

## Earth Sc 2E13 - Lecture 7 – Climate Change

1. What is the evidence of Climate Change?
2. What was the Kyoto Protocol?
3. Canada and the Kyoto Protocol

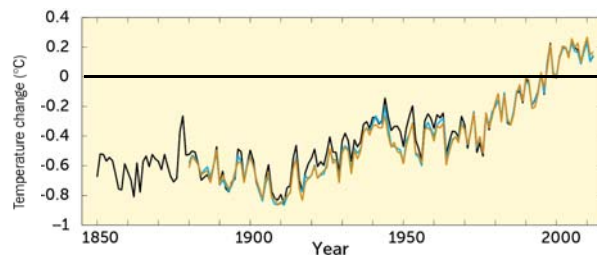
## Key Concepts

- Evidence of Climate Change and Scientific Explanations for it
- Forecast of Impacts on Natural Systems and Human Society
- Impacts on PEI
- The Kyoto Protocol, its stipulations, and its fate
- Canada's record on Climate Change

## 1. What is the evidence of Climate Change?

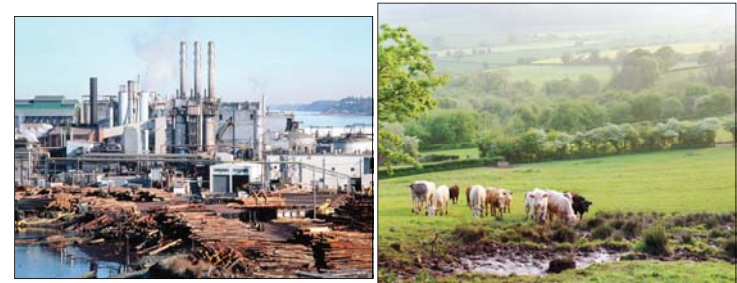
- Since 19<sup>th</sup> century, average global temperature has increased by:

Variation in global average surface temperature between 1856 and 2005.



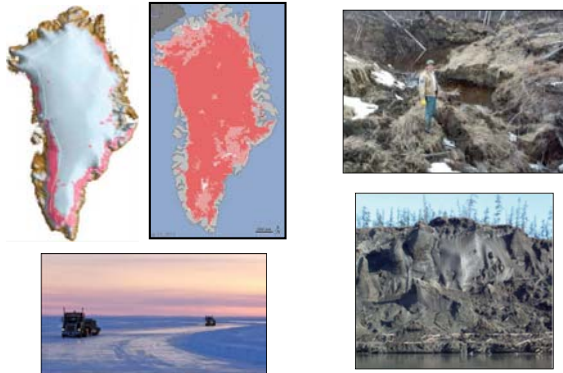
## Scientific Explanations of Climate Change

- Strong consensus that increase in greenhouse gases (GHG) is:



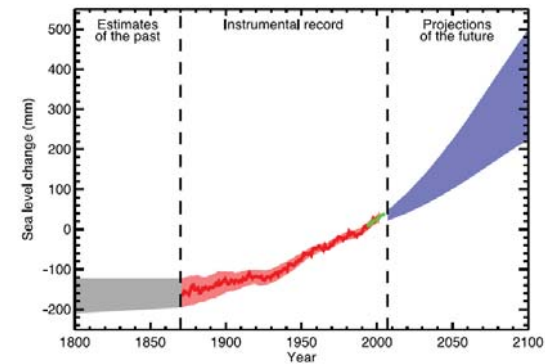
## What are the Implications of Climate Change on the Cryosphere?

- Melting of ice in the Arctic

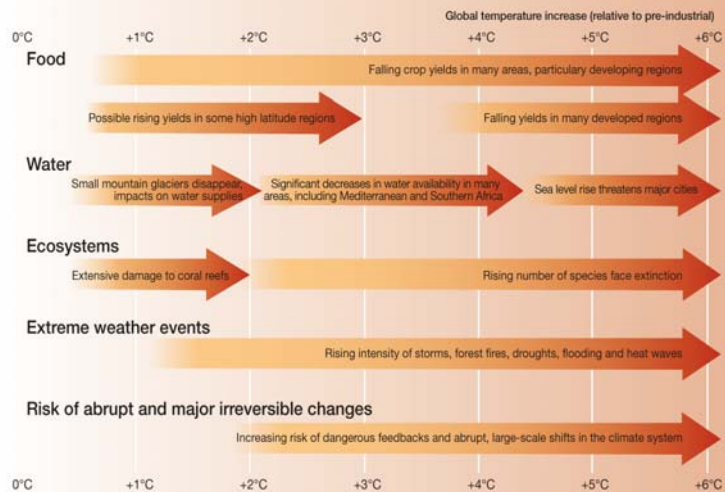


## What is the Impact of Sea Level Rise?

Globally:

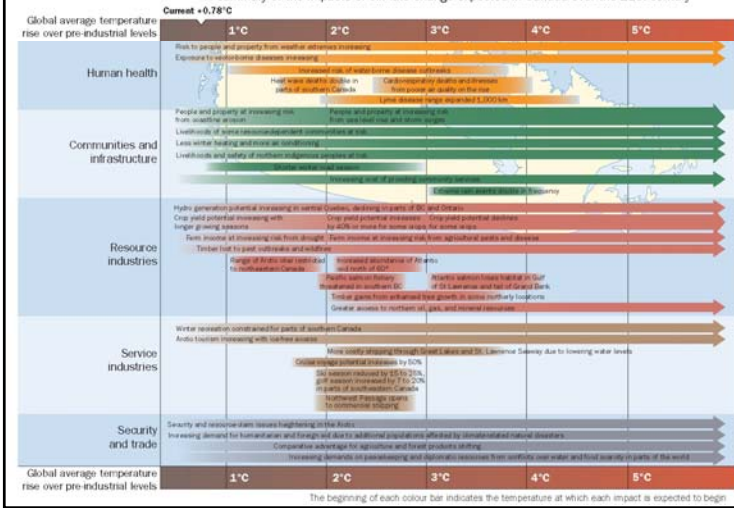


### Projected impacts of climate change



### DEGREES OF CHANGE

A summary of the impacts of climate change expected in Canada over the 21st century



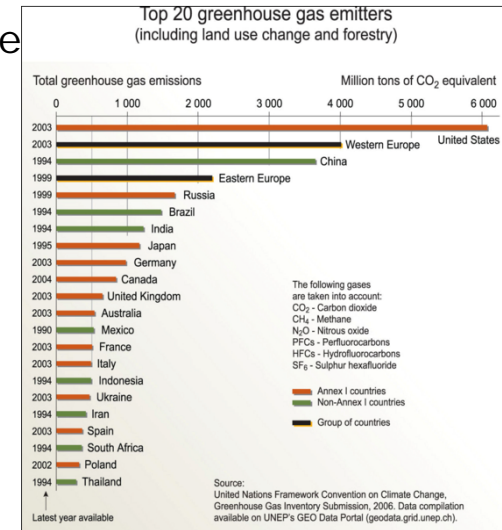
## 2. What was the Kyoto Protocol?

- More than 160 countries represented
- 



## What is the Kyoto Protocol?

- Targets for 38 developed nations to reduce GHGs emissions
- 



## Ratification of the Protocol

- Binding under international law
- 



Table 7.1 Greenhouse Gas Emission Reduction Targets under the Kyoto Protocol for Selected Countries

Country	Reduction commitment as percentage of base year
Australia	108
Canada	94
European Community	92
France	92
Germany	92
Iceland	110
Japan	94
Netherlands	92
New Zealand	100
Norway	101
Russian Federation	100
Sweden	92
Ukraine	100
United Kingdom	92
United States	93

Source: Kyoto Protocol 1997, Annex B.

## The main greenhouse gases

Greenhouse gases	Chemical formula	Pre-industrial concentration	Concentration in 1994	Atmospheric lifetime (years)**	Anthropogenic sources	Global warming potential (GWP)*
Carbon-dioxide	CO <sub>2</sub>	280 ppmv	358 ppmv	50-200	Fossil fuel combustion Land use conversion Cement production	1
Methane	CH <sub>4</sub>	700 ppbv	1720 ppmv	12-17	Fossil fuels Rice paddies Waste dumps Livestock	21 **
Nitrous oxide	N <sub>2</sub> O	275 ppbv	312 ppmv	120-150	Fertilizer Industrial processes combustion	310
CFCs	CFC12	0	503 pptv	102	Liquid coolants, Foams	125-152
HCFCs	HCFC-22	0	105 pptv	13	Liquid coolants	125
Perfluorocarbon	CF <sub>4</sub>	0	110 pptv	50 000	Production of aluminium	6 500
Sulphur hexa-fluoride	SF <sub>6</sub>	0	72 pptv	1 000	Production of magnesium	23 900

Note: ppbv= 1 part per billion by volume, ppmv= 1 part per million by volume

\* GWP for 100 year time horizon. \*\* Includes indirect effects of tropospheric ozone production and stratospheric water vapour production. \*\*\* On page 15 of the IPCC SAR, No single lifetime for CO<sub>2</sub> can be defined because of the different rates of uptake by different sink processes.

