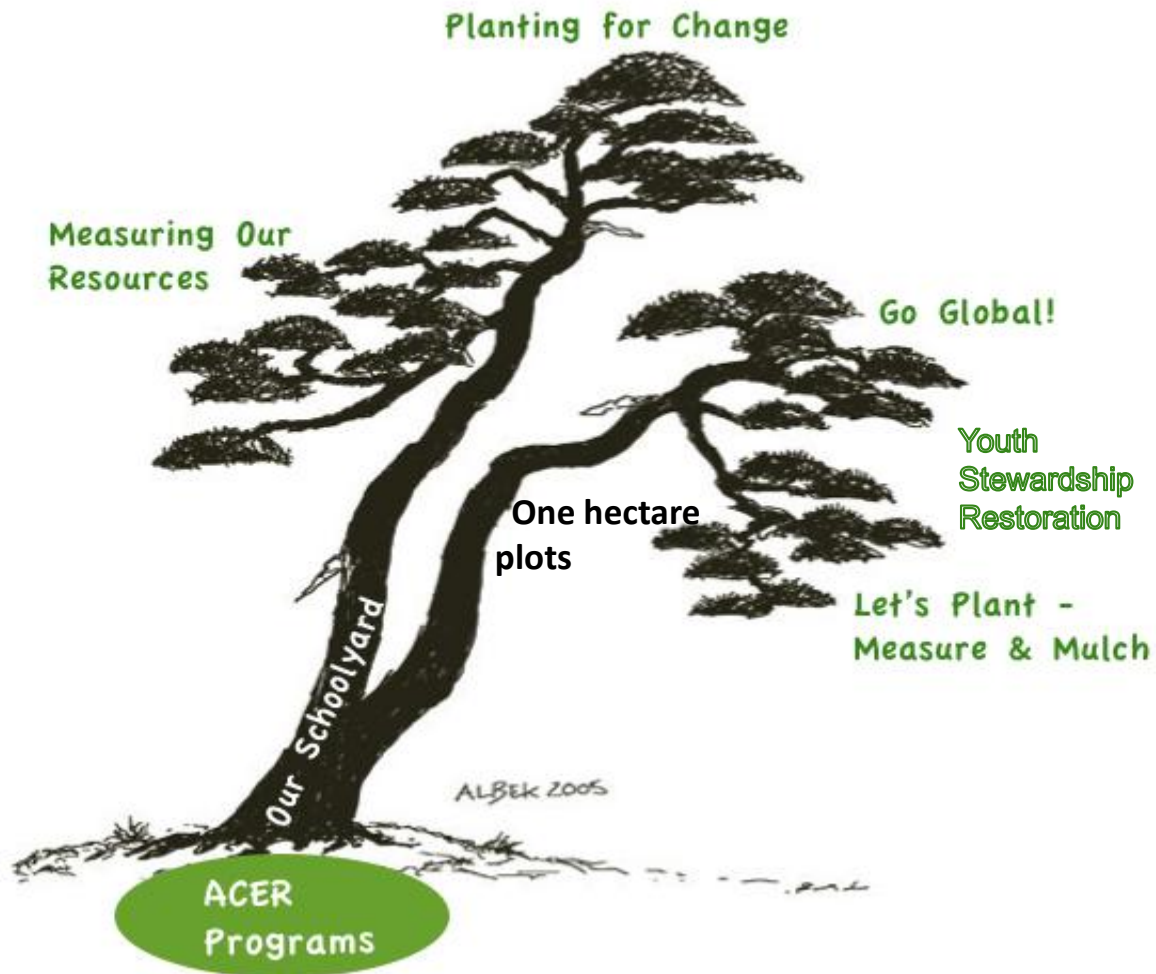


Climate Change: The Need to Take [Adaptive] Action in Watershed Management

Dr. Quentin Chiotti
Fabio Tonto

Association for Canadian Educational
Resources

Associate Member of Graduate Studies
Centre for Environment
University of Toronto





**Incoming
Solar Energy**

**Reflected Energy
~31%**

The Atmosphere's Energy Budget

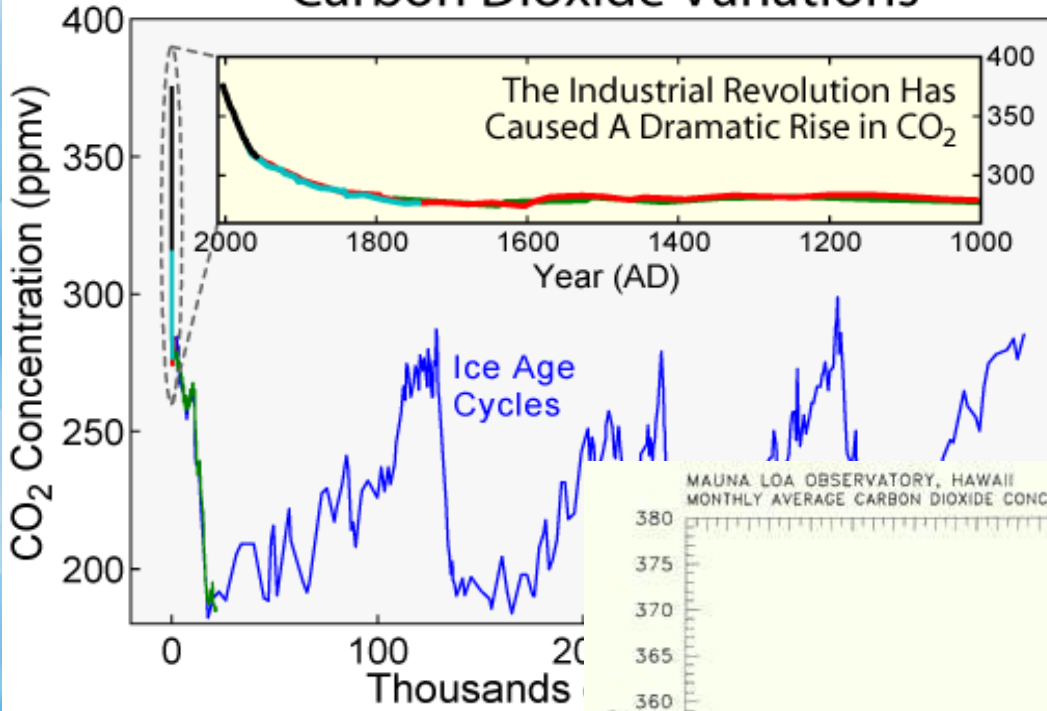
Natural greenhouse effect warms the
surface by 33°C; -19°C instead of +14°C

