

GOING GOING GOING GONE - CLIMATE CHANGE AND THE COLUMBIA ICEFIELD

OBJECTIVES

Students will:

- understand seasonal variation in glacier mass
- understand the effect of climate change on glacier mass
- calculate loss of glacier ice on the Athabasca Glacier over the next 10 years.
- determine the loss of ice volume in Rocky Mountain Glaciers

MATERIALS

Projector and Speakers
Internet Connection
Student Worksheets
Video Links

OVERVIEW

Part A: What is climate change?

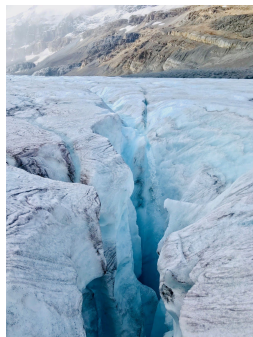
Part B: Climate Change and Alberta

Part C: Climate Change and our glaciers

Part D: It's all in the math a thought experiment

Part E: Ice Volume

Part F: Extension



TIME REQUIRED
60 min



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Alberta Curriculum Connections:

Grade 4 Social Studies: Alberta: A Sense of the Land
Grade 5 Social Studies: Physical Geography of Canada
Grade 5 Science: Wetland Ecosystems
Grade 7 Science: Interactions and Ecosystems
Grade 8 Science: Freshwater and Saltwater Systems
Science 10: Energy Flow in Global Systems
Science 20: Change in Living Systems
Biology 20: Energy and Matter Exchange in the Biosphere
Science 14: Investigating matter and Energy in the Environment
CTS: Environmental Stewardship 1010
CTS: Primary Resources 1010

“Probably 80 per cent of the mountain glaciers in Alberta and British Columbia will disappear in the next 50 years” – David Hik, Professor of Terrestrial Ecology at Simon Fraser University.

Procedure:

Part A What is climate Change? [Watch the video](#) GHG and biotic carbon storage.

Part B Climate Change in Alberta: [Watch this video](#):

Define Mitigation and Adaptation:

Part C Go to <https://guardiansoftheice.com/the-columbia-icefield/> and watch the simulation of 80 year projection of the Columbia Ice Field Retreat.

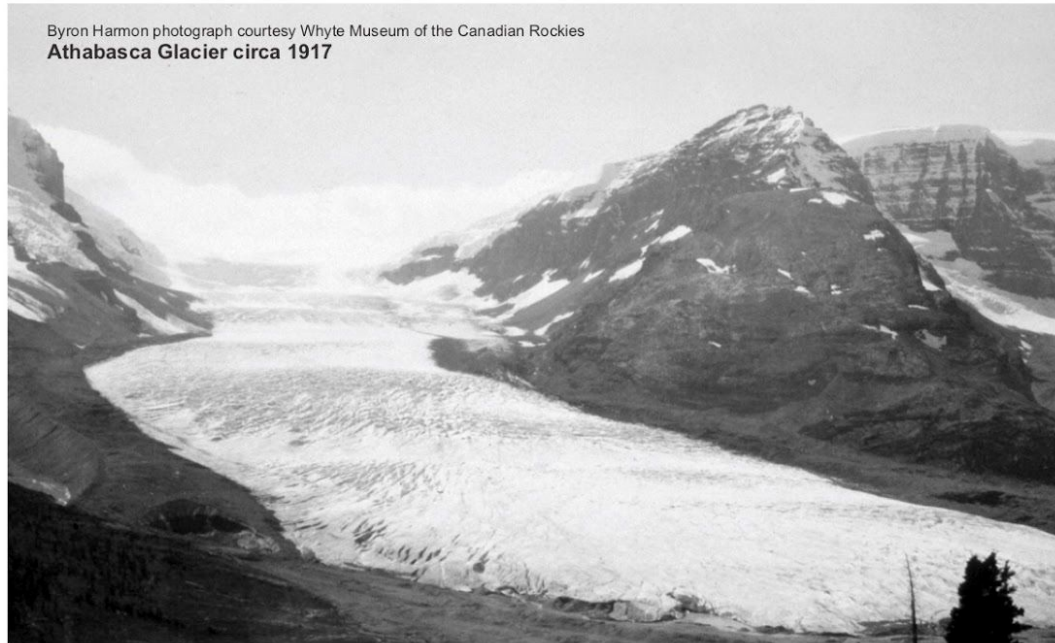
5. Summarize what you see:

