



# EC Adaptation and Impacts Research



Grace Koshida, AIRS

Extremes Workshop

Winnipeg, MB,

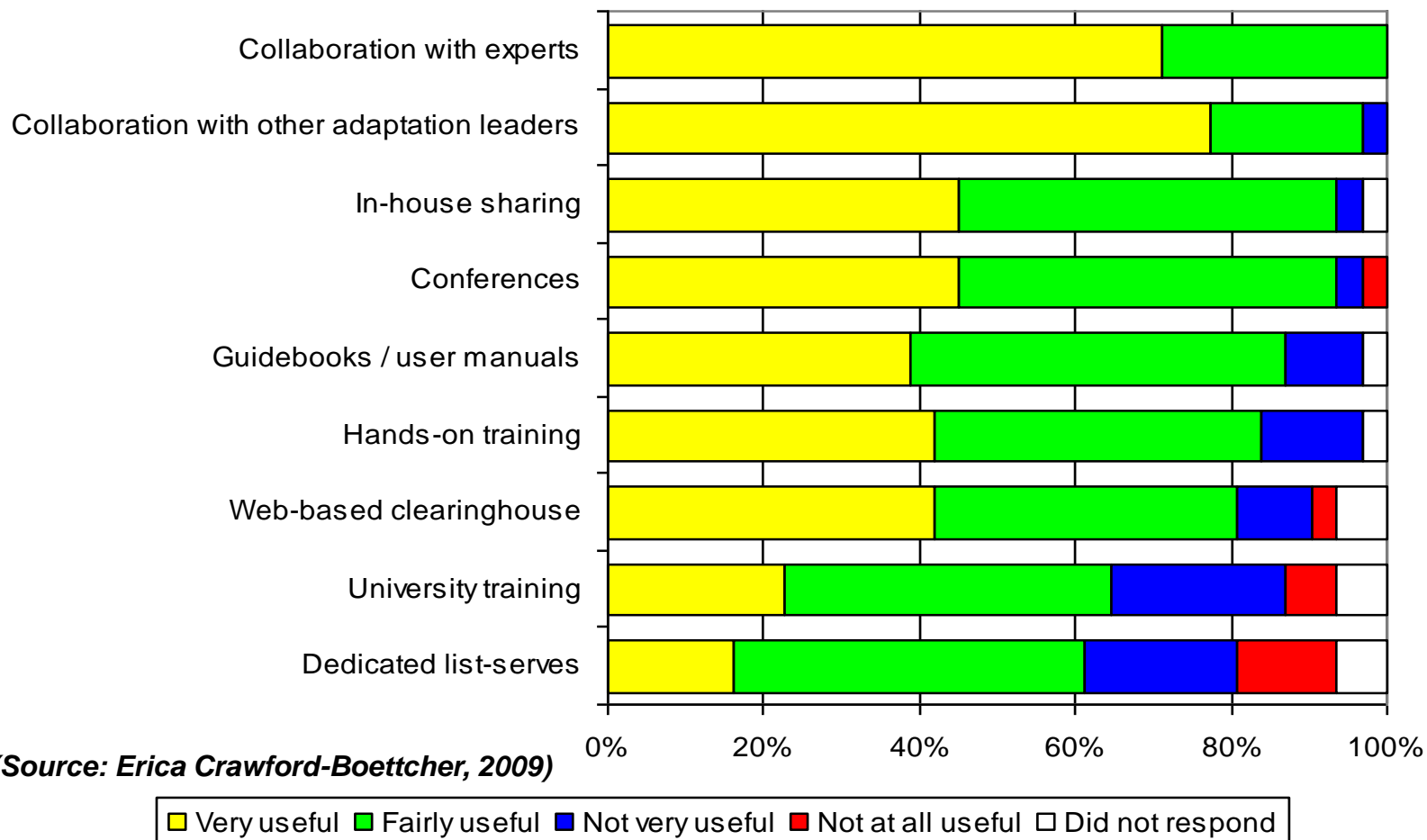
February 7-9, 2011

[Grace.Koshida@ec.gc.ca](mailto:Grace.Koshida@ec.gc.ca)



# EVALUATION SURVEYS:

*Clients priority is collaboration with Adaptation experts*





## Most Expensive Canadian Natural Disasters (Total Estimated Economic Impact $\geq$ \$1 Billion)

Date of occurrence	Event	Location	Estimated Total Cost (billion 2000\$)
2001-2002	Drought	Prairie provinces, Ontario, Nova Scotia, PEI	\$5.8
1980	Drought	Prairie provinces	\$5.8
January 4-10, 1998	Freezing rain	Ontario to New Brunswick	\$5.4
1988	Drought	Prairie provinces	\$4.1
1979	Drought	Prairie provinces	\$3.4
1984	Drought	Prairie provinces	\$1.9
July 19, 1996	Flood	Saguenay region, Québec	\$1.6
May, 1950	Flood	Winnipeg, Manitoba	\$1.1
October 15, 1954	Hurricane Hazel	Toronto and southern Ontario	\$1.1
1931-1938	Drought	Prairie provinces	\$1.0
1989	Drought	Prairie provinces	\$1.0

