Natural Resources Canada | Ressources naturelles Canada

Can Canada's Forests Adapt to a Changing Climate, and How?

David Price

Canadian Forest Service, Edmonton

Up North on Climate Conference
Thunder Bay, 24 April 2018

Canada

Topic Chooser

- Is global climate changing?
- Are humans causing climate change?
- How will Canada (Ontario) be affected?
- What are effects on forests?
- How can forest communities adapt?

Topic Chooser

Is global climate changing?

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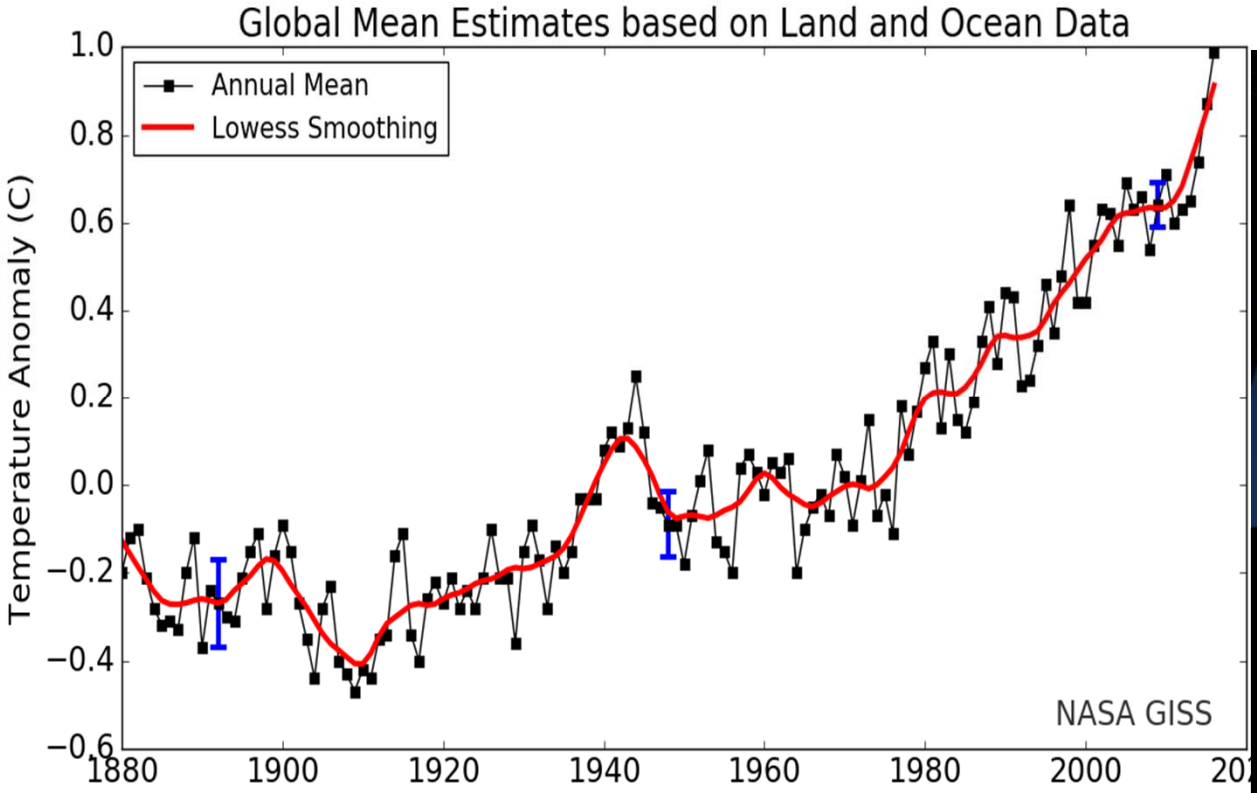
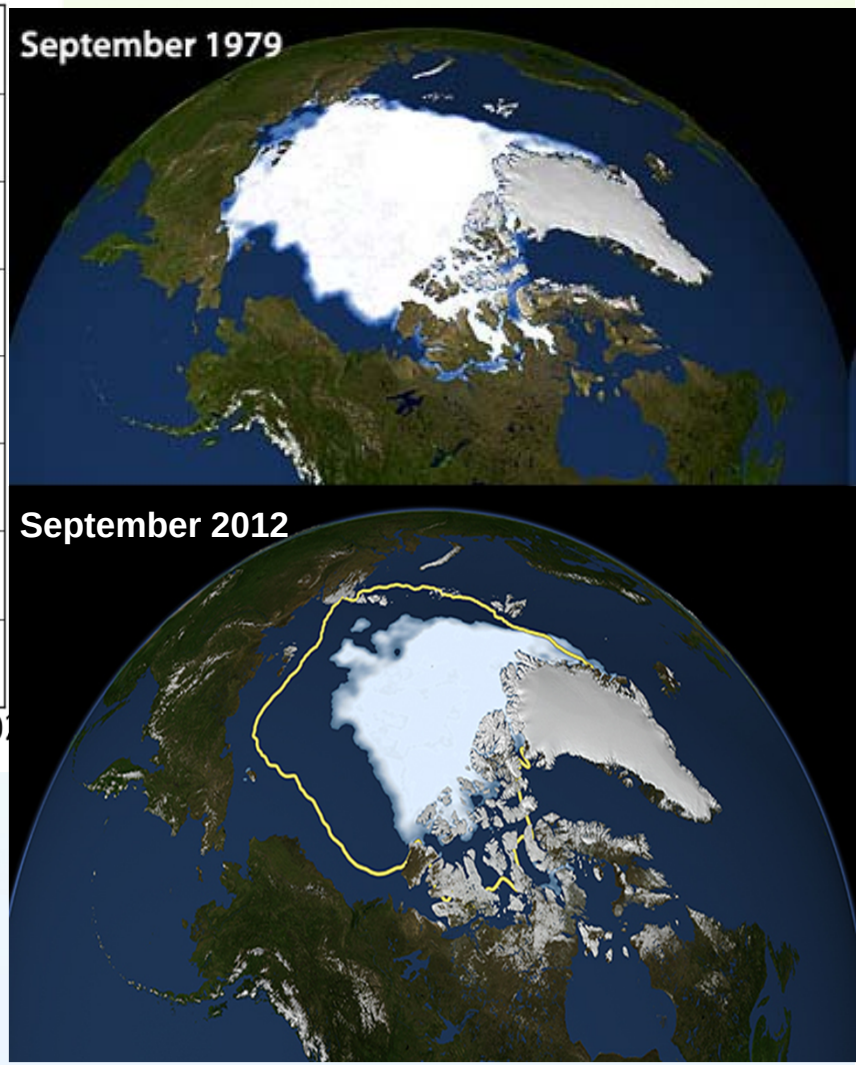
(Return to Topic Chooser Home)

Global temperature record





http://www.nasa.gov/topics/earth/features/2012-seaicemin.html

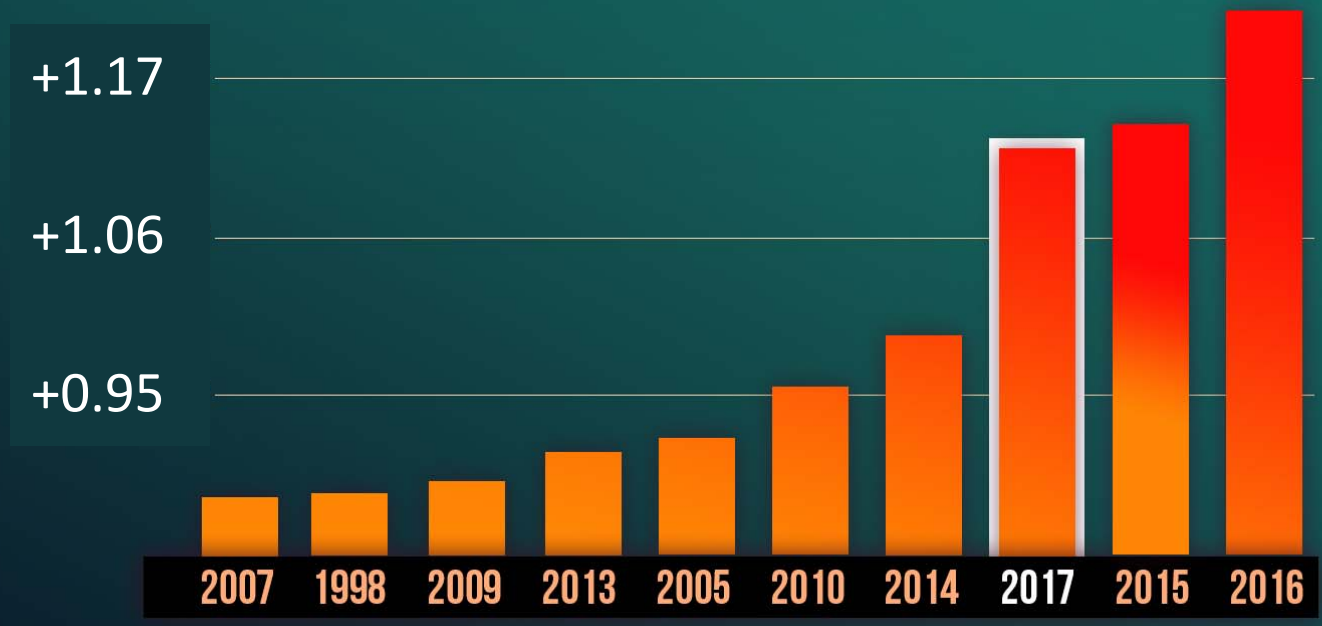
From NASA web site at: http://data.giss.nasa.gov/gistemp/graphs/

- **Warming of more than 1ºC over the past century**
- **Year 2016 was the warmest on record**

see: http://www.ncdc.noaa.gov/sotc/global/201612

10 HOTTEST YEARS ON RECORD (GLOBAL MEAN)

Temperature Anomaly relative to 1881—1910 (°C)



http://www.climatecentral.org/gallery/graphics/the-10-hottest-global-years-on-record

