Global Warming and what to do about it

Gerald Oakham Peter Black

Action to limit Climate Change is Urgently Needed

HEADLINES:-

- “Climate change is making some homes uninsurable” (CBC Business)
- “Paris marks hottest day on record as heat wave scorches Western Europe” (Globe & Mail - July)
- “This June was the planet’s hottest month in recorded history”

REALITY:-

- Global warming, caused by humans, is already happening
- If global warming continues unchecked, our way of life will worsen forever

ACTION:-

- Lobby politicians and elect a government that will act on Climate Change

Outline of Presentation

- Global Warming
  - It's extent and cause
  - The harm it is causing already
  - The greater harm it could cause if left unchecked

- Responses to global warming
  - Mitigation
  - Adaptation

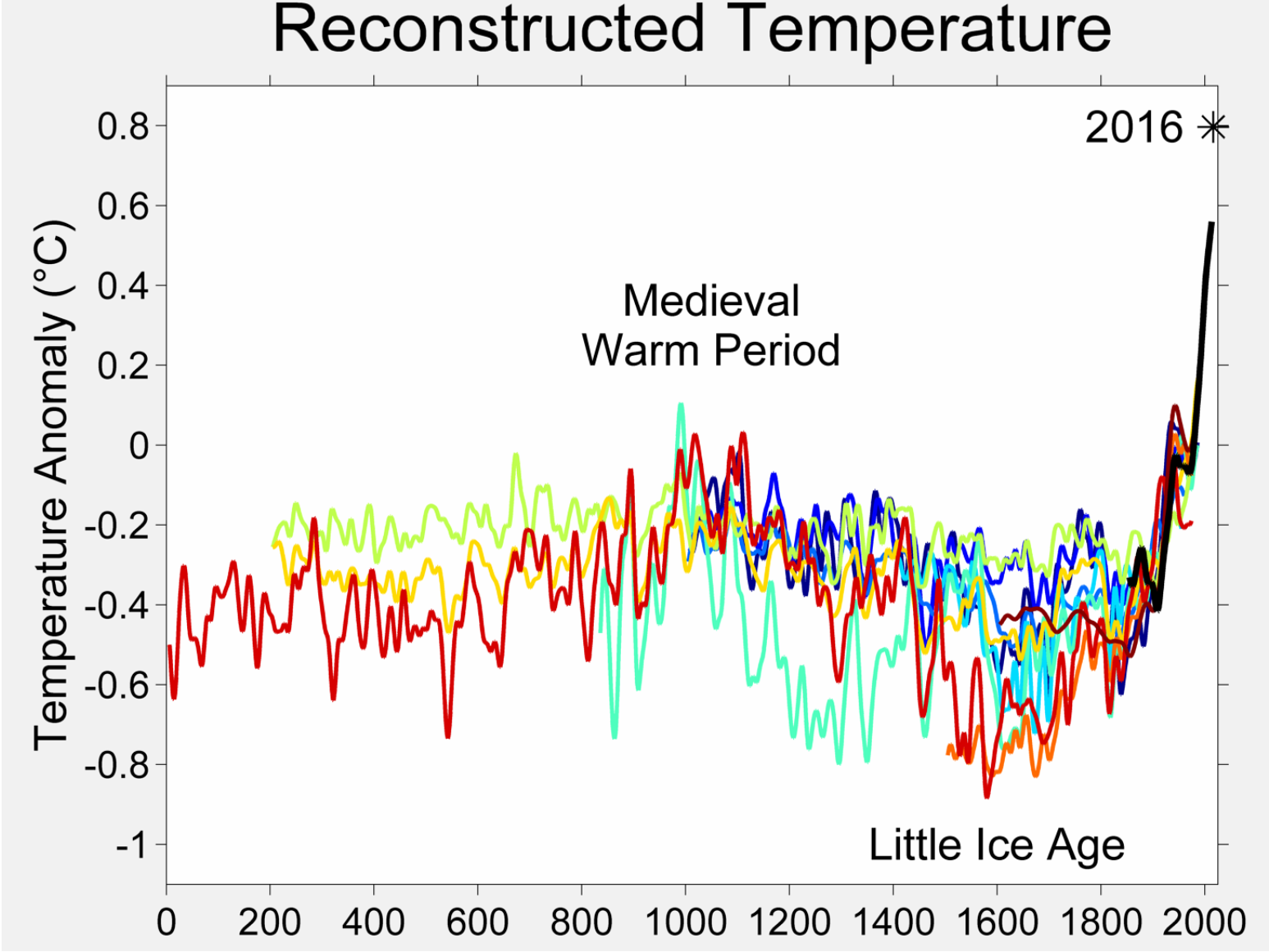
Global Warming's Extent and Cause

- Global temperature has risen by 1 degree since start of Industrial Revolution
  - Canadian temperatures have increased by almost double this amount
- This is caused by emissions of **Green House Gases** (GHGs) due to human activity

“Historical” global temperatures

- Temperature record reconstructed by looking at ice cores, fossil composition, tree ring growth, etc.
- Smooth temperature variations over past 2000 years with sudden increase in past century
- Variations local not global

Plot taken from Wikipedia, Global Temperature Record



Global Temperatures since Industrial Revolution

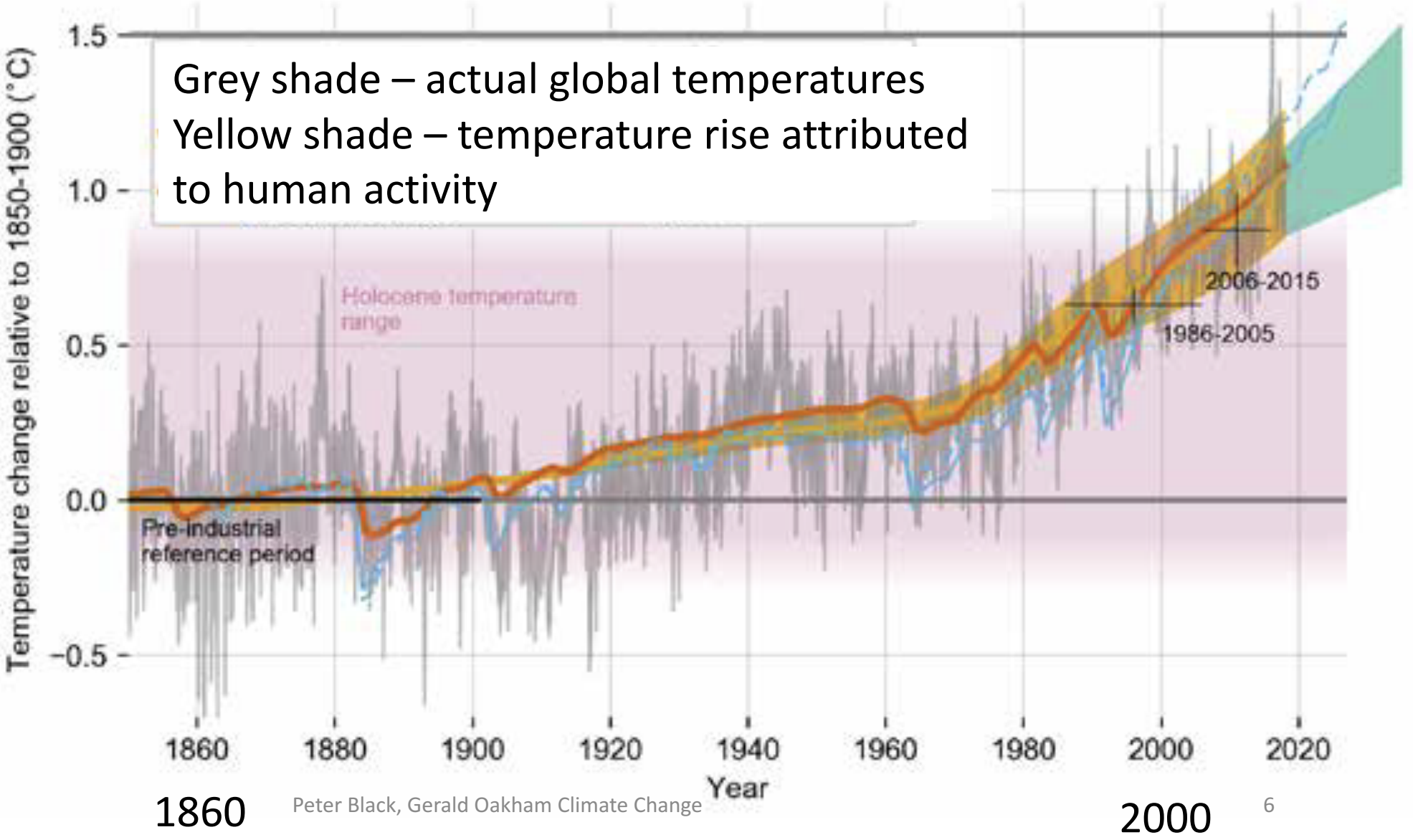
Plot from IPCC = International Panel on Climate Change

Global temperature is average of many readings

Global temperatures have risen 1 degree in past 150 years.