Source: Public Safety Canada (PSC), Wheaton et al., 2007

From Etkin et al., 2010 report



# Canadians at Risk (2010)

- Last publication from CNHAP (Canadian Natural Hazards Assessment Project) prepared by David Etkin et al.
  - Written for general public
  - Special issue of *Natural Hazards* journal (2005), CNHAP decision-makers summary (2004)
- Report available via ICLR web site

<http://www.iclr.org/canadiansatrisk.html>

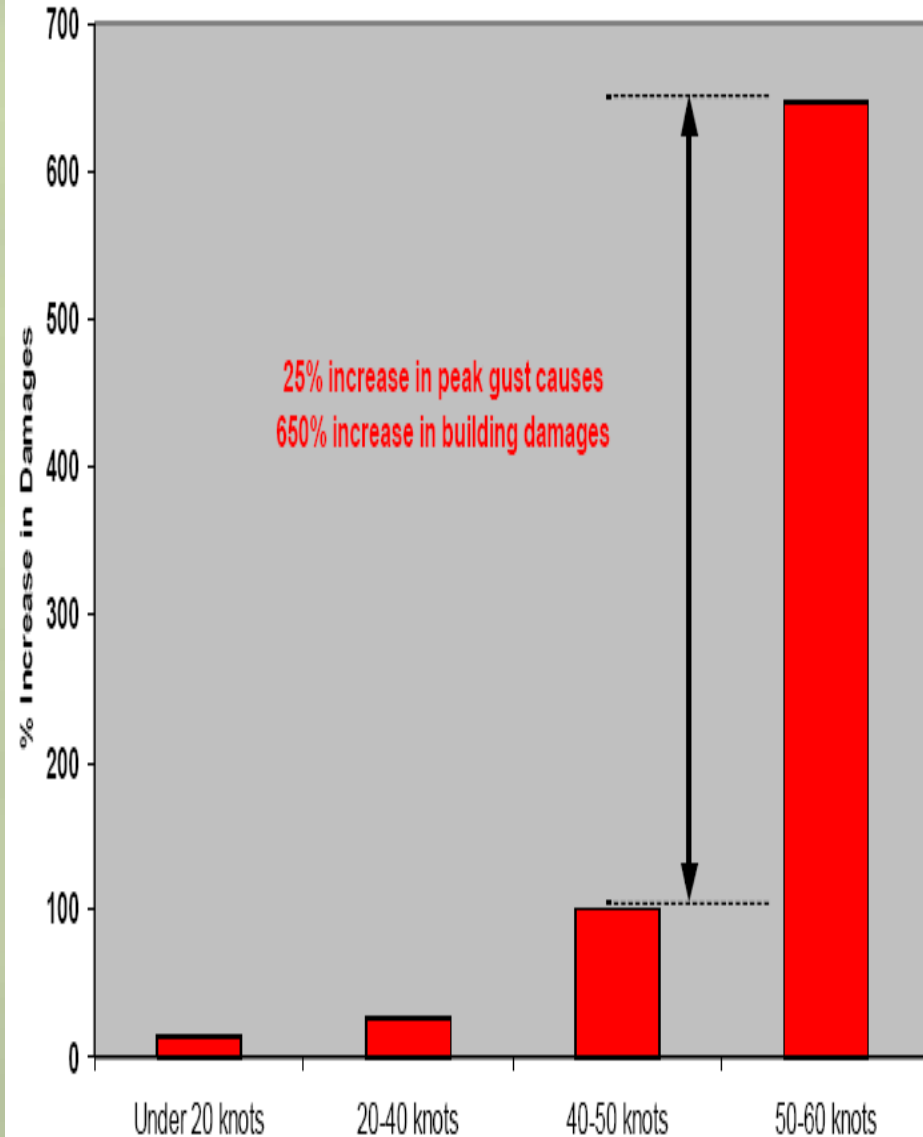
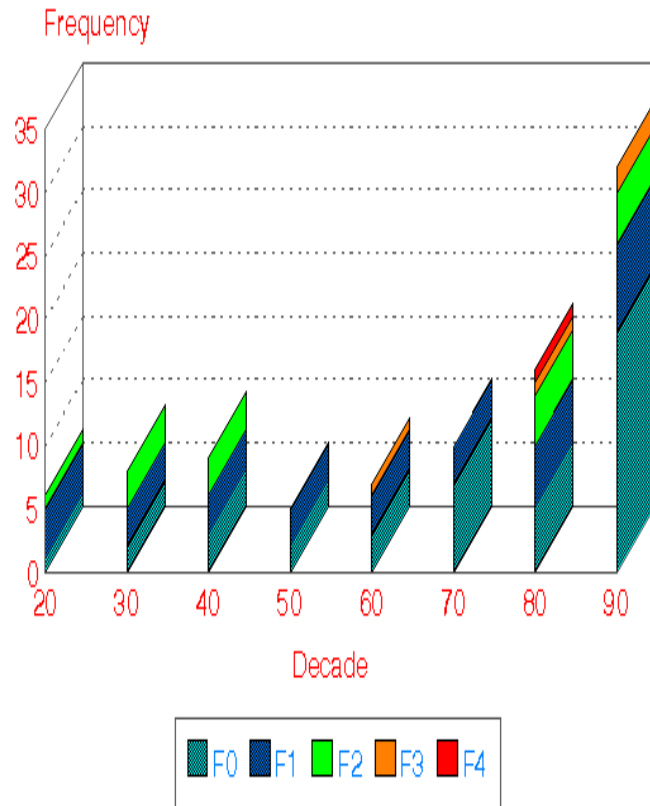