**Outgoing
Heat Energy**

**Energy Trapped
By Greenhouse Gases**

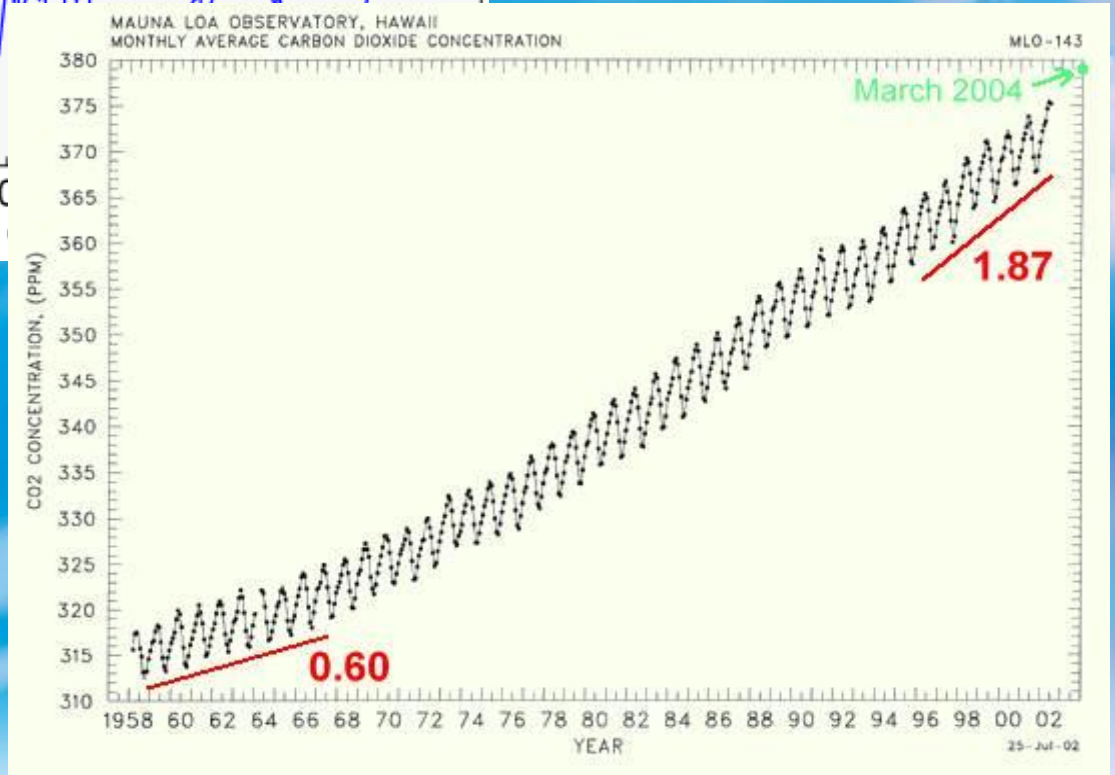
- CO₂ 0.028%
- CH₄ 0.0007%
- N₂O 0.0003%