Global warming caused by human activity.

From IPCC. Figure 2.1
SR1.5 Chapter 1



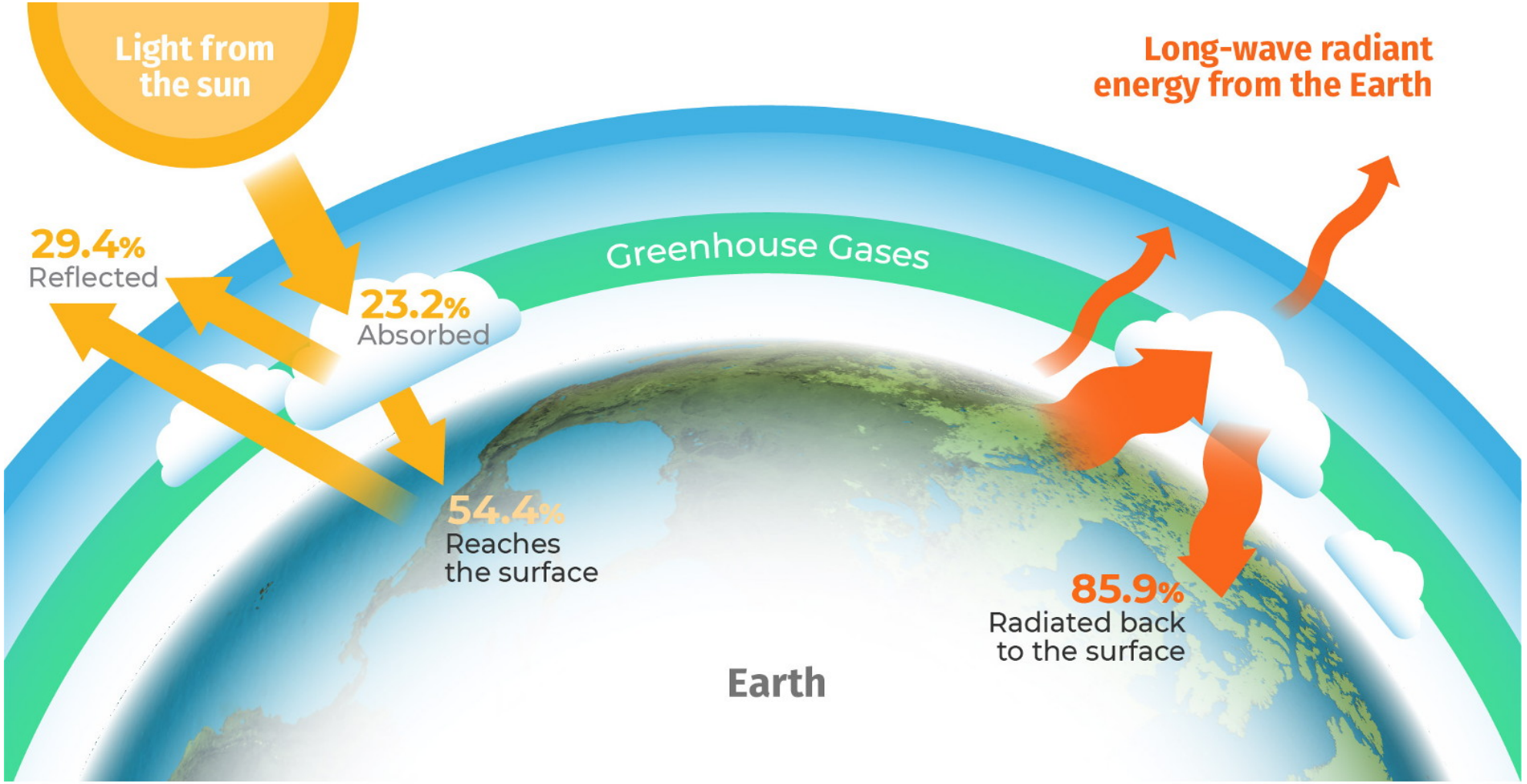
1860 2000

CO_2 and Operation of Planet's Biosphere

- Carbon dioxide (CO_2) is major component of cycle of life on Earth
  - Plants absorb carbon dioxide (CO_2) and give off oxygen
  - Humans and other animals take in oxygen and exhale CO_2
  - CO_2 levels have been **below 300 ppm for past 800,000 years**.**
- In last few hundred years, CO_2 emissions "exploded"
  - Invention of machines and electricity production based on fossil fuels emitting CO_2
  - Huge increase in population and incomes
  - Deforestation for agriculture reduced plant life to absorb CO_2
  - Meat consumption = more animals producing methane, another GHG
- CO_2 levels in Atmosphere **now close to 400 ppm and rising rapidly**

** Based on plot from US National Oceanic and Atmospheric Administration

Greenhouse effect

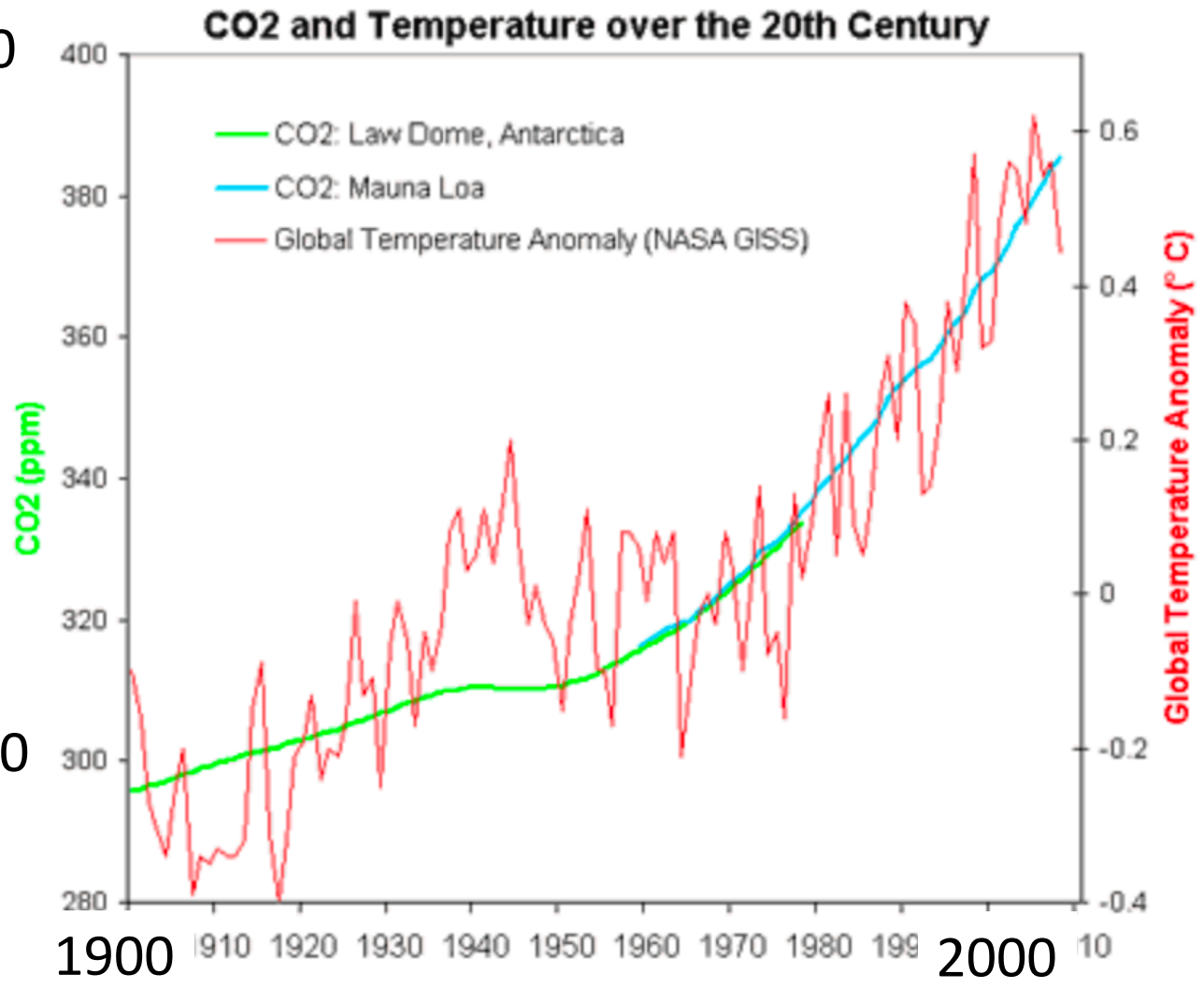


Comparison of CO_2 and Temperature Changes

Rise in global temperature is caused by rising levels of Green House Gases (GHGs) such as CO_2.

Rising levels of atmospheric CO_2 are consistent with amount of CO_2 emitted by human activity.