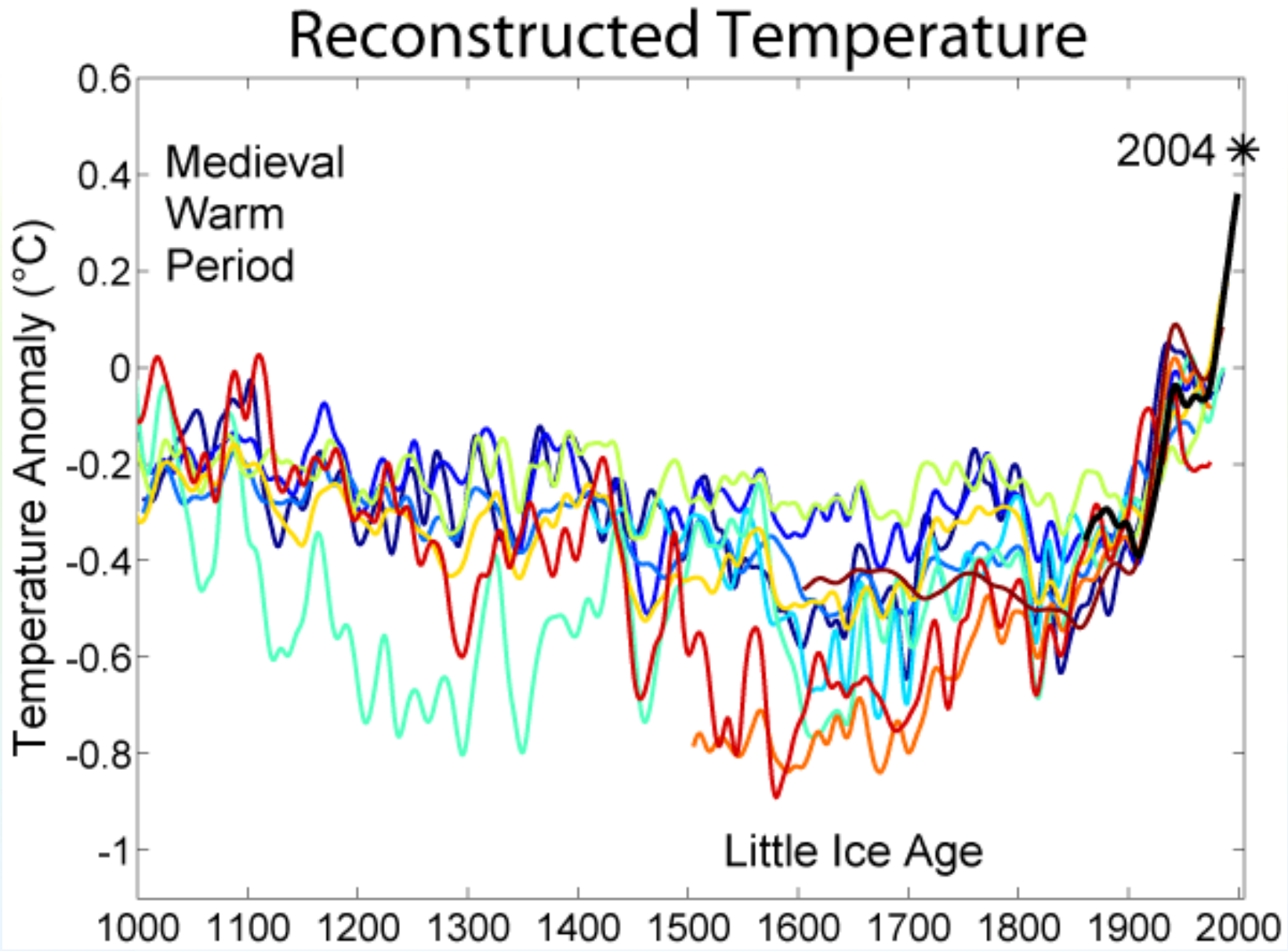


Image from: Global Warming Art: http://www.globalwarmingart.com/wiki/Image:1000_Year_Temperature_Comparison_png

Questions?

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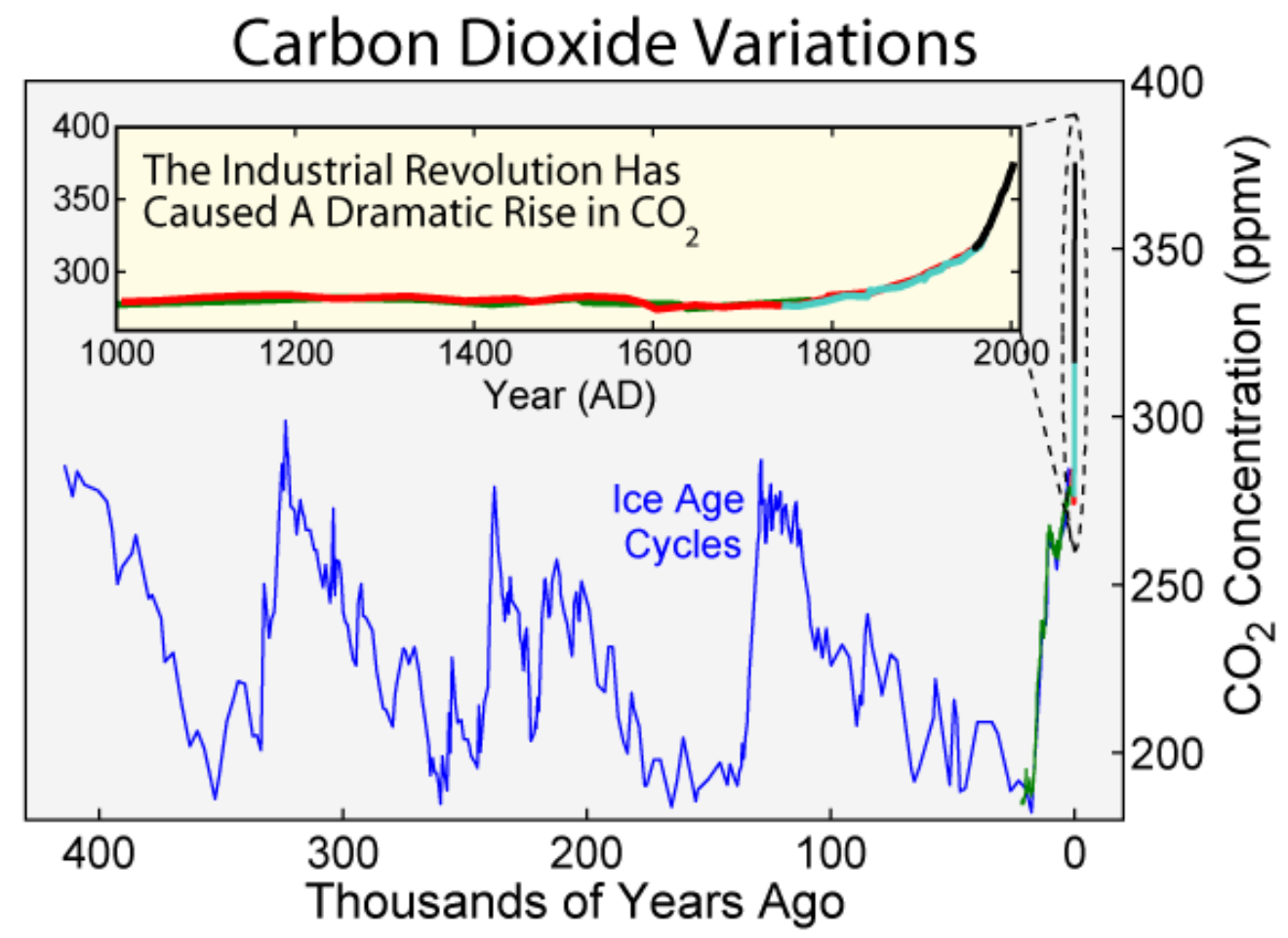
Global temperature record correlates with CO_2 Emissions



CO_2 Concentration Change

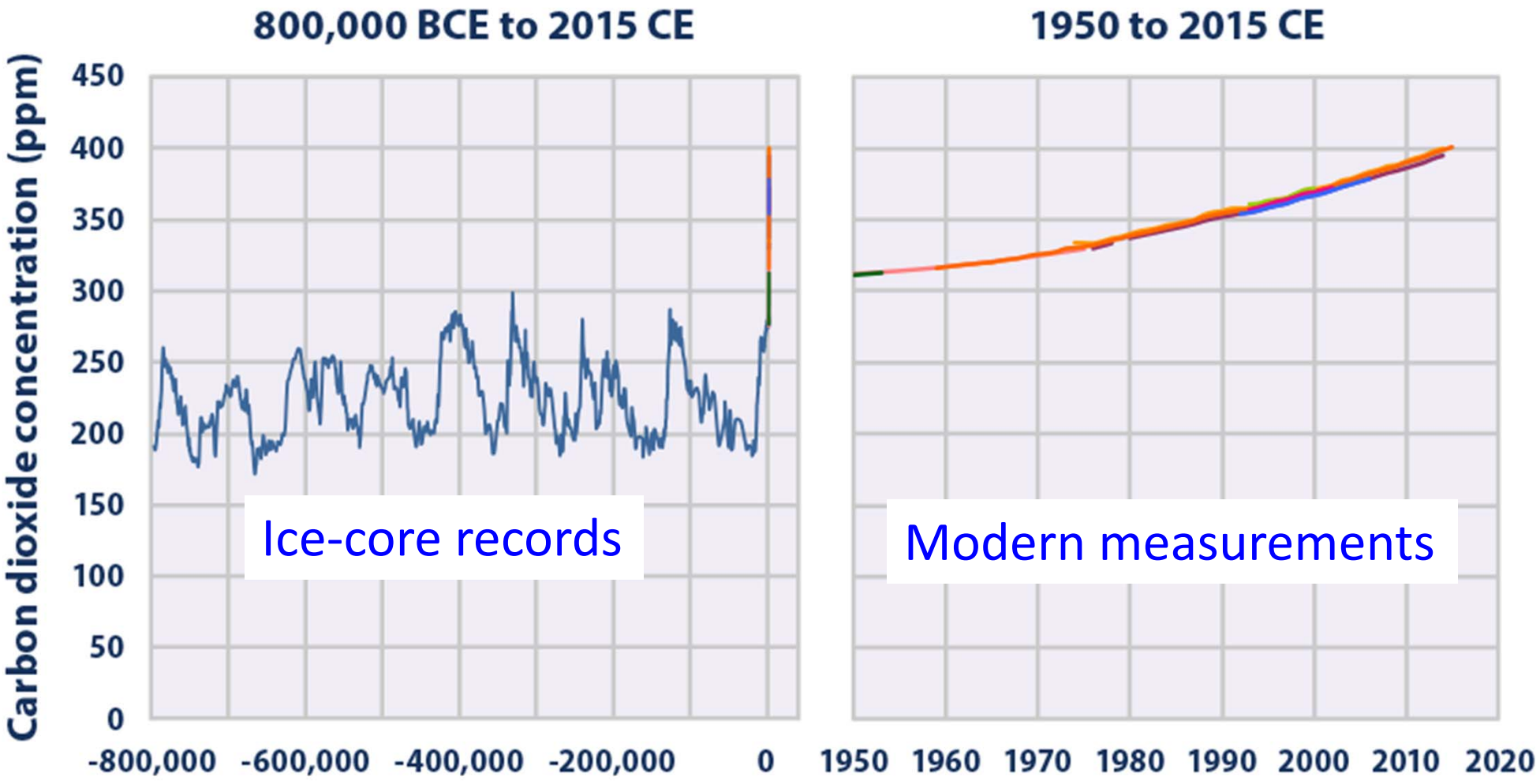
Pre-industrial (1850):
~270 ppmv

Present-day (2018):
~409 ppmv

(409 – 270)/270 = **0.515**

~50% increase since 1850!

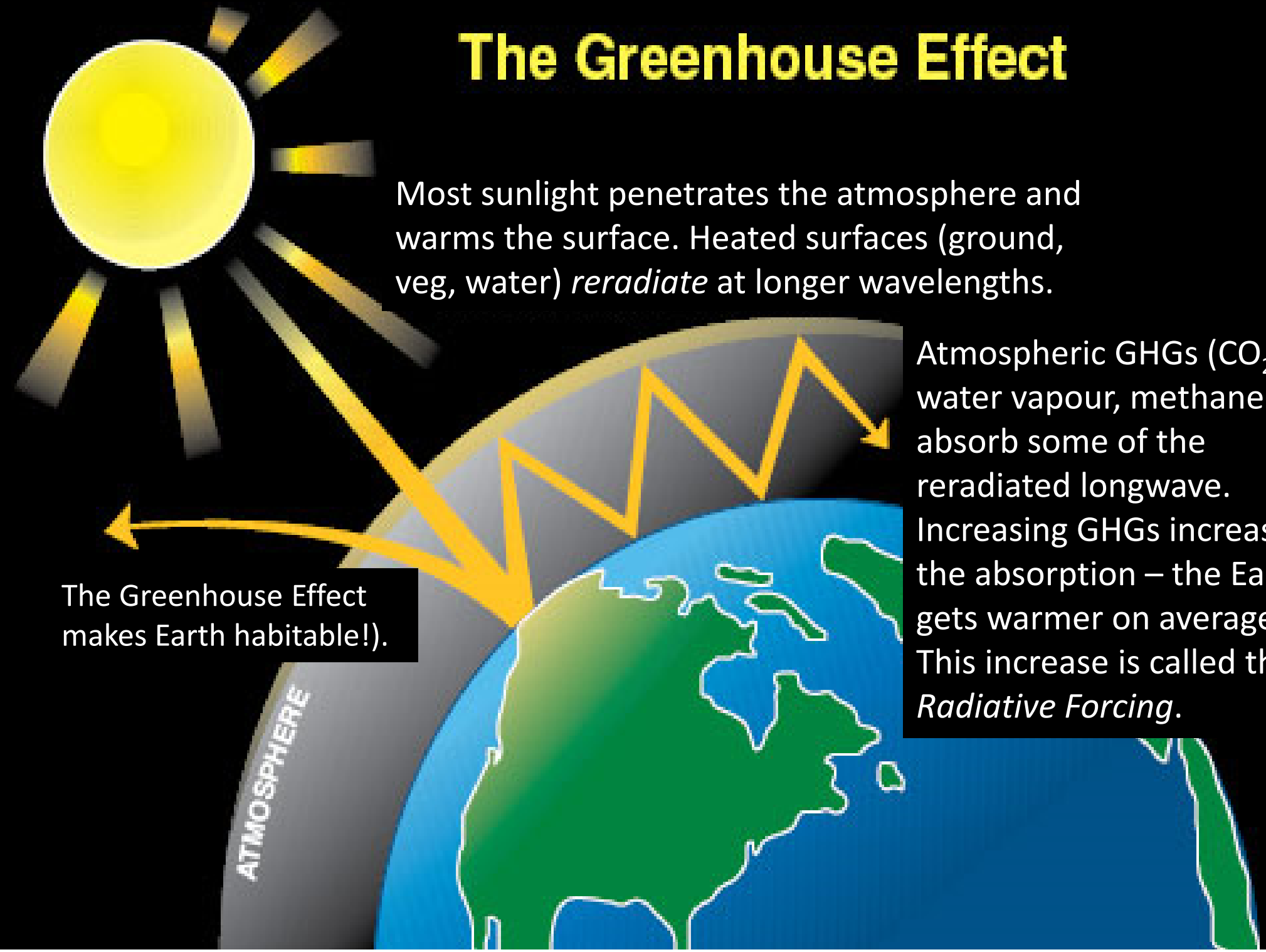
Global temperature record correlates with average CO_2 Concentration Increase