Carbon Dioxide Variations

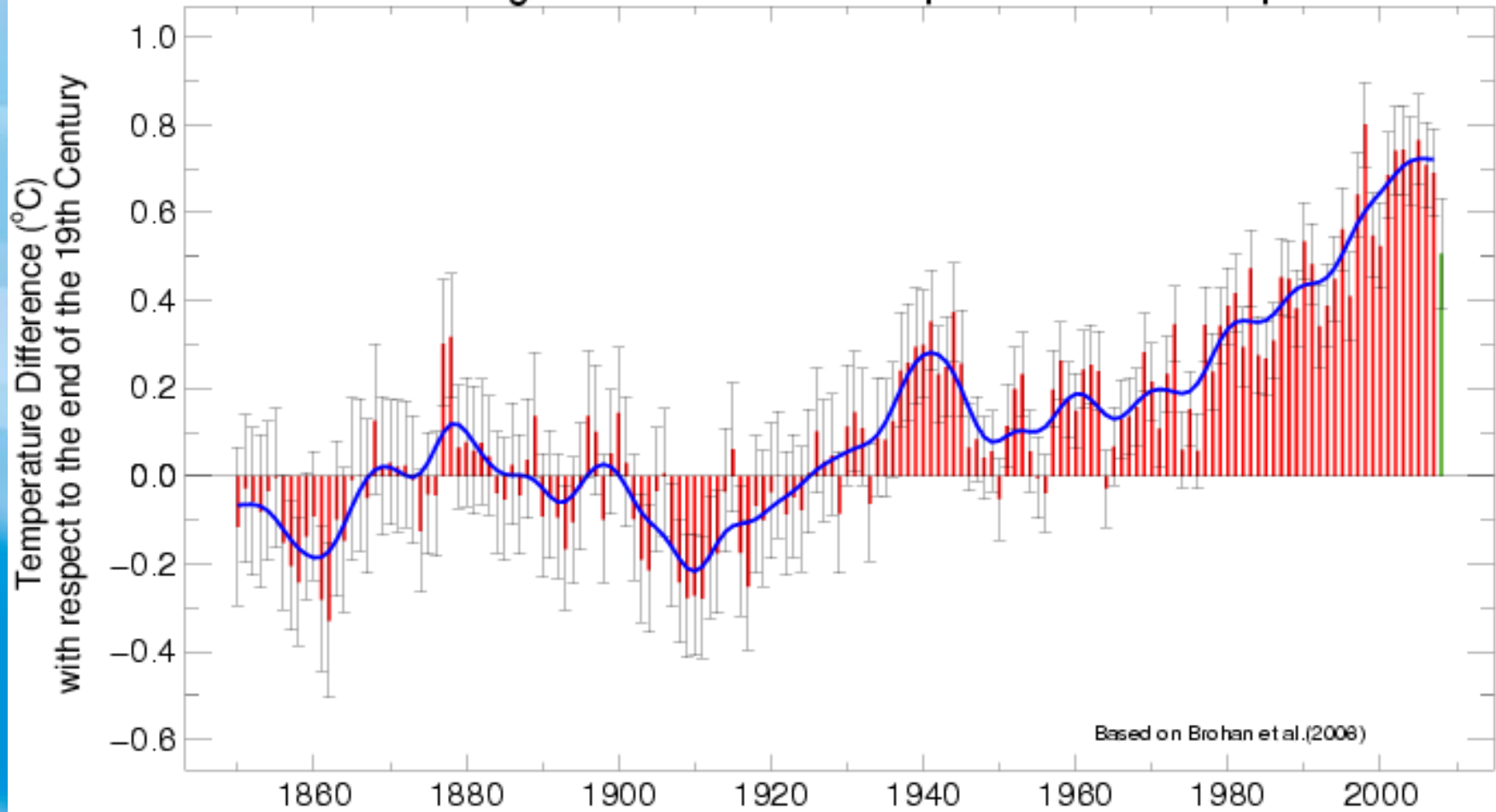


**Current CO₂ is
385 ppm;
CO₂e is
435 ppm**

**Pre-industrial levels
were 275 ppm
2xCO₂ = 550 ppm**

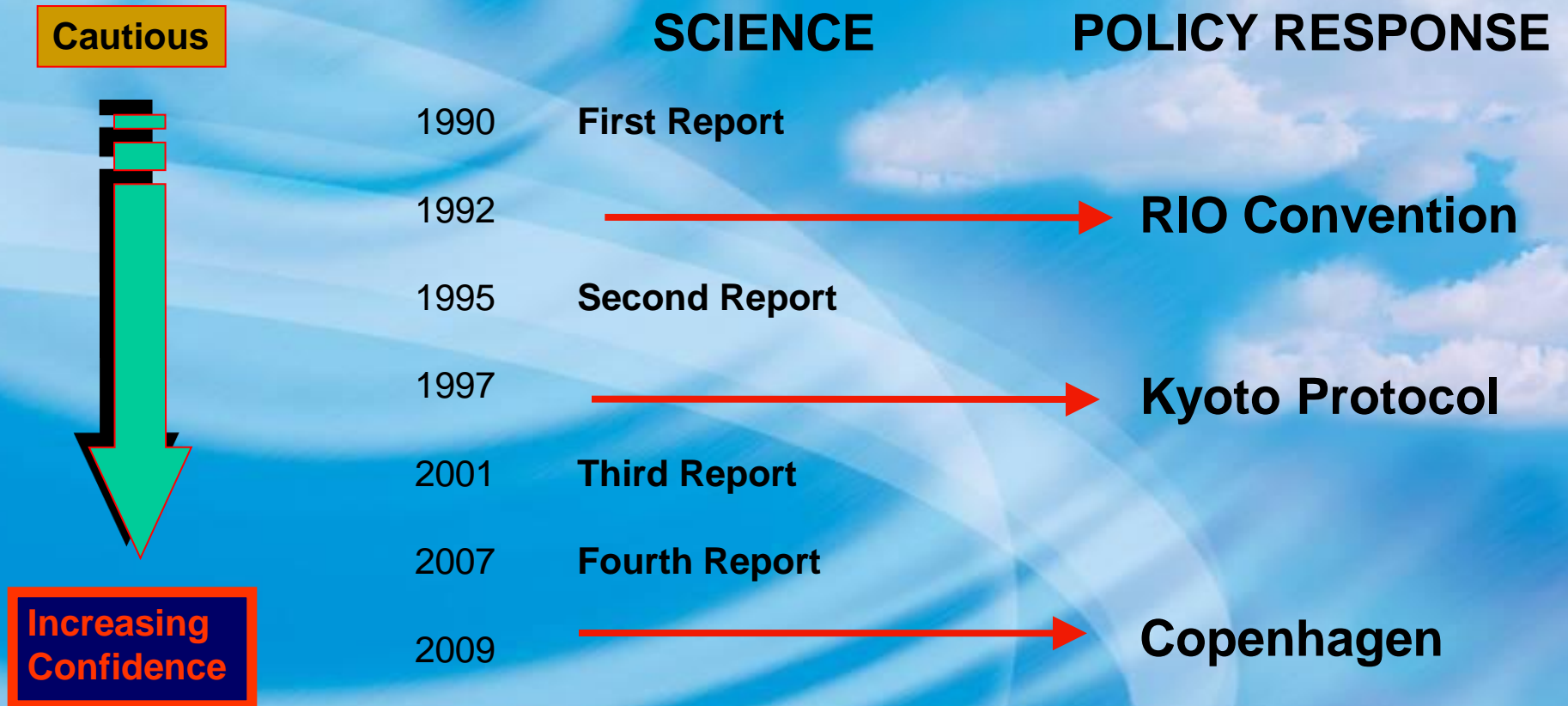


Global Average Near-Surface Temperatures 1850–Apr 2008



Based on Brohan et al. (2006)

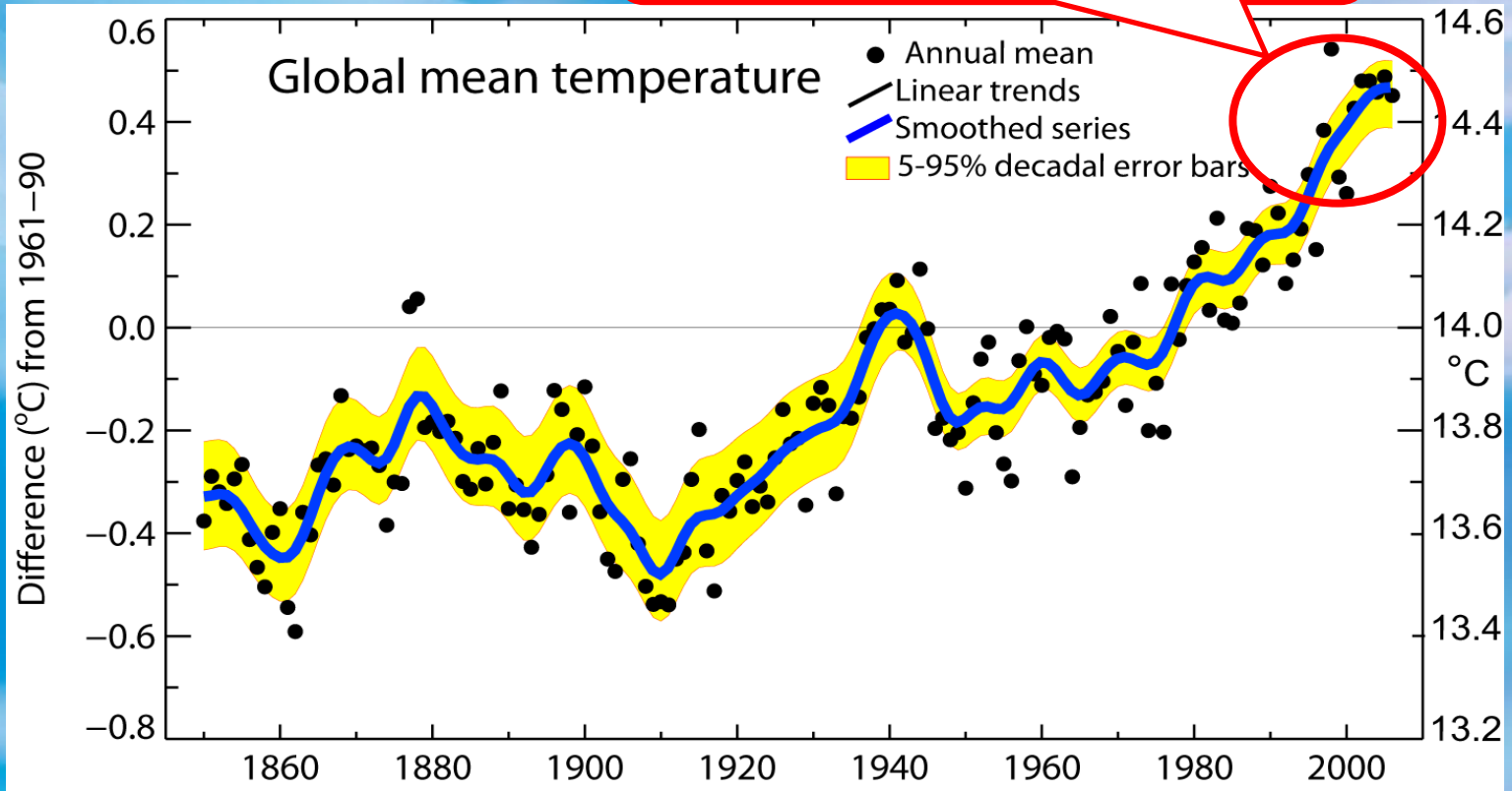
The IPCC is the principle source of sound advice on climate change science