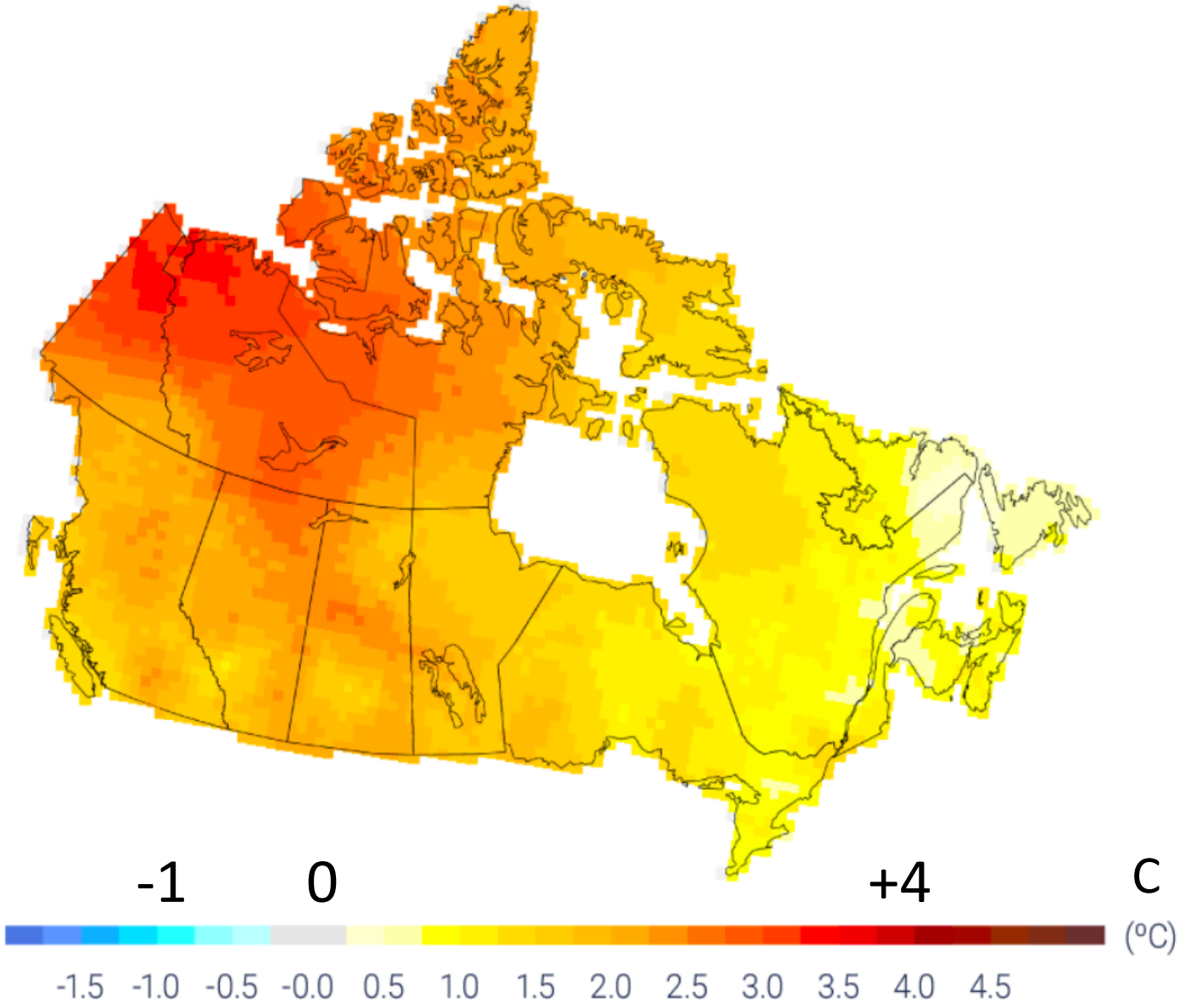
400



300

Average Canadian temperatures have increased 1.7 C degrees between 1948 and 2016.

Temperature increases in the north are higher: 2.3 C.



From Canada's Changing Climate report (2019)

Temperature increases in Northern Latitudes

- Global warming results in higher increases at locations closer to poles
- A couple of reasons for this:-

1) Local effects
   - As temperatures rise, snow and ice melt (for more of year)
   - Less sunlight reflected back to space (albedo effect)
   - Higher local warming
2) Global effects
   - As temperatures warm, atmospheric circulation increases
   - A greater percentage of heat gets transferred from the tropics to the poles

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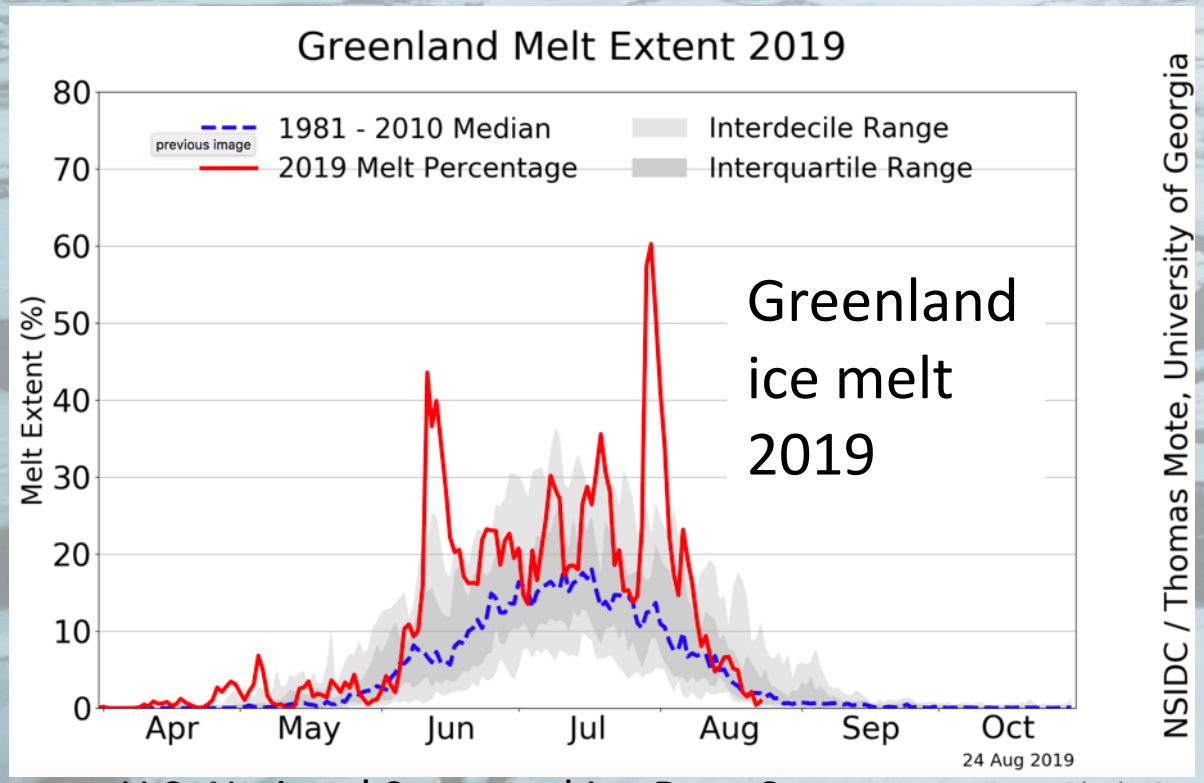
- Responses to global warming
  - mitigation
  - adaptation