# INFRASTRUCTURE VULNERABILITY

## Small Increases = Escalating Infrastructure Damages

### DUFFERIN'S DAMAGING WINDS AND TORNADES 1920-1999





## PERFORMANCE OUTCOME:

### *Extreme Analysis for New and Improved National Building Codes and Standards*



*Environment Canada is the recognized authority for climatic design values, their up-dates and improvements, for all national infrastructure codes and standards under the Canadian Commission for Building and Fire Codes and the Canadian Standards Association (CSA) Committees. The National Building Codes and their climatic design values become Provincial and Territorial laws and Municipal by-laws.*

**DECISION-MAKERS PERFORMANCE  
MEASURES FOR CANADA: 61000+ UPDATED  
CLIMATIC DESIGN VALUES FOR 600 SITES FOR  
2010 & 2015 NATIONAL BUILDING CODE.**



# First Nations: Adapting to Climate Extremes

- INAC: focus North of 60
- EC-AIRS: Research in collaboration with Brock University (Plummer) and Saskatchewan Research Council (SRC)
  - Ohsweken Workshop (2009)
  - 3 FN consultations in SK on adapting to climate hazards (SRC)
  - Indigenous Adaptation Network (IAN) website launched (2010)

## Climate Change Hazards

*A proposal to explore emerging hazards, vulnerabilities and adaptive capacity of First Nations communities*



Final Report on Consultations in First Nations Communities

Prepared for the Saskatchewan Research Council  
Submission prepared by Patrick Derocher and Associates  
March 25, 2009

## A Transboundary Dialogue on Climate Change and Water in the Great Lakes Basin: Exploring the Vulnerability and Adaptive Capacity of Aboriginal Peoples



Six Nations Polytechnic  
Ohsweken, Ontario  
March 27, 2009

Prepared By: Ryan Plummer, Paul General, Kate Cave and  
Bradley May



# Indigenous Adaptation Network (IAN)

<http://www.indigenousadaptationnetwork.com>



- The Indigenous Adaptation Network
- News & Announcements
- Building Capacity for Adaptation
- Voices, Stories and Art of Adaptation
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[Building Capacity for Adaptation](#)
[Publications](#)
[Indigenous Adaptation Network - Information Brief Series](#)

Information briefs are short documents that convey information that is accurate, accessible and targeted to specific subjects to environmental change and adaptation.

Please click on the cover image to download the information brief.

Information Brief #1: Climate Change and Water – Finding Pathways for Adaptation and Resilience



## Climate Change and Water - Finding Pathways for Adaptation and Resilience

Water is essential for life and is an integral aspect to many Indigenous cultures. The hydrologic cycle makes earth inhabitable, water enables critical biological processes and aquatic ecosystems provide an environment upon which organisms depend for their survival. Water is also used directly by humans for many purposes such as drinking, agriculture, industry, hygiene or waste, tourism and recreation, aquaculture and transportation.

Concerns relating to water are pervasive. Examples include pollution from identifiable or localized (point) sources as well as diffuse (non-point) sources, destruction and loss of aquatic habitat. These issues are amplified for Indigenous Peoples because of the powerful cultural connections and their immediate relationship to the environment through subsistence practices. Access to reliable sources of safe drinking water has been and continues to be a problem in many communities with potentially severe consequences for human health. In Canada, a total of 112 First Nation communities were under boil water advisories as of December 31<sup>st</sup>, 2009<sup>1</sup>.