“Warming of the climate system is unequivocal”

IPCC Fourth Assessment Report, 2007

**Warmest 12 years:
1998, 2005, 2003, 2002, 2004, 2006
2001, 1997, 1995, 1999, 1990, 2000**



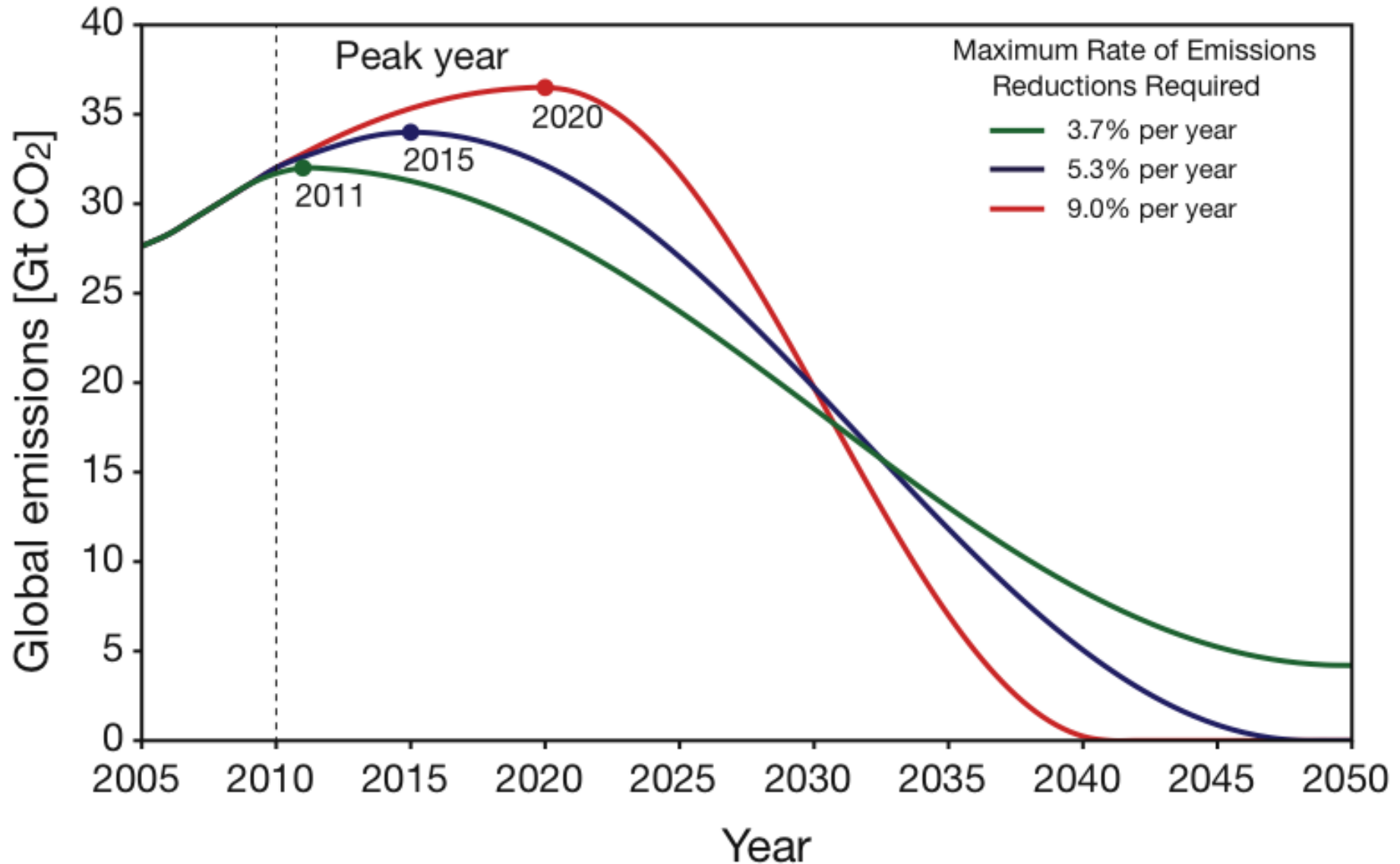
UN Framework Convention on Climate Change

- 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.

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



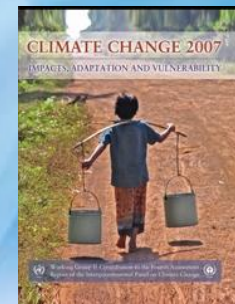
Inevitability of Climate Change

“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**”