Data source: EPA (2016): Compilation of 10 underlying datasets.

The Greenhouse Effect

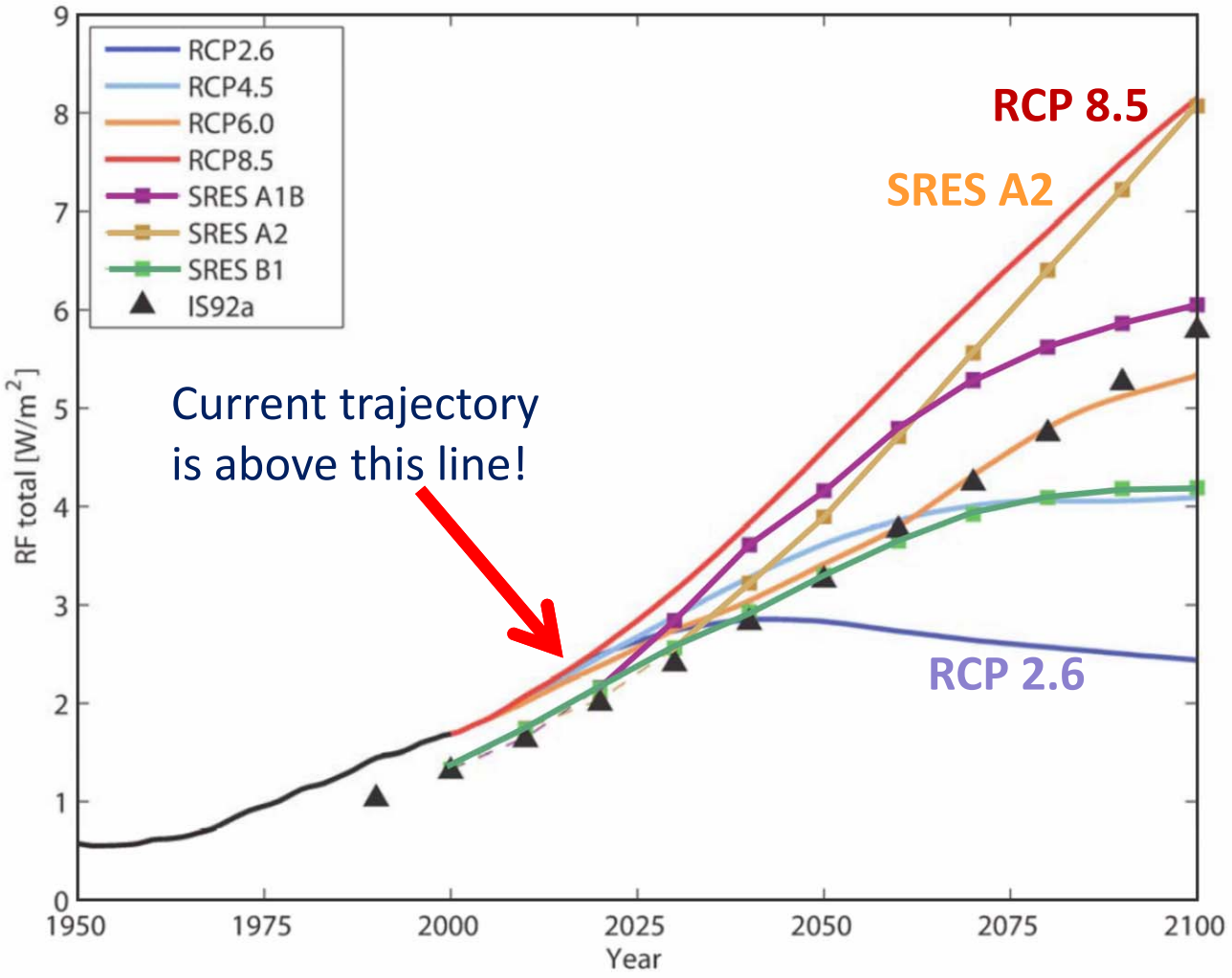
Most sunlight penetrates the atmosphere and warms the surface. Heated surfaces (ground, veg, water) *reradiate* at longer wavelengths.



Atmospheric GHGs (CO_2, water vapour, methane) absorb some of the reradiated longwave. Increasing GHGs increases the absorption – the Earth gets warmer on average. This increase is called the *Radiative Forcing*.

The Greenhouse Effect makes Earth habitable!).

IPCC radiative forcing (RF) scenarios



For the IPCC's Fifth Assessment Report (AR5) a new set of "radiative forcing" scenarios were developed. These "RCP" scenarios supersede the "SRES" scenarios used in the Third and Fourth Assessments. This Figure 1.15 appears in the AR5 WG1 report to compare the SRES and RCP scenarios.

© http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_All.pdf

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Some effects of climate warming

(already seen to be happening)

Thawing of permafrost

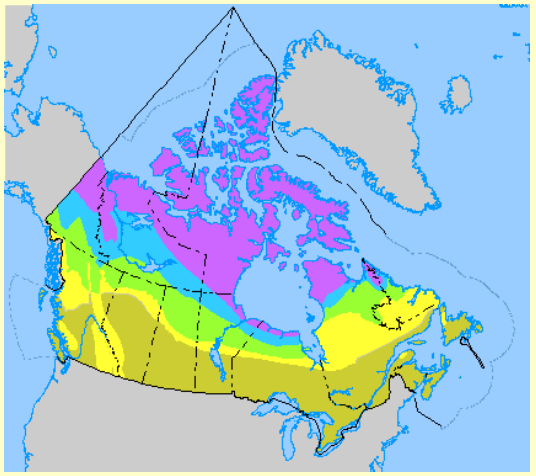
- mainly northern boreal forest & Arctic
- profound changes to ecosystems
- poses problems for existing infrastructure

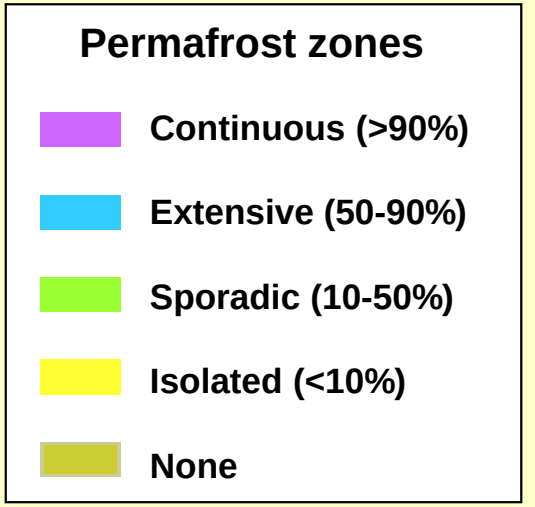
Glacier melting

- implications for water supply to the prairies

Shorter winter period of frozen ground

- poses major challenges for winter access to forested land base & remote communities



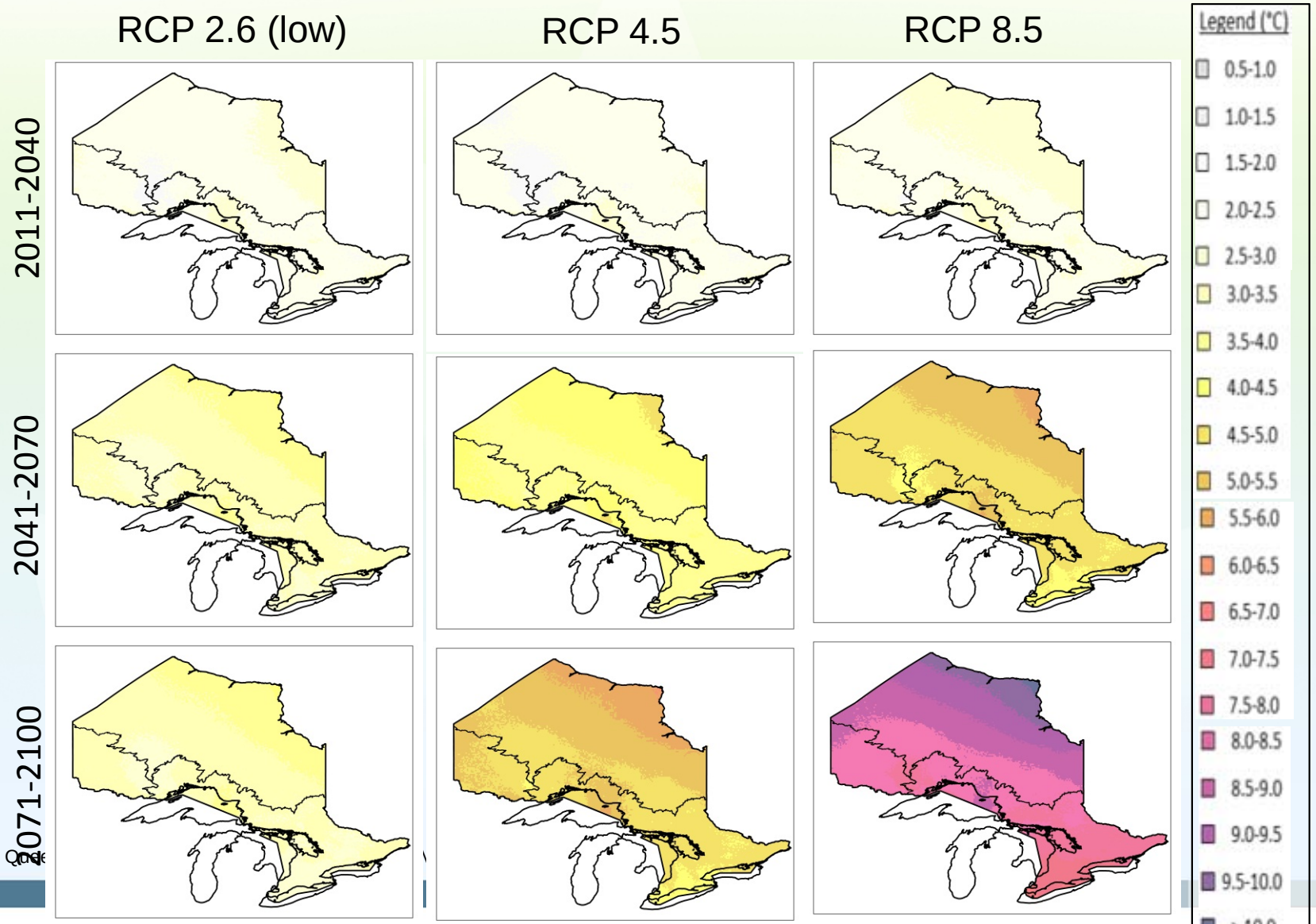


From National Atlas of Canada
http://atlas.gc.ca/site/english/maps/environment/land/permafrost