Source: IPCC radiative forcing report, Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996.

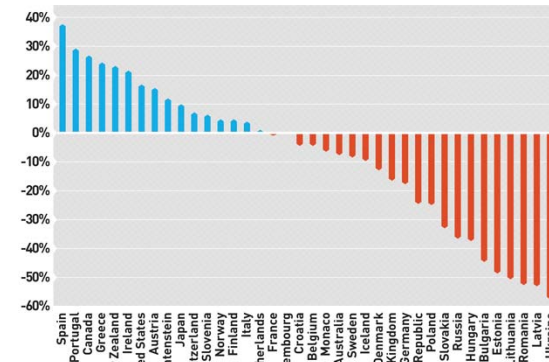


## Emission Credits and Trading

- Credits: can be earned by a nation based on land-use or forestry initiatives that reduce measurable GHGs emissions



## Gap between actual emissions and Kyoto Protocol GHG reduction objectives

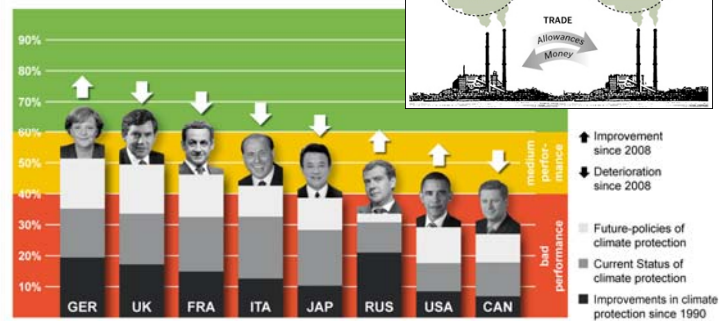


Source: Montreal Economic Institute (MEI), 2015

## GHG Reduction Post-Kyoto

### G8 fails on climate goals

The G8 doesn't fight climate change effectively



Source: G8 Climate Scorecards 2009. Report by Ecofys commissioned by WWF and Allianz SE.

## The Paris Agreement (2015)

- Global agreement to:



- Each country sets its targets and how to meet them



## 4. Canada and the Kyoto Protocol

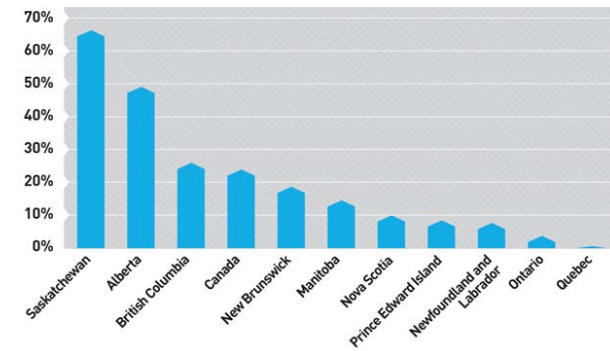
- Signed in 2002:

### Largest industrial CO<sub>2</sub> emitters

Facilities emitting more than 100 000 tonnes of CO<sub>2</sub> each year



## Gap between actual emissions and Canada's Kyoto Protocol GHG reduction objectives



Source: Montreal Economic Institute (MEI), 2015

## What Else?



## Conclusion

- Since the mid-19<sup>th</sup> century, global surface temperature has been steadily increasing, and this process is expected to continue in the future
- This process is linked to an increase in the atmospheric concentration of greenhouse gases, due to human activity
- Depending on the magnitude of the future change in temperature, numerous environmental and social negative impacts are expected to occur
- Governments worldwide have been attempting to address this issue, so far with mitigated success

## Things to Consider

1. How would your lifestyle change if you were to give up personal vehicle travel and rely only on public or self-propelled transportation (i.e., biking, walking, roller-blading, skateboarding, etc.)?
  - What would be the pros and cons of doing this? Does one option outweigh the other?
2. Canada has not met its targets of reducing its greenhouse gas emissions. Do you think that most Canadians agree with this approach, or do you feel that most citizens would like to see stronger climate change action in Canada?
  - What are the underlying reasons for both attitudes? How can citizens have an impact on decision-making at the federal level?

## TO DO!

1. Next lecture: Oceans and Fisheries – chapter 8 in textbook
2. Podcasts: Oceans and Fisheries – Units 1 to 3
3. Tutorials **this week**: Group Discussion; bring the “Group Discussion Answer Sheet”
4. Term Paper **this week**: Annotated Bibliography (**print it**) + review by a peer (bring a copy of the Review Grid)
5. Tutorials after Midterm Recess: Draft of Term Paper due + Group Discussion