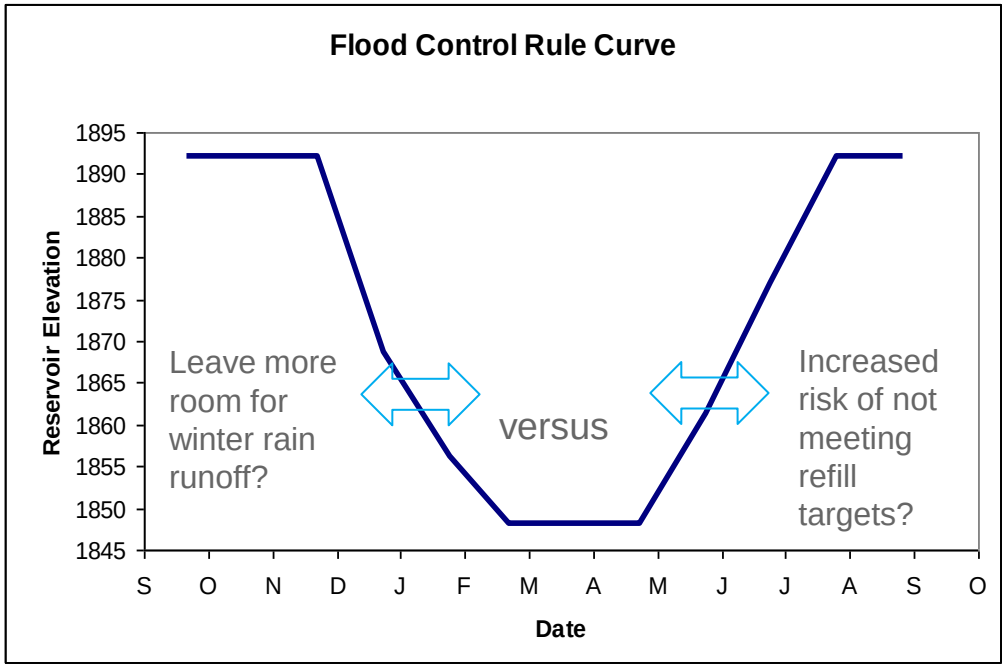
How does this change flood control planning?



Summary

- CRT 2014 review will consider climate change projections
- Columbia basin can expect:
  - Warmer temperatures
  - Wetter Fall, Winter, Spring; Drier summers
  - Diminished snowpack except at high elevation
  - Loss of glaciers
  - Slightly higher annual runoff
  - Changes in timing of runoff
  - Less predictable runoff
- These climate and hydrologic changes could impact future flood risk management and generation profiles in the entire Columbia basin

- These are projections of changes to average conditions. We do not yet understand how severe weather may change in the future

Where to find more information

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Regional climate change data & tools

- Pacificclimate.org – PCIC website

Reports

- bchydro.com – search “potential climate change”
- US summary reports Search “RMJOC Climate change”
- University of Washington Climate Impacts Group
- CBT.org – Columbia Basin Trust

Discussion

- Your issues /concerns for climate change and Columbia River Treaty Review
- Recommendations to Treaty Review Team

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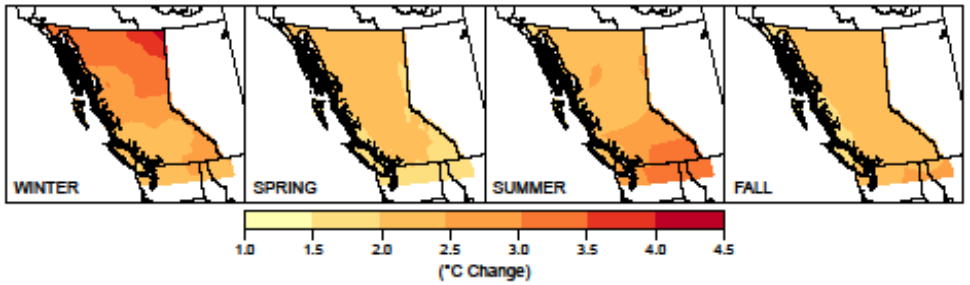

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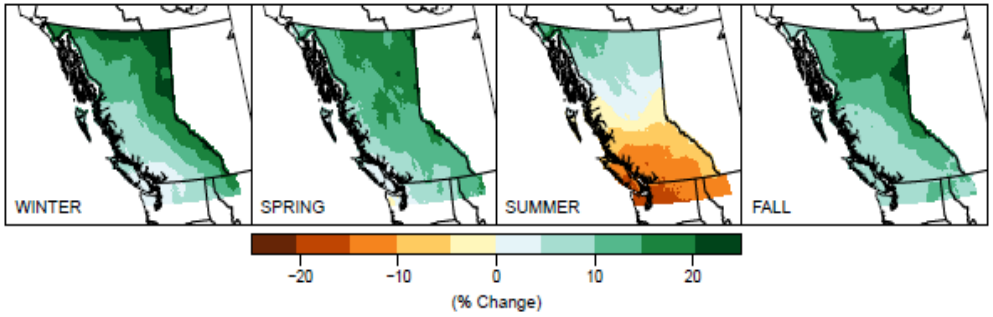

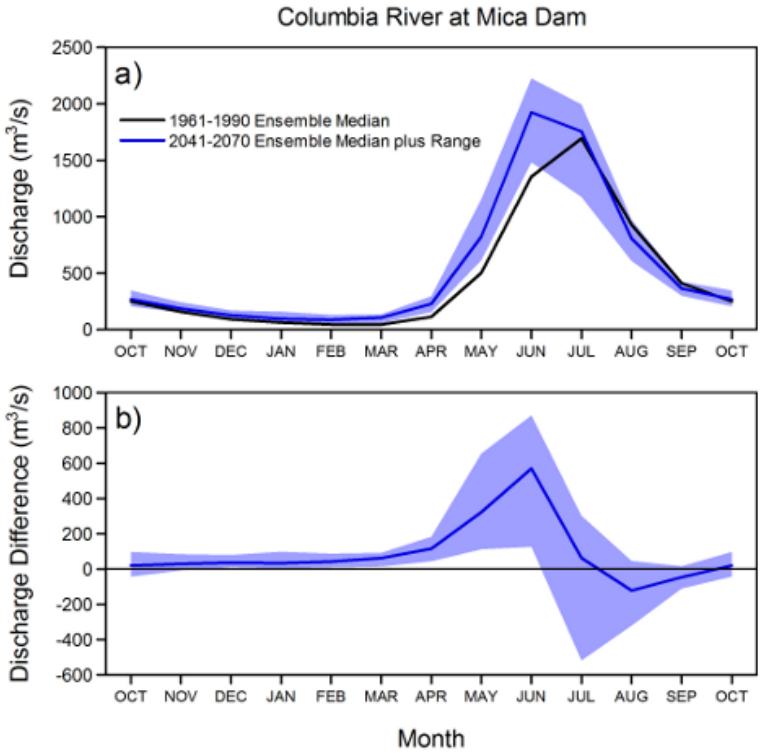

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