Slide from: Ted Hogg, CFS-NoFC

Climate Change in Ontario

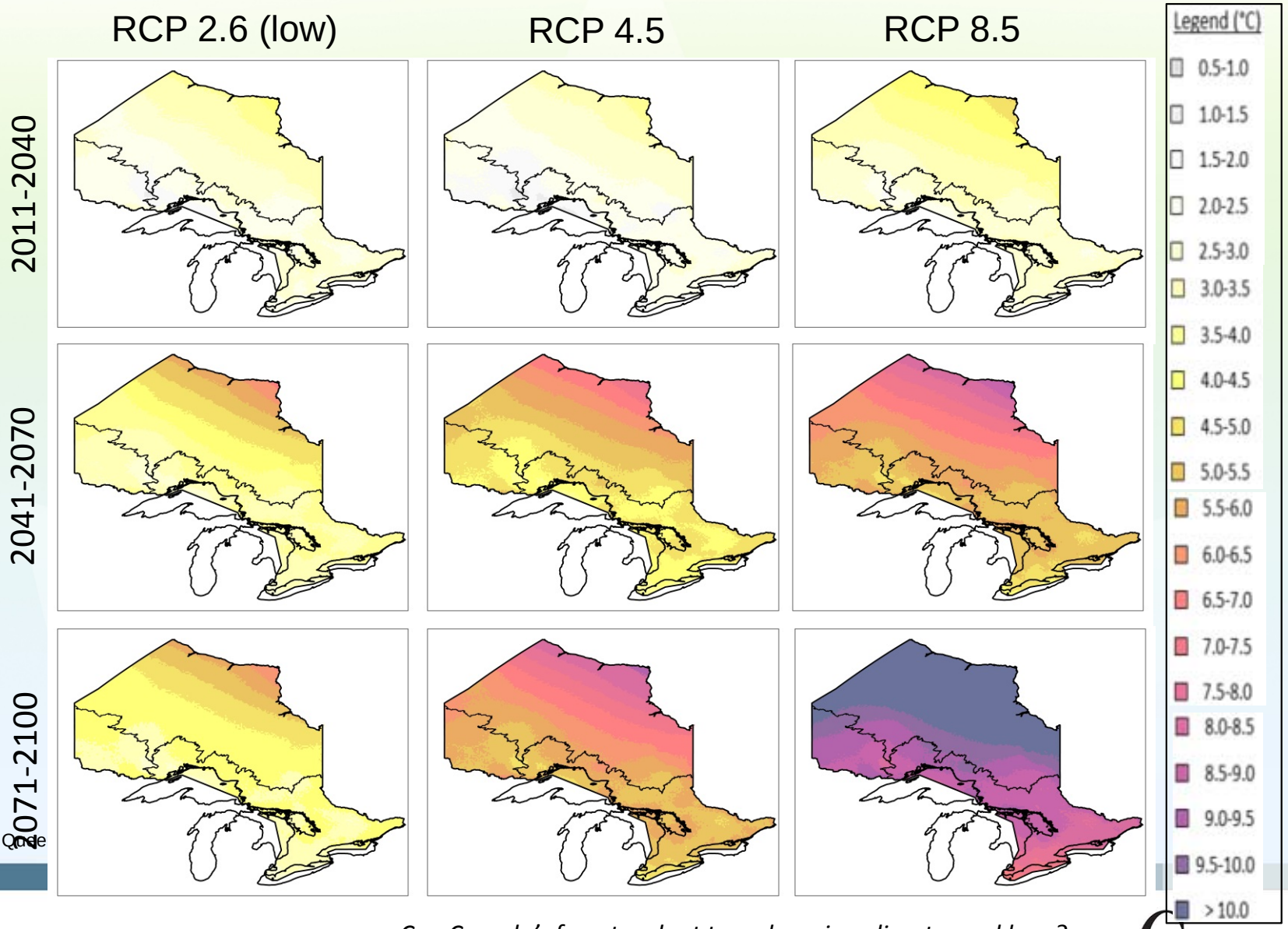
(Projected Change in Mean Annual Temperature; Composite GCM)



Can Canada's forests adapt to a changing climate, and how?

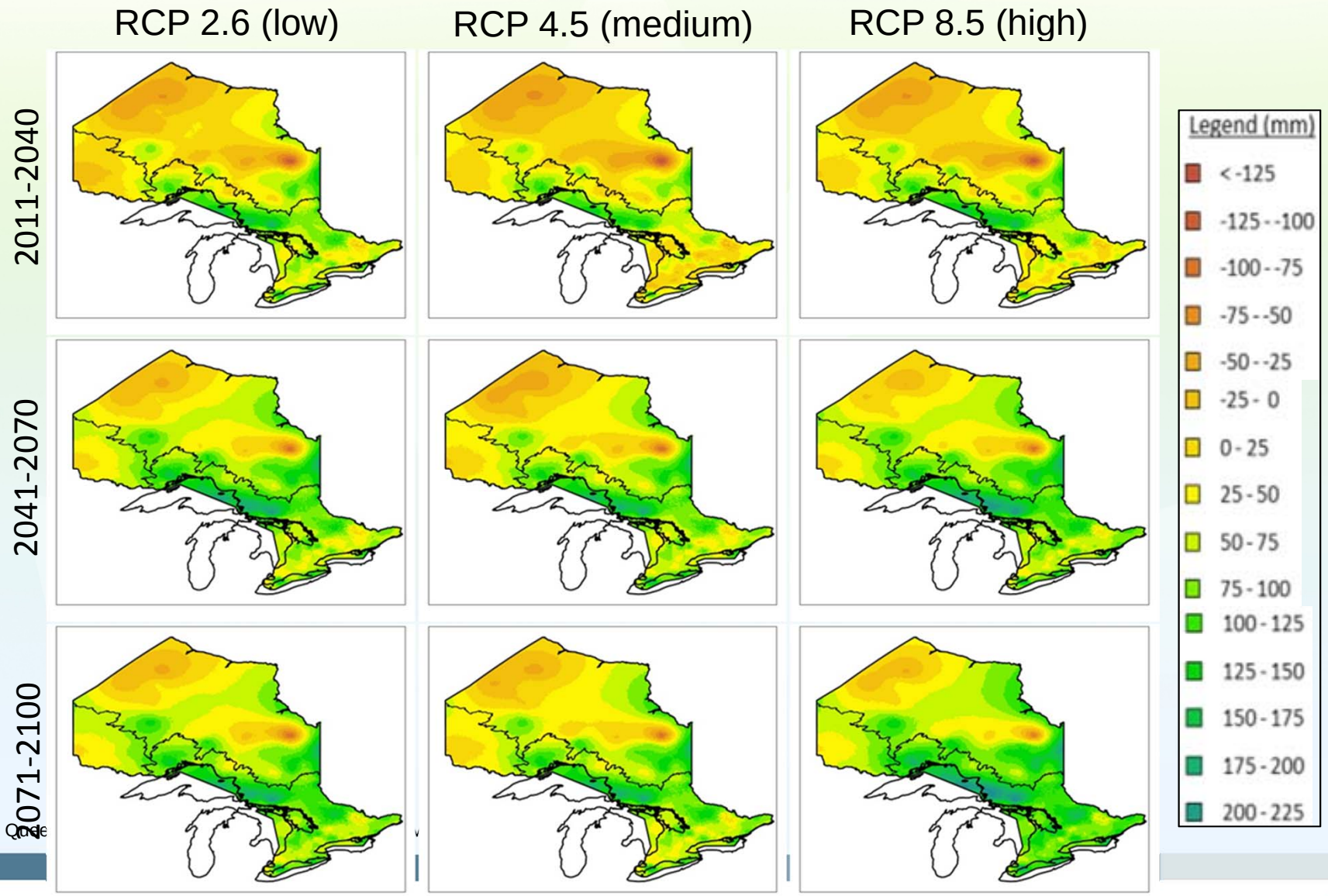
Climate Change in Ontario

(Projected Change in Winter Temperature; Composite GCM)

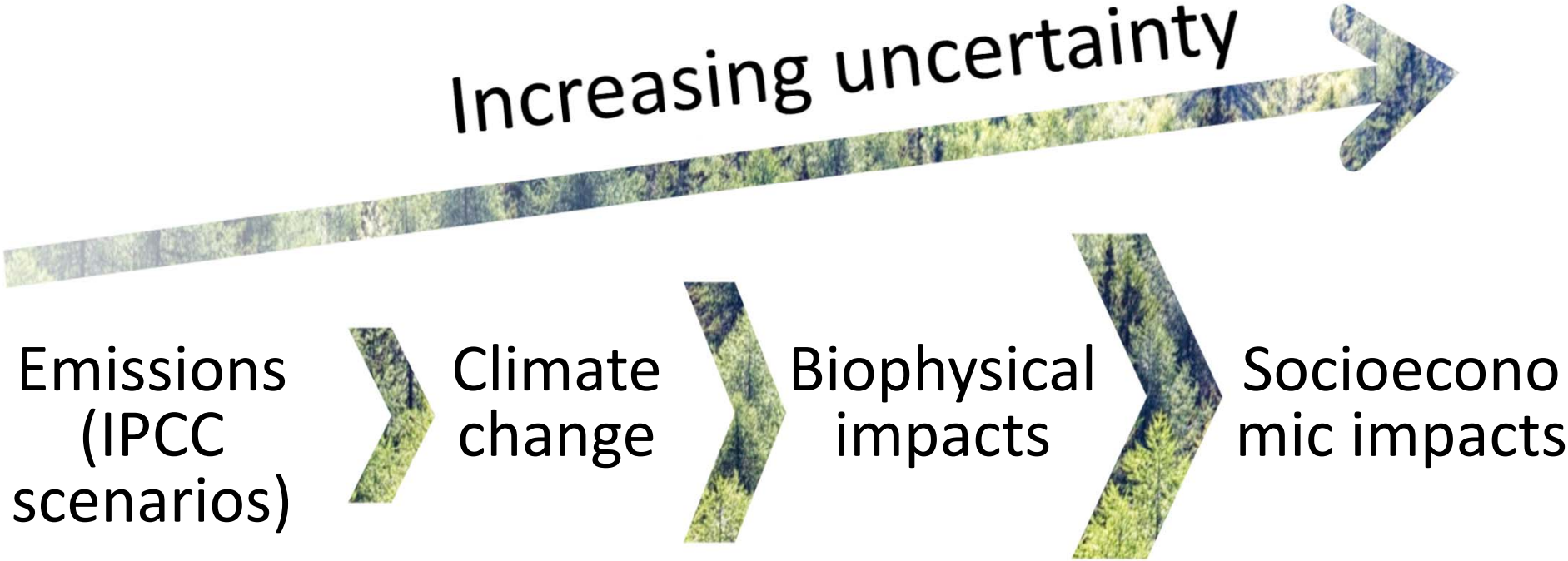


Climate Change in Ontario

(Projected Change in Annual Precipitation; Composite GCM)



Why Is Future Climate Uncertain?