Look at Figure 1: Athabasca Glacier Comparison

6. What is happening to the Athabasca Glacier?

Click here to see more images and learn more about the Athabasca Glacier:
<http://cgip.wikifoundry.com/page/Athabasca+Glacier>

Figure 1: Athabasca Glacier Comparison





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Part D: Math experiment

Each winter, snow and ice form on top of the glaciers. Each spring/summer/fall, ablation takes place. Ablation is the sum of all melting, evaporation and sublimation off the surface of the ice.

7. If the glacier gains 1 m of snow/ice every year, but loses on average 6.5 m of snow each year by ablation, what is the net gain/loss at the end of 1 year? 5.5 m

8. Complete the following table:

Year	Starting Ice Depth	Gain/year	Loss/Year	Total gain/loss	Total Depth of Ice	Net Ice gain/Loss
1	80m	1m	6.5 m	5.5m	74.5m	-5.5m
2	74.5m	1m	6.5m	5.5m	69m	-11m
3	69m	1m	6.5m	5.5m	63.5m	-16.5m
4	63.5m	1m	6.5m	5.5m	58m	-22m
5	58m	1m	6.5m	5.5m	52.5m	-27.5m

9. Where is the loss of ice going? meltwater into the river

10. How has the depth of ice changed?

11. Can you come up with a formula to determine how much ice will be lost in 10 years? 25 m?

$$x - t(5.5) = y$$

x=starting depth

Y=final depth

t = years

12. [Watch this video](#) of Peter Lemieux talking about ablation on the icefield.

13. Video: [How much glacier ice are we losing?](#)

Part E: Water Volume Researchers have studied glaciers since 1985 and concluded that we are losing an area that was previously covered by glaciers.

14. In the Columbia Icefield area, how many square km of ice have been lost? 57.4 square km

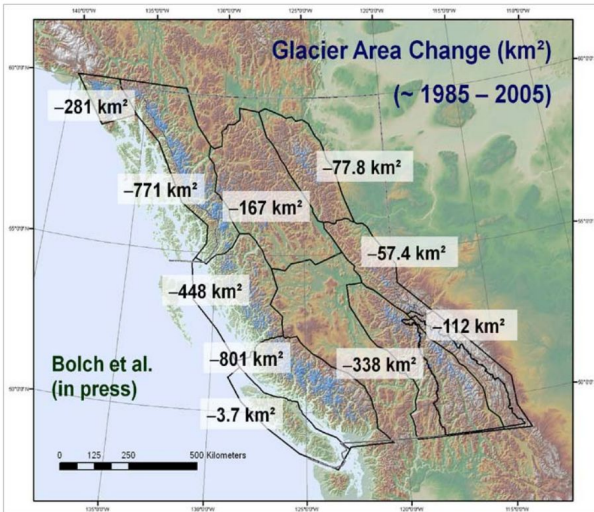


Figure 11. Changes in glacier area in major glacioclimatic regions of B.C. and Alberta from 1985 to 2005.

From: Alberta Glacier Inventory and Ice Volume Estimation, Marshall and White 2010

In Alberta we have lost approximately 25% of the area previously covered by glaciers.