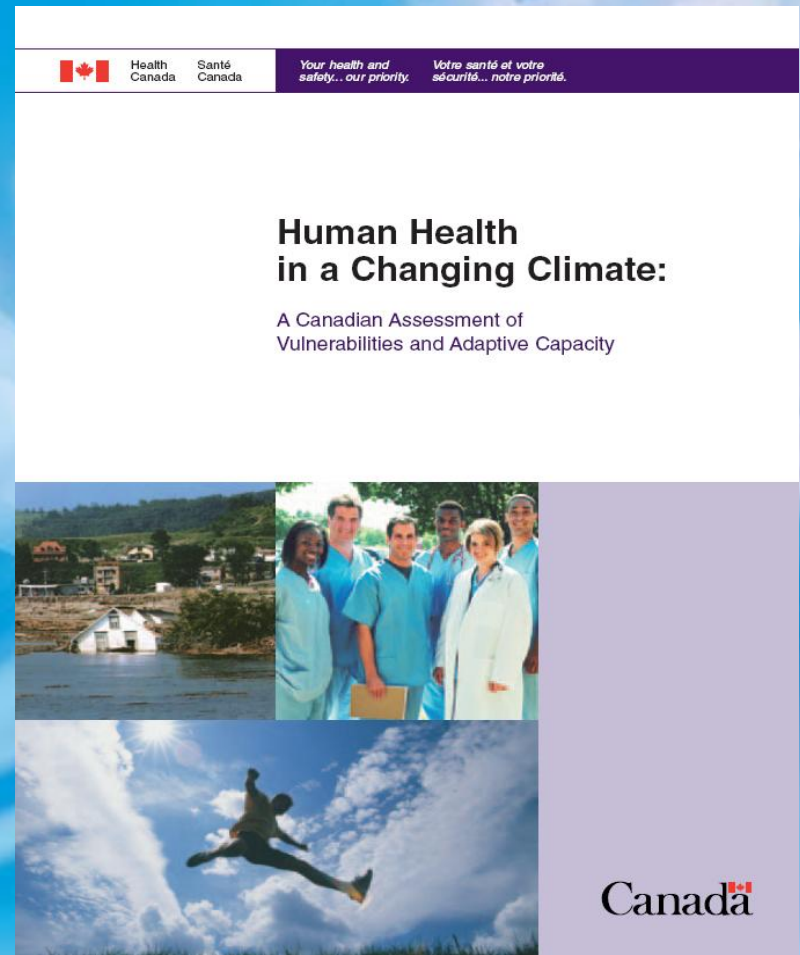
*Robert Watson, Chair of IPCC to CoP6
Delegates, The Hague, November 2000*

“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)



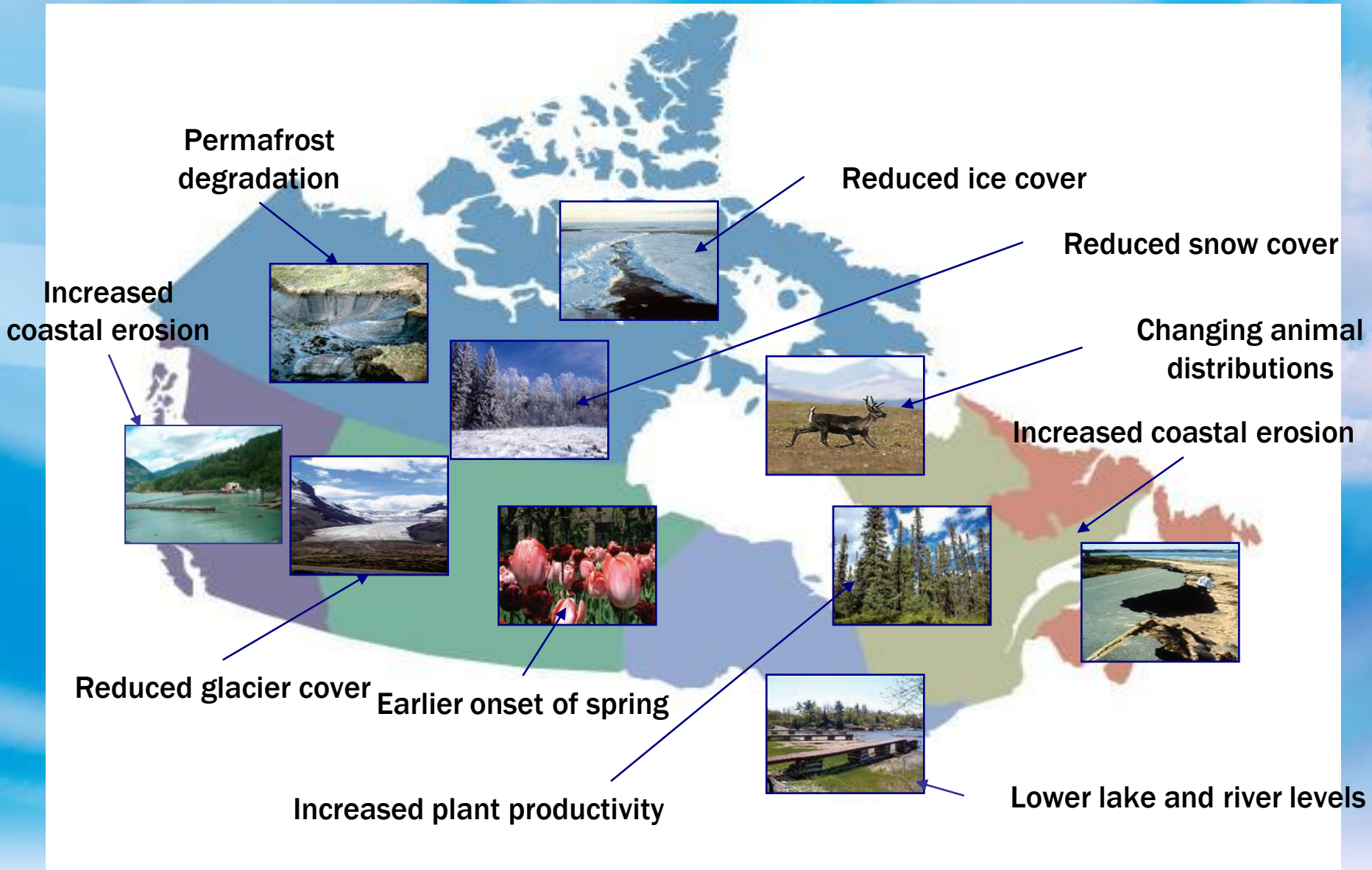
Impacts and Adaptation: Two National Assessment Reports



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

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

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





**Towards a Vision and Strategy for
Water Management in Canada**

**Final Report of the Water Policy in Canada:
National Workshop Series**

April 2007



**A New Approach to Water
Management in Canada**

Vision and Strategy

March 2008

The Issues

- **Climate change impacts**
- **Pollution**
- **Loss of ecosystem services**
- **Population growth and urban development**
- **Competing demands**
- **Water diversion threats**
- **Inadequate drinking water treatment**

A future very different than the past 100 years

- Substantial temperature increases in all seasons
- Changes in the seasonal distribution of precipitation
 - More in the winter and less in the summer, but less snow and more rain
 - Earlier spring freshet
 - Extremes, in the form of droughts and high-intensity rainfall events, also expected to become more common
- Evapotranspiration also expected to increase

CHAPTER 6 Ontario

Lead authors:
Quentin Chiotti* and Beth Lavender*

Contributing authors:
Ken Abraham (Ontario Ministry of Natural Resources), John Casselman (Queen's University), Steve Colombo (Ontario Ministry of Natural Resources), Philippe Crabbé (University of Ottawa), Bill Crins (Ontario Ministry of Natural Resources), Rob Davis (Ontario Ministry of Natural Resources), Al Douglas (MIRARCO), Paul A. Gray (Ontario Ministry of Natural Resources), Lawrence Ignace (Environment Canada), Chris Lemieux (University of Waterloo), Rob McAlpine (Ontario Ministry of Natural Resources), Martyn Obbard (Ontario Ministry of Natural Resources), Charles O'Hara (Ontario Ministry of Transportation), Jacqueline Richard (MIRARCO), Carrie Sadowski (Ontario Ministry of Natural Resources), Daniel Scott (University of Waterloo), Mark Taylor (AMEC Earth and Environmental), Ellen Wall (University of Guelph)

Quentin Chiotti and Beth Lavender. © 2011. Ontario Pollution Probe Foundation. All rights reserved. This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. For more information, see <http://creativecommons.org/licenses/by-nc-sa/4.0/>.