The climate models make projections, not predictions

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Forest dieback in Alberta and Saskatchewan

Major cause: Prolonged drought (1998 and 2001-2003)

- Severe aspen mortality in the parkland (resembling fire in some areas!)
- Other species also affected (white spruce, jack pine, urban trees)

Drought-damaged aspen foliage

Drought-induced mortality of white spruce, Battle River valley near Alliance, Alberta (Photo by Ted Hogg, July 2004)

Severe aspen mortality following drought near North Battleford, Saskatchewan (Photo by M. Michaelian, August 2004)

Fire and climate effects on conifers

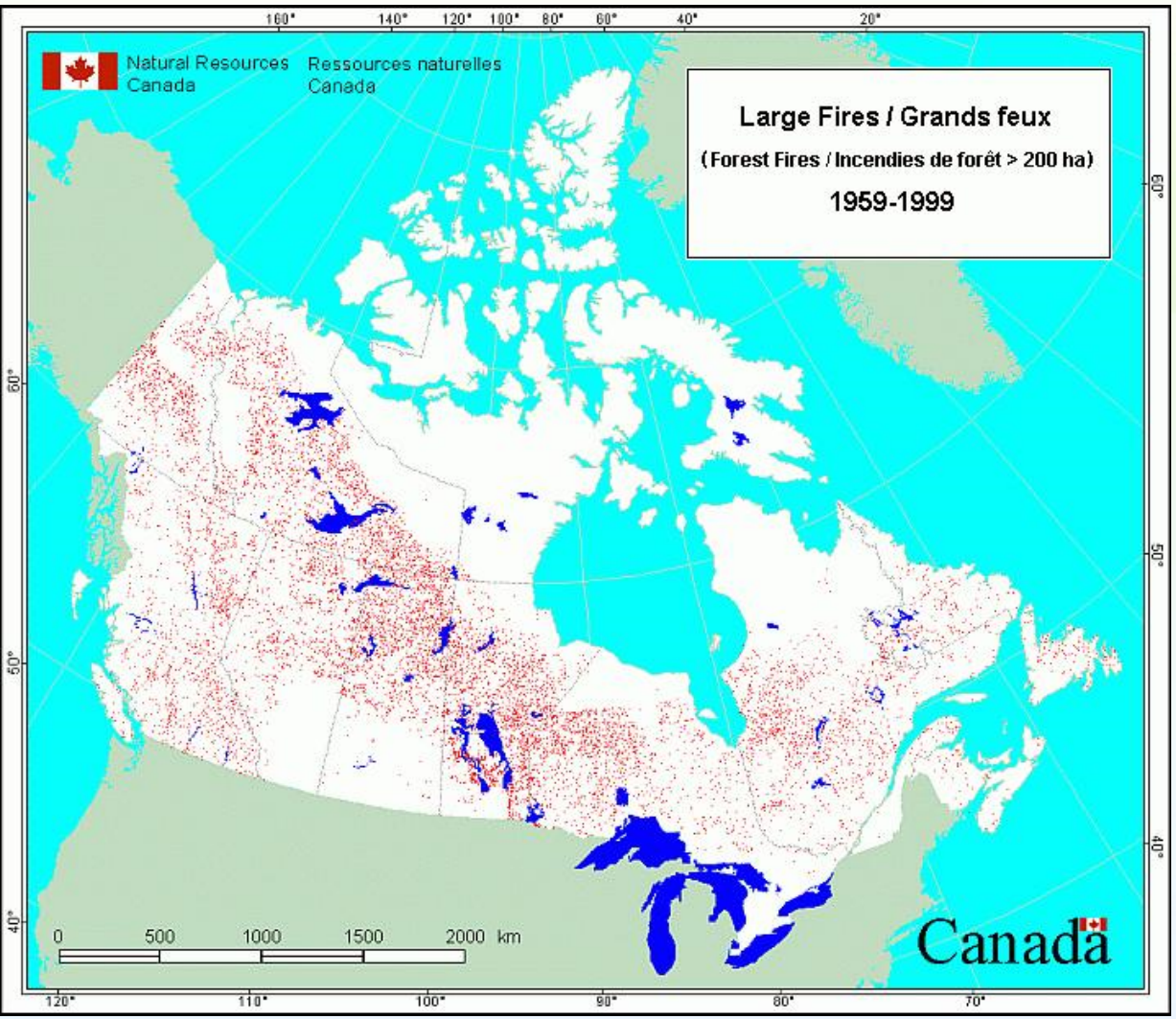
- Expected increases in fire occurrence (annual area burned)
- Will conifers be able to regenerate naturally under a drier future climate?

Conversion of jack pine forest to grassland following fire near Prince Albert, SK (Hyde & Smith 1996, SERM report)

Conversion of mature white spruce forest to prairie-like vegetation 45 years after the Takhini burn near Whitehorse, YT

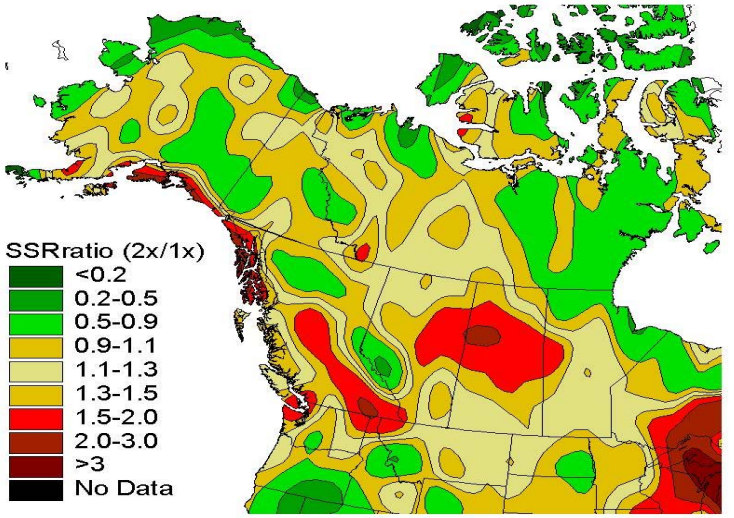
Slide from: Ted Hogg, CFS-NoFC

Future climate effects on fire occurrence



From Amiro et al., 2001
Canadian Forest Service

Predicted changes in fire under doubling of CO_2

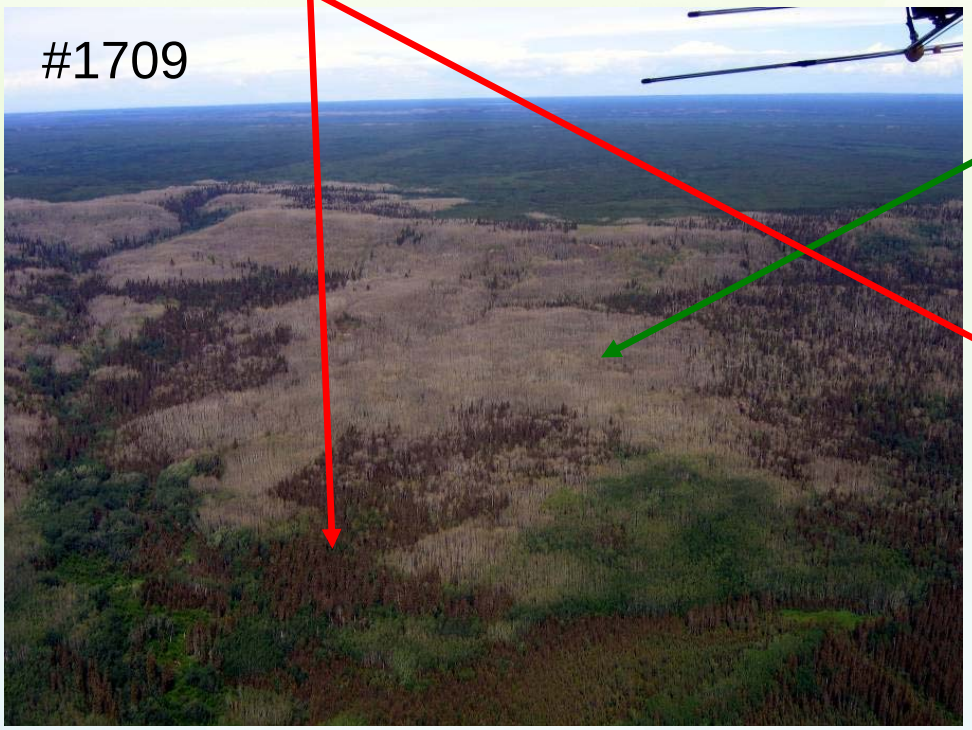


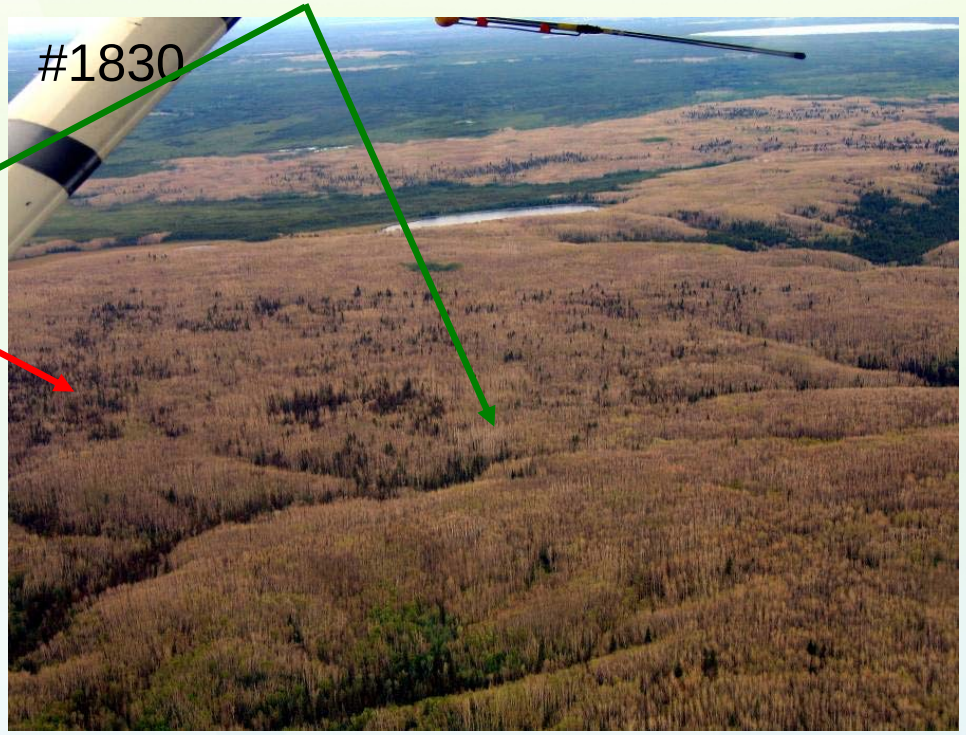
From Flannigan et al.,
Canadian Forest Service

East of Fort McMurray, AB. 26 June 2008

Spruce Budworm (SBW)

Forest Tent Caterpillar (FTC)