Climate change and its impacts on water raise several fundamental questions for Indigenous communities. How will climate change impact water? What challenges are anticipated for water managers and communities? How can individuals, organizations and communities respond to the issue of climate change and water? Adaptive responses by Indigenous

**Main Messages**

- Water figures prominently in explanations of creation and is central to many Indigenous cultures.
- Climate change impacts on water are being experienced now and are projected to intensify in the future.
- The Medicine Wheel as a holistic approach illustrates how individuals, communities and nations are affected physically, emotionally, spiritually and mentally.
- There are many ways you can respond to the impacts of climate change on water.

### The Meaning and Centrality of Water in Indigenous Cultures<sup>1</sup>

Water has a central place in Indigenous cultures. It figures dominantly in statements of appreciation, creation stories, ceremonies and symbolism. In the Thanksgiving Address, for example, the Haudenosaunee people speak to the spirit of water, fulfillment of its duty, and the associated responsibilities to maintain harmony. Although impossible to capture completely in writing, some of the key features that distinguish an Indigenous perspective on water include the following:

- A holistic viewpoint
- Recognition that water supports all aspects of life
- A profound respect for water
- A sensitivity to changes associated with water
- A deep understanding of the interconnectedness of all things





# National Drought Assessment update (2010-2012)


## Update projects

(Wheaton et al., 2005, 2007)

- Assess changes in vulnerability and adaptive capacity to severe droughts from 2001-2002 droughts
- Preliminary 2008-2010 Prairies drought assessment completed by SRC (**Wheaton, Wittrock, Siemens**)
- 2005 & 2007 Southern Ontario drought analyses (**Koshida, Smeh, Gafarova**)
- **National Drought Study Workshop planned (late 2011-early 2012)**

Saskatchewan Research Council

### Agricultural Adaptation to Drought (ADA) in Canada: The Case of 2001 to 2002



By E. Wheaton, G. Koshida, B. Bonsal, T. Johnston, W. Richards, V. Wittrock

May 2007

Prepared for Government of Canada's  
Climate Change Impacts and Adaptation Program

Canada Saskatchewan Research Council  
Environment and Forestry  
SRC Publication No. 11927-1E07

SRC smart science solutions



## More than a Close Call: A Preliminary Assessment of the Characteristics, Impacts of and Adaptations to the Drought of 2008-2010 in the Canadian Prairies

Prepared for Environment Canada  
Adaptation and Impacts Research Division (AIRD)

V. Wittrock<sup>1</sup>, E. Wheaton<sup>2</sup>, E. Siemens<sup>3</sup>

<sup>1</sup>Saskatchewan Research Council,  
Environment and Forestry Division  
<sup>2</sup>Saskatchewan Research Council,  
Environment and Forestry Division and  
University of Saskatchewan, and  
<sup>3</sup>University of Saskatchewan.