* Pollution Probe Foundation, ON
* Ontario Pollution Probe Foundation, ON

ONTARIO

Lead authors:

Quentin Chiotti (*Pollution Probe*)

Beth Lavender (*Natural Resources Canada*)

Contributing authors:

Ken Abraham (*Ontario Ministry of Natural Resources*)

John Casselman (*Queen's University*)

Steve Colombo (*Ontario Ministry of Natural Resources*)

Philippe Crabbé (*University of Ottawa*)

Bill Crins (*Ontario Ministry of Natural Resources*)

Rob Davis (*Ontario Ministry of Natural Resources*)

Al Douglas (*MIRARCO*)

Paul A. Gray (*Ontario Ministry of Natural Resources*)

Lawrence Ignace (*Environment Canada*)

Chris Lemieux (*University of Waterloo*)

Rob McAlpine (*Ontario Ministry of Natural Resources*)

Martyn Obbard (*Ontario Ministry of Natural Resources*)

Charles O'Hara (*Ontario Ministry of Transportation*)

Jacqueline Richard (*MIRARCO*)

Carrie Sadowski (*Ontario Ministry of Natural Resources*)

Daniel Scott (*University of Waterloo*)

Mark Taylor (*AMEC Earth and Environmental*)

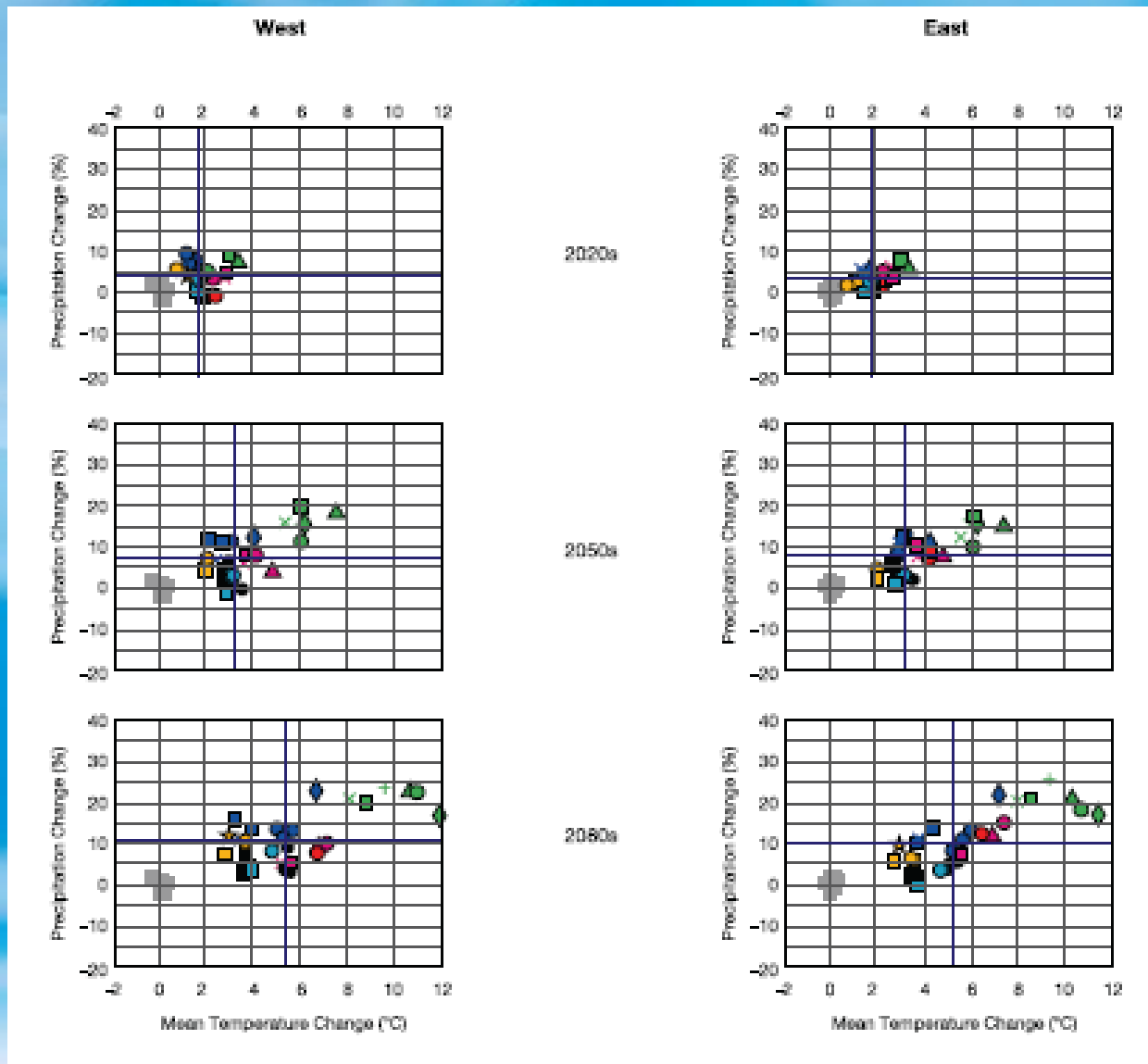
Ellen Wall (*University of Guelph*)

The impacts of climate change are already being felt



H.