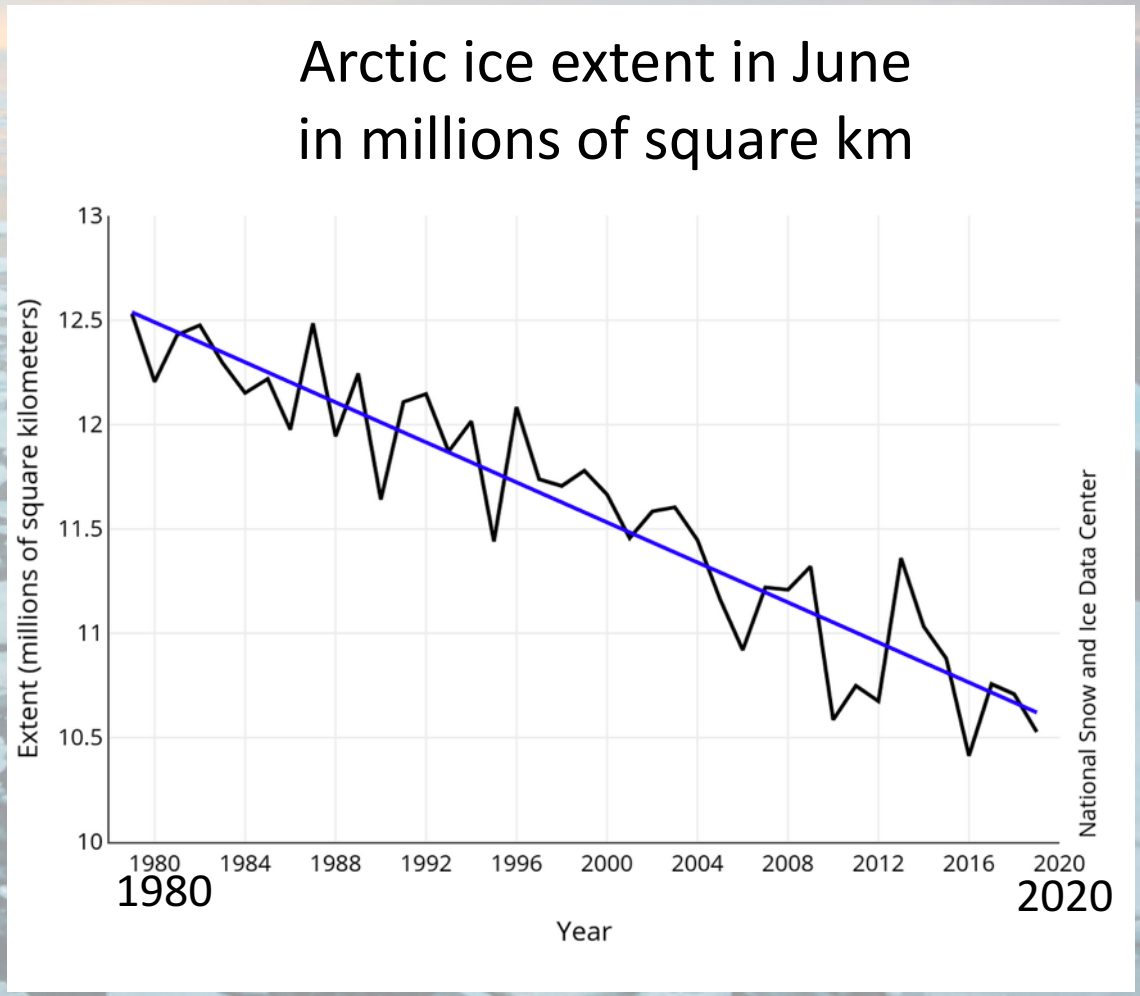
Worldwide Harm Caused by Global Warming Already (I)

- At the Poles
  - Loss of Arctic Sea Ice
  - Loss Greenland Glacial ice
    - In one day in 2018 12.5 billion tonnes of ice melted



Greenland ice melt 2019

U.S. National Snow and Ice Data Centre



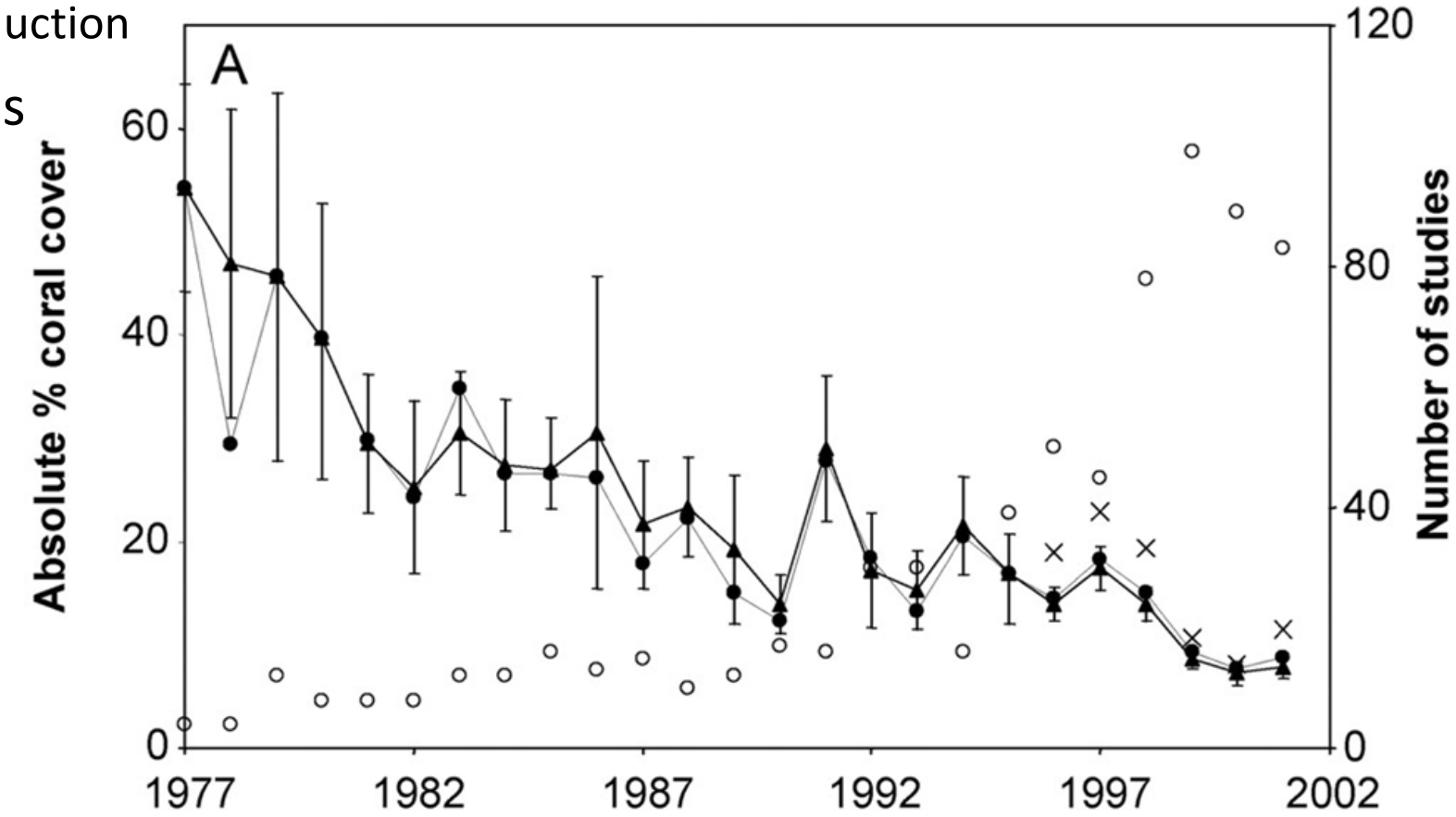
1980 - satellite data available

Worldwide Harm Caused by Global Warming Already (II)

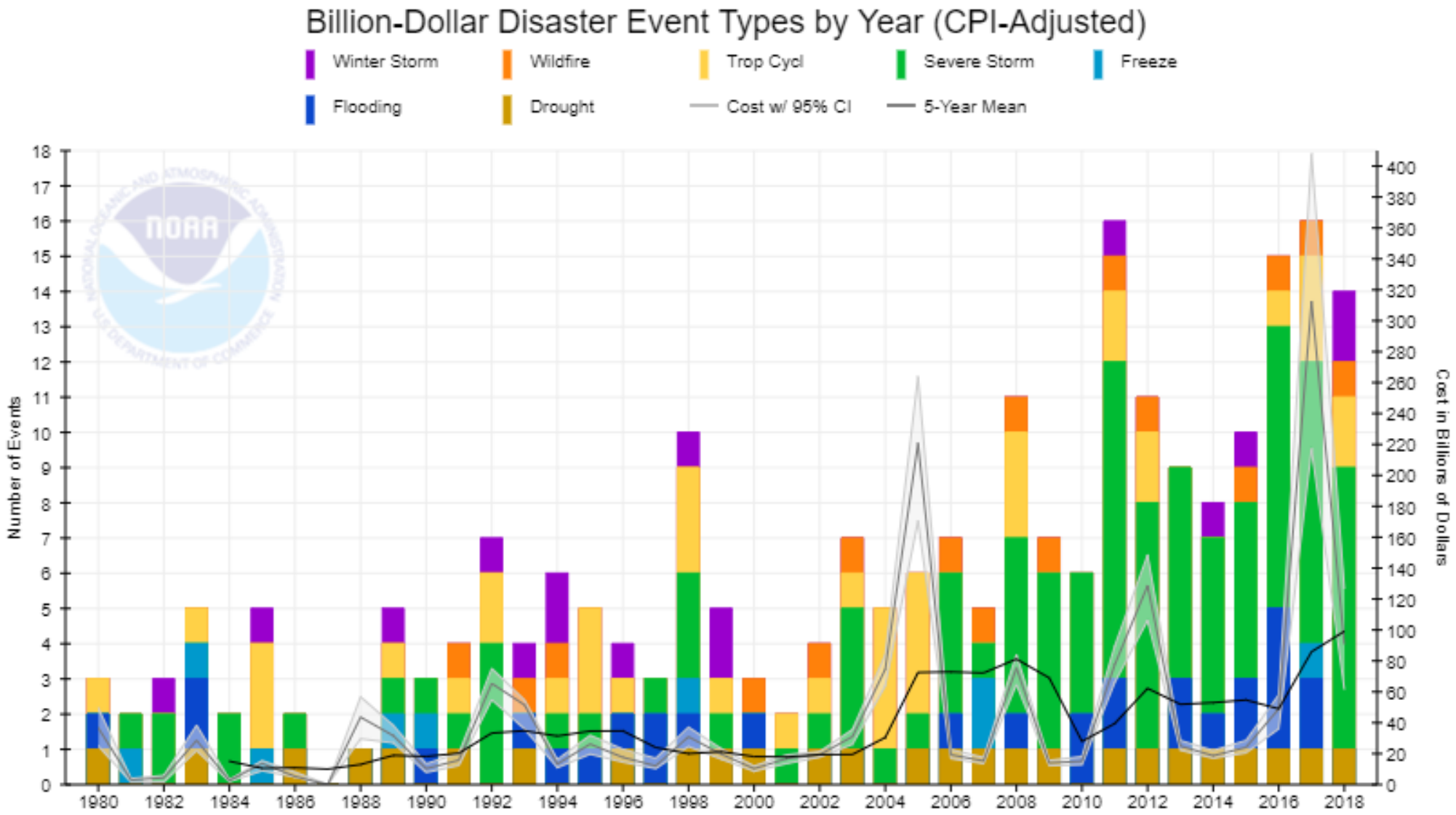
- Ocean acidification
  - Death of large percentage of coral reefs
  - Species loss near coral reefs
  - Impact on commercial shell fish production
- Global changes in weather patterns
- More intense tropical storms