SRC Publication No. 12803-1E10

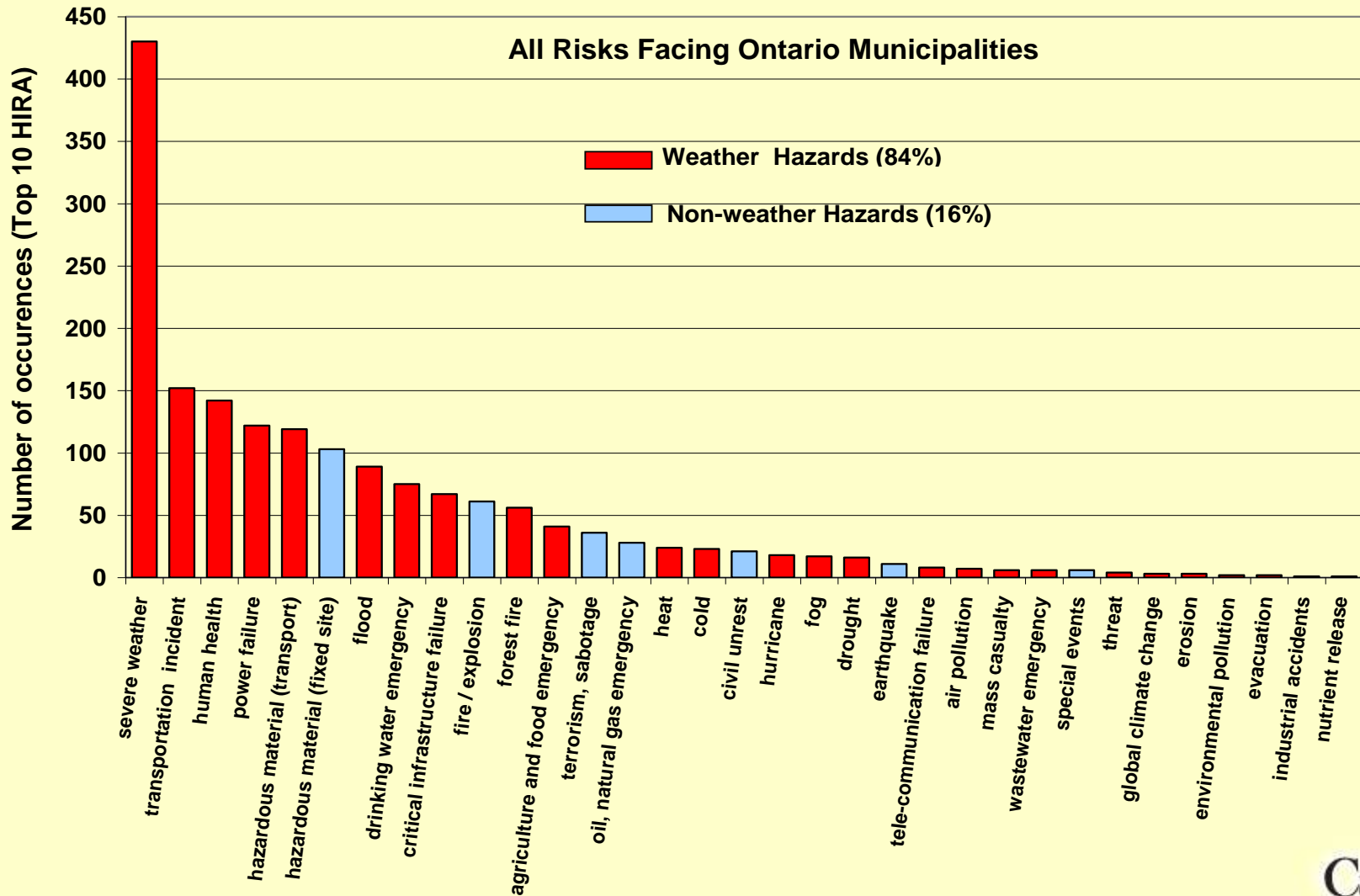
March 2010





# ONTARIO DISASTER MANAGEMENT SURVEY:

## *Severe Weather is the Number One Municipal Hazard*



# Canadian Atmospheric Hazards Network (CAHN)

(> 1 Million Visits/Year)

[www.hazards.ca](http://www.hazards.ca)

**Pacific / Yukon Region**  
 Bill Taylor, Tina Neale,  
 Robin Bing Rong



Atmospheric Hazards  
 Dangers / Atmosphériques  
 Pacific / Yukon

Canada

Atmospheric Hazards

Atmosphériques Dangers / Atmosphériques

Atmosphériques Dangers / Atmosphériques

Atmosphériques Dangers / Atmosphériques



**Under Development**  
 Atmospheric Hazards Website –  
 Pacific and Yukon Region  
 Bill Taylor, Environment Canada

#201 - 401 Burrard Street  
 Vancouver, BC V6C 3S5  
 #YR Hazards@ec.gc.ca

**Ontario Region**  
 Joan Klaassen, Neil Comer



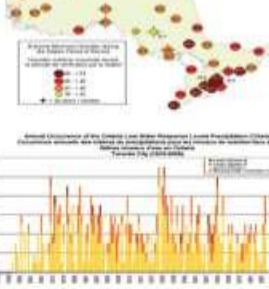
Atmospheric Hazards  
 Dangers / Atmosphériques  
 Ontario

Canada

Atmospheric Hazards

Atmosphériques Dangers / Atmosphériques

Atmosphériques Dangers / Atmosphériques



**Atmospheric Hazards Website –  
 Ontario Region**  
 Joan Klaassen, Environment Canada

4905 Dufferin Street  
 Toronto, ON M3H 5T4  
 Joan.Klaassen@ec.gc.ca

**Canadian Atmospheric  
 Hazards Network**  
 Sharon Fernandez, Heather Auld,  
 Don MacIver

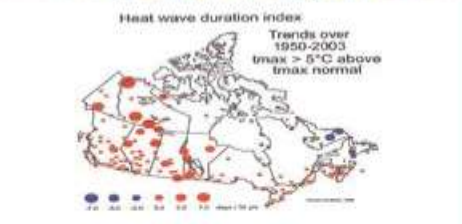


**Hazards**

Air Quality  
 Blizzards  
 Drought  
 Extreme Cold  
 Extreme Heat  
 Extreme Rainfall  
 Extreme Wind

Flood  
 Fog and Visibility  
 Freezing Precipitation  
 Hail  
 Heavy Snow  
 Humidex  
 Hurricanes

Ice Storms  
 Marine  
 Storm Surge  
 Thunderstorms/Lightning  
 Tornadoes  
 Windchill  
 Winter Rainfall