15. In Alberta we have lost approximately 25% of the area previously covered by glaciers. In the Columbia Icefield area, what percentage of Ice has been lost? 16.4%

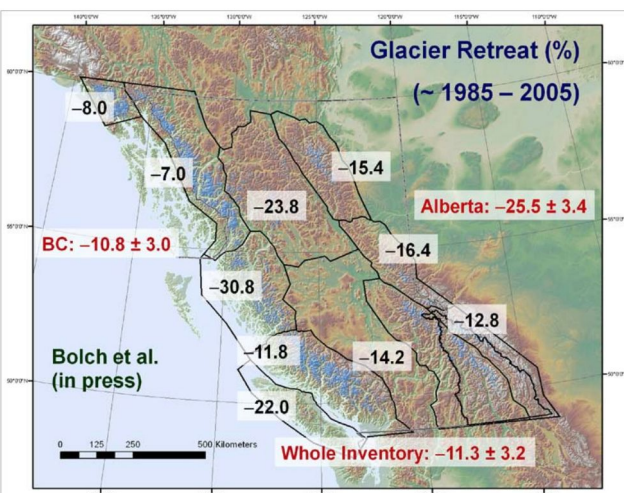


Figure 12. Changes in percentage glaciated area in B.C. and Alberta from 1985 to 2005.

From: Alberta Glacier Inventory and Ice Volume Estimation, Marshall and White 2010

Scientists have also calculated the volume of water this loss represents. Here are estimates of runoff under the different scenarios:

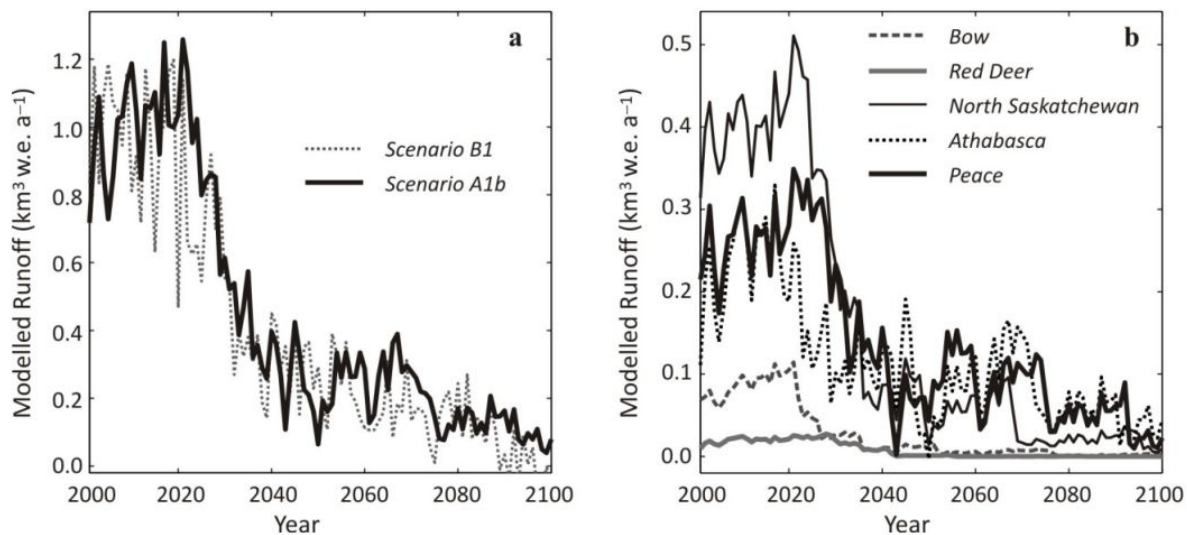


Figure 23. Modelled 21st century glacier runoff associated with the ice volume demise in Figure 22. (a) All of the eastern slopes of the Rocky Mountains and (b) for individual basins (A1b scenario).

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16. In both scenarios, what is happening to the amount of runoff into Alberta's major rivers?