Coral reef loss

Toby Gardner and colleagues from the University of East Anglia in Norwich, UK



Severe weather: Billion dollar disaster events in US



From NOAA US National Oceanic and Atmospheric Administration

Global Warming already experienced in Canada

- More intense forest fires in BC and Alberta
  - Fort McMurray fire in 2016
  - Up to 25% of residents now suffering from PTSD as a result
- Frequent floods in Eastern Canada
  - Ottawa recently had two 1-in-100 year floods in quick succession
- Permafrost in north
  - Homes have to be rebuilt due to loss of foundation
  - Ice roads do not last as long
- Loss of Ice in north
  - Impact on animals and society
- Increase in invasive plants/animals from South as habitat zones move north
  - Increase in Lyme disease in Ontario and Quebec

Black Legged tick

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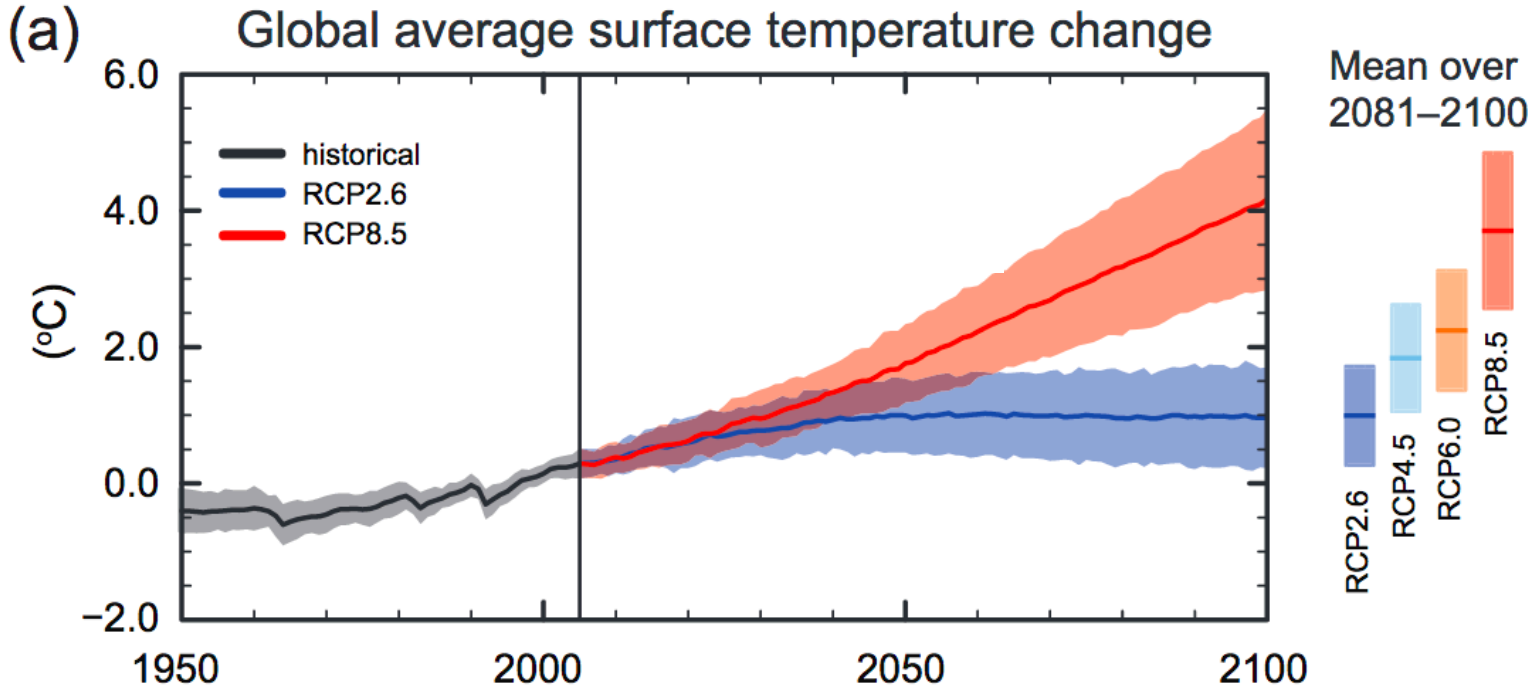
- Responses to global warming - adaptation

Predictions of Climate Change: climate modelling

- Predictions come from models of earth's biosphere
- Climate scientists use several climate models to provide most likely changes to environment due to increases in GHGs
- IPCC combines these predictions.
- Variations in predictions of models give range of likely outcomes
- Different scenarios are used to explore impact of different human actions such as:
  - "Business as usual"
  - "Cut GHG emissions according to IPCC recommendation to limit temperature increase to 1.5 C."
  - (More on IPCC recommendations later.)

Projected world temperature rises for different scenarios

Note blue scenario requires both reduction in GHG emissions and carbon capture (more on this later).



Scenarios:-

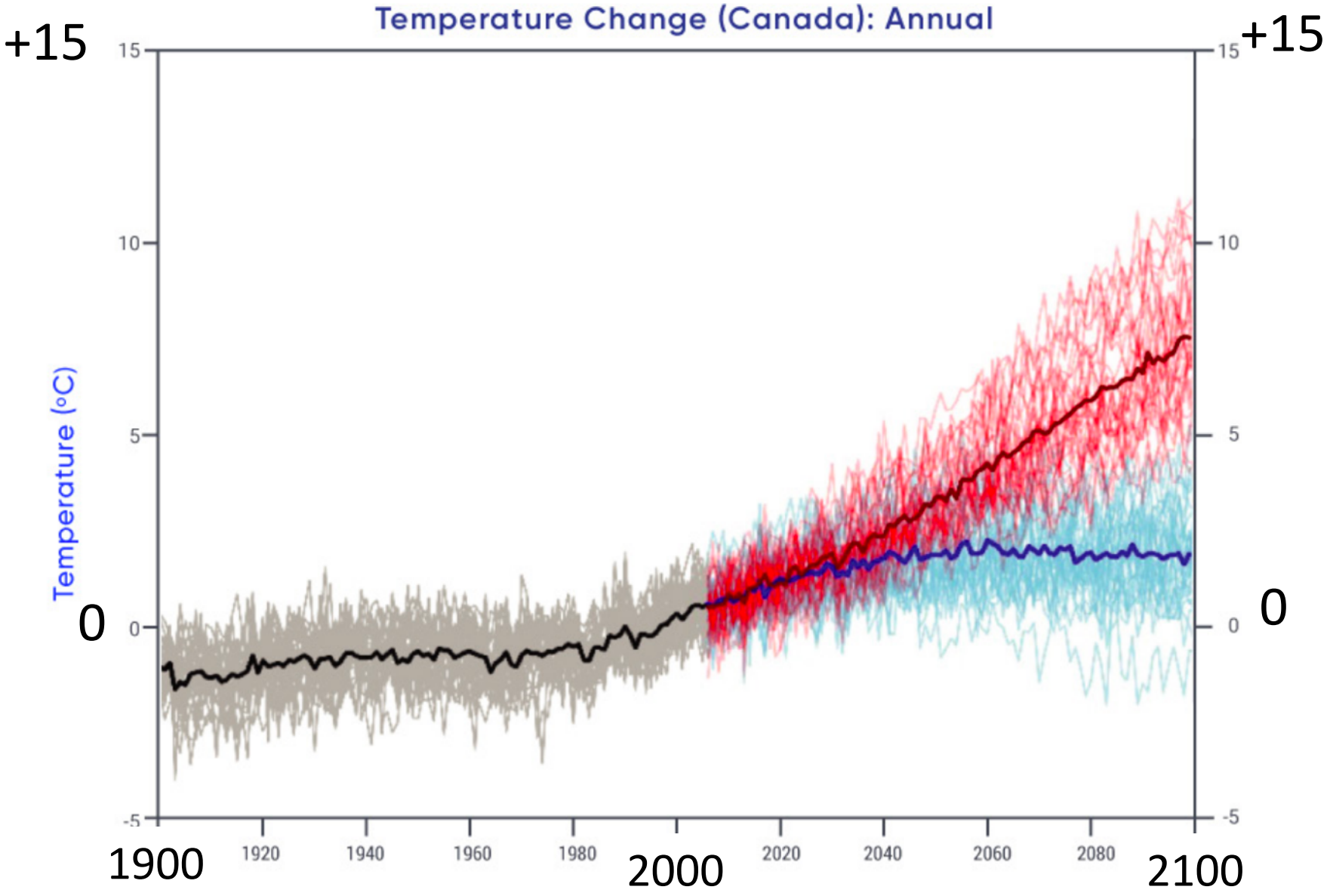
Blue – optimistic action to reduce GHG emissions