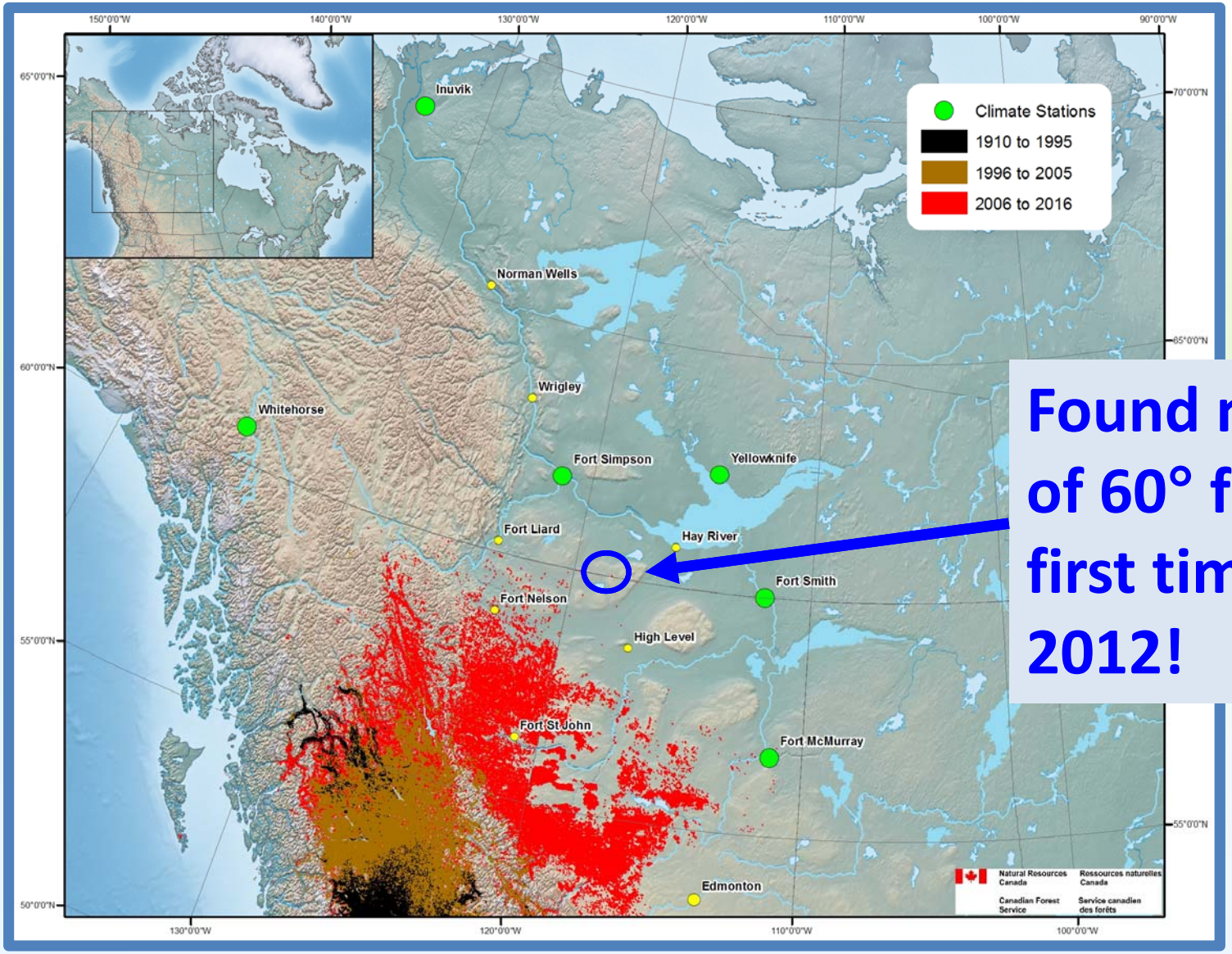


From overview flight for remote sensing research by Ron Hall et al., CFS & CCRS

(photos by Eric Arsenault & Mike Michaelian, CFS Northern Forestry Centre)

Mountain Pine Beetle!

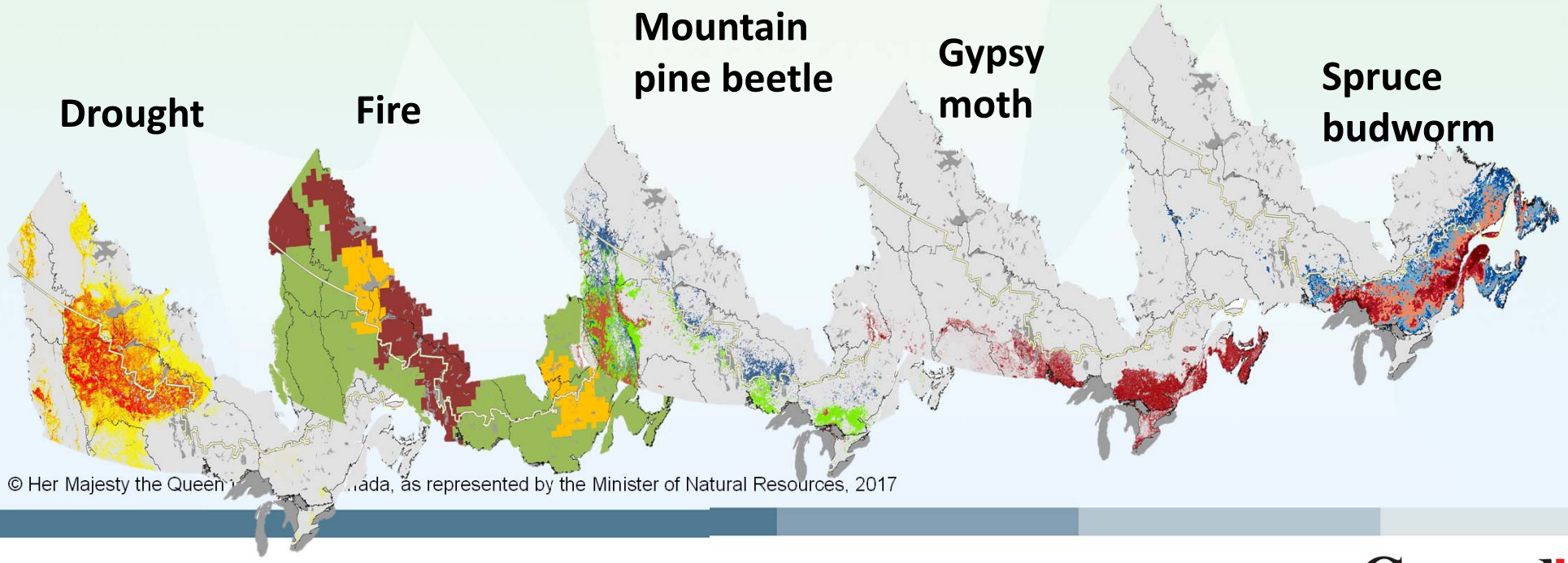
Spread of Mountain Pine Beetle 1910-2016



The cumulative effects of disturbances and other changes to the forest will be complex

- Pests, such as mountain pine beetle, and drought may leave trees more susceptible to fire: could lead to annual area burned doubling by 2100.
- Projected changes to forest productivity and tree species composition will add to cumulative effects on forests.

Short-term impact projections (2011-2040)