**National Atmospheric Hazards Website**  
 Don MacIver, Environment Canada

4905 Dufferin Street, Toronto, ON M3H 5T4  
 Don.MacIver@ec.gc.ca

**Adaptation and Impacts Research Division**  
 Prairie & Northern region is under development

**Quebec Region**  
 Stéphane Gagnon,  
 André Colnair

**CRIACC**

Centre de Recherche en Impact et Adaptation au Climat et à son Changement

Atmospheric Hazards  
 Dangers / Atmosphériques  
 Québec

Atmosphériques Dangers / Atmosphériques

Atmosphériques Dangers / Atmosphériques



**CRIACC**

Indicateurs et normales climatiques pour le sud du Québec

0 - 10  
 11 - 20  
 21 - 30  
 31 - 40  
 41 - 50

**Atmospheric Hazards Website –  
 Québec Region**  
 Stéphane Gagnon, Environment Canada

800 de la Gauchetière Street West  
 Montréal, QC H5A 1L9  
 Stéphane.Gagnon@ec.gc.ca

**Atlantic Region**  
 William Richards



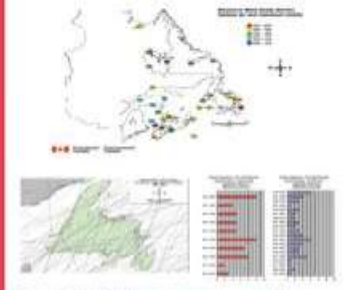
Atmospheric Hazards  
 Dangers / Atmosphériques  
 Atlantique/Atlantic

Canada

Atmospheric Hazards

Atmosphériques Dangers / Atmosphériques

Atmosphériques Dangers / Atmosphériques



**Under Development**  
 Atmospheric Hazards Website –  
 Atlantic Region  
 William Richards, Environment Canada

77 Westmorland Street  
 Fredericton, NB E3B 6Z3  
 William.Richards@ec.gc.ca

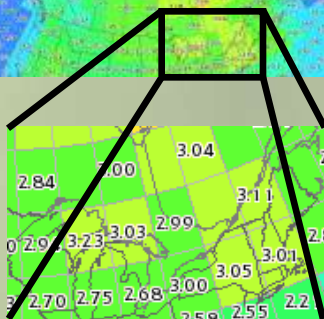
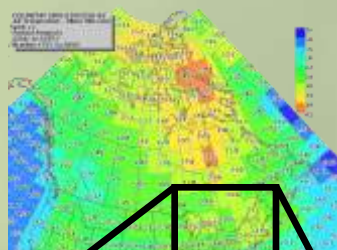
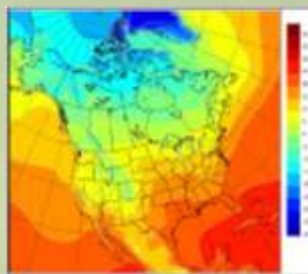


# Canadian Climate Change Scenarios Network (CCCSN)

( > 2 Million Visits/Year )

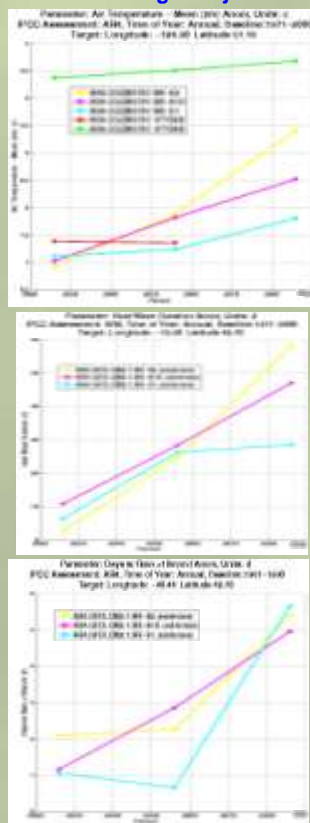
## Scenario Maps

- ✓ Updated and redesigned
- ✓ Fourth Assessment (AR4) results



## Scatterplots

- ✓ New Variables and Extremes
- ✓ Climate Change Projections



## Data

- ✓ New Downscaling Models and Tools
- ✓ New interfaces Download data and visualization of maps from Global Climate Models & Canadian Regional Climate model

### Downscaling Tools

- SDSM - Statistical DownScaling Model
- LARS-WG - Stochastic Weather Generator
- ASD - Automated Statistical Downscaling tool



### Download Data

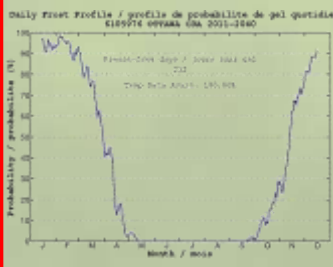
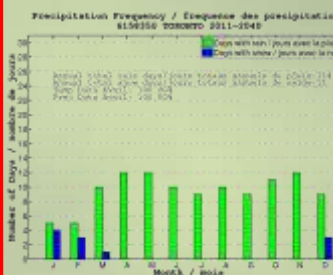
- Canadian Observations
- Statistical Downscaling Input Data
- Reanalysis Products