Red – pessimistic little action to reduce GHG emissions

(GHG – Green House Gases)

Plot from
From IPCC
AR5 report

Average projected temperature rises for Canada: Blue optimistic Red - Pessimistic



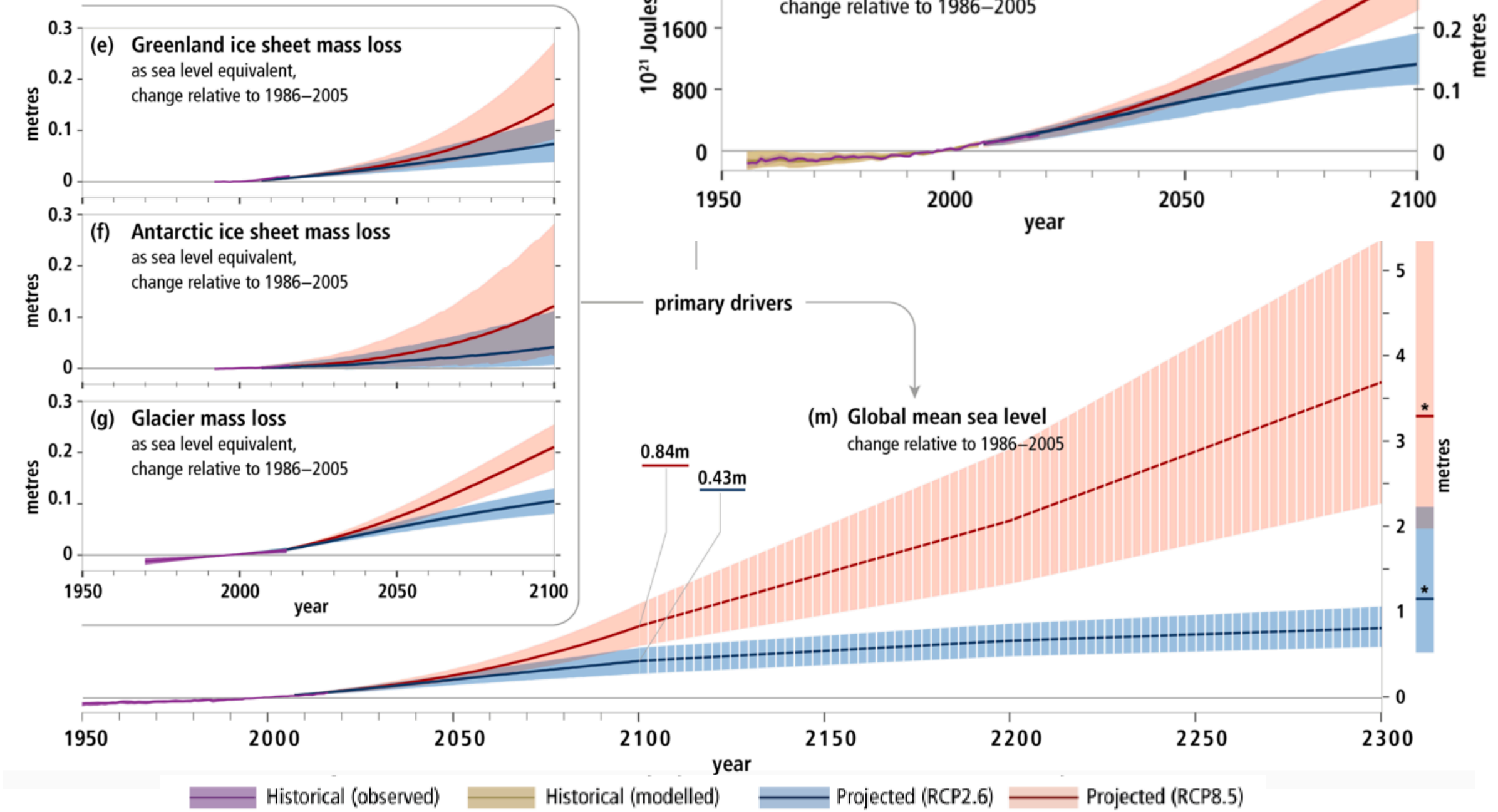
From Canada's Changing Climate report (2019)

What harm would 1.5 or 2 degree warming cause

While precise predictions are difficult, the following is likely:-

- Ice free Arctic in summer by the 2030s
- Melting Greenland and Antarctic Ice Sheets and ocean warming cause sea level rise (up to 1m by 2100)
  - (7m sea level rise if all Greenland ice melts)
- Increase in major weather events
- Shifting weather patterns (more snow/less snow depending on location), storms
- Habitat loss for animals and humans
- Ecological migration – political unrest

Sea level rise from IPCC SR Ocean and Cryosphere report September 2019



Predictions of Climate Change: Tipping points

- The earth's climate has semi-stable features that can give rise to run-away temperature increases. (Tipping points)
- This would be in addition to the temperature increases already discussed.
- Examples:
  - **Permafrost**: melting of permafrost releases methane, a powerful GHG that accelerates global warming
  - **Arctic sea ice**: loss of sea ice reduces albedo effect, more heat is absorbed from sun which accelerates global warming
  - **Greenland glacier.** Melting darkens glacier surface leading to larger absorption of heat leading to more ice melting
- Exact temperature at which tipping points would begin is difficult to predict!

Outline

- Global Warming

- Responses to global warming - mitigation
  - International initiatives
  - Canadian Initiatives
  - Initiatives you can take

- Responses to global warming - adaptation

Mitigation – International Initiatives

- 1992 – United Nations Framework Convention on Climate Change ("UN Convention")
  - aim to stabilize GHG concentrations to prevent dangerous interference with climate system
- Conference of Parties (COP) – meets every year since 1995
  - growing number of countries assess progress and reach agreements
- 2015 COP Meeting – Paris Agreement
  - 197 countries agreed to limit their GHG emissions in order to limit future GW to less than 2.0 degrees and "do their best" to limit it to 1.5 degrees
- Next COP meeting – Chile 2019 – Dec 2-13

