Climate Change: The Need to Take [Adaptive] Action

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Experience

- PDF at The University of Lethbridge Agriculture Study
- Adaptation and Impacts Research Group, Environment Canada at the University of Toronto
- Science Authority, for the TNR Study
- Contributor to the Canada Country Study
- Lead author, report on climate change and health in the TNR
- Senior Scientist, Pollution Probe
- Co-lead author, Ontario chapter, contributor HC report
- Member of the Ontario Expert Panel on Climate Change Adaptation
- Member of Advisory Committee to Health Canada's Heat Stress Response Program
- Member of Advisory Committee to NRTEE "Climate Prosperity" Program
- Co-lead, The Gateway Project with MNR funded by NRCan

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Outline

- Science of Climate Change
- Urgency and Necessity of Adaptation
- National Assessments on Climate Change Risks, Vulnerability and Adaptive Capacity
- Climate Change Impacts and Adaptation in Canada
- Climate Change Impacts and Adaptation in Ontario
- Adaptation in Practice: The Ontario Example

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Scientists have studied the relationship between greenhouse gas concentrations and climate for more than a century





Windsor 2011

The IPCC is the principle source of sound advice on climate change science



Direct Observations of Recent Climate Change

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.

"Warming of the climate system is unequivocal" IPCC Fourth Assessment Report, 2007



Direct Observations of Recent Climate Change

At continental, regional, and ocean basin scales, numerous long-term changes in climate have been observed. These include:

- Changes in Arctic temperatures and ice,
- Widespread changes in precipitation amounts, ocean salinity, wind patterns
- and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones



Personal Observations: Glacial Retreat in the Rockies

Ghost Glacier, Mt. Edith Cavell, Jasper Park, Canadian National Railway.

Copenhagen Diagnosis 2009: Observed and modeled Arctic sea-ice extent



Copenhagen Diagnosis 2009: Sea-level change 1970-2010



Recently in the news...

- Mass tree deaths prompt fears of Amazon 'climate tipping point'
 - Scientists fear billions of tree deaths caused by 2010 drought could see vast forest turn from carbon sink to carbon source

Recently in the news...

- Report: Great Lakes can experience
 water shortages
 - Despite having more fresh water than anywhere else in the world, the Great Lakes region could experience shortages in some locations because of climate shifts or surging demand, a federal analysis says.

Recently in the news...

- 2010 ties 2005 as warmest year on record worldwide
 - It's a tie: Last year equaled 2005 as the warmest year on record, government climate experts reported Wednesday.
 - In addition, the Global Historical Climatology Network said Wednesday that last year was the wettest on record.

Reconstructed, observed and future warming projections



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is 2.0-4.5°C.

0°C

-1°C

ⁱo

Year

300

0°C

00,00

Projections of Future Changes in Climate

Projected warming in 21st century expected to be

greatest over land and at most high northern latitudes

and least over the Southern Ocean and parts of the North Atlantic Ocean



0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5

Projections of Future Changes in Climate

Projected Patterns of Precipitation Changes



Precipitation increases very likely in high latitudes; Decreases likely in most subtropical land regions

Very likely that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent

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UN Framework Convention on Climate Change

Article 2

• "... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent **dangerous** anthropogenic interference with the climate system.

Dangerous – how much change? Stabilization – at what level?

The International Community has chosen 2C° global warming as the "dangerous" level – only 1.3C° more warming.

The abundance, atmospheric lifetime, and Global Warming Potential of GHGs vary considerably

GHG	Abundance (1998, ppbv)	Lifetime (years)	GWP (100 yr)
CO ₂ Carbon Dioxide	365,000	variable	1
CH ₄ Methane	1745	12	23
N ₂ O Nitrous Oxide	314	114	296
CFCs, HCFCs	up to 0.5	2-1700	120-14,000
HFCs	up to 0.02	0.3-220	12-12,000
PFCs, SF ₆	up to 0.08	2600-50,000	5700-22,200

Emissions pathways to give 67% chance of limiting global warming to 2°C



Inevitability of Climate Change

"The overwhelming majority of scientific experts, whilst recognizing that scientific uncertainties exist, nonetheless believe that human-induced climate change is inevitable. The question is not whether climate will change... but rather how much... how fast, and where"

Robert Watson, Chair of IPCC to CoP6 Delegates, The Hague, November 2000

"Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable" (WGII SPM)

Even in regions with high incomes, some people, areas and activities can be particularly **at risk** from climate change (Synthesis Report)







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Impacts and Adaptation: Two National Assessment Reports

Health

Santé





Canada

http://www.adaptation.nrcan.gc.ca/assess/2007/index_e.php

ccadaptation@hc-sc.gc.ca E-Mail: info@hc-sc.gc.ca

tre santé et votre

Highlights

- The report reflects the advances made in understanding climate change impacts and adaptation in Canada.
- It highlights key issues facing each region of the country (Northern Canada, Atlantic Canada, Quebec, Ontario, Prairies and BC) in a policy-relevant manner.
- It provides a concise, credible up-to-date source of information that will inform adaptation decision-making.
- 145 authors from governments, universities and NGOs from across Canada participated, and over 3100 references were cited; 448 pages
- Chapters were reviewed by 110 scientific experts and government (Federal, Provincial/Territorial) officials.

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The impacts of changing climate are already evident in every region of Canada.