- Global & Canadian Regional Climate Models
- Over 30 GCMs in total

## Bioclimate Profiles

- ✓ Bioclimate Profiles for more than 500 locations
- ✓ New Climate Change Science



## Publications & Links

- ✓ Regional Websites & Impacts and Adaptation Research Papers
- ✓ Expert Advice on Climate Change Scenario Applications
- Impacts and Adaptations Research Papers

### EC Publications

- H. Auld and D. MacIver, 2005. Cities and Communities: The Changing Climate and Increasing Vulnerability of Infrastructure. Occasional Paper 3, Environment Canada.
- H. Auld and D. MacIver, 2007. Changing Weather Patterns, Uncertainty and Infrastructure Risks: Emerging Adaptation Requirements. Occasional Paper 9, Environment Canada.
- E. Barrow, et al., 2004. Climate Variability and Change in Canada: Past, Present and Future. Environment Canada.
- S. Cohen and T. Neale, 2006. Participatory Integrated Assessment of Water Management and Climate Change in the Okanagan Basin, British Columbia: Final Report. Environment Canada.
- A. Fenech, et al., 2006. The Americas: Building the Adaptive Capacity to Global Environmental Change. Environment Canada.
- M. Karsh, et al., 2007. Climate-Based Predictions Of Forest Biodiversity Using Smithsonian's Global Earth Observing Network. Occasional Paper 8, Environment Canada.
- D. MacIver and M. Mirza, 2005 - 2007. Adaptation Science Newsletter, Issues 1 - 8, Environment Canada.
- D. MacIver, 2005. Mainstreaming Adaptation and Impacts Science into Solutions. Occasional Paper 2, Environment Canada.
- D. MacIver, et al., 2006. Influences on the Sugar Maple Industry in North America. Occasional Paper 7, Environment Canada.
- D. MacIver, et al., 2007. Coastal Zone Management under a Changing Climate in the Great Lakes. Environment Canada.
- B. Mills, et al., 2007. The Road Well-Travelled: Implications of Climate Change for Pavement Infrastructure in Southern Canada. Environment Canada.
- M. Mirza, 2004. Climate Change and the Canadian Energy Sector: Report on Vulnerability Impact and Adaptation. Environment Canada.
- L. Mortsch, et al., 2005. Development of Climate Change Scenarios for Impact and Adaptation Studies in the Great Lakes - St. Lawrence Basin. Environment Canada.
- L. Mortsch, et al. (eds.), 2006. Great Lakes Coastal Wetland Communities: Vulnerable to Climate Change and Response to Adaptation Strategies. Environment Canada.

### Other Publications

- B. Bass and B. Baskaran, 2003. Evaluating Rooftop and Vertical Gardens as an Adaptation Strategy for Urban Areas. Report no. NRCC-46737.
- G. Koshida, et al., 2007. Tap Runs Dry: Managing urban water supply now and in the future in Canada. In: Proceedings of the Third International Conference on Climate and Water, September 3-6, 2007, Helsinki, Finland, pp. 532-537.
- E. Oberndorfer, et al., 2007. Green Roofs as Urban Ecosystems: Ecological Structures, Functions, and Services. BioScience, 57(10), 823-833.