Mitigation – International Initiatives

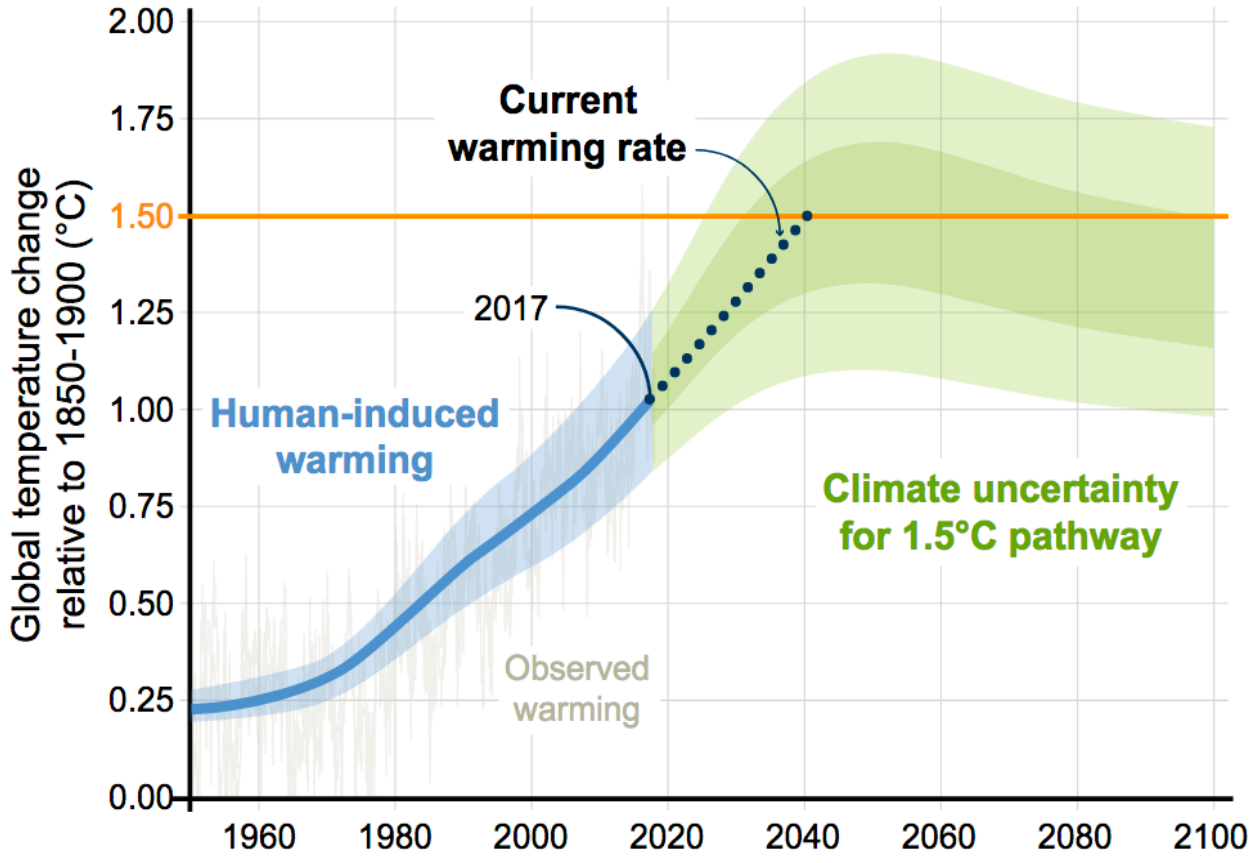
- 1988 - Intergovernmental Panel on Climate Change (IPCC)
  - UN body to support UN Convention
  - produces consensus reports by leading climate scientists with support of participating governments
    - scientific authority supported by political representatives
- Oct 2018 – IPCC Special Report on Global Warming (GW)
  - Paris Agreement would allow GW of 3 degrees by 2100
  - **limiting GW to 1.5 degrees would require decrease in net emissions from 2010 of 45% by 2030 and zero net emissions by 2050**

Figure from IPCC report shows that initiatives in Paris Agreement would lead to global warming exceeding 1.5 degrees by 2040

Any plan to keep warming below 1.5 degrees requires both GHG control **and removing CO2** from atmosphere (carbon capture)

FAQ1.2: How close are we to 1.5°C?

Human-induced warming reached approximately 1°C above pre-industrial levels in 2017



Carbon Capture

- All IPCC scenarios to limit temperature rise assume significant amount of Carbon Capture
  - taking CO2 from atmosphere and putting it into stable form
- Biological
  - Planting trees (limited land available for this)
- Industrial
  - Chemical processes to convert CO_2 to carbon to be used or stored.
    - Requires lot of energy (need clean energy source)
    - More efficient from point source (factory) rather than from atmosphere
  - Some CO_2 being pumped into oil wells to help extract oil and keep CO_2 underground
  - Several small carbon capture plants exist – 4 in Canada
  - So far, all these plants worldwide only capture 30 Megatonnes per year.
    - (Canada's annual CO2 emissions > 700 MT/year.)
  - Great deal of work required to produce effective commercial-scale plants

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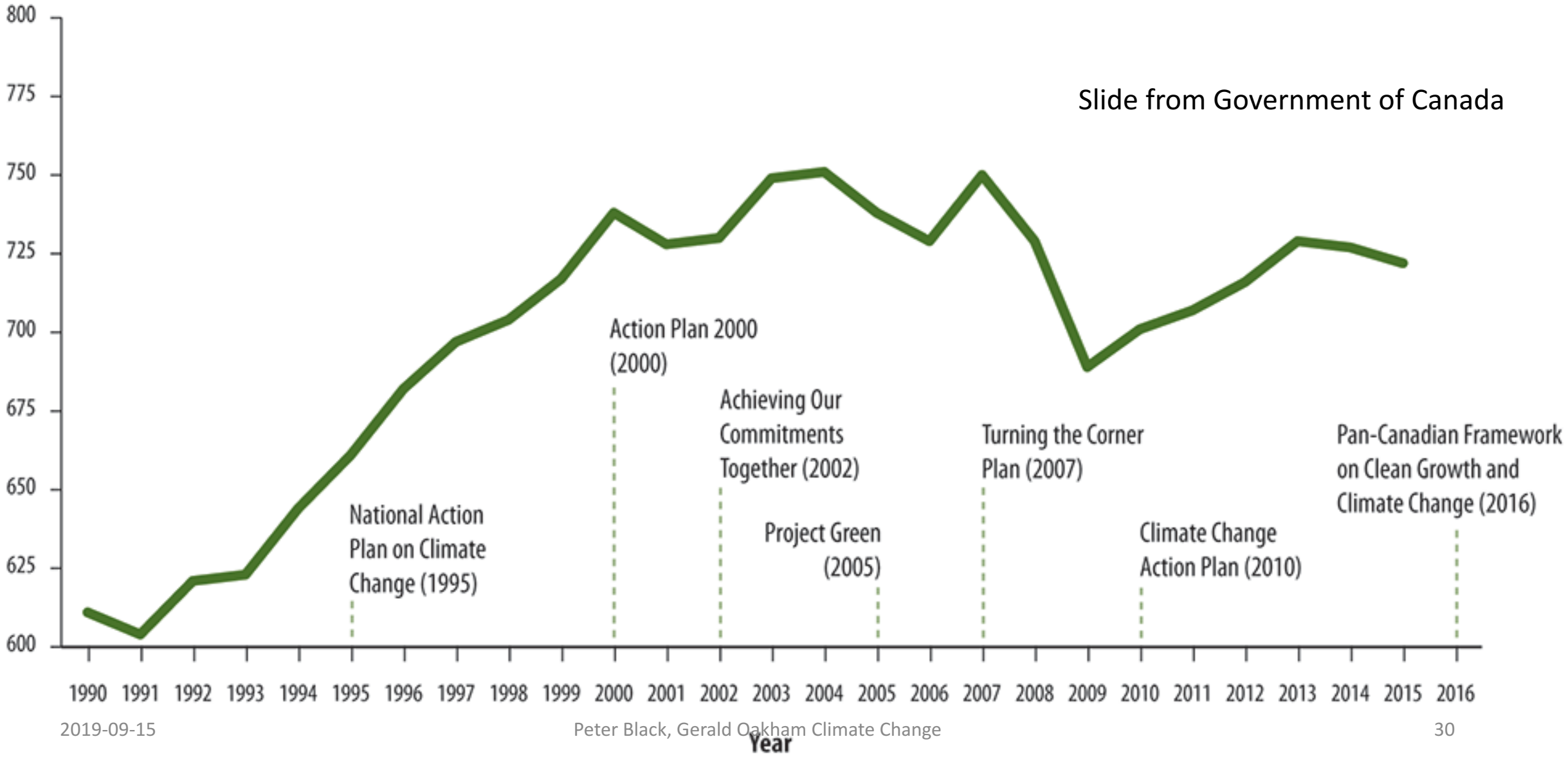
  - Canadian initiatives
  - Initiatives you can take
- Responses to global warming - adaptation