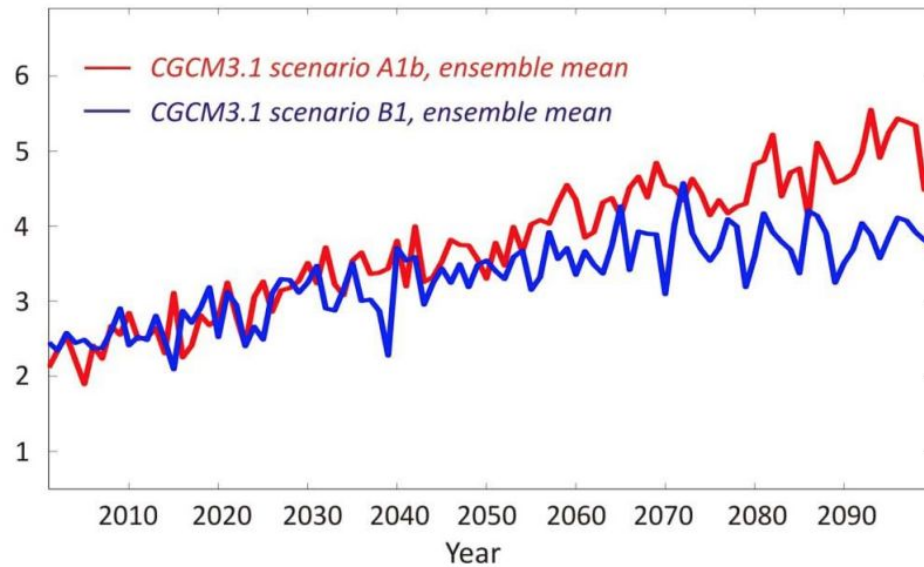
17. What implications does this have on your life?

What about the future? Scientists use climate models to estimate the impact various climate change scenarios may have on the glaciers.

Find Peyto Glacier on Figure 1. Peyto glacier has been studied and various climate models have been applied to predict what will happen to the glacier under different climate change scenarios.

Scenario A1b and B1 represent two middle of the road, realistic scenarios according to the IPCC (international Panel on Climate Change). Look at the following graph.

18. What do the climate models predict will happen to the surface temperatures on Peyto Glacier? increase in surface temperature resulting in greater melting.



From: Alberta Glacier Inventory and Ice Volume Estimation, Marshall and White 2010

19. What effect do you think this will have on the mass balance of Peyto glaciers? decline in mass balance

This is what they predict:

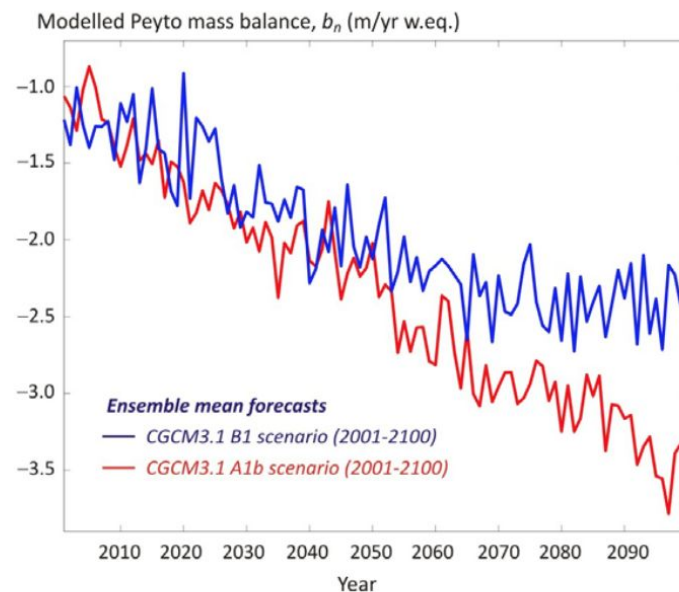


Figure 21. Future glacier mass balance forecasts resulting from the synoptic flow conditions in the ensemble mean CGCM climate change scenarios. Values are referenced to the 2005 glacier surface.