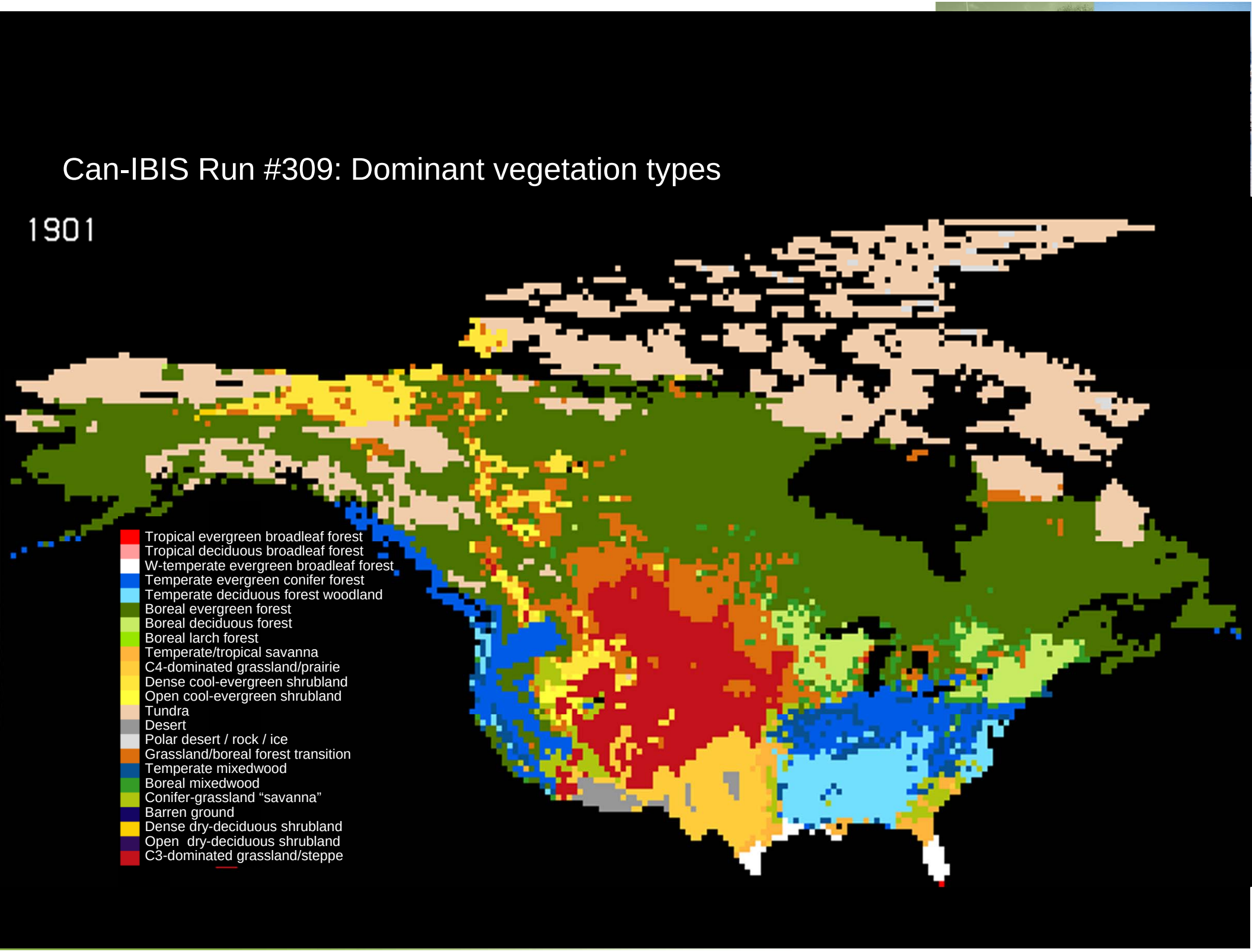
Summary

- Climate and Climate Change in Ontario -

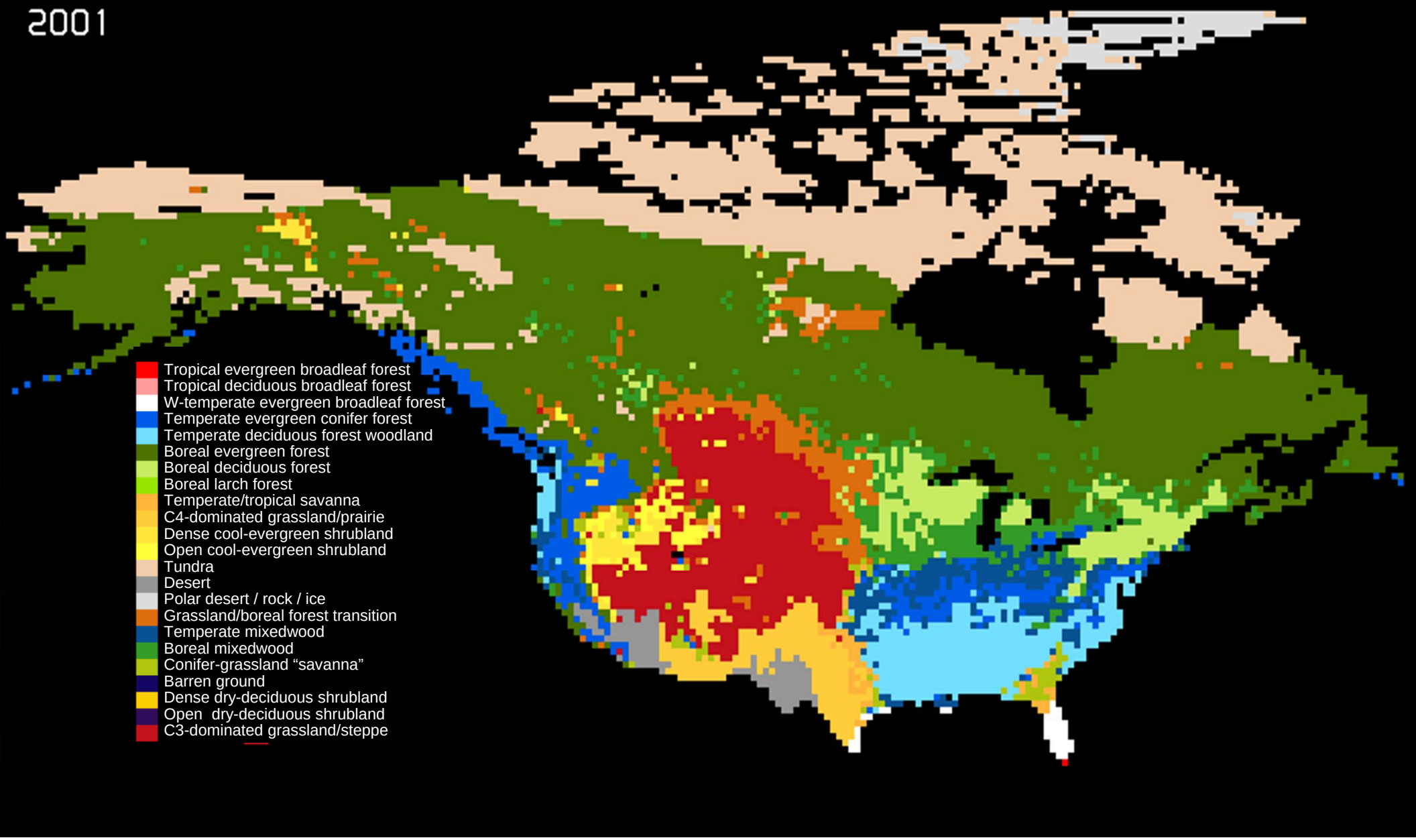
- Ontario has been getting warmer and wetter over the past century
- These trends are expected to continue in the future
- Warmness expected to outpace wetness = drier in the future
- These changes will have big implications for forests, including susceptibility to MPB

Questions?

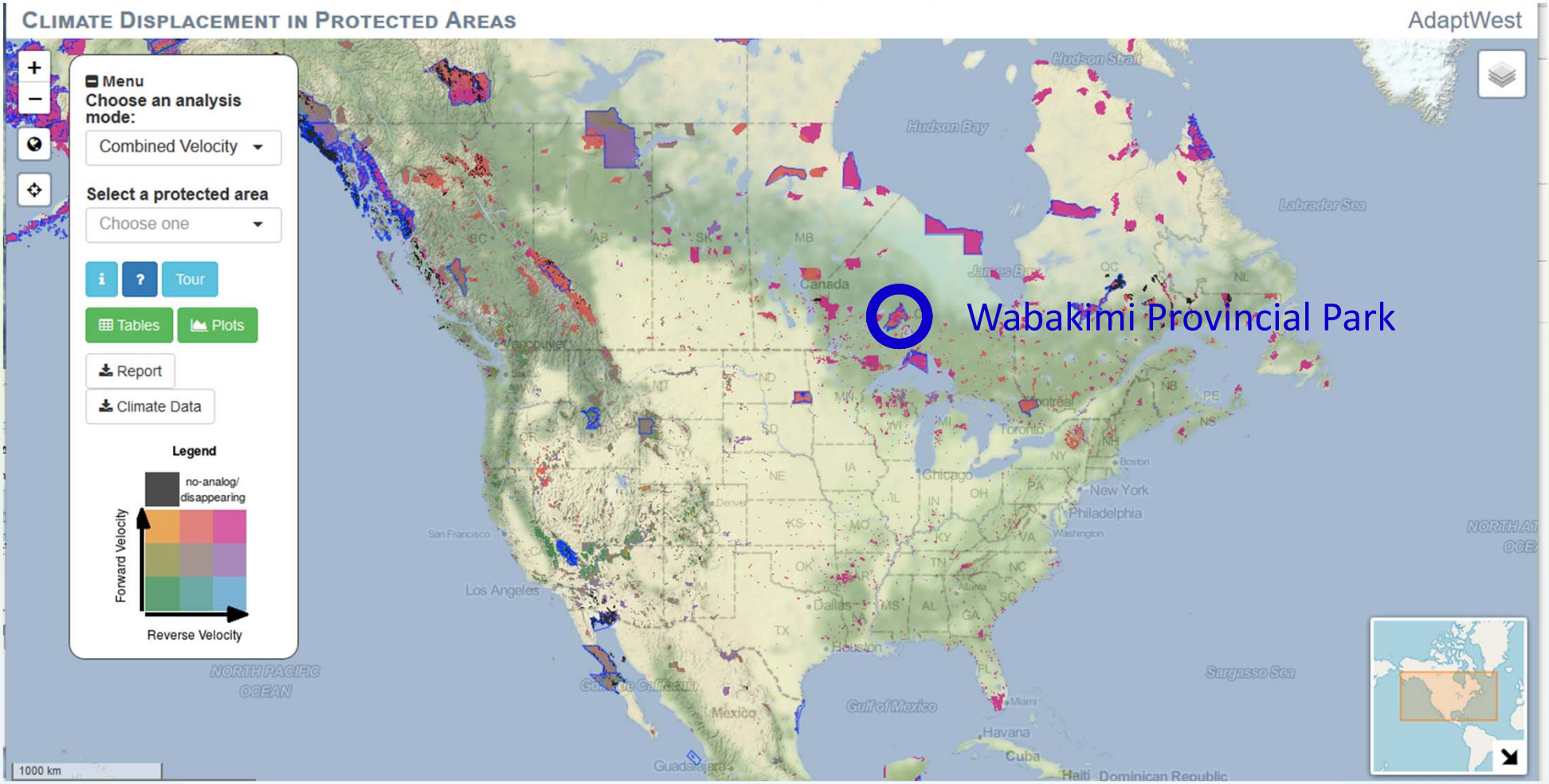
Can-IBIS Run #309: Dominant vegetation types



Can-IBIS Run #309: Dominant vegetation types (CGCM2-A2)



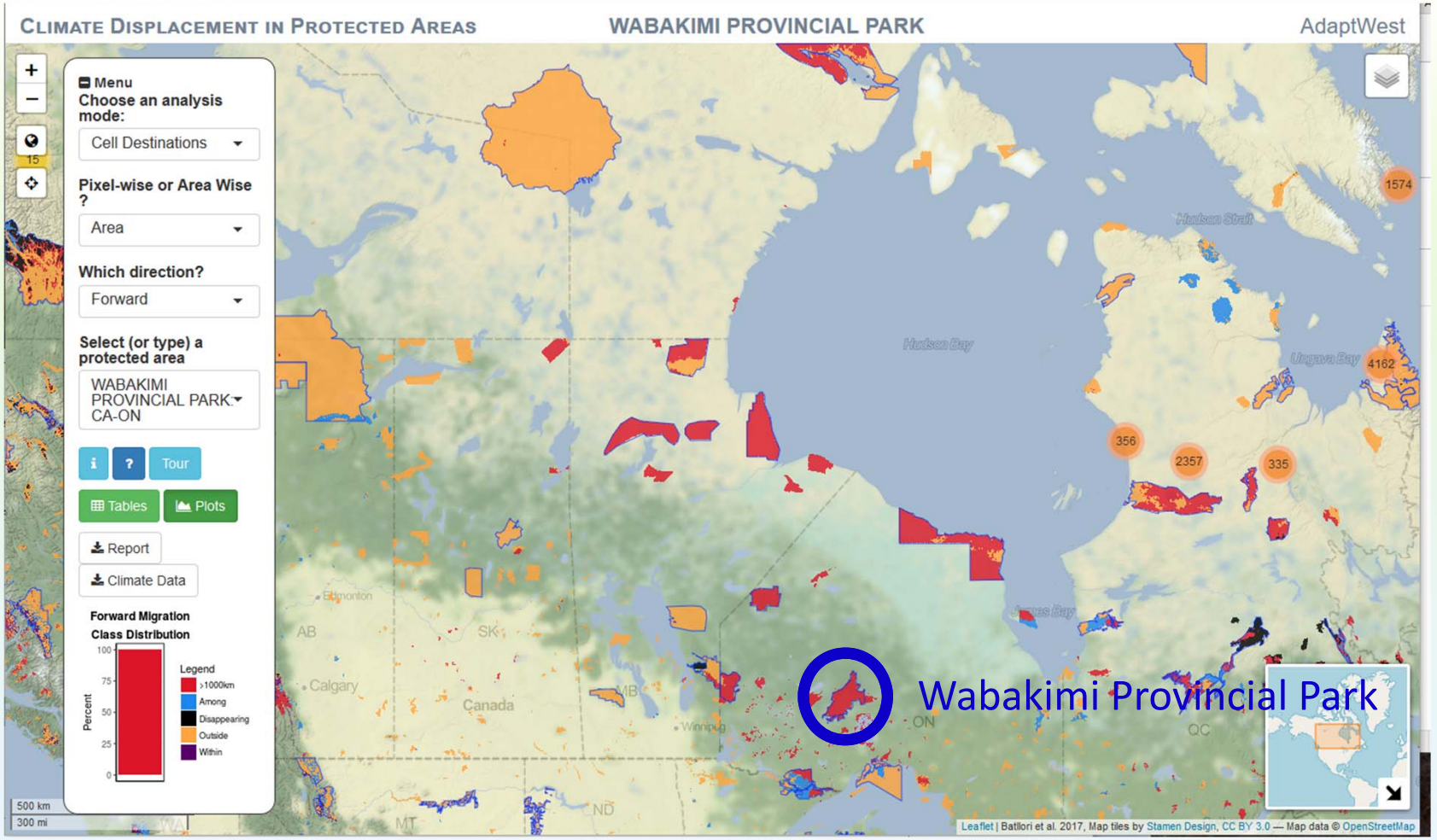
North American Protected Areas



Batilori et al. 2017, *Global Change Biology*; Parisien et al. 2018 (W.I.P.)

https://adaptwest.databasin.org/pages/climate-displacement-protected-areas

North American Protected Areas



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How Will Climate Change Affect Your Community?

Rising permafrost temperatures -- causing roads, railways, and building foundations to buckle and deteriorate

Thinning ice -- polar bears can't hunt, losing weight losing cubs

More forest fires consuming vast areas of this vital resource and risk of more disease in forests

Changing ecological conditions -- grasslands will move further north, edging out our boreal forests