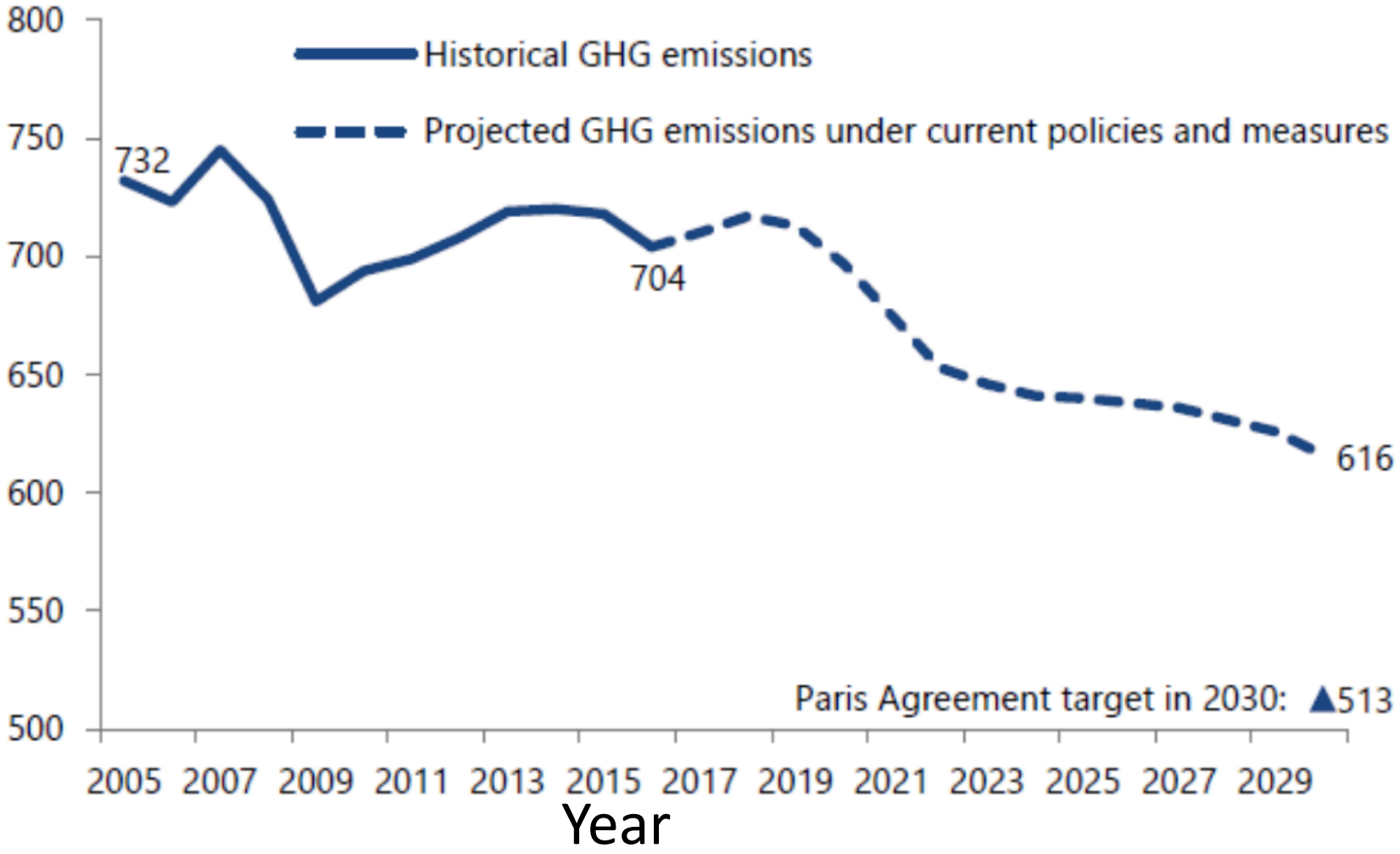
Canada's Green House Gas Emissions



Slide from Government of Canada

Canada's GHG emissions projected under current policies

Megatonnes of CO_2 equivalent



Source: Environment and Climate Change Canada.

Canada's Climate Change Action Plan (2016) (major federal measures)

- Increasing price on carbon (certain provinces)
- $60 billion over decade
  - Electric-vehicle rebate, public transit, energy efficiency, low carbon technology
- Regulations (planned)
  - Phase out coal-based electricity
  - Reduce carbon content in fuels (Clean Fuel Standard – 2022-30)
  - Increase gas mileage in cars/trucks

Source: Globe and Mail – Aug 27 and Sep 1 and Mark Jaccard website

Need for Radical Action is now mainstream news

"The climate is changing in ways that carry

the risk of catastrophe

in the absence of radical action"

Economist Magazine

July 2019

Achieving Net Zero Emissions by 2050
(initiatives likely needed)

- Decarbonize electricity generation
  - switch to renewables – hydro, wind, solar, biomass, maintain nuclear power while developing energy storage.
- Decarbonize ground transportation – switch to electric or hydrogen
- Industry – increasing price on carbon emission
- Energy efficiency for buildings – regulate building codes and retrofit
- Forest management – prevent deforestation, pursue reforestation/afforestation.
- Set up carbon capture plants
  - some activities will always need fossil fuels – air travel, concrete
- Major measures to address shift in labour force – support needed

Outline

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- Responses to global warming - mitigation
  - International initiatives
  - Canadian Initiatives
  - Initiatives we can take – individually and collectively
- Responses to global warming - adaptation

Initiatives We Can Take to reduce global warming

- Individually
  - Reduce carbon footprint
  - Purchase carbon offsets

- Collectively
  - **Elect Climate-Change-Effective Governments**
  - Continuously pressure governments to take effective action

Individually - Reduce Carbon Footprint

Modify consumption patterns

- electricity, home heating
- vehicle use, travel
- purchase local products

Switch to cleaner technology - now or when it needs replacing

- electricity – LED lights
- home heating – insulation and furnace
- vehicle – more efficient or cleaner: hybrid or electric

- Investments
  - Divest from oil stocks
  - Purchase green investments funds

Environmental Investing
(an example)

- In 2007, Green Chip Financial (not blue chip) established new fund
  - Mackenzie Global Environmental Equity Fund
- Investing in environmental economy
  - Historical energy transition in economy
- 800 environmental companies – market capitalization over $6 trillion
  - Renewable energy, clean technologies, water, food, alternate transportation
- Environmental stocks often underpriced
  - financial industry less knowledgeable, more cynical about them
- Competitive rate of return

Individually - Purchase Carbon Offsets

Flight offsets
YOW-NY (return) - $7
YOW – UK (return) $66

- Airplane travel
  - purchase offset for each flight
  - airlines and other businesses provide offsets – e.g., Air Canada, Less.ca
- Residential and vehicle use
  - offset businesses will use carbon offset payment to “pull” renewable energy onto hydro grid or to support biomass to offset fossil-based residential energy use – e.g, Bullfrog Power
  - similar principle applied to fuel used in vehicle

Elect Climate-Change-Effective Governments

- Only governments can bring about radical action needed
- Governments have unique powers
  - taxation
  - regulation
- Federal election – October 21
- Need to elect government committed to effective climate change action
- Need to understand CC platforms of different parties
  - All parties have now released their positions on climate change

Elect C-C-Effective Governments

- Polls show 65% of Canadians want CC-effective government
- Need to vote for party in your riding with
  - effective climate change plan
  - chance of winning riding
- If your favoured party does not have a climate change policy you agree with - lobby your riding candidate, your party leader and your party to change.
- Be aware of issues with “first-past-the-post” voting system.
  - Vote splitting can have unintended consequences
  - Possible to elect candidate with only 35% of the vote

Continuously Pressure Candidates/Governments

- Federal election – press candidates to take effective action
  - attend mtgs
  - meet with candidates one-on-one
  - send letters/emails to candidates voicing your concerns
- See our website for draft letters to election candidates
  - climatetalkottawa.com
- After election, continue to press your MP

Elect Climate Change Effective Governments

- We have 11 years to reduce GHG emissions to limit climate change
- Our Government needs to make changes in next 18 months
- Which party gets elected in October is critical for Canada's environment and our future

Continuously Pressure Governments

- Support movements/organizations which are demanding radical action
  - Fridays for Future
  - Extinction Rebellion

Fridays for Future

- Students on strike to pressure governments to act
- Movement started by Greta Thunberg August 2018
  - 16 year-old Swede
- Students striking in 30 countries
- 10-20 thousand in Ottawa on 27th of September:-

Extinction Rebellion

- Began Oxford, England – October 2018
  - engage in non-violent direct action and civil disobedience to protest government inaction on climate change
  - Pressure government to enact legally binding policy measures to reduce carbon emissions to net zero by 2025
- Extinction Rebellion Ottawa
  - began January 2019
  - talks, marches, traffic disruption
  - 600 members

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Adaptation

- Even with major effort to limit GHG emissions, temperatures will rise and have an impact on our lives.
- It is important at all levels of government that plans are put in place to deal with these changes
- It is equally important that individuals take this into account in their plans

Adaptation: Government

- Federal Government
  - Northern areas will be ice free for large parts of summer
    - Policy required to deal with this - new northern bases, ice capable ships, search and rescue bases.
  - Climate emergencies will put larger strain on Armed Forces – need to expand forces or create new civil defense force
  - Review how insurance policies deal with disasters (role of Government?)
  - Climate refugee claims will exceed level we have seen so far – a policy is required for this

Adaptation: Government

- Provincial/Federal
  - Flooding on coasts and beside rivers
    - What is best way to help citizens – financial assistance, paying them to move?
  - Storm proofing hydro grids
- Municipalities
  - Update flood plain maps – control construction
  - Cooling centres - plans to assist citizens in heatwaves
  - Ensure emergency planning is up to date

Ottawa Tornadoes 2018

Adaptation: Canadians

- General
  - Avoid buying houses or living in areas designated as flood plains
- Home upgrades
  - To roofs for stronger winds (shingles)
  - To deal with heavy rains (eavestroughs, downspouts, landscaping)
  - To home insulation
- Emergency preparations for extended hydro outages
  - Batteries, flashlights, battery radio, canned foods, candles, etc
  - (current battery back-up for cell phone towers is quite limited!)
- Northern Canada ??

Concluding remarks

Climate Change Action is Required

- Global warming is not a future event – it is happening now and having major and visible impacts
- Globally we have 11 years to make changes to limit Climate Change
- We have 18 months to put in place regulations required to meet the 2030 goal

It is critical that we elect a government in October that will make this their top priority.

Your participation is crucial