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From: Alberta Glacier Inventory and Ice Volume Estimation, Marshall and White 2010

20. What is happening to the amount of ice on Peyto glacier in the future? declining

21. What does this mean for the volume of drinking water available to communities downstream of these glaciers? there will be less water available to use to drink!

[Watch this video](#) of Dr. Ali Criscitiello talking about why we should protect glaciers

Part D: Extension - Forest Fires and Glaciers

Research what the past few summers have been like for forest fires in Alberta. How many ha of forest have burned? What were the consequences of those fires, both environmentally and for our health? [Watch this video](#) about Dr. Criscitiello talking about the effect of forest fires on the glaciers.

References:

"Alberta WaterPortal." Alberta WaterPortal, albertawater.com/glaciers-overview.

GLIMS Viewer, www.glims.org/maps/glims.

Canadian Glacier Inventory Project, cgip.wikifoundry.com/page/1. Rocky Mountain Introduction.

<http://cgip.wikifoundry.com/page/1.+Rocky+Mountain+Introduction>

"Dynamics of Alberta's Water Supply." Glacier Inventory and Ice Volume Estimation, albertawater.com/dynamics-of-alberta-s-water-supply/44-learn/source/glacier-inventory-and-ice-volume-estimation

<https://albertawater.com/docs-work/projects-and-research/dynamics-of-albertas-water-supply/18-alberta-glacier-inventory-and-ice-volume-estimation-marshall-et-al/file>

Ommanney, C.S.L.. (2002). Glaciers of the Canadian Rockies. US Geological Survey Professional Paper. J199-J289. <https://pubs.usgs.gov/pp/p1386j/canadianrockies/canrock-lores.pdf>



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Student Worksheet

Name: _____

Part A What is climate Change?

[Watch the video](#) GHG and biotic carbon storage.

1. Explain the natural Greenhouse Effect:
2. How is Climate Change different from the natural Greenhouse Effect?

Part B Climate Change in Alberta: [Watch this video](#):

3. Define Mitigation:
4. Define Adaptation:



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Part C Go to <https://guardiansoftheice.com/the-columbia-icefield/> and watch the simulation of 80 year projection of the Columbia Ice Field Retreat.

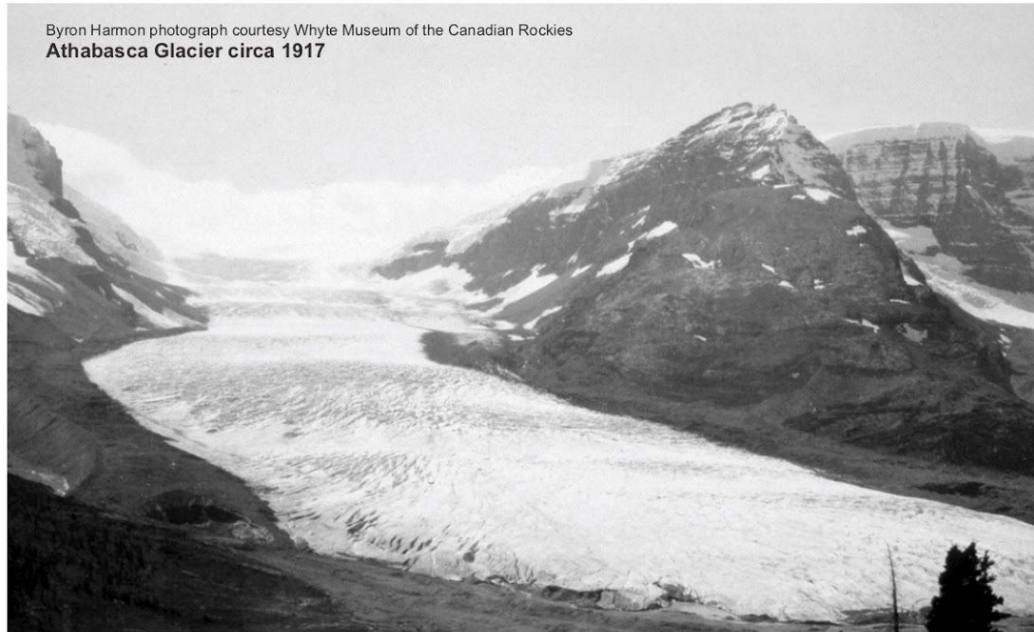
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4						
5						