More extreme weather events -- heavy rains and longer and more frequent droughts

Significantly less snow cover -- less moisture for agriculture

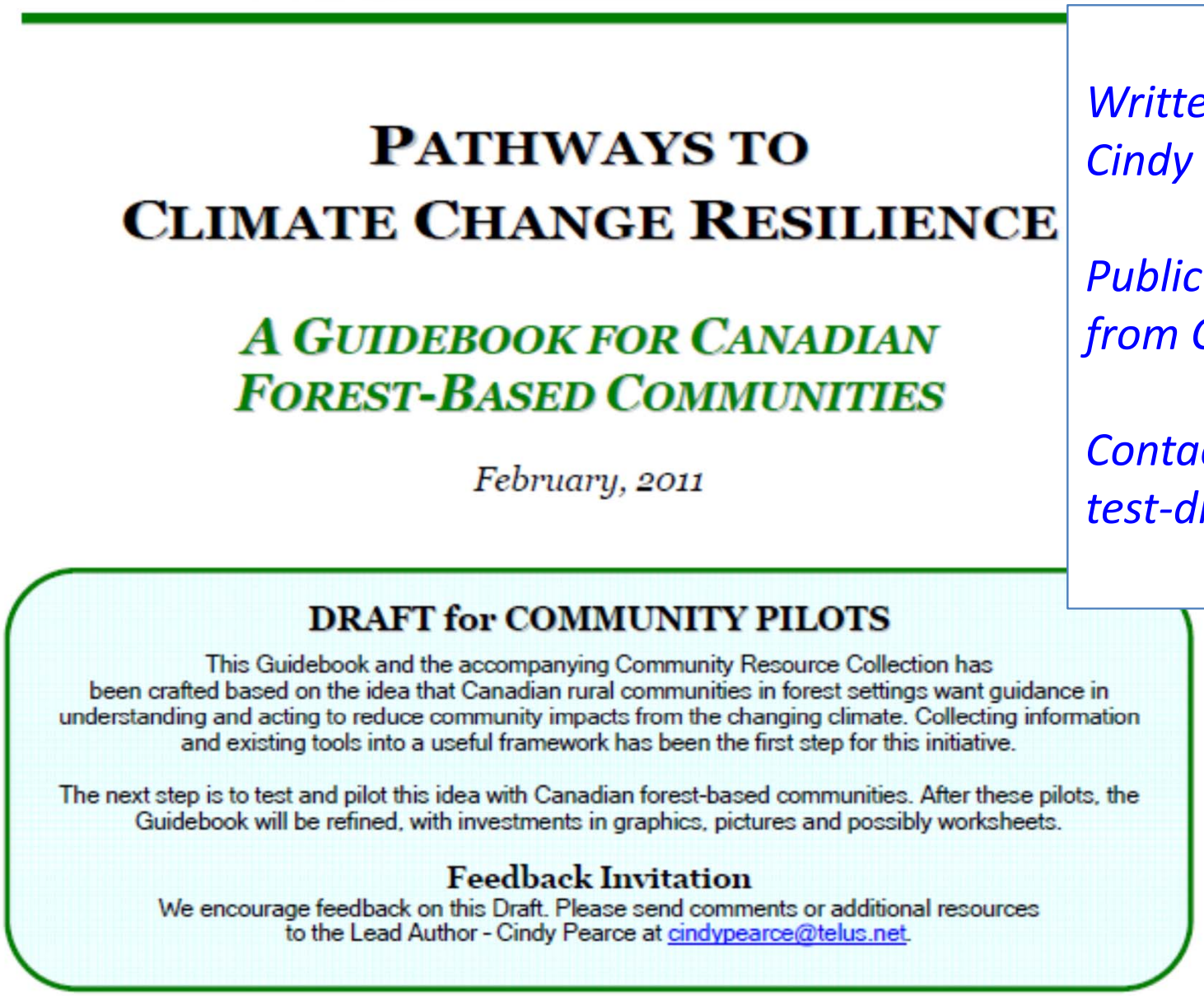
Greater risk of flooding -- like 1997s "Flood of the Century" or worse

http://www.gov.mb.ca/conservation/climate/climate_effect.html

Canada Canada

Canada

Coming Soon!



PATHWAYS TO
CLIMATE CHANGE RESILIENCE

A GUIDEBOOK FOR CANADIAN FOREST-BASED COMMUNITIES

February, 2011

DRAFT for COMMUNITY PILOTS

This Guidebook and the accompanying Community Resource Collection has been crafted based on the idea that Canadian rural communities in forest settings want guidance in understanding and acting to reduce community impacts from the changing climate. Collecting information and existing tools into a useful framework has been the first step for this initiative.

The next step is to test and pilot this idea with Canadian forest-based communities. After these pilots, the Guidebook will be refined, with investments in graphics, pictures and possibly worksheets.

Feedback Invitation

We encourage feedback on this Draft. Please send comments or additional resources to the Lead Author - Cindy Pearce at cindypearce@telus.net.

Written by Cindy Pearce

Publically available from CFS late-2018?

Contact us for a test-drive!!

Adaptation Trail Map

Climate Resilience Trail Map for Rural Canadian Forest Based Communities

1. Get Prepared

- Link with current plans
- Start the discussion
- Purpose, goals
- Create a team & workplan

2. Learn about Climate Change

- Observations
- Historical changes
- Future projections

3. Chart & Scan Impacts & Opportunities

- Environmental responses
- Potential community impacts
- Global climate factors
- Non-climate factors

4. Decide Priorities

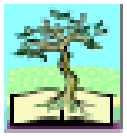
- Adaptive capacity
- Assessment approaches

5. Plan and Take Action

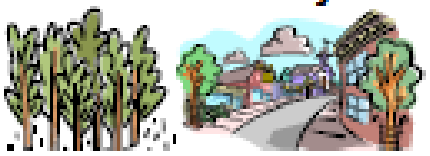
- Possible actions
- Action priorities
- Adaptation plan
- Implement actions

6. Watch, Learn & Refine

- Watch for changes & new information
- Refine plans & actions



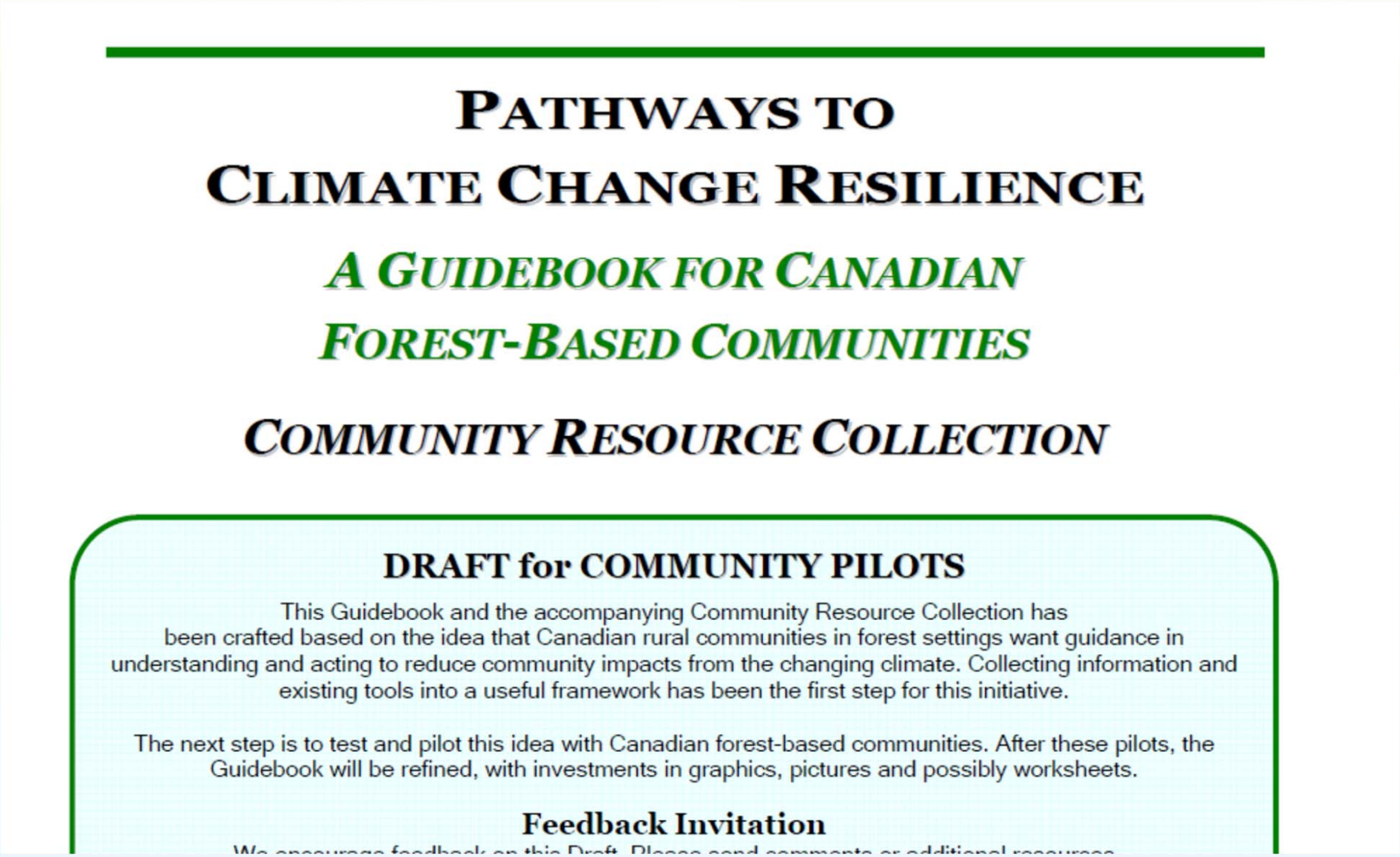
A More Climate Resilient Community



Alternative Pathways

Revisit as needed

Community Resource Collection (publications, websites, tools, data)



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COMMUNITY RESOURCE COLLECTION

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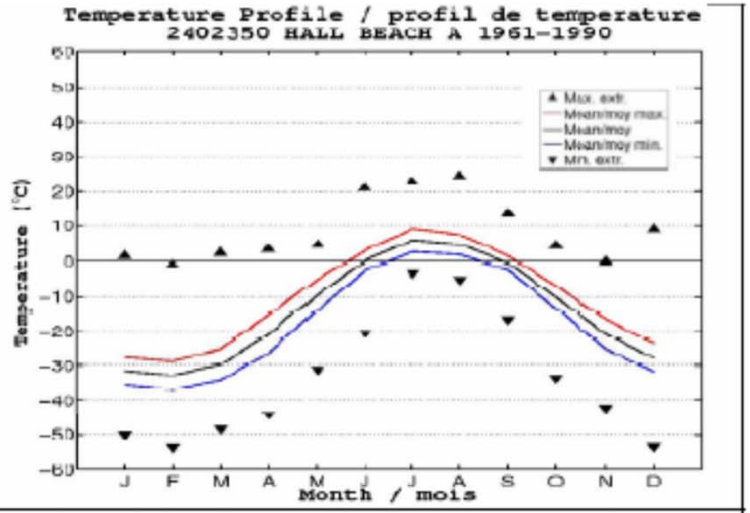
Community Resource Collection

Temperature

This temperature profile provides monthly average **minimum**, **mean** and **maximum** temperature and also extreme minimum and extreme maximum temperature during the 1961-1990 reference period.



Precipitation

This precipitation profile provides the number of days of **rain** (light shade) and **snow** (darker shade) are indicated on a monthly basis, with the values averaged over the 1961-1990 reference period.

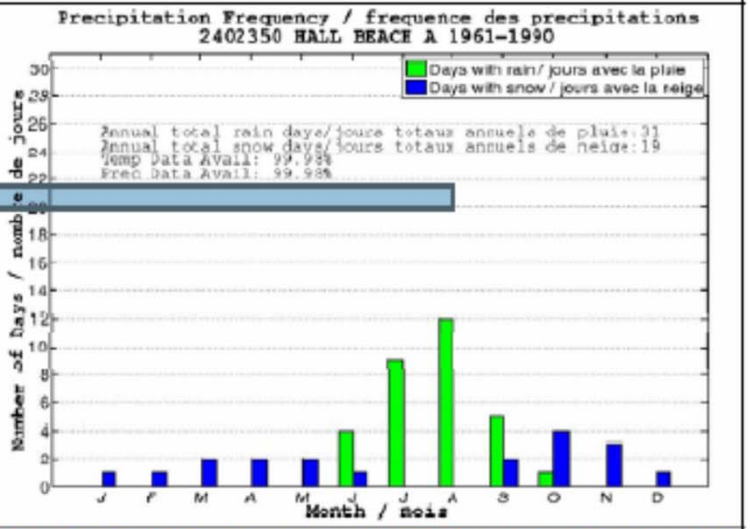


Figure 1: Temperature and Precipitation for Hall Beach based on historical records during the 1961 – 1990 reference period.

Source: Canadian Climate Change Scenarios Network website (http://www.ccsn.ca/index-e.html)

Climate profile

Figure 1 on the left shows the historical climate of Hall Beach.

Table 3 on the next page summarizes potential future climate information.

Community Adaptation Process Example

Black River First Nation Climate Resilience

Does it seem like the weather is becoming more unpredictable and more intense in the Black River traditional area? Do you wonder whether the recent storms and very high winds, and the

Questions?