Many Regions of Canada's Coastline are Vulnerable to Sea Level Rise



Geological Survey of Canada, Bulletin 505

Winter Temperature Change 2080s



Moisture Deficit 1961-1990



Climate Change: Projected Moisture Deficit 2050 (CGCM1)



Point potential evapotranspiration

Lyme Disease

Model simulation results suggest that *Ixodes scapularis* populations in Canada (red triangles) occur at the limit of temperature suitability for the tick. Temperature may be a significant factor limiting northward expansion of the geographic range of *I. scapularis*, but this is expected to change rapidly with projected climate change



Key Findings

- The results from the assessment provide sound scientific evidence that Canada's climate is changing and that the impacts from of a changing climate are already evident in every region of the country.
- It is anticipated that climate change will exacerbate many current climate risks, while presenting new risks and opportunities, especially for communities, infrastructure and ecosystems.
- While Canada has a relatively high capacity to adapt, this capacity is unevenly distributed between and within regions and populations.

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CHAPTER 6 Ontario

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The impacts of climate change are already being felt













Annual Change: Mean Temperature and Precipitation



Ontario Temperature Change 2071-2100

Summer

Winter



Average summer and winter temperature, CGCM2, A2 scenario

Key Findings

- The social, economic and cultural health of Ontario is influenced by climate.
- Since 1948, average annual temperatures in Ontario have increased by as much as 1.4°C. This trend is projected to continue, with the most pronounced temperature increases occurring in winter. Projections also indicate that intense rainfall events, heat waves and smog episodes are likely to become more frequent.
- Physical infrastructure, water quality and supply, human health and well-being, remote and resource-based communities, and ecosystems are highly sensitive to climate.
- Impacts include disruptions to critical infrastructure; water shortages; increased health risks; remote and resourcebased communities; unmanaged and managed ecosystems
- Ontario has a strong capacity to adapt to climate change, but...

Gradual Change vs Severe Weather

Impacts from Gradual Change

- Ecosystem shifts
- Lyme disease
- Winter roads
- Increased demand for electricity in summer
- Lower Great Lakes water levels
- Water shortages
- Winter tourism/spring tourism
- Forest pest outbreaks
- Degradation of wetlands

Impacts from Severe Weather

- Storm water flooding
- Electricity transmission failure
- Water-borne disease
 outbreaks
- Heat stress
- Smog episodes
- Water shortages
- Loss in agricultural productivity
- Increase in forest fires

Chapter 4

Air Quality, Climate Change and Health



Serge Lamy Véronique Bouchet

Contributions: Kachieven Daset Sophie Coustimeau Barry Jessiman Branka Josic Stan Judek Chard Noory Tom Koasisity Chic Litvak Radon tio Pavitovic Niedea Pavitobeca Dave Salo Two scenarios: (1) the individual effects of an increase in temperature on air quality (scenario CC4) and (2) the effects of changes in biogenic emissions of air pollutant precursors along with increases in temperature (scenario CC4b).

 4 degree increase in summer temperature, using 2002 as reference year

Projects of Air Quality with Climate Change

- Increased emissions of biogenic VOCs and soil NO may result in higher ambient O3 concentrations
- In contrast, reductions in the average PM2.5 concentration were observed from baseline

Projections for 2080



Figure 4.7 Changes in summer time average daily maximum 8-hour O_3 concentration (ppb) projected under the 2080s climate change scenario simulation relative to that for the 1990s





Number of Ozone exceedences to increase by 15% Episodes could lengthen by up to 30 hours 658 more premature deaths, 4.6% increase in health costs

Heat waves in Canadian cities will become more frequent



Background ambient levels of O₃ could increase by 40 ppm Emission increase by 20% by 2050 and 32% by 2080. The annual total number of poor O3 days would increase 4-11 and 10-20 respectively. Air pollution mortality will increase by 20-25% and 30-40% by 2050 and 2080 Number of heat-related deaths will double and triple





- Uncertainty no justification for inaction
- Do we have sufficient information to begin to take action on adaptation?

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Advisory Systems



Example of a sign indicating that a cooling shelter has been opened during an extreme heat event.

Air Quality Health Index



Ontario Expert Panel on Climate Change Adaptation

Adapting ** Climate Change **Ontario

Report of the Expert Parel on Climate Change Adaptation

November 2019

Co-Chairs: Dr. Ian Burton Dr. David Pearson

Members: Grand Council Chief John Beaucage **Alain Bourque** Dr. Quentin Chiotti Dr. Judith Read Guernsey **David Lapp Eva Ligeti** Dr. Gordon McBean **Jo-Ellen** Parry **Dr. Barry Smit**

Federal Support

 Dec 2007- \$85.9M for programming to help Canadians increase their capacity to adapt to a changing climate

 Includes \$35M for NRCan to establish Regional Adaptation Collaboratives program (\$30M) & develop Tools for Adaptation (\$5M)
 Now \$19.8M for RACS

 Health Canada investing in development of heat alert systems



- The **Gateway** will be a web-based integrated Provincial weather and water information discovery and access service to facilitate decision-making at the community (or local) level.
- The Gateway will allow easy, timely access to data and information required for critical business functions such as:
 - Flood and Drought Management
 - Source Water Protection
 - Permit to Take Water
 - Municipal Infrastructure Management
- This important weather and water related data and information will be easier to discover, access and share between multi-level agencies as adaptation measures are developed for current and future climate conditions.

MNR, ACER, CA's, Communities, other stakeholders



Gaps Analysis, Gateway Input and Testing, Knowledge Transfer

Project Coordinators



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Thank You