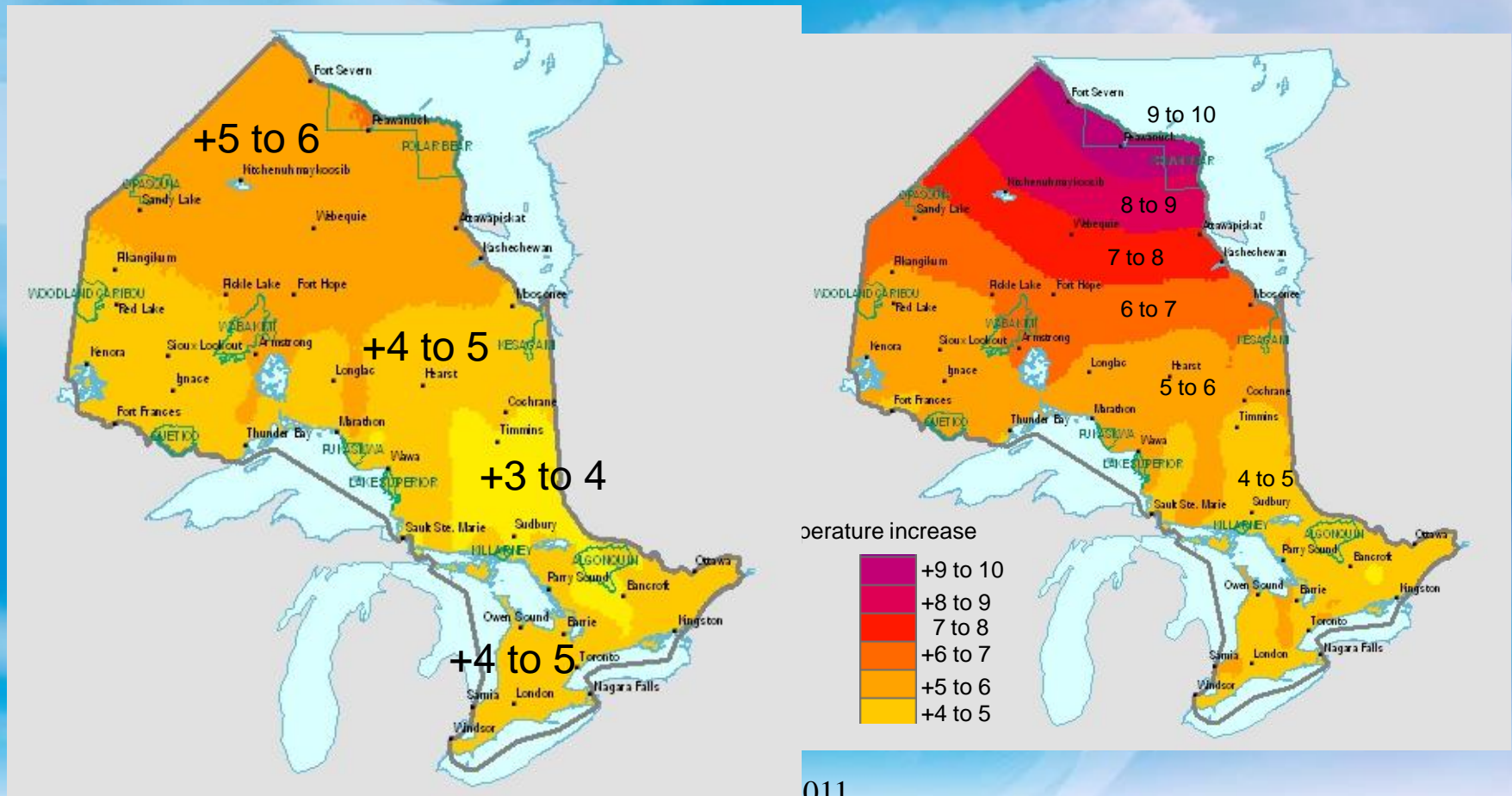
Annual Change: Mean Temperature and Precipitation