9. Where is the water from the lost ice going?

10. How has the depth of ice changed?

11. Can you come up with a formula to determine how much ice will be lost in 10 years? 25 m?

x=starting depth
Y=final depth
t = years

12. [Watch this video](#) of Peter Lemieux talking about ablation on the icefield.
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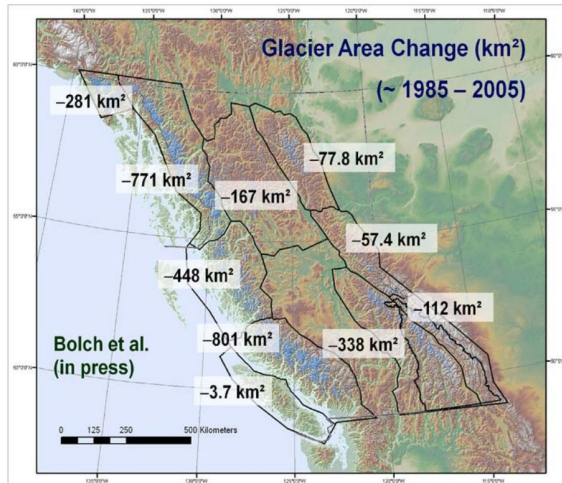


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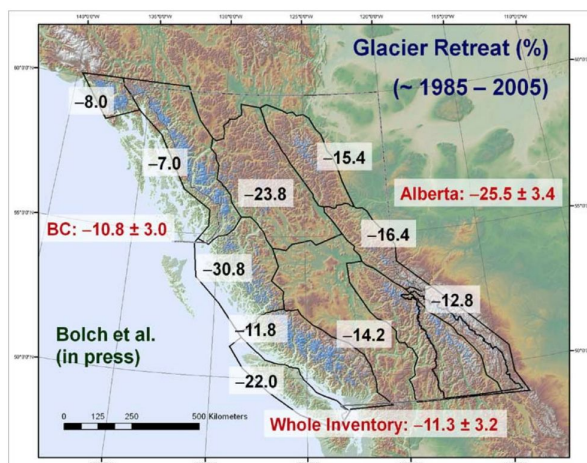


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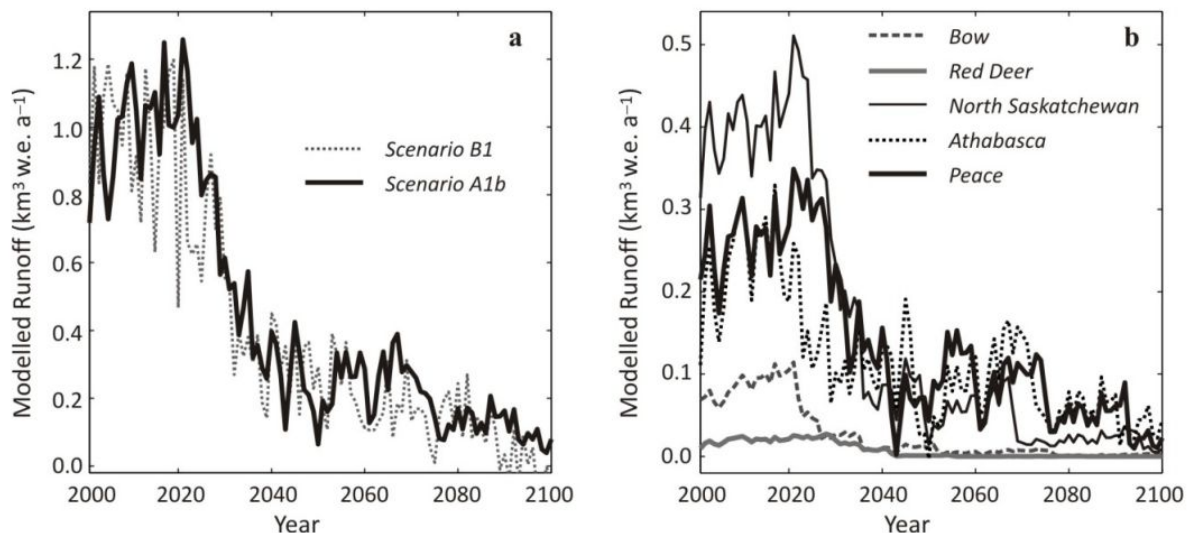