### Links

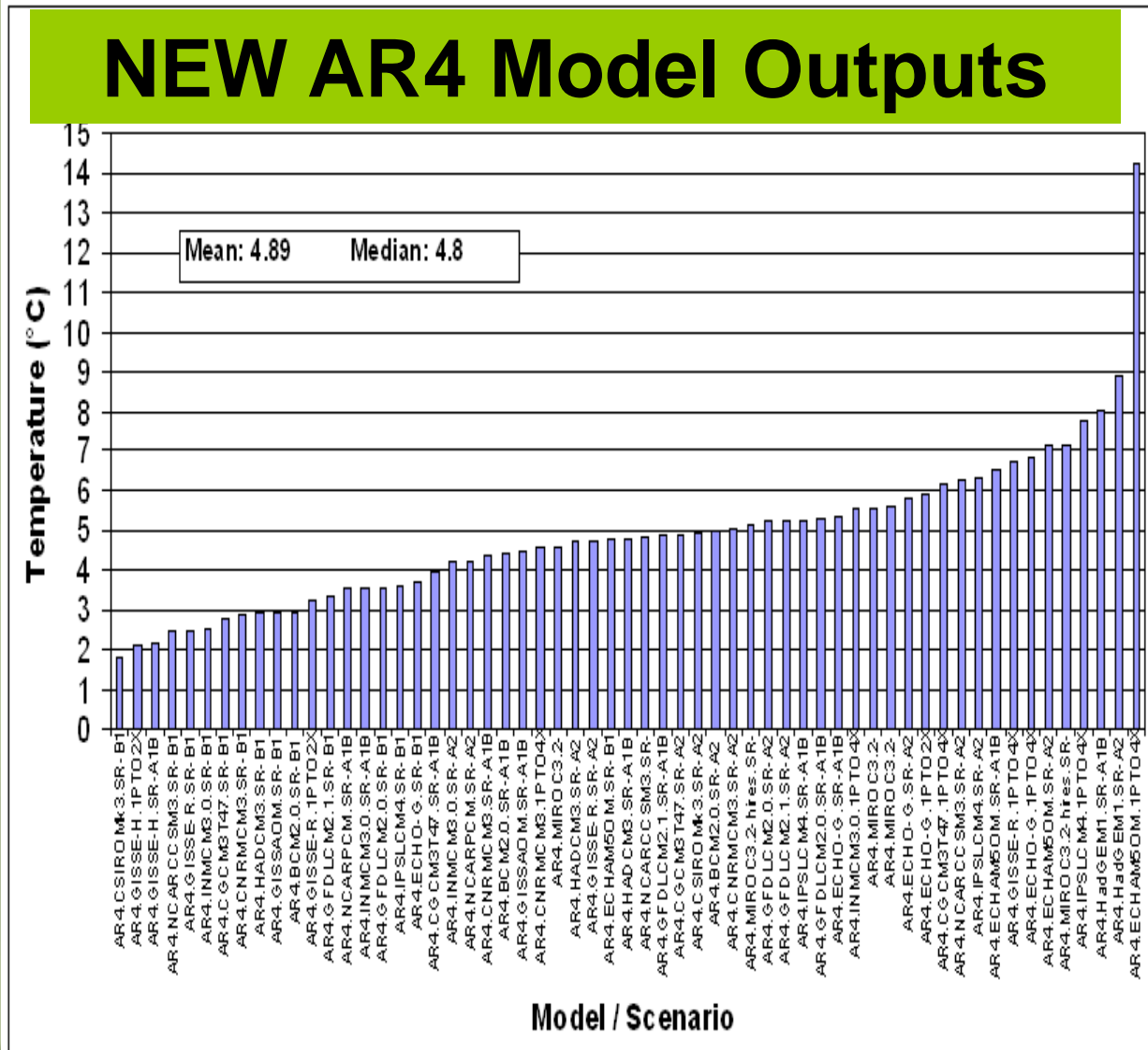
- Canadian Atmospheric Hazards Network: [www.hazards.ca](http://www.hazards.ca)
- Canadian Centre for Climate Modelling and Analysis: [www.ccmma.bc.ec.gc.ca](http://www.ccmma.bc.ec.gc.ca)
- University of British Columbia: [www.climaterecord.ca/ClimateChange/ClimateChangeResearch/Research/ResearchProjects/CurrentProjects/AR4/](http://www.climaterecord.ca/ClimateChange/ClimateChangeResearch/Research/ResearchProjects/CurrentProjects/AR4/)
- University of Toronto: [www.environment.utoronto.ca/Research/ResearchProjects/CurrentProjects/AR4/](http://www.environment.utoronto.ca/Research/ResearchProjects/CurrentProjects/AR4/)
- University of Waterloo: [www.fes.uwaterloo.ca/research/index.html](http://www.fes.uwaterloo.ca/research/index.html)





# New Climate Change Models and Scenarios

## New Global and Regional Model Outputs



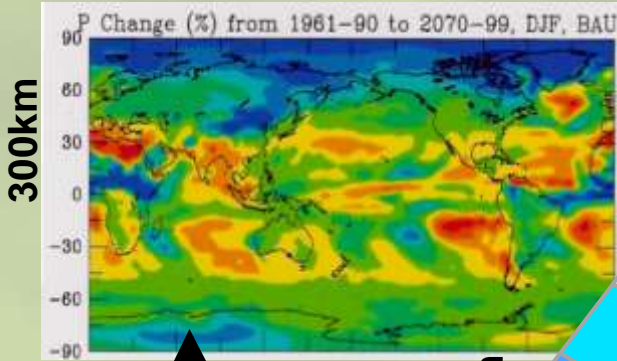


# Climate Change Downscaling Models

WHY ? Because there is a **mismatch of scales** between what global/regional climate models can supply and what impact and adaptation models require.

Two types of downscaling:

- Dynamical Downscaling
- Statistical Downscaling



300km

50km

10km

1m

Point

Adaptation Solutions

Global Circulation Models





## Other Misc Activities briefly...

- IPCC Special Report on Extremes (lead authors: Auld, Burton)
- IPCC AR5 WGII (leads: Burton, Cohen, Mortsch, Mirza)
- Regional IDF curves with CSA (Auld, Klaassen, Morris)

**Adaptation Solutions? --- Think bigger and faster!**