Ontario Temperature Change 2071-2100

Summer

Winter



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

Ontario Expert Panel on Climate Change Adaptation



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

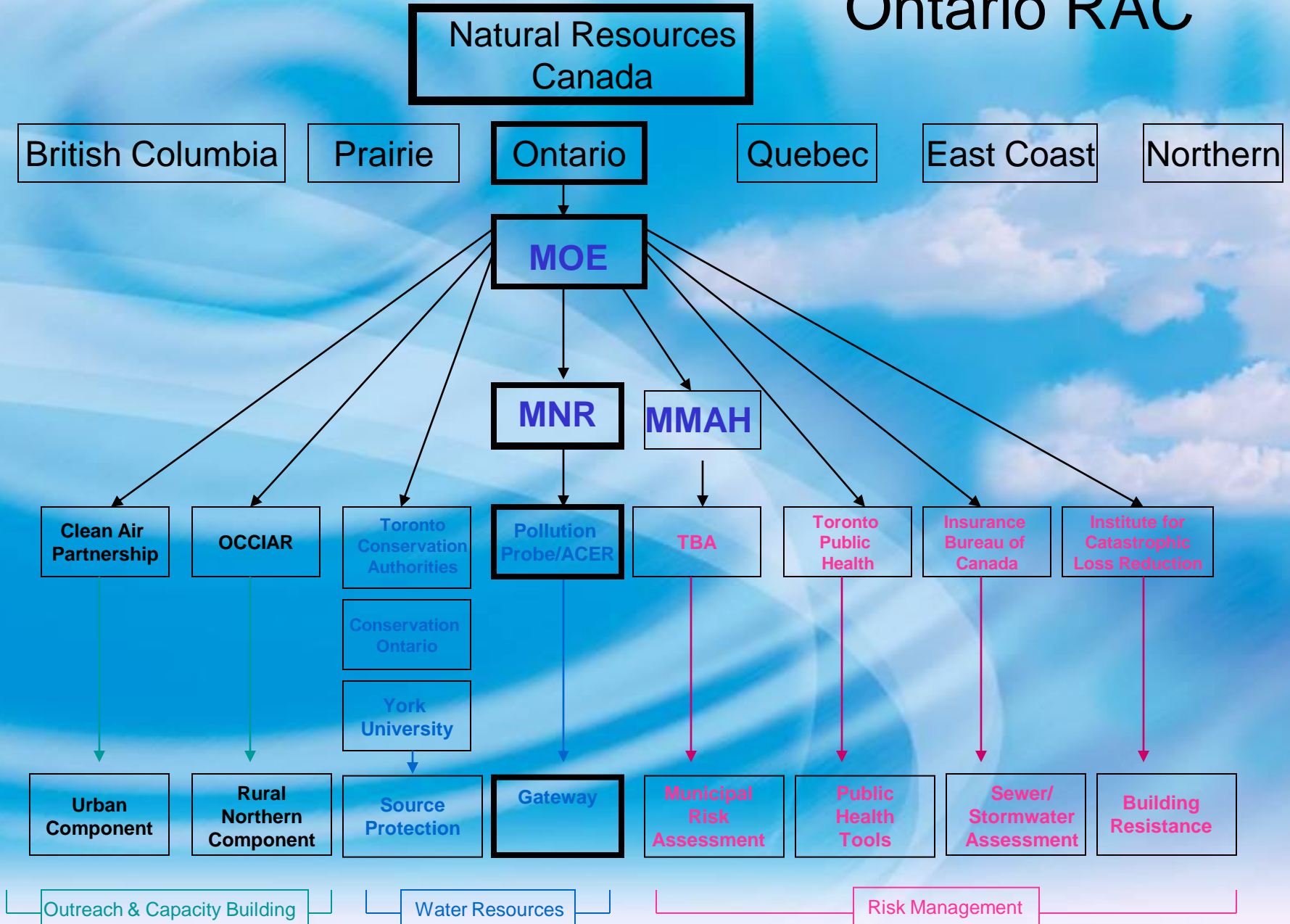
Jo-Ellen Parry

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

Ontario RAC



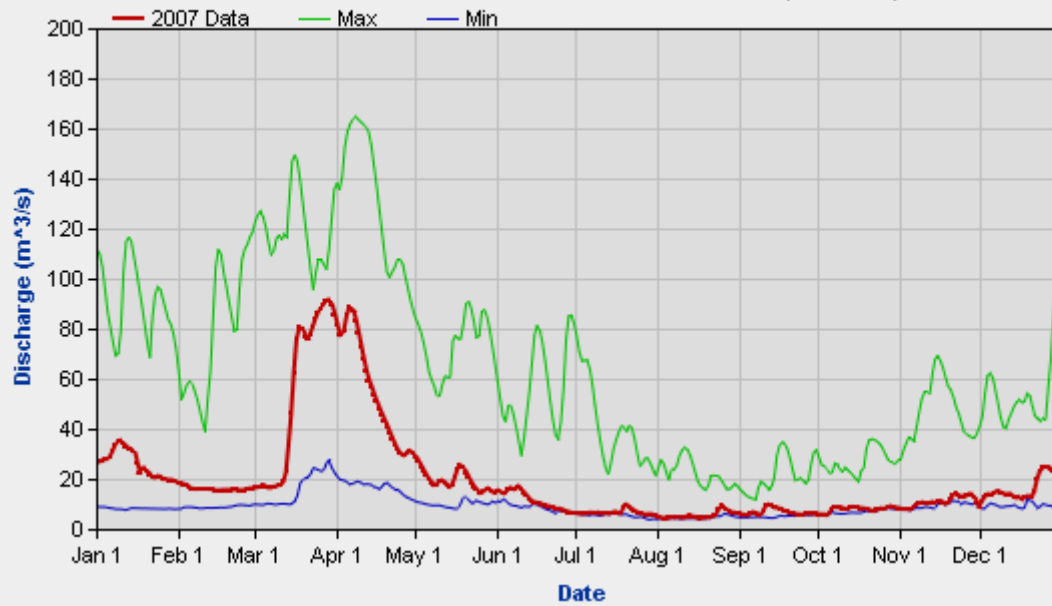
Weather & Water Information Gateway

- 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.

Participating LACs

- Peterborough and Otonabee Region Conservation Authority – flooding
- GTA and Toronto and Region Conservation Authority – Storm water management
- NCC and the Mississippi and Rideau Source Protection Planning Committee – Source water protection planning
- Nottawasaga Valley Conservation Authority – Low water response
- Sudbury and the Nickel District Conservation Authority
- Conservation Ontario

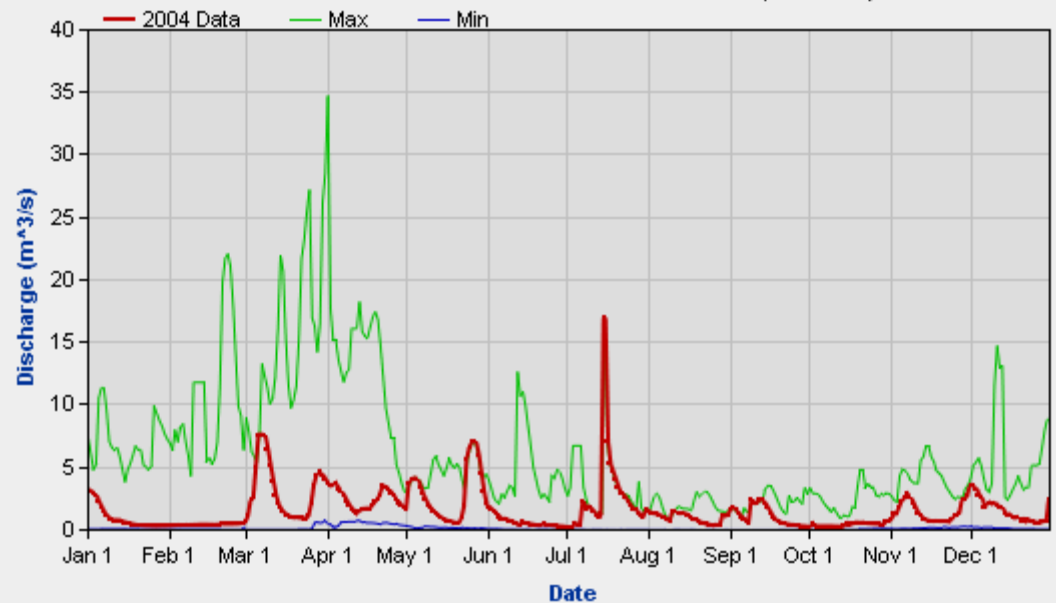
Daily Discharge for
NOTTAWASAGA RIVER NEAR EDENVALE (02ED027)



Too Little Water

Too Much Water

Daily Discharge for
JACKSON CREEK AT PETERBOROUGH (02HJ001)



Decision-Making Context

- main influences on decision making?
- significant guidelines and regulations?
- tools and guidelines currently used?
- how much do you take climate change into account?
- what information is needed to make informed adaptation decisions?
- historical information
- updating data and standards
- climate change information needs

What are your information needs?

- Information, data and tools
 - Stream flow gauges
 - Rainfall gauges
 - Updated IDF Curves
 - Flood risk mapping
 - Culvert vulnerability and design
 - Climate change modeling
 - Assessment tools and Guidance documents

Project Coordinators



Ian D. Cameron, P.Eng.
Coordinator,
Surface Water Monitoring Centre
Ontario Ministry of Natural Resources
300 Water Street
Peterborough, Ont.
K9J 8M5
Tel: (705) 755-1215
ian.d.cameron@ontario.ca

James Britton
Manager,
Water Resources Information Program
Ontario Ministry of Natural Resources
300 Water Street
Peterborough, Ont.
K9J 8M5
Tel: (705) 755-1870
James.Britton@ontario.ca



Dr. Quentin Chiotti
The Gateway Project
Co-lead,
Unit 44, 3665 Flamewood Drive
Mississauga, ON
L4Y 3P5
Tel: 416-222-8936
qchiotti@rogers.com