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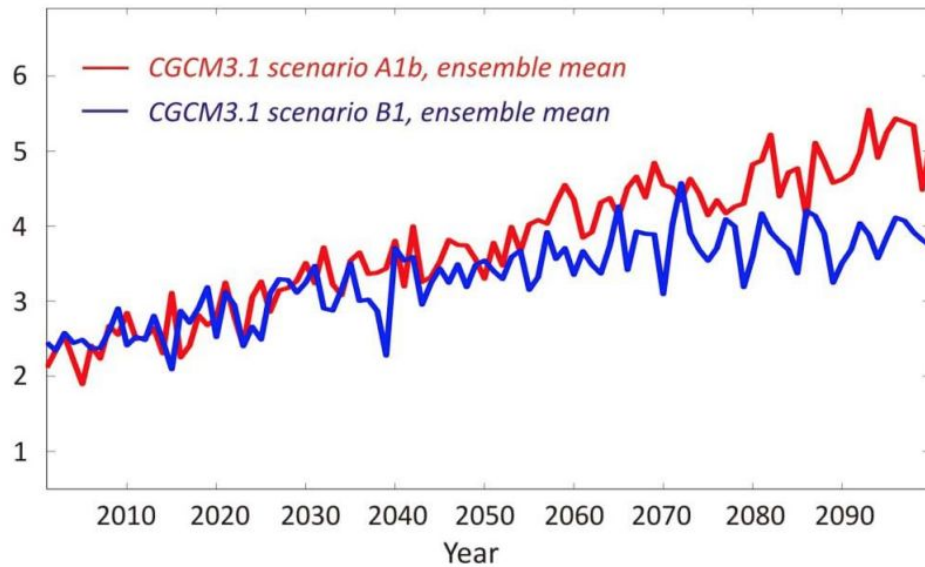
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Surface Temperatures on the Peyto Glacier

From: Alberta Glacier Inventory and Ice Volume Estimation, Marshall and White 2010

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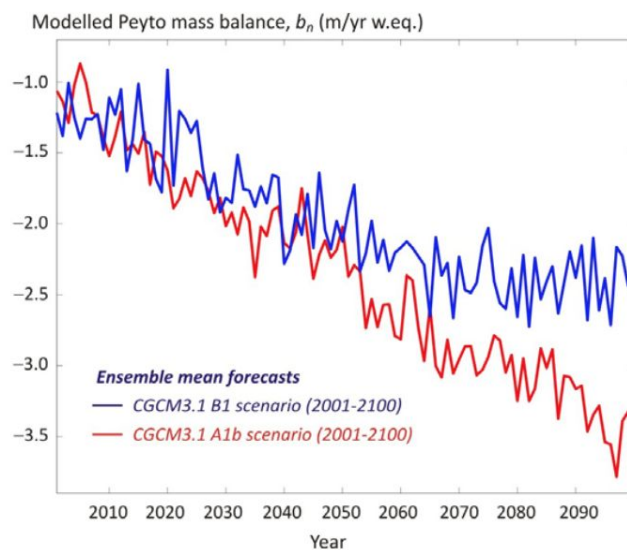


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